Docusign Envelope ID: 8E5678BF-5A13-8A97-800D-1DCAE9AB1C15

CITY OF CHANDLER, ARIZONA

WATER RECLAMATION FACILITY IMPROVEMENTS PHASE 3
CITY PROJECT NO.: WW2401.401

CONSTRUCTION SERVICES AGREEMENT

(CONSTRUCTION MANAGER AT RISK)

Leticia Vargas

Leticia Vargas, P.E.
CIP City Engineer

Docusign Envelope ID: 8E5678BF-5A13-8A97-800D-1DCAE9AB1C15

CITY OF CHANDLER, ARIZONA

WATER RECLAMATION FACILITY IMPROVEMENTS PHASE 3
CITY PROJECT NO.: WW2401.401

TABLE OF CONTENTS

ARTICLE 1 - PARTICIPANTS AND PROJECT 1

ARTICLE 2 - AGREEMENT DOCUMENTS 3

ARTICLE 3 - PRE-CONSTRUCTION SERVICES 3

ARTICLE 4 - CONSTRUCTION SERVICES 3

ARTICLE 5 - CITY RESPONSIBILITIES 5

ARTICLE 6 - AGREEMENT TIME 5

ARTICLE 7 - AGREEMENT PRICE 7

ARTICLE 8 – FORCED LABOR OF ETHNIC UYGHURS PROHIBITED 7

EXHIBIT A – PROJECT SPECIFIC SPECIAL PROVISIONS A-1
EXHIBIT B – GENERAL CONDITIONS B-1
EXHIBIT C – TECHNICAL SPECIFICATIONS C-1
EXHIBIT D – ACCEPTED GMP/PRICE PROPOSAL D-1
EXHIBIT E – SUBCONTRACTOR'S LIST FORM E-1
EXHIBIT F – GIS / GPS DATA DELIVERY REQUIREMENTS (IF APPLICABLE) F-1
EXHIBIT G – SUBCONTRACTOR DOCUMENTS WITH CM@RISK G-1

Docusign Envelope ID: 8E5678BF-5A13-8A97-800D-1DCAE9AB1C15

CONSTRUCTION MANAGER AT RISK
CONSTRUCTION SERVICES AGREEMENT
PROJECT NO.: WW2401.401

This Agreement (the "AGREEMENT") is made and entered into on the ____day of _____, 2026, ("Effective Date") by and between City of Chandler, an Arizona municipal corporation, hereinafter called "City" and McCarthy Building Companies, Inc. the "Construction Manager at Risk" or "CM@Risk" designated below (City and CM@Risk may individually be referred to as "Party" and collectively referred to as "Parties").

City and CM@Risk agree as follows:

ARTICLE 1 - PARTICIPANTS AND PROJECT

CITY: **CIP City Engineer: Daniel Haskins, P.E.**
Public Works & Utilities Department
P.O. Box 4008, Mail Stop 407 Chandler, AZ 85244-4008
Phone: 480-782-3335 Email: Daniel.haskins@chandleraz.gov

CITY: **Construction Project Manager: Adam Kleiser**
Public Works & Utilities Department
P.O. Box 4008, Mail Stop 407 Chandler, AZ 85244-4008
Phone: 480-782-3325 Email: adam.kleiser@chandleraz.gov

CM@RISK:	**Legal Company Name:**	McCarthy Building Companies, Inc.
	Mailing Address:	6225 North 24th Street, Suite 125 Phoenix AZ 85016
	Physical Address:	6225 North 24th Street, Suite 125 Phoenix AZ 85016
	Arizona Roc No.:	B-1 080911
	Federal Tax Id No.:	43-0399290
	State Where Organized:	Missouri
	Business Organization:	S Corporation
	Statutory Agent Name:	Corporation Service Company
	Statutory Agent Mailing Address:	7955 South Priest Drive, Suite 102 Tempe, AZ 85284
	Statutory Agent Physical Address:	7955 South Priest Drive, Suite 102 Tempe, AZ 85284

CM@Risk's Authorized Project Representative:

Name:	Jaren Murphy
Title:	Senior Vice President Water
Phone:	480-449-4700
Email:	jmurphy@mccarthy.com

Docusign Envelope ID: 8E5678BF-5A13-8A97-800D-1DCAE9AB1C15

PROJECT DESCRIPTION:

Phase 3 of the Chandler WRF Improvements program provides critical process, electrical, and infrastructure upgrades at both the Airport Water Reclamation Facilities (AWRF) and Ocotillo Water Reclamation Facilities (OWRF). The work includes procurement of long-lead equipment to maintain schedule reliability. At AWRF, improvements focus on balance-of-plant upgrades such as pump station repairs, headworks enhancements, aeration basin diffuser replacement, installation of a sixth disc filter, clarifier and valve replacements, chemical feed system enhancements, fuel storage, site piping, and supporting electrical and instrumentation work. OWRF improvements include electrical system upgrades, MCC replacements, new power distribution infrastructure, clarifier improvements, expanded pumping capacity, bio-reactor enhancements, structural rehabilitation, and supporting sitework.

PROJECT LOCATION:

Airport Water Reclamation Facility (AWRF), located at 905 E. Queen Creek Road, and the Ocotillo Water Reclamation Facility (OWRF), located at 333 S. Old Price Road.

Docusign Envelope ID: 8E5678BF-5A13-8A97-800D-1DCAE9AB1C15

ARTICLE 2 - AGREEMENT DOCUMENTS

2.1 AGREEMENT DOCUMENTS

The Agreement between City and CM@Risk will consist of the following Agreement Documents:

1. This Construction Services Agreement and all of its Exhibits, including Project Plans and Technical Specifications.
2. General Conditions and General Conditions Appendices, incorporated by reference.
3. Project Specific Special Provisions as set forth in **Exhibit A**, incorporated by reference.
4. Accepted GMP/Price Proposal as set forth in **Exhibit D**, incorporated by reference.

2.2 In the event of any inconsistency, conflict, or ambiguity between or among the Agreement Documents, the Agreement Documents will take precedence as described in Section 14.1.4 of the General Conditions.

2.3 DEFINITIONS

The definitions in Sections 2 and 15 of the General Conditions apply to all the Agreement Documents, including this Agreement.

ARTICLE 3 - PRE-CONSTRUCTION SERVICES

Although CM@Risk has performed Pre-Construction Services pursuant to a separate Agreement between City and CM@Risk, the completion, quality and accuracy of those services and the deliverables provided by City thereunder directly impact CM@Risk's performance of its obligations under this Agreement. Therefore, all of CM@Risk's obligations, duties, and warranties in relation to Pre-Construction Services and deliverables survive completion of the Pre-Construction Services Agreement and are incorporated herein. Any breach of any of CM@Risk's duties, obligations, or warranties under the Pre-Construction Services Agreement will likewise be considered a breach of this Agreement.

ARTICLE 4 - CONSTRUCTION SERVICES

4.1 GENERAL

4.1.1 CM@Risk agrees at its own cost and expense, to do all work necessary and required to fully, timely and properly complete the construction of the Project in strict accordance with the Agreement Documents in a good and workmanlike manner, free and clear of all claims, liens, and charges whatsoever, in the manner and under the conditions specified, and within the schedule, stated in attached **Exhibit A**.

4.1.2 CM@Risk must provide all of the labor and materials, and perform the Work in accordance with Section 4 of the General Conditions. Some, but not all, of the major

Docusign Envelope ID: 8E5678BF-5A13-8A97-800D-1DCAE9AB1C15

components of the Construction Services and the corresponding subsections of Section 4 of the General Conditions are set forth below.

4.1.3 This is an Agreement for complete construction services in accordance with the Construction Manager at Risk method of delivery of construction services. CM@RISK has participated in the design process and been an active member of the Project Design Team and is fully aware of any issues and constraints involved in this Construction Project.

4.1.4 CM@RISK is the CITY's fiduciary responsible for undertaking all necessary action contemplated under the Agreement documents to construct the Project and ensure timely and quality completion of the Project at a cost within the Guaranteed Maximum Price (GMP).

4.1.5 At all times relevant to this Agreement and performance of the Work, the CM@Risk must fully comply with all Laws, Regulations, or Legal Requirements applicable to City, the Project and the Agreement, including, without limitation, those set forth on attached **Exhibit A**.

4.1.6 CM@Risk must perform the Work under this Agreement using only those firms, team members and individuals designated by CM@Risk consistent with the Statement of Qualifications dated July 16, 2024, the GMP Proposal, or otherwise approved by City pursuant to the General Conditions. No other entities or individuals may be used without prior approval of the Project Manager

4.1.7 CM@Risk will comply with all terms and conditions of the General Conditions.

4.1.8 In the event of a conflict between this Agreement and the General Conditions or an exhibit hereto or appendix thereto, the terms of this Agreement will control.

4.1.9 Ownership of Work Product. Notwithstanding anything to the contrary in this Agreement, all Work Product prepared or otherwise created in connection with the performance of this Agreement, including the Work, are to be and remain the property of City. For purposes of this provision, "Work Product" will include all designs, drawings, plans, specifications, ideas, renderings and other information or matter, in whatever form created (e.g., electronic or printed) and in all media now known or hereinafter created. All Work Product will be considered Work Made for Hire as defined in the United States Copyright Act 17 U.S.C. § 101 (Copyright Act). If for any reason, any such Work is found not to be a Work Made for Hire, CM@Risk hereby transfers and assigns ownership of the copyright in such Work to City. The rights in this Section are exclusive to City in perpetuity.

4.2 CM@RISK'S PRE-AGREEMENT AND PRE-WORK DELIVERABLES

4.2.1 The CM@Risk must provide the Deliverables in accordance with Section 4.2 of the General Conditions.

Docusign Envelope ID: 8E5678BF-5A13-8A97-800D-1DCAE9AB1C15

4.3 **PRE-CONSTRUCTION CONFERENCE**

Refer to Section 4.3 of the General Conditions.

4.4 **PERFORMANCE OF THE WORK (INCLUDING FIELD MEASUREMENTS, SUBCONTRACTORS, AND SUPPLIERS)**

Refer to Section 4.4 of the General Conditions.

4.5 **CONTROL OF THE PROJECT SITE**

Refer to Section 4.5 of the General Conditions.

4.6 **PROJECT SAFETY**

Refer to Section 4.6 of the General Conditions.

4.7 **MATERIALS QUALITY, SUBSTITUTIONS AND SHOP DRAWINGS**

Refer to Section 4.7 of the General Conditions.

4.8 **PROJECT RECORD DOCUMENTS**

Refer to Section 4.8 of the General Conditions.

4.9 **WARRANTY AND CORRECTION OF DEFECTIVE WORK**

Refer to Section 4.9 of the General Conditions.

ARTICLE 5 - CITY RESPONSIBILITIES

5.1 City will have the responsibilities, and provide the information specified in, and subject to the conditions set forth in, Section 5 of the General Conditions.

ARTICLE 6 - AGREEMENT TIME

6.1 **GENERAL**

6.1.1 The Agreement Duration is 1,159 Calendar Days.

6.1.2 The Agreement Time will start with the Notice to Proceed (NTP) and end with Final Acceptance, as set forth in Article 6.4 below. The Notice to Proceed cannot be issued until approval and acceptance by City of the GMP or Fixed Price.

6.1.3 The Agreement Time will be as set forth in the Project Schedule. CM@Risk agrees that it will commence performance of the Work and complete the Project through Final Acceptance within the Agreement Time.

6.1.4 Time is of the essence of this Agreement for the Project, and for each phase and designated Milestone thereof.

Docusign Envelope ID: 8E5678BF-5A13-8A97-800D-1DCAE9AB1C15

6.2 PROJECT SCHEDULE

6.2.1 The Project Schedule approved as part of the GMP Proposal and incorporated herein as part of the attached **Exhibit D** must be updated and maintained throughout CM@Risk's performance under this Agreement in accordance with Section 6.2 of the General Conditions.

6.2.2 Failure on the part of CM@Risk to adhere to the approved Project Schedule will be deemed a material breach and sufficient grounds for termination of this Agreement by City.

6.3 SUBSTANTIAL COMPLETION

Substantial Completion must be achieved no later than the Substantial Completion Date set forth in the Project Schedule. Substantial Completion will be determined in accordance with Section 6.3 of the General Conditions.

6.4 FINAL ACCEPTANCE

6.4.1 Final Acceptance will be obtained within the time period set forth in the Project Schedule.

6.4.2 Final Acceptance will be issued pursuant to Section 6.5 of the General Conditions.

6.5 LIQUIDATED DAMAGES

6.5.1 Substantial Completion Liquidated Damages. CM@Risk acknowledges and agrees that if CM@Risk fails to obtain Substantial Completion of the Work within the Agreement Time, City will sustain extensive damages and serious loss as a result of such failure. The exact amount of such damages will be extremely difficult to ascertain. Therefore, City and CM@Risk agree that if CM@Risk fails to achieve Substantial Completion of the Work within the Agreement Time, City will be entitled to retain or recover from CM@Risk, as liquidated damages and not as a penalty, the sum per calendar day as indicated in MAG § 108.9.

6.5.2 Final Acceptance Liquidated Damages. For the same reasons set forth in Article 6.5.1 above, City and CM@Risk further agree that if CM@Risk fails to achieve Final Acceptance of the Work within the Agreement Time, City will be entitled to retain or recover from CM@Risk, as liquidated damages and not as a penalty, the sum per calendar day as indicated in MAG § 108.9 commencing from the actual date of Substantial Completion or Final Acceptance as required under the Agreement.

6.5.3 MAG Liquidated Damages. If no liquidated damages are specified in Articles 6.5.1 or 6.5.2 above, then the liquidated damages provisions in MAG § 108.9 will apply.

Docusign Envelope ID: 8E5678BF-5A13-8A97-800D-1DCAE9AB1C15

6.5.4 City may deduct liquidated damages described in this Article 6.5 from any unpaid amounts then or thereafter due CM@Risk under this Agreement. Any liquidated damages not so deducted from any unpaid amounts due CM@Risk will be payable to City at the demand of City, together with interest from the date of the demand at the highest lawful rate of interest payable by CM@Risk.

6.6 MUTUAL WAIVER OF CONSEQUENTIAL DAMAGES ONLY

6.6.1 CM@Risk and City waive claims against each other for consequential damages arising out of or relating to this Agreement. This mutual waiver includes:

6.6.1.1 Damages incurred by City for rental expenses, for losses of use, income, profit, financing, business and reputation, and for loss of management or employee productivity or of the services of such persons; and

6.6.1.2 Damages incurred by CM@Risk for principal office expenses including the compensation of personnel stationed there, for losses of financing, business and reputation, and for loss of profit except anticipated profit arising directly from the Work.

6.6.2 This mutual waiver is applicable, without limitation, to all consequential damages due to either Party's termination of this Agreement. Nothing contained in this Article 6.6 will be deemed to preclude an award of liquidated damages, when applicable, in accordance with Article 6.5 above.

6.6.3 Nothing herein will be deemed to constitute a waiver of any other remedy available to City in the event of CM@Risk's default under this Agreement prior to full performance of the Work including, as applicable, specific performance or completion of the Work on behalf of CM@Risk, the cost and expense of which will be offset against any monies then or thereafter due to CM@Risk (if any) and otherwise immediately reimbursed to City by CM@Risk.

ARTICLE 7 - AGREEMENT PRICE

7.1 AGREEMENT PRICE

7.1.1 In exchange for CM@Risk's full, timely, and acceptable performances and construction of the Work under this Agreement, and subject to all of the terms of this Agreement, City will pay CM@Risk the "Agreement Price," which:

The sum of the CM@Risk's Fee and reimbursable Cost of the Work, as defined in Section 15 of the General Conditions, which the CM@Risk guarantees will not exceed the GMP set forth in **Exhibit D** in the amount of $50,800,000**.** Costs which would cause the GMP to be exceeded must be paid by CM@Risk without reimbursement from City.

Docusign Envelope ID: 8E5678BF-5A13-8A97-800D-1DCAE9AB1C15

7.1.2 The Agreement Price is all-inclusive and specifically includes all fees, cost, insurance and bond premiums, allowances, construction contingency, owner's contingency, and taxes of any type necessary to fully, properly and timely perform and construct Work.

7.2 **CHANGES TO AGREEMENT PRICE**
Shall be determined under Section 9 of the General Conditions.

ARTICLE 8 - FORCED LABOR OF ETHNIC UYGHURS PROHIBITED

8.1 **FORCED LABOR OF ETHNIC UYGHURS PROHIBITED.** By entering into this Agreement, Contractor certifies and agrees Contractor does not currently use and will not use for the term of this Agreement: (i) the forced labor of ethnic Uyghurs in the People's Republic of China; or (ii) any goods or services produced by the forced labor of ethnic Uyghurs in the People's Republic of China; or (iii) any contractors, subcontractors or suppliers that use the forced labor or any goods or services produced by the forced labor of ethnic Uyghurs in the People's Republic of China.

SIGNATURE PAGE TO FOLLOW

Docusign Envelope ID: 8E5678BF-5A13-8A97-800D-1DCAE9AB1C15

IN WITNESS WHEREOF, the Parties hereto have executed this Agreement through their duly authorized representatives and bind their respective entitles as of the effective date.

"CITY" CITY OF CHANDLER

MAYOR

RECOMMENDED BY:

Leticia Vargas — September 30, 2026

Leticia Vargas, P.E.
CIP City Engineer

APPROVED AS TO FORM:

City Attorney

ATTEST:

City Clerk Seal

"CM@Risk"
MCCARTHY BUILDING COMPANIES, INC.

Jaren Murphy — September 30, 2026

Signature Date

Jaren Murphy

Print Name

Sr Vice President

Title

jmurphy@mccarthy.com

Signer Email Address

EXHIBIT A

PROJECT SPECIFIC
SPECIAL PROVISIONS

4.2.7 Aerial Construction Photography

General Conditions Section 4 Subsections 4.2.7.1 & 4.2.7.2 are not applicable to this project.

4.2.8 Government Approvals and Permits

General Conditions Section 4 Subsection 4.2.8.1, City permit fees will be paid internally by the City and all other fees will be the responsibility of the Contractor.

Subletting of Agreement

Contractor must perform, with his own organization, work amounting to not less than 50 percent of the total Agreement cost.

Failure to submit Subcontractor's List Form, demonstrating self-performance not less than 50 percent of the total Agreement cost, will cause the bid to be deemed non-responsive.

Contractors should contact the Arizona Registrar of Contractors for information on license requirements.

BACKGROUND SCREENING/BADGE REQUIREMENTS:

CM@Risk and Subcontractor Worker Background Screening. CM@Risk agrees that all contract workers and subcontractors (collectively "Contract Worker(s)") that CM@Risk furnishes to City under this Agreement will be subject to background and security checks and screening as set forth in this Section (collectively "Background Screening") at CM@Risk's sole cost and expense. As part of the Background Screening, CM@Risk must provide to a person designated by the City the name(s), address(es), and phone number(s) of all Contract Workers who will provide any services under this Agreement. All Contract Workers must comply with these Background Screening requirements. All Contract Workers must be able to provide proof of the legal right to work in the United States. The Background Screening provided by CM@Risk must comply with all applicable laws, rules, and regulations. CM@Risk further agrees that the Background Screening required in this Section is necessary to preserve and protect public health, safety, and welfare. The Background Screening requirements set forth in this Section are the minimum requirements for this Agreement. City in no way warrants that these minimum requirements are sufficient to protect CM@Risk from any liabilities that may arise out of CM@Risk's services under this Agreement or CM@Risk's failure to comply with this Section. Therefore, in addition to the specific measures set forth below, CM@Risk and its Contract Workers must take such other reasonable, prudent, and necessary measures to further preserve and protect public health, safety, and welfare when providing services under this Agreement.

EXHIBIT A

Background Screening Requirements and Criteria. Before offering or scheduling any services under this Agreement, CM@Risk agrees that all Contract Workers, including the CM@Risk, if the CM@Risk is an individual or sole proprietorship, must have successfully passed a Background Screening in accordance with this Section. CM@Risk warrants that no person will be permitted to substitute for a Contract Worker who has satisfied the Background Screening requirements until the proposed substitute has also satisfied the Background Screening requirements in this Section. For review and approval, CM@Risk must submit to a person designated by the City proof of a completed Background Screening for each Contract Worker over the age of 18 performing services under this Agreement no fewer than two (2) weeks before the proposed start date of such Contract Worker's services. The Background Screening must have been completed within the 12-month period preceding the Contract Worker's start date under this Agreement and must include the results of a social security (SSN) trace, a national criminal databased check with source verification, and a sex offender database search.

Additional City Rights Regarding Security Inquiries. In addition to the foregoing, City reserves the rights but not the obligations to: (1) have a Contract Worker be required to provide fingerprints and execute such other documentation as may be necessary to obtain criminal justice information pursuant to A.R.S. § 41-1750(G) (4) or Chandler City Code § 4-22; (2) act on newly acquired information whether or not such information should have been previously discovered; (3) unilaterally change its standards and criteria relative to the acceptability of Contract Workers; and (4) object, at any time and for any reason, to a Contract Worker performing work (including supervision and oversight) under this Agreement.

CM@Risk Certification. By executing this Agreement, CM@Risk certifies that CM@Risk has read and understands the Background Screening requirements and criteria in this Section and will fully comply with such requirements. CM@Risk further certifies that any Background Screening information to be furnished to City related to CM@Risk or its Contract Workers will be complete, current, and accurate. A Contract Worker rejected for work under this Agreement will not be proposed to perform work under other City contracts or engagements without City's prior written approval.

Terms of This Section Applicable to all of CM@Risk's Contracts and Subcontracts. CM@Risk must include the terms of this Section for Contract Worker Background Screening in all contracts and subcontracts for services furnished under this Agreement including, but not limited to, supervision and oversight services.

Materiality of Background Screening Requirements: Indemnity. The Background Screening requirements of this Section are material to City's entry into this Agreement and any breach of this Section by CM@Risk will be deemed a material breach of this Agreement. In addition to the indemnity provisions set forth in this Agreement, CM@Risk must defend, indemnify, and hold harmless City for any and all Claims arising out of this

Background Screening Section including, but not limited to, the disqualification of a Contract Worker by CM@Risk or City for failure to satisfy this Section.

Continuing Duty, Audit. CM@Risk's obligations and requirements that Contract Workers satisfy this Background Screening Section will continue throughout the entire term of this Agreement. CM@Risk must notify City immediately of any change to a Background Screening of a Contract Worker previously accepted by City. CM@Risk must maintain all records and documents related to all Background Screenings and City reserves the right to audit CM@Risk's compliance with this Section under the terms of this Agreement.

EXHIBIT B

GENERAL CONDITIONS

GENERAL CONDITIONS

Approved date: July 20, 2022

TABLE OF CONTENTS

SECTION 1 - SCOPE OF THESE GENERAL CONDITIONS 3

SECTION 2 - GENERAL DEFINITIONS 3

SECTION 3 - STANDARD SPECIFICATIONS AND DETAILS 7

SECTION 4 - CONTRACTOR'S RESPONSIBILITIES FOR CONSTRUCTION SERVICES 8

SECTION 5 - CITY RESPONSIBILITIES 27

SECTION 6 - AGREEMENT TIME 29

SECTION 7 - AGREEMENT PRICE 35

SECTION 8 - PAYMENT 35

SECTION 9 - CHANGES TO THE AGREEMENT 40

SECTION 10 - SUSPENSION AND TERMINATION 43

SECTION 11 - INSURANCE AND BONDS 44

SECTION 12 - INDEMNIFICATION 50

SECTION 13 - DISPUTE RESOLUTION 50

SECTION 14 - MISCELLANEOUS PROVISIONS 51

SECTION 15 - PROVISIONS APPLICABLE SOLELY TO GMP AND COST-BASED AGREEMENTS, CHANGE ORDERS, AND JOB ORDERS 58

SECTION 16 - PROVISIONS APPLICABLE SOLELY TO JOB ORDER AGREEMENTS (JOC) 61

SECTION 17 - PROVISIONS APPLICABLE SOLELY TO PRE-CONSTRUCTION SERVICES FOR CONSTRUCTION MANAGER AT RISK 66

SECTION 18 - APPENDICES ..... APP-1 of 30

Appendix 1 – Policy Statement for Calculating Delays and Damages
Appendix 2 – Cost Reduction Incentive Proposals for Design Bid Build Agreements
Appendix 3 – Contractor's Affidavit Regarding Settlement of Claims
Appendix 4 – Forms of Performance Bond
Appendix 5 – Forms of Payment Bond
Appendix 6 – Dispute Resolution
Appendix 7 – Certificate of Completion
Appendix 8 – Construction Sign Detail
Appendix 9 – Cost of the Work (Applicable solely to Construction Manager at Risk and Job Order Contracting)
Appendix 10 Landscape Establishment Period

SECTION 1 - SCOPE OF THESE GENERAL CONDITIONS

These General Conditions encompass provisions that apply, and are incorporated into all construction Agreements entered into by the City of Chandler, unless otherwise specifically excluded in the executed Agreement.

SECTION 2 - GENERAL DEFINITIONS

Allowance: A specific amount for a specific item of Work, if any, that City agrees has not been sufficiently designed, detailed, or selected (including design changes from 90% to 100% as authorized by and at the discretion of the City) at the time the Agreement Price is agreed to for Contractor to provide a definitive price.

Alternate Systems Evaluations or Alternative Analysis: Alternatives for design, means and methods or other scope considerations that are evaluated using value analysis principles and have the potential to reduce construction costs while still delivering a quality and functional Project that meets City requirements.

Change Order: A written instrument issued after execution of the Agreement Documents signed by City and Contractor, stating their agreement upon all of the following: the addition, deletion or revision in the scope of services or deliverables; the amount of the adjustment to the Agreement Price, the extent of the adjustment to the Agreement Time, or modifications of other agreement terms. The Agreement Price and the Agreement Time may be changed only by Change Order.

Consultant: Person or firm that provides professional services.

City (Owner or OWNER): City of Chandler, a municipal corporation, with whom Contractor has entered into the Agreement and for whom the Work or Services are to be provided pursuant to the Agreement(s).

Contingent Bid Items: This is a minor bid item which is likely, but not certain, to occur during the course of work. If the Engineer determines that this work is required, the Contractor will accomplish the work and payment will be made based on the contingent unit bid price included in the proposal. Since the quantity listed in the proposal is primarily for bid comparison, the amount of work required by the Engineer may vary materially from this.

Agreement: The written agreement executed between City and Contractor, including all of the Agreement Documents.

Agreement Documents: The documents which together form the Agreement between City and Contractor, as identified in Article 2 of the Agreement, or are otherwise incorporated into the Agreement, including the Agreement, the exhibits thereto, these General Conditions, any Notice to Proceed, and any Job Order (if applicable), the Plans and Specifications, Project Schedule, written and properly executed Change Orders, MAG Specifications and City's amendments thereto, and any other documents so designated in the Agreement.

Agreement Price: The agreed-upon price to be paid to Contractor for full, timely, and acceptable completion of the Work or Services under the terms of the Agreement.

Agreement Time(s): The number of calendar days or the dates related to the applicable phase, Substantial Completion, or Final Acceptance as stated in Agreement Documents. Agreement Time starts

with the Notice to Proceed (NTP) and ends with Final Acceptance. The Agreement Time is set forth in the Agreement and is based upon the Project Schedule agreed to by City in writing.

Contractor: The person or business association with whom City has entered into an agreement for construction related Work or Services in relation to the Project at issue.

Contractor Payment Request: The form that is accepted by City and used by Contractor in requesting progress payments or final payment and which must include such supporting documentation as is required by the Agreement Documents or City.

Construction Budget: The City's budget for construction of the Project.

Construction Documents: The Plans, Specifications, and Drawings prepared and issued by the Design Professional and approved by City for construction, meaning the documents are sealed by the Design Professional (as required), acceptable for permitting and incorporated into the Agreement by this reference. All amendments and modifications to the Construction Documents must be approved in writing by City prior to incorporation into the Agreement.

Cost of the Work: The term Cost of the Work will mean costs necessarily incurred by Contractor in the proper performance of the Work. Such costs will be at rates not higher than the standard paid at the place of the Project except with prior consent of City.

Critical Path Method (CPM): A scheduling technique which identifies the logical sequence of the activities occurring in a Construction Project, the anticipated time required to complete each activity in the Project, and the activities that must be completed on schedule to finish the Project within the anticipated time. Typically, activities are arranged in a network that shows both activities and their dependencies. CPM is also used as a management technique which enables contracting parties to predict when activities may occur so that resources can be effectively used and limitations can be identified.

Critical Path: Critical Path is the sequence of project network activities which add up to the longest overall duration. Once established in the Project Schedule, the Critical Path for the Project must not be changed without prior written approval of City.

Day: Calendar day(s) unless otherwise specifically stated in the Agreement Documents.

Design Professional: The qualified, licensed person, firm or corporation who furnishes design and construction administration services required under the Agreement Documents. These services may include, but are not limited to: development of Construction Drawings and Documents, review of Contractor Submittal(s), review of and response to Requests for Information, approval and certification of progress payment applications, construction administration, and construction agreement close out.

Differing Site Conditions: Concealed or latent physical conditions or subsurface conditions at the Site that, (i) materially differ from the conditions indicated in the Agreement Documents, or (ii) are of an unusual nature, differing materially from the conditions ordinarily encountered and generally recognized as inherent in the Work at the general area of the Site. Caliche, rock, hard-digging or sandy/silty soil encountered on a project is not considered a "Differing Site Condition."

Drawings (Plans): Documents, which visually represent the scope, extent and character of the Work to be furnished and performed by Contractor during the construction phase and which have been prepared

or approved by the Design Professional and City. These documents include Drawings that have reached a sufficient state of completion and released by Design Professional solely for the purposes of review and use in performing constructability or bid-ability reviews by Contractor and in preparing cost estimates (e.g. Master Planning and Programming, Schematic Design, Design Development, and Construction Drawings), but *"not for construction*." Shop Drawings are not Drawings as so defined.

Final Acceptance: The City's acceptance of the facility or project from the Contractor after all Work is completed, tested, and inspected in accordance with the Agreement requirements. Final Acceptance results in a Letter of Acceptance (LOA).

Fixed Price: A fixed price or amount for an Agreement Price, Scope of Work, materials, or other item under an Agreement, Change Order, or other agreement, which City agrees, in writing, to pay instead of the actual cost.

Float: The number of Days by which an activity can be delayed without lengthening the Critical Path and extending the Agreement Time. Unless otherwise expressly agreed in writing, all Float belongs to City.

Laws, Regulations, or Legal Requirements: Any and all applicable laws, rules, regulations, ordinances, codes and orders applicable to the Project of any and all governmental bodies, agencies, authorities and courts having jurisdiction and any applicable provisions of the Development Agreement for the Project (if any), including, without limitation, those provisions relating to the design and construction of the Project.

Line Item: The individual elements of Work identified on a bid or other schedule and associated with a price or a unit price and quantity particular to that individual element of the Work. Also refers to individual items of work within the Schedule of Values.

Liquidated Damages: Designated damages for the City to collect as compensation upon a specific breach (example: late delivery).

Long-Lead Item: Long-lead item refers to the equipment, product, or system that is identified at the earliest stage of a project to have a delivery time long enough to affect directly the Critical Path/the overall lead time of the project.

MAG: The Maricopa Association of Governments.

MAG Specifications: The most current version of the Uniform Standard Specifications for Public Works Construction published by MAG.

MAG Standard Details: The most current version of the Uniform Standard Details as published by MAG.

Minor change: A change in the Work having no impact on cost or time or the City-approved design intent, as determined by City.

Notice to Proceed (NTP): A written notice given by City to Contractor fixing the date on which Contractor will start to perform Contractor's obligations under the Agreement.

Project: The Project specified in the Agreement (including a Job Order).

Project Manager: The Project Manager designated in Article 1 of the Agreement, or any successor thereto

designated by City. The Project Manager has the authority to act on behalf of City, as delineated and limited by the Agreement Documents and applicable law. And City will communicate with Contractor through the Project Manager. However, the Project Manager has no authority to bind City or City Council in contravention of any City code, State or Federal statute or regulation, or these General Conditions.

Project Schedule: The schedule for the completion of the Project agreed to and required by City.

Project Specific Conditions: Additional conditions which apply to the specific Project and Scope of Work which are set forth in Exhibit D of the Agreement.

Project Team: The Project Team consisting of the Design Professional, Contractor, Project Manager, and such others as City may designate.

Punch List: The list initially prepared by Contractor pursuant to the Agreement Documents, reviewed and supplemented by the Project Manager (and at the sole option of the Project Manager, the Design Professional) and approved by City containing items of incomplete work not impacting Substantial Completion, if allowed for under the Agreement, and to be completed or corrected by Contractor after Substantial Completion and before Final Acceptance in accordance with the Agreement Documents.

Quality Assurance (QA) Testing: Testing performed to verify the accuracy and applicability of the QC testing results and to ascertain that the materials installed meet the specified levels of quality in accordance with the Agreement Documents.

Quality Control (QC) Testing: Testing performed to assure that the materials installed comply with the requirements in the Agreement Documents.

Requests for Information (RFIs): Formal written request from Contractor to City or Design Professional for the Project seeking clarification or additional information needed for Contractor to properly complete the Work or Services under the Agreement. City may require RFI's to be submitted on a specific form or in a specified format.

Schedule of Values (SOV): The specified document prepared by Contractor, and approved and accepted by City, which divides the Agreement Price into pay items, such that the sum of all pay items equals the Agreement Price for the construction phase Work, or for any portion of the Work having a separate specified Agreement Price.

Scope of Work: The scope of work agreed to or required by City and incorporated into the Agreement as Exhibit A.

Shop Drawings: All drawings, diagrams, schedules and other data specifically prepared for the Work by Contractor or a Subcontractor, Sub-subcontractor, manufacturer, supplier or distributor to illustrate some portion of the Work.

Site: The land or premises on which the Project is located.

Specifications: The part(s) of the Agreement Documents for the construction phase consisting of written technical descriptions of materials, equipment, construction systems, standards and workmanship as applied to the Work and certain administrative details applicable thereto. Where specified, the Project must be constructed using the current Uniform Standard Specifications and Details for Public Works

Construction as furnished by the Maricopa Association of Governments, as amended by City.

Subconsultant: A person, firm or corporation having an Agreement with Consultant/Contractor to furnish services required as its independent professional associate or consultant with respect to the Project.

Subcontractor: An individual or firm having a direct Agreement with Contractor or any other individual or firm having an Agreement with the aforesaid contractors at any tier, who undertakes to perform a part of pre-construction services or construction phase Work at the Site for which Contractor is responsible. Subcontractors must be selected through the Subcontractor selection process described in the Agreement Documents, if any.

Substantial Completion: The date when the City determines that the Work (or separable units of Phases as provided in the Agreement Documents) is essentially and satisfactorily complete in accordance with the Agreement Documents such that the Project is ready for use by the City for its intended purpose, opening to the general public, full occupancy or use by City (including, without limitation, all separate units, or rooms, facilities, access, income-generating areas, and all areas serving the general public, as applicable, must be ready for full operation without material inconvenience or discomfort), including, to the extent applicable to the Work, the following: all materials, equipment, systems, controls, features, facilities, accessories, and similar elements are installed in the proper manner and in operating condition, inspected, and approved; surfaces have been painted; masonry and concrete cleaned with any sealer or other finish applied; utilities and systems connected and functioning; site work complete; permanent heating, ventilation, air conditioning, vertical transportation, and other systems properly operating with proper controls; lighting and electrical systems installed, operable and controlled; paving completed, signage installed, and other work as applicable, has been performed to a similar state of essential and satisfactory completion.

Supplier: A manufacturer, fabricator, distributor, or vendor having a direct Agreement with Contractor or with any Subcontractor to furnish materials or equipment to be incorporated in the construction phase Work by Contractor or any Subcontractor.

Total Float: Number of Days by which pre-construction services or construction phase Work or any part of the same may be delayed without necessarily extending a pertinent Agreement Time or schedule milestone in the Project Schedule.

Work: The entire completion of construction or the various separately identifiable parts thereof, required to be furnished during the construction phase. Work includes and is the result of performing or furnishing labor and furnishing and incorporating materials, resources and equipment into the construction, and performing or furnishing services and documents as required by the Agreement Documents for the construction phase.

Writing: Typing, printing, photography and other modes of representing or reproducing words in a visible form, including email, and expressions.

SECTION 3 - STANDARD SPECIFICATIONS AND DETAILS

3.1 City operates under the latest revision of the MAG Specifications and MAG Standard Details as amended by City. City's current amendment to the MAG Specifications, part of the City's Unified Development Manual, may be found and downloaded from City's website at http://www.chandleraz.gov.

3.2 Copies of the MAG Specifications and MAG Standard Details are available at the Maricopa Association of Governments office, 302 N. 1st Avenue, Suite 300, Phoenix, Arizona. They may also be downloaded from their website at: http://www.azmag.gov/Newsroom/Publications

3.3 The MAG Specifications and Standard Details and City's amendments thereto are incorporated into the Agreement by this reference.

SECTION 4 - CONTRACTOR'S RESPONSIBILITIES FOR CONSTRUCTION SERVICES

4.1 **GENERAL**

4.1.1 Contractor must construct the Work in accordance with the Agreement Documents and as outlined in Exhibit A of the Agreement to the satisfaction of City, exercising the degree of professional care, skill, diligence, quality and judgment that a professional construction manager engaged, experienced and specializing in the construction management of construction and facilities of similar scope, function, size, quality, complexity and detail in urban areas throughout the United States comparable to Chandler, Arizona would exercise at such time, under similar conditions. Contractor must, at all times, perform the Work in conformance with sound and generally accepted engineering principles and construction management and construction contracting practices.

4.1.2 If Contractor observes errors, discrepancies or omissions in the Agreement Documents, Contractor must promptly notify the Design Professional and City and request clarification. If Contractor, with the exercise of reasonable care, should have recognized such error, inconsistency, omission, or difference and fails to report it to City, and if Contractor proceeds with the Work affected by such observed errors, discrepancies or omissions, without receiving such clarifications, Contractor does so at its own risk and will be liable to City for damages resulting from proceeding without clarification.

4.1.3 Project Team and agents of each of them, testing agencies and governmental agencies with jurisdictional interests will be provided access to the Work at reasonable times for their observation, inspection, and testing. Contractor must provide proper and safe conditions for such access.

4.1.4 Contractor must comply with, and require all Subcontractors to comply with, the Arizona Contractors' license laws, including all requirements with respect to being duly registered and licensed.

4.1.5 Contractor must ensure that all employees performing any Work for which Contractor is responsible have a legal right to live and work in the United States. In addition, all compensation of any such employee must meet all applicable requirements of the Fair Labor Standards Act (FLSA) and Federal Minimum Wage laws.

4.1.6 Contractor must comply with the Immigration Reform and Control Act of 1986 (IRCA). Contractor understands and acknowledges the applicability of the IRCA activities. Contractor agrees to comply with the IRCA while performing their work and to permit City inspection of Contractor personnel records to verify such compliance.

4.1.7 Pursuant to MAG Specifications §§ 107.4, Contractor must report immediately any discovery of archeological ruins or artifacts. Excavation must stop immediately so that City can decide on the pertinent steps to follow such discovery.

4.1.8 All property owners that may be affected by the proposed construction activities must be notified of the scope, duration of the construction activities and possible interference with their day-to-day activities by Contractor prior to start of construction. In addition, individual residential or commercial interferences, such as driveway restrictions, water outages, and all other Work adjacent to residence/business, require 48-hour notification in advance of specific adjoining Work. Notification may be through door hangers or other procedures approved by the City.

4.1.9 Access must be maintained to adjacent properties at all times during construction. Where property has more than one point of access, no more than one access will be restricted or closed at any one time. Access to adjacent private driveways will be maintained during all non-working hours.

4.1.10 Contractor must furnish and erect construction signs in accordance with Project Specifications. The signs must be professionally prepared and subject to approval by City, must be maintained by Contractor for the duration of the project, and must be removed by Contractor during the final project clean up.

4.1.11 The number of signs required, the size, shape, installation requirements and information to be included for construction signs is established on the detail sheet, provided, however, signs must be a minimum of 4 foot by 8 foot and must be installed so that the bottom of the sign is at least 4 foot above grade. No direct payment will be made for furnishing and erecting construction signs. The cost thereof must be included in other items for which direct payment is made. Sign locations will be determined by City.

4.1.12 All required construction signs must be installed by Contractor within 7 Days of Notice to Proceed.

4.1.13 The Work to be accomplished under these Agreement Documents has been designed for City by a Design Professional retained by City for this purpose. It is understood that normal construction Administration for the purpose of interpretation of the Agreement Documents is provided by City. Should any services of the Design Professional be required to assist in the corrections of errors or omissions by Contractor, or services of the Design Professional be required because of changes in structure or equipment where Contractor has requested approval of substitute methods or material, or any other items detailed herein below, those services will be provided by the Design Professional at the standard hourly rates previously negotiated with City and must be paid for by the Contractor.

4.1.14 Contractor must reimburse City for costs incurred by the Design Professional for additional services to the Project through no fault of City or the Design Professional including, but not limited to, the following conditions:

a. Additional Site visits, investigations, inspections, design work or reports by the Design Professional which are required due to damages to existing facilities or completed Work caused by the Contractor in his performance, Contractor's negligence, or Contractor's Work which is rejected as defective or as failing to conform to the Agreement Documents;

b. Design Professional construction phase services rendered on the project during the time the project remains incomplete after the Agreement date of final completion will be charged to Contractor at a rate previously negotiated City; and

c. All retesting required due to the failure of Contractor's Work to meet the requirements of the Agreement Documents will be at Contractor's expense. All standby and travel time by the City's testing lab, the Design Professional or City due to Contractor's inability to be prepared for testing at the agreed upon time will be at the Contractor's expense.

4.1.15 City may withhold from any payment otherwise due to Contractor any amounts necessary to pay the Design Professional for such additional services as provided herein above.

4.1.16 Contractor will not be required to bear additional costs incurred by City due to errors by the Design Professional.

4.2 **CONTRACTOR'S PRE-AGREEMENT AND PRE-WORK DELIVERABLES**

4.2.1 Prior to award of the Agreement, Contractor must execute Agreement and deliver to City. Failure to do so may delay Agreement award. Contractor must also provide to City its Contractor's License classification and number and its Federal Tax I.D. number.

4.2.2 Before beginning any Work under the Agreement, Agreement must be fully executed by City.

4.2.3 After Agreement award, City will issue to Contractor an award letter. At that time Contractor must deliver to City such bonds and certificates of insurance with endorsements in such amounts (and other evidence of insurance requested by City) required under Section 11 of these General Conditions, and as the Agreement requires.

4.2.4 As evidence of Workmen's Compensation Insurance, Contractor must, upon request, provide a letter of certification from the Industrial Commission of Arizona that Contractor is insured by the State Compensation Fund or is an authorized self-insurer or a certificate of insurance issued by an insurance company authorized by the Insurance Department of Arizona to write Workmen's Compensation and Occupational Disease Insurance in the State of Arizona.

4.2.5 Within 10 Days of the date of the executed Agreement letter issued by City, Contractor must submit to City for review and acceptance the following items:

4.2.5.1 Comprehensive construction Project Schedule including a Critical Path Method (CPM) diagram schedule as described in Section 6.2. Project Schedule must be in Microsoft Project standard file format. Within 10 Days of receipt of City's comments, Contractor must make all required corrections, adjustments, and additions to complete the Project Schedule and resubmit to City for review.

4.2.5.2 Preliminary schedule of submittals and Shop Drawings. Within 10 Days of receipt of City's comments, Contractor must submit the corrected and completed schedule of Shop Drawings submissions for approval. Contractor's schedule of Shop Drawings and sample submittals will be acceptable to City if it provides a workable arrangement for reviewing and processing the required submittals.

4.2.5.3 Schedule of Values in a form specified by City reflecting the subcontracts and other categories that will be used to submit Pay Applications for the Work. The total amount of the Schedule of Values must not be greater than the Agreement Price. The Schedule of Values will be reviewed at the Pre-Construction Conference and revised by Contractor within 10 Days after Pre-Construction Conference in response to comments and questions from

City. Once accepted by City in writing, the Schedule of Values for the Project must not be changed without the prior written approval of City.

4.2.6 Video Recording Requirement. Prior to performing any Work, Contractor must document the existing conditions of the Site, all other areas where Work will occur and all adjacent areas that may be impacted by the Work via digital video format. Contractor must video record and index all areas, features, buildings and other public and private improvements that could potentially be impacted by the Work. Video recording must be coordinated with City. When video recording private property, Contractor must also coordinate the video recording with the private property owner, if possible. Contractor must provide City with a copy of said digital video format prior to performing any Work.

4.2.7 Aerial Drone Construction Photography.

4.2.7.1 If Agreement duration is greater than 90 calendar days, Contractor must engage a professional unmanned aerial vehicle (UAV) aerial pilot to photograph the Site prior to construction mobilization, at three-month intervals during construction, and following final inspection. Drone camera specifications must meet the following minimum requirements:

a. 1-inch CMOS
b. Pixels: 20M
c. FOV 84 8.8 mm/24 mm (35 mm format equivalent) f/2.8-f/11 auto focus at 1 m-
d. For photographing: 16.9 Aspect Ratio: 5472x3078
e. For video shooting: MP4/MOV/H.264
f. FHD: 1920x1080 120p @100Mbps
g. File format: High Definition (HD) JPEG for digital photos and HD MPEG 4 for digital video.
h. All metadata to be recorded including GPS data and preserved with photographs provided.

Interval	**JPEG**
3 month intervals	At an altitude (AGL) between 70-90 ft.
3 month intervals	Images to be taken every 50-100 ft. to be determined based on project scope.

4.2.7.2 Drone photos to be taken in sequential geographical order and then organized and provided in the same manner unless otherwise specified.

4.2.7.3 Photos to be provided digitally via an online file share service and/or by a USB drive to contractor.

4.2.7.4 Drone pilots to obey ALL local (city, county, state) UAV regulations as well as FAA UAV guidelines including, but not limited to, conducting all flights during daylight hours, not exceeding maximum altitude ceilings (depending on area), not flying over people, yielding to other aircraft.

4.2.7.5 Drone pilots must fly drone within visual line of sight (VSOL) and have visual spotter when needed. Drone pilots only to operate in favorable weather conditions when minimum visibility is 3 miles or greater.

4.2.7.6 Drone pilots to conduct a preflight checklist and visually inspect the entire flight path prior to flying to ensure a safe flight.

4.2.7.7 Airspace Authorizations. Operations in Class G airspace are allowed without air traffic control (ATC) permission. Operations in Class B, C, D and E airspace need ATC authorization. Drone pilots to schedule each flight in advance and based on airspace if required will notify nearby airports/control towers, etc.

4.2.8 Government Approvals and Permits.

4.2.8.1 Contractor must obtain all necessary permits for the Work and pay all applicable fees, unless otherwise noted on the Plans and in the Specifications. City permit fees will be paid internally by City. For bidding purposes, an allowance for all permit fees is included in the bid schedule under the item "allowance for permit fees." The Contractor will be paid for the actual cost of the permit fees upon submitting a receipt showing the fee Contractor has paid. Excluded from the above allowance are items such as all costs incurred by the Contractor in securing the permit except for the actual permit fee established by the agency, cost for all shutdowns or outages, cost for pole bracing, cost of permits for construction water, cost of construction water, cost for any additional insurance requirements, cost for any licenses, and other similar type costs. Contractor is specifically notified of the need to obtain the necessary environmental permits or file the necessary environmental and regulatory permit notices.

4.2.8.2 Copies of all permits and the associated notices must be provided to City prior to starting the permitted activity.

4.3 PRE-CONSTRUCTION CONFERENCE

4.3.1 Prior to the commencement of any Work, City will schedule a Pre-Construction Conference.

4.3.2 The purpose of this Conference is to establish a working relationship between Contractor, the utility firms, and various City agencies. The agenda will include critical elements of the Work schedule, submittal schedule, cost breakdown of major lump sum items, Payment Requests and processing, coordination with the involved utility firms, and emergency telephone numbers for all representatives involved in the course of construction.

4.3.3 Minimum attendance by Contractor at any mandatory meeting with City must be (1) Contractor's Representative, who is authorized to execute and sign documents on behalf of the firm, (2) Contractor's on-site Superintendent, and (3) Contractor's Safety Office, or other employee responsible for safety.

4.4 PERFORMANCE OF THE WORK (INCLUDING FIELD MEASUREMENTS, SUBCONTRACTORS, AND SUPPLIERS)

4.4.1 Unless otherwise provided in the Agreement Documents to be the responsibility of City or a separate Contractor, Contractor must provide through itself or Subcontractors the necessary supervision, labor, inspection, testing, start-up, material, equipment, machinery, temporary utilities and other temporary facilities to permit Contractor to complete the Work consistent with the Agreement Documents.

4.4.2 Contractor must perform all construction activities efficiently and with the requisite expertise, skill and competence to satisfy the requirements of the Agreement Documents. Contractor must at all times exercise complete and exclusive control over the means, methods, safety, sequences and techniques of construction.

4.4.3 Contractor's Superintendent must be present at the Site at all times that material Work

under this Agreement is taking place. Contractor's Superintendent or designee must be present at the Site at all times any other Work under this Agreement is taking place. Superintendent must not be replaced without written notice to City. Whenever the Superintendent is not present at a particular part of the Work where the City or Design Professional may desire to inform the Contractor relative to interpretation of the Drawings and Specifications or to disapproval or rejection of materials or Work performed, the City or Design Professional may provide such information in writing to the foreman or other worker in charge of the particular part of the Work in reference to which the information is given. Information so given will be as binding as if given to the Superintendent.

4.4.4 All elements of the Work must be under the direct supervision of a foreman or his designated representative on the Site who must have the authority to take actions required to properly carry out that particular element of the Work.

4.4.5 Working Hours. Except in connection with the safety or protection of persons or the Work or property at the Site or adjacent thereto, and except as otherwise indicated, all Work at the Site must be performed during regular working hours, and Contractor will not permit overtime work or the performance of Work on Saturday, Sunday or any legal holiday without City's written consent given after prior written notice to City. If it will become absolutely necessary to perform Work at night or on Saturdays, Sundays or legal holidays, the City must be informed at least 24 hours in advance of the beginning of performance of such Work. Only such Work will be done at night as can be done satisfactorily as determined by the City. Good lighting and all other necessary facilities for carrying out and inspecting the Work must be provided and maintained at all points where such Work is being done. Further, unless such non-normal work hours are performed at City's request or required by the Agreement Documents, Contractor must pay to City all additional costs incurred by City by reason of such non-normal working hours. Expenses incurred by City for overtime compensation must be reimbursed by Contractor as follows: (i) City staff at the rate set forth in current City Fee Schedule as published on City website, (ii) Design Professional and staff at the standard hourly rates previously negotiated with City, and (iii) all others at actual cost plus ten percent administrative overhead. Such costs may be deducted by City from any payments due to Contractor. Provided, however, if overtime work or work during other than normal hours is at the request of City and not due to Contractor delay, City will pay the cost of City overtime expenses.

4.4.6 Where the Agreement Documents require that a particular product be installed or applied by an applicator approved by the manufacturer, it is Contractor's responsibility to ensure the Subcontractor employed for such work is approved by the manufacturer. All materials and equipment must be stored, applied, installed, connected, erected, used, cleaned and conditioned in accordance with the instructions of the applicable manufacturer, fabricator, supplier or distributor, except as otherwise provided in the Agreement Documents; but no provisions of any such instructions will be effective to impose on City of Design Professional responsibility for the means, methods, techniques, sequences or procedures of construction or for safety precautions incident thereto.

4.4.7 Before starting the Work, Contractor must carefully study and compare the various Plans, Drawings, other Agreement Documents, and Specifications relative to that portion of the Work, as well as the information furnished by City, must take field measurements of any existing conditions related to that portion of the Work and must observe any conditions at the Site affecting it. The exactness of grades, elevations, dimensions, or locations given on any Drawings, or the Work installed by other contractors, is not guaranteed by City.

4.4.8 Before ordering materials or doing Work, Contractor and each Subcontractor must verify measurements at the Site and will be responsible for the correctness of such measurements. No extra charge or compensation will be allowed because of differences between actual dimensions and the dimensions indicated on the Agreement Documents, including the Drawings.

4.4.9 Ground Level Construction Photography.

4.4.9.1 The Contractor must furnish progress photographs of the project. The photographer selected by the Contractor must be approved by the City and must be either a commercial photographer or an individual experienced and equipped for such photography.

4.4.9.2 The Contractor must deliver to City all photographs taken during that period with each application for payment. If the current photographs do not accompany the application, the application will not be reviewed and will be returned to the Contractor as incomplete.

4.4.9.3 Photographs must be identified by use of typewritten labels affixed to the back of the photograph. The label must provide a description of the view, the direction from which the photograph was taken, the name of the project, City's project number, the name of Contractor and the date of the photography. The stationing must also be included for all pipeline installations.

4.4.9.4 Photographs must be taken during the construction period and must be of aesthetic composition and depict the progress of the Work from the beginning of construction through and including the finished product. City may vary the specified frequency so that significant progress or changes can be recorded on the photographs.

4.4.10 Underground Facilities.

4.4.10.1 The existence and number of facilities as shown on the Plans are estimated from information furnished by the particular utility. Contractor is responsible for field verification and location of all utilities prior to the start of construction. No field work will be allowed to start until Contractor has contacted Arizona 811 and all affected utilities have been located. In addition, Contractor must expose and physically locate all potentially conflicting utilities prior to construction. The actual locations of the utilities must be compared to locations shown on the Plans and any required changes in alignment and grade must be made at the time of construction in consultation with Project Manager. It is generally recognized and Contractor should anticipate that information from Arizona 811 or information from utility companies during project design, frequently fails to disclose all underground facilities. The fact that more utility lines or other underground facilities are located in the Project Site than shown on the Project Plans does not constitute an "unforeseen Condition" and such undisclosed underground facilities do not differ materially from the conditions which Contractor should expect. The provisions of Sections 105.4, 105.6, 107.11 and 109.8.1 of the MAG Uniform Standard Specifications for Public Works Construction apply and are incorporated herein by this reference.

4.4.10.2 Contractor is responsible for all coordination with utility companies. The provisions of Sections 105.4, 105.6, 107.11 and 109.8.1 of the MAG Uniform Standard Specifications for Public Works Construction strictly apply and no additional compensation will be paid to Contractor for delays due to utility work on the project.

4.4.11 Relocation of Existing Water Meters. When a service line has been extended and a line

setter installed in a meter box, City forces will re-install meter. No compression fittings will be utilized.

4.4.12 Water Turn-On or Turn-Off.

4.4.12.1 Contractor must coordinate all water line turn-ons and turn-offs through the City. Application must be made to the Municipal Utility Division and Contractor must pay the established charges. The City will close existing valves, but will not guarantee a bone-dry Shutdown.

4.4.12.2 Contractor must notify all customers affected by the turn-off not less than 48 hours in advance. Notification must be in writing, must give the reason for the turn-off and must give the estimated time and duration that water service will be interrupted. Contractor is also notified that water turn-off will not be permitted on the Day before and after Thanksgiving Day and Christmas Day.

4.4.12.3 No direct payment will be made to Contractor for turn-ons or turn-offs. Costs associated therewith will be included in other items for which direct payment is made.

4.4.13 Tests and Inspections.

4.4.13.1 Contractor must give City timely (at a minimum, twenty-four hours) notice of readiness of the Work for all required inspections, tests or approvals. Contractor must give timely notice to City in advance of backfilling or otherwise covering any part of the Work so that city representative may, if desired, observe such part of the Work before it is concealed. Whenever Contractor varies the normal period during which Work or any portion of it is carried on each Day, Contractor must give timely notice to City so that city representative may, if desired, be present to observe the Work in progress. If Contractor fails to give such timely notice, any Work done in the absence of city representative will be subject to rejection. If Contractor gives such notice to City, but then is not ready for such inspections, tests, approvals or observations at the time so noticed, Contractor must reimburse City for all costs incurred by the attendance of city representatives.

4.4.13.2 If any law, ordinance, rule, regulation, code, or orders of any public body having jurisdiction requires any Work (or part thereof) to be inspected, tested or approved, Contractor (unless another party is specified in the Agreement Documents) must assume full responsibility therefor, pay all costs in connection therewith and furnish City the required certificates of inspection, testing, or approval. Contractor must also be responsible for and must pay all costs in connection with any inspection or testing required by the Specifications in connection with City's acceptance of a manufacturer, fabricator, supplier or distributor of materials or equipment proposed to be incorporated in the Work, or of materials or equipment submitted for approval prior to Contractor's purchase thereof for incorporation in the Work. The cost of all other inspections, tests and approvals required by the Agreement Documents will be paid by City (unless otherwise specified).

4.4.13.3 All inspections, tests or approvals other than those required by law, ordinance, rule, regulation, code or order of any public body having jurisdiction must be performed by organizations acceptable to City and by the Design Professional if so specified.

4.4.13.4 Neither observations by City, the Design Professional nor inspections, tests or approvals by others will relieve Contractor from their obligations to perform the Work in accordance with the Agreement Documents.

4.4.14 Uncovering Work. If any Work that is to be observed, inspected, tested or approved is covered without written concurrence of City, it must, if requested by City be uncovered for observation. Unless Contractor has given City timely notice of Contractor's intention to cover such Work and City has not acted with reasonable promptness in response to such notice, Contractor must furnish all necessary labor, material and bear all the expenses of such uncovering, exposure, observation, inspection and testing and of satisfactory reconstruction, including compensation for additional professional services, and an appropriate deductive Change Order will be issued.

4.4.15 In all cases of interconnection of its Work with existing or other Work, Contractor must verify at the Site all dimensions relating to such existing or other Work. Any errors due to Contractor's failure to so verify all such grades, elevations, locations or dimensions must be promptly rectified by Contractor without any increase in the Agreement Price. Any design errors or omissions noted by Contractor during this review must be reported promptly to City.

4.4.16 Contractor must establish and maintain all construction grades, lines, levels, and benchmarks, and will be responsible for accuracy and protection of same. This Work must be performed or supervised by a licensed civil engineer or surveyor in the State of Arizona.

4.4.17 Contractor must photograph all buried piping of greater than four (4) inches in diameter prior to backfill.

4.4.18 Contractor is responsible for the proper performance of the work of Subcontractors and any acts and omissions in connection with such performance. Nothing in the Agreement Documents is intended or deemed to create any legal or contractual relationship between City and any Subcontractor or Sub-Subcontractor, including but not limited to any third-party beneficiary rights.

4.4.19 Contractor must coordinate the activities of all Subcontractors. Contractor must coordinate performance of the Work with City's Public Works & Utilities Department and other departments or agencies within City. The Design Professional and other contractors or parties involved in the Project. If City performs other work on the Project or at the Site with separate contractors under City's control, Contractor agrees to cooperate and coordinate its activities with those of such separate contractors so that the Project can be completed in an orderly and coordinated manner without unreasonable disruption.

4.4.20 Contractor will not substitute or change any Subcontractor or Supplier without the prior written approval of City. Any substitute or replacement Subcontractor or Supplier must be required to meet the same qualifications and selection criteria and process as the original Subcontractor or Supplier. If a Subcontract/Supplier selection plan has been approved by City, Contractor will follow that plan unless otherwise approved by City in writing.

4.4.21 Contractor must not change or replace any members of its Project team, including Contractor's Representative, Project Manager, or Superintendent, without an explanation for the change being given to City, and receiving prior written approval of the change from City, which approval will not be unreasonably withheld.

4.4.22 Subcontractors whose scope of work has a value greater than 15% of the total Agreement Price are required to furnish performance and payment bonds to Contractor, unless

otherwise approved in writing by City.

4.4.23 Contractor must comply with MAG Specification § 108.2 (E) unless otherwise specified in Agreement Documents.

4.5 **CONTROL OF THE PROJECT SITE**

4.5.1 Throughout all phases of construction, including suspension of Work, Contractor must keep the Site reasonably free from debris, trash and construction wastes to permit Contractor to perform its construction services efficiently, safely and without interfering with the use of adjacent land areas. Prior to Final Acceptance of the Work, or a portion of the Work, Contractor must remove all debris, trash, construction wastes, materials, equipment, machinery and tools arising from the Work or applicable portions thereof to permit City to occupy the Project or a portion of the Project for its intended use.

4.5.2 Contractor must take whatever steps, procedures or means necessary to prevent dust nuisance due to construction operations. The dust control measures must be maintained at all times to the satisfaction of City and in accordance with the requirements of the Maricopa County Bureau of Air Pollution Control Rules and Regulations.

4.5.3 Contractor must maintain Americans with Disabilities Act (ADA) and American National Standards Institute (ANSI) accessibility requirements during construction activities, including without limitation compliance with the 2010 regulations governing implementation of the ADA to the extent applicable. ADA and ANSI accessibility requirements must include, but not be limited to, parking, building access, areas of refuge, and emergency exit paths of travel. Contractor is responsible for the coordination of all Work to minimize disruption to residents and the public.

4.5.4 Only materials and equipment used directly in the Work will be brought to and stored on the Site by Contractor. When equipment is no longer required for Work, it must be removed promptly from the Site. Protection of construction materials and equipment stored at the Site from weather, theft, damage and all other adversity is solely the responsibility of the Contractor.

4.5.5 Contractor agrees all persons working on the Site must act at all times in the best interest of the Project and will comply with all applicable rules and regulations reasonably set forth by City related to the Site. Notwithstanding the foregoing or anything in this Agreement to the contrary, City may remove from the Site any individual who City deems in their reasonable discretion to be creating a disturbance or causing any problem on the Site.

4.5.6 Contractor will be responsible to City for the acts and omissions of Contractor's employees, Subcontractors and their agents and employees, and any other person performing any of the Work under an Agreement with Contractor, or claiming by, through or under Contractor, for all damages, losses, costs and expenses resulting from such acts or omissions.

4.5.7 City may conduct criminal, drive history, and all other requested background checks of Contractor and Subcontractor personnel performing Work or who have access to City's information, data, or facilities in accordance with City's current background check policies, or the provisions of the Project Specific Conditions. Any officer, employee or agent that fails to background check must be replaced immediately.

4.5.8 City will have a final authority, based upon security reasons: (i) to determine when

security clearance of Contractor's and Subcontractor's personnel is required; (ii) to determine the nature of the security clearance, up to and including fingerprinting personnel; and (iii) to determine whether or not any individual or entity may provide Services or perform Work under the Agreement.

4.5.9 If City objects to any personnel for any reasonable cause, then Contractor must, upon notice from City, remove such individual from the Project.

4.6 **PROJECT SAFETY**

4.6.1 The Project and all Work performed in relation thereto is governed by applicable provisions of the federal laws, including but not limited to, the latest amendments of the following:

a. Williams-Steiger Occupational Safety & Health Act of 1970, Public Law, 91-596.

b. Part 1910 and Part 1926 – Occupational Safety and Health Standards, Chapter XVII of Title 29, Code of Federal Regulations.

c. Part 1518 – Safety and Health Regulations for Construction, Chapter XIII of Title 29, Code of Federal Regulations.

4.6.2 Contractor is responsible for safety of the job Site for employees of Contractor as well as for members of the general public and others who may drive or walk through or be at the Site.

4.6.3 Contractor recognizes the importance of performing the Work in a safe manner so as to prevent damage, injury or loss to: (i) all individuals at the Site, whether working or visiting; (ii) the Work, including materials and equipment incorporated into the Work and stored On-Site or Off-Site; and (iii) all other property at the Site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures and utilities not designated for removal, relocation or replacement in the course of construction; and (iv) the owners or tenants of adjacent property and their patrons, employees and invitees.

4.6.4 Contractor assumes responsibility for implementing and monitoring all safety precautions and programs related to the performance of the Work.

4.6.5 Contractor must provide a "competent person' as required by O.S.H.A regulations. The "competent person" must be identified at the Pre-Construction Conference with City advised in writing of any changes.

4.6.6 The "competent person" must make routine daily inspections of the Site and must hold weekly safety meetings with Contractor's personnel, Subcontractors and others as applicable.

4.6.7 Contractor and Subcontractors must comply with all legal and regulatory requirements relating to safety, as well as any City specific safety requirements set forth in the Agreement Documents, provided that such City-specific requirements do not violate any applicable legal and regulatory requirements.

4.6.8 Contractor will immediately report in writing any safety-related injury, loss, damage or accident arising from the Work to Project Manager and, to the extent mandated by Legal Requirements, to all government or quasi-government authorities having jurisdiction over safety-related matters involving the Project or the Work.

4.6.9 Contractor's responsibility for safety under this Section is not intended in any way to relieve Subcontractors and Sub-Subcontractors of their own contractual and legal obligations and responsibility for (i) complying with all Legal Requirements, including those related to health and safety matters, and (ii) taking all necessary measures to implement and monitor all safety precautions and programs to guard against injury, losses, damages or accidents resulting from their performance of the Work.

4.6.10 As between City and Contractor, Contractor is responsible to City for any and all the safety issues relating to the Work on the Project. Contractor must administer and manage the safety program. This will include, but not necessarily be limited to review of the safety programs of each Subcontractor. Contractor must monitor the establishment and execution of compliance with all applicable regulatory and advisory agency construction safety standards. Contractor's responsibility for review, monitoring, and coordination of the Subcontractor's safety programs will not extend to direct control over execution of the Subcontractors' safety programs. Notwithstanding Contractor's safety obligations to City, it is agreed and understood that each individual Subcontractor will remain controlling employer responsible for the safety programs and precautions applicable to its own work and the activities of other's work in areas designated to be controlled by such Subcontractor for purposes of workers compensation insurance coverage.

4.6.11 Nothing in this agreement will relieve Contractor of his responsibility to maintain traffic, structures, etc., as noted on the Plans, Specifications, and Project Specific Conditions. Contractor is responsible to provide all necessary shoring, bracing and trench support as is necessary to maintain traffic structures, etc., as stipulated in the Plans, Specifications, and Special Provisions. If the stability of adjoining building, walls, roadways, etc., is endangered by Contractor's excavation, shoring, bracing, or under pinning must be provided as necessary to ensure project safety. Cost for shoring, bracing, underpinnings, and trench support will be included in the appropriate items listed in the Agreement Price, and no additional payment will be made for this work.

4.7 MATERIALS QUALITY, SUBSTITUTIONS, AND SHOP DRAWINGS

4.7.1 Quality Control and Quality Assurance Testing.

4.7.1.1 All construction materials to be used or incorporated in the Project are subject to inspection, Quality Control & Quality Assurance Testing, and approval or rejection by City. Any material rejected by City must be removed immediately and replaced in an acceptable manner to City at no additional cost to City. When QC/QA tests indicate noncompliance with the Agreement Documents, retesting must be performed by the same testing laboratory that performed the tests that indicated noncompliance.

4.7.1.2 The Contractor must establish, provide, and maintain an effective Quality Control Testing Program (QCTP). The Contractor must develop his own program or procure the services of a consultant. In either case, the party performing the tests must be currently certified by the National Bureau of Standards in the National Voluntary Laboratory Accreditation Program (NVLAP) for construction services or the AASHTO Accreditation Plan (AAP) for Soils, Asphalt and Concrete. The Contractor must provide all support necessary to perform QC and QA testing and sampling (i.e. shoring for testing trench backfill, backhoes, motor graders, loaders, etc. to facilitate testing and sampling). The City will perform the QA testing.

4.7.1.3 The Contractor must submit a written QCTP to the City as a required submittal. The Contractor must not begin Work until the Quality Control Program has been reviewed and

accepted by the City. Resumes of all personnel that will be associated directly or indirectly with the QCTP must be included.

4.7.1.4 The QCTP must include, but not be limited to, on-site/field and laboratory testing of all material delivered to the Site and any existing materials or conditions pertinent to the project.

4.7.1.5 All testing must be under the direction of a Professional Engineer registered in the State of Arizona, knowledgeable in Materials Testing. All "Test Report" forms must be stamped by said Engineer.

4.7.1.6 The written QCTP will set forth the responsibilities of the engineer, project manager, supervisory personnel and each technician assigned to this project. Substitutions or replacement of personnel must require prior written approval by the City. All personnel must be proficient within their assigned duties and possess certification(s) commensurate with their position and responsibilities. The minimum certification(s) for each technician must be NICET Level II, Arizona Technical Testing Institute, American Concrete Institute, or other nationally recognized program applicable to the project and approved by the City of Chandler. The written QCTP must include a description of the required field and construction materials laboratory tests, including required frequencies that meet the minimums established herein.

4.7.1.7 The Contractor must establish a system to record and report all material test results. The daily test reports must include, but not be limited to:

a. Test designation;
b. Date of test;
c. Name of tester;
d. Location of test/sample (station and offset);
e. Product suppliers and product codes (as applicable);
f. Depth/elevation of test/sample;
g. Test result;
h. Control requirement(s);
i. Cause of rejection (if applicable);
j. Results of retests (if applicable); and
k. Remedial action (if applicable).

4.7.1.8 The Contractor must submit test results to the designated City representative.

4.7.1.9 The Contractor must also submit a weekly report to the City summarizing the testing and construction activities completed by emailing the report to the email addresses noted above. All weekly reports must be submitted simultaneously to the Contractor and the City of Chandler. The report must include individual summary sheets for each utility line, structure, and portion of the pavement section. Cores must be numbered sequentially throughout the Project. Re-cores must reference the original core by number and must contain the averaged values for thickness and density. Total pavement thickness must be reported**.** Vertical location of tests for underground utilities must indicate the depth of the

excavation at the location of the test (i.e., cut to flow line [if applicable], depth to bottom or top of pipe, etc.). Density tests must be numbered sequentially. If the minimum number of tests has not been performed per the written QCTP, this must be stated in the weekly summary report with an explanation of the circumstances.

4.7.1.10 The City will maintain a copy of the Project test results and weekly reports in the Project file. In cases where quality control activities do not comply with the Agreement provisions, the City may:

a. Order the Contractor to replace ineffective or unqualified quality control personnel.

b. Order the Contractor to stop operations until appropriate corrective action is taken.

4.7.1.11 Although minimum testing requirements are specified herein, the Contractor bears full responsibility for the quality of the materials and their installation and may elect to perform additional testing beyond the requirements set forth herein to ensure compliance.

4.7.1.12 The Quality Control requirements contained in this Section are in addition to and separate from Quality Assurance Testing, which will be performed by the City of Chandler or its representative. If the Quality Assurance test results are not in agreement with the Quality Control test results, the Contractor will have the option to retain a third party consultant for referee tests. The third party consultant must meet the same requirements as the consultant performing the Quality Control Testing. The results of the third party will be binding. All cost incurred by the referee testing will be the Contractor's expense. If the Contractor elects not to retain a third party for referee testing, the City of Chandler test results will prevail.

4.7.1.13 Except as otherwise noted within this Section, Work or materials required by this Section are non- pay items. Per MAG Section 101, a non-pay item is an item of Work for which no separate payment will be made, the cost of which is to be included as an incidental cost for associated item(s) included on the Bid Schedule or Schedule of Values.

4.7.2 Trade Names and Substitutions.

4.7.2.1 Substitutions prior to bid will only be considered if in compliance with Arizona Revised Statute § 34-104.

4.7.2.2 Contractor, if requested by City, must submit Samples or any additional information that may be necessary to evaluate the acceptability of the substitution.

4.7.2.3 City will make the final decision and will notify Contractor in writing as to whether the substitution has been accepted or rejected.

4.7.2.4 If City does not respond within 15 working days, Contractor must continue to perform the Work in accordance with the Agreement Documents and the substitution will be considered rejected.

4.7.3 Shop Drawings.

4.7.3.1 Contractor must prepare and submit Shop Drawings which show details of all Work to insure proper installation of the Work using those materials and equipment specified under the approved Plans and Specifications.

4.7.3.2 Contractor must submit a schedule of Shop Drawing submissions, which avoids bulk submissions to the extent reasonably possible, with the Project Schedule for City approval. The schedule of Shop Drawing submissions must include all of the items for which Shop Drawings are required by the Agreement Documents, including the Specifications. Unless otherwise noted, Shop Drawings will not be required for items specified or detailed in the Uniform Standard Specifications and Details or the Technical Specifications.

4.7.3.3 Shop Drawings must be numbered consecutively for each Specification section and must accurately and distinctly present the following:

a. All working and erection dimensions.

b. Arrangements and sectional views.

c. Necessary details, including complete information for making connections between work under this Agreement and work under other Agreements.

d. Kinds of materials and finishes.

e. Parts list and description thereof.

4.7.3.4 Each Drawing or page must include:

a. Project Name, City of Chandler Project Number and descriptions.

b. Submittal date and space for revision dates.

c. Identification of equipment, product or material.

d. Name of Contractor and Subcontractor.

e. Name of Supplier and Manufacturer.

f. Relation to adjacent structure of material.

g. Physical dimensions clearly identified.

h. ASTM and Federal Specifications references.

i. Identification of and justification for deviations from the Agreement Documents.

j. Contractor's stamp, initialed or signed, dated and certifying the review of submittal, certification of field measurements and compliance with Agreement.

k. Location at which the equipment or materials are to be installed.

4.7.3.5 Location will mean both physical location and location relative to other connected or attached material. City will return unchecked any submittal, which does not contain complete data on the Work and full information on related matters.

4.7.3.6 Stock or standard drawings will not be accepted for review unless full identification and supplementary information is shown thereon in ink or typewritten form.

4.7.3.7 Contractor must schedule, prepare and submit all Shop Drawings in accordance with a time-table that will allow its suppliers and manufacturers sufficient time to fabricate, manufacture, inspect, test and deliver their respective products to the project Site in a timely manner so as to not delay the complete performance of the Work.

4.7.3.8 If the Shop Drawings show departures from the Agreement requirements, Contractor must make specific mention thereof in the Letter of Transmittal; otherwise review of such submittals by City will not constitute review of the departure. Review of the Drawings will constitute review of the specific subject matter for which the Drawings were submitted and not of any other structure, material, equipment, or apparatus shown on the Drawings.

4.7.3.9 The review of Shop Drawings will be general and will not relieve Contractor of responsibility for the accuracy of such Drawings, nor for the proper fitting and construction of the Work, nor for the furnishing of materials or Work required by the Agreement. No construction called for by Shop Drawings will be initiated until such Drawings have been reviewed and approved by City.

4.7.3.10 The procedure in seeking review of the Shop Drawings will be as follows:

a. Contractor must submit complete sets of Shop Drawings and other descriptive data as specified in this Section.

b. After Contractor's submittal or resubmittal of Shop Drawings, if Contractor has submitted Shop Drawings in accordance with the City-approved submittal schedule, or upon resubmission, City will be provided with three (3) calendar weeks for review. Should City require additional review time above and beyond the three (3) calendar weeks, Contractor may ask for a time extension or monetary compensation, if they can present valid, factual evidence that actual damages were incurred by Contractor. City will determine the amount of the time extension or the monetary compensation to be awarded Contractor, if any, in accordance with City's Policy Statement for Calculating Delays and Damages, Appendix 1.

4.7.3.11 Contractor will be responsible for all extra costs incurred by City caused by Contractor's failure to comply with the procedure outline above.

4.7.4 Long Lead Time Items. Contractor must submit Shop Drawings, as required by the Engineer, on all long lead items to be furnished and installed as part of the project within 10 Days after the date of the executed Agreement letter issued by City. In addition, Contractor must order all long lead items to be furnished and installed as part of this Project within 3 Days after receiving approved Shop Drawings. For all long lead times for which Shop Drawings are not required, Contractor must order said long lead items within 15 Days after the date of the executed Agreement letter issued by City. Within 2 Days after ordering long lead items, Contractor must supply copies of all purchase orders, along with an accurate delivery schedule from the supplier.

4.7.5 Construction Water. If Contractor uses water from City's water system for construction water, Contractor must obtain a fire hydrant meter from City of Chandler Utility Services (480-782-2280) and all construction water must be obtained through the hydrant meter. Contractor must pay all fees related to the hydrant meter and all water bills for construction water. All cost for meters and construction water will be included in the Agreement Price.

4.8 PROJECT RECORD DOCUMENTS

4.8.1 During the construction period, Contractor must maintain at the jobsite a full-size set of prints of the Construction Document Drawings and Shop Drawings for Project Record Document purposes.

4.8.2 Contractor must mark these Drawings to indicate the actual installation where the installation varies from the original Construction Documents. Contractor must give particular attention to information on elements that will be concealed, which would be difficult to identify or measure and record later. Items required to be marked include but are not limited to:

a. Dimensional changes to the Drawings.

b. Revisions to details shown on Drawings.

c. Locations and depths of underground utilities.

d. Revisions to routing of piping and conduits.

e. Actual equipment locations.

f. Changes made by Change Order or Addendum.

g. Details not on original Agreement Drawings.

4.8.3 Contractor must mark completely and accurately Project Record Drawing sets of Construction Documents.

4.8.4 Contractor must mark Project Record Drawings sets with red erasable colored pencil.

4.8.5 Contractor must note Request for Information (RFI) Numbers and Change Order numbers, etc., as required to identify the source of the change to the Construction Documents.

4.8.6 Contractor must submit Project Record Drawing sets and Shop Drawings to City or its representative for review and comment.

4.8.7 Upon receipt of the reviewed Project Record Drawings from City, Contractor must correct any deficiencies and omissions to the Drawings and submit the final original of the Project Record Drawings to City prior to Final Payment.

4.8.8 Project Manager will review the Project Record Drawings monthly prior to the date established for the Payment Request and will be the sole judge of acceptance of these Drawings.

4.9 WARRANTY AND CORRECTION OF DEFECTIVE WORK

4.9.1 Contractor warrants to City that the construction, including all materials and equipment furnished as part of the Work, will be new unless otherwise specified in the Agreement Documents, of good quality, and free of defects in materials and workmanship. Contractor's warranty obligation excludes defects caused by abuse, alterations, or unreasonable failure to maintain the construction by persons other than Contractor, subcontractors, or others under Contractor's control. Nothing in this warranty will limit any manufacturer's warranty which provides City with greater warranty rights than set forth herein or in the Agreement. Contractor will provide City with all manufacturers' warranties and operation and maintenance manuals upon substantial completion of the Work. Contractor's warranty must be for one (1) year, in accordance with MAG Specification § 108.8, and will commence for all portions of the Work upon Final Acceptance of the entire Work as determined by City under the Agreement. All statutory or other warranties, express or implied, related to latent defects will remain in force and are not limited by this provision.

4.9.2 City May Stop the Work. If the Work is defective, or Contractor fails to supply sufficient skilled workmen or suitable materials or equipment, City may order Contractor to stop the

Work without cost to City, or any portion thereof, until the cause for such order has been eliminated; however, this right of City to stop the Work will not give rise to any duty on the part of City to exercise this right for the benefit of Contractor or any other party.

4.9.3 Correction or Removal of Defective Work.

4.9.3.1 If required by City, Contractor must promptly, without cost to City and as specified by City, either correct any defective Work, whether or not fabricated, installed or completed, or, if the Work has been rejected by City, remove it from the Site and replace it with non-defective Work. Contractor must correct any Work which may be displaced in correcting, removing or replacing defective Work. No compensation will be allowed Contractor for such removal, replacement or remedial Work. Contractor must reimburse City for costs incurred by City due to such correction or removal including but not limited to additional expenses for inspection, testing or observation and for repeated reviews by the City or Design Professional.

4.9.3.2 Upon failure on the part of the Contractor to comply within a reasonably prompt time with any written order of City to correct or remove defective Work, City has authority to cause nonconforming materials or rejected Work to be remedied, removed, or replaced at the Contractor's expense and to deduct the costs from any moneys due or to become due the Contractor.

4.9.4 City May Correct Defective Work. If Contractor fails within a reasonable time after written notice of City to proceed to correct defective Work or to remove and replace rejected Work as required by City or if Contractor fails to perform the Work in accordance with the Agreement Documents (including any requirements of the progress schedule), City may, after 7 Days' written notice to Contractor, correct and remedy any such deficiency. To the extent necessary to complete corrective and remedial action, City may exclude Contractor from all or part of the Work, and suspend Contractor's services related thereto, take possession of Contractor's tools, appliances, construction equipment and machinery at the Site and incorporate in the Work all materials and equipment stored at the Site or for which City has paid Contractor, but which are stored elsewhere. Contractor must allow City, city representatives, agents and employees such access to the Site as may be necessary to enable City to exercise City’s rights under this Section. All direct and indirect costs of City in exercising such rights will be charged against Contractor in an amount verified by City representative, and a Change Order will be issued incorporating the necessary revisions in the Agreement Documents and a reduction in the Agreement Price. Such direct and indirect costs will include, in particular but without limitation, compensation for additional professional services required and all costs of repair and replacement of Work or others destroyed or damaged by correction, removal or replacement of Contractor's defective Work. Contractor will not be allowed an extension of the Agreement Time because of any delay in Contractor’s performance of the Work attributable to the exercise by City or City's rights hereunder.

4.9.5 Correction or Removal of Unauthorized Work.

4.9.5.1 Any Work done beyond the lines and grades shown on the Drawings or established by the Design Professional or any changes in, additions to, or deductions from the Work done without written authority will be considered as unauthorized and will not be paid for. Work so done may be ordered remedied, removed, or replaced at the Contractor's expense.

4.9.5.2 Upon failure on the part of the Contractor to comply promptly with any order of the City,

City will have authority to cause unauthorized Work to be remedied, removed, or replaced at the Contractor's expense and to deduct the costs from any moneys due or to become due the Contractor.

4.9.6 Correction Period - One Year Guarantee.

4.9.6.1 If, within one year after the date of Final Acceptance, or such longer period of time as may be prescribed by law or by the terms of any applicable special guarantee required by the Agreement Documents, or by any specific provision of the Agreement Documents, any Work is found to be defective, Contractor must promptly, without cost to City and in accordance with City's written instructions, either correct such defective Work, or, if it has been rejected by City, remove it from the Site and replace it with non-defective Work. If Contractor does not promptly comply with the terms of such instructions, or in an emergency where delay would cause serious risk of loss or damage, City may have the defective Work corrected or the rejected Work removed and replaced, and all direct and indirect costs of such removal and replacement, including compensation for additional professional services, must be paid by Contractor. Such action by the City will not relieve the Contractor of the guarantees required by this Section or elsewhere in the Agreement Documents.

4.9.6.2 If, in the opinion of the City, defective Work creates a dangerous condition or requires immediate correction or attention to prevent further loss to the City or to prevent interruption of operation of the City, the City will attempt to give the notice required by this Section. If the Contractor cannot be contacted or does not comply with the City's request for correction within a reasonable time as determined by the City, the City may, notwithstanding the provisions of this Section, proceed to make such correction or provide such attention; and the costs of such correction or attention will be charged against the Contractor. Such action by the City will not relieve the Contractor of the guarantees required by this Section or elsewhere in the Agreement Documents.

4.9.6.3 This Section does not in any way limit the guarantee on any items for which a longer guarantee is specified or on any items for which a manufacturer or supplier gives a guarantee for a longer period. The Contractor agrees to act as co-guarantor with such manufacturer or supplier and must furnish the City all appropriate guarantee or warranty certificates upon completion of the Project. No guarantee period, whether provided for in this Section or elsewhere, will in any way limit the liability of Contractor or their sureties or insurers under the indemnity or insurance provisions of these General Conditions and the Project Specific Special Conditions.

4.9.7 Acceptance of Defective Work.

4.9.7.1 If, instead of requiring correction or removal and replacement of defective Work, City may accept Work when in the best interest of the City to do so with appropriate monetary credit from Contractor. If any such acceptance occurs prior to final payment, a Change Order will be issued incorporating the necessary revisions in the Agreement Documents, including appropriate reduction in the Agreement Price; or, if the acceptance occurs after final payment, an appropriate amount must be paid by Contractor to City.

4.9.7.2 Alternatively, City may require Contractor to furnish at Contractor's expense, a special performance guarantee or other surety prior to acceptance of defective work.

4.9.8 The Warranty period begins on the Final Acceptance date noted in the Certificate of Completion, irrespective of early completion by some Subcontractors of their work.

4.9.9 Contractor's warranty obligation must be in accordance with MAG Specifications.

4.9.10 Nothing in the warranties contained in the Agreement Documents are intended to limit any manufacturer's warranty which provides City with greater warranty rights than set forth in this Section or the Agreement Documents. Contractor must provide City with all manufacturers' warranties prior to Substantial Completion, if applicable, or Final Acceptance.

4.9.11 Contractor agrees that it will be responsible to manage and administer the correction of any Work that is not in conformance with the Agreement Documents during the warranty periods set forth in this Section, or during any longer periods to the extent required by the Agreement Documents. A progress payment, or partial or entire use or occupancy of the Project by City, will not constitute acceptance of Work not in accordance with the Agreement Documents.

4.9.12 When notified of a warranty issue, Contractor must respond in writing within 48-hours and must perform warranty Work as soon as material for said repairs are available (as judged solely by City), and in any event Contractor must, take immediate steps to commence and complete correction of nonconforming Work no later than the time period set forth in City's written notification in accordance with the Agreement Documents. This includes the correction, removal or replacement of the nonconforming Work and any damage caused to other parts of the Work affected by the nonconforming Work. If defects develop which are determined by City to be an emergency, City will notify Contractor, via the most expeditious means regarding the nature and condition of the defects. In turn, Contractor must immediately dispatch necessary forces to correct the defect or the emergency condition in accordance with Agreement Documents.

4.9.13 The time periods referenced in this Section apply only to Contractor's obligation to correct nonconforming Work and is not intended to constitute a period of limitations for any other rights or remedies that City may have regarding Contractor's other obligations under the Agreement Documents.

4.9.14 Without limiting the foregoing or anything in these General Conditions or the Agreement to the contrary, Contractor must obtain and provide to City all warranties for any portion of the Project offered by the manufacturer, installer or provider thereof. City and the user of the facility will have the right to the full value and benefit of all such warranties. Contractor must ensure all such warranties are fully transferrable to facilitate the full value of this Section.

4.9.15 Contractor's warranty excludes damages or defects caused by abuse, alterations to the Work not executed by or through Contractor, improper or insufficient maintenance, improper operation, or normal wear and tear and normal usage.

4.9.16 In the event of any noncompliance with this entire Section 4, City may require Contractor to stop or suspend the Work in whole or in part.

SECTION 5 - CITY RESPONSIBILITIES

5.1 CITY PROJECT MANAGER AND INSPECTORS

5.1.1 Project Manager is responsible for providing City-supplied information and approvals in a timely manner to assist Contractor to fulfill its obligations under the Agreement Documents.

5.1.2 Project Manager will also provide Contractor with prompt notice when it observes any failure on the part of Contractor to fulfill its contractual obligations, including any default or defect in the Project or non-conformance with the Drawings and Specifications.

5.1.3 City may utilize Field Inspectors to assist Project Manager during construction in observing performance of Contractor. City's use of Inspectors is for the purpose of assisting Project Manager.

5.1.4 The Inspectors are authorized to inspect all Work and materials furnished. Such inspections may extend to all or part of the Work and to preparation, fabrication or manufacture of the materials to be used. The Inspectors have the authority to issue instructions contrary to the Construction Documents if approved and coordinated with the directions of Project Manager.

5.1.5 The Inspectors have the authority to reject work or materials until any questions at issue can be decided by Project Manager.

5.1.6 The use of Inspectors by City will not make City responsible for or give City control over construction means, methods, techniques, sequences or procedures or for safety precautions or programs or responsibility for Contractor's failure to perform the Work in accordance with Agreement Documents. The Inspectors are not authorized to direct any of Contractor's activities, employees or Subcontractors.

5.2 **DESIGN PROFESSIONAL SERVICES**

City may contract separately with one or more Design Professionals to provide construction administration of the Project. The Design Professional's Agreement, as well as other firms hired by City may be furnished to Contractor. Contractor does not have the right to limit or restrict or reject any Agreement modifications that are mutually acceptable to City and Design Professional.

5.3 **CITY'S SEPARATE CONTRACTORS**

City is responsible for all work performed on the Project or at the Site by separate contractors retained by City. City will contractually require its separate contractors to reasonably cooperate with, and reasonably coordinate their activities so as not to interfere with Contractor in order to enable Contractor to timely complete the Work consistent with the Agreement Documents. Contractor must immediately notify the Project manager, and address the matter in the next monthly status report, if any activities of such separate contractors are expected to interfere, or are interfering, with Contractor and such interference will or could result in any delay in Contractor's performance of the Work.

5.4 **PERMIT REVIEW AND INSPECTIONS**

5.4.1 If requested by Contractor, Project Manager will provide assistance and guidance in obtaining necessary reviews, permits and inspections.

5.4.2 The regulating agencies of City, such as Development and Sustainability, Fire and Planning Departments, enforce legal requirements. The enforcement activities of City are independent and separate from this Agreement.

5.5 **PLANS AND SPECIFICATIONS TO THE CONTRACTOR**.

Contractor will be provided up to five copies of the Agreement Documents as are reasonably necessary for the execution of the Work. Additional copies will be furnished,

upon request, at the cost of reproduction.

SECTION 6 - AGREEMENT TIME

6.1 AGREEMENT TIME

6.1.1 The Agreement Time will start with the Notice to Proceed ("NTP") and end with Final Acceptance.

6.1.2 Beginning on the date of the NTP, Contractor must begin to fulfill Contractor's obligations under the Agreement. Contractor's obligations include providing City and other agencies with any submittals required by the Project Specific Special Provisions, including but not limited to, an approved Project Schedule, Traffic Control Plans, and a Stormwater Pollution Prevention Plan. Contractor must submit all such required submittals before any physical construction work commences on the Site. NTP does not authorize construction work until all agreement insurance, bonds, and schedules are submitted to and accepted by the City.

6.1.3 The Agreement Time will be as set forth in the Project Schedule. Contractor agrees that it will commence performance of the Work and complete the Project through both Substantial Completion and Final Acceptance within the Agreement Time.

6.1.4 Time is of the essence of this Agreement, for the Project, for the Work, and for each phase and designated Milestone thereof.

6.1.5 Failure of Contractor to perform any covenant or condition contained in the Agreement Documents within the time periods specified herein, will constitute a material breach of this Agreement entitling City to terminate the Agreement unless Contractor applies for and receives an extension of time, in accordance with the procedures set forth in the Agreement Documents.

6.1.6 Failure of City to insist upon the performance of any covenant or condition within the time periods specified herein, will not constitute a waiver of Contractor's duty to perform every other covenant or condition within the designated periods, unless a specific waiver is granted in writing for each such covenant or condition.

6.1.7 City's agreement to waive a specific time provision or to extend the time for performance will not constitute a waiver of any other time provisions contained in the Agreement Documents. Failure of Contractor to complete performance promptly within the additional time authorized in the waiver or extension of time agreement constitutes a material breach of this Agreement entitling City to all the remedies set forth herein or provided by law.

6.2 PROJECT SCHEDULE

6.2.1 The Project Schedule must be in Microsoft Project standard file format, must be updated and maintained throughout the Agreement Time, and must contain the following:

6.2.1.1 Detailed representation of all activities for the project, both on-site construction and major procurement. All significant activities together with the resource loading requirements for each and all items appearing on the schedule of values or bid schedule for progress payments must be shown on the Project Schedule or in attached transmittal letter as described in Section 6.2.8.

6.2.1.2 Dependencies between activities must be indicated so that it may establish as to the effect the progress of any one activity would have on other activities and on the Schedule.

6.2.1.3 Activities for submission, review, and approval of all required submittals.

6.2.1.4 An amount of time will be established prior to the final completion date for "punch list and cleanup". No other activities will be scheduled during this period. Punch list and cleanup must be shown on the Project Schedule and must be entirely completed prior to the expiration of the Agreement Time.

6.2.2 Within 10 Days of receipt of City's comments, Contractor must make all required corrections, adjustments, and additions to complete the Project Schedule and resubmit to City for review. City's review of and response to the Project Schedule is for the purpose of: (1) City planning and staffing for the Project as may be required from time to time; (2) ensuring Contractor's general conformance with the scheduling requirements of the Agreement Documents and completion of the Project within the Agreement Time; and (3) monitoring and evaluating the construction status for purposes of approving monthly progress payments. Acceptance of a submitted schedule by City should in no way be construed as an affirmation or admission that the schedule is reasonable or workable by Contractor. The responsibility for completing the Work on the Project within the Agreement Time remains the obligation of Contractor. City's review does not relieve Contractor from compliance with the requirements of the Agreement Documents or be construed as relieving Contractor of its complete and exclusive control over the means, methods, sequences and techniques for executing the work.

6.2.3 The Project Schedule must show milestones, including milestones for City-furnished information, and must include activities for City-furnished material and construction by other contractors when those activities are interrelated with Contractor activities.

6.2.4 The Project Schedule must be revised as required by conditions and progress of the Work, but such revisions do not relieve Contractor of its obligations to complete the Work within the Agreement Time, as adjusted in accordance with the Agreement Documents. No modification to the Agreement Documents or the Agreement Time will be effective unless approved in advance by City.

6.2.5 For all items of materials and equipment that are critical or may require long lead times to acquire, the Project Schedule must show dates for submission, review and approval of submittals, ordering, and delivery.

6.2.6 An updated Project Schedule must be submitted monthly to City as part of the Payment Request. The monthly submittal must include one full size plot of the entire schedule and one electronic copy containing the schedule in Microsoft Project standard file format. In addition, Contractor must, upon request by City, provide a copy of all submitted schedule data in electronic format which must be clearly labeled with the Project description, scheduling program name and version number, and schedule print/data date.

6.2.7 Contractor must provide City with a monthly status report with each Project Schedule detailing the progress of the Work, including: (i) if the Work is proceeding according to schedule, (ii) any discrepancies, conflicts, or ambiguities found to exist in the Agreement Documents that require resolution, and (iii) other information detailing items that require resolution so as not to jeopardize the ability to complete the Work in the Agreement Time.

6.2.8 With each Project Schedule submittal, Contractor must include a transmittal letter including the following:

a. Description of problem tasks, referenced to field instructions or requests for information (RFI's), as appropriate.

b. Current and anticipated delays including:

(i) Cause of the delay.

(ii) Corrective action and schedule adjustments to correct the delay.

(iii) Known or potential impacts and their delay on other activities, milestones, and their impact on the Substantial Completion and Final Acceptance dates.

(iv) Changes in construction sequence.

c. Pending items and status thereof including but not limited to:

(i) Time Extension requests;

(ii) Substantial Completion date status;

(iii) Final Acceptance date status.

d. If ahead of schedule, the number of calendar Days ahead.

e. If behind schedule, the number of calendar Days behind.

f. Other Project or scheduling concerns.

6.2.9 Critical Path Method (CPM).

6.2.9.1 Unless otherwise specified in the Agreement, the Project Schedule must include a Critical Path Method (CPM) diagram schedule showing the sequence of activities, the interdependence of each activity and identifies the Critical Path.

6.2.9.2 The CPM diagram schedule must be in calendar Days and indicate duration, earliest and latest start and finish dates for all activities, and total Float Times for all activities except critical activities. The CPM diagram must be presented in a time scaled graphical format for the Project as a whole.

6.2.9.3 The CPM diagram schedule must indicate all relationships between activities.

6.2.9.4 The activities making the Project Schedule must contain sufficient detail to assure that adequate planning has been done for proper execution of the Work and such that it provides an appropriate basis for monitoring and evaluation the progress of the Work. Individual activities must not exceed 30 Days in length, in most cases.

6.2.9.5 The CPM diagram schedule must be based upon activities, which coincide with the Schedule of Values.

6.2.9.6 The CPM diagram schedule must show all submittals associated with each work activity and the review time for each submittal.

6.2.10 Float Time.

6.2.10.1 The total Float Time within the overall schedule is for the exclusive use of City, but City may approve Contractor's use of Float as needed to meet Agreement Milestones and

the Project completion date.

6.2.10.2 Contractor will not be allowed to sequence, hide, or reallocate Float Time through such strategies, as extending activity duration estimates to consume available Float, using preferential logic, or using extensive crew/resource sequencing, tec. No time extensions will be granted nor delay damages paid until a delay occurs which extends the Work beyond the Agreement Time.

6.2.11 City-Caused Delays. City-caused delays on the Project, if any, may be offset by City-caused time savings (i.e., Critical Path submittals returned in less time than allowed by the Agreement, approval of substitution requests and credit changes which result in savings of time to Contractor, etc.) In such an event, Contractor will not be entitled to receive a time extension or delay damages until all City-caused time savings are exceeded and the Agreement Time is also exceeded.

6.2.12 Rain-Related Delays. Contractor is required, in preparing the Project Schedule to take into account all relevant weather conditions, including normal rainfall and distribution. No additional compensation will be given for any rain-related delays or impacts on the Work or the Project Schedule. No time extension will be granted in the Project Schedule unless the rainfall during the construction of Work is unusually severe, was not reasonably anticipated, and the total rainfall was significantly in excess of the normal rainfall for the Project Site location. Normal rainfall for the Project will be determined from the 10-year average rainfall for the Site as measured by the National Oceanic and Atmospheric Administration or comparable source of reliable information for rainfall in Chandler, Arizona. In addition, the excessive rainfall must have actually impacted Work activities on the Critical Path and caused delay beyond any remaining Float at the time of the rain- caused delay. The burden of documenting normal rainfall, the excessive rainfall and the impact on Critical Path activities is on Contractor. All other provisions in the Agreement Documents relating to claims, including without limitation notice requirements, apply to any claim by Contractor for a rain delay.

6.2.13 City's "Policy Statement for Calculating Delays and Damages," Appendix 1 to these General Conditions, will apply to all claims of delay and delay damages.

6.2.14 Force Majeure. If Contractor is delayed or prevented from the performance of any Work required under this Agreement by reason of acts of God or other causes beyond the control and without fault of Contractor (financial inability excepted), performance of that Work will be excused, but only for the period of the delay. The time for performance of the Work will be extended for a period equivalent to the period of delay. In addition, the parties agree if Contractor's delayed or suspended performance directly arises out of or directly results from the COVID-19 pandemic, Contractor's delayed or suspended performance may be excused as set forth in this clause. Provided, however; Contractor must give the City written notice within 30 days of the occurrence of the event giving rise to COVID-19 pandemic related delayed or suspended performance. For COVID-19 pandemic related delay or suspended performance, the parties must agree in writing to the length of the excused delay or suspended performance. Further, Contractor must obtain the City's written approval to use any allowance established as part of the project for delays and costs related to the COVID-19 pandemic.

6.3 SUBSTANTIAL COMPLETION

6.3.1 When Contractor considers that the Work, phase or a portion thereof, which City agrees in

writing to accept separately, is substantially complete, City will prepare and submit to Contractor a comprehensive Punch List of items to be completed or corrected prior to Final Acceptance and Final Payment. Failure to include an item on such Punch List does not alter the responsibility of Contractor to complete all Work in accordance with the Agreement Documents.

6.3.2 Upon receipt of Contractor's Punch List, Project Manager will make an inspection to determine whether the Work or designated portion thereof is substantially complete. Project Manager may, at Project Manager's sole option, be assisted in such inspection by the Design Professional for the Project. If the inspection by the Project Manager discloses any item, whether or not included on Contractor's Punch List, which is not sufficiently completed in accordance with the Agreement Documents so that City can occupy or utilize the Work, phase or designated portion thereof for its intended use, Contractor must, before issuance of the Certificate of Substantial Completion, complete or correct such item upon notification by Project Manager. In such case, Contractor must then submit a request for another inspection by Project Manager to determine Substantial Completion.

6.3.3 Certificate of Substantial Completion.

6.3.3.1 The Project Manager will not issue a Certificate of Substantial Completion unless and until the Work (or separable units or Phases as provided in the Agreement Documents) is essentially and satisfactorily complete in accordance with the Agreement Documents, such that the Project is ready for use by City for its intended purpose, opening to the general public, full occupancy or use by City (including, without limitation, all separate units, or rooms, facilities, access, income-generating areas, and all areas serving the general public, as applicable, must be ready for full-operation without material inconvenience or discomfort), including, to the extent applicable to the Work, the following: all materials, equipment, systems, controls, features, facilities, accessories and similar elements are installed in the proper manner and in operating condition, inspected and approved; surfaces have been painted; masonry and concrete cleaned with any sealer or other finish applied; utilities and systems connected and functioning; site work complete; permanent heating, ventilation, air condition, vertical transportation and other systems properly operating with proper controls; lighting and electrical systems installed, operable and controlled; paving completed, signage installed, and other Work as applicable, has been performed to a similar state of essential and satisfactory completion. A minor amount of Work, as determined by and at the discretion of the Project Manager, such as installation of minor accessories or items, a minor amount of painting, minor replacement of defective work, minor adjustment of controls or sound systems, or completion or correction of minor exterior work that cannot be completed as a result of weather conditions, will not delay determination of Substantial Completion. If prior written approval is obtained from City for purposes of Substantial Completion, specified areas of the entire Work or Project may be individually certified as Substantially Complete. In no event will Substantial Completion be deemed to have occurred unless and until: (i) a temporary certificate of occupancy has been issued by the appropriate Governmental Authorities (as applicable) and (ii) all terms and Work required under this Agreement have been fulfilled by Contractor and same will have also been approved and accepted by City, subject only to the Punch List items.

6.3.3.2 If requested by City, Contractor must complete and turn-over to City the Project on a phased basis. Each phase will have a separate inspection by the Project Manager, a Punch List generated, and then an inspection by City with final approval and acceptance only after the

Project Manager's Punch List.

6.4 **PARTIAL UTILIZATION**

6.4.1 City at City's option may use and occupy any substantially completed parts of the Work which has specifically been identified in the Agreement Documents, or which City, the Design Professional and Contractor agree constitutes a separately functioning and usable part of the Work that can be used by City for its intended purpose, without significant interference with Contractor's performance of the remainder of the Work, provided, however, if the portion of the Work to be used or occupied has not been found to be substantially complete, City must do so in accordance with Section 6.3 prior to such occupancy.

6.4.2 In lieu of the issuance of a Certificate of Substantial Completion as to part of the Work, City may take over operation of a facility constituting part of the Work whether or not it is substantially complete if such facility is functionally and separately usable; provided that prior to any such takeover, City and Contractor agree in writing as to the division of responsibilities between City and Contractor for security, operation, safety, maintenance, correction period, heat, utilities and insurance with respect to such facility.

6.4.3 Substantial Completion of or City's beneficial occupancy of a part of the Project will not alter the fact that the one-year warranty for the whole Project starts at the date of Final Completion of the whole Project.

6.5 **FINAL ACCEPTANCE**

6.5.1 Unless otherwise expressly agreed to in writing by City, Final Acceptance must be obtained by no later than 30 Days (60 Days for federally funded agreements) after the date of Substantial Completion. Failure to timely obtain Final Acceptance will be a material breach of the Agreement.

6.5.2 Upon receipt of written notice that the Work is ready for final inspection and acceptance, City and Contractor will jointly inspect to verify that the remaining items of Work have been completed. There will be no partial acceptance. Final Acceptance will not occur until all items of Work, including Punch List Items, have been completed to City's satisfaction as reflected in the written Final Acceptance.

6.5.3 Final Payment will not be due, owing, or paid by City until Final Acceptance is issued.

6.5.4 Landscape Establishment Period. Unless otherwise expressly agreed to in writing by City, the Landscape Establishment Period will begin on the date of Final Acceptance of the Project and will run 90 Calendar Days thereafter. Landscape Establishment Period requirements are detailed in General Conditions Appendices, attached herein.

6.6 **CONTINUATION OF WORK**

6.6.1 Permitting Contractor to continue and finish the Work or any part of it after the time fixed for its completion (whether milestone, phase, Substantial Completion or Final Acceptance) or after the date to which the time fixed for any completion may have been extended, does not operate as a waiver by City of any rights under the Agreement Documents, law or equity.

6.6.2 Furthermore, the timely completion of the Work being of the utmost importance under this Agreement, notwithstanding the existence of one or more disputes between the parties

concerning the scope of the Work, the Project Schedule, Agreement Time, payments or any other matter, and further notwithstanding a party's invocation of the Dispute Resolution provisions specified in Appendix 6 of these General Conditions, unless City suspends the Agreement or Contractor's performance pursuant to Section 10 of these General Conditions, Contractor will continue to prosecute the Work, including any Change Order work or Extra Work Orders, in a diligent and timely manner and not stop, slow down or impede by action or inaction the progress of the Work, including commencing performance of and thereafter completing any additional work called out in any Change Order or Extra Work Order issued by Project Manager with the approval of City, so long as City makes payment to Contractor in accordance with Section 8 of these General Conditions.

SECTION 7 - AGREEMENT PRICE

7.1 UNIT PRICE AGREEMENTS

7.1.1 The Agreement Price for all Unit Price Agreements will be the amount set forth in the Agreement or Change Order multiplied by the verified quantity provided.

7.1.2 Measurements of quantities to determine the total Agreement Price must be in accordance with MAG Specification §§ 109.1 and 109.2.

7.1.3 The Unit Price may only be changed as set forth in Section 9 below.

7.2 CHANGE ORDERS

7.2.1 Unit Price Change Orders. The Change Order Price for all Unit Price Change Orders will be the amount set forth in the Change Order multiplied by the verified quantity provided.

7.2.2 Measurements of quantities to determine the total Change Order Price must be in accordance with MAG Specifications §§ 109.1 and 109.2.

7.2.3 The Unit Price may only be changed as set forth in Section 9 below.

7.2.4 MAG Specification § 109.4.1 is modified as follows: Before § 109.4.1, the following is added: Any deduction or increase in the Agreement Price must be supported by a signed, written Change Order fully executed by City, and supported by such backup as the Project Manager may require.

7.3 SALES TAX

Contractor is required to pay all applicable sales tax in accordance with the law of the state of Arizona and this cost must be included in all Agreement Prices. When equipment, materials or supplies generally taxable to Contractor are eligible for a tax exemption due to the nature of the Project, Contractor must assist City in applying for and obtaining such tax credits and exemptions which will be paid or credited to City.

SECTION 8 - PAYMENT

8.1 PAYMENT FOR CONSTRUCTION SERVICES

8.1.1 Payment for the Work will be made in accordance with MAG Standard Specification § 109 as amended below.

8.1.2 Contractor must submit to City for review a completed Contractor Payment Request signed

by Contractor, covering the Work completed as of the date of the Request and accompanied by such supporting documentation as is required by the Agreement Documents and also as City may reasonably require. A Contractor Payment Request will not be considered complete unless it is accompanied by an updated Project Schedule and a certification that the on-site, red lined, as built Drawings are up to date. If payment is requested on the basis of materials and equipment not incorporated in the Work but delivered and suitably, securely stored at the Site or at another location (such as a bonded warehouse) agreed to in writing, the Contractor Payment Request must also be accompanied by such data, satisfactory to City, as will establish City's title to the material and equipment and protect City's interest therein, including applicable insurance. Each subsequent Contractor Payment Request must include an affidavit of Contractor stating that all previous progress payments received on account of the Work have been applied to discharge in full all of Contractor's obligations reflected in prior Contractor Payment Requests.

8.1.3 Except for Work performed under a JOC Agreement, the Contracting Agency will retain 10 percent of all estimates as a guarantee for complete performance of the Agreement in accordance with Arizona Revised Statutes Section 34-221 or 34-607. The Contractor may elect to deposit securities in lieu of retention in accordance with Arizona Revised Statutes Section 34-221, Paragraph C.5. or 34-607, Paragraph B.5. See Appendix 11 for City's standard form Construction Escrow Agreement, which must be fully executed prior to depositing funds into escrow account.

8.1.4 The payment process functions as follows: Prior to the payment cycle date, Contractor must send a draft Contractor Payment Request to Project Manager. The Project Team will review the Request and agree upon any necessary adjustments. Contractor must certify the final Request by signing and returning to Project Manager.

8.1.5 When construction of the Project is fifty percent (50%) completed, Contractor may request payment of one-half of the retention pursuant to A.R.S. § 34-609(B)(3), subject to all of City's rights to withhold or offset payments, and other rights of City, under the Agreement.

8.1.6 City reserves the right under A.R.S. § 34-609(B)(3) to reinstate the ten percent (10%) retention if City determines that satisfactory progress is not being made.

8.1.7 Contractor's Warranty of Title.

8.1.7.1 Contractor warrants and guarantees that title to all Work, materials and equipment covered by any Contractor Payment Request, whether incorporated in the Project or not, will pass to City at the time of payment, free and clear of all liens, claims, security interests, and encumbrances, provided that this will not preclude the Contractor from installing metering devices or other equipment of utility companies or municipalities, the title of which is commonly retained by the utility company or municipality.

8.1.7.2 No materials, supplies, or equipment for the Work under this Agreement will be purchased subject to any chattel mortgage or under a conditional sale contract or other agreement by which an interest therein, or any part thereof, is retained by the seller or supplier.

8.1.7.3 Nothing contained in this Section will defeat or impair the right of such persons furnishing materials or labor under any bond given by the Contractor for their protection, or any right under any law permitting such persons to look to funds due the Contractor in the hands of the City. The provisions of this Section must be inserted in all subcontracts and material agreements, and notices of its provision must be given to all persons furnishing materials

for the Work when no formal agreement is entered into for such materials.

8.2 **PAYMENT UPON SUBSTANTIAL COMPLETION**

8.2.1 No payment will be made upon Substantial Completion, except for a regularly-scheduled monthly progress payment, as allowed by Section 8.2.2.

8.2.2 No further payments will be made to Contractor until Final Acceptance.

8.3 **FINAL PAYMENT**

8.3.1 Subject to all of City's rights to withhold or offset payment, and other rights under the Agreement, Final Payment including remaining retainage will be paid only after:

a. Work has been fully completed (including completion of all incorrect or incomplete work items) and the written Final Acceptance has been issued by City;

b. Necessary operating manuals, any excess materials and supplies necessary for matching materials and supplies incorporated into the Work, acceptable sewer video results (if applicable), and complete "as-built" Drawings (including the Building Information Model, if required by the Agreement Documents) have been delivered to City, as specified in this Section 8.3;

c. Full and unconditional lien waivers and releases by Contractor and any person performing labor or supplying material, machinery, fixtures, or tools for the Work have been delivered to Contractor;

d. All conditions and requirements imposed by City or any financing entity for the corresponding disbursement have been met; and

e. Contractor delivers to City a Contractor Payment Request requesting Final Payment.

8.3.2 Contractor must also submit a signed copy of Contractor's Affidavit Regarding Settlement of Claims, Appendix 3 to these General Conditions, and Certificate of Completion, Appendix 7 to these General Conditions, prior to Final Payment.

8.3.3 In addition, if required under the Project Specific Special Provisions, Contractor must compile a complete equipment list and maintenance manual to be submitted to City as a precondition to Final Payment. The list must include the following items for all equipment supplied under the Plumbing, Electrical, Air Conditioning, Elevator, and other Special Equipment Specifications:

a. Name, Model and Manufacturer.

b. Complete parts lists and Drawings.

c. Local source of supply for replacement parts along with suppliers' telephone numbers.

d. Local service organizations serving the equipment and their telephone numbers.

e. All tags, inspection slips, instruction packages, etc., removed from equipment must be properly identified as to pieces of equipment from

which they were taken.

8.3.4 Contractor must also deliver to City, prior to Final Payment, one (1) digital (in the format specified by City), and if requested by City, one (1) hard copy, of any applicable Maintenance manuals. Each manual must include all manufacturer's operation and maintenance instructions and "as-built" Drawings with the list herein specified. It must also include all other diagrams and instructions necessary to properly operate and maintain the equipment, the name, address and telephone number of Contractor and all Subcontractors involved.

8.4 **CITY'S RIGHT TO WITHHOLD PAYMENT**

City may withhold payment to such extent as may be necessary in City's opinion to protect City from loss for which Contractor is responsible, including, without limitation, if any of the following conditions exist:

a. Defective Work not remedied;

b. Third party claims filed or reasonable evidence indicating probable filing of such claims unless security acceptable to City is provided by Contractor;

c. Failure of Contractor to make payments properly to Subcontractors or for labor, materials or equipment;

d. Reasonable evidence that the Work cannot be completed for the unpaid balance of the Agreement Price;

e. Damage to City or another Contractor;

f. Reasonable evidence that the Work will not be completed within the Agreement Time, and that the unpaid balance would not be adequate to cover actual or liquidated damages for the anticipated delay;

g. Failure to carry out the Work in accordance with the Agreement Documents; or

h. Contractor is in default of any of its other obligations under the Agreement Documents.

8.5 **JOINT/DIRECT CHECKS**

To promote the timely completion and progress of the Work or when appropriate and necessary, payments to Contractor may be made jointly to Contractor and its employees, agents, Subcontractors and suppliers, or any of them. For federally funded agreements, see federal provisions for additional requirements for the joint check process.

8.6 **PAYMENT NOT A WAIVER**

No payment (nor use or occupancy of the Project by City) will be deemed acceptance or approval of the Work or as a waiver of any claims, rights, or remedies of City.

8.7 **LIENS AND BOND CLAIMS**

Contractor must make all payments, in the time required, of all labor and materials furnished to Contractor in the course of the Work and must promptly furnish evidence of such payments as City may require. Contractor must pay when due all claims arising out of performance of the Work covered by this Agreement for which a lien may be filed either against the real estate or leasehold interest of City, or against payments due from City to Contractor, or for which a claim may be made against any payment or performance bond

or both. To the fullest extent permitted by law, Contractor agrees that no liens or other claims in the nature of a lien against the real estate, leasehold, or other interest of City, against payment due from City to Contractor, or against any payment or performance bond, must be filed or made in connection with the Work by any party who has supplied professional services, labor, materials, machinery, fixtures, tools, or equipment used in or in connection with the performance of this Agreement, and Contractor agrees to remove or to cause to be removed any such liens or claims in the nature of a lien or bond claim within 10 Days upon receiving notice or obtaining actual knowledge of the existence of such liens or claim. In addition, Contractor agrees to defend, indemnify, and hold harmless City from and against any and all such liens and claims. This paragraph does not apply to claims and liens of Contractor due to non-payment for work performed.

8.8 **FINANCIAL RECORDKEEPING AND CITY'S AUDIT RIGHT**

8.8.1 Records for all Agreements between City and Contractor must, upon reasonable notice, be open to inspection and subject to audit, scanning, and reproduction during normal business working hours. Such audits may be performed by any City's representative or any outside representative engaged by City for the purpose of examining such records. City or its designee may conduct such audits or inspections throughout the term of this Agreement and for a period of five years after Final Payment or longer if required by law. City's representatives may (without limitation) conduct verifications such as counting employees at the Site, witnessing the distribution of payroll, verifying information and amounts through interviews and written confirmations with Contractor employees, field and agency labor, Subcontractors, and vendors.

8.8.2 Contractor's "records" must include any and all information, materials and data of every kind and character, including without limitation, records, books, papers, documents, subscriptions, recordings, agreements, purchase orders, leases, contracts, commitments, arrangements, notes daily diaries, superintendent reports, drawings, receipts, vouchers and memoranda, and any and all other agreements, sources of information and matters that may in City's judgment have any bearing on or pertain to any matters, rights, duties or obligations under or covered by any Agreement Document. Such records must include (hard copy, as well as computer readable data if it can be made available), written policies and procedures; time sheets; payroll registers; payroll records; cancelled payroll checks; subcontract files (including proposals of successful and unsuccessful bidders, bid recaps, negotiation notes, etc.); original bid estimates; estimating work sheets; correspondence; Change Order files (including documentation covering negotiated settlements); back-charge logs and supporting documentation; invoices and related payment documentation; general ledger, information detailing cash and trade discounts earned, insurance rebates and dividends; and any other Contractor records which may have a bearing on matters of interest to City or the Project in connection with Contractor's dealings with City or the Project (all foregoing hereinafter referred to as "records") to the extent necessary to adequately permit evaluation and verification of any or all of the following:

a. Compliance with Agreement requirements for deliverables;

b. Compliance with approved Plans and Specifications;

c. Compliance with § 14.9 below;

d. Compliance with Agreement provisions regarding the pricing of Change Orders;

e. Accuracy of Contractor representations regarding the pricing of invoices; or

f. Accuracy of Contractor representations related to claims submitted by Contractor or any of their employees.

8.8.3 Contractor must require all payees (examples of payees include Subcontractors, Suppliers, Insurance Carriers, etc.) to comply with the provisions of this Section by including the requirements hereof in a written agreement between Contractor and payee. Contractor will ensure that all payees (including those entering into lump sum agreements) have the same right to audit provisions contained in this Agreement included in their agreements with Contractor.

8.8.4 City's authorized representative(s) (including, without limitation, Project Manager) must have reasonable access to Contractor's facilities, must be allowed to interview all current or former employees to discuss matters pertinent to the performance of this Agreement and must be provided adequate and appropriate work space, in order to conduct audits in compliance with this Section.

8.8.5 If an audit inspection or examination in accordance with this Section, discloses overpricing or overcharges to City (of any nature) by Contractor or Contractor's Subcontractors in excess of $100,000 in addition to making adjustments for the overcharges, the reasonable actual cost of City's audit must be reimbursed to City by Contractor. Any adjustments or payments which must be made as a result of any such audit or inspection of Contractor's invoices or records must be made within a reasonable amount of time (not to exceed 90 Days) from presentation of City's findings to Contractor.

8.8.6 In addition to the normal paperwork documentation Contractor typically furnishes to City, Contractor agrees to furnish, upon written request from City, any of the documentation necessary for City to exercise its audit rights under this Section 8.8 in computer readable file formats (Word, Excel, or .pdf), as City may designate.

8.8.7 City, its authorized representative, and the appropriate agency, reserve the right to audit Contractor's records in compliance with local, state or federal policies, statutes or at City's discretion, within three (3) years of Final Acceptance of the Work.

SECTION 9 - CHANGES TO THE AGREEMENT

9.1 **FIELD ORDERS**

City may authorize minor changes in the Work not involving an adjustment in the Agreement Price or the Agreement Times, which are consistent with the overall intent of the Agreement Documents. These may be accomplished by a written Field Order on the standard form approved and executed by City. Such Field Orders must be binding and Contractor must perform the change promptly. If Contractor believes that a Field Order justifies an increase in the Agreement Price or Agreement Time, Contractor may make a claim therefor as provided in Section 7.2.

9.2 **EXTRA WORK/CHANGES IN THE WORK**

9.2.1 City reserves the right to make such changes in the Plans and Specifications for the Work, as it may deem appropriate and any such change as set forth in a written Change Order must be deemed a part of this Agreement as if originally incorporated herein.

9.2.2 In the event City and Contractor cannot agree on the terms of a Change Order, or

when circumstances otherwise require, the Project Manager has the authority to direct the Contractor to perform extra work, if the work in question is an item not provided for in the Agreement as awarded. The Project Manager will have the authority to determine, based upon factual evidence presented by the Contractor, whether the work in question is an item not provided for in the Agreement as awarded. If the Project Manager directs the Contractor to perform extra work, the Project Manager's instructions will include a price that the Contractor cannot exceed in charging the City for the extra work. Upon receipt of the Project Manager's directions to perform extra work, the Contractor must promptly proceed with the extra work and document the actual cost thereof. Contractor's right to payment for extra work will be determined under Subsection 9.2.4 below. The Contractor is responsible to manage the extra work to ensure that the price limits set by the Project Manager are not exceeded. Contractor must perform the extra work and submit documentation for the actual cost of the extra work to the City. A Change Order will be issued to cover this work.

9.2.3 Contractor will not be entitled to payment for extra work unless a written Change Order, in form and content prescribed by City, has been executed by City. On all requests for Change Orders, Contractor must specify the increased or decreased costs and whether it believes any extensions of time will be necessary to complete its Work as modified by the Change Order. If extra work is performed under Subsection 9.2.2 above, a corresponding Change Order will be prepared, approved and processed by City before payment can be made to Contractor.

9.2.4 In general, pricing for Change Orders will include the same mark-up percentages that were in effect when the Agreement was awarded. The cost or credit to the City resulting from a change in the Work is subject to Appendix 1 (Policy Statement for Calculating Delays and Damages) and will be determined, based on the type of pricing for the Agreement involved, as follows:

a. By mutual acceptance of a lump sum properly itemized in a form acceptable to City;

b. By unit prices stated in the Agreement Documents;

c. When the City determines that a Unit Price Book Job Order associated with a Job Order Agreement requires a Change Order, by using the same Total Cost Data and CCI that are in effect when the Change Order is anticipated to be issued; or

d. By actual cost and a percentage fee covering overhead and profit, as follows:

(i) Contractor will perform the extra work and be compensated for actual cost of labor, materials and equipment.

(ii) Contractor will have the right to add the fee percentage applicable to the Work under the Agreement, or if no such fee has been agreed to by the parties, not more than five percent (5%) to the Subcontractor's prices for authorized extra work performed solely by Subcontractors. Such percentage will include all of Contractor's charges for overhead, profit, administration and supervision.

(iii) Contractor or Subcontractor will have the right to add the fee percentage applicable to Work under the Agreement for self-performed extra work, or if no such fee has been agreed to by the

parties, Contractor's or Subcontractor's maximum total allowable additions for overhead, profit, administration and supervision will not exceed ten percent (10%) of actual verifiable labor, materials and equipment for such self- performed extra work.

9.2.5 Any agreement which modifies the terms of the Agreement (including Change Orders) will be approved in writing by the Project Manager. Once properly executed by both parties, these modifications to the Agreement will have the same effect as if they had been included in the original Agreement.

9.3 **ACCURACY OF CHANGE ORDER PRICING INFORMATION**

9.3.1 Subject to Sections 9.3.2 through 9.3.4, signature by the contracting parties constitutes full accord and satisfaction between City and Contractor for all costs, damages, and expenses of whatever kind of nature, including delay, impact or acceleration damages, which may be occasioned by a Change Order of other modification of the Agreement agreed to in writing.

9.3.2 Accurate Change Order Pricing Information: Contractor agrees that it is responsible for submitting accurate cost and pricing data to City to support its Fixed Price, Unit Price, or Cost Plus Change Order Proposals or other Agreement Price adjustments under the Agreement. Contractor further agrees to submit Change Order proposals with cost and pricing data which is accurate, complete, current, and in accordance with the terms of the Agreement with respect to pricing of change orders. Contractor agrees that any "buy-out savings" on Change Orders will accrue 100% to Owner. "Buy-out savings" are defined as any savings negotiated by the Contractor with a Subcontractor or a Material Supplier after receiving approval of a Change Order amount that was designated to be paid to a specific Subcontractor or Supplier for the Approved Change Order work.

9.3.3 Right to Verify Change Order Pricing Information: Contractor agrees that City, through its designated representative, will have the right to examine, copy, and scan the records of the Contractor, Subcontractor or Sub-Subcontractor's records (during the Agreement period and up to three years after final payment is made on the Agreement) to verify the accuracy and appropriateness of the pricing data used to price all Change Order proposals or claims. Contractor agrees that if City determines the cost and pricing data submitted (whether approved or not) was inaccurate, incomplete, not current, or not in compliance with the terms of the Agreement regarding pricing of Change Orders, an appropriate Agreement Price adjustment will be made. Such post-approval Contact Price adjustments will apply to all levels of contractors and Subcontractors and to all types of Change Order proposals, specifically including Fixed Price, Unit Price, and Cost Plus Change Orders.

9.3.4 Requirements for Detailed Change Order Pricing Information: Contractor agrees to provide a detailed breakdown of allowable labor and labor burden cost (i.e., base wage rate of applicable classifications of workers, payroll taxes, and insurance and benefits costs). This information will be used to evaluate the potential cost of labor and labor burden related to Change Order work. It is intended that this information represent an accurate estimate of the Contractor's actual labor and labor burden cost components. Information is not intended to establish fixed billing or Change Order pricing labor rates. However, at the time Change Orders are priced, the submitted cost data for labor rates may be used to price Change Order work. The accuracy of any such agreed upon labor rate cost components used to price Change Orders will be subject to later audit. Approved Change Order

amounts may be adjusted later to correct the impact of inaccurate labor cost components if the agreed upon labor cost components are determined to be inaccurate.

9.4 **EMERGENCIES**

In any emergency affecting the safety of persons or property, Contractor will act, at its discretion, to prevent threatened damage, injury or loss. Any change in the Agreement Price or Agreement Time resulting from emergency work will be determined as provided in this Section.

9.5 **DIFFERING SITE CONDITIONS**

9.5.1 If Differing Site Conditions are encountered at the Project Site, then notice by the observing party must be given to the other party promptly before conditions are disturbed (to the extent practicable) and in no event later than 14 Days after first observance of the conditions. City will promptly investigate such conditions and, if City determines that Differing Site Conditions exist and they materially cause an increase in the cost of, or time required for, performance of any part of the Work, Contractor will be entitled to equitable adjustment in the Agreement Price or Construction Schedule (and other time requirements), or both. If it is determined by City that the conditions at the Project Site are not Differing Site Conditions and no change is justified, then City will so notify Contractor in writing, stating the reasons. Claims in opposition to such determination must be made within 14 Days after City has given notice of its decision. If City and Contractor cannot agree on an adjustment in the Agreement Price or Construction Schedule (and other time requirements), the adjustment may be submitted to dispute resolution as provided these General Conditions.

9.6 **CHANGES IN LAWS, REGULATIONS, OR LEGAL REQUIREMENTS OR TAXES**

In the event of a material change in applicable Laws, Regulations, or Legal Requirements, or taxes subsequent to the date of the Agreement by the parties, Contractor may be entitled to a Change Order, in City's discretion, to the extent Contractor can document to the satisfaction of City that such change significantly increases Contractor's actual cost of performance of the Work.

SECTION 10 -SUSPENSION AND TERMINATION

10.1 **SUSPENSION**

City may suspend the Agreement and Contractor's performance in accordance with MAG Specifications § 105.1 and 108.7.

10.2 **TERMINATION BY THE CITY FOR CAUSE**

10.2.1 MAG Specifications § 108.11 applies to the Agreement.

10.2.2 City may also terminate the Agreement if City determines, in its sole discretion that Contractor has:

a. After prior written notice, refused or failed to supply enough properly skilled workers or proper materials;

b. After prior written notice, failed to make payment to Subcontractors for materials or labor in accordance with the respective agreements between Contractor and the Subcontractors;

c. After prior written notice, disregards laws, ordinances, or rules, regulations or orders of a public authority having jurisdiction;

d. After prior written notice, repeatedly failed to comply with written directives from City;

e. Is adjudged as bankrupt or insolvent;

f. Made a general assignment for the benefit of creditors;

g. Appointed a trustee or receiver for itself or any of its property;

h. Filed a petition to take advantage of any debtor's act, or to reorganize under the bankruptcy or similar laws; or

i. Otherwise breached a provision of the Agreement Documents or any other Agreement between City and Contractor.

10.2.3 When any of the above reasons exist, City may terminate the Agreement, without prejudice to any other rights or remedies of City, after giving Contractor and Contractors' surety, if any, 7 Days written notice of City's intent to terminate the Agreement and Contractor's failure to cure any such reasons. Upon such termination, City may: (1) take possession of the Site and of all materials thereon owned by Contractor; or (2) finish the Work by whatever reasonable method City may deem expedient. When City terminates the Agreement for one of the reasons state above, Contractor will not be entitled to receive further payment until the Work is finished. If the unpaid balance of the Agreement Price existing at the time of such termination exceeds the costs and expenses of finishing the Work and any other damages incurred by City, such excess will be paid to Contractor. If such costs, expenses and damages exceed such unpaid balance, Contractor must pay the difference to City. This obligation for payment will survive termination of the Agreement.

10.3 **TERMINATION BY CITY FOR CONVENIENCE**

City may also terminate the Agreement at any time for its convenience upon 7 Days written notice to Contractor specifying the termination date. In the event of termination which is not the fault, in whole or in part, of Contractor, City will pay to Contractor only such compensation, including reimbursable expenses, due for Work properly performed on the Project prior to the termination date. Upon any termination of the Agreement, no further payments will be due from City to Contractor.

10.4 **A.R.S. § 38-511**

The Agreement is subject to, and may be terminated by City in accordance with, the provisions of A.R.S. § 38-511.

SECTION 11 -INSURANCE AND BONDS

11.1 **INSURANCE REQUIREMENTS**

11.1.1 After Agreement award, the Contractor must furnish the City a certificate of insurance on a standard insurance industry ACORD form. The ACORD form must be issued by an insurance company authorized to transact business in the State of Arizona possessing a current A.M. Best, Inc. rating of A-7, or better and legally authorized to do business in the State of Arizona with policies and forms satisfactory to City. Provided, however, the A.M. Best rating requirement may not be deemed to apply to required Worker's Compensation coverage.

11.1.2 The Contractor and any of its Subcontractors must procure and maintain, until all of their obligations have been discharged, including any warranty periods under this Agreement are satisfied, the insurances set forth below.

11.1.3 The insurance requirements set forth below are minimum requirements for this Agreement and in no way limit the indemnity covenants contained in this Agreement.

11.1.4 The City in no way warrants that the minimum insurance limits contained in this Agreement are sufficient to protect Contractor from liabilities that might arise out of the performance of the Agreement services under this Agreement by Contractor**,** its agents, representatives, employees, or Subcontractors and the Contractor is free to purchase any additional insurance as may be determined necessary.

11.1.5 Failure to demand evidence of full compliance with the insurance requirements in this Agreement or failure to identify any insurance deficiency will not relieve the Contractor from, nor will it be considered a waiver of its obligation to maintain the required insurance at all times during the performance of this Agreement.

11.1.6 Use of Subcontractors: If any Work is subcontracted in any way, the Contractor must execute a written agreement with Subcontractor containing the same Indemnification Clause and Insurance Requirements as the City requires of the Contractor in this Agreement. The Contractor is responsible for executing the Agreement with the Subcontractor and obtaining Certificates of Insurance and verifying the insurance requirements.

11.2 **MINIMUM SCOPE AND LIMITS OF INSURANCE**

11.2.1 The Contractor must provide coverage with limits of liability not less than those stated below.

11.2.1.1 Commercial General Liability-Occurrence Form. Contractor must maintain "occurrence" form Commercial General Liability insurance with a limit of not less than $2,000,000 for each occurrence, $4,000,000 aggregate. Said insurance must also include coverage for products and completed operations, independent contractors, personal injury and advertising injury. If any Excess insurance is utilized to fulfill the requirements of this paragraph, the Excess insurance must be "follow form" equal or broader in coverage scope than underlying insurance.

11.2.1.2 Automobile Liability-Any Automobile or Owned, Hired and Non-Owned Vehicles. Contractor must maintain Business/Automobile Liability insurance with a limit of $1,000,000 each accident on Contractor owned, hired, and non-owned vehicles assigned to or used in the performance under this Agreement. If any Excess or Umbrella insurance is utilized to fulfill the requirements of this paragraph, the Excess or Umbrella insurance must be "follow form" equal or broader in coverage scope than underlying insurance.

11.2.1.3 Workers Compensation and Employers Liability Insurance. Contractor must maintain Workers Compensation insurance to cover obligations imposed by federal and state statutes having jurisdiction of Contractor employees engaged in the performance of Work under this Agreement and must also maintain Employers' Liability insurance of not less than $1,000,000 for each accident and $1,000,000 disease for each employee.

11.2.1.4 Builders' Risk/Installation Floater Insurance. The Contractor bears all responsibility for loss to all equipment or Work under construction. Unless waived in writing by the City the Contractor will purchase and maintain in force Builders' Risk/Installation Floater insurance on the entire Work until completed and accepted by the City. This insurance will be Special Causes of Loss policy form, (minimally including perils of fire, flood, lightning, explosion,

windstorm and hail, smoke, aircraft and vehicles, riot and civil commotion, theft, vandalism, malicious mischief, and collapse), completed value, replacement cost policy form equal to the Agreement Price and all subsequent modifications. The Contractor's Builders' Risk/Installation Floater insurance must be primary and not contributory.

a. Builders' Risk/Installation Floater insurance must cover the entire Work including reasonable compensation for architects and engineers' services and expenses and other "soft costs" made necessary by an insured loss. Builders' Risk/Installation Floater insurance must provide coverage from the time any covered property comes under the Contractor's control and or responsibility, and continue without interruption during course of construction, renovation and or installation, including any time during which any Project property or equipment is in transit, off Site, or while on Site for future use or installation. Insured property must include, but not be limited to, scaffolding, false work, and temporary buildings at the Site. This insurance must also cover the cost of removing debris, including demolition as may be legally required by operation of any law, ordinance, regulation or code.

b. The Contractor must also purchase and maintain Boiler and Machinery insurance with the same requirements as Builders' Risk/Installation Floater insurance cited above if the Work to be performed involves any exposures or insurable property normally covered under a Boiler and Machinery insurance policy or made necessary as required by law or testing requirements in the performance of this Agreement. The Contractor will be responsible for any and all deductibles under these policies and the Contractor waives all rights of recovery and subrogation against the City under the Contractor- Builders' Risk/Installation Floater insurance described herein.

c. Builders' Risk/Installation Floater Insurance must be maintained until whichever of the following first occurs: (i) final payment has been made; or, (ii) until no person or entity, other than the City, has an insurable interest in the property required to be covered.

d. The Builders' Risk/Installation Floater insurance must be endorsed so that the insurance will not be canceled or lapse because of any partial use or occupancy by the City.

e. The Builders Risk/Installation Floater insurance must include as named insureds, the City, the Contractor, and all tiers of Subcontractors and others with an insurable interest in the Work who will be named as additional insureds unless they are able to provide the same level of coverage with the City and Contractor named as additional insureds. Certificates must contain a provision that the insurance will not be canceled or materially altered without at least 30 Days advance notice to the City. The City must also be named as a Loss Payee under the Builders' Risk/Installation Floater coverage.

f. The Builders Risk/Installation Floater insurance must be written using the Special Causes of Loss policy form, replacement cost basis.

g. All rights of subrogation under the Builders Risk/Installation Floater insurance are, by this Agreement, waived against the City, its officers, officials, agents and employees.

h. The Contractor is responsible for payment of all deductibles under the Builders' Risk/Installation Floater insurance policy.

11.2.1.5 Pollution Liability Insurance (Including Errors and Omissions). For Job Orders, Pollution Liability Insurance is only required if applicable and determined on a project specific basis. Contractor must maintain Pollution Liability Insurance with a limit of not less than $5,000,000 per loss, $5,000,000 aggregate for losses caused by pollution conditions including coverage for bodily injury, property damage, defense costs, clean-up costs, and completed operations that arise from the operations of Contractor as described in this Agreement.

a. The policy must provide for complete professional service coverage, including coverage for pollution liability that is a result of a breach of professional duties.

b. The policy must provide for protection again claims for third-party bodily injury, property damage, or environmental damage caused for pollution conditions resulting from general contracting activities for which Contractor is legally liable.

c. The policy must provide for cleanup costs when mandated by governmental entities, when required by law, or as a result of third-party claims.

d. Completed Operations Coverage must be kept in place for up to the statute of repose.

e. The policy must be endorsed to include the following additional insured language: "City, its elected officials, trustees, employees, agents, and volunteers must be named as additional insureds with respect to liability arising out of the activities performed by, or on behalf of Contractor".

f. If Work under this Agreement requires the transportation of any hazardous material or regulated substances, Contractor must carry Auto Liability with a CA 9948 endorsement or equivalent.

g. If Work under this Agreement requires the disposal of any hazardous materials from the job site, Contractor must obtain a certificate of insurance for Pollution Legal Liability from the disposal site operator with a limit of not less than $5,000,000 per loss, $5,000,000 aggregate.

11.2.1.6 Cyber Technology Errors and Omissions, Network Security, and Privacy Liability Insurance. The policy must cover professional misconduct or lack of ordinary skill for those positions defined in the Scope of Services of this Agreement with a limit of not less than $5,000,000 for each occurrence, $5,000,000 aggregate. In the event that the professional liability insurance required by this Agreement is written on a claims-made basis, Contractor warrants that any retroactive date under the policy must precede the effective date of this Agreement; and that either continuous coverage will be maintained or an extended discovery period will be exercised for a period of two (2) years beginning at the time work under this Agreement is completed. If such insurance is maintained on an occurrence form basis, Contractor must maintain such insurance for an additional period of one (1) year following termination of Agreement. If such insurance is maintained on a claims-made basis, Contractor must maintain such insurance for an additional period of three (3) years following termination of the Agreement. If Contractor contends that any of the insurance it maintains pursuant to other sections of this Exhibit C satisfies this requirement (or

otherwise insures the risks described in this section), then Contractor must provide proof of same.

The insurance must provide coverage for the following risks:

1. Liability arising from theft, dissemination, or use of confidential information (a defined term including but not limited to bank account, credit card account, personal information such as name, address, social security numbers, etc. information) stored or transmitted in electronic form.
2. Network Security Liability arising from the unauthorized access to, use of, or tampering with computer systems including hacker attacks, inability of an authorized third party, to gain access to your services including denial of service, unless caused by a mechanical or electrical failure.
3. Liability arising from the introduction of a computer virus into, or otherwise causing damage to, a customer's or third person's computer, computer system, network, or similar computer related property and the data, software, and programs thereon.

The policy must provide a waiver of subrogation.

11.3 **ADDITIONAL POLICY PROVISIONS REQUIRED**

11.3.1 Self-Insured Retentions or Deductibles. Any self-insured retentions and deductibles must be declared and approved by the City. If not approved, the City may require that the insurer reduce or eliminate any deductible or self-insured retentions with respect to the City, its officers, officials, agents, employees, and volunteers.

11.3.2 The Contractor's insurance must contain broad form contractual liability coverage.

11.3.3 The Contractor's insurance coverage must be primary insurance with respect to the City, its officers, officials, agents, and employees. Any insurance or self-insurance maintained by the City, its officers, officials, agents, and employees will be in excess of the coverage provided by the Contractor and must not contribute to it.

11.3.4 The Contractor's insurance must apply separately to each insured against whom claim is made or suit is brought, except with respect to the limits of the insurer's liability.

11.3.5 Coverage provided by the Contractor must not be limited to the liability assumed under the indemnification provisions of this Agreement.

11.3.6 The policies must contain a severability of interest clause and waiver of subrogation against the City, its officers, officials, agents, and employees, for losses arising from Work performed by the Contractor for the City.

11.3.7 The Contractor, its successors and or assigns, are required to maintain Commercial General Liability insurance as specified in this Agreement for a minimum period of 3 years following completion and acceptance of the Work. The Contractor must submit a Certificate of Insurance evidencing Commercial General Liability insurance during this 3 year period containing all the Agreement insurance requirements, including naming the required Additional Insureds set forth herein.

11.3.8 If a Certificate of Insurance is submitted as verification of coverage, the City will reasonably

rely upon the Certificate of Insurance as evidence of coverage but this acceptance and reliance will not waive or alter in any way the insurance requirements or obligations of this Agreement.

11.3.9 Insurance Cancellation During Agreement Term.

11.3.9.1 If any of the required policies expire during the life of this Agreement, the Contractor must forward renewal or replacement Certificates to the City within 10 Days after the renewal date containing all the required insurance provisions.

11.3.9.2 Each insurance policy required by the insurance provisions of this Agreement must provide the required coverage and must not be suspended, voided or canceled except after 30 Days prior written notice has been given to the City, except when cancellation is for non-payment of premium, then 10 Days prior notice may be given. Such notice must be sent directly to Chandler Law-Risk Management Department, Post Office Box 4008, Mailstop 628, Chandler, Arizona 85225. If any insurance company refuses to provide the require notice, the Contractor or its insurance broker must notify the City of any cancellation, suspension, non-renewal of any insurance within 7 Days of receipt of insurers' notification to that effect.

11.3.10 City as Additional Insured. The above-referenced policies are to contain, or be endorsed to contain, the following provisions:

11.3.10.1 The Commercial General Liability and Automobile Liability policies are to contain, or be endorsed to contain, the following provisions: The City, its officers, officials, agents, and employees are additional insureds with respect to liability arising out of activities performed by, or on behalf of, the Contractor including the City's general supervision of the Contractor; Products and Completed Operations of the Contractor; and automobiles owned, leased, hired, or borrowed by the Contractor.

11.3.10.2 The City, its officers, officials, agents, and employees must be additional insureds to the full limits of liability purchased by the Contractor even if those limits of liability are in excess of those required by this Agreement.

11.4 **BONDS AND OTHER PERFORMANCE SECURITY**

11.4.1 After Agreement award, Contractor must provide a Performance Bond and a Payment Bond, each in an amount equal to the full amount of the Agreement Price.

11.4.2 Each such bond must be executed by a surety company or companies holding a Certificate of Authority to transact surety business in the State of Arizona, issued by the Director of the Arizona Department of Insurance and must be named in the current list of "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies" as published in Circular 570 (amended) by the Audit Staff Bureau of Accounts, U.S. Treasury Department. A copy of the Certificate of Authority must accompany the bonds. The Certificate must have been issued or updated within two (2) years prior to the execution of this Agreement. The bonds must be written or countersigned by an authorized representative of the surety who is either a resident of the state of Arizona or whose principal office is maintained in this state, as by law required.

11.4.3 The bonds must be made payable and be acceptable to City. The bond forms for the performance and payment bonds must be in the forms required under A.R.S. § 34-221, *et. Seq.,* as in Appendices 4 and 5 of these General Conditions.

11.4.4 Upon the request of any person or entity appearing to be a potential beneficiary of bonds covering payment of obligations arising under the Agreement Documents, Contractor must promptly furnish a copy of the bonds or must permit a copy to be made.

11.4.5 All bonds submitted for this Project must be provided by a company which has been rated AM Best rating of A- or better for the prior four quarters by the latest edition of the 'Results Best's Key Rating Guide (Property/Casualty)" published by the A.M. Best Company.

11.4.6 Personal or individual bonds are not acceptable.

11.4.7 If the surety on any Bond furnished by Contractor is declared a bankrupt or becomes insolvent, or Contractor's right to do business is terminated in any state where any part of the Project is located, or it ceases to meet the requirements of this Section 11.4, Contractor must within 5 Days thereafter substitute another Bond and surety, both of which must be acceptable to City.

SECTION 12 - INDEMNIFICATION

12.1 To the extent permitted by law, the Contractor and its owners, officers, directors, agents, employees, and subconsultants (collectively "lndemnitor") must indemnify, save, and hold harmless the City and its officers, officials, agents, and employees (collectively "lndemnitee") from any and all claims, actions, liabilities, damages, losses, or expenses (including court costs, attorneys' fees, and costs of claim processing, investigation, and litigation) (collectively "Claims") caused or alleged to be caused, in whole or in part, by the negligent, reckless, wrongful, or willful acts, errors, or omissions of Indemnitor in connection with this Agreement. This indemnity includes any Claim or amount arising out of or recovered under workers' compensation laws or on account of Indemnitor's failure to conform to any federal, state, or local law, statute, ordinance, rule, regulation, or court decree. Indemnitor must indemnify lndemnitee from and against any and all Claims, except those arising solely from lndemnitee's own negligent, reckless, wrongful, or willful acts, errors, or omissions. Indemnitor is responsible for primary loss investigation, defense, and judgment costs where this indemnification applies. In consideration of the award of this Agreement, Indemnitor agrees to waive all rights of subrogation against lndemnitee for losses arising from or related to this Agreement. Indemnitor's obligations under this provision survive the termination or expiration of this Agreement.

SECTION 13 -DISPUTE RESOLUTION

13.1 All disputes arising out of or relating to the Agreement, the Work or the Project, other than termination under Section 10, will be resolved pursuant to the Dispute Resolution process set forth in Appendix 6 of these General Conditions, and not pursuant to MAG Specifications § 110.

13.2 Contractor agrees that during any dispute between the parties, Contractor will continue to perform its obligations under the Agreement until such dispute is resolved.

13.3 Notwithstanding any other provision in this Agreement, City has the right to immediately file in court and pursue an action for a temporary restraining order and injunctive relief against Contractor if City determines that such action is necessary to protect its interests under the Agreement, to obtain specific performance of any provision of the Agreement, to advance the completion of the Project, or to protect health, welfare and safety.

SECTION 14 - MISCELLANEOUS PROVISIONS

14.1 AGREEMENT DOCUMENTS

14.1.1 The Agreement Documents are intended to permit the parties to complete the Work and all obligations required by the Agreement Documents within the Agreement Times for the Agreement Price. The Agreement Documents are intended to be complementary and interpreted in harmony so as to avoid conflict, with words and phrases interpreted in a manner consistent with construction and design industry standards.

14.1.2 It is the intent of the Agreement Documents to describe a functionally complete Project (or part thereof) to be constructed in accordance with the Agreement Documents. Any labor, documentation, services, materials, or equipment that may reasonably be inferred from the Agreement Documents or from prevailing custom or trade usage as being required to produce the intended result must be provided by Contractor whether or not specifically called for at no additional cost to City.

14.1.3 The Agreement Documents establish the rights and obligations of the parties and include the Agreement, Addenda (which pertain to the Agreement Documents), Contractor's Bid or Proposal (including documentation accompanying the Bid and any post-Bid documentation submitted prior to Agreement award) when attached as an exhibit to the Agreement, the accepted Project Schedule, the Notice to Proceed, the Performance Bond, the Payment Bond, Project Design, Engineering and Specifications, these General Conditions, the Project Specific Special Provisions, Technical Specifications, Agreement Drawings, as the same may be more specifically identified in the Agreement, Change Orders, Work Change Directives, Field Orders and the written interpretations and clarifications of the Design Professional or City representative and Modifications issued after execution of the Agreement. Approved Shop Drawings and the reports and drawings of subsurface and physical conditions are not Agreement Documents.

14.1.4 In the event of any inconsistency, conflict, or ambiguity between or among the Agreement Documents, the Agreement Documents will take precedence as follows from highest to lowest: Change Orders, Addenda, Agreement, Project Specific Special Provisions, General Conditions, Technical Specifications, Drawings/Plans, Chandler Amendments to MAG Standard Specifications and Chandler Standard Details, and MAG Uniform Standard Specifications and Details for Public Works Construction. If applicable to this Agreement, Federal Provisions prevail.

14.1.5 On the Drawings, given dimensions will take precedence over scaled measurements and large scale drawings over small-scale drawings.

14.1.6 Clarifications and interpretations of the Agreement Documents will be issued by the Design Professional through the City.

14.1.7 The headings used in this Agreement or any other Agreement Documents, are for ease of reference only and must not in any way be construed to limit or alter the meaning of any provision.

14.1.8 The Agreement Documents form the entire agreement between City and Contractor. No oral representations or other agreements have been made by the parties except as specifically stated in the Agreement Documents.

14.1.9 The Agreement Documents may not be changed, altered, or amended in any way except in writing signed by a duly authorized representative of each party in the form of a Change Order.

14.1.10 Re-Use of Documents. Neither Contractor nor any Subcontractor, manufacturer, fabricator, supplier or distributor will have or acquire any title to or ownership rights in any of the Drawings, Specifications or other documents (or copies of any thereof) prepared by or bearing the seal of the Design Professional; and they must not re-use any of them on extensions of the Project or any other project without written consent of City and the Design Professional and specific written verification or adaptation by the Design Professional.

14.2 **REFERENCE STANDARDS**

14.2.1 Reference to standards, specifications, manuals, or codes of any technical society, organization, or association, or to Laws or Regulations, whether such reference be specific or by implication, will mean the standard, specification, manual, code, or Laws or Regulations in effect at the time of opening of Bids (or on the Effective Date of the Agreement if there were no Bids), except as may be otherwise specifically stated in the Agreement Documents.

14.2.2 The provisions of any such standard, specification, manual or code, or any instruction of a Supplier will not change the duties or responsibilities of City, Contractor, Design Professional or Project Manager, or any of their Subcontractors, consultants, agents, or employees from those set forth in the Agreement Documents, nor will any such provision or instruction assign to City, Contractor, Design Professional, or any of their agents, or employees any duty or authority to supervise or direct the performance of the Work or any duty or authority to undertake responsibility inconsistent with the provisions of the Agreement Documents.

14.3 **COMPLIANCE WITH ARIZONA LAW AND FEDERAL LAW**

14.3.1 Compliance with A.R.S. § 41-4401. Pursuant to the provisions of A.R.S. § 41-4401, the Contractor hereby warrants to the City that the Contractor and each of its subcontractors ("Subcontractors") must comply with all Federal Immigration laws and regulations that relate to the immigration status of their employees and the requirement to use E-Verify set forth in A.R.S. §23-214(A).

14.3.2 A breach of the Contractor Immigration Warranty constitutes a material breach of this Agreement and subject to penalties up to and including termination of this Agreement.

14.3.3 The City retains the legal right to inspect the papers of any Contractor or Subcontractor employee who works on this Agreement to ensure that the Contractor or Subcontractor is complying with the Contractor Immigration Warranty. The Contractor agrees to assist the City in the conduct of any such inspections.

14.3.4 The City may, at its sole discretion, conduct random verifications of the employment records of the Contractor and any Subcontractors to ensure compliance with Contractors Immigration Warranty. The Contractor agrees to assist the City in performing any such random verifications.

14.3.5 The provisions of this Article must be included in any agreement the Contractor enters into with any and all of its subcontractors who provide services under this Agreement or any

subcontract. "Services" are defined as furnishing labor, time or effort in the State of Arizona by a contractor or subcontractor. Services include construction or maintenance of any structure, building or transportation facility or improvement to real property.

14.4 **HAZARDOUS ENVIRONMENTAL CONDITIONS**

14.4.1 Contractor will not be responsible for any Hazardous Environmental Condition uncovered or revealed at the Site which was not shown or indicated in Drawings or Specifications or identified in the Agreement Document to be within the scope of the Work. Contractor will be responsible for a Hazardous Environmental Condition created with any materials brought to the Site by Contractor, Subcontractors, Suppliers, or anyone else for whom Contractor is responsible.

14.4.2 If Contractor encounters a Hazardous Environmental Condition or if Contractor or anyone for whom Contractor is responsible creates a Hazardous Environmental Condition. Contractor must immediately:

a. Secure or otherwise isolate such condition;

b. Stop all Work in connection with such condition and in any area affected thereby; and

c. Notify City and promptly thereafter confirm such notice in writing.

14.4.3 City will promptly retain a qualified expert to evaluate such condition or take corrective action, if any.

14.4.4 Contractor will be responsible for any and all civil or criminal penalties, fines, damages, or other charges imposed by any regulatory agency or court for sewage discharges that are in violation of applicable statutes and laws and that are a result, direct or indirect, of work performed under this Agreement. Contractor will also be responsible for reimbursement to City for administration, reporting, and tracking expenses required as a result of any spill event. In the event the regulatory agency or court imposes a probationary period, Contractor must post bond for the probationary period to ensure that all such costs are reimbursed to City. This responsibility will apply whether penalties are imposed directly on Contractor or any of its Subcontractors, or the City of Chandler. Contractor must defend and indemnify City against such penalties. Regulatory agencies may include, but are not limited to, the Arizona Department of Environmental Quality (ADEQ) and the United States Environmental Protection Agency (USEPA).

14.5 **COOPERATION AND FURTHER DOCUMENTATION**

Contractor agrees to provide City such other duly executed documents as may be reasonably requested by City to implement the intent of the Agreement Documents.

14.6 **ASSIGNMENT**

Neither Contractor nor City will, without the written consent of the other assign, transfer or sublet any portion of this Agreement or part of the Work or the obligations required by the Agreement Documents, any such assignment will be void, will transfer no rights to the purported assignee, and would be a material breach of the Agreement.

14.7 **SUCCESSORS**

Contractor and City intend that the provisions of the Agreement Documents are binding upon the parties, their employees, agents, heirs, successors and assigns.

14.8 **LAWFUL PRESENCE**

Pursuant to A.R.S. §§ 1-501 and 1-502, City is prohibited from awarding an agreement to any natural person who cannot establish that such person is lawfully present in the United States. To establish lawful presence, a person must produce qualifying identification and sign a City-provided affidavit affirming the identification provided is genuine. This requirement will be imposed at the time of agreement award. This requirement does not apply to business organizations such as corporations, partnerships, or limited liability companies.

14.9 **NO BOYCOTT OF ISRAEL CERTIFICATION**

By Contractor's signature on this Agreement, Contractor certifies under A.R.S. § 35-393.01 that Contractor is not currently engaged in and for the duration of this Agreement will not engage in a boycott of Israel.

14.10 **NO THIRD PARTY BENEFICIARY**

Nothing under the Agreement Documents will be construed to give any rights or benefits in the Agreement Documents to anyone other than City and Contractor, and all duties and responsibilities undertaken pursuant to the Agreement Documents will be for the sole and exclusive benefit of City and Contractor and not for the benefit of any other party, unless otherwise expressly set forth in the Agreement Documents.

14.11 **GOVERNING LAW AND VENUE**

The Agreement and all Agreement Documents will be deemed to be made under, and will be construed in accordance with and governed by the laws of the State of Arizona without regard to the conflicts or choice of law provisions thereof. Any court action to enforce any provision of the Agreement or to obtain any remedy with respect hereto must be brought in the Superior Court, Maricopa County, Arizona, and for this purpose, each party hereby expressly and irrevocably consents to the jurisdiction and venue of such Court.

14.12 **SEVERABILITY**

If any provision of the Agreement Documents or the application thereof to any person or circumstance will be invalid, illegal or unenforceable to any extent, the remainder of the affected provision, the remainder of the Agreement Documents, and the application thereof will not be affected and will be enforceable to the fullest extent permitted by law.

14.13 **LEGAL REQUIREMENTS**

At all times relevant to its entry into this Agreement and performance of the Services and the Work, Contractor must fully comply with all Laws, Regulations, or Legal Requirements applicable to City, the Project, and the Agreement, including, without limitation, those set forth on Exhibit C of the Agreement.

14.14 **PARTIAL INVALIDITY**

If any provision of the Agreement is held by a court of competent jurisdiction to be invalid, void or unenforceable, the remaining provisions will nevertheless continue in full force without being impaired or invalidated in any way.

14.15 **ATTORNEYS' FEES**

Should either party to the Agreement bring an action to enforce any provision of the Agreement, the prevailing party will be entitled to recover reasonable attorneys' fees and costs in connection therewith.

14.16 **CONFLICT OF INTEREST**

14.16.1 Contractor agrees to disclose any financial or economic interest with the Project property, or any property affected by the Project, existing prior to the execution of the Agreement. Further, Contractor agrees to disclose any financial or economic interest with the Project property, or any property affected by the Project, if Contractor gains such interest during the course of this Agreement. If Contractor gains financial or economic interest in the Project during the course of this Agreement, this may be grounds for terminating this Agreement. Any decision to terminate the Agreement must be at the sole discretion of City.

14.16.2 Contractor will not engage the services on this Agreement of any present City employee who was involved as a decision maker in the selection or approval processes, or who negotiated or approved billings or Agreement Modifications for this Agreement.

14.16.3 Contractor agrees that it will not perform services on this Project for a contractor, subcontractor, or any supplier, not covered under this Agreement.

14.17 **INDEPENDENT CONTRACTOR**

Contractor is and must be an independent contractor. Any provisions in the Agreement Documents that may appear to give City the right to direct Contractor as to the details of accomplishing the Work or to exercise a measure of control over the Work means that Contractor must follow the wishes of City as the results of the Work only. These results must comply with all applicable laws and ordinances.

14.18 **NOTICE OF INJURY**

Should City or Contractor suffer injury or damage to their person or property because of any error, omission or act of the other party or of any of the other party's employees or agents or others for whose acts the other party is legally liable, claim must be made in writing to the other party within 7 Days of the first observance of such injury or damage.

14.19 **CONFIDENTIALITY**

Contractor, for the benefit of City, hereby agrees it will not release or cause or permit to be released to the public any press notices, publicity (oral or written) or advertising promotion relating to, any statement regarding, or any other public announcement or disclosure or cause or permit to be publicly announced or disclosed, in any manner whatsoever, the specific terms and conditions of this Agreement or any comment relating to the Project or the Site. Notwithstanding the foregoing, Contractor will be entitled to disclose the terms of the Agreement to the extent required by law or in the course of enforcing or defending a claim or action hereunder. Contractor must give City reasonably prompt notice of any disclosure or statement made pursuant to this provision.

14.20 **DATA CONFIDENTIALITY**

14.20.1 As used in the Agreement, “data” means all information, whether written or verbal, including plans, specifications, renderings, photographs, studies, investigations, audits, analyses, samples, reports, calculations, internal memos, meeting minutes, data field notes, work product, proposals, correspondence and any other similar documents or information prepared by, obtained by, or transmitted to the City in the performance of this Agreement.

14.20.2 Contractor agrees that all data, regardless of form, including originals, images, and reproductions, prepared by, obtained by, or transmitted to City in connection with the Contractor’s performance of this Agreement is confidential and proprietary information belonging to City.

14.20.3 Except as specifically provided in this Agreement, Contractor or its Subcontractors must not divulge data to any third party without prior written consent of City. Contractor or its Subcontractors must not use data for any purposes except to perform Work required under this Agreement. These prohibitions will not apply to the following data provided Contractor has first given the required notice to City:

a. Data which was known to Contractor or its Subcontractors prior to its performance under this Agreement unless such data was acquired in connection with Work performed for City;

b. Data which was acquired by Contractor or its Subcontractors in its performance under this Agreement and which was disclosed to Contractor or its Subcontractors by a third party, who to the best of Contractor's or its Subcontractor's knowledge and belief, had the legal right to make such disclosure and Contractor or its Subcontractors are not otherwise required to hold such data in confidence; or

c. Data which is required to be disclosed by virtue of law, regulation, or court order, to which the Contractor or its Subcontractors are subject.

14.20.4 In the event the Contractor or its Subcontractors are required or requested to disclose data to a third party, or any other information to which the Contractor or its Subcontractors became privy as a result of any other agreement with City, the Contractor must first notify City as set forth in this Section of the request or demand for the data. The Contractor or its Subcontractors must give City sufficient facts so that City can be given an opportunity to first give its consent or take such action that City may deem appropriate to protect such data or other information from disclosure.

14.20.5 Unless prohibited by law, within 10 Days after completion of services for a third party on real or personal property owned or leased by City, the Contractor must promptly deliver, as set forth in this Section, a copy of all data to City. All data will continue to be subject to the confidentiality agreements of this Agreement.

14.20.6 Contractor or its Subcontractors assume all liability for maintaining the confidentiality of the data in its possession and agree to compensate City if any of the provisions of this Section are violated by Contractor, its employees, agents, or Subcontractors. Solely for the purposes of seeking injunctive relief, it is agreed that a breach of this Section will be deemed to cause irreparable harm that justified injunctive relief in court. Contractor agrees that the requirements of this Section will be incorporated into all subcontracts entered into by Contractor. A violation of this Section may result in immediate termination of this Agreement without notice.

14.21 **SURVIVAL**

All warranties, representations and indemnifications by Contractor must survive the completion or termination of this Agreement.

14.22 **COVENANTS AGAINST CONTINGENT FEES**

Contractor warrants that no person has been employed or retained to solicit or secure this Agreement upon an agreement or understanding for a commission, percentage, brokerage, or contingent fee, and that no member of City Council, or any employee of City has any interest, financially, or otherwise, in the firm. For breach or violation of this warrant, City will have the right to annul the Agreement without liability or at its discretion to deduct from the Agreement Price or consideration, the full amount of such commission,

percentage, brokerage, or contingent fee.

14.23 **NO WAIVER**

The failure of either party to enforce any of the provisions of the Agreement Documents or to require performance of the other party of any of the provisions hereof must not be construed to be a waiver of such provisions, nor will it affect the validity of the Agreement Documents or any part thereof, or the right of either party to thereafter enforce each and every provision.

14.24 **NONEXCLUSIVE REMEDIES**

The remedies set forth in this Agreement are cumulative and not exclusive, and failure to exercise any remedy (including, without limitation, any right to terminate) will not preclude any party from exercising any other right in seeking any other remedy available to it at law or in equity.

14.25 **PROJECT COMMUNICATIONS**

14.25.1 All communications concerning the performance of the Work or the Project will be provided to the designated Project Manager and Contractor's Representative set forth in Article 1 of the Agreement. City may change the designated Project Manager and, subject to Section 4.4.20 of these General Conditions, Contractor may change Contractor Representative, by written notice to the other.

14.25.2 Project communications may be exchanged by e-mail, but email communications cannot change the terms of the Agreement or the Scope of Work, or effectuate any change that requires a written Change Order.

14.25.3 When any provisions of the Agreement Documents requires Contractor or the Design Professional to give written notice to City, it will be deemed to have been validly given if delivered in person or if delivered at or sent by registered or certified mail, postage prepaid, to the Parties indicated in Agreement Article 1, incorporated by reference.

14.25.4 When any provisions of the Agreement Documents requires City, Project Manager, or the Design Professional to give written notice to Contractor, it will be deemed to have been validly given if delivered in person to the person designated in the Agreement Documents as Contractor's Resident Superintendent, or if delivered at or sent by registered or certified mail, postage prepaid, to Contractor at the last address in the Agreement Documents or such substitute address which Contractor designates in writing, or to the business address known to the giver of notice.

14.26 **DRUG FREE WORKPLACE PROGRAM**

14.26.1 City has adopted a policy establishing a drug free workplace for itself and as a requirement for Contractors doing business with City, to ensure the safety and health of employees working on City projects.

14.26.2 Contractor must require a drug free workplace for all employees working under the Agreement. Specifically, all employees of Contractor who are working under an agreement with City must be notified, in writing, by Contractor that they are prohibited from the manufacture, distribution, dispensation, possession or unlawful use of a controlled substance in the workplace.

14.27 Failure to require a drug free workplace in accordance with the City's policy may result

in termination of the Agreement and possible debarment form bidding on future City projects.

SECTION 15 - PROVISIONS APPLICABLE SOLELY TO GMP AND COST-BASED AGREEMENTS, CHANGE ORDERS, AND JOB ORDERS

15.1 ADDITIONAL DEFINITIONS

The definitions set forth in Section 2 apply to GMP and Cost-Based Agreements, Change Orders, and Job Orders, together with the additional definitions set forth below.

Baseline Cost Model –
A breakdown and estimate of the scope of the Project developed by CM@Risk pursuant to Section 17.5 of these General Conditions.

CM@Risk or Construction Manager at Risk –
The person or firm selected by City to provide pre-construction and/or construction services as detailed in a Construction Manager at Risk Agreement with City. In these General Conditions, the term "Contractor" includes CM@Risk under both Pre-Construction and Construction Services Agreements.

CM@Risk Fee or Contractor's Fee –
An agreed to percentage in an accepted GMP that represents the Contractor's fee for performance of the Work.

Agreement Documents –
Where compensation under the Agreement is based upon a GMP accepted by City, the term "Agreement Documents" also includes the accepted GMP Proposal.

Agreement Price –
Where compensation under the Agreement based upon a GMP accepted by City, the term "Agreement Price" refers to the GMP.

Cost-Based Agreement, Change Order, or Job Order –
A Agreement, Change Order, or Job Order where the Agreement Price is based upon the actual cost of performing the Work, subject to the terms of the Agreement Documents, including this Section 15. These would include those generally referred to as "Cost of the Work plus a Fee with a GMP," "Time and Materials," or "Cost Plus a Fee."

Cost of the Work –
The direct costs necessarily incurred by Contractor in the proper, timely, and complete performance on the Work. The Cost of the Work will include only those costs set forth in Section 15.2 of these General Conditions.

Deliverables –
The work products prepared by Contractor in performing the scope of work described in the Agreement. Some of the major deliverables to be prepared and provided by Contractor during pre-construction may include but are not limited to: the Baseline Cost Model and Schedule that validate City's plan and budget, Construction Management Plan, Detailed Project Schedule, Schedule of Values, alternative system evaluations, procurement strategies and plans, Detailed Cost Estimates, construction market surveys, cash flow projections, GMP Proposals, Subcontractor procurement plan, Subcontractor agreements, Subcontractor bid packages, Supplier agreements, Constructability Review, Cost Control Log, Traffic control and phasing plans and others as indicated in this Agreement or required by the Project Team.

Pre-Construction Services Agreement –
The Agreement entered into between City and the CM@Risk for Pre-Construction Services to be provided by the CM@Risk, including, without limitation, the generation of a GMP Proposal. If the GMP Proposal is accepted by City and a Construction Agreement is entered into between City and CM@Risk, the duties, obligations and warranties of the CM@Risk under the Pre-Construction Services Agreement survive and are incorporated into the resulting Construction Agreement.

Pre-Construction Services –
The services to be provided under the Pre-Construction Services Agreement, including Section 17 of these General Conditions.

Detailed Project Schedule –
The Detailed Project Schedule developed by the CM@Risk for the review and approval of the Project Manager in accordance with Section 17.3 of these General Conditions, if applicable.

General Conditions Costs –
Those costs set forth in Section 4 of Appendix 9 to these General Conditions.

GMP Plans and Specifications –
The plan and specifications upon which the Guaranteed Maximum price Proposal is based.

GMP Proposal –
The proposal of Contractor submitted pursuant to Section 17.7 of these General Conditions for the entire Work and/or portion (phases) of the Work.

Guaranteed Maximum Price or GMP –
The Guaranteed Maximum Price set forth in the Agreement, Change Order, or Job Order if applicable.

15.2 **AGREEMENT PRICE**

15.2.1 The Agreement Price for all Agreements, Change Orders, and Job Orders based upon payment of the Cost of the Work plus a Fee with a GMP, time and materials, or cost-plus a fee will be the Cost of the Work incurred plus the Fee agreed to in writing by City, limited to the amount of the GMP, if agreed to. Unless otherwise expressly provided in the Agreement, Change Order, or Job Order, all Cost Based pricing will be subject to and limited to GMP.

15.2.2 The Agreement Price may only be changed as set forth in Section 9 above.

15.2.3 Only costs specifically designated as reimbursable costs are eligible for payment by City or may be charged against the Agreement Price. All other costs will not be paid by City and will not be chargeable against the Agreement Price.

15.2.4 Cost-Based Agreements. For Agreements, Change Orders, or Job Orders, reimbursable costs must be determined pursuant to Appendix 9 to these General Conditions, Cost of the Work, and not by MAG Specifications §109.5.

15.3 **ALLOWANCES**

15.3.1 Contractor must include in the Agreement Price all Allowances stated in the Agreement Documents and agreed to in writing by City. Items covered by these Allowances must be supplied for such amounts and by such persons as City may direct, provided Contractor will

not be required to employ persons against whom Contractor makes a reasonable objection. Materials, labor, and equipment under an Allowance will be selected by City in accordance with a schedule to be mutually agreed upon by City, Design Professional and Contractor or otherwise in reasonably sufficient time to avoid delay in the Work.

15.3.2 Unless otherwise provided in the Agreement Documents:

15.3.2.1 These Allowances must cover the cost to Contractor, less any applicable trade discount, of the materials, labor, and equipment required by the Allowances, delivered at the Site, and all applicable taxes;

15.3.2.2 Contractor's costs for unloading and handling on the Site, labor, installation costs, overhead, profit and other expenses relating to materials, labor, and equipment required by the Allowance must be included in the Agreement Sum and not in the Allowance; and

15.3.2.3 Whenever the cost is more or less than the Allowance, the Agreement Sum must be adjusted accordingly by Change Order, the amount of which will recognize the difference between actual costs for an Allowance item and the amount of the Allowance item and changes, if any, in handling costs on the Site, labor, installation costs, overhead, profit and other expenses.

15.4 **CONTINGENCY**

An agreed to amount in the GMP that may only be used in accordance with the terms set forth in these General Conditions and with prior written approval by the City.

15.4.1 Construction Contingency. This GMP includes a dollar amount listed as a Construction Contingency which will be readily available for increased costs for subcontractors, material, and equipment subject to prior approval of City, which approval will not be withheld unreasonably. The Construction Contingency may also be used, at the discretion of City, to reimburse CM@Risk for unexpected costs due to (a) scope gaps between trade subcontractors; (b) agreement default by trade subcontractors; (c) unforeseen field conditions, but only as defined in Section 9.5 above; (d) work completed to meet the intent of the design, but which was not indicated on the plans; (e) costs overruns not covered by allowances; (f) costs of corrective work not provided for elsewhere; and (g) implementation of any Recovery Plan. Cost for which CM@Risk desires to be paid from the Construction Contingency must be documented by CM@Risk on a time and materials basis and are subject to verification by City. If agreed to by City, a "Use of Contingency" form will be executed by both parties authorizing the actual cost of the work to be paid and included in the Work Item Direct Costs. The Construction Contingency is not allocated to any particular item of the Project but may be used for any portion of the work as determined above. Any amount not used in the Construction Contingency will belong to City and will reduce the GMP.

15.4.2 Owner's Contingency. This GMP also includes a dollar amount listed as an Owner's Contingency which may be used only by the City (owner department) for upgrades and changes in scope or other changes not already included within the intent of the Project Program. City will provide CM@Risk with a Work Change Directive authorizing CM@Risk to perform the additional work and to transfer funds from the Owner's Contingency to the Work Item Direct Costs category to be paid with such direct costs. These additional costs will be in an amount mutually agreed upon by CM@Risk and City or will be documented by CM@Risk on a time and materials basis and are subject to verification by City. Any amount not used in the Owner's Contingency will belong to the City and will reduce the GMP.

15.5 **REDUCTION IN RETENTION**

If the Agreement Price is based upon a GMP, in order to receive payment of one-half of the retention as set forth in Section 8.1.5 above, Contractor must also submit to the Project Manager a complete accounting of the Actual Reimbursable Cost of the Work to date, including all such documentation (including, without limitation, invoices, subcontract, subcontractor change orders, purchase orders, records of payment, etc.) as City may require, to establish whether the payments made to Contractor equal, exceed, or are less than the actual reimbursable Cost of the Work to date. Any excess payments by City, as determined by the Project Manager, will be deducted from the one-half retention payment to be made to Contractor, and any additional excess amounts paid to Contractor will be refunded by Contractor to City. The Project Manager's determinations as to Actual Reimbursable Cost of the Work will be the basis of payment until final Project Closeout and Final Payment under the Agreement.

15.6 **FINAL PAYMENT**

If the Agreement Price is based upon a GMP, as a further condition precedent to Final Payment by City, Contractor must submit to the Project Manager a complete final accounting of the Actual Reimbursable Cost of the Work, including all such documentation (including, without limitation, invoices, subcontracts, subcontractor change orders, purchase orders, records of payment, etc.) as City may require, to establish whether the payments made to Contractor equal, exceed, or are less than the Actual Reimbursable Cost of the Work to date. Any excess payments by City, as determined by the Project Manager, will be deducted from the one-half retention payment to be made to Contractor, and any additional excess amounts paid to Contractor will be refunded by Contractor to City. Disputes relating to the Final Cost of the Work will be subject to City's audit rights under Sections 8.8 above and 15.7 below, and the dispute resolution process under Section 13 above.

15.7 **OPEN BOOK**

On any GMP-based or Cost-Based Agreement, Job Order, or Change Order, City may attend any and all meetings or discussions pertaining to the Project, including bid openings, and must have access to all books, invoices, accounts, memoranda, correspondence, and written communications or records of any kind pertaining to the Project, including without limitation, those stored in electronic format.

15.8 **DIFFERING SITE CONDITIONS AND/OR CHANGE IN LAWS**

A Change Order for increased costs under Section 9.5 or 9.6 above will only be considered or granted by City to the extent such actual, documented costs are justified.

SECTION 16 - PROVISIONS APPLICABLE SOLELY TO JOB ORDER AGREEMENTS (JOC)

16.1 **ADDITIONAL DEFINITIONS**

The definitions set forth in Sections 2 and below will apply to all Job Order Agreements and Job Orders. In addition, the definitions set forth in Section 15.1 above will apply to all Cost-Based Job Orders.

Agreement –
Includes the Job Order Master Agreement and Job Order Project Agreements issued and agreed to by City and JOC Contractor.

JOC Contractor's Coefficient –
A numerical factor that represents JOC Contractor total costs (indirect and direct costs, sales tax,

profit, etc.) and other adjustments for market conditions.

Job Order Request for Proposal (RFP) –
The Request for Proposals issued by City for each Job Order Project Agreement relating to a specific Project.

Job Order Cost Proposal –
The Proposal submitted by JOC Contractor in response to a Job Order Request for Proposal (RFP) issued by City to develop a Job Order Project Agreement for a specific Project.

Guaranteed Maximum Price (GMP) Job Order –
Job Order under which JOC Contractor is compensated for actual costs incurred.

Job Order Project Agreement (Job Order) –
The agreement for a specific project, as it may be modified by all Change Orders, executed by the Parties, which incorporates the terms and conditions of the Job Order Master Agreement.

16.2 **ORDERING AND PROCESSING PROCEDURES FOR JOB ORDERS**

16.2.1 The process for developing and issuing a Job Order for a particular Project consists of three (3) procedures: (1) issuance of a RFP by City; (2) JOC Contractor's response to the RFP in the form of JOC Contractor's Job Order Cost Proposal; and (3) Issuance of a Job Order by City, as set for below.

16.2.2 RFP's For Job Orders

16.2.2.1 City will provide to JOC Contractor RFP with a Scope of Work (SOW) describing the Work to be performed, which may include special instructions and conditions, material submittal requirements, and, if applicable, a complete set of sketches, construction drawings and specifications for the Job Order.

16.2.2.2 Some Job Order RFP's will be issued by City without detailed sketches, drawing and specifications and will rely on JOC Contractor to produce them for City review and approval and is considered to be Pre-Construction and incidental design services included in JOC Contractor's overhead for GMP Job Orders. In addition JOC Contractor will not be reimbursed for any Pre-Job Order costs, including proposal preparation, attendance during negotiations, or site visits.

16.2.3 JOC Contractor's Job Order Cost Proposal

16.2.3.1 JOC Contractor must respond within ten (10) calendar days of the RFP date or site visit, whichever is later or as otherwise indicated on a case-by-case basis, by submitting JOC Contractor's Job Order Cost Proposal to the City representative.

16.2.3.2 Unless otherwise required under the terms of the RFP, JOC Contractor's Job Order Cost Proposal must include the following.

a. JOC Contractor's Job Order Cost Proposal in PDF and electronic format;

b. A Project Schedule and schedule of values that reflects the costs of each work element on the schedule. The schedule must show all milestones (e.g., permits, submittals, ordering materials, demolition, work phases, closeout and completion date); and

c. Necessary documentation will be required to indicate that adequate scoping, layout, setup and planning to accomplish the Work has been done. Examples of documentation that might reasonably be expected include sketches, drawings, calculations, catalog cuts and specifications produced to a level of detail and skill that could be expected of experienced, competent Project Managers with five or more periods experience in their respective trade.

16.2.3.3 JOC Contractor must select Subcontractors based on qualifications alone or on a combination of qualifications and price and must not select Subcontractors based on price alone. A qualifications and price selection may be a one-step selection based on a combination of qualifications and price or two-step selection. In a two-step selection, the first step must be based on qualifications alone and the second step may be based or a combination of qualifications and price or on price alone.

16.2.3.4 Upon request, JOC Contractor must provide City with copies of Subcontractor quotes and the basis for selection of each Subcontractor.

16.2.3.5 If City objects to a selected Subcontractor, City will make the objection and the reasons for the objection known to the JOC Contractor. JOC Contractor must then present an acceptable Subcontractor for the applicable discipline. City will not unreasonably object to or withhold approval of a Subcontractor.

16.2.3.6 For self-performed work, the City retains the right to have the JOC Contractor establish JOC Contractor's costs by bidding their costs against at least three (3) other interested trade Contractors. No self- performed work will be allowed to be performed on a lump sum basis.

16.2.4 Issuance of Job Order

16.2.4.1 City Representative will compare the JOC Contractor's Job Order Cost Proposal with the City's estimate, schedules and other requirements, and then, if the City Representative determines it is in the best interest of City, arrange a meeting with JOC Contractor, at which time the JOC Contractor's Job Order Cost Proposal will be discussed and negotiated.

16.2.4.2 If the City Representative determines that it is in the best interest of the City, City will then issue a Job Order to JOC Contractor for execution.

16.2.4.3 Specific Job Orders may vary, but unless agreed to by City in writing otherwise, the content of Job Orders under the Agreement will generally be as follow, all of which will be signed and/or initialed by JOC Contractor's designated representative:

a. The description of the Scope of the Work and Project Schedule (attached as Exhibit A to the Job Order);

b. The address or location of the Work;

c. The Agreement Price for Work (Construction) included in the Project (attached as Exhibit B to the Job Order);

d. The name of the JOC Contractor representative for the Project;

e. The Drawings and Specifications for the Project;

f. If any shop drawings, project date and/or samples are required for the Job Order, the date for delivery of each required item (included in the Project

Schedule, Exhibit A to the Job order); and

g. Project Specific Provisions, if any, in Exhibit A to the Job Order, including, without limitation, whether any of the following are required: Pre-Construction Conference, weekly progress meetings, field office, storage enclosure, materials and equipment handling facility, submittals, shop drawings, product data, equipment list, samples, project manual, schedule of values, Construction progress schedule, narrative reports, progress report, progress charts, progress photographs, materials status report, Construction diagram, Construction status report, operation and maintenance data, operating maintenance instructions and parts list, and as-build drawings.

16.2.5 Job Order Intent. Each Job Order will be interpreted to include all items reasonably necessary to complete the Project under that Job Order as described in the scope of the Work in that Job Order. All Work must be performed in a professional manner and all materials used must be new and of the highest quality and of the type best adapted to their purpose, unless otherwise specified. The Notice to Proceed date, and the award date established therein, will be deemed an integral part of the Job Order the same as if set forth therein.

16.3 **INCIDENTAL DESIGN SERVICES**

16.3.1 This effort includes all "extensions of design" for systems that are typically specified in a performance oriented manner by consultants and designers. Examples include: fire sprinkler systems, fire alarm and sprinkler systems, DDC controls, control systems, prefabricated metal building and similar situations. These designs are normally provided under submittals as a shop drawing with engineering backup and as appropriate, seals of registered engineers specializing in the particular system.

16.3.2 Incidental design includes all documents, sketches, schematic diagrams, floor plan layouts, equipment schedules and other documents produced by the JOC Contractor to define the work required for projects that the City does not develop formal or abbreviated designs requiring a seal by a registered engineer. Incidental design does not include preparation of designs requiring an architect or engineer seal.

16.3.3 JOC Contractor represents, covenants, and agrees, and contractually assumes the obligation to furnish, all of the required Design Services through properly licensed and experienced Design Professionals in complete accordance with all of the duties imposed on a Design Professional under the Agreement Documents, Laws, Regulations, or Legal Requirements, and the common law.

16.3.4 All Design Documents (and all other Project-related documents, models, computer drawings and other electronic expression, photographs and other expressions CADD, and BIM files and images included) that JOC Contractor and/or JOC Contractor's Design Professional(s) prepare in connection with a Job Order and the copyrights therein (collectively, the "Instruments of Service") will be the property of City. JOC Contractor covenants and agrees to execute any additional document reasonably requested by City to confirm such assignment without any additional compensation.

16.4 **CONSTRUCTION SERVICES**

16.4.1 The following subsections of this Section 16.4 set forth requirements beyond those set forth in Section 4 above which apply to Construction Services performed under a Job Order.

16.4.2 JOC Contractor must perform the Work using only those firms, team members and individuals designated by JOC Contractor consistent with each Job Order or otherwise approved by City pursuant to the General Conditions. No other entities or individuals may be used without the prior written approval of the Project Manager.

16.4.3 Construction Phasing

16.4.3.1 City use of the facilities is anticipated while the Work is being performed. The Work must be planned and accomplished so that there will be a minimum of interference and inconvenience to occupants in the building and agencies in the vicinity and to other craftsmen who may have to do work in the affected facilities. Any blockage of building exits or driveways must be coordinated in advance.

16.4.3.2 If applicable, furniture, portable office equipment and wall appurtenances not rigidly fastened to the walls must be moved by JOC Contractor, protected from damage and replaced to the original position upon completion of the work. If the work required by the Job Order will not allow furniture and portable office equipment to be replaced to its original position, new locations will be designated by City. Incidental costs associated with moving one-piece furnishings up to approximately 150 pounds to perform such tasks as painting, carpet or tile replacement, etc., are considered a general cost of building renovation and must be included in the JOC Contractor's Coefficient. Costs for large scale or wholesale removal and replacement of large quantities of desks or modular workstations, copiers, multiple full file cabinets, etc. to another location or storage outside the work space, or disassembly and reassembly of modular furniture is not considered part of the JOC Contractor's Coefficient and will be priced separately.

16.4.3.3 The work must, so far as practicable, be done in definite sections or divisions and confined to limited areas which must be completed before work in other sections or divisions are begun.

16.4.4 Work Site Conflicts. In the event of a conflict between JOC Contractor and others in an occupied facility or where other Contractors are performing work on the same facility under other Agreements, City will decide to dispute and that decision will be final.

16.4.5 Ownership of Work Product. Work Product prepared or otherwise created in connection with the performance of this Agreement, including the Work, are to be and remain the property of City. For purposes of this provision, "Work Product" will include all designs, drawings, plans, specifications, ideas, renderings and other information or matter, in whatever form created (e.g., electronic or printed) and in all media now known or hereinafter created. All Work Product will be considered Work Made for Hire as defined in the United States Copyright Act 17 U.S.C. §101 (Copyright Act). If for any reason any such Work is found not to be a work for hire, JOC Contractor hereby transfers and assigns ownership of the copyright in such Work to City. The rights in this Section are exclusive to City in perpetuity.

16.5 **OPTIONAL LIQUIDATED DAMAGES**

16.5.1 Specific Job Orders. City will have the right to assess liquidated damages in relation to any specific JOC Project Agreement as set forth below.

16.5.2 Substantial Completion Liquidated Damages. JOC Contractor acknowledges and agrees that if JOC Contractor fails to obtain Substantial Completion of the Work within the Agreement Time, City will sustain extensive damages and serious loss as a result of such failure. The exact amount of such damages will be extremely difficult to ascertain. Therefore, City and JOC Contractor agree that if JOC Contractor fails to achieve Substantial Completion of the Work within the Agreement Time, City will be entitled to retain or recover from JOC Contractor, as liquidated damages and not as a penalty, the sum per calendar day as indicated in MAG § 108.9.

16.5.3 Final Acceptance Liquidated Damages. For the same reasons set forth in Section 16.5.2 above, City and JOC Contractor further agree that if JOC Contractor fails to achieve Final Acceptance of the Work within the Agreement Time, City will be entitled to retain or recover from JOC Contractor, as liquidated damages and not as a penalty, the sum per calendar day as indicated in MAG § 108.9 commencing from the actual date of Substantial Completion or Final Acceptance as required under any specific JOC Project Agreement.

16.5.4 MAG Liquidated Damages. Liquidated damages provisions in MAG § 108.9 may apply to any specific JOC Project Agreement.

16.5.5 City may deduct liquidated damages assessed pursuant to this Section 16.5 from any unpaid amounts then or thereafter due JOC Contractor under the Agreement or any specific JOC Project Agreement between JOC Contractor and City. Any liquidated damages not so deducted from any unpaid amounts due JOC Contractor must be payable to City at the demand of City, together with interest from the date of the demand at the highest lawful rate of interest payable to JOC Contractor.

16.6 **PERFORMANCE MEASUREMENT**

16.6.1 Performance Assessment. After the Final Acceptance of Work under each Job Order, City will complete a written evaluation of the performance of JOC Contractor on the Job Order.

16.6.2 Consideration in Assignment of Work. JOC Contractor's record of cost, schedule and quality performance and comparative assessments will be significant considerations in City's determination whether to award future Job Orders. JOC Contractor agrees that any determination by City not to not award future Job Orders or Option periods based on performance will be at the sole discretion of City.

SECTION 17 - PROVISIONS APPLICABLE SOLELY TO PRE-CONSTRUCTION SERVICES FOR CONSTRUCTION MANAGER AT RISK

17.1 **ADDITIONAL DEFINITIONS**

The definitions set forth in Section 2 and 15.1 above will apply to all Pre-Construction Services Agreements.

17.2 **GENERAL**

17.2.1 CM@Risk must perform the Services required by, and in accordance with the Agreement Documents and as outlined in Exhibit A of the Agreement to the satisfaction of the Project Manager, exercising the degree of care, skill, diligence and judgment a professional construction manager experienced in the performance of such services for construction and/or facilities of similar scope, function, size, quality, complexity and detail to the Project in urban areas throughout the United States, would exercise at such time, under

similar conditions. CM@Risk must, at all times, perform the required services consistent with sound and generally accepted engineering principles and construction management and construction contracting practices.

17.2.2 As a participating member of the Project Team, CM@Risk must provide to City and Design Professional a written evaluation of City's Project Program and budget, each in terms of the other, with recommendations as to the appropriateness of each. CM@Risk must prepare a Baseline Cost Model that validates City's budget. The Baseline Cost Model must include all assumptions and basis of estimates in enough detail so that the Project Team can compare future detail estimates to the Baseline Cost model for variances. City and Design Professional will provide all the reasonably required data that is available in order to reach agreement between the team members that the Baseline Cost Model is an accurate projection of the costs of the Project.

17.2.3 CM@Risk must attend Project Team meetings, which may include, but are not limited to, bi- weekly Project management meetings, Project workshops, special Project meetings, construction document rolling reviews, public meetings and partnering sessions. CM@Risk attendance at design or other meetings in which CM@Risk is provided the opportunity but does not actively participate and/or is not properly prepared is not acceptable. Repeated instances of non-participation and/or lack of preparedness will be grounds for termination of CM@Risk Agreement for default.

17.2.4 CM@Risk must provide Pre-Construction Services, described herein, in a timely manner and consistent with the intent of the most current Drawings and Specifications. CM@Risk must promptly notify City in writing whenever CM@Risk determines any Drawings or Specifications are inappropriate for the Project and/or cause changes in the scope of Work that deviates more than the allowed contingencies within the Baseline Cost Model or requires an adjustment in the Baseline Cost Model, Detailed Cost Estimate, Detailed Project Schedule, GMP Proposals and/or in the Agreement Time for the Work, to the extent such as established.

17.2.5 CM@Risk when requested by City, must attend, make presentations and participate as may be appropriate in public agency and or community meetings, relevant to the Project. CM@Risk must provide drawings, schedule diagrams, budget charges and other materials describing the Project when their use is required or appropriate in any such public agency meetings.

17.2.6 Ownership of Work Product. All Work Product prepared or otherwise created in connection with the performance of this Agreement, including the Work, are to be and remain the property of City. For purposes of this provision, "Work Product" will include all designs, drawings, plans, specifications, ideas, renderings and other information or material, in whatever form created (e.g., electronic or printed) and in all media now know or hereinafter created. All Work Product will be considered Work Made for Hire as defined in the United States Copyright Act 17 U.S.C.
§101 (Copyright Act). If for any reason any such Work is found not to be a work for hire, Contractor hereby transfers and assigns ownership of the copyright in such Work to City. The rights in this Section are exclusive to City in perpetuity.

17.2.7 CM@Risk represents to City in completing Pre-Construction Services and providing the reports and analysis required thereunder, that Work can be properly and timely constructed within the GMP Proposal, if accepted. CM@Risk does not assume any design

responsibilities unless specifically called for in the scope of work, but CM@Risk will be responsible for their errors, omissions or inconsistencies included in the Work.

17.3 **DETAILED PROJECT SCHEDULE**

17.3.1 The fundamental purpose of the Detailed Project Schedule is to identify, coordinate and record the tasks and activities to be performed by all of the Project Team members and then for the Project Team to utilize that Deliverable as a basis for managing and monitoring all member's compliance with the schedule requirements of the Project. Each Project Team member is responsible for its compliance with the Detailed Project Schedule requirements. CM@Risk must, however, develop and maintain the Detailed Project Schedule on behalf of and to be used by the Project Team based on input from the other Project Team members. The Baseline Project Schedule must be developed as part of the Baseline Cost Model. The Detailed Project Schedule must use the Critical Path method ("CPM") technique, unless required otherwise, in writing by City. CM@Risk must use scheduling software acceptable to City to develop the Detailed Project Schedule. The Detailed Project Schedule must be presented in graphical and tabular reports as agreed upon by the Project Team. If Project phasing as described below is required, the Detailed Project Schedule must indicate milestone dates for the phases once determined. As part of construction phase, City may require CM@Risk to prepare a "resource loaded" schedule for all work, including work performed by Subcontractors, detailing each of the project tasks and the required/anticipated number of personnel per day for each task. CM@Risk must also indicate on the schedule its ability to meet said required/anticipated personnel requirements.

17.3.2 CM@Risk must include and integrate in the Detailed Project Schedule the services and activities required of City, Design Professional and CM@Risk including all construction phase activities based on the input received from City and the Design Professional. The Detailed Project Schedule must define activities as determined by City to the extent required to show: (a) the coordination between preliminary design and various pre-construction documents, (b) any separate long-lead procurements, (c) any permitting issues, (d) any land, right-of-way, or easement acquisition, (e) bid packaging strategy and awards to Subcontractors and Suppliers, (f) major stages of construction, (g) start-up and commissioning, and (h) occupancy of the completed Work by City. The Detailed Project Schedule must include by example and not limitation, proposed activity sequences and durations for design, procurement, construction and testing activities, milestone dates for actions and decisions by the Project Team, preparation and processing of shop drawings and samples, delivery of materials or equipment requiring long-lead time procurement (if any), milestone dates for various construction phases, Total Float for all activities to the extent authorized by City, relationships between the activities, City's occupancy requirements showing portions of the Project having occupancy priority, and proposed dates for Final Acceptance.

17.3.3 A Baseline Project Schedule must be initiated with the project Baseline Cost Model and agreed to by the project team at the same time. CM@Risk must update and maintain a detailed Project Schedule throughout pre-construction such that it will not require major changes at the start of the construction phase to incorporate CM@Risk's plan for the performance of the construction phase Work. CM@Risk must provide updates and/or revisions to the Detailed Project Schedule for use by the Project Team, whenever required, but no less often than at the Project Team meetings. CM@Risk must include with such submittals a narrative describing its analysis of the progress achieved to-date vs. the

Baseline Project Schedule, including any concerns regarding delays or potential delays, and any recommendations regarding mitigating actions.

17.3.4 If phased construction is deemed appropriate at the time of developing the Baseline Cost Model or during the development of the Detailed Project Schedule, and City approves, CM@Risk must review the design and make recommendations regarding the phased issuance of Construction Documents to facilitate phased construction of the Work, with the objective of reducing the Project Schedule and/or Cost of the Work. CM@Risk must take into consideration such factors as natural and practical lines of work severability, sequencing effectiveness, access and availability constraints, total time for completion, construction market conditions, labor and materials availability, and any other factors pertinent to saving time and cost.

17.3.5 Long Lead Time Items. As part of developing the Detailed Project Schedule, CM@Risk must identify all long lead time materials, fabrications, equipment, or other items which may impact the Project Schedule and may require early action on the part of the Project Team. Dates for selecting and ordering long lead time items will be included and highlighted in the Detailed Project Schedule

17.3.6 Equipment Plan. Contractor must develop an Equipment Plan that addresses all rental and owned equipment, regardless of whether such equipment will be provided by CM@Risk or subcontractor(s), that will be necessary to construct the Project and the cost of which will be included as a Cost of the Work in the GMP Proposal. The Equipment Plan will seek to minimize the cost of the equipment to City and maximize the efficient and coordinated use of the equipment for completion of the Project. The Equipment Plan will not only include the costs and allowable lease rates for the equipment, but will also include an equipment schedule that will be incorporated into the Detailed Project Schedule and the Schedule of Values submitted with the GMP Proposal.

17.4 DESIGN DOCUMENT REVIEWS

17.4.1 CM@Risk must evaluate periodically the availability of labor, materials/equipment, cost-sensitive aspects of the design; and other factors that may create an unacceptable variance to the Baseline Cost Model and/or Baseline Project Schedule.

17.4.2 CM@Risk must recommend, in conjunction with the Project Team, those additional surface and subsurface investigations that, in its professional opinion, are required to provide the necessary information for CM@Risk to construct the Project. These additional investigations, if agreed to be necessary by the Project Manager and the Design Professional, will be acquired by City and copies of the reports will be provided to CM@Risk.

17.4.3 CM@Risk must meet with the Project Team as required to review designs during their development. CM@Risk must familiarize itself with the evolving documents through pre- construction. CM@Risk must proactively advise the Project Team and make recommendations on factors related to construction costs, and concerns pertaining to the feasibility and practicality of any proposed means and methods, selected materials, equipment and building systems, and, labor and material availability. CM@Risk must furthermore advise the Project Team on proposed site improvements, excavation and foundation considerations, as well as, concerns that exist with respect to coordination of the Drawings and Specifications. CM@Risk must use established value analysis principles in recommending cost effective alternatives.

17.4.4 CM@Risk must routinely conduct constructability and bid-ability reviews of the Drawings and Specifications as necessary to satisfy the needs of the Project Team. The reviews must attempt to identify all discrepancies and inconsistencies in the Construction Documents especially those related to clarity, consistency, completeness and coordination of Work of Subcontractors and Suppliers.

17.4.4.1 CM@Risk must evaluate whether: (a) the Drawings and Specifications are configured to enable efficient construction; (b) design elements are standardized; (c) construction efficiency is properly considered in the Drawings and Specifications; (d) module/preassembly design is prepared to facilitate fabrication, transport and installation; (e) sequences of Work required by or inferable from the Drawings and Specifications are practicable; (f) the design has taken into consideration efficiency issues concerning access and entrance to the site, laydown and storage of materials, staging of site facilities, construction parking, and other similar pertinent issues; and (g) the design maintains continued operation of the existing City systems and maintains traffic on adjacent roadways. CM@Risk must also review the Drawings and Specifications to ensure that what is depicted therein can be constructed as designed and must promptly inform the Project Team of any issues.

17.4.4.2 CM@Risk must check cross-reference and complementary Drawings and sections within the Specifications and in general evaluate whether: (a) the Drawings and Specifications are sufficiently clear and detailed to minimize ambiguity and to reduce scope interpretation discrepancies; (b) named materials and equipment are commercially available and are performing well, or otherwise, in similar installations; (c) Specifications include alternatives in the event a requirement cannot be met in the field; and (d) in its professional opinion, the Project is likely to be subject to Differing Site Conditions.

17.4.4.3 The results of the reviews must be provided to Project Team in formal, written reports clearly identifying all reviewed documents and the discovered discrepancies and inconsistencies in the Drawings and Specifications with notations and recommendations made on the Drawings, Specifications and other documents. CM@Risk must meet with Project Team to discuss any findings and review reports.

17.4.4.4 CM@Risk's reviews must be from a Contractor's perspective, and though it will serve to eliminate/reduce the number of RFIs) and changes during the construction phase, responsibility for the Drawings and Specifications will remain with the Design Professional and not CM@Risk.

17.4.5 It is CM@Risk's responsibility to assist the Design Professional in ascertaining that, in CM@Risk's professional opinion, the Construction Documents are in accordance with applicable Laws, Regulations, or Legal Requirements, building codes, sound engineering principle's rules and regulations. If CM@Risk recognizes that portions of the Construction Documents are at variance with applicable laws, statutes, ordinances, building codes, sound engineering principle's rules and regulations, it must promptly notify the Project Team in writing, describing the apparent variance of deficiency. However, the Design Professional is ultimately responsible for the compliance of the Drawings and Specifications with those laws, statutes, ordinances, building codes, rules and regulations.

17.4.6 The Project Team will routinely identify and evaluate using value analysis principles and alternate systems, approaches, design changes that have the potential to reduce Project costs while still delivering a high quality and fully functional Project consistent with

the Project Program. If the Project Team agrees, CM@Risk in cooperation with the Design Professional, will perform a cost/benefit analysis of the alternatives and submit such in writing to the Project Team. City, through the Project Manager, will direct which alternatives will be incorporated into the Project. The Design Professional will have full design responsibility for the review and incorporation of CM@Risk suggested alternatives into the Drawings and Specifications. CM@Risk must analyze the costs and schedule impacts of the alternatives against the Baseline Cost Model and Schedule and provide a recommendation for the Project Team's consideration and City's approval prior to the establishment of the GMP.

17.5 **BASELINE COSTS MODEL, DETAILED COST ESTIMATES, AND SCHEDULE OF VALUES**

17.5.1 At the conclusion of the Master Planning and Programming, if required, CM@Risk will review all available information regarding the design and scope of the Project using CM@Risk's experience in performing similar work, knowledge of similar projects and current and projected construction costs and, based upon that review, must develop a Baseline Cost Model for review by the Project Team and approval by City. Once approved by City, the Baseline Cost Model will be continually referenced as detailed estimates are created as the design progresses throughout Pre-Construction until the final GMP for the entire Project is established. A final GMP for the entire Project must be established and approved by City prior to the start of construction. It is the responsibility of CM@Risk to ensure City has sufficient information to evaluate and approve a final GMP prior to the time necessary to start construction so construction can be completed within the Agreement Time. The Project Detailed Cost Estimate will be the best representation from CM@Risk of what the complete functional Project's construction costs will be as indicated by the most current available documents and will be constantly checked against the Baseline Cost Model. CM@Risk must communicate to the Project Team and assumptions made in preparing the Baseline Cost Model. The Baseline Cost Model must support CM@Risk's Detailed Cost Estimates and may be broken down initially as dictated by the available information, as required by City.

17.5.2 After receipt of the Design Professional's most current documents from certain specified pre- construction milestones, CM@Risk must provide a draft Detailed Cost Estimate including a detailed written report detailing any variances to the Baseline Cost Model and Baseline Project Schedule. The Design Professional and CM@Risk will reconcile any disagreements on the estimate to arrive at an agreed upon Detailed Cost Estimate for the construction costs based on the scope of the Project through that specified pre-construction milestone. Pre-Construction milestones applicable to this paragraph are: Master Planning and Programming, Schematic Design, 50% Design Development, 100% Design Development, and 50% Construction Drawings, If no consensus is reached, City will make the final determination. If the Project Team requires additional updates of the Detailed Cost Estimate beyond that specified in this paragraph, CM@Risk must provide the requested information in a timely manner.

17.5.3 If at any point the Detailed Cost Estimate submitted to City exceeds the previously accepted Baseline Cost Model or previously approved Detailed Cost Estimate agreed to as set forth in Section 17.5.2 above, CM@Risk must make appropriate recommendations to project Team on means/methods, materials, and or other design elements that it believes will reduce the estimated construction costs, such that it is equal to or less than the established Project Team's Baseline Cost Model.

17.5.4 Unless other levels of completion are agreed to in writing in the Construction Documents, at 50% Construction Drawings and included with the associated report, CM@Risk must also submit to the Project Team for review and approval a Schedule of Values that complies with the following requirements. The Schedule of Values must be based on City standard bid schedule and highlight significant variances from any previously submitted Schedule of Values. The Schedule of Values must be directly related to the breakdowns reflected in the Detailed Project Schedule and CM@Risk's Detailed Cost Estimate. In addition, the Schedule of Values must: (a) detail unit prices and quantity take-offs, (b) detail all other contingencies and unit price Work shown and specified in the detailed design documents.

17.5.5 CM@Risk is to track, estimate/price and address the Project Team's overall project cost issues that arise outside of the Baseline Cost Model and the latest approved Detailed Cost Estimate such as: City generated changes, Project Team proposed changes, alternate system analysis, constructability items and value engineering analysis. The system used to implement this process will be referred to as the Design Evolution Log. This is to be addressed between the Baseline Cost Model and the Master Planning and Programming Detailed Cost Estimate, and then (unless other levels of completion are agreed to in writing in the Construction Documents) between the Detailed Cost Estimates for each of the pre-construction milestones thereafter, Schematic Design, 50% Design Development, 100% Design Development, and 50% Construction Documents, and the bid packages for all Phases.

17.5.6 Upon request by City, CM@Risk must submit to City a cash flow projection for the Project based on the current updated/revised Detailed Project Schedule and the anticipated level of payments for CM@Risk during the design and construction phases. In addition, if requested by City and based on information provided by City, CM@Risk must prepare a cash flow projection for the entire Project based on historical records for similar types of projects to assist City in the financing process.

17.5.7 Construction Water. CM@Risk must estimate the quantity of water to be used and include the cost thereof in each Detailed Cost Estimate and GMP Proposal provided by City.

17.6 SUBCONTRACTOR AND MAJOR SUPPLIER SELECTIONS

17.6.1 There are two ways to select Subcontractors and major Suppliers prior to submission of a GMP Proposal: (1) qualifications-based selection; or (2) a combination of qualifications and price. Except as noted below, the selection of Subcontractors/Suppliers is the sole responsibility of CM@Risk. In any case, CM@Risk is solely responsible for the performance of the selected Subcontractors/Suppliers, and for compliance with the requirements of Title 34 of the Arizona Revised Statutes in the selection of a Subcontractors/Suppliers, to the extent applicable. CM@Risk must comply with its Subcontractor Selection Plan submitted with its Statement of Qualifications.

17.6.2 City may approve the selection of a Subcontractor(s) or Suppliers(s) based only on their qualifications when CM@Risk can demonstrate it is in the best interest of the Project. All Work that is performed, after such a qualifications-based selection, for a price that is negotiated by CM@Risk will be billed in accordance with the GMP for actual costs and may be subject to audit by City.

17.6.2.1 Qualifications based selection of a Subcontractor(s)/Supplier(s) should only occur prior to the submittal of the GMP Proposal.

17.6.2.2 If a Subcontractor/Supplier selection plan was submitted and agreed to by City, CM@Risk must apply the plan in the evaluation of the qualifications of a Subcontractor(s) or Supplier(s) and provide City with its review and recommendations.

17.6.2.3 CM@Risk must receive written City approval for each selected Subcontractor(s) and Supplier(s).

17.6.2.4 CM@Risk must negotiate costs for services/supplies from each Subcontractor/Supplier selected under this method.

17.6.3 All Work must be competitively bid unless a Subcontractor or Supplier was selected pursuant to Section 17.6.2 above.

17.6.3.1 CM@Risk must develop Subcontractor and Supplier interest, submit the names of a minimum of three qualified Subcontractors or Suppliers for each trade in the Project for approval by City and solicit bids for the various Work categories. If there are not three qualified Subcontractors/Suppliers available for a specific trade or there are extenuating circumstances warranting such, CM@Risk may request approval by City to submit less than three names. Without prior written notice to City, no change in the recommended Subcontractors/Supplies will be allowed.

17.6.3.2 If City objects to any nominated Subcontractor/Supplier or to any self-performed Work for good reason, CM@Risk must nominate a substitute Subcontractor/Supplier that is acceptable to City.

17.6.3.3 CM@Risk must distribute Drawings and Specifications, and when appropriate, conduct a Pre- Bid Conference with prospective Subcontractors and Suppliers.

17.6.3.4 If CM@Risk desires to self-perform certain portions of the Work, it must request to be one of the approved Subcontractor bidders for those specific bid packages. CM@Risk's bid will be evaluated in accordance with the process identified below. If events warrant and City concurs that it is necessary in order to ensure compliance with the Project Schedule and/or the most recent Detailed Cost Estimate, CM@Risk may be authorized to self-perform Work without bidding or rebidding the Work. When CM@Risk self-performs work without bidding, only the actual costs associated with performing the Work in accordance with the approved GMP will be billed and may be subject to audit by City.

17.6.3.5 CM@Risk must receive, open, record and evaluate the bids; provided, however, that if CM@Risk or one of its affiliates is bidding to self-perform the Work that is the subject of the bid, then the bids must be received, opened, recorded and evaluated by Project Manager instead of CM@Risk. Bids for each category of Work must be opened and recorded at a pre-determined time. The apparent low bidders must be interviewed to determine the responsiveness of their proposals. In evaluating the responsiveness of bid proposals CM@Risk, in addition to bid price, may consider the following factors: past performance on similar projects, qualifications and experience of personnel assigned, quality management plan, approach or understanding of the Work to be performed, and performance schedule to complete the Work. The final evaluation of Subcontractor/Supplier bids must be done with Project Manager in attendance to observe and witness the process. CM@Risk must resolve any Subcontractor/Supplier bid withdrawal, protest or disqualification in connection with the award at no increase in the Cost of Work.

17.6.4 CM@Risk will be required to prepare two different reports on the subcontracting process.

17.6.4.1 Within fifteen days after each major Subcontractor/Supplier bid opening process; CM@Risk must prepare a report for City's review and approval identifying the recommended Subcontractors/Supplier for each category of Work. The report must detail: (a) the name of the recommended Subcontractor/Supplier and the amount of the Subcontractor/Supplier bid for each sub-agreement; (b) the sum of all recommended Subcontractor/Supplier bids received; (c) and trade work and its cost that CM@Risk intends to self-perform, if any.

17.6.4.2 Upon completion of the Subcontractor/Supplier bidding process, CM@Risk must submit a summary report to City of the entire Subcontractor/Supplier selection process. The report must indicate, by bid process, all Subcontractors/Suppliers contacted to determine interest, the Subcontractors/Suppliers solicited, the bids received and costs negotiated, and the recommended Subcontractors/Suppliers for each category of Work.

17.6.5 The approved Subcontractors/Suppliers will provide a Schedule of Values with their bid proposals, which will be used to create the overall Project Schedule of Values.

17.6.6 If after receipt of sub-bids or after award to Subcontractors and Suppliers, City objects to any nominated Subcontractor/Supplier or to any self-performed Work without any reasonable basis, CM@Risk must nominate a substitute Subcontractor or Supplier, preferably if such option is still available, from those who submitted Subcontractor bids for the Work affected. Once such substitute Subcontractors and Suppliers are consented to by City, CM@Risk's proposed GMP for the Work or portion thereof must be correspondingly adjusted to reflect any higher or lower costs form any such substitution.

17.7 **GMP PROPOSAL**

17.7.1 When a GMP Proposal is submitted for a phase of the Work, the GMP will have a Detailed Cost Estimate of the Costs of the Work (as set forth in Section 15.2) in each phase of the Work that is being proposed plus the current estimate for all other Work. City will not approve the GMP for the phase of work without a total estimate for the complete Project. City may request a GMP Proposal for all or any portion of the Project and at any time during pre-construction. Any GMP Proposals submitted by CM@Risk must be based on and consistent with Baseline Cost Model and the current update/revised Detailed Cost Estimate at the time of the request and include any clarifications or assumptions upon which the GMP Proposal(s) are based.

17.7.2 A GMP Proposal for the entire Project will be the sum of the Cost of the Work, CM@Risk Fee, and General Conditions Cost. CM@Risk guarantees to complete the Project at or less than the final GMP Proposal amount plus approved Change Orders. CM@Risk will be responsible for any costs for expenses that would cause the Cost of the Work actually incurred, including the Construction Fee and General Conditions Costs, to exceed the GMP.

17.7.3 CM@Risk must prepare its GMP Proposal in accordance with City's request for GMP Proposal requirements based on the most current completed Drawings and Specifications at that time, which unless otherwise directed by City in writing, will be at 100% Construction Drawings. CM@Risk must mark the face of each document of each set upon which its GMP Proposal is based. These documents must be identified as the GMP Plans and Specifications. CM@Risk must send one set of those documents to the Project Manager, keep one set and return the third set to the Design Professional.

17.7.4 An updated/revised Detailed Project Schedule, Equipment Plan, and Schedule of Values

must be included in any GMP Proposal(s), all of which must reflect the GMP Plans and Specifications the Detailed Project Schedule must be shown in relationship to the Project Schedule and identify any variance to the Baseline Project Schedule. Any such Detailed Project Schedule updates/revisions must continue to comply with the requirements of Section 17.3.1 through 17.3.5.

17.7.5 GMP Proposals(s) Review and Approval

17.7.5.1 CM@Risk must meet with the Project Team to review the GMP Proposal(s) and the written statement of its basis. In the event the Project Team discovers inconsistencies or inaccuracies in the information presented, CM@Risk must make adjustments as necessary to the GMP Proposal.

17.7.5.2 If during the review and negotiation of GMP Proposals design changes are required, City may authorize and cause the Design Professional to revise the GMP Plans and Specifications to the extent necessary to reflect the agreed-upon assumptions and clarifications contained in the final approved GMP Proposal. Such revised GMP Plans and Specification will be furnished to CM@Risk. CM@Risk must promptly notify the Project Team in writing if any such revised GMP Plans and Specifications are inconsistent with the agreed upon assumptions and clarifications.

17.7.6 All portions of or items comprising the GMP Proposal are subject to audit by City, as deemed appropriate by City, including, without limitation, any based upon unit prices or Work to be self- performed by CM@Risk, or its affiliates.

17.8 **PAYMENT PROCEDURE FOR PRE-CONSTRUCTION SERVICES**

17.8.1 Requests for monthly payments by CM@Risk for Pre-Construction Services must be submitted monthly and must be accompanied by a progress report, detailed invoices and receipts, if applicable. Any requests for payment must include, as a minimum, a narrative description of the tasks accomplished during the billing period, a listing of any Deliverables submitted, and copies of any Subconsultants' requests for payment, plus similar narrative and listings of Deliverables associated with their Work. Payment for services negotiated as a lump sum will be made in accordance with the percentage of work completed during the preceding month.

17.8.2 In no event will City pay more than seventy-five (75%) of the Agreement Price until acceptance of ALL Pre-Construction Services and award of the final approved Construction Services Agreement for the entire Project by City Council. If CM@Risk does not prepare a GMP Proposal that is acceptable to City, or the GMP Proposal exceeds the City's Construction Budget, then CM@Risk understands and acknowledges that it will forfeit any right to receive the 25% of the Agreement Price being retained by City.

17.8.3 CM@Risk agrees that no charges or claims for costs or damages of any type will be made by it for any delays or hindrances beyond the reasonable control of City during the progress of any portion of Pre-Construction Services specified in this Agreement. Such delays or hindrances, if any, will be solely compensated for by an extension of time for such reasonable period and may be mutually agreed between the parties. It is understood and agreed, however, that permitting CM@Risk to proceed to complete any such Services, in whole or in part after the date to which the time of completion may have been extended, will in no way act as a waiver on the part of City of any of their respective legal rights herein.

17.8.4 No compensation to CM@Risk will be allowed contrary to Article I, Chapter I, Title 34 of the Arizona Revised Statutes.

17.8.5 If any service(s) executed by CM@Risk is abandoned or suspended in whole or in part, for a period of more than 180 days through no fault of CM@Risk, CM@Risk is to be paid for the services performed prior to the abandonment or suspension.

17.9 **SURVIVAL OF THE DESIGN SERVICES AGREEMENT, DUTIES, OBLIGATIONS AND WARRANTIES**

If the GMP Proposal is accepted by City and a Construction Agreement is entered into between City and CM@Risk, the duties, obligations and warranties of CM@Risk under the Pre- Construction Services Agreement survive and are incorporated into the resulting Construction Agreement.

SECTION 15 – APPENDICES

The following Appendices attached hereto are referenced in the General Conditions and are incorporated herein.

Appendix 1 – Policy Statement for Calculating Delays and Damages
Appendix 2 – Cost Reduction Incentive Proposals for Design Bid Build Agreements
Appendix 3 – Contractor's Affidavit Regarding Settlement of Claims
Appendix 4 – Forms of Performance Bond
Appendix 5 – Forms of Payment Bond
Appendix 6 – Dispute Resolution
Appendix 7 – Certificate of Completion
Appendix 8 – Construction Sign Detail
Appendix 9 – Cost of the Work (Applicable solely to Construction Manager at Risk and Job Order Contracting)
Appendix 10 Landscape Establishment Period
Appendix 11 Standard Form Construction Escrow Agreement

CALCULATING DELAYS AND DAMAGES

The purpose of this policy statement is to establish guidelines and procedures for negotiation between the Contractor and City of Chandler relating to compensation for delays pursuant to Arizona Revised Statutes (A.R.S.) 34-221(F). This policy statement contains notice requirements in addition to those set forth in the Agreement Documents, and will be the Agreement Provision contemplated by that statute.

NOTE: As used herein, the term "Engineer" will refer to the City of Chandler City Engineer or his/her designated representative. Nothing in this Policy Statement will be construed to void any provision in the Agreement which requires timely notice of delays or provides for arbitration or any other procedure for settlement or provides for liquidated damages.

I. TYPES OF DELAYS:

For the purposes of this document, there are essentially four types of delays encountered by City of Chandler Construction Contractors; excusable/compensable, excusable/non-compensable, non- excusable, and concurrent. Only delays that extend Agreement Completion Time set forth in the Agreement Document will be considered for issues relating to Agreement extensions or additional compensation. All other delays are considered to be activity delays and do not entitle the Contractor to either time extensions or additional compensation. Agreement Completion Time will be defined as the date set forth in Maricopa Association of Governments (MAG) Uniform Standard Specification Section 101 and as may be modified by the Agreement Documents.

A. Excusable/Compensable:

These are delays caused solely by the City's actions or inactions, are unreasonable under the circumstances, and which were not within the contemplation of the parties to the Agreement at or prior to the time of execution of the Agreement. Since the Contractor presumably has no control over the events causing the delay, he may be entitled to both Agreement time extensions and additional compensation for delay damages. Further, he/she may be entitled to additional compensation from the impact of that delay on other work. Examples of excusable/compensable (E/C) delays include: failure to properly locate an underground City-owned utility within 2 feet of the actual location; failure to relocate City-owned utilities far enough in advance of construction in an area where the Contractor is scheduled to work that it delays start or completion of the Contractor's regularly scheduled work; failure to provide City-furnished equipment or materials in a timely manner if required by the Agreement; failure to acquire necessary Right-of-Way or Public Utility Easements prior to the Contractor beginning Work in the area; failure to timely return Shop Drawings or other Agreement Submittals in accordance with the Agreement; unreasonable delay by the City in making decisions which affect critical activities; surveying errors when the City is contractually responsible for providing Project Surveying. This list is not meant to be all inclusive, but is intended merely as examples of the type of City action or inaction which can result in a Contractor's claim for additional time and compensation.

B. Excusable/Non-compensable:

These are delays over which neither the City nor the Contractor had control. Since both parties to the Agreement have been potentially damaged by the delay, but neither have caused it, only Time Extensions are warranted. Examples of excusable, non-compensable (E/N) delays include: unusually severe weather; fire; acts of God; failure of non-City owned utilities (SRP, CenturyLink, Cable TV, Southern Pacific Railroad, and Southwest Gas, etc.) to properly or timely locate accurately; failure of non-City owned utilities to relocate in advance of construction; the voluntary or involuntary filing for Bankruptcy protection by a Supplier or Subcontractor which causes the Supplier/Subcontractor to fail to meet a contractual deadline provided the Contractor can provide documentation that he/she executed the required Purchase Orders/Subcontract Agreements and received delivery schedules which, if met, would have eliminated the delay; delays as a result of an incomplete shutdown of a City or non-City owned utility main (the City does not guarantee a complete shutdown). This list also is not necessarily all inclusive but merely indicative of type and class of E/N delays.

C. Non-excusable/Non-compensable:

These are delays caused by the actions or inactions of Contractor or an officer, employee, agent, Subcontractor, Supplier or any other party for whom the Contractor is responsible. Since the Contractor has assumed responsibility for the risks associated with the events that caused the delay, he/she are not entitled to either time extensions or monetary delay damages. All non-excusable delays are also non-compensable. Examples of non- excusable, non-compensable (N/N) delays include: failure to perform by the Contractor, its Subcontractors and/or Suppliers (except as noted in section I.B above); failure to provide adequate labor, materials, and/or equipment on the Project; failure to perform contractually-required coordination with utilities, agencies and other Contractors; failure to notify the Engineer, in writing, of delay impacts within two working days, as required by MAG 104.2.3, or the next work day, as required by MAG 109.8.2; failure to timely submit Shop Drawings; failure to pothole or otherwise visually locate utilities sufficiently ahead of the Work to allow the Engineer to direct corrective action when necessary; delays due to retesting of previously failed work, re-inspection, and/or restaking resulting from faulty workmanship, poor quality control, or lack of compliance with Agreement Specifications. Again, this list is not necessarily all inclusive.

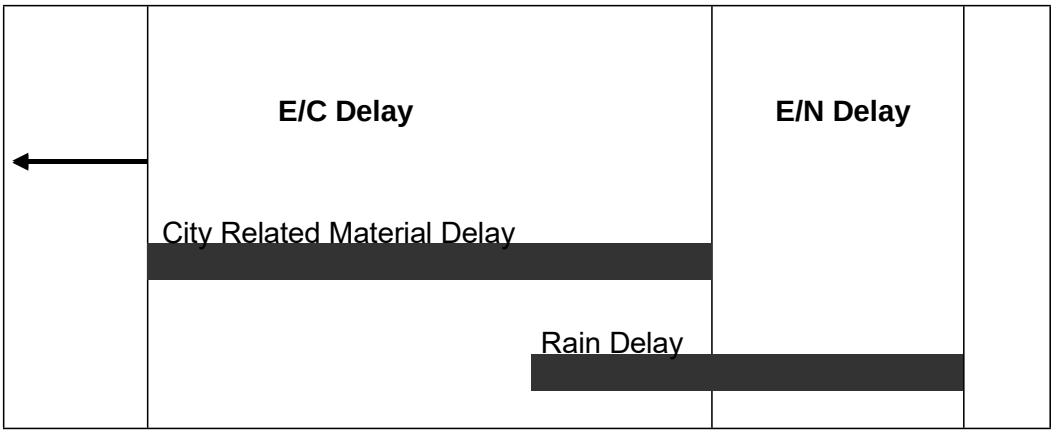
D. Concurrent:

When two or more delays occur simultaneously or overlap, each delay is analyzed separately to determine its impact on the overall project completion date based on when that delay started. Once again, only those delays which actually extend the Agreement completion time are considered as delays. The concurrent delay is considered an additional delay only to the extent it prolongs the delay to the Agreement Completion Time beyond the date that the one it is concurrent with had already delayed that date. For example, if two delays are concurrent, and one is five days long and the second is seven days long, the second concurrent delay will only extend the Agreement Completion Time by two days. The same method of analysis is

used when there are multiple concurrent delays. Only those extending the Project Completion Date are considered to be delays for the purposes of this policy. The portion of each concurrent delay that delays the completion of the work is classified in the same manner as described previously for individual delays and being either E/C, E/N or N/N.

An example of a concurrent delay is where the City delays furnishing material, but the Contractor could not have installed it anyway due to unusually severe weather. The effect of the first delaying activity will extend for the full duration and will be considered controlling on the Contractor's schedule. A subsequent, concurrent delay will thereafter only be considered to effect the project completion (if at all) once the first delaying activity has ceased to impact the project completion. In this case, if the unusually severe weather continued and delayed the work after the material was delivered, the first portion of the delay would be classified E/C (delay for material) and the second as E/N (delay due to unusually severe weather). Using the procedure set forth above, the entire concurrent portion would be considered E/C as shown in the chart which follows.

Example of a Concurrent Delay:



II. ANALYZING THE DELAY:

The Contractor must provide all documents required or requested by the Engineer to analyze the delay(s). It is important to understand that, prior to the delay analysis, delays and their impacts are alleged issues. The information the Contractor provides will be compared with the Inspector's Daily Log, Schedules and other available Project information and together they will support or refute that delays occurred and, if so, how they impact other work and the overall project completion. The Contractor's delay in providing these documents will be considered prima facie evidence that either the delay did not occur or it did not impact the Project Completion Date and any claim for time extension or damages will be denied.

The Engineer will accept delay analyses in CPM format, as these may demonstrate to his/her satisfaction whether or not Project Completion has been impacted by a specific event. If the Contractor chooses not to use CPM scheduling procedures, then the burden will be on the Contractor to prove to the Engineer's satisfaction that the Project Completion has been impacted. The procedures

below assume that the Contractor is using CPM scheduling methods. As a minimum the Contractor must provide the following materials to the Engineer:

A. As-Planned Schedule. The initial construction schedule, required by the Agreement Documents, will be considered the baseline schedule. It is to the Contractor's advantage that the As-Planned (baseline) Schedule be as detailed as possible in order for delays, as they occur, to be incorporated into the schedule in representative locations. It is also to the Contractor's advantage to use a computer software program to generate the schedule since updated schedules are required monthly by the Agreement Documents and since updated schedules are required to support delays and requests for additional compensation for delays. The As-Planned (baseline) Schedule must be presented in network format which clearly shows the interrelationships of the activities. The Contractor must also provide a printout of the activities showing early start, early finish, late start, late finish, duration and float. The activity list printout must also indicate predecessor and successor activities.

B. As-Built Schedules. The as planned (baseline) schedule must be updated with complete progress-to-date information (actualized) up to the date of the start of the alleged delay. Each updated schedule will serve as the as-built schedule for analyzing the alleged delay and provide a new baseline as-planned schedule for the next delay. This process must be repeated for each alleged delay as it occurs. In updating the baseline schedule, the alleged delay must be treated as an activity and inserted into the schedule as a predecessor to the impacted activity (ies). When an activity that has already started is impacted, it is preferable to divide this activity into two parts and show the impact affecting the second part. For schedules which incorporate a time line (or data date), the delay activity must be inserted at the time it actually occurred. Some software scheduling programs have a PAUSE-RESUME feature that can be used to facilitate the requirements. The updated schedule must also be accompanied by a listing of activities as with the baseline schedule. This activities list must contain the alleged delay as an activity showing the duration and the activities which are predecessors and successors to it. When computer generated schedules are used, the Contractor must provide, in electronic media format, the complete data files for the updated schedule that included the delay activity, preferably either in Suretrak or in Microsoft Project. Each electronic media must contain a label identifying the Project name, Contractor's name, program name and version number, data date and project finish date.

C. Other Documents: In order to determine the amount of the alleged delay and if it is compensable, the Contractor must provide all backup documentation relevant to the issue and as required by the Engineer. This documentation must include copies of such items as: purchase orders; delivery schedules; correspondence; memoranda of telephone calls; force account daily worksheets (initialed by the Inspector); payroll data; estimating (bid) worksheets; and any other materials which may be requested by the Engineer.

D. Procedure: Only after receipt of sufficient documentation will the Engineer analyze each alleged delay and determine if it is supported or refuted. If supported, the Engineer will determine if it is excusable or non-excusable, compensable or non-

compensable. If the Engineer determines that the delay did not affect the Project Completion, the as-planned schedule, which has been updated to the date of the alleged delay, must be revised to indicate this. If the Engineer determines the delay did occur but was N/N, then no time extension will be granted. It is imperative that an actualized schedule be submitted as soon as the occurrence of the alleged delay is known. In no event will the Contractor submit an actualized updated schedule later than 60 days after the occurrence of the alleged delay becomes known.

If the Engineer determines the delay did occur and was excusable but, due to a reason listed in section I.B. is non-compensable, he/she will determine the length of the E/N delay and prepare a Change Order to add that time to the Agreement. The Engineer's decision will be final.

If the Engineer determines the delay was excusable and compensable, he/she will determine the length of the E/C delay and proceed to review the Contractor's damage calculations in accordance with Section III. The Engineer will check the Contractor's calculations, review the backup documentation provided, and prepare a Change Order to cover both the additional compensation and the time extension. The Engineer's decision on both the time extension and additional compensation for the delay will be final.

If the issue involves a concurrent delay, the Engineer will analyze available data to determine the portions which are E/C, E/N, and/or N/N as described above. The Engineer will proceed to determine the length of E/C delay and verify the Contractor's delay damage calculations, if any are provided. Upon completion of this review, the Engineer will prepare a Change Order for the Contractor's review and signature. The Engineer's decision regarding excusable delay and additional compensation for the delay is final.

The amount of time the Engineer will require to analyze the alleged delay(s) will depend upon the Engineer's workload, the complexity of the delay analysis, availability of supporting data, extent of cooperation by the Contractor, and other factors beyond the Engineer's control. It is entirely possible other delay(s) may occur while the Engineer is analyzing particular claim for delay(s). The Engineer's failure to respond to the Contractor in a set period of time will not be used as the basis for a further delay claim or as justification for extending and existing delay claim. The time required for delay analysis by the Engineer will not be counted against the time allotted for processing Final Payment as required by (MAG Section 109.7(B)) or the release of retention and Final Payment as prescribed by A.R.S. Arizona Revised Statutes §34-221.

III. CALCULATING MONETARY DELAY DAMAGES:

Additional compensation for delay, when authorized by the Engineer, will be calculated in accordance with MAG Section 109.5 ACTUAL COST WORK with the following exceptions:

A. No additional compensation or other monetary damages will be awarded or paid for any loss of anticipated profits by the Contractor, Subcontractors or Suppliers.

B. No additional compensation or other monetary damages will be awarded for home office overhead or non-project general conditions of the Contractor, Subcontractors or Suppliers.

C. Equipment:

1. Contractor-owned equipment rate calculations must be computed in accordance with Section 109.04(D)(3), Arizona Department of Transportation "Standard Specifications for Road and Bridge Construction," 2008 or latest edition and as modified herein. Year and regional adjustment factors must be based on the most recent publications of the Rental Rate Blue Book for Construction Equipment, published by the Equipment Guide-Book Company, San Jose, CA, same as provided by ADOT and in print as of the date of alleged delay. In no event will the compensation for Contractor-owned equipment exceed the purchase price, including tax, paid by the Contractor for the equipment. Compensation will not be allowed for small tools or equipment that show a daily equipment rental rate of less than $5.00 per day or for unlisted equipment that has a value of less than for hundred dollars ($400.00).
2. For leased and rented equipment or equipment not otherwise listed in the Blue Book, rental contracts, or other supporting data will be used to establish the hourly rate. No hourly operating expense will be allowed for delay on standby equipment. In no case will equipment be considered for rental which exceeds the hourly rate for the first eight hours and the daily rate divided by eight for all additional hours as compared with similar equipment listed in the Blue Book. The hourly standby rate must be computed as the lesser of:

    a. Dividing the monthly invoice or rental value by 176 hours per month when the equipment is utilized by the Contractor for more than three weeks;

    b. Dividing the monthly invoice or rental value by 40 hours per week when the equipment is utilized by the Contractor for more than three days.

    In no event will compensation be paid for delay at more than 8 hours per day or 40 hours per week.

3. Except for vehicles used by supervisory personnel, all equipment will be paid at the "standby" rate during the delay period.

4. Equipment brought solely to mitigate the delay (such as pumps, light plants, etc.) may be paid in accordance with ADOT section 109.04(D) (3).

5. The Blue Book regional adjustment will apply in determining rental rates.

D. Material:

Allowable material charges may include, in addition to material incorporated in the

work material used to mitigate the delay such as barricades, plates, shoring, cold mix, etc. Except in emergencies the Contractor will not employ such material without the prior written approval of the Engineer.

E. Labor:

1. Except for Supervisory Personnel (Superintendent, Project Engineer, and Foremen), labor wages will not be paid after the first one-half day of claimed delay or impact. It is expected the Contractor will reassign or layoff unneeded employees.

2. For Foreman wages to be included, that Foreman must have been actively employed on the project prior to the commencement of the delay and be directly responsible for the activity being delayed.

3. Labor burden must be actual amounts incurred but must not exceed the ADOT approved rate.

F. All costs (equipment, material, and labor) must be substantiated by the City of Chandler's Daily Work Reports.

IV. DOCUMENT REQUIRED FOR CLAIM ANALYSIS:

For purposes of reviewing the Contractor's request for additional compensation, it will be required that the Contractor submit the following listed information. Information requested must be prepared on forms which are substantially similar to the City of Chandler's Daily Work Report form, a copy of which is attached as an exhibit.

A. Labor:

For each employee, laborer, and foreman, for which compensation is requested: Name, classification, dates of work performed, daily hours worked, total hours worked, labor rates, labor burden rates, overtime or premium time charges. Further, the Contractor must make available for inspection and copying to the Engineer the following listed documentation.

1. Certified payroll reports for the period of work claimed.
2. Accounting of Fringe Benefits – certified by a CPA.
3. Contractor's and Subcontractor's daily field reports and daily diaries.

B. Materials:

For all materials for which compensation is requested, if any, total quantities of materials, prices, extensions and transportation costs must be provided on a daily basis. Further, the Contractor must make available for inspection and copying to the Engineer the following listed documentation.

1. Invoices for all materials incorporated.
2. Weigh tickets.
3. Purchase orders.

4. Delivery schedules.
5. Quotes or proposals from manufacturers or supplier.
6. Freight bills, Bills of Lading, or other documentation to show transportation costs.
7. Restocking charges-invoices from vendor.

C. Equipment:

For all equipment, the Contractor must provide the Engineer with the designation, dates and hours of usage, dates and hours of standby, if any, daily hours, total hours, rental rates and extension for each unit of equipment and machinery. Rental rates will be as established in Section III. Further, the Contractor must make available for inspection and copying to the Engineer the following listed documentation.

1. Owned:
   a. Purchase contracts(s).
   b. Depreciation schedule(s).
   c. Invoices for fuel, lube, repairs and other operating costs.

2. Leased:
   a. Lease agreement with hourly rate, overtime rate, double shift rate, etc.
   b. Invoices or other documentation showing hours worked on a daily basis.

D. Subcontractors/Owner-Operators:

In the event the Contractor submits a claim which includes requests for compensation for Subcontractors of Owner-Operators, the same information requested of the Contractor must be provided by the Subcontractor/Owner-Operator. Further, the Contractor must make available for inspection and copying to the Engineer the following listed documentation.

1. Bid/Estimate work sheets and/or spreadsheets.
2. Subcontract Agreements or Agreements with Owner-Operator.
3. All invoices and billing statements received from the Subcontractor/Owner-Operator which relates to the amount requested.

E. Miscellaneous:

Further, the Contractor must make available for inspection and copying to the Engineer the following listed documentation.

1. Evidence of payment for bonds and insurance premiums (MAG 109.5.6).
2. Taxes – unless the Contractor can show otherwise, taxes are reimbursable at 65% of the total cost (less bonds and insurance).

V. TIME LIMIT ON SUBMISSIONS OF CLAIM FOR DELAY OR IMPACT DAMAGES:

No claims for delay or impact damages will be considered or allowed more than 45 days after the event or occurrence which the Contractor claims gives rise to the delay or impact. In no event will a

claim for delay or impact damages be considered after submission by the Contractor of the Final Payment Request.

COST REDUCTION INCENTIVE PROPOSALS FOR DESIGN BID BUILD AGREEMENTS

The Contractor may submit to the Engineer proposals for modifying the Plans, Specifications, or other requirements of the Agreement for the sole purpose of reducing the total cost of Project construction. The proposals must not impair in any manner the essential functions or characteristics of the project; including but not limited to service life, economy of operations, ease of maintenance, desired appearance, compatibility with existing or planned equipment, standardization of systems, or design and safety standards.

It must not be inferred from this Policy that the Engineer is required to consider any proposal submitted.

Submissions that propose changes in the basic design of a bridge, propose changes in pipe line size, materials, bedding conditions, pipe specifications; or that propose any change in pavement design will not be considered.

Proposals submitted pursuant to this Policy will be identified as Cost Reduction Incentive Proposals. They must be submitted in writing and, at a minimum, contain the following.

1. Complete the attached or similar cost reduction incentive proposal form.

2. A description of both the existing Agreement Requirements for performing the work and the proposed changes.

3. All Engineering Drawings and computations necessary for the thorough and expeditious evaluation.

4. An itemization of the existing Agreement Requirements that must be changed if the Proposal is adopted and a recommendation as to the manner in which the change should be made.

5. A detailed estimate of the cost of performing the Work under the existing Agreement and under the proposed changes, including the cost of developing and implementing the changes.

6. The Agreement items affected by the proposed changes and any variations in quantities resulting from the changes.

7. An objective estimate of any effects the proposal will have on collateral cost to the City, costs of related items, and cost of maintenance and operation.

8. A statement as to the effect that the Proposal will have on the time for the completion of the Project.

9. A statement as to the time by which a Change Order adopting the Proposal must be executed or when the Engineer must have given verbal approval.

Proposals will be processed expeditiously; however, the City will not be liable for any delay in acting upon any Proposal nor for any failure to accept any Proposal pursuant to this Special Provision.

The Engineer will be the sole judge of the acceptability of a Proposal and of the estimated net savings in construction costs from the adoption of all or any part of the Proposal. The Contractor will be notified in writing by the Engineer as to whether his/her Proposal has been accepted. The decision by the Engineer is final.

When the City deems such action to be appropriate, it reserves the right to require the Contractor to share equally in the cost to the City of investigating, evaluating, and processing the proposal as a condition for the consideration of such Proposal. Such cost must be shared whether the Proposal is accepted or rejected. When such a condition is imposed, the City will estimate these costs and the Contractor must indicate his acceptance thereof in writing. Such acceptance will authorize the City to deduct the Contractor's share of the costs from any monies due or that may become due to the Contractor under the Agreement.

If the Contractor's Proposal is accepted in whole or in part, the necessary Agreement Modifications and Agreement Price Adjustments will be affected by the execution of a Change Order which will specifically state that it is executed pursuant to this Special Provision.

The Contractor must continue to perform the work in accordance with the requirements of the Agreement until a Change Order incorporating the Proposal has been executed or until he/she has been given verbal approval by the Engineer that his/her Proposal has been accepted. If the Change Order has not been executed or he/she has not been given verbal approval on or before the date specified on the attached cost reduction incentive proposal form or on or before such other date as the Contractor may have subsequently specified in writing, the Proposal may be deemed to be rejected.

The executed Change Order will incorporate the changes in the Plans, Specifications, or other requirements of the Agreement which are necessary to permit the Proposal, or such part of it which has been accepted, to be put into effect, and will include any condition – upon which the City's approval thereof is based, if such approval is conditional. The executed Change Order may also extend the time for the completion of the Agreement if such an extension has been deemed to be warranted by the Engineer as a result of his evaluation of the Proposal.

The executed Change Order will also establish the estimated net savings in the cost of performing the Work attributable to the Proposal effectuated by the Change Order. In determining the net savings, the right is reserved to the Engineer to disregard the Agreement bid prices if, in his/her judgment, such prices do not represent a fair measure of the value of the Work to be performed or to be deleted. The net savings will be established by determining the Contractor's cost of performing the Work, taking into account his/her cost of developing the Proposal and implementing the change, and reducing this amount by any ascertainable collateral costs to the City. The executed Change Order may provide that the Contractor be paid 50 percent of the estimated net savings amount.

The executed Change Order may also provide for the adjustment in Agreement prices. Agreement prices may be adjusted by subtracting the City's share of the accrued net savings.

The amount specified to be paid to the Contractor in the executed Change Order which effectuates a Cost Reduction Proposal will constitute full compensation to the Contractor for the Cost Reduction

Proposal and the performance of the work thereof pursuant to the said Change Order.

Upon acceptance of a Cost Reduction Incentive Proposal, any restrictions imposed by the Contractor on its use or on disclosure of the information will become void, and the City thereafter will have the right to use all or any part of the Proposal without obligation or compensation of any kind to the Contractor.

COST REDUCTION INCENTIVE PROPOSAL FORM

TO: CIP City Engineer

FROM:

PROJECT NAME: **WATER RECLAMATION FACILITY IMPROVEMENTS PHASE 3**

CITY PROJECT NUMBER: **WW2401.401**

DATE:

Summary of Change (Brief description of proposed change including advantages and disadvantages):

ESTIMATED COST SUMMARY (Attached detailed estimate):

A.	Original Cost:	$
B.	Proposed Cost:	$
C.	Construction Savings (A-B):	$
D.	Gross Savings (Included OH %, Bond %)	$
E.	Contractor Implementing	$
F.	City Implementing Cost:	$
	Reduction in Agreement Price (C+D-E-F) x 50%:	$

Date by which a Change Order must be issued so as to obtain maximum cost reduction:

CITY OF CHANDLER, ARIZONA
PUBLIC WORKS & UTILITIES DEPARTMENT

CONTRACTOR'S AFFIDAVIT REGARDING SETTLEMENT OF CLAIMS

_____, Arizona
Date _____

Project Name: Water Reclamation Facility Improvements Phase 3
City Project No.: WW2401.401

To the City of Chandler, Arizona

Gentlemen:

This is to certify that all lawful claims for materials, rental of equipment and labor used in connection with the construction of the above project, whether by subcontractor or claimant in person, have been duly discharged.

The undersigned, for the total compensation of $_____, as set out in the final pay application, as full and complete payment under the terms of the Agreement, hereby waives and relinquishes any and all further claims or right of lien under, in connection with, or as a result of the above described project. The undersigned further agrees to indemnify and save harmless the City of Chandler against any and all liens, claims or liens, suits, actions, damages, charges and expenses whatsoever, which said City may suffer arising out of the failure of the undersigned to pay for all labor performances and materials furnished for the performance of said installation.

Signed and dated at _____, this _____ day of _____ 20_____.

_____
CONTRACTOR

By _____

STATE OF ARIZONA)
) SS
COUNTY OF MARICOPA)

The foregoing instrument was subscribed and sworn to before me this _____ day of _____ 20 _____.

_____
Notary Public

_____
My Commission Expires

PERFORMANCE BOND

ARIZONA STATUTORY PERFORMANCE BOND
PURSUANT TO TITLES 28, 34, AND 41, ARIZONA REVISED STATUTES
(Penalty of this bond must be 100% of the Agreement amount)

KNOW ALL MEN BY THESE PRESENTS THAT:_____

(hereinafter "Principal"), and _____ (hereinafter "Surety"), a corporation organized and existing under the laws of the State of _____ with its principal office in the City of _____, holding a certificate of authority to transact surety business in Arizona issued by the Director of Insurance pursuant to Title 20, Chapter 2, Article 1, as Surety, are held and firmly bound unto _____(hereinafter "Obligee") in the amount of _____ (Dollars) ($_____), for the payment whereof, Principal and Surety bind themselves, and their heirs, administrators, executors, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, the Principal has entered into a certain written Agreement with the Obligee, dated

the _____ day of _____, 20___ for construction of **WW2401.401, Water Reclamation Facility Improvements Phase 3** which Agreement is hereby referred to and made a part hereof as fully and to the same extent as if copies at length herein.

NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION IS SUCH, that if the Principal faithfully performs and fulfills all the undertakings, covenants, terms, and conditions of the Agreement during the original term of the Agreement and any extension of the Agreement, with or without notice of the Surety, and during the life of any guaranty required under the Agreement, and also performs and fulfills all the undertakings, covenants, terms, conditions, and agreements of all duly authorized modifications of the Agreement that may hereafter be made, notice of which modifications to the Surety being hereby waived, the above obligation is void. Otherwise it remains in full force and effect.

PROVIDED, HOWEVER that this bond is executed pursuant to the provisions of Title 34, Chapter 2, Article 2, Arizona Revised Statutes, and all liabilities on this bond will be determined in accordance with the provisions of Title 34, Chapter 2, Article 2, Arizona Revised Statutes, to the same extent as if it were copied at length in this Agreement.

The prevailing party in a suit on this bond may recover as part of the judgment reasonable attorney fees that may be fixed by a judge of the court.

Witness our hands this _____ day of _____, 20__.

_____
PRINCIPAL SEAL

_____
AGENT OF RECORD

By _____

_____
SURETY SEAL

_____
AGENT ADDRESS

PAYMENT BOND

ARIZONA STATUTORY PAYMENT BOND
PURSUANT TO TITLES 28, 34, AND 41, OF THE ARIZONA REVISED STATUTES
(Penalty of this Bond must be 100% of the Agreement amount)

KNOW ALL MEN BY THESE PRESENTS THAT:_____

(hereinafter "Principal"), as Principal, and _____(hereinafter "Surety"), a corporation organized and existing under the laws of the State of _____ with its principal office in the City of _____, holding a certificate of authority to transact surety business in Arizona issued by the Director of the Department of Insurance pursuant to Title 20, Chapter 2, Article 1, as Surety, are held and firmly bound unto _____ (hereinafter "Obligee") in the amount of _____ (Dollars) ($_____), for the payment whereof, the Principal and Surety bind themselves, and their heirs, administrators, executors, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, the Principal has entered into a certain written Agreement with the Obligee, dated the _____ day of _____, 20___ for construction of **WW2401.401, Water Reclamation Facility Improvements Phase 3** which Agreement is hereby referred to and made a part hereof as fully and to the same extent as if copied at length herein.

NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION IS SUCH, that if the Principal promptly pays all moneys due to all persons supplying labor or materials to the Principal or the Principal's subcontractors in the prosecution of the work provided for in said Agreement, this obligation is void. Otherwise it remains in full force and effect.

PROVIDED, HOWEVER that this bond is executed pursuant to the provisions of Title 34, Chapter 2, Article 2 Arizona Revised Statutes, and all liabilities on this bond will be determined in accordance with the provisions, conditions and limitations of Title 34, Chapter 2, Article 2, Arizona Revised Statutes, to the same extent as if it were copied at length in this Agreement.

The prevailing party in a suit on this bond may recover as part of the judgment reasonable attorney fees that may be fixed by a judge of the court.

Witness our hands this _____ day of _____, 20__.

_____
PRINCIPAL SEAL

_____
AGENT OF RECORD

By _____

_____
SURETY SEAL

_____
AGENT ADDRESS

DISPUTE RESOLUTION

A. INFORMAL DISPUTE RESOLUTION

The parties to the Agreement agree that time is of the essence in relation to performance of the Agreement and completion of the Project, therefore any and all disputes in relation to the Agreement will initially be referred to the Project Manager, the Design Professional Representative and/or the Contractor Representative as applicable to the dispute, for immediate resolution. If, after good faith efforts to reach a resolution, none is reached, any party to the dispute may submit the dispute to the Dispute Resolution Representative ("DRR") process set forth below, which is intended to be an expedited process.

B. DISPUTE RESOLUTION REPRESENTATIVE ("DRR") PROCESS

1. The Parties under the Agreement agree that all claims and disputes in relation to the Project which are not resolved in the ordinary course of the Project ("Claim" or "Claims") will, as a prerequisite to any mediation, or litigation of the Claim, first be submitted for resolution between the designated Dispute Resolution Representatives of the Parties as set forth herein (the "DRR Process").

2. The DRR Process will be initiated through service of a DRR Notice as set forth below:

   a. For claims by the Contractor or the Design Professional, the DRR Process will be initiated by the party asserting the claim serving written notice on the City setting forth in detail: (i) the basis for the claim; (ii) the effect of the Claim upon the construction of, and/or Project Schedule for, the Project;
   (iii) the specific relief requested, the amount thereof, and how such was calculated; (iv) the parties involved in the Claim, and how they are involved; (v) the specific Agreement provisions in the Agreement Documents (including, if applicable, drawings and specifications) which apply; and (vi) efforts made to date to resolve the Claim.

   b. For claims by the City, the DRR process will be initiated by the City providing written notice to the other parties of the basis and amount of its claim, the parties involved in the Claim, and how they are involved, the provisions in the Agreement Documents that apply, and the relief requested.

   c. The DRR Notice will be hand-delivered and e-mailed to the other parties' designated Dispute Resolution Representatives.

3. The other parties will respond in writing to the DRR Notice ("DRR Response") within ten (10) calendar days of receipt of the DRR Notice, setting forth those items set forth in the DRR Notice that they agree with, dispute, and/or have questions concerning. The DRR Response will be hand-delivered and e-mailed to the other parties' Dispute Resolution Representatives.

4. The designated Dispute Resolution Representatives for the Parties to the claim will then meet as soon as possible and in any event within twenty (20) calendar days of submission of the DRR Notice (regardless of whether a DRR Response has been submitted by all parties involved in the dispute), at a mutually agreed upon time and place, to attempt to resolve the Claim based upon the DRR Notice and DRR Response.

5. At any time after the first meeting required above, either party may terminate the DRR Process by written notice to the other party.

6. The parties may agree, in writing, to extend or modify the time limits or other provisions of the DRR process in relation to a specific pending Claim.

7. Unless otherwise designated in a written notice to the other parties, the City and the representatives of the Contractor and of the Design Professional will act as the parties' designated Dispute Resolution Representatives.

8. If a resolution of the Claim is reached, that resolution must be set forth in writing and must be signed by the Parties' designated Dispute Resolution Representative. If the resolution involves a change in any Agreement Documents, the Agreement Price, the Project Schedule, or any other change requiring a written Change Order or Amendment, the parties must execute an appropriate written Change Order or Amendment pursuant to the terms of the Agreement Documents.

C. MEDIATION

1. Unless extended by written agreement of the parties involved in the dispute, any Claim not resolved through the DRR process set forth above within five (5) calendar days after the meeting required under B (4) above, or after the DRR is terminated pursuant to B (5) above, whichever is earlier, will be submitted to mediation as a condition precedent to litigation by either party.

2. The mediation will be commenced by written demand upon the other party for mediation. If the parties cannot agree upon a mediator within ten (10) calendar days of the written demand, either party may make a request to the Civil Presiding Judge of the Maricopa County Superior Court to appoint a mediator. The mediation will occur within forth (40) calendar days of the written demand for mediation, unless the parties agree, in writing, to a longer period of time.

3. The qualifications for the mediator will be that he/she be: (a) an experienced mediator, arbitrator or litigator of construction disputes; and (b) having engaged a significant portion of his/her time involving and/or resolving construction disputes for at least the past five (5) years.

4. Each party will provide to the other party and the mediator all of the information and documentation required under B(1) and (2) above, together with any additional information and documentation which the party believes relevant. In addition, the parties will exchange, and provide to the mediator such additional memoranda, information and/or documentation, as the

mediator may request, and in the form and at such times, as the mediator may direct.

5. The parties will share the mediator's fee and any filing fees equally. The mediation will be held in Chandler, Arizona, unless another location is mutually agreed upon. Agreements reached in mediation will be specifically enforceable in any court having jurisdiction thereof.

D. LITIGATION

Any claim arising out of or related to the Agreement, except Claims relating to aesthetic effect and except those claims waived as provided for in the Agreement Documents, must be resolved through litigation in the Maricopa County, Arizona Superior Court.

CITY OF CHANDLER, ARIZONA
PUBLIC WORKS & UTILITIES DEPARTMENT

CERTIFICATE OF COMPLETION

PROJECT NAME:	**WATER RECLAMATION FACILITY IMPROVEMENTS PHASE 3**		
CITY PROJECT NO.:	**WW2401.401**		
If Federally Funded:			
FEDERAL NO.:		**ADOT NO:**	

(*This section to be completed by Prime*)
I HEREBY CERTIFY THAT ALL GOODS AND/OR SERVICES REQUIRED BY CITY OF CHANDLER FOR THIS PROJECT HAVE BEEN DELIVERED IN ACCORDANCE WITH THE AGREEMENT DOCUMENTS AND BID SPECIFICATIONS AND ALL ACTIVITIES REQUIRED BY THE AGREEMENTOR UNDER THE AGREEMENT HAVE BEEN COMPLETED AS OF THE COMPLETION DATE LISTED HERE:

FINAL ACCEPTANCE DATE:	

PRIME CONTRACTOR:

FIRM NAME:			
PRINCIPAL:			
TITLE:			
SIGNATURE:		DATE:	

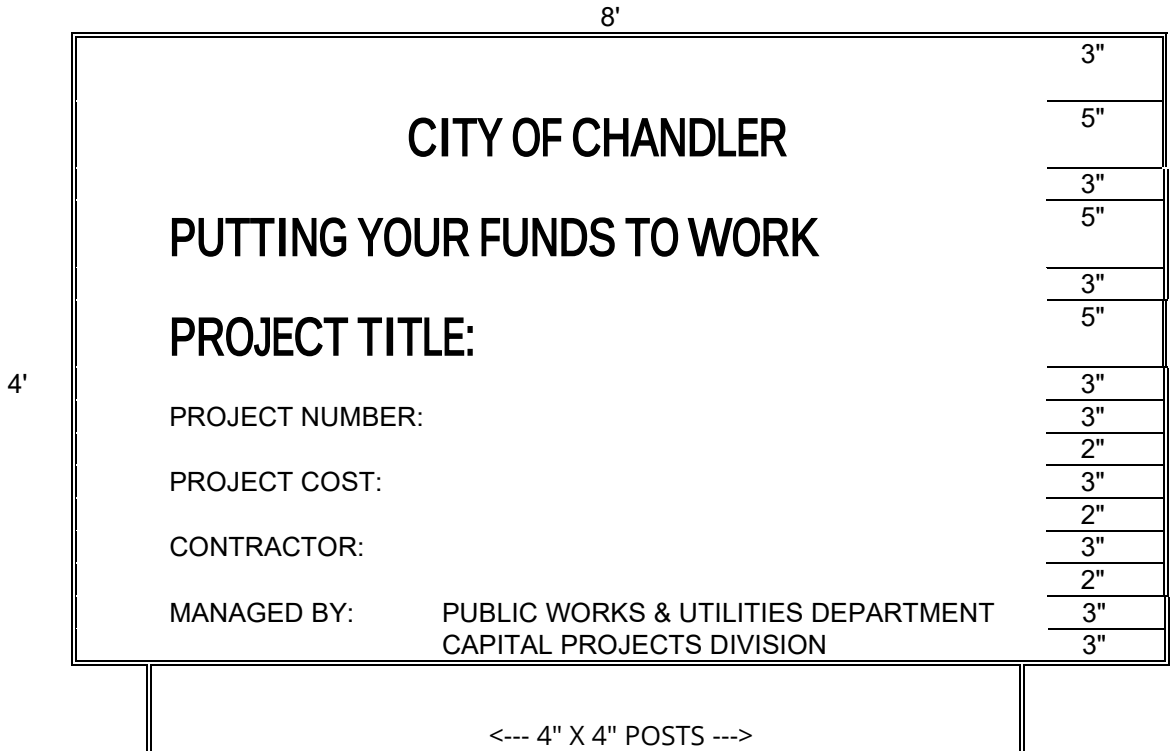
CERTIFIED BY [*INSERT NAME AND TITLE OF PARTY THAT OVERSEES CONSTRUCTION*]:

FIRM NAME:			
SIGNATURE:		DATE:	

PROJECT ACCEPTED BY CITY OF CHANDLER:

NAME:			
SIGNATURE:		DATE:	

CONSTRUCTION SIGN DETAIL



NOTES:

SIGN(S) MUST BE FURNISHED AND ERECTED PRIOR TO COMMENCEMENT OF CONSTRUCTION. POSTS MUST BE ANCHORED A MINIMUM OF TWO FEET INTO THE GROUND. BOTTOM OF SIGN MUST BE A MINIMUM OF FOUR FEET ABOVE THE GROUND.

TYPICAL PROJECT IDENTIFICATION SIGN FOR GENERAL PROJECTS MUST BE NON-REFLECTORIZED GREEN BACKGROUND, AND NON-REFLECTORIZED WHITE LETTERS AND NUMERALS.

ONE SIGN MUST BE ERECTED FOR BUILDINGS AND OTHER LIMITED AREA SINGLE SITES. FOR MULTIPLE SITES, ONE SIGN MUST BE ERECTED AT EACH SITE.

FOR LINEAR PROJECTS ONE HALF MILE OR LONGER, PLACE ONE SIGN AT EACH END OF THE PROJECT.

COST OF THE WORK

(APPLICABLE SOLELY TO CONSTRUCTION MANAGER AT RISK AND JOB ORDER CONTRACTING)

SECTION 1 – COSTS TO BE REIMBURSED

1.1 Cost of the Work

The term Cost of the Work will mean costs necessarily incurred by Contractor in the proper performance of the Work. Such costs must be at rates not higher than the standard paid at the place of the Project except with prior consent of City. The Cost of the Work will include only the items set forth in this Section 1.

1.2 Labor Costs

1.2.1 Wages of construction workers directly employed by the Contractor to perform the construction of the Work at the site or, with City's approval, at off-site workshops. Cost to be reimbursed will be the actual wages paid to the individuals performing the work.

1.2.2 Wages or salaries of the Contractor's supervisory and administrative personnel when stationed at the site with City's approval. No Contractor personnel stationed at the Contractor's home or branch offices will be charged to the Cost of the Work. Non-field office based Contractor management and support personnel are expected to provide service and advice from time to time throughout the job and his/her time devoted to Project matters is considered to be covered by the Contractor's Fee.

1.2.3 Wages and salaries of Contractor's supervisory or administrative personnel who would normally be stationed at the field office in accordance with Section 1.2.2 but who become engaged, at factories, workshops or on the road, in expediting the production or transportation of materials or equipment required for the Work, but only for that portion of his/her time required for the Work. Employee bonuses and/or costs associated with Employee Stock Ownership Plans ("ESOP") will not be considered reimbursable labor or labor burden costs and will be considered non-reimbursable costs considered to be covered by the Contractor's Fee.

1.2.4 Costs paid or incurred by Contractor for taxes, insurance, contributions, assessments and benefits required by law or collective bargaining agreements and, for personnel not covered by such agreements, customary benefits such as sick leave, medical and health benefits, holiday, vacations and pensions, provided such costs are based on wages and salaries included in the Cost of the Work under Subparagraphs 1.2.1 through 1.2.3.

1.2.4.1 Cost of the Work will include the actual net cost to Contractor for worker's compensation insurance attributable to the wages chargeable to the Cost of Work per this Agreement. The actual net cost of worker's compensation must take into consideration all cost adjustments due to experience modifiers, premium discounts, policy dividends, retrospective rating plan premium adjustments, assigned risk pool rebates, any applicable weekly maximums, etc. Contractor may charge an estimated amount for worker's compensation insurance costs, but will make appropriate cost adjustments to actual costs within 45 days of receipt of actual cost adjustments from the insurance carrier.

1.2.4.3 Overtime wages paid to salaried personnel (if approved in advance in writing by City) will be reimbursed at the actual rate of overtime pay paid to the individual. No time charges for overtime hours worked on the Project will be allowed if the individual is not paid for the overtime worked.

1.2.4.4 Any overtime premium or shift differential expense to be incurred by Contractor for hourly workers will require City's advance written approval before the incremental cost of the overtime premium or shift differential will be considered a reimbursable cost. If the Contractor is required to work overtime as a result of an inexcusable delay or other coordination problems caused by the Contractor or anyone he/she is responsible for, the overtime premium and/or shift differential expense portion of the payroll expense and related labor burden costs will be considered as cost not to be reimbursed.

1.2.4.5 Reimbursable labor burden costs will be limited to payroll taxes, worker's compensation insurance, the employer's portion of union benefit costs for union employees working on the Project, and the actual verifiable fringe benefit costs incurred by Contractor for non-union individuals working on the Project subject to the following maximum percentages for the following reimbursable non-union fringe benefit costs. The following maximums (as a percentage of reimbursable actual wages by individual) will apply for each of the following types of fringe benefit costs specifically attributable to each of the non-union personnel working on the Project:

- Medical Insurance, Dental, Life & AD&D Insurance: 12.00%
- Holiday, vacation and other paid time not worked: 10.00%
- Pension Plan Contributions to Vested Employee Account, Simplified Employee Pension Plans, or 401K matching plans (Note: ESOP related costs are covered by the Contractor Fee) 10.00%

For non-union personnel, no other fringe benefit costs (other than the three specific categories listed immediately above, will be considered reimbursable Cost of Work. Any labor burden costs that are in excess of the amounts considered reimbursable or are otherwise not considered reimbursable under the terms of this agreement are intended to be covered by the Contractor Fee.

1.3 Subcontract Costs

1.3.1 Payments made by Contractor to Subcontractors in accordance with the requirements of the subcontracts.

1.3.2 For Scope of Work Bid Packages typically performed by Subcontractors, Contractor may "self- perform" such work on an actual cost basis subject to an agreed upon Guaranteed Maximum Price for the "self-performed work". The Contractor must, unless agreed to by City in writing, bid his/her proposed guaranteed Maximum Price for the work to be "self-performed" against at least three other interested trade Contractors. All savings under any such Subcontract for "self-performed work" must be applied to reduce the Cost of Work under the Agreement and the Guaranteed Maximum Price. For purposes of defining "self-performed work" subject to this provision, any division of Contractor, or any separate Contractor or Subcontractor that is partially owned or wholly owned by the Contractor or any of his/her employees or employee's relatives will be considered a related party entity and will be subject to this provision regarding "self-performed work". No self-performed work will

be allowed to be performed on a Fixed Price basis.

1.3.3 Contractor (with respect to its Suppliers, Subcontractors and all lower tier Subcontractors) must provide City advance written notice and must obtain City's approval for any proposed Subcontract Change Order, Material Purchase Order, or other financial commitment in an amount in excess of $5,000 prior to placing such order or entering into such agreement (regardless of whether or not any such commitment will affect the prime Agreement Guaranteed Maximum Cost). It is agreed that sums applicable to any Subcontract Change Order, Purchase Order or other financial commitment entered into in violation of the above notice and approval requirement will not be included in the amounts owning to Contractor, Subcontractors or Suppliers whether as Costs of the Work or as reasonable termination costs in the event of termination.

1.4 Costs of Material and Equipment Incorporated in the Completed Construction

1.4.1 Costs, including transportation and storage, of materials and equipment incorporated or to be incorporated in the completed construction.

1.4.2 Costs of materials described in the preceding Subparagraph 1.4.1 in excess of those actually installed to allow for reasonable waste and spoilage. Unused excess materials, in any, will become City's property at the completion of the Work or, at City's option, may be sold by the Contractor. Any amounts realized from such sales must be credited to City as a deduction from the Cost of Work.

1.4.3 Proceeds from the sale of recyclable materials, scrap, waste, etc. will be credited to job cost.

1.5 Costs of Other materials and Equipment, Temporary Facilities and Related Items

1.5.1 Costs, including transportation and storage, installation, maintenance, dismantling and removal of materials, supplies, temporary facilities, machinery, equipment and hand tools not customarily owned by construction workers, that are provided by the Contractor at the site and fully consumed in the performance of the Work; and cost (less salvage value) of such items if not fully consumed, whether sold to others or retained by Contractor. Cost for items previously used by Contractor will mean fair market value.

1.5.2 Rental charges for temporary facilities, machinery, equipment, and hand tools not customarily owned by construction workers that are provided by Contractor at the site, whether rented from Contractor or others, and costs of transportation, installation, minor repairs and replacements, dismantling and removal thereof. Rates and quantities of equipment rented will be subject to City's prior written approval.

1.5.2.1 The Projected usage for each piece of equipment to be rented for use on the Project and the estimated total rentals must be considered by Contractor before the piece of equipment is rented so that an appropriate rent versus buy decision can be made. Purchased equipment must be considered "job owned". At the completion of the Project, Contractor must transfer title and possession of all remaining job-owned equipment to City, or Contractor may keep any such equipment for an appropriate fair market value credit to job cost, which will be mutually agreed to by City and Contractor.

1.5.2.2 Each piece of equipment to be rented must have hourly, daily, weekly and monthly rates and

the most economical rate available will be reimbursed based on the circumstances of actual need and usage of the piece of equipment while it is stationed at the jobsite. When the piece of equipment is no longer needed for the work, no rental charges will be reimbursed if the piece of equipment remains at the jobsite for the convenience of Contractor.

1.5.2.3 Equipment Rental Rates

1.5.2.3.1 Compensation for equipment used on the Project will be paid in accordance with the Equipment Plan submitted by Contractor in the accepted GMP Proposal and no payments will be made in excess of the rates set forth in the Equipment Plan, or actual documented costs, whichever is less.

1.5.2.3.2 All equipment rental rates and costs are subject to City's right to audit when submitted as part of Equipment Plan and/or at any time during the Project.

1.5.2.4 The aggregate rentals chargeable for each piece of Contractor owned tools or equipment must not exceed 50% of the fair market value of such equipment at the time of its commitment to the Work. The original purchase price and date of purchase of the equipment will be documented with a copy of the purchase invoice for the piece of equipment. Such aggregate limitations will apply and no further rentals will be charged even if a piece of equipment is taken off the job and is later replaced by a similar piece of equipment. For purposes of computing the aggregate rentals applicable to aggregate rental limitations, rental charges for similar pieces of equipment will be combined if the pieces of equipment were not used at the same time.

1.5.2.5 Fair market value for used material and equipment as referred to in the Agreement Documents will mean the estimated price a reasonable purchaser would pay to purchase the used material or equipment at the time it was initially needed for the job. Note: This is usually lower than the price a reasonable purchaser would pay for similar new construction material or construction equipment.

1.5.2.6 All losses resulting from lost, damaged or stolen tools and equipment will be the sole responsibility of Contractor, and not City, and the cost of such losses will not be reimbursable under the Agreement.

1.5.2.7 Contractor will be required to maintain a detailed equipment inventory of all job-owned equipment (either purchased and charged to job cost or job-owned through aggregate rentals) and such inventory must be submitted to City each month. For each piece of equipment, such inventory should contain at a minimum (1) original purchase price or acquisition cost (2) acquisition date (3) approved Fair Market Value at the time the piece of equipment was first used on the job and (4) final disposition.

1.5.2.8 All costs incurred for minor maintenance and repairs will be reimbursed at actual cost. Such costs include routine and preventative maintenance, minor repairs and other incidental costs. Repairs and/or replacement of a capital nature are considered to be covered by the rental rates. Major repairs and overhauls are not considered routine and ordinary; consequently such costs are not reimbursable and are intended to be covered by the rental rates.

1.5.3 Costs of removal of debris from the Site.

1.5.4 Costs of document reproductions, facsimile transmissions and long-distance telephone calls, postage and parcel delivery charges, telephone service at the site and reasonable petty cash expenses of the site office.

1.5.5 That portion of the reasonable expenses of Contractor's personnel incurred while traveling in discharge of duties connected with the Work.

1.5.5.1 No travel expenses will be reimbursed to Contractor's representatives unless Project related travel required them to travel to a destination more than 100 miles from the Project location. Any travel involving airfare will require advance written approval by an authorized City's representative.

1.5.6 Costs of materials and equipment suitably stored off the site at a mutually acceptable location, if approved in advance by the City.

1.5.7 Reproduction costs will be the actual costs of reproduction subject to a maximum of five cents ($.05) per square foot for prints and a maximum of five cents ($.05) per 8 ½ by 11-inch page for offset print or photo copied agreement documents, specifications, etc. Telephone costs will be the actual costs paid to the third party telephone company for the field office telephone.

1.6 Miscellaneous Costs

1.6.1 That portion of insurance and bond premiums that can be directly attributed to the Agreement. The City will reimburse Contractor for contractually required bond at time of first pay application for GMP and Cost-Based Agreements upon receipt of proof of payment from the Contractor. If the Contractor completes Work for less than the Agreement Price, Contractor must credit the City a pro- rated amount for the unused portion of the bond payment

1.6.1.1 Contractor's actual cost for insurance will be considered to be included within the Maximum limit for General Conditions Costs. All premiums for any insurance and bonds required for the Project must reflect the net actual costs to Contractor after taking into consideration cost adjustments due to experience modifiers, premium discounts, policy dividends, retrospective rating plan premium adjustments, assigned risk pool rebates, refunds, etc.

1.6.1.2 The amount to be reimbursed to Contractor for all contractually required insurance will be actual costs not to exceed a total of 2% of the Agreement Value, unless Contractor establishes to City's satisfaction that the actual cost is higher and City agrees to such actual higher cost in writing. If Contractor's cost of contractually required insurance is greater than the amount agreed to be reimbursed per this Agreement Provision, the difference will be considered to be covered by the Contractor's Fee. The City will reimburse Contractor for contractually required insurance on a monthly basis for GMP and Cost-Based Agreements. If Contractor can demonstrate substantial savings by paying for all insurance in advance, the City may agree to reimburse all insurance costs at time of first pay application for GMP and Cost-Based Agreements with proof of payment from Contractor.

1.6.2 Sales, use or similar taxes imposed by a governmental authority that are related to the Work.

1.6.3 Fees and assessments for the building permit and for other permits, licenses and inspections for which Contractor is required by the Agreement Documents to pay.

1.6.4 Fees of laboratories for tests required by the Agreement Documents, except those related to defective or nonconforming Work and which do not fall within the scope of ¶ 1.7.3 below.

1.6.5 Royalties and license fees paid for the use of a particular design, process or product required by the Agreement Documents; the cost of defending suites or claims for infringement of patent rights arising from such requirement of the Agreement Documents; and payments made in accordance with legal judgments against Contractor resulting from such suites or claims and payments of settlements made with City's consent. However, such costs of legal defenses, judgments and settlements must not be included in the calculation of the Contractor's Fee or subject to the Guaranteed Maximum Price.

1.6.6 Data processing costs related to the Work. However, any such data processing costs will be limited to the cost of personal computer hardware used at the field office in the normal day to day administration, management and control of the Project. The aggregate charges for any such hardware must not exceed the Fair Market Value of the hardware at the time it was brought to the field office. If the total charges for any particular piece of hardware reach an amount equal to the Fair Market Value, that particular piece of hardware must be turned over to City whenever it is no longer needed for the Project. If Contractor elects to keep the particular piece of hardware, the job costs must be credited with a mutually agreeable amount which will represent the Fair Market Value of the particular piece of hardware at the time it was no longer needed for the job. Software or other costs associated with the use of computer programs will not be considered to be a reimbursable cost and will be considered to be covered by the Contractor's Fee.

1.6.7 Deposits lost for causes other than Contractor's negligence or failure to fulfill a specific responsibility to City as set forth in the Agreement Documents.

1.6.8 Legal, mediation and arbitration costs, including attorneys' fees, other than those arising from disputes between City and Contractor, reasonably incurred by Contractor in the performance of the Work and with City's prior written approval; which approval will not be unreasonably withheld.

1.6.9 Expenses incurred in accordance with Contractor's standard personnel policy for relocation and temporary living allowances of personnel required for the Work, if pre-approved by City in writing. If City authorizes the reimbursement of relocation costs, the reimbursable relocation expenses will be limited to a maximum of $50,000 per person. Any relocation cost incurred by Contractor in excess of the amount reimbursed by City will be considered to be covered by the Contractor's Fee.

1.7 Other Costs and Emergencies

1.7.1 Other costs incurred in the performance of the Work if and to the extent approved in advance in writing by City.

1.7.2 Costs due to emergencies incurred in taking action to prevent threatened damage, injury or

loss in case of an emergency affecting the safety of persons and property.

1.7.3 Costs of repairing or correcting damaged or nonconforming Work executed by Contractor, Subcontractors or Suppliers, provided that such damaged or nonconforming Work was not caused by negligence or failure to fulfill a specific responsibility of Contractor and only to the extent that the cost of repair or correction is not recoverable by Contractor from insurance, sureties, Subcontractors or Suppliers.

1.8 Related Party Transactions

1.8.1 The term "related party" will mean a parent, subsidiary, affiliate or other entity having common ownership or management with Contractor; any entity in which any stockholder in, or management employee of, Contractor owns any interest in excess of ten percent in the aggregate; or any person or entity which has the right to control the business or affairs of Contractor. The term "related party" includes any member of the immediate family of any person identified above.

1.8.2 If any of the costs to be reimbursed arise from a transaction between Contractor and a related party, Contractor must notify City in writing of the specific nature of the contemplated transaction, including the identity of the related party and the anticipated cost to be incurred, before any such transaction is consummated or cost incurred. If City, after such notification, authorizes in writing the proposed transaction, then the cost incurred will be included as a cost to be reimbursed, and Contractor must procure the Work, equipment, goods or service from the related party, as a Subcontractor. If City fails to authorize the transaction, Contractor must procure the Work, equipment, goods or service from some person or entity other than a related party.

SECTION 2 – COSTS NOT TO BE REIMBURSED

2.1 The Cost of Work must not include:

2.1.1 Salaries and other compensation of Contractor's personnel stationed at Contractor's principal office or offices other than the site office, except as specifically provided in Subparagraphs 1.2.2 and 1.2.3.

2.1.2 Expenses of Contractors' principal office and offices other than the site office.

2.1.3 Overhead and general expenses, except as may be expressly included in Section 1.

2.1.3.1 Costs of Contractor's home office computer services or other outside computer processing services will be considered overhead and general expense. Accordingly, Contractor should not plan to perform any such computer related services or alternatives at the field office when such services or functions can be performed at Contractor's home or branch offices, or other outside service locations.

2.1.4 Contractor's capital expenses, including interest on Contractor's capital employed for the Work.

2.1.5 Rental costs of machinery and equipment, except as specifically provided in subparagraph 1.5.2.

2.1.6 Except as provided in Subparagraph 1.7.3 of the Agreement, costs due to the negligence or failure to fulfill a specific responsibility of Contractor, Subcontractors and Suppliers or anyone directly or indirectly employed by any of them or for whose acts of them may be liable.

2.1.7 Any cost not specifically and expressly described in Section 1.

2.1.8 Costs, other than costs included in Change Orders approved by City that would cause the GMP to be exceeded.

SECTION 3 – DISCOUNTS, REBATES, REFUNDS AND SAVINGS

3.1 Cash discounts obtained on payments made by Contractor will accrue to City if (1) before making the payment, Contractor included them in an Application for Payment and received payment therefore from City, or (2) City has deposited funds with Contractor with which to make payments; otherwise, cash discounts will accrue to Contractor. Trade discounts, rebates, refunds and amounts received from sales or surplus materials and equipment will accrue to City, and Contractor must make provisions so that they can be secured.

3.1.1 Cost of the Work will be credited with all insurance policy discounts, performance and payment bond rebates or refunds, refunds or return premiums from any Subcontractor default insurance, refunds or rebates from any Contractor controlled insurance programs applicable to the Project, merchandise rebates of any nature, refunds of any nature, insurance dividends; and a portion of any volume rebates or free material credits earned with purchase of material or other goods and services charged to the job.

3.1.2 "Cash" discounts which may accrue to Contractor will be limited to a maximum of 1.5% of invoice cost. Any portion of "Cash" discounts greater than 1.5% will automatically accrue to City if Contractor is eligible to take advantage of the discounts.

3.2 Amounts that accrue to City in accordance with the provisions of Paragraph 3.1 will be credited to City as a deduction from the Cost of the Work.

3.3 Any and all savings on the GMP, or any separately guaranteed items comprising the GMP, will belong to City, subject to any express right in the Agreement for Contractor to share in savings. Savings are subject to City's right to audit, and may be audited separately.

SECTION 4 – GENERAL CONDITIONS COSTS

4.1 General Conditions Costs may include, but are not limited to, the following types of costs incurred by Contractor during construction of the Work to the extent they are reimbursable Costs of the Work as delineated above: payroll costs for Work conducted at the site, payroll costs for the superintendent and full-time general foremen, payroll costs for management personnel resident and working on the site workers not included as direct labor costs engaged in support (e.g. loading/unloading, clean-up, etc.), administrative office personnel, costs of offices and temporary facilities including office materials, office supplies, office equipment, minor expenses, utilities, fuel, sanitary facilities and telephone services at the site, costs of liability insurance premiums not included in labor burdens for direct labor

costs, costs of bond premiums, costs of consultants not in the direct employ of Contractor or Subcontractors, fees for permits and licenses.

4.2 General Conditions Costs may be paid on a percentage of the Agreement Price or on a lump/stipulate sum basis as set forth in the Agreement. All costs included in the General Conditions Costs will not be separately invoiced to or paid by City.

4.3 The total amount of General Conditions Costs for the Work may be divided by the number of days allowed for performance of the Work, to determine a fixed daily rate for General Conditions Costs that may be used in computing the General Conditions Costs allocated to any period of time, or for any adjustments in the General Conditions Costs agreed to in writing by City.

LANDSCAPE ESTABLISHMENT PERIOD

Section 1 – Description and General

Contractor is in direct control of work performed under the Landscape Establishment Period. If work is subcontracted, a representative of the Contractor will be present at the site of the work for all hours that the subcontractor works. Subcontracting of Landscape Establishment work will be permitted for weed eradication with herbicides, because of special licensing. A licensed temporary service may be used to supply labor to Contractor if Contractor has received approval from City Representatives. Contractor will submit the required subcontract documentation.

Contractor must provide adequate personnel to accomplish the required maintenance of the plant materials at intervals acceptable to City Representatives.

If not healthy at the end of the maintenance period, the maintenance must be continued until the plant material is approved by City.

1.1 Time and Schedule

Unless otherwise expressly agreed to in writing by City, the Landscape Establishment Period will be per General Conditions Section 6.5.4.

1.2 Planted Stock and Seeding Establishment

1.2.1 Tree planting and staking must be per City of Chandler Standard Detail C-801.

1.2.2 All trees will stand erect on their own without stakes when brought to this site. If the tree cannot stand on its own when nursery stakes are removed, the tree will be removed and replaced.

1.3 Pre-Emergent Herbicide and Weed Control

1.3.1 Contractor will provide three applications of an approved pre-emergent herbicide on all unpaved areas of the project, as directed by City Representatives, to control weed growth in all areas of the project. The number of applications may be increased as directed by the City Representative, and at no additional cost to City, if the City Representative deems additional applications are required to control weed growth.

1.3.2 Application sequence will be approved in advance by City. The first application of pre-emergent will be completed prior to the application of Decomposed Granite and will be included with the cost of the Decomposed Granite as specified and part of the Construction Phase portion of work. The second application of pre-emergent will be completed after installation of the Decomposed Granit and no later than half-way through the Landscape Establishment Period. The third and final application of pre-emergent will be applied 15 days prior to completion of the Landscape Establishment portion of the project. The second and third pre-emergent applications will be included with the cost of Landscape Establishment. Watering will be completed in accordance with the manufacturer's recommendations, as included and as related to each application.

1.3.3 The pre-emergent herbicide will be applied in accordance with the Technical Specifications and the recommendations of the pre-emergent herbicide manufacturer, as approved by City Representatives.

1.3.4 The control of weeds will be accomplished by the use of herbicides. Manual removal of weeds will be required, after herbicides have taken affect.

1.3.5 Contractor is responsible for the removal and disposal of all trash and debris that during the Landscape Establishment Period. Contractor will keep the project in a neat and orderly manner during the duration of the Landscape Establishment Period.

1.4 Water

The water used during Landscape Establishment to properly maintain the plant material will be furnished by City, at designated sources from within the project limits, at no charge to Contractor. Contractor will be responsible for all equipment, materials and labor necessary to load, transport and unload water for watering purposes.

1.5 Plant Material Replacements

The plant material replacement will be considered as included in the work for Landscape Establishment, and will be made at no charge to the City.

1.5.1 Shrub and Plant Replacement - During the second half of the Landscaping Establishment period, Contractor will provide, where required, plant replacements as follows:

Original Size	**Replacement Size**
1 gallon	5 gallon
5 gallon	15 gallon
15 gallon	24-inch box
36-inch box	48-inch box

1.5.2 Tree Replacement – During the second half of the Landscape Establishment Period, Contractor will provide plant material replacements for existing plants that die as follows:

Existing Plant Material Sizes	**Replacement Size**
Trees:	
2-inch Caliper	24-inch box
4-inch Caliper	36-inch box
6-inch Caliper and greater	54-inch box
Shrubs:	
All Existing Shrubs	15 gallon

1.6 Measurement and Payment

See Technical Specifications for Measurement Payment provisions.

CONSTRUCTION ESCROW AGREEMENT
(In Lieu of Retention)
City of Chandler Project No. WW2401.401

THIS AGREEMENT ("Escrow Agreement") is made as of Date by and between the City of Chandler, an Arizona municipal corporation ("Owner") and Contractor Name, an Business Org Type ("Contractor") and Bank Name, a national banking association ("Escrow Agent").

RECITALS

A. Owner and Contractor entered into a Construction Contract dated Agreement Effective Date ("Construction Contract") for the City of Chandler Water Reclamation Facility Improvements Phase 3 Construction Project No. WW2401.401 ("Project").

B. Arizona Revised Statutes ("A.R.S.") § 34-221 requires a 10% retention of progress payments to ensure Contractor's performance.

C. Contractor has requested to deposit substitute securities in lieu of retention, and Owner has agreed, subject to the terms of this Escrow Agreement.

AGREEMENT

1. Deposit of Securities.

1.1. Contractor will deposit with Escrow Agent concurrently with the submission of a payment request qualified securities (as defined in A.R.S. § 34-221(C)(5)) ("Securities") in an amount at least equal to the required retention percentage of the payment request. These Securities must be accompanied with an assignment of securities in the same amount in the form attached as Exhibit "A" (collectively "Escrowed Funds"). The Escrowed Funds will be held in a dedicated account for the benefit of Owner.

1.2. Each month Bank will furnish Contractor a statement that shows the Escrowed Funds transactions and current balance as of the last day of the preceding month. Contractor must include this monthly statement with Contractor's payment request submitted to City.

2. Owner's Sole Right to Release Escrowed Funds.

2.1. Unilateral Release: Notwithstanding any other provision, Escrow Agent is authorized to release any portion of the Escrowed Funds to Owner upon receipt of a written demand signed by the Owner's representative, certifying that the Contractor has failed to fulfill contractual obligations, or is in breach, or that a dispute exists regarding the Project. **No consent or signature from the Contractor is required.**

2.2. Final Completion Release: The Escrowed Funds will only be released to Contractor upon final completion, acceptance of the work by the Owner, and submission of all final Project documents, as determined solely by the Owner.

3. Deposit of Additional Securities. If the market value of the Escrowed Funds falls below 10% of all approved or pending Project payment requests, the Contractor will, within 10 days of notice, deposit additional Securities to restore the 10% value. Contractor's failure to do so constitutes a material breach of the Construction Contract.

4. Interest Earnings. Interest earned on the Escrowed Funds may be paid to Contractor as provided in A.R.S. § 34-221. If Escrowed Funds are released to the Owner due to Contractor's breach and such Escrowed Funds are insufficient to hold Owner harmless for Contractor's breach, any and all accrued interest may also be released to Owner to satisfy any deficiency.

5. Escrow Fees. All fees, costs, and expenses of the Escrow Agent to establish and maintain the escrow account will be paid exclusively by Contractor.

6. Disputed Work/Withholding. In the event of a dispute between Owner and Contractor, the Owner may direct the Escrow Agent to withhold a maximum of 150% of the estimated cost to remedy defective work or settle third-party claims.

7. Governing Law. This Escrow Agreement will be governed by the laws of the State of Arizona.

8. Construction Contract; Conflict in Terms. The terms and conditions of the Construction Contract are incorporated into and made a part of this Escrow Agreement by this reference. If there is a conflict or ambiguity created by or that arises between the Construction Contract and this Escrow Agreement, the terms and conditions of the Construction Contract prevail and control.

Remainder of page left blank intentionally

DATED THIS _____ day of _____, 2026.

"CONTRACTOR"
McCarthy Building Companies, Inc.

_____
Signature Date

_____
Print Name

_____
Title

_____
Signer Email Address

"ESCROW AGENT"
BANK NAME

_____
Signature Date

_____
Print Name

_____
Title

_____
Signer Email Address

"CITY"
City of Chandler, Arizona

_____
CIP City Engineer

APPROVED AS TO FORM:

_____
City Attorney

ATTEST:

_____
City Clerk Seal

Exhibit "A"
ASSIGNMENT OF SECURITIES IN LIEU OF TEN PERCENT RETENTION
SECURITY DESCRIPTION: Escrow Account
ACCOUNT NO.: Escrow Account #

Archer Western Construction, LLC, an Arizona corporation, hereinafter referred to as "Assignor", having been awarded a construction contract in connection with City of Chandler's Construction Project No. WW2401.401, and desiring to take advantage of A.R.S. Sec. 34-221 and assign certain securities in lieu of ten percent (10%) retention of the contract proceeds as required by statute, hereby assigns to the CITY OF CHANDLER, an Arizona municipal corporation, hereinafter referred to as "Assignee", all of the Assignor's right, title and interest in and to the above identified securities up to the sum of $_____.

This assignment shall remain in force and effect until the construction project identified above is completed and accepted by Assignee, at which time Assignee shall release all of its interest in the assignment.

"ASSIGNOR"
Contractor Name

By: _____

Title: _____

RECEIPT AND WAIVER

The undersigned financial institution hereby acknowledges to the CITY OF CHANDLER, an Arizona municipal corporation, that it has received written notice from Assignor Contractor Name, a Business Org Type, of the assignment to the CITY OF CHANDLER of the above-identified securities in the amount of $Dollar Amount, held in Account No. Escrow Account #. The undersigned financial institution further hereby waives any and all rights or powers of set-off of said financial institutions against the CITY OF CHANDLER, in relation to the above-identified securities. The undersigned financial institution further warrants to the CITY OF CHANDLER that it has on deposit the securities described in the foregoing assignment and in the amount assigned.

"Financial Institution"
Bank Name

By: _____

Title: _____

EXHIBIT C

TECHNICAL SPECIFICATIONS

Chandler + Arizona
Where Values Make The Difference

CITY OF CHANDLER

WATER RECLAMATION FACILITIY IMPROVEMENTS

PHASE 3 PROJECT

VOLUME 2 OF 5

TECHNICAL SPECIFICATIONS

FOR CONSTRUCTION

City Project No. WW2401.201

Wilson Engineers Project No. 24-020

APRIL 2026







WILSON
ENGINEERS



TECHNICAL SPECIFICATIONS

TABLE OF CONTENTS FOR
CITY OF CHANDLER
WRF IMPROVEMENTS PHASE 3 PROJECT
COC PROJECT NO. WW2401.201
WILSON PROJECT NO. 24-020

DIVISION 1 - GENERAL REQUIREMENTS

01010	SUMMARY OF WORK
01012	PLANT OPERATION DURING CONSTRUCTION
01013	ENGINEERING SERVICES
01040	COORDINATION
01050	FIELD ENGINEERING AND SURVEYING
01090	REFERENCE STANDARDS AND ABBREVIATIONS
01202	PROGRESS MEETINGS
01300	SUBMITTALS
01310	PROGRESS SCHEDULE
01380	CONSTRUCTION PHOTOGRAPHS
01400	QUALITY CONTROL
01410	TESTING
01412	STORMWATER POLLUTION PREVENTION PLAN AND PERMIT
01414	EARTHMOVING AND DUST CONTROL
01416	SPECIAL INSPECTIONS
01451	TESTING LABORATORY SERVICES FURNISHED BY OWNER
01500	CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS
01640	MATERIALS AND EQUIPMENT
01650	STARTING OF SYSTEMS
01660	FIELD TEST OF EQUIPMENT
01700	CONTRACT CLOSEOUT
01710	CLEANING
01715	TESTING OF HYDRAULIC STRUCTURES
01720	RECORD DOCUMENTS
01730	OPERATION AND MAINTENANCE DATA
01750	SPARE PARTS AND MAINTENANCE MATERIAL
01800	EQUIPMENT SCHEDULE
01821	INSTRUCTION OF OPERATIONS AND MAINTENANCE PERSONNEL

DIVISION 2 - SITE CONSTRUCTION

02050	DEMOLITIONS
02100	SITE PREPARATION
02150	SHORING
02315	EARTHWORK, EXCAVATION, AND BACKFILL
02318	CRUSHED STONE AND GRAVEL

02319 RIPRAP
02371 FILTER FABRIC FOR RIPRAP CHANNELS
02500 ASPHALT PAVEMENT
02580 PAVEMENT MARKINGS
02751 PORTLAND CEMENT CONCRETE PAVING

DIVISION 3 – CONCRETE

03100 CONCRETE FORMWORK
03101 QUAKEWRAP SPIRE PANEL SYSTEM
03200 CONCRETE REINFORCEMENT
03251 CONCRETE JOINTS
03252 ANCHORAGE IN CONCRETE
03300 CAST-IN-PLACE CONCRETE
03400 PRECAST CONCRETE
03600 GROUT
03930 CONCRETE REPAIR AND REHABILITATION

DIVISION 4 – MASONRY

04220 SINGLE-WHYTE UNIT MASONRY

DIVISION 5 – METALS

05120 STRUCTURAL STEEL
05500 METAL FABRICATIONS
05501 MISCELLANEOUS METAL FABRICATIONS
05510 METAL STAIRS
05522 ALUMINUM RAILINGS
05532 ALUMINUM GRATING AND CHECKER PLATE
05581 FLOOR ACCESS HATCH COVERS
05600 FLAT PANEL COVERS

DIVISION 6 – WOOD AND PLASTICS

06410 ARCHITECTURAL WOOD CASEWORK
06611 FIBERGLASS REINFORCED PLASTIC FABRICATIONS

DIVISION 7 – THERMAL AND MOISTURE PROTECTION
07210 THERMAL INSULATION
07620 SHEET METAL FLASHING AND TRIM
07900 JOINT SEALANTS

DIVISION 8 – DOORS AND WINDOWS

08110 HOLLOW METAL FRAMES
08113 HOLLOW METAL DOORS AND FRAMES
08211 FLUSH WOOD DOORS
08331 OVERHEAD COILING DOORS
08360 ACCORDION FOLDING DOORS
08381 FLEXIBLE STRIP DOORS
08710 DOOR HARDWARE
08800 GLAZING

DIVISION 9 – FINISHING

09050 COMMON WORK RESULTS FOR FLOORING PREPARATION
09260 GYPSUM BOARD ASSEMBLIES
09300 TILING
09511 ACOUSTICAL CEILINGS
09680 TILE CARPETING
09900 PAINTING
09900.1 INTERIOR PAITING
09920 COATING SYSTEMS

DIVISION 10 – SPECIALTIES

10400 EQUIPMENT IDENTIFICATION PLATES
10440 FIRE PROTECTION SPECIALTIES
10811 BIRD CONTROL DEVICES

DIVISION 11 – EQUIPMENT

11218 MAGNETIC DRIVE SEALLESS END SUCTION PUMPS
11295 HYDRAULIC VALVES
11310 VERTICAL TURBINE PUMPS
11313 LOW-FLOW PROPELLER (IMLR) PUMPS
11335 SECONDARY CLARIFIER MECHANISM
11375 AERATION SYSTEMS
11400 DISC FILTER SYSTEM
11520 PROJECTION SCREENS

DIVISION 12 – FURNISHINGS

12360 COUNTERTOPS

DIVISION 13 – SPECIAL CONSTRUCTION

13213 PRECAST POLYMER CONCRETE TRENCH INSERT
13300 METAL BUILDING SYSTEMS
13400 ABOVEGROUND FUEL STORAGE TANK
13447 ELECTRIC MOTOR ACTUATORS

DIVISION 14 – HOISTING AND CONVEYING EQUIPMENT

14610 DAVIT CRANE
14630 HOISTS, TROLLEYS, AND MONORAILS

DIVISION 15 – MECHANICAL

15010 BASIC MECHANICAL REQUIREMENTS
15050 PIPING SYSTEMS
15051 BURIED PIPING INSTALLATION
15052 EXPOSED PIPING INSTALLATION
15061 DUCTILE IRON PIPE
15062 STEEL PIPE
15064 COPPER PIPE
15065 THERMOPLASTIC PIPE AND ACCESSORIES
15066 STAINLESS STEEL PIPE
15067 FIBERGLASS REINFORCED PLASTIC PIPE AND ACCESSORIES
15068 REINFORCED CONCRETE PIPE
15120 PIPING SPECIALTIES AND ACCESSORIES
15140 SUPPORTS AND ANCHORS
15260 PIPING INSULATION
15441 SUMP PUMPS
15700 GENERAL HVAC REQUIEREMENTS
15710 SUMMARY OF WORK FOR HEATING, VENTILATING AND AIR CONDITIONING
15720 AIR HANDLING AND AIR DISTRIBUTION SPECIALTIES
15730 CLEANING MECHANICAL SYSTEMS
15732 PACKAGE HEAT PUMP AIR CONDITIONING UNITS
15734 SPLIT SYSTEM AIR CONDITIONING UNITS (DUCTLESS)
15736 VARIABLE REFRIGERANT VOLUME SYSTEMS AND CONTROLS
15738 DEDICATED OUTDOOR AIR SYSTEM
15780 CONDENSATE AND EQUIPMENT DRAIN SYSTEMS
15890 SHEET METAL DUCTWORK
15910 MECHANICAL SYSTEMS INSULATION
15950 TESTING MECHANICAL SYSTEMS
15951 TESTING, ADJUSTING AND BALANCING OF MECHANICAL SYSTEMS

DIVISION 16 – ELECTRICAL

16000 GENERAL ELECTRICAL REQUIREMENTS
16001 PACKAGED SYSTEMS AND PACKAGED CONTROL PANELS
16010 ELECTRICAL: BASIC REQUIREMENTS

16050 BASIC MATERIALS AND METHODS
16060 ELECTRICAL DEMOLITION
16062 LIGHTNING PROTECTION
16111 CONDUITS
16117 CONCRETE MANHOLES, HANDHOLES AND PULL BOXES
16123 600 VOLT CLASS CABLE
16124 INSTRUMENTATION CLASS CABLE
16130 OUTLET, PULL, AND JUNCTION BOXES
16137 UNDERGROUND DUCT BANKS
16141 WIRING DEVICES
16142 WEATHERPROOF WHILE IN USE OUTLET ENCLOSURES
16143 TERMINAL BLOCKS
16160 ENCLOSURES
16161 CONTROL PANELS
16170 GROUNDING AND BONDING
16190 SUPPORTING DEVICES
16195 ELECTRICAL IDENTIFICATION
16225 ELECTRIC MOTORS 250 HORSEPOWER OR LESS
16282 SURGE PROTECTIVE DEVICE
16307 15000 VOLT CLASS CABLE
16321 OIL FILLED SUBSTATION TRANFORMERS
16341 MEDIUM VOLTAGE SWITCHES
16343 MEDIUM VOLTAGE METAL-CLAD SWITCHGEAR
16430 CUSTOMER POWER METERING SYSTEM
16431 LOW VOLTAGE DRAW-OUT METAL-ENCLOSED SWITCHGEAR
16440 DISCONNECT SWITCHES
16461 TRANSFORMERS - DRY TYPE
16470 PANELBOARDS
16474 MOTOR CONTROL EQUIPMENT
16475 MINI POWER CENTERS
16476 LOW VOLTAGE CIRCUIT BREAKERS
16477 600 V FUSES
16480 MOTOR CONTROLLERS
16481 MOTOR CONTROL CENTERS (MCC)
16482 SOLID STATE MOTOR CONTROLLERS
16485 VARIABLE FREQUENCY DRIVES – LOW VOLTAGE
16500 LIGHTING
16611 STATIC UNINTERRUPTIBLE POWER SUPPLY
16720 FIRE SURVEILLANCE AND ALARM SYSTEM
16912 ETHERNET NETWORK EQUIPMENT
16913 SINGLE MODE FIBER OPTIC CABLING
16920 ELECTRICAL ACCEPTANCE TESTING
16951 SHORT CIRCUIT, COORDINATION AND ARC FLASH HAZARD REPORT

DIVISION 17 – INSTRUMENTATION

17000	INSTRUMENTATION
17111	FLOAT SWITCHES
17120	PRESSURE TRANSMITTERS
17121	PRESSURE SWITCHES AND GAUGES
17124	SUBMERSIBLE LEVEL TRANSMITTER
17134	FLOW SWITCHES
17137	MAGNETIC FLOWMETERS
17150	LIMIT AND POSITION SWITCHES
17221	ELECTRONIC 4 –20 MA INDICATORS
17222	SIGNAL CONDITIONERS
17321	GAS DETECTION SYSTEM
17325	TURBIDITY AND TSS ANALYZERS
17452	PROGRAMMABLE LOGIC CONTROLLER SYSTEM SOFTWARE AND ACCESSORIES
17454	OPERATIONS AND CONTROL DESCRIPTIONS
17456	PROGRAMMING GENERAL
17461	PROGRAMMABLE LOGIC CONTROLLER SYSTEM (M340)

++ END OF TABLE OF CONTENTS ++

SECTION 01010

SUMMARY OF WORK

PART 1 - GENERAL

1.1 SUMMARY

A. The Work to be accomplished under these Contract Documents consists of furnishing all labor, materials, and equipment for all improvement items of Airport WRF and Ocotillo WRF.
   1. The improvement items for Airport WRF are:
      a. Modifications to the Influent Pump Station hatches and repair of T-Lock.
      b. Replace Headworks grating with removable FRP covered grating, and reroute the foul air suction to draw from under the covers.
      c. Replacement of the fine bubble diffusers and diffuser piping for Aeration Basins 5 and 6.
      d. Install the sixth disc filter and ancillary equipment.
      e. Replace disc filter monorail festoon with conductor bars.
      f. Convert Secondary Clarifiers No. 1 through No. 4 to stainless steel mechanisms.
      g. Replace the underground RAS control/isolation valve in Secondary Clarifiers No. 1 and No.3.
      h. Install chemical feed loop system for the NaOH and NaOCl dosage to the Headworks, Prestage Basins No. 1 and No. 2 odor control scrubbers.
      i. Furnish and install a 12,000-gallon Fuel Storage Station.
      j. Add stairs to Prestage Basin No. 2 for operator access.
      k. Install a Non-Hazardous Liquid Waste Disposal Station with a 20-cubic yard roll-off dumpster.
      l. Ancillary Electrical and Instrumentation work as indicated in the Contract Documents.
      m. Ancillary yard piping and site work as indicated in the Contract Documents.
      n. Renovate the old UV Room into a new office and conference room space.
      o. Demolish and re-feed existing panels in the old UV Room.
      p. Replace the administration building HVAC unit and its associated ductwork with a centralized space conditioning system.
      q. Renovate the existing kitchen area with a new layout and cabinetry.
      r. Replace countertops in facility bathrooms per contract drawings.
      s. Replace the reception desk.
      t. Renovate flooring and paint throughout the Administration Building.
   2. The improvement items for Ocotillo WRF are:
      a. Install a 7th IMLR Pump to the MLE IMLR Pump Station.

b. Install a new IMLR Pump to the MBR Bioreactors 1 and 2.
c. Convert MLE Secondary Clarifier No. 3 from suction pipe to spiral scraper type with a stainless steel mechanism.
d. Rehabilitate the MLE Effluent Pump Station Wet Well and modifications to the Electrical Room.
e. Install new MLE Power distribution in new MLE Electrical room to re-feed MLE site.
f. Tie in MLE power feed into the MBR Switchgear with Generator backup.
g. Install two new transformers outside the new MLE Electrical room to feed the new MLE Switchgear.
h. Re-feed existing Aeration Blower MCC No. 1 and No. 2.
i. Re-feed existing Dewatering MCC No. 1 and No. 2
j. Replace the MLE Effluent Pump Station MCC No. 1 and No. 2
k. Replace the MLE Aeration Basin MCC No. 1 and No. 2.
l. Replace MCC T1 and T2 with new Power Distribution Panel.
m. Replace MCC H1 and H2 with new Power Distribution Panel.
n. Relace MCC P with new Power Distribution Panel.
o. Replace MCC POC with a new lighting panel.
p. Furnish a 10,000-gallon Fuel Storage Station.
q. Ancillary Electrical and Instrumentation work as indicated in the Contract Documents.
r. Ancillary yard piping and site work as indicated in the Contract Documents.

3. The following work/notes pertain to both Airport WRF and Ocotillo WRF:
   a. There are a number of existing utilities and structures adjacent to the construction areas of this project. The CONTRACTOR is responsible for protecting all the existing facilities including utilities and structures during the entire duration of the project. The elevations of facilities adjacent to work area based on record drawings are shown on the Contract Documents for reference. The CONTRACTOR shall field verify all existing facilities and their respective locations and elevations prior to commencing work.
   b. All notifications to governmental and public agencies.
   c. Applications for and securing of all permits.
   d. Prepare and submit as-built electronic copy of Contract Documents to accurately reflect the final state of construction.
   e. Prepare and maintain Construction Schedules.
   f. Provide minimum of one year warranty on all warranted materials and labor.
   g. Provide a minimum of one year warranty on start-up assistance. Refer to equipment specification for specific warranty requirements.
   h. Provide on-site, hands-on operator training.
   i. All other miscellaneous work as specified in the Contract Documents.

B. The CONTRACTOR shall be responsible for site and personnel safety during all phases and all aspects of construction.

1.2 ACCESS TO AND FROM THE SITE

A. The address for the Chandler Airport WRF is 905 East Queen Creek Road.
   1. The CONTRACTOR'S personnel shall ingress and egress the site utilizing the existing west entrance to the site.

B. The address for the Chandler Ocotillo WRF is 3315 South Old Price Road.
   1. The CONTRACTOR'S personnel shall ingress and egress the site utilizing the existing southwest entrance to the site.

1.3 DESCRIPTION OF SITE

A. The Airport WRF site is located southwest of the Chandler Airport. The property is bounded by Queen Creek Road on the north, McQueen Road on the east, and Appleby Road (a dirt road) on the south. The Consolidated Canal passes through the southeast corner of the property.

B. The Ocotillo WRF site is bounded by Queen Creek Road on the north, S. Price Rd Road on the east, and Old Price Rd on the west.

1.4 PROXIMITY TO CHANDLER MUNICIPAL AIRPORT

A. The proximity of the Airport WRF site to the Chandler Municipal Airport, as a minimum, can create the following concerns:
   1. Aircraft noise levels.
   2. Obstructions to air navigation.
   3. Radio Telemetry Interference.
   4. Bird strike hazards to aircraft.

B. Obstructions to Air Navigation:
   1. Part 77 of the Federal Aviation Regulations (FAR) relates to potential obstructions to air navigation. Due to this Project's proximity to an airport, the FAR requires that a Notice of Proposed Construction be filed with the Federal Aviation Administration (FAA) for this Project. The FAA may require obstruction marking or lighting on construction equipment or may limit the height of construction equipment that can be used on this site.
   2. The CONTRACTOR shall be responsible for notifying the appropriate agencies, obtaining all required permits, and complying with applicable regulations.

C. Radio Telemetry Interference:
   1. The CONTRACTOR shall be responsible for coordination of construction site communications to prevent interference with aircraft communications and navigation.

D. Bird Strike Hazards to Aircraft:
   1. There is a potential for serious damage to an aircraft if the aircraft strikes a bird. The potential for bird strikes is increased by open bodies of water, refuse piles, or other activities which may attract birds.
   2. The CONTRACTOR shall be responsible for mitigation of all such activities associated with the Project.

E. The CONTRACTOR shall be responsible for public safety related to all Work at the WRF site.

F. CONTRACTOR shall provide copies of all documentation/correspondence referenced in this section to the ENGINEER for reference.

1.5 PROXIMITY TO CHANDLER MUNICIPAL TRANSFER STATION

A. The City of Chandler Municipal Transfer Station is located adjacent to the Airport WRF. Construction activities shall not interfere with operation of the transfer station.

B. City of Chandler Solid Waste Management Department utilizes the northwest portion of the site for storage and as a work yard. Construction activities shall not hinder normal operations.

1.6 GEOTECHNICAL INVESTIGATION

A. A copy of the geotechnical investigation is available from the OWNER upon request.

1.7 COORDINATION WITH EXISTING UTILITIES

A. Various utilities, including, but not limited to, potable and non-potable water pipes, sanitary sewer, and process pipes, electrical duct banks, communications cables, drainage and irrigation channels, and associated structures are in existence on the construction site, roadways, right-of-ways, and adjoining property.

B. Where required by the Contract Documents, the CONTRACTOR shall make connection to or modify existing utilities.

C. The CONTRACTOR shall connect to existing utilities without disrupting or interrupting the operation of the services of the existing utilities.

D. The existing utilities shall be assumed to be in service at the time the CONTRACTOR makes connection.

1.8 SCHEDULING OF WORK

A. CONTRACTOR will be performing Work in an existing wastewater treatment plant actively treating wastewater on a continuous basis. Extensive coordination

and scheduling of Work shown on the Plans is required to complete Work within the WRF. Refer to Section 01012, Plant Operation During Construction, for further information.

1.9 DEMOLITION

A. Conduct demolition activities in accordance with Section 02050, Demolitions.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

++ END OF SECTION ++

SECTION 01012

PLANT OPERATION DURING CONSTRUCTION

PART 1 - GENERAL

1.1 SUMMARY

A. The CONTRACTOR will be performing Work at an operating wastewater treatment plant site. As a result, the CONTRACTOR shall take all precautions necessary to ensure that the treated effluent quality and quantity are not impacted. These precautions include but are not limited to protecting piping, utilities, roads, and structures that are to remain and are not to be modified or replaced. Any temporary facilities required to achieve minimum level of treatment and capacity shall be provided by the CONTRACTOR at his own expense. Upon completion of the Work, all temporary facilities and materials shall be removed from the site.

B. All Work shall be completed in a manner which will result in minimum disruption to the operation of the existing facilities.

C. The CONTRACTOR shall not operate any equipment, valves, etc. that will affect the treatment process. CONTRACTOR shall coordinate any required modifications to the treatment process with the ENGINEER and OWNER. The CONTRACTOR shall witness and assist with all startups following any of the CONTRACTOR'S Work in the respective area to ensure proper operation of the modified or rehabilitated process.

D. CONTRACTOR'S means and methods shall be implemented such that the existing plant shall remain in continuous satisfactory operation during the entire construction period. Only shutdowns listed in this Specification Section will be allowed. Work shall be scheduled and conducted by the CONTRACTOR such that it shall not impede any treatment process, create potential hazards to operating equipment and OWNER'S personnel, reduce the quality of the plant effluent or cause odor or other nuisances. In performing the Work shown and specified, CONTRACTOR shall plan and schedule the Work to meet both the constraints outlined in this Section and plant operating requirements.

E. CONTRACTOR has the option of providing additional temporary facilities that can eliminate a constraint provided it is done without additional cost to the OWNER, presents no safety hazards, and provided that all requirements of these specifications are fulfilled. CONTRACTOR shall obtain ENGINEER'S approval prior to installing temporary facilities. Temporary facilities shall have same amount of reliability, redundancy, and automation currently available.

F. CONTRACTOR is responsible for coordinating all shutdowns with the ENGINEER. CONTRACTOR shall whenever possible, combine discrete shutdown procedures into a single shutdown when the duration of the shutdowns or the Work requirements allow. The intent of combining shutdown procedures is to minimize the impacts upon plant operations and processes by limiting the number of shutdowns required.

G. CONTRACTOR shall not shut off or disconnect any operating system. All plant equipment operation and shutdowns shall be executed by the OWNER, unless otherwise noted.

H. CONTRACTOR shall be responsible for supplying all temporary pipelines, valves, pumps, meters, spare parts, temporary electrical power and controls, and any other appurtenances required for the installation and operation of temporary bypass lines, pumping systems, blowers, or conveyance systems required to maintain operations of the plant during construction activities. All temporary facilities shall be tested prior to taking an existing system offline. CONTRACTOR shall submit to the ENGINEER for review and approval, the design of all temporary lines, conveyance systems, proposed temporary equipment, etc., at least 30 days prior to planned commencement of the Work. Equipment performance information shall be included with the submittal.

I. Shutdowns that require reduced or cessation of process air to the aeration basins, if excessive, will adversely affect the biological process (e.g. FRP T-connection). This may result in reduced treatment capacity for a period of up to several weeks in order for the process to recover. Therefore, CONTRACTOR shall make every effort to minimize the duration of air system shutdowns and complete Work within the specified shutdown duration. This Work shall be performed during periods of low flow.

J. Unless otherwise specified, the CONTRACTOR shall dewater the process basin that is taken offline at the beginning of each shutdown. The CONTRACTOR shall be responsible for washing down, dewatering and cleaning all basins. It is the responsibility of the CONTRACTOR to remove all washdown, cleaning and storm water that accumulates in the Work areas. CONTRACTOR shall be responsible for removing this material and disposing of it onsite as directed by the ENGINEER, into one of the treatment processes.

K. Non-Potable Water System, Potable Water System and the sampling system are to be protected at all times and must remain in service to all operating facilities.

L. The biological nutrient removal (BNR) process, fine screens, pre-stage basins, grit removal system, aeration basins, secondary clarifiers, filters, reclaimed water pump station, sludge holding tank, odor control, thickening building, sludge holding tanks, chlorine contact basin, wash water equalization basins, bio-filters, scum-

pump stations, chemical facilities and dewatering belt presses and related electrical equipment and appurtenances may not be removed from service. The unit processes that are planned to be removed from service are outlined later in the specification.

M. Paving operations shall not commence as deemed necessary for overall completion by agreement between the ENGINEER and CONTRACTOR.

N. Electrical Distribution, Instrumentation and Communication System: The site-wide electrical distribution, instrumentation and communication system shall be operational during this Project. Any shutdowns related to electrical connections shall be coordinated with the plant shutdown schedule. Temporary electrical conduits and communication conduits, wiring and temporary setup may be required if longer periods of outages are necessary.

O. Extensive coordination is required for the Work to be conducted in and around the facility. CONTRACTOR shall refer to Specification Section 01310, Progress Schedule, for further information regarding sequencing of construction.

P. OWNER'S personnel must have access and be able to perform normal operational duties at all times during construction. OWNER'S personnel must have operational access to all equipment at all times.

Q. The CONTRACTOR shall note that the WRF will be treating wastewater at all times during the construction of the Project. Gases such as H_2S will be present in the atmosphere in and around numerous processes. CONTRACTOR shall plan Work accordingly.

1.2 GENERAL CONSTRAINTS

A. The following Sections describe the proposed shutdown schedule, where applicable, for plant systems which are to be taken out of service. The operational status of new or existing systems other than the designated systems shall not be interrupted by the CONTRACTOR during the specified time period. New systems may only be used after the specified testing is completed and the systems are accepted for use by the ENGINEER, in writing.

B. The following constraints shall be applied to all equipment and appurtenant utility systems at the plant site.
   1. Access to AWRF Site: The CONTRACTOR shall access the AWRF site using the west most access to the facility on Queen Creek Road. An unobstructed traffic route through the plant gate shall be maintained at all times.
   2. Access to OWRF Site: The CONTRACTOR shall access the OWRF site using the southwest access gate on Old Price Road. An unobstructed traffic route through the plant gate shall be maintained at all times.
   3. Load Limits on Access Roads: Existing and new underground facilities, such as electrical duct banks, pipelines, etc., in, under and crossing plant roads, have

been designed for maximum wheel load of H-20. CONTRACTOR shall not exceed this weight limit and shall provide means of protecting the underground facilities and at grade manhole / handhole covers.

4. Safety Barriers: CONTRACTOR shall place safety barriers around unsafe areas located around operational areas accessible to OWNER'S personnel.
5. Personnel Access: WRF personnel shall have access to all areas which remain in operation throughout the construction period.
6. Potable and Non-Potable Water System: The existing potable and non-potable water system shall be kept in operation at all times, unless otherwise specified.
7. Plumbing Facilities: Plumbing facilities shall be kept in operation at all times, unless otherwise specified. All other plumbing systems, such as roof and floor drains, pumping, etc., shall be maintained for all structures.
8. Storm Drainage: Storm drainage on the site shall be operational at all times, unless otherwise specified.
9. Seal and Service Water Piping: A supply of service and seal water and the necessary connections to existing equipment shall be maintained during construction. In the event of damage to existing supply during construction, the CONTRACTOR shall repair and provide temporary piping during repair at no additional cost to the OWNER.
10. Draining Process Pipes and Conduits:
    a. Unless otherwise specified, the contents of pipes and conduits undergoing modifications shall be transferred to the Influent Pump Station using hoses, piping, pumps, or other applicable means. Treatment chemicals, including, but not limited to, polymer, alum, sodium hypochlorite, sodium hydroxide, and cleaning acids, shall be disposed of by the CONTRACTOR in an off-site location, in accordance with all local, State, and Federal regulations.
    b. If a drain is not available on the pipe to be drained, then a wet tap shall be made by CONTRACTOR using a tapping saddle and valve approved by the ENGINEER. No uncontrolled spillage of a pipe's contents shall be allowed.
    c. Any spillage shall be brought to the ENGINEER'S attention immediately in writing. CONTRACTOR shall wash down any spillage to floor drains, sumps and sump pump discharge piping and then flush out the system to prevent clogging and septic odors. If spillage is not suitable for drainage system, e.g., chemical spills, etc., as determined by the ENGINEER, CONTRACTOR shall remove spillage by other method such as Vactor truck, as approved by the ENGINEER.
11. Temporary Partitions and Enclosures: CONTRACTOR shall provide temporary partitions and enclosures necessary to maintain dust-free, heated, cooled, and ventilated spaces in all areas which are adjacent to his Work and which must be kept operational.
12. Dead End Valves or Pipe: CONTRACTOR shall provide blind flanges or plugs on all valves or pipes which dead-end a line on a temporary or permanent basis. Blind flanges and plugs shall be restrained.

13. Power, Light, and Communication Systems: Electrical power, lighting service and communication systems shall be maintained in uninterrupted operation in all areas.
14. Dead End Valves or Pipe: CONTRACTOR shall provide blind flanges or MJ Plugs on all valves or pipes which dead-end a line on a temporary or permanent basis. All dead end lines shall be braced and blocked and MJ Plugs shall also be restrained.
15. Prior to the usage of all new unit process equipment, the CONTRACTOR shall conduct start up and testing (per Section 01650, Starting of Systems) for the equipment prior to handing the operation of the equipment over to the OWNER. The CONTRACTOR shall also schedule training of the equipment with manufacturer's representatives prior to OWNER'S personnel taking over operational responsibility.
16. Tie-ins and shutdowns at the WRF may need to be performed after hours or on weekends to facilitate normal operation of the WRF. No additional compensation will be made for Work that may be needed during after hours or on weekends. This Work must be coordinated and approved by the ENGINEER.

1.3 SHUTDOWNS

A. General:
1. A shutdown shall be defined as a portion of the normal operation of the WRF unit that has to be suspended or taken out of service in order to perform the specified Work. For each shutdown, CONTRACTOR shall prepare a list of labor, materials, and equipment needed to perform tasks, an estimate of the time required, and a written description of steps required to complete all tasks. The list, the estimate, and written procedures shall be submitted to the ENGINEER for review 30 calendar days prior to the proposed start date of the shutdown. CONTRACTOR shall also request in writing from the ENGINEER, approval for each shutdown a minimum of 14 calendar days prior to the proposed shutdown date. No shutdown shall be initiated until the list of materials and labor is verified by the ENGINEER on site at least one week prior to the proposed start date. One meeting shall be held per shutdown after ENGINEER'S review of the information on written procedures and at least three weeks prior to proposed shutdown. A second meeting shall be held for verification of list of materials and labor.
2. The Work required herein and any other Work required by the CONTRACTOR and approved by the ENGINEER may interrupt normal plant operations and shall be accomplished at such times that will be convenient to the OWNER.
3. CONTRACTOR shall have on hand and located in close proximity to the Work area all tools, equipment, spare parts and materials, both temporary and permanent, necessary to complete each Work category without interruption. An adequate number of personnel shall be scheduled for each shutdown, so that Work shall be accomplished within the specified time frame.

Prefabrication of all piping and other assemblies shall be completed, to the greatest degree possible, prior to any shutdowns. The ENGINEER shall be satisfied that the CONTRACTOR has complied with these requirements, to the fullest extent possible, before shutdowns will be authorized.

4. If CONTRACTOR'S procedures cause an unscheduled shutdown of the facilities, CONTRACTOR shall perform Work as necessary to immediately reestablish satisfactory operation. CONTRACTOR shall notify the ENGINEER, in writing, immediately of an unscheduled shutdown. Unscheduled shutdowns and/or interruptions of facility operations that result in fines levied by the Arizona Department of Environmental Quality, or Maricopa County shall be the responsibility of the CONTRACTOR.
5. Scheduled shutdowns during the period of the CONTRACTOR'S Work will be as shown in Section 1.5 of this Specification. All Work requiring the WRF to be out of service shall be performed during the scheduled shutdowns identified below. It should be noted that the OWNER'S personnel shall continue to perform administrative, operational, and maintenance functions during shutdowns.
6. Shutdown of Electrical Systems: CONTRACTOR shall lock out and tag circuit breakers and switches operated by the OWNER and check cables and wires to be sure that they are de-energized to ground potential before Work begins. Upon completion of the Work, CONTRACTOR shall remove the locks and tags and notify the ENGINEER that the facilities are available for use.
7. Electrical Duct Bank Installation: Shutdown and relocation of conflicting utilities alignments with electrical duct bank will only be allowed for certain types of process pipelines. Any shutdown and relocations shall follow a strict time schedule in order to minimize impact to plant operations.
8. When temporary generators or fiber optic conduits are used, the CONTRACTOR shall provide temporary instrumentation wiring to operate temporary equipment to keep the WRF in operation. The instrumentation wiring and temporary equipment operation logic shall be submitted to and approved by the ENGINEER.

1.4 RELATED SECTIONS

A. Section 01010, Summary of Work.

B. Section 01310, Progress Schedule.

1.5 WRF TREATMENT REQUIREMENTS/LIST OF PROCESS SHUTDOWNS

A. WRF treatment requirements vary throughout the year. The AWRF's maximum monthly treatment capacity is 27 MGD (million gallons per day) and the OWRF's maximum monthly treatment capacity is 18 MGD. Hydraulic peak flows reaching 33 MGD (AWRF) and 22 MGD (OWRF) shall be accommodated throughout construction.

B. The table at the end of this specification shows a list of procedures for piping installations.

1.6 OTHER PROCESS SHUTDOWNS

A. Previous sections covered planned shutdowns processes at the WRF that run continuously. Several modifications may be required to other processes and ancillary facilities at the WRF. Work within these areas shall be coordinated with the ENGINEER. CONTRACTOR shall follow all procedures outlined in Paragraphs 1.1, 1.2, and 1.3 of this Specification for Work within these areas.

B. The above listed process areas/ancillary facilities could be shutdown up to a maximum period of four hours with prior notice. CONTRACTOR shall coordinate and obtain the approval from the ENGINEER regarding shutdown of the above listed processes.

1.7 SEQUENCING OF WORK

A. General:
   1. The CONTRACTOR is responsible for identifying all other critical sequencing items and is also responsible for scheduling the Work.
   2. The ENGINEER will review proposals from the CONTRACTOR regarding sequencing of work. Approval of sequencing proposals is at the discretion of the ENGINEER.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

It is assumed that all Process Units will be operating prior and during shutdowns shown in tables below:

ITEM NO.	ITEM DESCRIPTION	PROCESS UNITS AFFECTED DURING SERVICE	IMPACT ON OTHER PROCESS UNITS	PROCEDURE	CONSTRAINTS AND REMARKS	DURATION OF SHUTDOWN
AWRF						
A-1	Influent Pump Station T-lock Repair	IPS	IPS	1. Ensure necessary ventilation inside IPS wet well during repair. 2. Monitor inlet flow and adjust IPS pumping to lower the wet well level to lowest possible. Continue to monitor level throughout MOPO. 3. Install scaffolding. 4. Perform T-lock repair as shown on drawings. 5. Modify orientation of existing hatch locks. 6. Remove Scaffolding. 7. Resume normal flow and water level conditions.	Contractor shall submit a detailed procedure of MOPO before start of construction for approval. Contractor shall coordinate with Engineer and Plant staff.	TBD

ITEM NO.	ITEM DESCRIPTION	PROCESS UNITS AFFECTED DURING SERVICE	IMPACT ON OTHER PROCESS UNITS	PROCEDURE	CONSTRAINTS AND REMARKS	DURATION OF SHUTDOWN
A-2	Parshall Flume Rehabilitation	IPS	Reduced Plant Drain from All Processes RWIF	1. Install pump around at Manhole 9 to divert plant sewer flow to IPS influent bay. 2. Plug 30" RCP plant sewer line at Manhole 9 and at the IPS wet well to isolate Parshall flume. 3. Demo Parshall flume, concrete slab, and existing Manhole 10. 4. Install new plant sewer pipe, Manhole 10, and laser flow meter as shown on drawings. 5. Remove plugs in Manhole 9 and IPS influent bay. 6. Resume normal flow and water level conditions.	Contractor shall submit a detailed procedure of MOPO before start of construction for approval. Contractor shall coordinate with Engineer and Plant staff. Pump around capacity should be rated for a minimum of 10 MGD, and include a standby pump for redundancy. Coordinate with Plant staff to minimize plant sewer flows for duration of MOPO. Contractor shall monitor Plant Sewer Flows during work.	60 days

ITEM NO.	ITEM DESCRIPTION	PROCESS UNITS AFFECTED DURING SERVICE	IMPACT ON OTHER PROCESS UNITS	PROCEDURE	CONSTRAINTS AND REMARKS	DURATION OF SHUTDOWN
A-3	Installation of new FRP Foul Air piping in Headworks Building	Headworks	None	1.Install new FRP covers in Headworks Building 2nd floor. 2. Install all new FRP Four Air piping except for connection points to current system. 3. Shutdown and Lock Out Tag Out (LOTO) Headworks Odor Control Scrubber fan. 4. Demo pipe sections as shown on contract drawings. 5. Connect new FRP Foul air piping to current system. 6. Remove LOTO. 7. Balance air flows according to design CFMs.	Contractor shall submit a detailed procedure of MOPO before start of construction for approval. Contractor shall coordinate with Engineer and Plant staff. Contractor shall ensure that process wastewater is not contaminated with construction debris.	1 day
A-4	Aeration Basins No. 5 & 6 new diffuser and piping installation	Aeration Basin 5 & 6	NA	1. Close and LOTO respective Aeration Basin influent gate (located at the aeration basin control structure), and basin process air butterfly valve. 2. Drain and clean basin. 3. Demo and replace diffusers and supports. 4. Test new diffusers per specifications. 5. Remove LOTO.	Contractor shall coordinate shutdown, draining and start up with Engineer and Plant staff.	TBD

ITEM NO.	ITEM DESCRIPTION	PROCESS UNITS AFFECTED DURING SERVICE	IMPACT ON OTHER PROCESS UNITS	PROCEDURE	CONSTRAINTS AND REMARKS	DURATION OF SHUTDOWN
A-5	Secondary Clarifiers No. 1 – No. 4 mechanism replacement	Secondary Clarification	NA	1. Close and LOTO respective Secondary Clarifier influent gate (located at the Secondary Clarifier control structure). 2. LOTO existing MCC-BL2 main breakers. 3. Disconnect and remove wiring and conduits to existing Secondary Clarifiers No. 1 – No. 4 equipment as shown in the drawings. 4. Disconnect and remove existing Secondary Clarifier equipment as shown in Demolition and Electrical drawings. 5. Install new Secondary Clarifier equipment, and new wires in new conduits per Electrical drawings. 6. Connect new control wiring and conduits between new Secondary Clarifier control panels and existing PLC cabinet per drawings. 7. Remove LOTO. 8. Repeat procedure for the remaining Secondary Clarifiers.	Contractor shall submit a detailed procedure of MOPO before start of construction for approval. Contractor shall coordinate with engineer and plant staff to replace multiple clarifier mechanisms concurrently.	TBD

ITEM NO.	ITEM DESCRIPTION	PROCESS UNITS AFFECTED DURING SERVICE	IMPACT ON OTHER PROCESS UNITS	PROCEDURE	CONSTRAINTS AND REMARKS	DURATION OF SHUTDOWN
A-6	Secondary Clarifiers No. 1 and No. 3 12-inch drain plug valve replacement	Secondary Clarification	NA	1. Install plug in RAS/WAS pump station wet well and close SC splitter box gate. 2. Excavate and remove the existing drain plug valve. 3. Install new 12-inch drain plug valve as shown in the drawings. 4. Remove plug in RAS/WAS pump station wet well. 5. Repeat for remaining clarifier.	Perform valve replacement only during the mechanism replacement of the relevant Secondary Clarifier.	6 days
A-7	Secondary Clarifiers No. 4 16-inch drain plug valve replacement	Secondary Clarification	NA	1. Install plug in RAS/WAS pump station wet well and close SC splitter box gate. 2. Excavate and remove the existing drain plug valve. 3. Install new 16-inch drain plug valve as shown in the drawings. 4. Remove plug in RAS/WAS pump station wet well.	Perform valve replacement only during the mechanism replacement of the relevant Clarifier.	3 days

ITEM NO.	ITEM DESCRIPTION	PROCESS UNITS AFFECTED DURING SERVICE	IMPACT ON OTHER PROCESS UNITS	PROCEDURE	CONSTRAINTS AND REMARKS	DURATION OF SHUTDOWN
A-8	Chemical Feed Loop	Odor Control Scrubbers for Headworks, Prestage Basins No. 1, and Prestage Basins No. 2	NA	1. Install new pipe trenches, feed loop piping, and valves/appurtenances as shown in the drawings. 2. LOTO each OCS and existing chemical metering pumps. 3. Remove existing chemical metering pumps. 4. Install & test new chemical feed loop pumps. 5. Remove OCS LOTO.	Contractor shall coordinate OCS shutdown duration with Plant Staff. Temporary chemical feed pumps shall be provided to maintain operation of chemical scrubbers. Installation of new feed loop piping shall occur before demolition and removal of the existing chemical metering pumps to minimize downtime.	TBD
A-9	Disc Filter #6 Installation	Flocculation Basin No. 4	NA	1. Close and LOTO Disc Filter No. 6 Influent Slide Gate 2. Install Disc Filter No. 6. 3. Reopen slide gate and remove coffer dam.	Contractor shall submit a detailed procedure to ensure flow from the Rapid Mix Basins to Filters No. 1-5 during this period.	N/A

ITEM NO.	ITEM DESCRIPTION	PROCESS UNITS AFFECTED DURING SERVICE	IMPACT ON OTHER PROCESS UNITS	PROCEDURE	CONSTRAINTS AND REMARKS	DURATION OF SHUTDOWN
A-10	NHLW FRP Foul Air piping connection to Solids Thickening building Odor Control piping	Thickening Building Sludge Holding Tanks	NA	1.Ensure necessary ventilation in Thickening Building and Sludge Holding Tanks during MOPO. 2. Install all new Foul Air piping except for connection point to existing system. 3. LOTO Sludge Thickening Odor Control Fan. 4. Connect new FRP Foul Air Piping to existing system. 5. Remove LOTO. 6. Balance air flows according to design CFMs.	TBD	2 days
A-11	8” PVC Sanitary Sewer Connection to Manhole #62	Belt Press Pump Station	Solids	1. Isolate and LOTO necessary lines and valves for connection. 2. Install all pipes and accessories necessary for connection. 3. Remove LOTO.	Contractor shall identify the required isolation points and valves for LOTO and submit a detailed procedure for approval prior to commencing the MOPO.	2 days

ITEM NO.	ITEM DESCRIPTION	PROCESS UNITS AFFECTED DURING SERVICE	IMPACT ON OTHER PROCESS UNITS	PROCEDURE	CONSTRAINTS AND REMARKS	DURATION OF SHUTDOWN
A-12	Connection to Nonpotable Water line for NHLW Disposal station	NA	Nonpotable water to Dewatering Building and Bio Filters	1. Isolate and close upstream and downstream valves to connection point. 2. LOTO upstream and downstream valves. 3. Make connection to Nonpotable water line. 4. Reopen upstream and downstream valves. 5. Remove LOTO.	Contractor shall identify the required isolation points and valves for LOTO and submit a detailed procedure for approval prior to commencing the MOPO.	1 day
A-13	HVAC System Replacement	Administration Building	N/A	1. Provide temporary HVAC as necessary. 2. LOTO MCC-AD. 3. Demolish existing HVAC unit and ducting. 4. Install new space conditioning unit and ducting. 5. Remove LOTO. 6. Remove temporary HVAC.	Contractor shall submit a detailed procedure of MOPO before start of construction for approval. Contractor shall coordinate with Engineer and Plant staff. Further coordination required between the Contractor and Plant staff to determine the duration and impact on normal plant operations. New LP-ADMIN panel must be installed before space conditioning system can be energized.	TBD

ITEM NO.	ITEM DESCRIPTION	PROCESS UNITS AFFECTED DURING SERVICE	IMPACT ON OTHER PROCESS UNITS	PROCEDURE	CONSTRAINTS AND REMARKS	DURATION OF SHUTDOWN
A-14	Administration Demolitions and Re-feeding UV Room Panels	Administration Building	N/A	1. LOTO UV Room electrical equipment at MCC-AD. 2. Demo existing panels, disconnect switches, and conduit to extent shown on contract drawings. 3. Re-feed new LP-ADMIN and PP-ADMIN panels from MCC-AD. 4. Deenergize UV Room bridge crane prior to demolition. 5. Remove LOTO.	Contractor shall submit a detailed procedure of MOPO before start of construction for approval. Contractor shall coordinate with Engineer and Plant staff. Foxboro cabinets must stay energized and operational throughout all admin building construction activities. Provide temporary power as necessary.	TBD

ITEM NO.	ITEM DESCRIPTION	PROCESS UNITS AFFECTED DURING SERVICE	IMPACT ON OTHER PROCESS UNITS	PROCEDURE	CONSTRAINTS AND REMARKS	DURATION OF SHUTDOWN
OWRF						
O-1	MBR IMLR Pump installation	MBR Aeration Basins	Reduced Capacity in all processes	1. Perform construction one basin at a time. 2. LOTO all valves feeding the aeration basin. 3. Drain the basin fully. 4. Install new diffusers, pump and all new piping. 5. Remove LOTO. 6. Repeat for second basin.	Contractor shall submit a detailed procedure of MOPO before start of construction for approval. Contractor shall coordinate with Engineer and Plant staff.	TBD
O-2	MLE IMLR Pump No. 6	Anoxic Basins	TBD	1. LOTO necessary electrical & mechanical equipment 2. Install IMLR Pump, MCC and other electrical equipment. 3. Remove LOTO.	Contractor shall submit written procedure for review prior to installation. Contractor shall coordinate with Engineer and Plant staff.	6 days

ITEM NO.	ITEM DESCRIPTION	PROCESS UNITS AFFECTED DURING SERVICE	IMPACT ON OTHER PROCESS UNITS	PROCEDURE	CONSTRAINTS AND REMARKS	DURATION OF SHUTDOWN
O-3	Secondary Clarifier No. 3 mechanism replacement	Anoxic Basins, Blower Building equipment, Secondary Clarifier 3	NA	1. LOTO existing MCC-449-001/002 and MCC-419-001/002 main breakers. 2. Disconnect and remove wiring and conduits to existing Secondary Clarifier No. 3 equipment as shown in the drawings. 3. Disconnect and remove existing Secondary Clarifier No. 3 equipment as shown in the Demolition and Electrical drawings. 4. Install new MCC buckets, new Secondary Clarifier equipment, and new wires in new conduits per Electrical drawings. 5. Connect new control wiring and conduits between new secondary clarifier control panels and existing PLC cabinet PCP-449-001 per Electrical and Instrumentation drawings. 6. Remove LOTO	1. Only one half of MCC-449-001/002 and MCC-419-001/002 can be taken out of service at a time for installation of new equipment. 2. Coordinate with Plant operations for number of Anoxic basins and Blower building equipment required to be operational at all times.	93 days

ITEM NO.	ITEM DESCRIPTION	PROCESS UNITS AFFECTED DURING SERVICE	IMPACT ON OTHER PROCESS UNITS	PROCEDURE	CONSTRAINTS AND REMARKS	DURATION OF SHUTDOWN
O-4	Effluent Pump Station Beam Repairs	Effluent Pump Station, CCB Nos. 1 and 2	MLE, Reclaimed Water Pump Station	1. LOTO necessary valves and bring down water level in wet well. 2. Perform inspection of beam concrete to determine extent of repair needed. 3. Install coffer dam at opening on west side of effluent building. 4. Perform beam repair 5. Remove LOTO.	Contractor shall submit detailed plan and exact dates of shutdown requested for coordination with City a minimum of 6 months in advance. Contractor shall coordinate with Engineer and Plant staff.	10 days
O-5	SGR-120-001 A side energization			1. SWGR – 1AA must be installed and all conduit connected. The appropriate equipment must be in place. 2. Wire must be pulled to nearest manhole and terminated at SWGR-1AA to include all equipment located in between SGR-120-001 and SWG-1AA. 3. MOPO must contain information regarding load shedding and powering up redundant systems. 4. After load shedding and SES-120-001 is shut down, new breaker must be installed in SGR-120-001. 5. All wire must finish being installed, terminated and tested. 6. New Breaker in SES must be LOTO. 7. All inspections must be completed before reenergizing equipment.	The intent of this shut down is to bring service to the A side of SWGR – 1AA	TBD

ITEM NO.	ITEM DESCRIPTION	PROCESS UNITS AFFECTED DURING SERVICE	IMPACT ON OTHER PROCESS UNITS	PROCEDURE	CONSTRAINTS AND REMARKS	DURATION OF SHUTDOWN
O-6	SGR-120-002 B side energization			1. SWGR – 1AA must be installed and all conduit connected. The appropriate equipment must be in place. 2. Wire must be pulled to nearest manhole and terminated at SWGR-1AA to include all equipment located in between SGR-120-002 and SWG-1AA. 3. MOPO must contain information regarding load shedding and powering up redundant systems. 4. DP-120-001 does not contain redundant system. Generator will be needed to maintain power during shutdown phase. 5. All wire must finish being installed, terminated and tested. 6. Breakers in SES must be LOTO. 7. All inspections must be completed before reenergizing equipment.	The intent of this shut down is to bring service to the B side of SWGR – 1AA.	TBD

ITEM NO.	ITEM DESCRIPTION	PROCESS UNITS AFFECTED DURING SERVICE	IMPACT ON OTHER PROCESS UNITS	PROCEDURE	CONSTRAINTS AND REMARKS	DURATION OF SHUTDOWN
O-7	MCC D1/D2 Energization			1. Wire must be pulled to manhole closest to MCC D1/D2 and terminated at SWGR-1AA. 2. MOPO must contain information regarding load shedding and powering up redundant systems. 3. Tie-Breaker open and all equipment being fed from MCC D1/D2 must be powered by the B side of MCC D1/D2. 4. Complete conduit and terminate feeders for A side of MCC D1/D2. 5. All inspections must be completed before reenergizing equipment. 6. Verify tie Breaker is open on SWG – 1A. 7. Energize SWGR-1A A side. 8. Reenergize MCC D1/D2 A side. 9. Switch all equipment over from MCC D1/D2 from B side to A side. 10. Complete conduct and terminate feeders for B side of MCC D1/D2. 11. Complete all testing and inspections for B side.	The intent of this shut down is to bring service to the A and B side of SWGR – 1AA to MCC D1/D2.	TBD

ITEM NO.	ITEM DESCRIPTION	PROCESS UNITS AFFECTED DURING SERVICE	IMPACT ON OTHER PROCESS UNITS	PROCEDURE	CONSTRAINTS AND REMARKS	DURATION OF SHUTDOWN
O-8	AER-BLR-MCC 001/002 Energization			1. Wire must be pulled to manhole closest to AER-BLR- MCC 001/002 and terminated at SWGR-1AA. 2. MOPO must contain information regarding load shedding and powering up redundant systems. 3. Tie-Breaker open and all equipment being fed from AER-BLR-MCC 001/002 must be powered by the A side of AER-BLR-MCC 001/002. 4. Complete conduits and terminate feeders for B side of AER-BLR-MCC 001/002. 5. All inspections must be completed before reenergizing equipment.Verify tie Breaker is open on SWGR – 1A. 6. Energize SWGR-1A B side. 7. Reenergize AER-BLR-MCC 001/002 B side and complete switch over for all equipment energized by SWGR-1 side A. 8. Switch all equipment over from AER-BLR-MCC 001/002 from A side to B side. 9. Complete conduct and terminate feeders for A side of AER-BLR-MCC 001/002. 10. Complete all testing and inspections for B side.	The intent of this shut down is to bring service to the A and B side of SWGR – 1AA to AER-BLR-MCC 001/002.	TBD

ITEM NO.	ITEM DESCRIPTION	PROCESS UNITS AFFECTED DURING SERVICE	IMPACT ON OTHER PROCESS UNITS	PROCEDURE	CONSTRAINTS AND REMARKS	DURATION OF SHUTDOWN
O-9	EFF-MCC-001/002 Energization			1. Wire must be pulled to manhole closest to EFF-MCC 001/002 and terminated at SWGR-1AA. 2. MOPO must contain information regarding load shedding and powering up redundant systems. 3. Tie-Breaker open and all equipment being fed from all MCC's must be powered by the A side of MCC. 4. Complete conduits and terminate feeders for A side of EFF-MCC 001/002. 5. All inspections must be completed before reenergizing equipment. 6. Verify tie Breaker is open on SWGR – 1A. 7. Energize SWGR-1A A side. 8. Reenergize all completed MCC 's A side and complete switch over for all equipment energized by SWGR-1 side B. 9. Switch all equipment over from all refed MCC's from B side to A side. 10. Complete conduct and terminate feeders for B side of EFF-MCC 001/002. 11. Complete all testing and inspections for B side.	The intent of this shut down is to bring service to the A and B side of SWGR – 1AA to EFF-MCC 001/002 Coordinate with MOPO O-4 (Effluent Pump Station Beam Repairs).	TBD

ITEM NO.	ITEM DESCRIPTION	PROCESS UNITS AFFECTED DURING SERVICE	IMPACT ON OTHER PROCESS UNITS	PROCEDURE	CONSTRAINTS AND REMARKS	DURATION OF SHUTDOWN
O-10	ANX-MCC-001/002 Energization			1. Wire must be pulled to manhole closest to ANX-MCC-001/002 and terminated at SWGR-1AA. 2. MOPO must contain information regarding load shedding and powering up redundant systems. 3. Tie-Breaker open and all equipment being fed from all MCC's that are tied into new switchgear must be powered by the A side of MCC. 4. Complete conduits and terminate feeders for A side of ANX-MCC-001/002. 5. All inspections must be completed before reenergizing equipment. 6. Verify tie Breaker is open on SWGR – 1A. 7. Energize SWGR-1A B side. 8. Reenergize ANX-MCC-001/002 B side and complete switch over for all equipment energized by SWGR-1 side B. 9. Switch all equipment over from ANX-MCC-001/002 from B side to A side. 10. Complete conduct and terminate feeders for A side of all MCC's that have been completed. 11. Complete all testing and inspections for A side.	The intent of this shut down is to bring service to the A and B side of SWGR – 1AA to ANX-MCC-001/002. Coordinate with MOPO O-1 (MBR IMLR Pump installation).	TBD

ITEM NO.	ITEM DESCRIPTION	PROCESS UNITS AFFECTED DURING SERVICE	IMPACT ON OTHER PROCESS UNITS	PROCEDURE	CONSTRAINTS AND REMARKS	DURATION OF SHUTDOWN
O-11	PDP-639-001 Refeed			1. Conduit and feeder should be installed and terminated into SWGR – 1AB during the process of completing all work associated with SWGR and terminated into transfer switch enclosure but wire not terminated. 2. Shutdown of equipment must be coordinated with Site Operations. 3. Equipment will be shut down and terminations made in transfer switch. 4. Inspection and testing to be completed. 5. Energize panels and circuits.	The purpose of this MOPO is to refeed PDP-639-001 and remove feeder conductors from MCC T1/T2 and install them in panel SWGR-1AA and SWGR-1AB.	TBD
O-12	LPH Refeed			1. Conduit and feeder should be installed and terminated into SWGR – 1AB during the process of completing all work associated with SWGR and terminated into transfer switch enclosure but wire not terminated. 2. Shutdown of equipment must be coordinated with Site Operations. 3. Equipment will be shut down and terminations made in transfer switch. 4. Inspection and testing to be completed. 5. Energize panels and circuits.	The purpose of this MOPO is to refeed LPH and remove feeder conductors from MCC T1/T2 and install them in panel SWGR-1AA and SWGR-1AB.	TBD

++ END OF SECTION ++

SECTION 01013

ENGINEERING SERVICES

PART 1 - GENERAL

1.1 SUMMARY

A. The Work to be accomplished under these Contract Documents has been designed for the OWNER by a registered Professional Engineer retained by the OWNER for this purpose. It is understood that normal engineering for the purpose of interpretation of the Contract Documents is provided by the OWNER. Should any services of the ENGINEER be required to assist in the corrections of errors or omissions in construction by the CONTRACTOR, or services of the ENGINEER be required because of changes in structure or equipment where the CONTRACTOR has requested approval of substitute methods or materials, those services will be provided by the ENGINEER at the standard hourly rates previously negotiated with the OWNER and shall be paid for by the CONTRACTOR. Other services shall be described further in this Section.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 ENGINEERING SERVICES

A. The ENGINEER shall be reimbursed by the CONTRACTOR for the ENGINEER'S additional services to the Project through no fault of the OWNER or ENGINEER including, but not limited to, the following conditions:
   1. Additional Shop Drawing review(s) by the ENGINEER as described in Section 01300, Submittals.
   2. Additional site visits, investigations, inspections, design work, and/or reports by the ENGINEER which are required due to damages to existing facilities or completed Work caused by the CONTRACTOR in his performance, the CONTRACTOR'S negligence, or the CONTRACTOR'S Work which is rejected as defective or as failing to conform to the Contract Documents.
   3. All retesting required due to the failure of the CONTRACTOR'S Work to meet the requirements of the Contract Documents shall be at the CONTRACTOR'S expense. All standby and travel time by the OWNER'S testing lab or ENGINEER due to CONTRACTOR'S inability to be prepared for testing at the agreed upon time or inability of CONTRACTOR to meet performance requirements shall be at the CONTRACTOR'S expense. An hourly rate of three times the direct labor cost, but not less than $125/hour, will be charged to the

CONTRACTOR for every hour of engineering or testing lab personnel time, plus the cost of any retesting on a per test basis.

B. The ENGINEER shall bill the OWNER for additional Engineering Services performed as described in these Documents. The OWNER shall withhold payment for this from the CONTRACTOR'S final payment. A change order shall be executed deleting the amount due from the Contract sum and final payment.

++ END OF SECTION ++

SECTION 01040

COORDINATION

PART 1 - GENERAL

1.1 SUMMARY

A. The CONTRACTOR will be required to coordinate his activities with the pertinent utilities, the OWNER'S staff, subcontractors, and equipment suppliers in order not to delay the CONTRACTOR'S Project schedule and to minimize the disruption to plant operation throughout the construction period.

1.2 RELATED SECTIONS

A. Section 01300, Submittals.

1.3 SEQUENCING AND SCHEDULING

A. CONTRACTOR shall submit to the ENGINEER and OWNER a construction schedule in accordance with Section 01310, Progress Schedule.

B. The CONTRACTOR shall be responsible for coordinating in a timely manner with pertinent utility companies to avoid conflicts with their facilities.

C. The CONTRACTOR shall receive approval of the construction schedule prior to commencement of the Work.

D. The CONTRACTOR shall be responsible for coordinating the Work among all subcontractors as necessary.

E. The CONTRACTOR shall be responsible for all construction coordination necessary so that the Project may remain on schedule.

F. The CONTRACTOR shall coordinate the following with the OWNER and the ENGINEER.
   1. Testing.
   2. Inspections.
   3. Starting of Systems.
   4. Operations and Maintenance Training.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

++ END OF SECTION ++

SECTION 01050

FIELD ENGINEERING/SURVEYING

PART 1 - GENERAL

1.1 SUMMARY

A. The CONTRACTOR shall hire a surveyor licensed in the State of Arizona to perform all surveying responsibilities. It is also the CONTRACTOR'S responsibility to notify the ENGINEER, in writing, of any discrepancy found between the topographic survey provided and the baseline conditions provided in the Contract Documents within 14 days of the Notice to Proceed. The CONTRACTOR further takes the responsibility to correct any discrepancies not reported to the ENGINEER within the specified construction schedule as part of the finished grading required as part of this Project at no cost to the OWNER.

B. The licensed surveyor shall also fulfill construction staking requirements and responsibilities as specified in Article 6 of the General Conditions.

C. The CONTRACTOR shall provide competent, qualified personnel and materials required to perform all construction layout staking of the Work and will protect and preserve the established reference points and will make no change or relocations without the prior written approval of the OWNER.

D. The CONTRACTOR will report to the OWNER whenever any reference point is lost or destroyed or requires relocation because of necessary changes in grades or locations. The CONTRACTOR will replace and accurately relocate all reference points so lost, destroyed, or moved.

E. Field surveying shall include GIS location of all new underground piping and fittings as required by the City of Chandler.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

++ END OF SECTION ++

SECTION 01090

REFERENCE STANDARDS/ABBREVIATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section lists many of the construction industry organizations, professional and technical associations, societies and institutes, and government agencies issuing, promoting, or enforcing standards to which references may be made in the Contract Documents along with the abbreviations commonly used for those references. Also included are certain general requirements for the use of industry standards specified and for application of the standards in quality control.

1.2 USE OF REFERENCE STANDARDS

A. Work specified by reference to the published standard or specification of a government agency, technical association, trade association, professional society or institute, testing agency, or other organization shall conform to or surpass the minimum standards of quality for materials and workmanship established by the designated standard or specification.

B. Where so specified, products or workmanship shall also conform to the additional prescriptive or performance requirements included within the Contract Documents to establish a higher or more stringent standard of quality than that required by the referenced standard.

C. Where the specific date or issue of the standard is not included with the reference to the standard, the edition, including all amendments published and available on the first published date of the Invitation to Bid, shall apply.

D. Where two or more standards are specified to establish quality, the product and workmanship shall conform to or surpass the requirements of both.

E. In case of conflict between referenced standards, the more stringent shall apply.

F. Where both a standard and a brand name are specified for a product in the Contract Document, the proprietary product named shall conform to or surpass the requirements of the specified reference standard. The listing of a trade name in the Contract Documents shall not be construed as warranting that such product conforms to the respective reference standard.

G. Copies of Standards:
   1. Copies of applicable referenced standards have not been bound in the Contract Documents.

2. Where copies of standards are needed by the CONTRACTOR for superintendence and quality control of the Work, obtain a copy or copies directly from the publication source and maintain in an orderly manner at the job site, available to the CONTRACTOR'S personnel, subcontractors, OWNER, and ENGINEER.
3. Submit for approval the requests to use products conforming to printed standards or publications with a different publication date from that effective under the Contract. Clearly indicate the changes in product or workmanship quality involved in the proposed change, if any, and reasons for the request.

1.3 ABBREVIATIONS

A. Abbreviations for trade organizations and government agencies. The following is a list of construction industry organizations and government agencies to which references may be made in the Contract Documents, with abbreviations used.

AA	Aluminum Association
AAMA	American Architectural Manufacturers Association
AAMA	Architectural Aluminum Manufacturers' Association
AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
ADEQ	Arizona Department of Environmental Quality
ADHS	Arizona Department of Health Services
AFBMA	Anti-Friction Bearing Manufacturers' Association
AGMA	American Gear Manufacturers' Association
AHC	Architectural Hardware Consultant
AI	Asphalt Institute
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AMCA	Air Moving and Conditioning Association
ANSI	American National Standards Institute
ARI	Air Conditioning and Refrigeration Institute
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc.
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AWI	Architectural Woodwork Institute
AWS	American Welding Society
AWSC	American Welding Society Code
AWI	Architectural Woodwork Institute
AWWA	American Water Works Association
BHMA	Builders Hardware Manufacturers' Association
CDA	Copper Development Association
CISPI	Cast Iron Soil Pipe Institute
CMAA	Crane Manufacturers' Association of America

CRSI	Concrete Reinforcing Steel Institute
CSI	Construction Specifications Institute
FS	Federal Specification
GA	Gypsum Association
HI	Hydraulic Institute
HMI	Hoist Manufacturers' Institute
IBC	International Building Code
ICBO	International Conference of Building Officials
ICC	International Code Council
ICEA	Insulated Cable Engineers' Association
IECC	International Energy Conservation Code
IEEE	Institute of Electrical and Electronics Engineers, Inc.
IES	Illuminating Engineering Society
IFC	International Fire Code
IFGC	International Fuel Gas Code
IMC	International Mechanical Code
ISA	Instrument Society of America
IMIAWC	International Masonry Industry All Weather Council
JIC	Joint Industry Conferences of Hydraulic Manufacturers
LIA	Lead Industries Association
MAG	Maricopa Association of Governments
MBMA	Metal Building Manufacturers Association
MCESD	Maricopa County Environmental Services Department
MIA	Masonry Institute of America
MS	Military Specifications
MMA	Monorail Manufacturers' Association
NAAMM	National Association of Architectural Metal Manufacturers
NAAWS	North American Architectural Woodwork Standards
NEC	National Electrical Code
NEMA	National Electrical Manufacturers' Association
NESC	National Electric Safety Code
NFPA	National Fire Protection Association
NFPA	National Forest Products Association
NGA	National Glass Association
OSHA	Occupational Safety and Health Administration (both Federal and State)
PCI	Pre-cast Concrete Institute
PDI	Plumbing Drainage Institute
PS	Product Standards Section - U.S. Department of Commerce
RMA	Rubber Manufacturers' Association
SAE	Society of Automotive Engineers
SJI	Steel Joist Institute
SMACNA	Sheet Metal and Air Conditioning Contractors National Association
SSPC	Steel Structures Painting Council
TCNA	The Tile Council of North America

TMS	The Masonry Society
TPI	Truss Plate Institute
UBC	Uniform Building Code
UFC	Uniform Fire Code
UL	Underwriters' Laboratories, Inc.
WDMA	Window & Door Manufacturers Association
WEF	Water Environment Federation

B. Abbreviations for Common Terms:

AADF	Annual Average Daily Flow
ADA	Americans with Disabilities Act
ADMM	Average Day Maximum Month
AOC	Approval Of Construction
APP	Aquifer Protection Permit
ASR	Aquifer Storage and Recovery
ATC	Approval To Construct
AWRF	Airport Water Reclamation Facility
BFP	Belt Filter Press
BOD	Biochemical Oxygen Demand
BWPS	Backwash Pump Station
CCB	Chlorine Contact Basin
CCP	Concrete Cylinder Pipe
CFU	Colony Forming Units
CIP	Capital Improvement Program
CLSM	Controlled Low-Strength Material
COD	Chemical Oxygen Demand
DCS	Distributed Control System
DIP	Ductile Iron Pipe
DO	Dissolved Oxygen
DSD	Development Services Department
EL	Elevation
EPDM	Ethylene Propylene Diene Monomer
FOPP	Fiber Optic Patch Panel
FRP	Fiberglass Reinforced Plastic
GPD	Gallons Per Day
GPM	Gallons Per Minute
GRIC	Gila River Indian Community
GRS	Galvanized Rigid Steel
HP	Horsepower
HVAC	Heating, Ventilation, and Air Conditioning
ICC-ES	International Code Council Evaluation Service, Inc.
IMLR	Internal Mixed Liquor Recycle
IPC	International Plumbing Code
IPS	Influent Pump Station
LCA	Limited Condition Assessment
LCP	Local Control Panel

LED	Light-Emitting Diode
MBR	Membrane Bioreactor
MCC	Motor Control Center
MCP	Motor Control Panel
MGD	Million Gallons per Day
MLE	Modified Ludzack-Ettinger
MLSS	Mixed Liquor Suspended Solids
MOPO	Maintenance Of Plant Operations
NPW	Non-Potable Water
NTU	Nephelometric Turbidity Units
OCS	Odor Control System
OIT	Operator Interface Terminal
OMG	Ocotillo Management Group
OWRF	Ocotillo Water Reclamation Facility
PD	Positive Displacement
PIN	Process Information Network
PLC	Programmable Logic Controller
PSI	Pounds per Square Inch
PVC	Polyvinyl Chloride
Q	Influent Flow
RAS	Return Activated Sludge
RMB	Rapid Mix Basin
RPM	Rotations Per Minute
RW	Reclaimed Water
RWPS	Reclaimed Water Pump Station
SCADA	Supervisory Control And Data Acquisition
SCFM	Standard Cubic Feet per Minute
SES	Service Entrance Station
SHF	Solids Handling Facility
SHT	Sludge Holding Tank
SOTE	Surface Oxygen Transfer Efficiency
SWD	Side Water Depth
TBF	Traveling Bridge Filters
TDPS	Tank Drain Pump Station
TDS	Total Dissolved Solids
TN	Total Nitrogen
TOC	Table Of Contents
TSS	Total Suspended Solids
UV	Ultraviolet
VCP	Vendor Control Panel
VFD	Variable Frequency Drive
VPP	Vendor Power Panel
WAS	Waste Activated Sludge
WRF	Water Reclamation Facility
WSE	Water Surface Elevation
WW	Wash Water

WWEQ	Wash Water Equalization
WWTF	Wastewater Treatment Facility

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

++ END OF SECTION ++

SECTION 01202

PROGRESS MEETINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Date and Time:
   1. Regular weekly meetings for the duration of construction or as designated by ENGINEER.
   2. Other Meetings: On call.

B. Place: ENGINEER'S field office or mutually agreed upon location.

C. ENGINEER shall prepare agenda, preside at meetings, and prepare and distribute a transcript of proceedings to all parties.

D. CONTRACTOR shall provide data required and be prepared to discuss all items on agenda.

1.2 MINIMUM ATTENDANCE

A. CONTRACTOR, subcontractors and suppliers as required, representatives present for each party shall be authorized to act on their behalf.

B. ENGINEER.

C. Others as appropriate.

1.3 AGENDA

A. Agenda will include, but will not necessarily be limited to, the following:
   1. Transcript of previous meeting.
   2. Progress since last meeting.
      a. CONTRACTOR.
      b. Subcontractors.
   3. Planned progress for next period.
   4. Shop Drawings.
   5. Problems, conflicts, and observations.
   6. Change Orders.
   7. Applications for Payment.
   8. Quality standards and control.
   9. Schedules, including status of off-site fabrication and delivery schedules. Corrective measures required.
   10. Coordination between parties.
   11. Safety concerns.

12. Other business.
13. Next meeting date.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

++ END OF SECTION ++

SECTION 01300

SUBMITTALS

PART 1 - GENERAL

1.1 SUMMARY

A. The CONTRACTOR shall include a completed transmittal form for all submittals. Transmittal forms will be furnished to CONTRACTOR by ENGINEER at the pre-construction conference.

1.2 SECTION INCLUDES

A. Shop Drawings.

B. Material and equipment record.

C. Samples.

D. Operation and Maintenance (O&M) Manuals.

E. Progress Schedule.

F. Progress reports.

G. Daily reports.

H. Testing results.

I. Pre-construction video.

J. Construction photographs.

K. Record Drawings.

L. Spare parts lists.

M. List of spare parts furnished.

1.3 DATA REFERENCE SYMBOLS AND DESCRIPTIONS

A. The submittal data required for Shop Drawings and operations manuals shall contain, but not necessarily be limited to, that data and material as defined by the coded legend set forth below. The submittal data required shall be as indicated and specified under various headings of the Specifications.
   1. Letters of Certification of Compliance on materials, equipment, etc.

2. Samples.
3. Final Certified Drawings showing outline dimensions, foundation layout or mounting information, and other pertinent dimensions.
4. Field erection instructions, assembly drawings and/or diagrams, detailed reference drawing lists, lists of erection details, and list of spare parts supplied with equipment.
5. Shop Detail Drawings showing individual sub- assemblies and fabricated pieces with material specifications and other applicable data.
6. Installation instructions, operating and/or service manuals, and all other data pertinent to operating or servicing the complete apparatus. Preventative maintenance instructions and recommended frequency.
7. Schematic and wiring diagrams of power, control, and piping systems. A detailed description of operation shall be included for each diagram to describe all modes of operation of the system indicated. Where the integrated system requires interlocking and control of other components in normal operation, these components shall be included in the description of operation.
8. General bulletins and catalog cuts describing complete apparatus, including operating principles and fundamentals.
9. Service data sheets showing design performance, utility requirements, etc., as applicable to the specific duty for which the equipment is furnished.
10. Certified head and capacity curves for pumps. Impeller size furnished and maximum size available shall be noted on these data sheets.
11. Curves and/or data for overall range of operation from minimum to maximum capacity or load, showing capacity or load, utilities motive medium required, total or incremental differential head, and other pertinent information applicable to the equipment or its component assemblies.
12. Materials of construction of all components.
13. Renewal parts list with diagrammatic or cross-section drawings showing part identification. Material analysis or trades designation for each significant part is to be noted on parts lists or on a separate sheet.
14. Stuffing box sizes; packing sizes; specifications and arrangement; and mechanical seal details, specifications, etc., if furnished in equipment.
15. Bearing manufacturer's standard identification and/or interchangeable number for all anti-friction bearings in the equipment proper and its accessory items.
16. Material gradation, design mix, job mix formula, and/or material analysis.
17. Concrete reinforcement drawings, details, and calculations. Reinforcement drawings shall be redrawn by the CONTRACTOR to allow for clarity and scale necessary for easy review by the ENGINEER.
18. Competed equipment data sheets.

B. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be

underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

C. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**

1.4 SHOP DRAWINGS

A.

A. Shop Drawings shall be submitted through Wilson Engineers' online document processing platform. All Shop Drawing review comments and associated documents shall be returned to the CONTRACTOR through Wilson Engineers' online document processing platform.

B. The ENGINEER will plan to return Shop Drawings to the CONTRACTOR within 21 days of receipt by the ENGINEER.

C. The CONTRACTOR may request submittals be reviewed up to two times for each equipment or construction material item, regardless of manufacturer or supplier, by the ENGINEER. For additional reviews, CONTRACTOR will reimburse the ENGINEER for additional labor as specified in Section 01013, Engineering Services.

D. The CONTRACTOR will be held responsible for any delay in progress of the Work due to resubmittal of Shop Drawings. Time for completion of the Contract will not be extended due to the CONTRACTOR'S failure to promptly submit complete and acceptable Shop Drawings, product data, and samples.

E. Do not execute Work required by Shop Drawings until accepted Shop Drawings are received from the ENGINEER.

F. Before submitting Shop Drawings for review, the CONTRACTOR shall check Shop Drawings for accuracy, ascertain that all Work contiguous with and having bearing on other Work shown on Shop Drawings is accurately drawn, and that Work shown is in conformity with Contract requirements. The CONTRACTOR is responsible for all submittals from subcontractors and suppliers.

G. All such Drawings and details, when submitted, must bear the stamp of approval of the CONTRACTOR, bearing checked data, as evidence that such Drawings and details have been checked by him. Said "stamp" shall clearly state that the CONTRACTOR has checked the Drawings and, by his signature, he so certifies. Any Drawings submitted without such executed stamp of approval, or whenever it is evident (despite the stamp) that the Drawings have not been checked, they will be returned to the CONTRACTOR for resubmission and will not be considered. In such event, it will be deemed that the CONTRACTOR has not complied with this provision and the CONTRACTOR shall bear risk of all delays to the same extent as if no Drawings or details had been submitted.

H. The CONTRACTOR shall prepare composite Drawings and installation layouts, when required to solve tight field conditions. Such Drawings shall consist of dimensioned plans and elevations, and must give complete information particularly as to size and location of sleeves, inserts, attachments, openings, conduits, ducts, boxes, structural interferences, etc. These composite Drawings and installation layouts shall be coordinated in the field by the CONTRACTOR and his subcontractors for proper relationship to the work of other trades, based on field conditions, and shall be checked and approved by them before submission to the ENGINEER for his final review. The CONTRACTOR shall have competent technical personnel readily available for such coordinating and checking, as well as for supervision of field installation of work as per the Drawings and installation layouts, which have been previously determined by him to be correct and carry the ENGINEER'S review stamp.

I. Submission of Shop Drawings (in either original submission or when resubmitted with corrections) constitute evidence that the CONTRACTOR has checked all information thereon, and that he accepts and is willing to perform the Work as shown in a workmanlike manner and in accordance with best standard practice.

J. Cost of any changes in construction due to improper checking and coordination by the CONTRACTOR shall be paid for by the CONTRACTOR, and the CONTRACTOR shall be responsible for all additional costs, including coordination.

K. Shop Drawings shall clearly delineate the following information:
   1. ENGINEER'S name and Project number; Project name and address.
   2. Drawing title, number, date, and scale.
   3. Names of CONTRACTOR, Subcontractor, and fabricator.
   4. Working and erection dimensions.
   5. Arrangements and sectional views.
   6. Necessary details, including complete information for making connections with other work.
   7. Kinds of materials and finishes.
   8. Show descriptive names of materials and equipment, classified item numbers, and locations at which materials or equipment are to be installed in the Work. Use same reference identification as shown on Contract Drawings.

L. If Shop Drawings show variations from Contract Documents because of standard shop practice or other reasons, make specific mention of such variations in a separate memo attached to information listed in Paragraph 1.3.B of this Section.

M. Shop drawing review will be general. It shall not relieve the CONTRACTOR of responsibility for accuracy of such Shop Drawings, nor proper fitting, construction of Work, furnishing of materials, or Work required by Contract Documents and not indicated on Shop Drawings. Shop drawing review shall not be construed as approving departures from Contract Documents.

N. Review of Shop Drawings and schedules shall not relieve the CONTRACTOR from responsibility for any violation indicated on such Drawings or schedules of local, County, State, or Federal laws, rules, ordinances, or rules and regulations of commissions, boards, or other authorities or utilities having jurisdiction.

O. When product data, consisting of manufacturer's printed literature, is required to be submitted to the ENGINEER, it shall be submitted in original form. Any fading type of reproduction will not be accepted. Pertinent information shall be indicated and irrelevant information shall be crossed out.

P. Action taken by ENGINEER shall apply to entire submittal. ENGINEER shall not approve portions of a submittal while disapproving other portions.

Q. Resubmitted submittal shall contain entirety of information to review.

R. The following is a list of anticipated submittals for this project, however it may not be a complete list. This list does not alleviate Contractor from obligations of requirements of each individual Technical Specification that may require additional information. See individual Technical Specification Sections for additional requirements.

CHANDLER WRF IMPROVEMENTS PHASE 3 – PROCUREMENT SUBMITTAL LISTING		
ITEM NO	**SPEC SECT**	**DESCRIPTION OF SUBMITTAL**
1	01012	PLANT OPERATION DURING CONSTRUCTION
2	01050	FIELD ENGINEERING/SURVEYING
3	01300	SUBMITTALS
4	01310	PROGRESS SCHEDULE
5	01380	CONSTRUCTION PHOTOGRAPHS
6	01500	CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS
7	01650	STARTING OF SYSTEMS
8	01700	CONTRACT CLOSEOUT
9	01715	TESTING OF HYDRAULIC STRUCTURES

10	01720	RECORD DOCUMENTS
11	01730	OPERATION AND MAINTENANCE DATA
12	01750	SPARE PARTS AND MAINTENANCE MATERIALS
13	01821	INSTRUCTION OF OPERATIONS AND MAINTENANCE PERSONNEL
14	02050	DEMOLITIONS
15	02150	SHORING
16	02315	EARTHWORK, EXCAVATION, AND BACKFILL
17	02318	CRUSHED STONE, GRAVEL AND DECOMPOSED GRANITE
18	02319	RIPRAP
19	02500	ASPHALT PAVEMENT
20	02580	PAVEMENT MARKINGS
21	02751	PORTLAND CEMENT CONCRETE PAVING
22	03200	CONCRETE REINFORCEMENT
23	03251	CONCRETE JOINTS
24	03252	ANCHORAGE IN CONCRETE
25	03300	CAST-IN-PLACE CONCRETE
26	03600	GROUT
27	03930	CONCRETE REPAIR AND REHABILITATION
28	05120	STRUCTURAL STEEL
29	05501	MISCELLANEOUS METAL FABRICATIONS
30	05522	ALUMINUM HANDRAILS AND RAILINGS
31	05532	ALUMINUM GRATING AND CHECKER PLATE
32	05581	FLOOR ACCESS HATCH COVERS
33	05600	FLAT PANEL COVERS
34	06611	FIBERGLASS REINFORCED PLASTIC FABRICATIONS
35	08113	HOLLOW METAL DOORS AND FRAMES
36	08331	OVERHEAD COILING DOORS
37	08710	DOOR HARDWARE
38	09900	PAINTING
39	09900.1	INTERIOR PAINTING
40	00920	COATING SYSTEMS
41	10400	EQUIPMENT IDENTIFICATION PLATES
42	11218	MAGNETIC DRIVE SEALLESS END SUCTION PUMPS
43	11295	HYDRAULIC VALVES
44	11310	VERTICAL TURBINE PUMPS
45	11313	LOW-FLOW PROPELLER (IMLR) PUMPS
46	11335	SECONDARY CLARIFIER MECHANISM
47	11375	AERATION SYSTEMS
48	11400	DISC FILTER SYSTEM
49	13213	PRECAST POLYMER CONCRETE TRENCH INSERT
50	13300	METAL BUILDING SYSTEMS
51	13400	ABOVEGROUND FUEL STORAGE TANK

52	13447	ELECTRIC MOTOR ACTUATORS
53	14610	DAVIT CRANES
54	14630	HOISTS, TROLLEYS, MONORAILS
55	15050	PIPING SYSTEMS
56	15051	BURIED PIPING INSTALLATION
57	15052	EXPOSED PIPING INSTALLATION
58	15061	DUCTILE IRON PIPE
59	15062	STEEL PIPE
60	15064	COPPER PIPE
61	15065	THERMOPLASTIC PIPE AND ACCESSORIES
62	15066	STAINLESS STEEL PIPE
63	15067	FIBERGLASS REINFORCED PLASTIC PIPE AND ACCESSORIES
64	15068	REINFORCED CONCRETE PIPE
65	15120	PIPING SPECIALTIES AND ACCESSORIES
66	15140	SUPPORTS AND ANCHORS
67	15260	PIPING INSULATION
68	15441	SUMP PUMPS
69	15700	GENERAL HVAC REQUIEREMENTS
70	15710	SUMMARY OF WORK FOR HEATING, VENTILATING AND AIR CONDITIONING
71	15720	AIR HANDLING AND AIR DISTRIBUTION SPECIALTIES
72	15730	CLEANING MECHANICAL SYSTEMS
73	15732	PACKAGE HEAT PUMP AIR CONDITIONING UNITS
74	15734	SPLIT SYSTEM AIR CONDITIONING UNITS (DUCTLESS)
75	15780	CONDENSATE AND EQUIPMENT DRAIN SYSTEMS
76	15890	SHEET METAL DUCTWORK
77	15910	MECHANICAL SYSTEMS INSULATION
78	15950	TESTING MECHANICAL SYSTEMS
79	15951	TESTING, ADJUSTING AND BALANCING OF MECHANICAL SYSTEMS
80	16000	GENERAL ELECTRICAL REQUIREMENTS
81	16001	PACKAGED SYSTEMS AND PACKAGED CONTROL PANELS
82	16010	ELECTRICAL: BASIC REQUIREMENTS
83	16050	BASIC MATERIALS AND METHODS
84	16060	ELECTRICAL DEMOLITION
85	16062	LIGHTNING PROTECTION
86	16111	CONDUITS
87	16117	CONCRETE MANHOLES, HANDHOLES AND PULL BOXES
88	16123	600 VOLT CLASS CABLE

89	16124	INSTRUMENTATION CLASS CABLE
90	16130	OUTLET, PULL, AND JUNCTION BOXES
91	16137	UNDERGROUND DUCT BANKS
92	16141	WIRING DEVICES
93	16142	WEATHERPROOF WHILE IN USE OUTLET ENCLOSURES
94	16143	TERMINAL BLOCKS
95	16160	ENCLOSURES
96	16161	CONTROL PANELS
97	16170	GROUNDING AND BONDING
98	16190	SUPPORTING DEVICES
99	16195	ELECTRICAL IDENTIFICATION
100	16225	ELECTRIC MOTORS 250 HORSEPOWER OR LESS
101	16282	SURGE PROTECTIVE DEVICE
102	16307	15000 VOLT CLASS CABLE
103	16321	OIL FILLED SUBSTATION STRANFORMERS
104	16341	MEDIUM VOLTAGE SWITCHES
105	16343	MEDIUM VOLTAGE METAL-CLAD SWITCHGEAR
106	16412	LOW VOLTAGE CIRCUIT BREAKERS
107	16430	CUSTOMER POWER METERING SYSTEM
108	16431	LOW VOLTAGE DRAW-OUT METAL-ENCLOSED SWITCHGEAR
109	16440	DISCONNECT SWITCHES
110	16461	TRANSFORMERS - DRY TYPE
111	16470	PANELBOARDS
112	16474	MOTOR CONTROL EQUIPMENT
113	16475	MINI POWER CENTERS
114	16476	LOW VOLTAGE CIRCUIT BREAKERS
115	16477	600 V FUSES
116	16480	MOTOR CONTROLLERS
117	16481	MOTOR CONTROL CENTERS (MCC)
118	16482	SOLID STATE MOTOR CONTROLLERS
119	16485	VARIABLE FREQUENCY DRIVES – LOW VOLTAGE
120	16500	LIGHTING
121	16611	STATIC UNINTERRUPTIBLE POWER SUPPLY
122	16720	FIRE SURVEILLANCE AND ALARM SYSTEM
123	16912	ETHERNET NETWORK EQUIPMENT
124	16913	SINGLE MODE FIBER OPTIC CABLING
125	16920	ELECTRICAL ACCEPTANCE TESTING
126	16951	SHORT CIRCUIT, COORDINATION AND ARC FLASH HAZARD REPORT
127	17000	INSTRUMENTATION
128	17111	FLOAT SWITCHES
129	17120	PRESSURE TRANSMITTERS

130	17121	PRESSURE SWITCHES AND GAUGES
131	17124	SUBMERSIBLE LEVEL TRANSMITTER
132	17134	FLOW SWITCHES
133	17137	MAGNETIC FLOWMETERS
134	17150	LIMIT AND POSITION SWITCHES
135	17221	ELECTRONIC 4 –20 MA INDICATORS
136	17222	SIGNAL CONDITIONERS
137	17321	GAS DETECTION SYSTEM
138	17325	TURBIDITY AND TSS ANALYZERS
139	17451	DISTRIBUTED CONTROL SYSTEM
140	17452	PROGRAMMABLE LOGIC CONTROLLER SYSTEM SOFTWARE AND ACCESSORIES
141	17456	PROGRAMMING GENERAL
142	17461	PROGRAMMABLE LOGIC CONTROLLER SYSTEM (M340)

1.5 PROCEDURE

A. A letter of transmittal shall accompany each submittal. If data for more than one Section of the Specifications is submitted, a separate transmittal letter shall accompany the data submitted for each Section.

B. All letters of transmittal shall be submitted in duplicate.

C. At the beginning of each letter of transmittal, provide a reference heading indicating the following:
   1. OWNER'S Name: City of Chandler
   2. Project Name: WRF Improvements Phase 3
   3. Contract No.
   4. Transmittal No.
   5. Section No.

D. If any portion of a Shop Drawing deviates from the requirements of the Contract Documents, CONTRACTOR shall specifically note each variation in his letter of transmittal.

E. All Shop Drawings submitted for approval shall have a title block with complete identifying information satisfactory to ENGINEER.
   1. All Shop Drawings submitted shall bear the stamp of approval and signature of CONTRACTOR as evidence that they have been reviewed and verified to the completeness of the submittal by CONTRACTOR. Submittal without this stamp of approval will not be reviewed by ENGINEER and will be returned to CONTRACTOR. CONTRACTOR'S stamp shall contain the following minimum information:

Project Name: WRF Improvements Phase 3

CONTRACTOR'S Name: _____

Date: _____

Reference: _____

Item: _____

Specifications: _____

Section: _____

Page No.: _____

Para. No.: _____

Drawing No.: _____ of _____

Location: _____

Submittal No.: _____

Approved By: _____

F. In order to identify and track all submittals as separate and unique items, CONTRACTOR shall utilize the submittal identification numbering system as follows:
   1. The Submittal Number shall be a separate and unique number correlating to each individual submittal that is required to be tracked as a separate and unique item. The Submittal Number shall be a two part, nine character, alpha/numeric number assigned by CONTRACTOR in the following manner:
      a. The first part of the Submittal Number shall consist of five characters that pertain to the applicable Specification Section number.
      b. The second part of the Submittal Number shall consist of three numbers. The first digit identifies the Submittal type as follows:
         1) 0 - Shop Drawing.
         2) 1 - Operations and Maintenance Manual.
         3) 2 - Training Manual.
      c. The second and third digits (numbers 01 to 99) number each separate and unique Submittal submitted under each Specification Section.
      d. A dash shall separate the two parts of the Submittal Number.
      e. A typical Submittal Number for the third Working Shop Drawing submitted under Section 11400, Disc Filter System, would be 11400-0.03.

f. A typical Submittal Number for the first Working Operations and Maintenance Manual submitted under Section 11295, Hydraulic Valves, would be 11285-1.01.

1.6 MATERIAL AND EQUIPMENT RECORD

A. The CONTRACTOR shall maintain an up-to-date record of all materials and equipment furnished by him and any subcontractors to be incorporated in the Work.
   1. The ENGINEER will furnish the CONTRACTOR a master of the materials and equipment form. The CONTRACTOR shall maintain the records on reproductions of this form in the field office.

B. The CONTRACTOR shall provide the following information on these forms:
   1. The Specification Paragraph and Section Number where material or equipment are called for.
   2. Date ordered.
   3. Date required.
   4. The CONTRACTOR'S purchase order number.
   5. Supplier's purchase order number.
   6. Date promised.
   7. Date received.
   8. Supplier's name and address.
   9. Remarks.
   10. Shop Drawings and samples with approval date.
   11. Physical dimensions and ratings.
   12. Where submittal sheet describes items in addition to that item being submitted, the submitted item shall be clearly marked on the sheet and superfluous information shall be crossed out.

C. A digital copy of the materials and equipment record shall be submitted to the ENGINEER with each Application for Payment. If the current record has not been submitted, the Application shall not be reviewed and shall be returned to the CONTRACTOR as incomplete.

D. The CONTRACTOR shall permit free access to these records, including information on items recently received and not yet posted to the record by the ENGINEER or authorized representative of the OWNER at any time.

1.7 SAMPLES

A. Deliver no material to the building site prior to receipt of the ENGINEER'S written approval. Furnish materials equal in every respect to approved samples and execute Work in conformity therewith. Samples shall be provided with respective Shop Drawings.

B. The approval or acceptance of samples will not preclude the rejection of any material upon the discovery of defects in same prior to the Final Acceptance of the completed Work.

C. After a material has been approved, no change in brand or make will be permitted unless satisfactory written evidence is presented to and approved by the ENGINEER that the manufacturer cannot make scheduled delivery of approved material, or that material delivered has been rejected and substitution of suitable material is an urgent necessity, or that other conditions are apparent which indicate approval of such substitute materials to be in best interest of the OWNER. CONTRACTOR shall provide complete Shop Drawings for replacement product.

D. All samples of materials requiring laboratory tests shall be submitted to laboratory for testing not less than 90 days before such materials are required to be used in the work. Submit all other samples for approval within 30 days after signing of the Contract.

E. Submit samples in duplicate, except where greater or lesser number is specifically required by these Specifications. Submittal shall be made only by the CONTRACTOR, unless he has authorized his subcontractor to submit them and has notified the ENGINEER to this effect.

F. Each sample shall be accompanied by a Shop Drawing form and an itemized transmittal form. The transmittal shall contain list of samples, Project, CONTRACTOR, manufacturer, brand, quarry, quality, etc.; also Project number, Specifications reference, ASTM number (if any), and material being furnished. Enclose copies of transmittal with samples. Any deviation from Contract requirements shall be so stated in the transmittal.

G. Label each sample by a securely attached label giving the Project, CONTRACTOR, subcontractor or supplier, manufacturer's name, product trade name and number, material type, Specification Section and Paragraph reference etc.; also Project name and number and ASTM number (if any).

H. Samples shall be of adequate size to permit proper evaluation. The samples submitted shall show the full range of colors, textures and dimensions, and other variable characteristics expected. Samples of different items that must match or whose finish relates shall be delivered at the same time to facilitate coordination.

I. Samples which are rejected by the ENGINEER must be resubmitted as soon as possible after notification of rejection, and shall be marked "Resubmitted Sample" in addition to other information required.

J. The right is reserved to require submission of samples of any material, any material lists, or any information whether or not specifically specified in the Specifications.

1.8 OPERATION AND MAINTENANCE MANUALS

A. Three hard copies and one soft copy in a thumb drive, in PDF format, of an Operations and Maintenance (O&M) Manual containing the following items, in addition to any instructions packed with the equipment, are required for each individual item of equipment:
   1. Specifications.
   2. Drawings.
   3. Description of each individual item of equipment.
   4. Manufacturer name, model number, and serial numbers.
   5. Name address and phone number of both the manufacturer's customer service department and the local manufacturer's representative.
   6. Installation instructions.
   7. Operation and maintenance instructions, including lubrication schedule and lubricant specification.
   8. Parts list and part numbers.
   9. Spare parts list and spare parts numbers.
   10. Temporary storage recommendations.
   11. Warranty information.
   12. Final testing data.
   13. Additional data to be included in the manual shall be as required in these Specifications.

B. O&M Manuals are to be submitted to the ENGINEER upon delivery of the equipment to the site. Overall Project substantial completion will not be scheduled until all manuals are approved. Training shall not be scheduled until O&M Manuals are approved. Training shall not be scheduled until 30 days following delivery of approved O&M Manuals to the OWNER. Training shall be scheduled based on draft O&M Manuals upon approval of ENGINEER. Training shall be provided to the OWNER as one soft copy in a thumb drive and one digital copy.

C. The respective manuals for the individual items of equipment shall be combined into bound volumes covering the complete operating installation with individual equipment items tabled separately. Information for equipment subassemblies not manufactured by the major supplier shall also be included with the respective equipment item.

D. Manuals for particular items of equipment which are in the same area should be bound in the same volume where practicable.

E. Upon completion of the installation of each item of equipment, the CONTRACTOR shall provide As-Built Drawings of the local control panel to be added to the O&M Manual, as well as set-up parameters such as those required for VFDs, instrumentation, calibration, etc. Manuals for particular items of equipment which are in the same area (i.e., belt press, belt press feed pumps, and conveyors) should be bound in the same volume where practicable.

F. O&M Manuals shall be submitted in 3-ring binders meeting the following criteria:
   1. Binders shall be Wilson Jones Custom View Organization, D-Ring, white, non-stick, back mounted, binder models 362-13W, 386-14W, 386-34W, 386-44W, 386-49W, or 386-54W; or approved equal.
   2. Binder cover insert shall be created using a Microsoft word template supplied by ENGINEER. Modifications to the template shall be approved by the ENGINEER prior to submission of the O&M Manuals. The binder cover insert shall include the Specification number and title as presented within the Contract Documents, manufacturer name, year of purchase, year and month that equipment was placed into operation.
   3. Binder spine insert shall be created using a Microsoft word template supplied by ENGINEER. Modifications to the template shall be approved by the ENGINEER prior to submission of the O&M Manuals. The spine insert shall include the Specification number and title as presented within the Contract Documents, manufacturer name, year of purchase, year and month that equipment was placed into operation. Spine insert shall read top to bottom.

1.9 PROGRESS SCHEDULE

A. Progress Schedule as defined in Section 01310, Progress Schedule.

1.10 DAILY REPORTS

A. The CONTRACTOR will provide to the ENGINEER a daily report on a form provided by the ENGINEER indicating the Work in progress, Work completed, equipment used, numbers and category of personnel, and such other pertinent information as applicable. The daily reports shall be compiled and submitted monthly with the Application for Payment. The Application for Payment will not be reviewed and shall be returned to the CONTRACTOR as incomplete if the reports do not accompany it.

1.11 TESTING RESULTS

A. CONTRACTOR shall furnish to the ENGINEER copies of all testing results for all tests required in the Specifications.

1.12 CONSTRUCTION PHOTOGRAPHS

A. Construction photographs as defined in Section 01380, Construction Photographs.

1.13 RECORD DRAWINGS

A. Record Drawings as defined in Section 01700, Contract Closeout. The CONTRACTOR shall update Record Drawings Monthly and make available for review to the ENGINEER monthly one week prior to the Application for Payment submittal. Failure of the CONTRACTOR to maintain updated Record Drawings can be justification for refusal of Application for Payment.

1.14 UNIT RESPONSIBILITY

A. This Section contains the required Unit Responsibility Form for the CONTRACTOR to use in documenting Work required under this Contract.

B. The Unit Responsibility Form provided in Appendix A to this Section is referenced from other Sections in the Contract Documents. The CONTRACTOR shall submit it with the applicable equipment as required in those Sections.

1.15 CONTRACTOR'S FORMS

A. This Section contains the required forms for CONTRACTOR use in documenting testing Work and other Work required under this Contract. This Section supplements, but does not supersede, specific testing requirements found elsewhere in the Contract Documents.

B. The forms listed below are included in this Section and are referenced from other Sections in the Contract Documents. CONTRACTOR may utilize standard forms when authorized by ENGINEER. Forms will include, but will not necessarily be limited to, the following.

Form Designation	Title
A	Schedule of Values
B	Shop Drawings, Product Data and Sample Transmittal Schedule
C	Request for Change Order Proposal
D	Change Order Proposal
E	Request for Information
F	Request for Alteration
G	CONTRACTOR'S Daily Construction Report
H	Equipment Information Form
I	Manufacturer's Installation Certification Form
J	Equipment Test Report Form
K	Operation and Maintenance Transmittal Form
L	Manufacturer's Instruction Certification Form
M	Motor Data Form
N	Wire and Cable Resistance Test Data Form
O	Installed Motor Test Data Form
P	Dry Transformer Test Data Form
Q	Motor Control Center Test Form
R	Medium Voltage Motor Starter Test Form
S	Medium Voltage Switchgear Test Form
T	Protective Relay Test Form
U	Low Voltage Switchgear Test Form
V	Medium Voltage Load Interrupter Switch Test Form
W	Liquid-Filled Transformer Test Form

X	Automatic Transfer Switch Test Form
Y	Neutral Grounding Resistor Test
Z	Conduit and Wire Termination Sheet (not included)
AA	Loop Wiring and Insulation Resistance Test Data Form
BB	Control Circuit Piping Leak Test Form
CC	Controller Calibration Test Data Form
DD	Panel Indicator Calibration Test Data Form
EE	Recorder Calibration Test Data Form
FF	Signal Trip Calibration Test Data Form
GG	Field Switch Calibration Test Data Form
HH	Transmitter Calibration Test Data Form
II	Miscellaneous Instrument Calibration Test Data Form
JJ	Individual Loop Test Data Form
KK	Loop Commissioning Test Data Form
LL	Pipe Test Report

C. CONTRACTOR shall complete the above referenced forms prior to start-up of each piece of equipment, as listed in the Equipment and Valve Schedule. Each form shall pertain to each equipment number.

D. The CONTRACTOR shall submit to ENGINEER for approval one month after completion of start-up, a digital file for each process area with tabs and include all the forms completed prior to start-up. The forms shall be further tabbed within each process area of each form designation as listed above. For example, the Chemical Facilities tab (22) shall include separate tabs for forms H, J, K, and etc. The CONTRACTOR shall submit digital copies to the ENGINEER for approval.

E. All forms are provided in Appendix B of this Section.

1.16 ADDITIONAL SUBMITTALS

A. All additional submittals as required by the Contract Documents.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

APPENDIX A - Unit Responsibility Form

(Job Title)

CERTIFICATE OF UNIT RESPONSIBILITY
for Specification Section _____

_____
(Section title)

In accordance with Paragraph 01600.1.2.B of the Contract Documents, the undersigned manufacturer accepts unit responsibility for all components of equipment furnished under specification Section _____. We hereby certify that these components are compatible and comprise a functional unit suitable for the specified performance and design requirements.

_____
Notary Public

_____
Commission expiration date

Seal:

_____
Name of Corporation

_____
Address

By: _____
Duly Authorized Official

_____
Legal Title of Official

Date: _____

SCHEDULE OF VALUES

Sheet _____
of _____

Section No._____

Item Description	Material	Labor	Equipment	Total

SHOP DRAWINGS, PRODUCT DATA AND SAMPLE SUBMITTAL SCHEDULE

CONTRACTOR _____

Project Name _____

Project No. _____ Date _____ Page ___ of_____

Item No.	Description	Specification Section Number	Date To Be Submitted	Approval Needed By	Date Submitted	Date Reviewed	Transmittal Number

REQUEST FOR CHANGE ORDER PROPOSAL

Date: _____

CONTRACTOR _____

_____

_____

Project Name _____

Project No. _____

Change Order No. _____

NOTICE TO CONTRACTOR: Please submit a Change Order Proposal for the proposed modifications to the Contract Documents as described below. If acceptable, a Change Order will be issued to authorize the work. THIS IS NOT A CHANGE ORDER FOR AUTHORIZATION TO PROCEED WITH THE WORK AS DESCRIBED!

SCOPE OF WORK:

OWNER _____

CHANGE ORDER PROPOSAL

Date _____

Subject: Project Name _____

Project No._____

Change Order No._____

Dear Sir:

Certain items of extra work have been found necessary which are not covered by the Contract for the above referenced Project. Therefore, we submit the following amounts as the basis of compensation for such extra work:

JUSTIFICATION:

The Contract completion time will be (increased)(decreased) ____ consecutive calendar days.

Total Cost of Extra Work Covered by Above:	$_____
Previously Approved Extra Work:	$_____
Original Contract Amount	$_____
TOTAL:	$_____

By: _____

Title:_____

CONTRACTOR: _____

CITY OF CHANDLER
REQUEST FOR INFORMATION

CONTRACTOR _____ RFI# _____
Requested By _____ Directed to _____
Subject _____ Date Received _____
Spec. Section _____ Date Transmitted _____
Drawing References _____ Date Reply Received _____
Date Reply Needed _____ Date Reply Transmitted _____

INFORMATION NEEDED:

Date _____ Signature _____

REPLY:

Date _____ Signature _____

CITY OF CHANDLER
REQUEST FOR ALTERATION

CONTRACTOR_____ RFA# _____
Requested By_____ Directed to _____
Subject_____ Date Received _____
Spec. Section_____ Date Transmitted _____
Drawing References_____ Date Reply Received _____
Date Reply Needed_____ Date Reply Transmitted _____

REQUESTED ALTERATION:

Date _____ Signature _____

REPLY:

Date _____ Signature _____

CONTRACTOR _____

_____

_____

CONTRACTOR'S DAILY CONSTRUCTION REPORT

Project Name _____

Project No. _____ Report No. _____

_Date _____

CONTRACTORS WORK FORCE:		SUBCONTRACTORS WORK FORCE:		EQUIPMENT ON SITE:		
					In Use	Not in Use
Administrative	_____	Mechanical	_____	Cranes	____	____
Supervisors	_____	Electrical	_____	Loaders	____	____
Carpenters	_____	Instrumentation	_____	Dozers	____	____
Iron Workers	_____	Sitework	_____	Scrapers	____	____
Operators	_____	Masonry	_____	Compactors	____	____
Finishers	_____	Roofing	_____	Compressors	____	____
Welders	_____	Rebar	_____	Welders	____	____
Electricians	_____	Foundation	_____	Graders	____	____
Laborers	_____	Painting	_____	Trucks	____	____
_____	_____	_____	_____	Backhoe	____	____
_____	_____	_____	_____	_____	____	____
_____	_____	_____	_____			

Work Performed: _____

_____

_____

Material and Equipment Delivered: _____

_____

_____

Remarks: _____

_____

_____

By: _____

Title: _____

CITY OF CHANDLER
EQUIPMENT INFORMATION FORM

Name: _____ Date: _____

EQUIP #: _____ Desc: _____

COP #: _____ Type: _____

Manuf: _____ Locat: _____

Model #: _____ Vendor:_____

Serial #: _____ Doc. Ref: _____

DWG. Ref: _____ Assoc. Equip: _____

Size: _____ HP: _____

GPM: _____ PH/DC: _____

Temp: _____ Volts: _____

PSI: _____ Amps: _____

CFM: _____ RPM: _____

Output: _____ Power Ser: _____

Range: _____ Frame: _____

Order #: _____ Encl: _____

Electrical Data: _____

_____

_____

_____

Mechanical Data: _____

_____

_____

_____

Frequency	Week #	Work To Be Done
_____	_____	_____
_____	_____	_____
_____	_____	_____

MANUFACTURER'S INSTALLATION CERTIFICATION FORM

Contract No.: _____ Specification Section: _____

Equipment Name: _____

CONTRACTOR: _____

Manufacturer of Equipment Item: _____

The undersigned manufacturer of the equipment item described above hereby certifies that he has checked the installation of the equipment and that the equipment, as specified in the Contract Documents, has been provided in accordance with the manufacturer's recommendations, and that the trial operation of the equipment item has been satisfactory.

Comments: _____

_____

_____

_____

_____ _____

Date Manufacturer

_____

Signature of Authorized Representative

_____ _____

Date CONTRACTOR

_____

Signature of Authorized Representative

EQUIPMENT TEST REPORT FORM

NOTE: This example equipment test report is provided for the benefit of CONTRACTOR and is not specific to any piece of equipment to be installed as a part of this project. The example is furnished as a means of illustrating the level of detail required for the preparation of equipment test report forms for this project.

A.

CITY OF CHANDLER

_____ CONTRACTOR

EQUIPMENT/SYSTEM TEST REPORT

Equipment Name: _____
Equipment Number: _____
Specification Ref: _____
Location: _____
System: _____

	CONTRACTOR		ENGINEER	
	Verified	Date	Verified	Date
PREOPERATIONAL CHECKLIST				
Mechanical				
Lubrication.	_____	_____	_____	_____
Alignment.	_____	_____	_____	_____
Anchor bolts.	_____	_____	_____	_____
Seal water system operational.	_____	_____	_____	_____
Equipment rotates freely.	_____	_____	_____	_____
Safety guards.	_____	_____	_____	_____
Valves operational.	_____	_____	_____	_____
Hopper purge systems operational.	_____	_____	_____	_____
Sedimentation tank/hopper clean.	_____	_____	_____	_____
O&M Manual information complete.	_____	_____	_____	_____
Manufacturer's installation certificate complete.	_____	_____	_____	_____

	CONTRACTOR Verified	CONTRACTOR Date	ENGINEER Verified	ENGINEER Date
Electrical (circuit ring-out and high-pot tests)				
Circuits:				
Power to MCC __.	_____	_____	_____	_____
Control to HOA.	_____	_____	_____	_____
Indicators at MCC:				
Red (running).	_____	_____	_____	_____
Green (power).	_____	_____	_____	_____
Amber (auto).	_____	_____	_____	_____
Indicators at local control panel.	_____	_____	_____	_____
Wiring labels complete.	_____	_____	_____	_____
Nameplates:				
MCC.	_____	_____	_____	_____
Control station.	_____	_____	_____	_____
Control panel.	_____	_____	_____	_____
Equipment bumped for rotation.	_____	_____	_____	_____
Piping Systems				
Cleaned and flushed:				
Suction.	_____	_____	_____	_____
Discharge.	_____	_____	_____	_____
Pressure tests.	_____	_____	_____	_____
Temporary piping screens in place.	_____	_____	_____	_____
Instrumentation and Controls				
Flowmeter FE_____ calibration	_____	_____	_____	_____
Calibration Report No._____				
Flow recorder FR_____ calibrated against transmitter.	_____	_____	_____	_____
VFD speed indicator calibrated against independent reference.	_____	_____	_____	_____
Discharge overpressure shutdown switch calibration.	_____	_____	_____	_____
Simulate discharge overpressure shutdown.	_____	_____	_____	_____

	CONTRACTOR Verified	CONTRACTOR Date	ENGINEER Verified	ENGINEER Date

EQUIPMENT/SYSTEM PERFORMANCE TESTS

Mechanical

Motor operation temperature satisfactory.	_____	_____	_____	_____
Pump operating temperature satisfactory.	_____	_____	_____	_____
Unusual noise, etc?	_____	_____	_____	_____
Pump operation: 75 gpm/50 psig	_____	_____	_____	_____
Measurement:				
Flow _____				
Pressure _____ Test gage number _____				
Alignment hot.	_____	_____	_____	_____
Dowelled in.	_____	_____	_____	_____

Remarks: _____

_____

_____

Electrical

Local switch function:				
Runs in *HAND*	_____	_____	_____	_____
No control power in *OFF*	_____	_____	_____	_____
Timer control in *AUTO*	_____	_____	_____	_____
Overpressure protection switch PS_____ functional in both *HAND* and *AUTO*	_____	_____	_____	_____
Overpressure protection switch PS_____ set at 75 psig	_____	_____	_____	_____
PLC 2500 set at 24-hour cycle, 25 min *ON*	_____	_____	_____	_____

Equipment/System Performance Test Completed

Contractor _____ Date _____

Equipment/System Performance Test Accepted

Engineer _____ Date _____

OPERATION AND MAINTENANCE TRANSMITTAL FORM

Date:_____ Submittal No.: _____

To: Contract No.: _____

_____ Spec. Section: _____

_____ Submittal Description: _____

_____ From: _____

Attention: _____ _____

Checklist	CONTRACTOR		ENGINEER	
	Satisfactory	N/A	Accept	Deficient
1. Table of Contents				
2. Equipment forms				
3. Manufacturer information				
4. Vendor information				
5. Safety precautions				
6. Operator pre-start				
7. Start-up, shutdown, and post shutdown procedures				
8. Normal operations				
9. Emergency operations				
10. Operator service requirements				
11. Environmental conditions				
12. Lubrication data				
13. Preventive maintenance plan and schedule				
14. Troubleshooting guides and diagnostic techniques				
15. Wiring diagrams and control diagrams				
16. Maintenance and repair procedures				
17. Removal and replacement instructions				
18. Spare parts and supply list				
19. Corrective maintenance man-hours				
20. Parts identification				
21. Warranty information				
22. Personnel training requirements				
23. Testing equipment and special tool information				

Remarks: _____

_____
CONTRACTOR'S Signature

MANUFACTURER'S INSTRUCTION CERTIFICATION FORM

Contract No:_____Specification Section: _____ Equipment Name: _____

_____

CONTRACTOR: _____

Manufacturer of equipment item: _____

The undersigned manufacturer certifies that a service engineer has instructed the plant operating personnel in the proper maintenance and operation of the equipment designated herein.

Operations Check List (check appropriate spaces)

Start-up procedure reviewed.	_____
Shutdown procedure reviewed.	_____
Normal operation procedure reviewed.	_____
Others: _____	_____
_____	_____

Maintenance Check List (check appropriate spaces)

Described normal oil changes (frequency).	_____
Described special tools required.	_____
Described normal items to be reviewed for wear.	_____
Described preventive maintenance instructions.	_____
Described greasing frequency.	_____
Others: _____	_____
_____	_____

_____ _____
Date Manufacturer

_____
Signature of Authorized Representative

_____ _____
Date Signature of OWNER'S Representative

_____ _____
Date Signature of CONTRACTOR'S Representative

MOTOR DATA FORM

Equipment Name_____

Equipment No.(s) _____

Site Location _____

Nameplate Markings

Mfr _____ Mfr Model _____ Frame _____ HP____
Volts _____ Phase _____ RPM _____ Service factor ____
FLA _____ LRA _____ Freq _____ Amb temp rating _____degrees C
Time rating _____ Design letter _____
(NEMA MG1-10.35) (NEMA MG-1.16)

KVA code letter _____ Insulation class _____

The following information is required for explosionproof motors only:

A. Approved by UL for installation in Class _____, Div _____

B. UL frame temperature code _____; Group _____ Atmosphere _____
(NEC Tables 500-2 and 500-2(b))

The following information is required for all motors 1/2 horsepower and larger:

A. Guaranteed minimum efficiency _____
(Section 11000)

B. Nameplate or nominal efficiency _____

Data Not Necessarily Marked on Nameplate

Type of enclosure _____ Enclosure material_____

Temp rise _____degrees C (NEMA MG1-12.41,42)

Space heater included?_____ Yes _____ No; if Yes, _____watts _____volts

Type of motor winding overtemperature protection, if specified: _____

Use the space below to provide additional information on other motor modifications, if specified:

_____

_____

WIRE AND CABLE RESISTANCE TEST DATA FORM

Wire or Cable No.:_____ Temperature, ºF _____

Location of Test	Insulation resistance, megohms
1. _____	_____
2. _____	_____
3. _____	_____
4. _____	_____
5. _____	_____
6. _____	_____
7. _____	_____

CERTIFIED _____ Date_____
CONTRACTOR'S Representative

WITNESSED _____ Date_____
OWNER'S Representative

INSTALLED MOTOR TEST DATA FORM

Motor Equipment Number _____ Date of test _____

Equipment Driven _____

MCC Location _____ Ambient temp _____ºF

Resistance:

Insulation resistance phase-to-ground megohms:

Phase A _____, Phase B _____, Phase C _____

Current at Full Load:

Phase _____ Current, amps _____

Phase _____ Current, amps _____

Phase _____ Current, amps _____

Thermal Overload Device: Manufacturer/catalog # _____ Amperes _____

Circuit breaker (MCP) setting: _____

Motor Nameplate Markings:

Mfr _____ Mfr type _____ Frame _____ HP_____

Volts _____ Phase _____ RPM _____ **Service factor _____

Amps _____ Freq _____ Ambient temp rating _____ ºC

Time rating _____ **Design letter _____
(NEMA 1-10.35) (NEMA MG-1.16)

Code letter _____ Insulation class _____

**Required for 3-phase squirrel cage induction motors only.

CERTIFIED _____ Date_____
CONTRACTOR'S Representative

WITNESSED _____ Date_____
OWNER'S Representative

DRY TRANSFORMER TEST DATA FORM

Equipment No. _____ Temperature _____

Location _____

Winding: Primary _____ Secondary_____

A. INSULATION-RESISTANCE TEST:
The test shall be made with a megohmmeter at the test voltage for a period of 1 minute.

Voltage rating	Test voltage	Test results (megohms) Phase	Phase
0-600	1000	A-GRD ____	A-B ____
601-5000	2500	B-GRD ____	B-C ____
5000+	5000	C-GRD ____	C-A ____

Resistance readings less than the manufacturer's recommended value or less than 10 megohms shall be brought to the attention of the ENGINEER.

B. DIELECTRIC-ABSORPTION TEST:
The test shall be made with a megohmmeter at the test voltage for a period of 10 minutes.

1. TEST RESULTS: (megohms)

Phase	Phase
A-GRD ____	A-B _____
B-GRD ____	B-C _____
C-GRD ____	C-A _____

2. POLARIZATION INDEX:

$$\frac{10\ minute\ reading}{1\ minute\ reading} = polarization\ index$$

(from Paragraph "A" above)

Phase	Phase
A-GRD ____	A-B ____
B-GRD ____	B-C ____
C-GRD ____	C-A ____

Polarization index values less than two shall be brought to the attention of the ENGINEER.

CERTIFIED _____ Date_____
CONTRACTOR'S Representative

WITNESSED _____ Date_____
OWNER'S Representative

MOTOR CONTROL CENTER TEST FORM

Equipment No. _____ Ambient room temperature _____

Location _____

A. MECHANICAL CHECK:

1. All bolted connections either bus to bus or cable to bus shall be torqued to the manufacturer's recommendations.

B. ELECTRICAL TESTS:

1. Measure insulation resistance of each bus section phase to phase and phase to ground for one minute using a megohmmeter at 1000 volts.

	Test results (megohms)		
Phase		Phase	
A-GRD	_____	A-B	___
B-GRD	_____	B-C	___
C-GRD	_____	C-A	___

2. Set the circuit breaker in the starter unit to comply with the requirements of NEC, Article 430-52 and Table 430-152.

3. Motor overload heater elements shall be sized and installed based on the actual nameplate full load amperes of the motor connected to the starter.

CERTIFIED _____ Date_____
CONTRACTOR'S Representative

WITNESSED _____ Date_____
OWNER'S Representative

MEDIUM VOLTAGE MOTOR STARTER TEST FORM

Equipment No. _____

Location _____

Room Temperature _____

A. The protective devices shall be set in accordance with the specification before the tests are performed.

1. Measure contact resistance (micro-ohms)
   Phase: A_____ B_____ C _____

   Contacts shall be replaced if resistance exceeds 50 micro-ohms.

2. Perform an insulation resistance test (1000 volts DC for 1 minute).

Phase	A	B	C	
Pole to ground	___	___	___	megohms
Across open pole	___	___	___	megohms
Pole to pole	AB_____	BC_____	CA_____	megohms

3. Perform minimum pickup voltage tests on trip and close coils.

4. Motor RTDs shall be tested by using a hot oil bath. The temperature at which the sensor trips shall be recorded for each RTD.

5. The Contactor shall be tripped by operation of each protective device.

CERTIFIED _____ Date_____
CONTRACTOR'S Representative

WITNESSED _____ Date_____
OWNER'S Representative

MEDIUM VOLTAGE SWITCHGEAR TEST FORM

Equipment No. _____

Location _____

Room Temperature _____

A. The protective devices shall be set in accordance with the specification before the tests are performed.

1. Measure contact resistance (micro-ohms)
   Phase: A____ B____ C _____

   Contacts shall be replaced if resistance exceeds 50 micro-ohms.

2. Perform an insulation resistance test (1000 volts DC for 1 minute).

Phase	A	B	C	
Pole to ground	__	__	__	megohms
Across open pole	__	__	__	megohms
Pole to pole	AB__	BC__	CA__	megohms

3. Perform minimum pickup voltage tests on trip and close coils.

4. Verify the instrument transformer ratios. Check the transformer's polarity electrically.

5. The Contactor shall be tripped by operation of each protective device.

CERTIFIED _____ Date_____
CONTRACTOR'S Representative

WITNESSED _____ Date_____
OWNER'S Representative

PROTECTIVE RELAY TEST FORM

Location _____

Switchgear Breaker No. _____

Protective Relay Description _____

A. The protective relays shall be tested in the following manner:

1. Each protective relay circuit shall have its insulation resistance tested to ground.

2. Perform the following tests on the specified relay setting:

a. Pickup parameters on each operating element.

b Timing test shall be performed at three points on the time dial curve.

c. Pickup target and seal-in units.

B. The results shall be recorded and signed by CONTRACTOR. A copy shall be provided to the ENGINEER.

CERTIFIED _____ Date_____
CONTRACTOR'S Representative

WITNESSED _____ Date_____
OWNER'S Representative

LOW VOLTAGE SWITCHGEAR TEST FORM

Equipment No. _____

Location _____

Room Temperature _____

A. The protective devices shall be set in accordance with the specification before the tests are performed.

1. Measure contact resistance (micro-ohms)

   Phase: A_____ B_____ C_____
   Contacts shall be replaced if resistance exceeds 50 micro-ohms.

2. Perform an insulation resistance test (1000 volts DC for 1 minute).

Phase	A	B	C	
Pole to ground	___	___	____	megohms
Across open pole	___	___	___	megohms
Pole to pole	AB ___	BC ___	CA __	megohms

3. Minimum pickup current shall be determined by primary current injection.

4. Long time delay shall be determined by primary injection at 300% pickup current.

5. Short time pickup and time delay shall be determined by primary injection of current.

6. Instantaneous pickup current shall be determined by primary injection.

7. Trip unit reset characteristics shall be verified.

8. Auxiliary protective devices, such as ground fault or under voltage relays, shall be activated to ensure operation of shunt trip devices.

CERTIFIED _____ Date_____
CONTRACTOR'S Representative

WITNESSED _____ Date_____
OWNER'S Representative

MEDIUM VOLTAGE LOAD INTERRUPTER SWITCH TEST FORM

Equipment Number _____

Location _____

Date _____

1. Measure switch blade resistance (micro-ohms).

   Phase: A_____ B_____ C_____

Contacts shall be replaced if resistance exceeds 50 micro-ohms.

2. Perform an insulation resistance test (1000 volts DC for 1 minute).

Phase	A	B	C	
Pole to ground		___	___	___ megohms
Across open pole		___	___	___ megohms
Pole to pole	AB___	BC ___	CA ___	megohms

The results shall be recorded and signed. A copy shall be provided to the ENGINEER.

CERTIFIED _____ Date_____
CONTRACTOR'S Representative

WITNESSED _____ Date_____
OWNER'S Representative

LIQUID-FILLED TRANSFORMER TEST FORM

Equipment Number _____

Location _____

Date/Weather Conditions _____

A. Perform the "Insulation-Resistance Test" and "Dielectric Absorption Test" using Dry Transformer Test Data Form.

B. Perform an applied voltage (low frequency dielectric) test in accordance with ANSI C57.12.90, Paragraph 10.5, Applied Voltage Test. Applied voltage levels shall be 75% of recommended factory test levels or recommended test levels of ANSI C57.12.00, Table 5.

C. Insulating oil shall be sampled and shall be laboratory tested for the following:

1. Dielectric strength.
2. Acid neutralization.
3. Interfacial tension.
4. Color.
5. Power factor.

D. Perform a turns ratio test between the windings for all tap positions.

E. The temperature and pressure switches shall be tested using a hot oil bath and air pump.

F. The results shall be recorded and signed by CONTRACTOR and ENGINEER. A copy shall be provided to the ENGINEER. Any readings which are abnormal to ANSI industry standards shall be reported to the ENGINEER.

CERTIFIED _____ Date_____
CONTRACTOR'S Representative

WITNESSED _____ Date_____
OWNER'S Representative

AUTOMATIC TRANSFER SWITCH TEST FORM

Equipment Number _____

Location _____

Date _____

1. Perform an insulation resistance test (1000 volts DC for 1 minute):

	Phase A	Phase B	Phase C	
Pole to ground	___	___	___	megohms
Pole to pole	AB___	BC___	CA___	megohms

2. Perform the following operations and initial:

   a. Manual transfer _____

   b. Loss of normal power; ___sec delay

   c. Return to normal power; ___sec delay

   The results shall be recorded and signed. A copy shall be provided to the ENGINEER.

CERTIFIED _____ Date_____
CONTRACTOR'S Representative

WITNESSED _____ Date_____
OWNER'S Representative

NEUTRAL GROUNDING RESISTOR TEST

Equipment No.: _____

Location: _____

Date: _____

A. The pickup and time delay setting on the ground fault relay shall be set in accordance with Division 16 Specifications.

1. The transformer neutral insulation resistance shall be measured with and without the grounding resistor connected to insure no parallel ground paths exist.

2. The protective relay pickup current shall be determined by injecting test current into the current sensor. The pickup current should be within ten percent of the dial setting. Record the dial setting and actual pickup tie.

3. The relay timing shall be tested by injecting 150% and 300% of pickup current into the current sensor. The relay timing shall be in accordance with the manufacturer's published time-current characteristic curves. Record the relay timing at 150% and 300% of pickup current.

4. The circuit interrupting device shall be operated by operating the relay.

B. The results shall be recorded and signed by the CONTRACTOR and ENGINEER.

CERTIFIED _____ Date _____
CONTRACTOR'S Representative

WITNESSED _____ Date _____
OWNER'S Representative

LOOP WIRING AND INSULATION RESISTANCE TEST DATA FORM

Loop No.:_____

List all wiring associated with a loop in table below. Make applicable measurements as indicated after disconnecting wiring.

			Continuity Resistance[1]		Insulation Resistance[2]			
Wire No.	Panel Tie	Field TB	Cond./ Cond.	Cond./ Shield	Shield/ Gnd.	Shield/ Cond.	Cond./ Gnd.	Shield/ Shield
A	____	____	--	(A/SH)	_____	_____	_____	_____
B	____	____	(A/B)	--	_____	_____	_____	_____
C	____	____	(A/C)	--	_____	_____	_____	_____
D	____	____	(A/D)	--	_____	_____	_____	_____
etc	____	____						

1 Continuity Test. Connect ohmmeter leads between wires A and B and jumper opposite ends together. Record resistance in table. Repeat procedure between A and C, A and D, etc. Any deviation of ±2 ohms between any reading and the average of a particular run indicates a poor conductor, and corrective action shall be taken before continuing with the loop test.

2 Insulation Test. Connect one end of a 500 volt megger to the panel ground bus and the other sequentially to each completely disconnected wire and shield. Test the insulation resistance and record each reading.

CERTIFIED _____ Date_____
CONTRACTOR'S Representative

WITNESSED _____ Date_____
OWNER'S Representative

CONTROL CIRCUIT PIPING LEAK TEST FORM

Loop No.:_____

List tubing associated with loop in table below. Make applicable measurements after isolating any air consuming pilots from circuit.

Tube No.	Tubing Equivalent Length of 1/4-Inch Copper[1]	Test Period (seconds)	Permitted Pressure Drop (psi)[2]	Measured Pressure Drop (psi)
A	_____	_____	_____	_____
B	_____	_____	_____	_____
C	_____	_____	_____	_____
D	_____	_____	_____	_____
Etc.	_____	_____	_____	_____

[1] Convert actual tubing and air motor volume to equivalent 1/4-inch copper tubing.

[2] Pressure drop shall not exceed 1 psi per hundred feet 1/4-inch tubing per 5 seconds.

CERTIFIED _____ Date_____
CONTRACTOR'S Representative

WITNESSED _____ Date_____
OWNER'S Representative

CONTROLLER CALIBRATION TEST DATA FORM

Tag No. and Description: _____

Make and Model No.:_____ Serial No.:_____

Input:_____ Process Variable (PV) Scale: _____

Output:_____ Output Scale: _____

PV Scale Calibration

% of Range	Input	Expected Reading	Actual Reading	% Deviation
0	_____	_____	_____	_____
50	_____	_____	_____	_____
100	_____	_____	_____	_____

% Deviation Allowed: _____

Connect output to PV for following tests:

	Set Point (SP) Indicator Accuracy		Output Meter Accuracy			Controller Accuracy		
SP	PV Reading	Expected % Dev.	Actual Reading	Expected Reading	Actual % Dev.	Output	Output	% Dev.
(0%)	_____	_____	_____	_____	_____	_____	_____	_____
(50%)	_____	_____	_____	_____	_____	_____	_____	_____
(100%)	_____	_____	_____	_____	_____	_____	_____	_____

%Dev. Allowed: _____ % Dev. Allowed:_____ % Dev. Allowed:_____

CERTIFIED _____ Date_____
CONTRACTOR'S Representative

WITNESSED _____ Date_____
OWNER'S Representative

PANEL INDICATOR CALIBRATION TEST DATA FORM

Tag No. and Description: _____

Make and Model No.:_____ Serial No.:_____

Input:_____

Scale:_____ Range: _____

PV Scale Calibration

% of Range	Input	Expected Reading	Actual Reading	% Deviation
0	_____	_____	_____	_____
50	_____	_____	_____	_____
100	_____	_____	_____	_____

% Deviation Allowed:_____

CERTIFIED _____ Date_____
CONTRACTOR'S Representative

WITNESSED _____ Date_____
OWNER'S Representative

RECORDER CALIBRATION TEST DATA FORM

Tag No. and Description: _____

Make and Model No.:_____ Serial No.: _____

Input:_____ Chart: _____

Scale:_____ Range:_____

% of Range	Input	Expected Reading	Actual Reading	% Deviation
0	_____	_____	_____	_____
50	_____	_____	_____	_____
100	_____	_____	_____	_____

% Deviation Allowed:_____

CERTIFIED _____ Date_____
CONTRACTOR'S Representative

WITNESSED _____ Date_____
OWNER'S Representative

SIGNAL TRIP CALIBRATION TEST DATA FORM

Tag No. and Description: _____

Make and Model No.:_____ Serial No.: _____

Input:_____

Scale:_____ Range:_____

Set Point(s):_____

After setting set point(s), run signal input through entire range and calculate deadband.

Set Point	Incr. Input Trip Point	Decr. Input Trip Point	Calc. Deadband	Required Deadband
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

CERTIFIED _____ Date_____
CONTRACTOR'S Representative

WITNESSED _____ Date_____
OWNER'S Representative

FIELD SWITCH CALIBRATION TEST DATA FORM

Tag No. and Description: _____

Make and Model No.:_____ Serial No: _____

Input:_____

Range:_____

Set Point(s):_____

Simulate process variable (flow, pressure, temperature, etc.) and set desired set point(s). Run through entire range of switch and calculate deadband.

Set Point	Incr. Input Trip Point	Decr. Input Trip Point	Calc. Deadband	Required Deadband
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

CERTIFIED _____ Date_____
CONTRACTOR'S Representative

WITNESSED _____ Date_____
OWNER'S Representative

TRANSMITTER CALIBRATION TEST DATA FORM

Tag No. and Description: _____

Make and Model No.: _____ Serial No.: _____

Input: _____

Output: _____

Range: _____ Scale: _____

Simulate process variable (flow, pressure, temperature, etc.) and measure output with appropriate meter.

% of Range	Input	Expected Output	Actual Output	% Deviation
0	_____	_____	_____	_____
50	_____	_____	_____	_____
100	_____	_____	_____	_____

% Deviation Allowed: _____

CERTIFIED _____ Date _____
CONTRACTOR'S Representative

WITNESSED _____ Date _____
OWNER'S Representative

MISCELLANEOUS INSTRUMENT CALIBRATION TEST DATA FORM

(For instruments not covered by any of the preceding test forms, CONTRACTOR shall create a form containing all necessary information and calibration procedures.)

CERTIFIED _____ Date_____
CONTRACTOR'S Representative

WITNESSED _____ Date_____
OWNER'S Representative

INDIVIDUAL LOOP TEST DATA FORM

Loop No.:_____

Description: (Give complete description of loop's function using tag numbers where appropriate.)

P&ID No.: (Attach copy of P&ID.)

a. Wiring tested:

b. Instrumentation tubing/piping tested:

c. Instruments calibrated:

d. List step-by-step procedures for testing loop parameters. Test loop with instruments, including transmitters and control valves, connected and functioning. If it is not possible to produce a real process variable, then a simulated signal may be used with the ENGINEER'S approval.

CERTIFIED _____ Date_____
CONTRACTOR'S Representative

WITNESSED _____ Date_____
OWNER'S Representative

LOOP COMMISSIONING TEST DATA FORM

Loop No.:_____

a. Loop tested:
(Attach Test Form 17007-J)

b. Controlled or connected equipment tests confirmed:

c. Give complete description of loop's interface with process.

d. With associated equipment and process in operation, provide annotated chart trace of loop response to changes in set points for verification of performance. This chart should demonstrate 1/4-amplitude damping as output adjusts to set point change. Show set points, starting and finishing times on chart, as well as any other pertinent data.

Connect 2-pen recorder to process variable (PV) and to controller output. Use 1 inch/second chart speed.
Pen 1 - PV - Connections:
Pen 2 - Output - Connections:

CERTIFIED _____ Date_____
CONTRACTOR'S Representative

WITNESSED _____ Date_____
OWNER'S Representative

CITY OF CHANDLER

PIPE TEST REPORT

CONTRACTOR: _____ DATE: _____

PIPING SYSTEM: _____

LOCATION: _____

REF. DRAWING NO.: _____

PIPE MATERIAL	PIPE JOINT	PIPE SIZE	TOTAL LENGTH TESTED	TEST PRESSURE	TEST TIME	ALLOW LOSS

ALLOWABLE LOSS FORMULA: _____

TYPE OF TEST: WATER _____ AIR _____ OTHER _____

TIME TEST STARTED: _____ STARTING TEST PRESSURE: _____

TOTAL TIME: _____ ACTUAL LOSS: _____

ACCEPTED: _____ REJECTED: _____

COMMENTS: _____

_____

_____

CONTRACTOR REPRESENTATIVE : _____
(NAME) (DATE)

ENGINEER REPRESENTATIVE: _____
(NAME) (DATE)

++ END OF SECTION ++

SECTION 01310

PROGRESS SCHEDULE

PART 1 - GENERAL

1.1 SUMMARY

A. To assure completion of the Work within the Contract times established, all activities of the CONTRACTOR shall be scheduled and monitored by use of a CPM (Critical Path Method) Schedule. The CONTRACTOR shall provide a CPM Schedule for Work done under this Contract in accordance with the requirements of this Section and the General Conditions.

B. The CONTRACTOR shall employ or retain services of at least one person experienced in CPM Scheduling for the duration of the Contract. This person shall cooperate with the ENGINEER and shall update the CONTRACTOR'S schedule as required by these Specifications.

C. A preliminary CPM Schedule for the entire Project shall be submitted to the ENGINEER at the Pre-construction Conference in bar chart forms. The bar chart shall be referenced to time.

D. At the Pre-construction Conference, the CONTRACTOR shall furnish to the ENGINEER a detailed preliminary CPM Schedule in bar chart form showing the CONTRACTOR'S proposed operations for the first four (4) months of the Contract period.

E. The CONTRACTOR shall submit, at the Pre-construction Conference a projection of estimated monthly payments through the life of the Contract. Initial projections shall be correlated with and provided at the same time as the Schedule of Values. Projections shall be updated when requested by the ENGINEER.

1.2 DEFINITIONS

A. Unless otherwise noted, terms shall be defined for this Project as follows:
   1. Activity - means a component step or operation in the construction of Work.
   2. Event - means a point in time during construction of the Work.
   3. Network or Network Diagram - means a flow diagram which is a symbolic representation of activities and events that must be performed in accordance with the Contract and which shows the order and interdependence of activities and the sequence in which Work is to be accomplished as planned by the CONTRACTOR.
   4. Earliest Start Date - means the earliest date on which an activity can start.
   5. Earliest Finish Date - means the earliest date on which an activity can finish without changing the Contract duration.

6. Latest Start Date - means the latest date on which an activity can start without changing the Contract duration.
7. Latest Finish Date - means the latest date on which an activity can finish without changing the Contract duration.
8. Latest Free Start Date - means the latest date on which an activity can start without affecting the scheduling of any other activities.
9. Latest Free Finish Date - means the latest date on which an activity can finish without affecting the scheduling of any other activities.
10. Total Float - means the number of calendar days by which an activity can be delayed without necessarily extended a pertinent Contract Time. Total Float is by definition at least equal to Contract Float.
11. Contract Float - If the schedule anticipates early completion of all or any part of the Work, Contract Float is the number of calendar days between CONTRACTOR'S anticipated date for early completion of all or any such part of the Work and the corresponding specified Contract Time.
12. Free Float - means the amount of time in calendar days by which an activity can be delayed without affecting the scheduling of any other activity.
13. Duration - means the amount of time in consecutive calendar days required to perform an activity from the date on which Work commences on the activity to the date on which the activity is complete.
14. Milestone - means a significant event such as date of Notice to Proceed, Substantial Completion, Final Completion, and specified mandatory completion dates when portions of the Work or site are to be turned over to the OWNER or other contractors.
15. Critical Path - means the continuous sequence of activities and events throughout the network that comprises the longest time path through the network from start to finish.
16. Critical Activity - means an activity which cannot be delayed without altering the Contract Times.
17. Mandatory Date - means the date specified for completion of a Work activity or when other contractors must be permitted to start Work.
18. Sub-network - means a network relating to a particular phase, portion, or subdivision of the Work.
19. Arrow Method - means that method of network diagram construction in which activities are represented by arrows.
20. Lag - means the amount of time between the commencement of an activity and the commencement of an activity which immediately follows it, expressed in the number of calendar days.
21. Lag Factor - means the amount of time between the commencement of an activity and the commencement of an activity which immediately follows it, expressed as a percentage of the duration of the first activity.

1.3 SUBMITTALS

A. All CPM Schedules (both original and revisions) shall be submitted per requirements of Specification 01300, Submittals. Each CPM Schedule submittal shall bear

CONTRACTOR'S stamp or written indication of approval as representative to OWNER that CONTRACTOR has determined or verified all data on that CPM Schedule, and that CONTRACTOR and the subcontractors and suppliers have reviewed and coordinated the sequences in that CPM Schedule with the requirements of the work.

B. At the Pre-construction Conference, the CONTRACTOR shall submit to the OWNER and ENGINEER sufficient descriptive information about the CPM software the CONTRACTOR has chosen to employ to comply with the requirements of this Section.

C. Neither the OWNER'S or ENGINEER'S review of a CPM Schedule, nor a statement of "Resubmittal Not Required", will relieve the CONTRACTOR from responsibility for complying with the Contract Times and those sequences of Work indicated in or required by the Contract Documents, or completing any Work omitted from that Progress Schedule within the Contract Times. The CONTRACTOR shall make appropriate adjustments or corrections in a CPM Schedule returned as "Revise and Resubmit" and shall submit to the ENGINEER the corresponding CPM Schedule resubmittal as required herein. CPM Schedule resubmittals shall use the same revision number followed by the letters "A", "B", etc., as applicable.
   1. CONTRACTOR shall submit to ENGINEER with the first Application for Payment, the initial progress schedule, and the schedule of Shop Drawing and sample submittals. CONTRACTOR shall correct all schedules returned for revision and resubmission, taking into account comments made by OWNER and ENGINEER and shall resubmit any schedule if directed by ENGINEER. The final revision of the schedule shall be the As Planned Schedule from which subsequent schedules revisions shall be developed and used by CONTRACTOR when making proposals or claims for adjustments in Contract Time or Contract Price.
   2. Early dates in the progress schedule shall be based on proceeding with all or part of the Work exactly on the date when the corresponding Contract Time commences to run. Late dates shall be based on completing all or part of the Work exactly on the corresponding Contract Time, regardless of whether CONTRACTOR anticipates early completion. If sequences of Work are imposed by the Contract Documents, the progress schedule shall show in detail CONTRACTOR'S approach to conforming with those sequences.
   3. Progress schedule revisions submitted shall (a) adequately depict CONTRACTOR'S current approach to remaining Work, (b) report on progress or schedule recovery actions, and (c) facilitate evaluation of progress payments, and (d) accurately depict the progress and sequence of the Work to date.

D. Shop Drawings: Submit for approval the following:
   1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓)

shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

2. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 MONTHLY PROGRESS REPORTS

A. On the first working day (or as otherwise scheduled) of each month, the CONTRACTOR shall meet with the ENGINEER and present, in duplicate, a report of his operations during the preceding month, including actual starting and ending dates on activities shown on the network diagram. Where such starting or ending dates were delayed beyond those required by the CPM Schedule, the CONTRACTOR shall describe the action he is taking to regain lost time and state the anticipated completion dates of subsequent activities affected by the delayed items. He shall also point out known or anticipated delays on continuing activities and outline the action he is taking to regain lost time, or avoid future delays, and state the anticipated completion dates of subsequent activities affected by the delayed items. On the basis of the reports presented at the meeting, the CONTRACTOR will develop a revised mathematical analysis, bar chart and narrative report, and will furnish eight copies therefore to the ENGINEER not later than the fifth working day of the month. The updated Bar Chart shall detail one-month window in the CPM Schedule. Each activity covering Work at the site shall reflect the Work of a specific crew, span 15 Business Days or less, and indicate which CPM Schedule Activity includes the same Work. Activities covering Submittals and the procurement of items of materials or equipment shall segregate the time required for preparation of Submittals, review and return of Submittals, and fabrication and delivery, as

applicable, and shall not combine items furnished by separate suppliers (first and second tiers).

B. Updated mathematical analyses shall include the information included in the initial submittal and the following additional information:
   1. Actual start date of activities which have been started by calendar date.
   2. Actual finish date of activities which have been completed by calendar date.
   3. Actual number of days worked on activities which have been completed.
   4. Percentage completion of activities which have been started.
   5. Actual dates on which attained Milestones were achieved.
   6. Additions or deletions of activities or events since the previous report.
   7. Changes in sequence or estimated duration of activities.
   8. Where progress along any path is behind schedule such that activities lying on the path are delayed by an amount greater than their initial Total Float, the Total Float shall show as a negative value.

C. The updated bar chart shall be a revision of the initial accepted bar chart based upon the updated mathematical analysis and shall show changes from the initial bar chart.

D. The updated narrative report shall be based upon the initial narrative report and shall describe in detail any revisions, either current or forecast, to information submitted with the initial narrative reports, together with a description of current and anticipated problems and delaying factors affecting progress of the Work, their impact on progress of the Work, and an explanation of corrective actions taken or proposed. The narrative shall, at a minimum, compare current Late Dates vs. Contract Times and Milestone Times; provide sufficient detail to allow objective verification of the progress of the Work; identify the assumptions made and activities affected in incorporating Work involved in Change Orders; describe actual or potential delays and their extent, related causes and the steps taken or anticipated to mitigate their impact; and itemize any revisions, and their bases, made in CPM Schedule activities and sequences.

3.2 REVISION OF NETWORK DIAGRAM

A. Unless the ENGINEER direct otherwise, the network diagram shall be revised every three months during the duration of the Project to reflect departures and changes from the previous network diagram. The revised network diagram shall be furnished to the ENGINEER with the corresponding Application for Payment. Each submittal shall consist of the required copies of the updated CPM Schedule narrative.
   1. Schedule Revisions shall be solely for the purpose of showing how the CONTRACTOR'S planning, scheduling, and execution of Work remaining demonstrate continued compliance with the Contract Times and those sequences of Work indicated in or required by the Contract Documents, and preparing schedule recovery plans. CPM Schedule Revisions shall accurately represent all changes, adjustments or updates in the sequencing and timing of Work remaining made or required to be made by the CONTRACTOR.

2. Schedule Revisions shall accurately portray how completed Work was performed and any delays and any other significant events experienced since the previous CPM Schedule Revision.
3. Schedule Revisions shall incorporate changes in ACTIVITIES and sequence agreed upon in previously authorized Change Orders.
4. The CONTRACTOR shall ensure that the CPM Schedule diagram accurately reflects for each Activity the "as-built" information shown on the pertinent documents, such as daily reports and Submittal logs (and in the later case, reflect dates for resubmissions and re-reviews). As a minimum, schedule as-built data shall include actual start dates (discounting early starts not representing true as-built conditions), remaining days of Work, percent complete, and actual finish dates (when the Activities were completed so that dependent Work could proceed).
5. The ENGINEER will return a CPM Schedule Revision Submittal with comments limited to the un-progressed portion within 20 days. If a re-submittal of a CPM Schedule Revision is required, the CONTRACTOR shall, within 10 days, submit the required copies of a corrected and adjusted CPM Schedule Revision. Once an issue of a CPM Schedule Revision is returned to the CONTRACTOR as "Re-submittal Not Required", with or without comments, it shall represent the most current CPM Schedule as of the date of the Revision, and it shall be the basis for monitoring of the CONTRACTOR'S performance and progress against Late Dates.
6. Each CPM Schedule Revisions Submittal shall include a statement signed by the CONTRACTOR certifying that the CONTRACTOR has not, as of the cut-off date of that CPM Schedule Revision, been delayed by any actions, of or failure to act by the OWNER or ENGINEER, except as otherwise specifically stated.

3.3 REPORTS

A. CPM Schedule reports shall include cost updates, written narratives, network logic diagrams, graphic bar tabular printouts, and graphic bar charts, in both detailed and summary format.

B. Network Diagrams shall legibly show the order and interdependence of activities, and the sequence in which the work is to be accomplished as planned by the CONTRACTOR.

C. Tabular printouts shall show one activity per line along with appropriate data for the purpose intended including various combinations of the following:
   1. Activity ID.
   2. Activity description.
   3. Preceding and succeeding activity identification and descriptions.
   4. Original duration (in calendar days).
   5. Revised duration (in calendar days).
   6. Days remaining (in calendar days).
   7. Percent complete.

8. Earliest start date (by calendar date).
9. Earliest finish date (by calendar date).
10. Latest start date (by calendar date).
11. Latest finish date (by calendar date).
12. Actual start date (by calendar date).
13. Actual finish date (by calendar date).
14. Total Float.
15. Free Float.

D. Activities shall include in addition to the construction activities, the submittal, review and approval of samples, manufacturers' data, and Shop Drawings, the procurement of materials and equipment, installation and testing.

E. Bar charts will be required for summary purposes to compare actual progress with baseline As-Planned Schedule.

F. The network diagram shall be made to a time schedule and shall show the order and interdependence of activities and sequence in which the Work is to be accomplished as planned by the CONTRACTOR. The diagram shall show how the start of a given activity is dependent upon completion of preceding activities and how its completion restricts the start of following activities. Float need not be shown on the network diagram.

G. The diagram shall be constructed in such a manner that sub-networks relating to particular phases or portions of the Work can be readily extracted or revised as required. Each sub-network shall show time allocations for Shop Drawing review and fabrication time in addition to work time. The network diagram shall show the following information related to the activities:
   1. Activity number or label if the precedence method of diagramming is being used or the preceding and following event numbers if the arrow method of diagramming is used.
   2. A brief description of the activity.
   3. Estimated duration in consecutive calendar days of each activity.
   4. If the precedence method of diagramming is being used, lags or lag factors may be used at the CONTRACTOR'S option.
   5. All activities relating to the furnishing and performance of the Work shall be shown. Activities which are interdependent because of restrictions of available manpower or construction equipment shall be so shown.
   6. In addition to construction activities, the diagram shall show the date of the Work authorization and mandatory completion dates.
   7. Detail of information shall be such that duration times of activities shall span 40 calendar days or less with not over 2% of the activities exceeding these limits. The activities which comprise separate portions of the Work shall be separately identifiable by coding.
   8. The network diagram shall be drawn on 11-inch by 17-inch size sheets with flow of activities generally from left to right. The critical path shall be clearly

marked. Wherever possible, activities relating to a particular sub-network shall be grouped together on a single sheet.

H. Mathematical analysis of the network diagram shall be based on the network diagram and shall be a computer printout tabulating each activity and showing the following information for each activity:
   1. Activity number or label if the precedence method of diagramming is being used or the preceding and following event numbers if the arrow method is being used.
   2. Activity description.
   3. Estimated duration in consecutive calendar days or each activity.
   4. Earliest start date by calendar date.
   5. Earliest finish date by calendar date.
   6. Latest start date by calendar date.
   7. Latest finish date by calendar date.
   8. Latest free start date by calendar date.
   9. Latest free finish date by calendar date.
   10. Total Float.
   11. Free Float.
   12. Critical activities and activities on critical path shall be marked.
   13. Earliest start and finish dates shall be regarded as CONTRACTOR'S scheduled start and finish dates.

I. Earliest start and finish dates shall be regarded as the CONTRACTOR'S scheduled start and finish dates.

J. The bar chart shall be based on the network diagram and mathematical analysis. Related activities may be grouped together into a single item. However, the completed bar chart shall consist of not less than 50 items. The length of each bar shall correspond to the net aggregate durations of activities represented by the bar. Portions of bars which represent critical activities shall be marked. Bars shall be broken during extended periods of no work such as shutdowns for inclement weather.
   1. The bar chart shall be drawn on 11-inch by 17-inch size sheets showing the total Contract duration in months. Bars representing related activities for any given portion of the Work shall be grouped together and a descriptive title shall be shown for each bar. A list of all activities represented by each bar shall be included with the bar charts.

K. The narrative report shall describe in detail, but not be limited to, the CONTRACTOR'S proposed methods of carrying out each phase or portion of the Work together with the number of personnel, number of shifts, hours per shift, work week, and the number, size and type of major pieces of construction equipment required for the work. The report shall include a charge showing the CONTRACTOR'S estimated monthly earnings and accumulated earnings.

L. Except where directed in writing by the OWNER, the CONTRACTOR shall promptly take appropriate action to recover schedule whenever the CONTRACTOR fails to achieve a Contract Time or Milestone Time or perform Activities within the Late Dates in the most current revision of the CPM Schedule, or the CONTRACTOR'S progress falls behind that required to comply with that Contract Time, Milestone Time, or Late Dates. The CONTRACTOR shall submit with the Application for Payment following recognition of the problem a schedule recovery plan describing the cause of schedule slippage or delayed progress and the actions taken to correct them within the shortest reasonable time.

M. Appropriate schedule recovery actions may include, but not be limited to, assignment of additional labor, subcontractors, or construction equipment, Work during other than normal working hours (subject to the requirements of Article 8 of the General Conditions), expediting of Submittals or deliveries, or any combination of any of them. Overlapping or re-sequencing of Activities to increase activity concurrence shall be appropriate only if properly substantiated in the schedule recovery plan.

N. The CONTRACTOR'S failure, refusal or neglect to (a) submit a schedule recovery plan furnishing sufficient and convincing evidence that the CONTRACTOR can recover schedule within the shortest reasonable time acceptable to the OWNER, or (b) take appropriate schedule recover action, shall be reasonable evidence that the CONTRACTOR is not prosecuting the Work with all due diligence and shall give sufficient basis to the OWNER to demand adequate, written assurance of performance under the General Conditions, withhold from any payment an amount based on the OWNER'S estimate of the liquidated damages that would become due because of the actual or anticipated late completion, and in the OWNER'S sole discretion, order alternate schedule recovery actions.

O. An extension in Contract Time or an increase in Contract Price arising from delays which postpone, extend or in any other manner alter the schedule or completion of all or part of the Work will not be granted unless the CONTRACTOR, through an analysis of a Schedule reflecting data as of the date prior to the origination of the delay, as designated in demonstrations that conditions justifying extensions in Contract Time or increases in Contract Price as provided in Articles 8 and 11 of the General Conditions, have been met, and that analysis by the CONTRACTOR is verifiable by objective evaluation.

P. A version of the As-Planned Schedule shall accurately show (a) all work progress (by the cut-off date) and any delays and any other significant events experienced before the cut-off date, and (b) any changed in Activities and sequences agreed upon in previously authorized Change Orders considering the proper records and all valid data provided under the requirements of Paragraphs 3.2 A.2.and 3.2 A.3., respectively. Any such As-Planned Schedule shall purposely exclude all Activity and sequencing changes initiated by the CONTRACTOR that affect Work after the cut-off date (whenever incorporated into any contemporaneous CPM Schedule

Revisions under the requirements of Paragraph 3. 2 A.1. or otherwise), until the timing and sequences suggested by those changes actually take place.

Q. The ENGINEER may refuse to recommend any part of the payment if, in the ENGINEER'S judgment, the CONTRACTOR'S failure, refusal or neglect to provide the required CPM Schedule information precludes a proper evaluation of the CONTRACTOR'S progress. The OWNER may withhold a set-off from any payment recommended by the ENGINEER, if in the OWNER'S judgment, the CONTRACTOR'S failure, refusal or neglect to provide the required CPM Schedule information precludes a proper evaluation of whether the CONTRACTOR is prosecuting the Work, or any separable part of the Work, with all due diligence or not.

++ END OF SECTION ++

SECTION 01380

CONSTRUCTION PHOTOGRAPHS

PART 1 - GENERAL

1.1 SUMMARY

A. Pre-construction Video:
   1. The CONTRACTOR shall furnish a pre-construction video recording of the entire Project site showing the existing condition of all pavement, concrete, piping, equipment, structures, landscaping, building, and other site features. The video shall be provided electronically shall be submitted through box or Procure to the ENGINEER and approved prior to mobilization or initiating any construction activities. The CONTRACTOR shall notify the ENGINEER at least 48 hours prior to making the recording so that the ENGINEER may accompany the recorder.

B. Ground Level Construction Photographs:
   1. The minimum number of color digital photographs required will be 200 per month.
   2. Take a minimum of 200 color digital photographs of the completed or substantially completed Work at Project Completion. These photographs shall be submitted with the Final Application for Payment. These photographs are not part of the photographs required under Paragraph 1.1 - B.1, above.
   3. The CONTRACTOR shall take color digital photographs daily of all underground work in progress; work being done that will be exposed above ground shall be photographed on a bi-weekly basis. Photographs shall be taken in such a way to include an area or directional landmark. A minimum of five overall general project photographs depicting the overall project activities shall be taken monthly. A photograph log shall be maintained throughout the project with the following information for each photo: photograph number, a brief description, date, job title, location or station of pipeline (if applicable), and direction of the view in the photograph. The CONTRACTOR shall submit a plan that illustrates how the photograph log will be organized for approval by the OWNER.
   4. ENGINEER will approve the views to be taken and select the time at which they will be taken. Views will vary depending on the Progress Schedule.
   5. Color digital photographs shall be taken and downloaded daily. Photos shall be grouped into folders and the folders shall be named with the date they were taken and a brief description of the photo subject. For example: '2016-01-31 Roadway Demolition.'
   6. A minimum of 15 color digital photographs will be taken each time the photographer is at the site.

7. Submit aerial photographs of the site with Initial and Final Application for Payment. One oblique photograph shall be taken from each cardinal direction (North, South, East, and West). Provide 2 copies of each. One copy for the ENGINEERS use and the other to be turned over to the OWNER.

C. Aerial Construction Photographs:
   1. The CONTRACTOR shall engage a professional aerial photographer to photograph the site prior to construction mobilization, at monthly intervals during construction, and following final inspection. The photos shall be taken from two elevations, 1:6400 and 1:3600.
   2. The pilot must be well qualified, possessing a minimum of 250 hours of photographic map flying experience. The photographer shall possess a minimum of 250 hours of experience representing actual time spent in executing vertical aerial photography on photographic assignments. Oblique photography is also considered as qualifying experience.
   3. The airplane to be used shall be entirely capable of stable performance at the necessary altitude and air speeds, and shall be equipped with all essential navigational and photographic instruments and accessories, and all maintained in operational condition during the period of the contract. No windows shall be interposed between the camera lens system and the terrain. The camera lens system shall not be in the direct path of any gases or oil from the aircraft engines.

1.2 PHOTOGRAPH FORMAT

A. Furnish all photographs electronically.

B. Provide all digital photographs electronically through box or Procure. The file format shall be ".png". The digital photographs shall be provided in addition to the standard photographs required under Paragraph 1.1-B.2, above. Provide a file for all required under paragraphs 1.1-B.1 and 1.1-B.2.

C. Provide interior and exterior photographs of each buried structure prior to burial. Provide a minimum of four internal views and four external views of each structure. One view shall be provided of each wall, detail, floor and top of structure.

PART 2 - PRODUCTS (NOT USED)

2.1 PROCEDURES

A. Requirements: Photographic exposures shall be taken during the construction period. The ENGINEER may vary the specified frequency so that significant progress or changes can be recorded on the photographs.

B. The ground level construction photographs shall be of aesthetic composition and shall depict the progress of the Work from the beginning of construction through and including the finished product and shall include, but not be limited to, the items listed in Section 01010, Summary of Work.

C. Ground-level construction photographs and aerial-construction photographs shall be submitted monthly shall be submitted with the application for payment. The Application for Payment shall not be reviewed and shall be returned to the CONTRACTOR as incomplete if the currently due photographs have not been submitted.

D. All buried piping above 4-inches shall be photographed prior to backfill. One photograph shall be taken at every 20 feet of length.

++ END OF SECTION ++

SECTION 01400

QUALITY CONTROL

PART 1 - GENERAL

1.1 SUMMARY

A. Provide quality control including field lining as specified herein.

1.2 RELATED SECTIONS

A. Section 01300, Submittals.

B. Section 01640, Materials and Equipment.

C. Section 01650, Starting of Systems.

1.3 QUALIFICATIONS

A. Installation of materials and equipment shall be performed in a workmanlike manner by mechanics skilled in their particular trade.

B. The determination for the performance qualification is the responsibility of CONTRACTOR and each welder or welding operator shall be qualified by tests using equipment, procedures and a base metal and electrode or filler wire from the same compatible group number that will be encountered in the applicable procedure. Welders or welding operators who make acceptable procedure qualification test welds will be considered performance qualified for the welding procedures used. Performance qualification shall be determined in accordance with Section IX of the ASME Boiler and Pressure Vessel Code. Welders and welding operators qualified by another employer may be accepted as permitted by ANSI B31.1. ENGINEER shall be notified 24 hours in advance as to the time and place of tests and, wherever practical, the tests shall be performed at the Work site. ENGINEER shall be furnished a listing of the names and identification symbol as noted on the performance qualification test records to be used to identify the work performed by the welder or welding operator who after completing a welded joint shall identify it as his work by applying his assigned symbol for permanent record.

1.4 REGULATORY REQUIREMENTS

A. Unless indicated or specified otherwise, all materials and workmanship for the mechanical trades shall conform to the editions of the various standards, codes, manuals and specifications in effect on the date of advertisement for bids.

1.5 CERTIFICATIONS

A. Submittals of certifications of compliance from the CONTRACTOR or manufacturer required as specified for equipment in these documents shall be submitted to the ENGINEER as specified in Section 01300, Submittals.

1.6 FIELD TESTING

A. All testing called for in the Specifications shall be the responsibility of the CONTRACTOR.

1.7 SUPERVISION OF INSTALLATION BY MANUFACTURER

A. As required in the individual equipment specifications, an experienced, competent, and authorized factory representative of the equipment manufacturer shall visit the site of the work and inspect, check, adjust if necessary, and approve the equipment installation, and shall be present when the equipment is placed in operation. The equipment supplier's representative shall revisit the job site as often as necessary until any trouble is corrected and the equipment installation and operation is satisfactory to ENGINEER. The equipment supplier's representative shall furnish to ENGINEER, through CONTRACTOR a written report certifying that the equipment (1) has been properly installed and lubricated; (2) is in accurate alignment; (3) is free from any undue stress imposed by connecting piping or anchor bolts; and (4) has been operated under full load conditions and that it operated satisfactorily.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 DEMONSTRATION

A. The CONTRACTOR shall demonstrate as, specified in Section 01650, Starting of Systems, to the satisfaction of the ENGINEER, OWNER and manufacturer's representative that all newly installed equipment operates in a satisfactory manner.

++ END OF SECTION ++

SECTION 01410

TESTING

PART 1 - GENERAL

1.1 SUMMARY

A. Testing:
   1. See Article 4.7.1 of the General Conditions for testing requirements and responsibilities. All Quality Control testing called for in the Specifications shall be the responsibility of the CONTRACTOR. Quality Assurance shall be by the ENGINEER. CONTRACTOR shall coordinate testing with the ENGINEER. Copies of all test reports shall be submitted to the ENGINEER. All retesting required due to the failure of the CONTRACTOR'S Work to meet the requirements of the Contract Documents shall be at the CONTRACTOR'S expense. All standby and travel time by the testing lab or the ENGINEER due to the CONTRACTOR'S inability to be prepared for testing at the agreed upon time, or inability of the CONTRACTOR to meet performance requirements, shall be at the CONTRACTOR'S expense.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

++ END OF SECTION ++

SECTION 01412

STORMWATER POLLUTION PREVENTION PLAN AND PERMIT

PART 1 - GENERAL

1.1 SUMMARY

A. Comply with the terms and conditions of Arizona Pollutant Discharge Elimination System (AZPDES) administered by the Arizona Department of Environmental Quality (ADEQ). Under provisions of that permit, CONTRACTOR is designated as permittee and responsible for providing necessary material and for taking appropriate measures to minimize pollutants in stormwater runoff from the Project. Obtain a DeMinimus Discharge Permit from ADEQ for any discharge that is to Waters of the U.S., and comply with the requirements of the permit.

B. The Contract Price shall include all material, labor, and other permits and incidental costs related to:
   1. Preparing, updating, and revising the Stormwater Construction Pollution Prevention Plan (SWPPP).
   2. Installing and maintaining all structural and nonstructural items chosen by CONTRACTOR to comply with the construction SWPPP.
   3. Cleanup and disposal costs associated with cleanup and repair following storm events or CONTRACTOR-caused spills on the Project.
   4. Implementing and maintaining Best Management Practices to comply with the OWNER'S stormwater code.
   5. Preparing the Notice of Intent and Notice of Termination shall be covered by the AZPDES General Permit for Arizona.
   6. Obtain and comply with DeMinimus Permit, if such permit is required.

C. Coordinate the requirements under this Section with Section 02315, Earthwork, Excavation, and Backfill, permit requirements. All necessary SWPPP controls and practices must be implemented prior to commencement of any construction activity.

1.2 RELATED SECTIONS

A. Section 02315, Earthwork, Excavation, and Backfill.

1.3 SUBMITTALS

A. Submit, at least two days prior to the initial start of construction on the Project, completed and signed Notice of Intent forms to the State of Arizona at the following addresses:
   1. Stormwater Program-Water Permits Section/NOI
      Arizona Department of Environmental Quality
      1110 West Washington, 5415B-3
      Phoenix, AZ 85007

B. Submit to the OWNER, no later than 30 days, before submitting to the State agency the following:
   1. Notice of Intent (NOI) to be covered by the AZPDES General Permit for Arizona, including certifications of signature.
   2. SWPPP for the Project, including certification of signature. Stormwater Plan shall include CONTRACTOR'S proposed temporary means for stormwater control during all phases of construction and include stormwater pumping/retention plans. This submittal shall be coordinated with CONTRACTOR'S Excavation Plan Submittal, specified in Section 02315, Earthwork, Excavation, and Backfill.
   3. A manual has been prepared by the Maricopa County Flood Control District to aid in CONTRACTOR'S preparation of the SWPPP. This manual, "Drainage Design Manual for Maricopa County Arizona, Volume III, Erosion Control" is available at the Flood Control District Office, 2801 West Durango Street, Phoenix, Arizona. The complete Construction General Permit is in the December 8, 1999, Federal Register available at local libraries and is also available from the ADEQ website at www.adeq.state.az.us/environ/water/permits/download/constgp.pdf.

C. Submit to the OWNER, as part of the Construction SWPPP, a construction site inspection report that includes the following:
   1. Inspection scope.
   2. Inspector qualifications.
   3. Observations of SWPPP non-compliance and corrective steps taken.
   4. Certificate of Compliance with SWPPP and the AZPDES General Permit for Stormwater Discharge in the event of no incidents. Reports shall be submitted each quarter, at a minimum, throughout the Contract duration.

D. Submit to the OWNER, upon Project completion, the Notice of Termination (NOT) of coverage under AZPDES General Permit.

E. Shop Drawings: Submit for approval the following:
   1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓)

shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

2. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

++ END OF SECTION ++

SECTION 01414

EARTHMOVING AND DUST CONTROL

PART 1 - GENERAL

1.1 SUMMARY

A. CONTRACTOR shall obtain all Earthmoving Permits and any other permits required for earthmoving and dust generating operations related to the Work, as required by the Maricopa County Air Pollution Control Regulations.

B. CONTRACTOR shall not cause or allow any dust generating operation, earthmoving operation, use of property, or any other operation which causes fugitive dust emissions that exceed the 20% visible emission opacity limit in Rule 300 of Maricopa County's Air Pollution Control Regulations.

C. If requested by the OWNER, ENGINEER, or Maricopa County representative, CONTRACTOR shall conduct opacity observations for visible emissions of fugitive dust in accordance with techniques specified in USEPA Reference Method 9.

D. In addition to Earthmoving Permits, CONTRACTOR shall obtain an approved Dust Control Plan from Maricopa County. At a minimum, the Dust Control Plan shall include the following information:
   1. Name(s), address(es), and phone number(s) of the person(s) responsible for the preparation, submittal, and implementation of the Dust Control Plan and responsible for the dust generating operations.
   2. A site plan that describes the total area of land surface to be disturbed (in acres); the operations and activities to be performed on the site; actual and potential sources of fugitive dust emissions; and the delivery, transportation, and storage areas for the site (including types of materials stored and appropriate size of material stock piles).
   3. Description of the Reasonably Available Control Measures (RACM) to be applied during all periods of dust generating operations at all actual and potential sources of fugitive dust.
   4. Description of dust suppressants to be applied, including product specifications; method, frequency, and intensity of application; type, number, and capacity of application equipment; and certifications related to the suppressant's appropriate and safe use.
   5. Description of specific surface treatment(s) or RACM used to control material track-out where unpaved or access points join paved surfaces.
   6. Description of at least one alternative RACM for each actual and potential fugitive dust source shall be designated as a contingency measure.

E. CONTRACTOR shall post a copy of all Earthmoving Permits as well as the approved Dust Control Plan, in a conspicuous location at the Work site and provide a copy of each to the ENGINEER.

F. CONTRACTOR shall maintain a daily written log that records the actual application or implementation of the RACMS described in the approved Dust Control Plan. CONTRACTOR shall maintain this written log and supporting documentation on-site and shall make available for review on request by ENGINEER, OWNER, or Maricopa County representative. CONTRACTOR shall retain copies of the Dust Control Plan, RACM implementation records, and all supporting documentations for a minimum of three years.

G. CONTRACTOR, at a minimum, shall provide all necessary equipment and materials to apply sufficient dust suppressants (e.g., water, etc.), properly clean (sweep, etc.) all track-out areas, and provide adequate physical stabilizations (e.g., gravel, recycled asphalt, etc.) to meet all requirements of the Earthmoving Permit and approved Dust Control Plan. CONTRACTOR shall use these methods to control fugitive dust generation from all CONTRACTOR operations on all CONTRACTOR areas including, but not limited to:
   1. Construction areas.
   2. Vehicle and equipment parking areas.
   3. Material storage areas.
   4. Office and trailer areas.
   5. Haul and access roadways.
   6. Track-out areas.
   7. All other areas where CONTRACTOR shall be working, storing, or parking vehicles, equipment, and materials.

H. CONTRACTOR shall pay all fines issued to the OWNER by the USEPA, ADEQ, or Maricopa County due to violation of CONTRACTOR'S Earthmoving Permit and Dust Control Plan.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

++ END OF SECTION ++

SECTION 01416

SPECIAL INSPECTIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:
   1. This Section describes the requirements for providing special tests and inspections required by the International Building Code.

B. Purpose:
   1. This Document was developed to address the requirements of the 2024 International Building Code IBC, chapter 17.
   2. One or more special inspectors will be hired by the Owner or the Owner's Agent to provide inspections during construction on the types of work stated herein.
   3. A Certificate of Special Inspections will be submitted to the Building Code Official as a condition for permit issuance. This specification includes a complete list of materials and work requiring special inspections, the inspections to be performed and a list of the minimum qualifications of the individuals, approved agencies or firms intended to be retained for conducting such inspections.

1.2 DEFINITIONS

A. Special Inspector: Representative of the Owner approved inspection agency designated for that portion of the work.

B. Testing Agency: Approved agency, not affiliated or hired by the Contractor, which is responsible for the materials testing requirements of the project including but not limited to concrete cylinder breaks, soils testing, and masonry materials testing.

C. Soils Engineer or Geotechnical Engineer: For the purposes of Special Inspection "Soils Engineer," "Geotechnical Engineering," and "Special Inspector" shall be interchangeable as pertains to the Division 02 specifications.

D. NICET: National Institute for Certification in Engineering Technologies.

E. RPSI: Registered Professional for Special Inspections.

1.3 CONTRACTOR'S RESPONSIBILITIES

A. Cooperate with testing agency personnel, special inspector, and agents of the Building Code Official and provide access to the work.

1. Providing access to the work shall include all labor and facilities to perform inspections and tests as listed in the specifications for the duration of the inspections or tests involved.
2. Provide means to obtain and handle samples taken on site.

B. Attend a pre-construction meeting to coordinate and clarify inspection and testing procedures, requirements.

C. Notify special inspector and/or testing agency of work to be inspected/tested minimum of 48 hours prior.

D. Work for which special inspections are required shall remain accessible and exposed for the purposes of special inspections until completion of required special inspections.

E. Any portion of work that is not in conformance shall be corrected and re-inspected. Such portions of the work shall not be covered or concealed until authorized by Owner's Representative.

F. Work to be inspected should be complete at time of inspector's arrival on-site.

G. Payment for Special Inspection services will be in accordance with the following:
   1. Payment described below is for the Testing Agency and Special Inspector costs and does not include the Contractor's costs listed in Paragraph 1.3 A.
   2. After Contractor notification, inspector arrives at site and performs inspection within the timeframe defined in Item 4 below.
      a. Inspection reveals work is satisfactory.
      b. Owner pays all costs associated with this inspection.
   3. After Contractor notification, inspector arrives at site and performs inspection within the timeframe defined in Item 4 below.
      a. Inspection reveals work is deficient.
      b. Contractor corrects deficiencies within timeframe defined in Item 4 below.
      c. Work is re-inspected and work is satisfactory.
      d. Owner pays all costs associated with this inspection.
   4. After Contractor notification, inspector arrives at site and work is not ready for inspection when inspector arrives.
      a. Inspector will remain on-site for a maximum of 2 hours awaiting the completion of the work.
      b. If work is not ready for inspection at the end of this period, inspector will be dismissed until Contractor requests re-inspection.
      c. All costs associated with this inspection trip will be charged to the Contractor.
   5. After Contractor notification, inspector arrives at site and performs inspection within the timeframe defined above.

a. Inspection reveals work is deficient.
b. Contractor attempts to correct deficiencies within 2 HR timeframe and calls for re-inspection.
c. Work is re-inspected and found to still be deficient.
d. Inspector will be dismissed.
e. All costs associated with this inspection trip will be charged to the Contractor.

6. Owner will pay for "passing" soils on the Project. Costs of corrective actions and cost of failed test areas requiring retesting are the sole responsibility of the Contractor.

H. Special Inspection is intended to be an independent quality assurance. Special Inspections shall not relieve the Contractor of any quality assurance, quality control, workmanship, or warranty responsibilities. Contractor's own personnel shall review all work to be inspected for conformance with Contract Documents prior to calling for inspection.

1.4 REPORTING DUTIES AND AUTHORITY

A. Reporting requirements for special inspector per IBC 2024.
1. Comply with requirements of IBC Section 1704.2.4.
2. Provide written documentation of all inspections and testing.
a. Include exact location of work.
b. If testing of specimens is included, include detailed information on storage and curing of specimens prior to testing.
3. Furnish inspection and test reports to the Contractor, the Engineer's Project Manager and the Owner's on-site representative.
a. Indicate that work inspected was done in conformance with approved construction documents.
b. Immediately report any discrepancies to the Contractor for correction.
1) Deficient work that has been covered up or concealed prior to re-inspection shall be reported to the Engineer and the Building Code Official.
c. If the discrepancies are not corrected in a timely fashion, notify the Engineer's Project Manager and Owner's on-site representative.
4. Issue an electronic report summarizing all inspections, corrective action notifications and resolution of discrepancies and non-conforming work every two weeks (14 calendar days).
a. Copy will be available to:
1) Engineer's Project Manager.
2) Owner.
3) The Building Code Official.
4) General Contractor.
5. At the end of the Project, the RPSI shall compile all test reports for each inspected material and for each Special Inspector and summarize into a single PDF and submit to the Engineer and Building Code Official.

a. Final summary report to be signed and sealed by a Registered Professional for Special Inspections stating:
    1) The required Special Inspections have been performed.
    2) All discrepancies have been resolved except as specifically stated in the summary report.

B. Special Inspector does not have authority to stop work or modify the requirements of the Contract Documents.

1.5 QUALIFICATIONS

A. Qualifications stated here are the minimum recommended by the Engineer. If the Building Code Official has more stringent qualifications, the more stringent qualifications will take precedence.

B. All Special Inspections and Testing to be done under the direction of a Professional Engineer or Registered Architect registered in the State of Arizona herein referred to as Registered Professional for Special Inspections (RPSI).

C. Soil, concrete, grout, steel and aluminum related testing.
1. The Testing Agency shall have a minimum of 10 years' experience in the testing of these materials.
2. The Testing Agency's technician(s) conducting this testing:
    a. Shall have a minimum of five years' experience in the testing of soil, concrete, mortar, grout, steel and aluminum as appropriate.
3. Concrete related work:
    a. International Code Council certification for Reinforced Concrete and American Concrete Institute Concrete Field-Testing Technician – Grade 1.

D. Special Structural Inspections:
1. Professional Engineers or Architects, licensed in the State of Arizona, may perform special inspections in accordance with their license qualifications.
2. Other individuals, working under the direct supervision of a licensed engineer and meeting the following qualifications, may perform special inspections.
3. Soils related work:
    a. NICET Level II Certification in geotechnical engineering technology/construction; or
    b. Registered Geologist; or
    c. Engineer Intern under the direct supervision of a Licensed Professional Engineer.
4. Concrete related work:
    a. International Code Council certification for Reinforced Concrete Special Inspector or American Concrete Institute Concrete Construction Special Inspector.
    b. Alternatively, may be an Engineer Intern under the direct supervision of a Licensed Professional Engineer.

5. Precast concrete erection related work:
    a. Engineer Intern under the direct supervision of a Licensed Professional Engineer.
6. Precast concrete erection welding:
    a. American Welding Society as a Certified Welding Inspector; or
    b. International Code Council Structural Steel and Welding Certification and American Welding Society Qualified and one year of related experience; or
    c. NDT Level II or II Certificate (for non-destructive testing only).
7. Steel and aluminum related work:
    a. Frame and material verification (Appendix E, Items 3 and 6):
        1) International Code Council Structural Steel and Welding Certification and one-year related experience.
        2) Alternatively, may be an Engineer Intern with appropriate training.
    b. Welding:
        1) American Welding Society as a Certified Welding Inspector; or
        2) International Code Council Structural Steel and Welding Certification and American Welding Society Qualified and one year of related experience; or
        3) NDT Level II or II Certificate (for non-destructive testing only).
    c. High strength bolting:
        1) International Code Council Structural Steel and Welding Certification and one-year related experience.
        2) Alternatively, may be an Engineer Intern with appropriate training.
8. Other equivalent certifications will not be acceptable unless approved by the Engineer.

1.6 TESTS

A. Selection of the material required to be tested shall be by the Owner's Testing Laboratory and not the Contractor.

1.7 SPECIAL TESTING AND INSPECTIONS

A. Testing laboratory: Special tests will be performed by the Owner's testing laboratory as specified.

B. The following types of work require special inspection as described in IBC. Refer to the following verification, testing, and inspection schedules.
    1. Appendix A, Cast-In-Place Concrete Special Inspection Schedule.
    2. Appendix D, Soils Verification and Inspection Schedule.
    3. Appendix E, Structural Steel Special Inspection Schedule.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

APPENDIX A
CAST-IN-PLACE CONCRETE SPECIAL INSPECTION SCHEDULE

Verification and Inspection	Reference Standard	Frequency of Inspection	
		Continuous During Task Listed	Periodic During Task Listed
1. Inspection of reinforcing steel, including prestressing tendons, and verify placement	ACI 318: Ch. 20, 25.2, 25.3, 26.6.1-26.6.3	—	X
2. Inspect anchors cast in concrete	ACI 318: 26.13.3.3	—	X
3. Inspection of adhesive and mechanical anchors post-installed in hardened concrete members (downward inclined orientations)	ACI 318: 26.13.3	—	X
4. Inspection of adhesive anchors post-installed in hardened concrete members (horizontally or upwardly inclined orientations to resist sustained tension loads)	ACI 318: 26.13.3.2	X	—
5. Verifying use of required design mix	ACI 318: Ch. 19, 26.4.3, 26.4.4	—	X
6. At the time fresh concrete is sampled to fabricate specimens for strength tests, perform slump and air content tests, and determine the temperature of the concrete.	ASTM C31, ASTM C172, ACI 318: 26.5, 26.12	X	—
7. Inspection of concrete placement for proper application techniques	ACI 318: 26.5	X	—
8. Verify maintenance of specified curing temperature and techniques	ACI 318: 26.5.3-26.5.5	—	X
9. Verify in-situ concrete strength, prior to removal of shores and forms from beams and structural slabs	ACI 318: 26.11.2	—	X
10. Inspect formwork for shape, location, and dimensions of the concrete member being formed	ACI 318: 26.11.1.2(b)	—	X

APPENDIX D
SOILS VERIFICATION AND INSPECTION SCHEDULE

Verification and Inspection	Reference Standard	Frequency of Inspection	
		Continuous During Task Listed	Periodic During Task Listed
1. Verify materials below shallow foundations are adequate to achieve the design bearing capacity	IBC 1705.6	—	X
2. Verify excavations are extended to proper depth and have reached proper material	IBC 1705.6	—	X
3. Perform classification and testing of compacted fill materials	IBC 1705.6	—	X
4. During fill placement, verify use of proper materials and procedures in accordance with the provisions of the geotechnical report. Verify densities and lift thicknesses during placement and compaction of compacted fill.	IBC 1705.6	X	—
5. Prior to placement of compacted fill, inspect subgrade and verify that site has been prepared properly	IBC 1705.6	—	X

APPENDIX E
STRUCTURAL STEEL SPECIAL INSPECTION SCHEDULE

Verification and Inspection	Reference Standard	Frequency of Inspection	
		Continuous During Task Listed	Periodic During Task Listed
1. Material verification of high-strength bolts, nuts and washers:			
a. Identification markings to conform to ASTM standards specified in the approved construction documents.	AISC 360: Table N5.6-1	—	X
b. Manufacturer's certificate of compliance required.	AISC 360: Table N5.6-1	—	X
2. Inspection of high-strength bolting:			
a. Bearing-type connections.	AISC 360: Table N5.6-2	—	X
3. Material verification of structural steel:			
a. Identification markings to conform to ASTM standards specified in the approved construction documents.	AISC 360: Chapter N	—	X
b. Manufacturers' certified mill test reports.	AISC 360: Chapter N	X	-
4. Material verification of weld filler materials:			
a. Identification markings to conform to AWS specification in the approved construction documents.	AISC 360: Table N5.4-1	—	X
b. Manufacturer's certificate of compliance required.	AISC 360: Table N5.4-1	—	X
5. Inspection of welding:			
a. Structural steel:		—	—
1) Complete and partial penetration groove welds.	AISC 360: Table N5.4-1, N5.4-2, N5.4-3	X	—
2) Multi-pass fillet welds.	AISC 360: Table N5.4-1, N5.4-2, N5.4-3	X	—
3) Single-pass fillet welds > 5/16".	AISC 360: Table N5.4-1, N5.4-2, N5.4-3	X	—

Verification and Inspection	Reference Standard	Frequency of Inspection	
		Continuous During Task Listed	Periodic During Task Listed
4) Single-pass fillet welds < 5/16".	AISC 360: Table N5.4-1, N5.4-2, N5.4-3	—	X

++ END OF SECTION ++

SECTION 01451

TESTING LABORATORY SERVICES FURNISHED BY OWNER

PART 1 - GENERAL

1.1 SUMMARY

A. The OWNER will employ and pay for an independent testing laboratory to perform Quality Assurance only.

B. Inspection, sampling, and testing for Quality Assurance shall be as specified in the individual Sections. These include, but are not limited to:
   1. Section 02315, Earthwork, Excavation, and Backfill.
   2. Section 02318, Crushed Stone, Gravel and Decomposed Granite.
   3. Section 02500, Asphalt Pavement.
   4. Section 03300, Cast-In-Place Concrete.
   5. Section 03600, Grout.
   6. Section 04220, Single-Wythe Unit Masonry.
   7. Section 05120, Structural Steel.
   8. Section 15050, Piping Systems.

C. The OWNER will pay for the testing listed above for Quality Assurance only, except for repeat testing which results from CONTRACTOR'S negligence or his repeated failure to meet Contract Document requirements.

D. CONTRACTOR shall pay for:
   1. All Quality Control testing called for in the specifications.
   2. Tests made for CONTRACTOR'S convenience.
   3. Repeat tests required because of CONTRACTOR'S negligence or repeated failure, three or more tests for the same item, to meet Contract Document requirements.

E. The testing laboratory is not authorized to approve or accept any portion of the Work; rescind, alter, or augment the requirements of the Contract Documents; or perform any duties of CONTRACTOR.

1.2 QUALIFICATIONS OF LABORATORY

A. Where applicable, the testing laboratory will meet "Recommended Requirements for Independent Laboratory Qualification", latest edition, published by American Council of Independent Laboratories, and the basic requirements of ASTM E329 "Standards of Recommended Practice for Inspection and Testing Agencies for Concrete and Steel as Used in Construction".

B. Testing equipment used by the laboratory will be calibrated at maximum 12 month intervals by devices of accuracy traceable to either National Bureau of Standards or accepted values of natural physical constants.

1.3 LABORATORY DUTIES

A. The Testing Laboratory shall:
   1. Cooperate with CONTRACTOR and provide qualified personnel promptly on notice.
   2. Perform specified inspections, sampling, and testing of materials and methods of construction; comply with applicable standards; and ascertain compliance with requirements of Contract Documents.
   3. Promptly notify ENGINEER and CONTRACTOR of irregularities or deficiencies of Work that are observed during performance of services.
   4. Promptly submit five copies of reports of inspections and tests to ENGINEER, including:
      a. Date issued.
      b. Project title and number.
      c. Testing laboratory name and address.
      d. Date of inspection or sampling.
      e. Record of temperature and weather.
      f. Date of test.
      g. Identification of product and Specification Section.
      h. Location in Project.
      i. Type of inspection or test.
      j. Results of tests and observations regarding compliance with Contract Documents.
   5. Perform additional tests and services as required by OWNER.

1.4 CONTRACTOR'S RESPONSIBILITIES

A. CONTRACTOR shall:
   1. Cooperate with laboratory personnel and provide access to Work and to manufacturer's operations.
   2. Provide to laboratory preliminary representative samples of materials to be tested, in required quantities.
   3. Furnish copies of product test reports.
   4. Provide to the laboratory the preliminary design mix proposed for concrete and other material mixes that require testing by the testing laboratory.
   5. Furnish labor and facilities:
      a. To provide access to Work to be tested.
      b. To obtain and handle samples at the site.
      c. To facilitate inspections and tests.
      d. For laboratory's exclusive use for storage and curing of test samples.
      e. Forms for preparing concrete test beams and cylinders.

6. Notify laboratory and ENGINEER sufficiently in advance of operations to allow for assignment of personnel and scheduling of tests.
7. Arrange with laboratory and pay for additional samples and tests required for CONTRACTOR'S convenience.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

++ END OF SECTION ++

SECTION 01500

CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish and install construction facilities and temporary controls as specified herein including all appurtenances required or a complete and operational facility.

1.2 SECTION INCLUDES

A. Temporary utilities required during construction.

B. Temporary construction facilities, including field offices.

C. Requirements for security and protection of facilities and property.

D. Requirements for access to the Work.

E. Temporary controls for protection of environment.

F. Project sign.

1.3 SUBMITTALS

A. Temporary Utility Submittals:
   1. Electric power supply and distribution plans.
   2. Temporary water supply and distribution plans.
   3. Copies of approvals of local utility companies for CONTRACTOR'S intended temporary utility plans.

B. Temporary Construction Submittals:
   1. Access roads and parking area plans.
   2. Storage building plans, including gravel surfaced area.
   3. Fencing and protective barrier locations and details.
   4. ENGINEER'S and plant staff field office plans and equipment list.
   5. Staging area plan and notification of any obstructions encountered during mobilization.

C. Shop Drawings: Submit for approval the following:
   1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the

specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

2. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**

1.4 STAGING AREA

A. Use the area designated for CONTRACTOR'S temporary facilities as shown on Drawings. CONTRACTOR shall use a separate entrance to enter the staging area and the trailer area. All construction vehicles shall stay off the main entrance.

B. Notify ENGINEER of obstructions not shown or not readily apparent by visual inspection of the staging area. Do not remove obstructions without OWNER'S prior consent.

1.5 TEMPORARY UTILITIES

A. Costs after Substantial Completion:
   1. Upon acceptance of the Work or a portion of the Work defined and certified as substantially complete by ENGINEER, and OWNER commences full-time successful operation of the facility or portion thereof, the OWNER will bear the cost for utilities used for OWNER'S operation. CONTRACTOR shall continue to pay for temporary utilities used until Final Acceptance of the Work, except as provided herein.

B. Electric Power:
   1. The CONTRACTOR shall make arrangements with the OWNER for obtaining temporary electric power service during the Contract period.
   2. Temporary electric power installations shall meet construction safety requirements of OSHA, State, and other governing agencies.

C. Water:
   1. The OWNER will furnish, without charge, reasonable quantities of construction water required by the CONTRACTOR in performance of the Work under the

Contract. However, the CONTRACTOR shall provide all facilities necessary to convey the water from the OWNER-designated source to the points of use in accordance with the requirements of the Contract Documents.

2. The CONTRACTOR shall not make connection to or draw water from any water system without first obtaining permission from the OWNER or the authority having jurisdiction over the use of the said water system. For each water system connection, the CONTRACTOR shall first attach to the water system a valve and a meter. The size and type of valve and meter shall be acceptable to OWNER or jurisdictional authority.
3. Before Final Acceptance of the Work, all temporary connections to the said water system shall be entirely removed. All affected improvements shall be restored to their original condition or better, to the satisfaction of the ENGINEER and to the OWNER or jurisdictional authority.
4. All potable water used by CONTRACTOR'S employees, subcontractor's employees and the temporary construction facilities during construction shall be furnished by the CONTRACTOR and shall be bottled water or water furnished in approved metal dispensers. Notices shall be posted conspicuously throughout the site warning temporary piped water may be contaminated.

D. Temporary Fire Protection:
   1. The CONTRACTOR shall provide all facilities and equipment necessary to provide temporary fire protection for the Chandler Airport WRF and Ocotillo WRF Project sites in accordance with the requirements of the 2018 International Fire Code.

E. Sanitation:
   1. Provide and maintain sanitary facilities for CONTRACTOR'S employees and subcontractors' employees that comply with regulations of local and State health departments.
   2. Provide chemical toilets of suitable types and maintain them in a sanitary condition at all times conforming to code requirements and acceptable to health authorities. They shall be of watertight construction so that no contamination of the area can result from their use. The CONTRACTOR shall make arrangements for frequent emptying of toilets. Upon completion of Work, CONTRACTOR shall remove toilets and restore area to original condition.
   3. Use of OWNER'S existing sanitary facilities by construction personnel will not be allowed unless OWNER approval is provided.

F. Communications:
   1. The CONTRACTOR shall provide and maintain at all times during the progress of the Work, not less than one telephone in good working order at the CONTRACTOR'S construction field office.

1.6 PROJECT SIGN

A. Submit a layout drawing for approval showing the location, size, and color of logos and lettering.

B. The sign shall be maintained in good condition until completion of the Contract, at which time the sign shall become the property of the OWNER.

C. The CONTRACTOR and his subcontractors may erect signs for information and direction. No commercial or advertising signs will be allowed on the site of the Work.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 SECURITY

A. The CONTRACTOR shall provide security such as fencing and locked gates to prevent unauthorized persons from entering the construction site and a secured storage area for materials and equipment.

B. The CONTRACTOR shall safely guard all work, materials, equipment, and property from loss, theft, damage, and vandalism.

C. The CONTRACTOR shall make no claim against the OWNER for damage resulting from trespass.

D. If existing fencing or barriers are breached or removed for purposes of construction, the CONTRACTOR shall provide and maintain temporary security fencing equal to the existing in a manner satisfactory to the ENGINEER and OWNER.

E. Security measures taken by the CONTRACTOR shall be at least equal to those usually provided by the OWNER to protect his existing facilities during normal operation.

F. Maintain security program throughout construction until Final Acceptance and occupancy precludes need for the CONTRACTOR'S security program.

G. All costs for security as specified in this Section shall be borne by the CONTRACTOR.

H. CONTRACTOR hereby acknowledges and agrees to limit access to the site to those persons cleared by OWNER. CONTRACTOR expressly acknowledges OWNER'S right to deny or limit entry to the site to any person(s) that OWNER deems to be a security risk.

3.2 TEMPORARY CONSTRUCTION FACILITIES

A. Access Roads and Parking:
   1. Construct temporary construction access roads and detours as necessary to execute the Work and as approved by the ENGINEER. Maintain in good condition until no longer needed, then remove the temporary roads and leave the area in a condition satisfactory to the ENGINEER. Construction traffic shall use the construction access road to enter and exit the staging and trailer areas. Construction traffic shall not use the plant's main entrance.

B. Storage Yards and Buildings:
   1. Construct temporary storage yards for the storage of products that are not subject to damage by weather conditions. Materials such as pipe, reinforcing, and structural steel shall be stored on pallets or racks, off the ground, and in a manner to allow ready access for inspection and inventory. Temporary gravel surfacing of storage yards must be approved by the ENGINEER.
   2. Erect or provide temporary storage buildings of various sizes needed to protect mechanical and electrical equipment and other materials, as recommended by manufacturers of such equipment and materials.
      a. Provide environmental control systems that meet recommendations of manufacturers of equipment and materials stored in the buildings.
      b. Buildings shall be of sufficient size.
      c. Arrange or partition buildings to provide security for their contents and ready access for inspection and inventory.
      d. At or near completion of the Work, temporary storage buildings shall be dismantled, removed from the site, and remain the property of the CONTRACTOR.
   3. Store combustible materials (paints, solvents, fuels, etc.) in a well ventilated building remote from other buildings.

C. Fencing and Barricades:
   1. Barricades: Provide barricades as necessary to prevent unauthorized entry to construction areas, both inside and outside of fenced area. Also provide barricades to protect existing facilities and adjacent properties from potential damage. Locate barriers to enable access by facility operators and property owners. Provide temporary fencing while working in and around the perimeter area without the existing WRF fence (ex., between removal and replacement of existing fence, during grading operations adjacent to the perimeter area without fence, etc.).

D. Offices:
   1. CONTRACTOR shall provide, maintain, and subsequently remove as its property, one field office for each site. The field office at AWRF shall meet the requirements of Section 3.2.D.2 and the field office at OWRF shall be fitted in the old Administration Building and meet the requirements of Section 3.2.D.2.r through 3.2.D.2.nn. Field offices shall be for the exclusive use of ENGINEER,

OWNER, and its representatives. Field office shall be new or like new in appearance and function.

2. ENGINEER'S field office, equipped as specified below, shall be available for ENGINEER within two weeks after commencement of Contract Time and shall remain on the site for 30 days after Final Acceptance of all Work.
   a. All metal frame.
   b. All metal exterior, sides, and roof.
   c. Security guard screens on all windows.
   d. Toilet and wash basin with hot and cold water and drains.
   e. Insulated double walls, floor, and roof.
   f. Self-contained, built-in electric heater capable of maintaining 70º F in winter and self-contained air conditioning unit capable of maintaining 75º F in summer.
   g. Fluorescent ceiling lights in all rooms.
   h. 110 volt electric wall plugs in all rooms, with maximum spacing between receptacles not to exceed 8 feet.
   i. Minimum Interior Height: 8 feet.
   j. Minimum Exterior Width: 24 feet.
   k. Minimum Exterior Length: 70 feet.
   l. Railed stairway to entrances.
   m. Sign on entrance door.
   n. Trailer shall contain a minimum of five offices, meeting room, reception area, lavatories, and work areas. Interior layout is to be as directed by ENGINEER.
   o. Doors with Cylinder Locks: Entrance door, exit door.
   p. Number of Windows with window covering: 2 per office.
   q. Window coverings: polyester curtains or as directed by ENGINEER.
   r. Bottled Water Service: 1 with cooler.
   s. Paper Towel Dispenser with Towels: 1 each.
   t. Paper Cup Dispenser with Cups: 1 each.
   u. Desks: 3, 30-inches by 60-inches.
   v. Swivel Chairs: 4 each.
   w. Folding Chairs: 12 each.
   x. Four-Drawer Steel File with Lock: 2 each, legal width.
   y. Drawing Rack with Drawing Hangers: 1 each.
   z. Bookcase: 8 each.
   aa. Wastepaper Basket: 5 each.
   bb. Clothes Rack: 1 each.
   cc. First-Aid Kit: 1 each.
   dd. One new color combination wireless copy machine/printer/scanner. Unit shall be able to connect to network and have document feeder, with reduction, enlargement, auto-document feed, auto stapler function, high capacity feeder, bypass tray, four paper trays, top tray, stacker tray and sorting capability. Provide service, warranty (including toner and replacement cartridges) and maintenance for the duration of the Contract. Provide 8-1/2-inch by 11-inch, 8-1/2 inch by 14-inch, and 11-inch by 17-

inch copy paper for the duration of the Contract. Copier shall make up to 11-inch by 17-inch copies. Copier shall copy at a rate no slower than 40 copies per minute.

ee. Carbon Dioxide (10-Pound) Fire Extinguisher: 2 each.

ff. Tables: 1, 48-inch diameter; 3, 3 foot by 6 foot.

gg. Locking storage cabinet: 1 each.

hh. Provide continuous Internet and DSL service with all associated equipment a maximum of two weeks after trailer is installed. Configure Internet and DSL so service is available by all workstations. Provide one internet connection along with cabling and required hardware for each desk. Internet download speed shall be 100Mbps minimum.

ii. Potable water hose bib with 20 feet of hose connected to potable water supply, near main entrance to ENGINEER'S trailer. Hose bib shall be freeze protected.

jj. 4.9 cubic foot refrigerator with freezer compartment.

kk. Waste refuse disposal service.

3. All items shall be furnished and maintained by the CONTRACTOR from the notice to proceed to the date of final acceptance. The cost of these items shall be considered incidental to the cost of the Project. No separate measurement of payment shall be made for these items.
4. The field office shall be located where directed by the ENGINEER; leveled, blocked, tied down, and skirted as directed; and relocated when necessary and approved.
5. The CONTRACTOR shall provide and maintain connections to the City's potable water including backflow prevention as required, connections to the City's sanitary sewer, and electrical service to the field offices, including an adequate disconnect switch and an automatic circuit breaker panel located on the inside of the office.
6. CONTRACTOR shall maintain field offices in good repair and acceptable appearance. Provide daily cleaning service and maintenance and replenishment, as applicable, of paper towels, paper cups, soap, toilet paper, bottled water service, duplicator paper, and toner.
7. Provide gravel or crushed rock under and around the field offices to a minimum distance of 40 feet. Provide sanitary facilities in compliance with State and local health authorities.

3.3 EXAMINATION OF EXISTING FACILITIES

A. General:

1. After the Contract is awarded and before the commencement of Work, CONTRACTOR and ENGINEER shall make a thorough examination of all existing buildings, structures, and other improvements in the vicinity of the Work, as applicable, which might be damaged by construction operations.
2. Periodic examinations of existing buildings, structures, and other improvements in the vicinity of the Work shall be made jointly by authorized representatives of the CONTRACTOR, ENGINEER, and the OWNER. The scope of the

examination shall include cracks in structures, settlement, leakage, and similar conditions.

3. Records in triplicate of all observations shall be prepared by the CONTRACTOR and each copy of every document shall be signed by the authorized representative of the OWNER and of the CONTRACTOR. Photographs, as requested by the OWNER, shall be made by the CONTRACTOR and signed in the manner specified above. One signed copy of every document and photograph will be kept on file in the office of the ENGINEER.
4. These records and photographs are intended for use as indisputable evidence in ascertaining whether and to what extent damage occurred as a result of the CONTRACTOR'S operations, and are for the protection of the adjacent property owners, the CONTRACTOR, and the OWNER.

3.4 SAFETY REQUIREMENTS

A. General:
1. CONTRACTOR shall do whatever work is necessary for safety and be solely and completely responsible for conditions of the job site, including safety of all persons (including employees) and property during the Contract period. This requirement shall apply continuously and not be limited to normal working hours.
2. Safety provisions shall conform to Federal and State Departments of Labor Occupational Safety and Health Act (OSHA), and other applicable Federal, State, County, and local laws, ordinances, codes, requirements set forth herein, and regulations that may be specified in other parts of these Contract Documents. Where these are in conflict, the more stringent requirement shall be followed. CONTRACTOR shall become thoroughly familiar with governing safety provisions and shall comply with the obligations set forth therein.
3. CONTRACTOR shall develop and maintain for the duration of the CONTRACT a safety program that will effectively incorporate and implement required safety provisions. CONTRACTOR shall appoint a qualified employee who is authorized to supervise and enforce compliance with the safety program.
4. ENGINEER'S duty to conduct construction review of the CONTRACTOR'S performance is not intended to include a review or approval of the adequacy of CONTRACTOR'S safety supervisor, safety program, or safety measures taken in, on, or near the construction site.
5. As part of safety program, CONTRACTOR shall maintain at its office or other well known place at the job site, safety equipment applicable to the Work as prescribed by the governing safety authorities, and articles necessary for giving first-aid to the injured. Establish procedures for the immediate removal to a hospital or a doctor's care of persons who may be injured on the job site.
6. CONTRACTOR shall do all work necessary to protect the general public from hazards, including, but not limited to, surface irregularities or unramped grade changes in pedestrian sidewalk or walkway, and trenches or excavations in

roadway. Barricades, lanterns, and proper signs shall be furnished in sufficient amount to safeguard the public and the Work.

7. Construct and maintain satisfactory and substantial temporary chain-link fencing, solid fencing, railing, barricades, steel plates, as applicable, at all openings, obstructions, or other hazards in streets, sidewalks, floors, roofs, and walkways. Such barriers shall have adequate warning lights as necessary or required for safety.
8. Comply with OWNER'S safety rules while on OWNER'S property.
9. If death or serious injuries or damages are caused, the accident shall be reported immediately by telephone or messenger to the ENGINEER and OWNER. In addition, CONTRACTOR shall promptly report in writing all accidents whatsoever arising out of, or in connection with, the performance of the Work whether on or adjacent to the site, giving full details and statements of witnesses.
10. If claim is made by anyone against CONTRACTOR or any subcontractor on account of accident, CONTRACTOR shall promptly report the facts in writing, giving full details of the claim.

B. Traffic Safety and Access:
   1. Comply with rules and regulations of the City, State, and County authorities regarding closing or restricting the use of public streets or highways. No public or private road shall be closed except by written permission of the proper authority. Assure the least possible obstruction to traffic and normal commercial pursuits.
   2. Where traffic will pass over backfilled trenches before they are paved, maintain top of trench to allow normal vehicular traffic to pass over. Provide temporary access driveways where required. Cleanup operations shall follow immediately behind backfilling.
   3. When flagmen and guards are required by regulation or when deemed necessary for safety, furnish them with approved orange-wearing apparel and other regulation traffic control devices.
   4. Traffic control procedures and devices used on all local rights-of-way shall meet the requirements of the applicable current laws and regulations for traffic control.
   5. Notify the fire department, police department and obtain required permits before closing any street or portion thereof. Notify said departments when the streets are again passable for emergency vehicles. Do not block off emergency vehicle access to consecutive arterial crossings or dead-end streets in excess of 300 linear feet without written permission from the fire department. Conduct operations with the least interference to fire equipment access, and at no time prevent such access.
   6. CONTRACTOR shall leave its night emergency telephone number or numbers with the police department, so that contact may be made easily at all times in case of barricade and flare trouble or other emergencies.
   7. Maintain postal service facilities in accordance with the requirements of the U.S. Postal Service. Move mailboxes to temporary locations designated by the

Service, and on completion of Work in each area replace them in their original location and in a condition satisfactory to the Service.

C. Fire Prevention:
   1. Perform all Work in a fire safe manner. Furnish and maintain on the site adequate firefighting equipment capable of extinguishing incipient fires. Comply with applicable Federal, local, and State fire prevention regulations. Where these regulations do not apply, follow applicable parts of the National Fire Prevention Standard for Safeguarding Building Construction Operations (NFPA No. 241).

D. Protection of Work and Property:
   1. General:
      a. CONTRACTOR shall employ such means and methods necessary to adequately protect public property and property of the OWNER against damage. In the event of damage to such property, immediately restore the property to a condition equal to its original condition and to the satisfaction of the ENGINEER and the OWNER of said property, and bear all costs therefore.
      b. Protect stored materials and other items located adjacent to the proposed Work.
   2. Finished Construction:
      a. General Construction Contractor shall assume the responsibility for protection of finished construction and shall repair and restore any and all damage to finished work to its original or better condition.
      b. Prevent wheeling of loads over finished floors, either with or without plank protection, except in rubber-tired wheelbarrows, buggies, or dollies. Protect finished floors and concrete floors exposed as well as those covered with composition tile or other applied surfacing. All finished floors shall be protected from stains due to spillage of oil, paint, or any other construction-related materials. Any such stains that are allowed to occur shall be removed, if necessary by removing and replacing the floor, at the CONTRACTOR'S expense.
      c. At such time temporary facilities and utilities are no longer required for the Work, notify ENGINEER of intent and schedule for their removal. Remove temporary facilities and utilities from the site as CONTRACTOR'S property and leave the site in such condition as specified, as shown on the Drawings, or as directed by the ENGINEER.
      d. In unfinished areas, leave the site evenly graded, seeded, or planted as necessary, in a condition that will restore original drainage and with an appearance equal to or better than original.

3.5 ENVIRONMENTAL CONTROLS

A. General:
   1. The CONTRACTOR, in executing the Work, shall maintain affected areas within and outside project boundaries free from environmental pollution that would be in violation of Federal, State, or local regulations.
   2. Do not impair operation of existing sewer systems. Prevent construction material, pavement, concrete, earth, volatile and corrosive wastes, and other debris from entering sewers, pump stations, or other sewer structures. Maintain original site drainage wherever possible.

B. Waste Material Disposal:
   1. Excess excavated material not required or suitable for backfill, and other waste material, must be disposed of in licensed landfills. The CONTRACTOR shall submit the proposed haul route(s) for each site intended to be used.
   2. Unacceptable disposal sites include, but are not limited to, sites within a wetland or critical habitat and sites where disposal will have a detrimental effect on surface water or groundwater quality.
   3. In lieu of the foregoing, CONTRACTOR may make his own arrangements for disposal subject to submission of proof that the owner(s) of the proposed site(s) has a valid fill permit issued by the appropriate governmental agency. Submit intended haul route plan, including a map of the proposed route(s). Provide watertight conveyance for liquids, semi-liquids, or saturated solids that tend to bleed during transport.
   4. Maintain areas covered by the Contract and affected public properties free from accumulations of waste, debris, and rubbish caused by construction operations. Remove excavated materials from the site.
   5. Cleaning and disposal shall comply with local ordinances and pollution control laws. Do not burn or bury rubbish or waste materials on the project site. Do not dispose of volatile wastes such as mineral spirits, oil, chemicals, or paint thinner in storm or sanitary drains. Disposal of wastes into streams or waterways is prohibited. Provide acceptable containers for collection and disposal of waste materials, debris, and rubbish.

C. Air Pollution Control:
   1. CONTRACTOR shall comply with Maricopa County's requirements regarding dust control.
   2. Minimize air pollution likely to occur from construction operations by wetting down bare soils during windy periods, requiring proper combustion emission control devices on construction vehicles and equipment, and by shutdown of motorized equipment not in use. Trash burning will not be permitted on the construction site.
   3. Operations of dumping rock and of carrying rock away in trucks shall be conducted to cause a minimum of dust. Give unpaved streets, roads, detours, or haul roads used in the construction area a dust-preventive treatment, or

periodically water to prevent dust. Strictly adhere to applicable environmental regulations for dust prevention.

D. Noise Control:
   1. Minimize noise by executing work using appropriate construction methods and equipment. Provide acoustical barriers so noise emanating from tools or equipment will not exceed legal noise levels.
   2. Submit plans to mitigate construction noise impacts and to comply with noise control ordinances including method of construction, equipment to be used, and acoustical treatments.
   3. If piles are required, use spudding or drilling techniques to penetrate through fill and overburden. Penetrate intermediate hard layers to minimize noise impact by minimizing the number of piledriver hammer blows. Use only piledriver hammers with mufflers capable of reducing noise, and use barriers or shielding techniques to comply with applicable noise criteria.

E. Pest and Rodent Control:
   1. Comply with local health requirements for pest and rodent control. Cooperate with agencies and companies authorized to spray or provide other treatments to prevent insect outbreaks.
   2. Maintain closures of means of entry into finished buildings by rodents. Inspect for rodents during cleaning, remove debris, and treat infested areas to OWNER'S satisfaction.

++ END OF SECTION ++

SECTION 01640

MATERIALS AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. The CONTRACTOR shall furnish all materials and equipment and perform all operations required to completely install and place in operation the various mechanical apparatus and systems indicated on the Drawings and as specified herein. It is not the intention to mention herein each and every item required. However, all installations shall be complete and operable in the methods intended. These general equipment requirements apply, in general, to all equipment. They shall supplement the detailed Equipment Specifications, but in case of conflict, the Equipment Specifications shall govern.

1.2 RELATED SECTIONS

A. Section 01300, Submittals.

PART 2 - PRODUCTS

2.1 GENERAL

A. Materials and equipment shall be of new, of first quality and best grade, essentially the standard catalog products of reputable manufacturers, and shall be of the type, size, and capacity, and for the type of service specified. It is the intent of these Specifications that the highest quality equipment shall be provided for the intended service. Units proposed shall be carefully matched to the particular hydraulic and mechanical requirements for each installation, and the CONTRACTOR shall submit complete hydraulic and mechanical data for approval of the ENGINEER. Where two or more units of the same class of equipment are required, these units shall be the products of a single manufacturer; however, the component parts of the system need not be the products of the same manufacturer unless otherwise specified.

1. Materials and Workmanship. Materials used in the manufacture of the equipment shall be of the best quality used for the purpose in commercial practice. Materials shall be suitable for service conditions. Iron castings shall be tough, close-grained gray iron free from blowholes, flaws, or excessive shrinkage, and shall conform to ASTM A48. Except where otherwise specified, structural and miscellaneous fabricated steel used in items of equipment shall conform to the Standards of the American Institute of Steel Construction. All structural members shall be considered as subject to shock or vibratory loads. Unless otherwise specified, all steel which will be submerged, all or in part, during normal operation of the equipment shall have a minimum nominal thickness of 1/4-inch. Equipment shall be installed

in accordance with the recommendations of the manufacturer and the best standard practice for each type of equipment.

2. Approval of Materials, Equipment, and Shop Drawings. Detailed Shop Drawings shall be prepared for the equipment to be furnished under this Project. General Drawings for equipment will not be acceptable. Approval of equipment under this provision shall not be construed as authorizing any deviations from the Specification unless the attention of the ENGINEER has been directed to the specific deviation.
    a. The decision of the ENGINEER on any questions concerning the acceptability of materials, equipment, or installation shall be final and binding. The Shop Drawing material required for the various submittals shall be in accordance with the coded legend set forth in Section 01300, Submittals, and as indicated and specified under various headings of these specifications.
3. Nameplates: Equipment shall be furnished with nameplates of bronze, monel, or stainless steel. Aluminum will not be acceptable. Each nameplate shall include pertinent hydraulic and mechanical data. Information shown shall be permanently stamped or cast into each nameplate and shall include the manufacturer's name and model number.
4. ASME Stamp: Where materials and equipment are specified to be constructed in accordance with the standard of the American Society of Mechanical Engineers Code for Unfired Pressure Vessels, the CONTRACTOR shall submit proof that the items furnished under this Section of the Specifications conform to such requirements. The ASME stamp, label, or listing will be acceptable as sufficient evidence that the items conform to these requirements and shall be provided on all pressure vessels falling within the ASME Code jurisdiction.

B. Electric Motors:
1. General: Unless otherwise required by the detailed equipment specifications, motors furnished with equipment shall be rated for continuous duty at 50° C ambient temperature with a 1.15 service factor. Motors designated for use with variable speed drives and where indicated shall be derated to accommodate the application. Where frequent starting occurs, motors shall be designed for frequent starting duty equivalent to the duty service required by the driven equipment. The horsepower rating of each motor shall be as required to drive the equipment under full load, including all losses in speed reducers and power transmission, and to be non-overloading over the entire range of equipment head capacity curves without the use of motor service factors. It is the intent of this general specification to allow the manufacturer's standard motor on integrally constructed motor driven equipment such as appliances, hand tools, etc., that is specified by model number in which a redesign of the complete unit would be required for a motor with other features as may be specified herein. All motors furnished under these Specifications shall be of recognized manufacture, of adequate capacity for the loads involved, and wound to the current characteristics

noted. All motors shall conform to the standards of manufacture and performance of the National Electrical Manufacturers Association as shown in their latest publications.

2. Enclosures: Unless otherwise required by the detailed equipment specifications, the enclosures for motors shall be as indicated below:
   a. Motors installed outdoors shall be totally enclosed or totally enclosed fan-cooled except that vertically mounted motors may be weather protected Type I.
   b. Motors installed indoors may be open drip-proof unless otherwise indicated.
3. Motor horsepower requirements in the equipment specifications are estimated. If the horsepower requirements for the equipment furnished vary from the estimated horsepower, the CONTRACTOR shall be responsible for making all necessary revisions to wiring, conduit, motor starters, circuit breaker, and other electrical equipment at no additional cost to OWNER.
4. Anchor Bolts: Equipment suppliers shall furnish suitable anchor bolts of specified metallurgy for each item of equipment. Anchor bolts, together with templates or setting drawings, shall be delivered sufficiently early to permit setting the anchor bolts when the structural concrete is placed. Two nuts shall be furnished for each bolt. Unless otherwise shown or specified, anchor bolts for items of equipment mounted on baseplates shall be long enough to permit 1-1/2-inch of grout beneath the base plant and to provide adequate anchorage into structural concrete.
5. Equipment Bases: A cast iron or welded steel baseplate shall be provided for each pump and other item of equipment which is to be installed on a concrete base. Each baseplate shall support the unit and its drive assembly, and shall be of a neat design with pads for anchoring the units. Baseplates shall be anchored to the concrete base with suitable anchor bolts and grouted in place.
6. Equipment Guards: All belts or chain drives, fan blades, couplings, and other moving or rotating parts shall be covered on all sides by a safety guard. All safety guards in outdoor locations shall be designed to prevent the entrance of rain and dripping water.
7. Special Tools and Accessories: Equipment requiring periodic repair and adjustment shall be furnished complete with all special tools, instruments, and accessories required for proper maintenance. Equipment requiring special devices for lifting or handling shall be furnished complete with those devices.
8. Standard specifications prepared by recognized organizations mentioned elsewhere shall govern except as provided otherwise by these specifications and/or its accompanying drawings. Special care shall be exercised in requests for quotations and in orders, to refer to the standard specifications and to all modifications thereof.
9. Standard Codes, Regulations, and Specifications: Unless indicated or specified otherwise, all materials and workmanship for the mechanical trades shall conform to the editions of the various standards, codes, manuals, and

specifications in effect on the date of advertisement for bids, which are referred to in the various sections herein.

PART 3 - EXECUTION

3.1 PROTECTION OF EQUIPMENT

A. General. All equipment shall be boxed, crated, or otherwise completely enclosed and protected during shipment, handling, and storage. All equipment shall be protected from exposure to the elements and shall be kept thoroughly dry at all times.

B. Painted surfaces shall be protected against impact, abrasion, discoloration, and other damage. All painted surfaces which are damaged prior to acceptance of equipment shall be repainted to the satisfaction of the ENGINEER.

C. Electrical equipment, controls, and insulation shall be protected against dust, moisture, or water damage.

3.2 INSTALLATION

A. Installation of materials and equipment specified herein shall be performed in a workmanlike manner by mechanics skilled in their particular trade. Piping and equipment shall be installed square and plumb and accessible for proper operation and service. Installations shall be consistent in completeness and appearance whether enclosed or exposed. Any item which does not present a neat and workmanlike appearance shall be replaced without additional cost to OWNER.

3.3 ELECTRIC WIRING

A. The CONTRACTOR shall do all electric wiring of every type for both power supply and for instrumentation and control in accordance with the provisions specified herein, except for such items as are normally wired at their point of manufacture and so delivered, and unless specifically noted to the contrary herein. The CONTRACTOR shall erect all motors and shall mount all starters and controls, furnishing the supporting structures.

3.4 GUARANTEE

A. The CONTRACTOR shall guarantee all equipment against:
   1. Faulty or inadequate design.
   2. Improper assembly or erection.
   3. Defective workmanship or materials.
   4. Leakage, breakage, or other failure.
   5. The guarantee period shall be as defined in the General Conditions.

++ END OF SECTION ++

SECTION 01650

STARTING OF SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Description:
   1. This Section contains requirements for CONTRACTOR'S performance in documenting testing work required under this Contract. In addition, this Section contains requirements for CONTRACTOR'S starting of systems, performance testing during startup, performance testing of all mechanical, electrical, instrumentation, HVAC equipment and systems, and training. This Section supplements, but does not supersede specific testing requirements, found elsewhere in the Contract Documents.

1.2 RELATED SECTIONS

A. Section 01300, Submittals.

B. Section 01310, Progress Schedule

1.3 SUBMITTALS

A. Descriptive submittals shall be made in accordance with Section 01300, Submittals. Submit for approval the following:
   1. A complete description of CONTRACTOR'S plan for documenting the results from the test program in conformance with the requirements of Paragraph 2.1.A., below, including:
      a. Proposed plan for documenting the calibration of all test instruments.
      b. Proposed plan for calibration of all instrument systems, including flow/level meters and all temperature, pressure, weight, and analysis systems.
      c. Sample forms for documenting the results of field pressure and performance tests.
   2. The credentials and certification of the testing laboratory proposed by CONTRACTOR for calibration of all test equipment.
   3. Pre-start-up check-out procedures reviewed and approved by the respective equipment manufacturers.
   4. Detailed testing plans, setting forth step-by-step descriptions of the procedures proposed by CONTRACTOR for the systematic startup and performance testing of all equipment and systems installed under this Contract.

5. A schedule and subsequent updates, presenting CONTRACTOR'S plan for startup and performance testing the equipment and systems installed under this Contract.
6. A schedule establishing the expected time period (calendar dates) when CONTRACTOR plans to commence performance testing of the completed systems, along with a description of the temporary systems and installations planned to allow operational testing to take place.
7. All records produced during the startup and testing program.
8. Systems or unit process or any piece of equipment shall not be started up without the approved Operation and Maintenance Manuals being turned over to the OWNER.
9. Written notice to ENGINEER a minimum of 72 hours prior to beginning of any test.

B. Shop Drawings: Submit for approval the following:
1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
2. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**

PART 2 - PRODUCTS

2.1 DOCUMENTATION

A. Documentation Plans

1. CONTRACTOR shall develop a records keeping system to document compliance with the requirements of this Section. Calibration documentation shall include identification (by make, manufacturer, model, and serial number) of all test equipment, date of original calibration, subsequent calibrations, calibration method, and test laboratory.
2. Equipment and system documentation shall include date of test, equipment number or system name, nature of test, test objectives, test results, test instruments employed for the test and signature spaces for the OWNER'S and ENGINEER'S witnesses. A separate file shall be established for each system and item of equipment. These files shall include the following information as a minimum:
    a. Metallurgical tests, if required in detailed Specification Section.
    b. Factory performance tests.
    c. Accelerometer recordings made during shipment, if required in detailed Specification Section.
    d. Field calibration tests[1].
    e. Field pressure tests[1].
    f. Field performance tests[1].
    g. Field operational tests[1].

    ([1] Each of these tests are required even though not specifically noted in detailed Specification Section.)

B. Test Plans:
1. CONTRACTOR shall develop test plans detailing the coordinated, sequential testing of each item of equipment and system installed under this Contract. Each test plan shall be specific to the item of equipment or system to be tested. Test plans shall identify by specific equipment or tag number each device or control station to be manipulated or observed during the test procedure and the specific results to be observed or obtained. Test plans shall also be specific as to support systems required to complete the test work, temporary systems required during the test work, subcontractors and manufacturers' representatives to be present and expected test duration. As a minimum, the test plans shall include the following features:
    a. Step-by-step proving procedure for all control and electrical circuits by imposing low voltage currents and using appropriate indicators to affirm that the circuit is properly identified and connected to the proper device.
    b. Calibration of all analysis instruments and control sensors.
    c. Performance testing of each individual item of mechanical, electrical, and instrumentation equipment. Performance tests shall be selected to duplicate the operating conditions described in the Contract Documents.
    d. System performance tests designed to duplicate, as closely as possible, operating conditions described in the Contract Documents.
2. Test plans shall contain a complete description of the procedures to be employed to achieve the desired test environment.
3. As a condition precedent to receiving progress payments in excess of 75% of the Contract amount, or in any event, progress payments due to

CONTRACTOR eight weeks in advance of the proposed date the CONTRACTOR intends to begin any testing work (whichever occurs earliest in the Project Schedule), CONTRACTOR shall have submitted all test plans required for the systematic field performance and operational tests for all equipment and systems installed under this Contract. Once the ENGINEER has reviewed and approved CONTRACTOR'S test plans, CONTRACTOR shall reproduce the plans in sufficient number for CONTRACTOR'S purposes and an additional 10 copies for delivery to the ENGINEER. No test work shall begin until the CONTRACTOR has delivered the specified number of final test plans to the ENGINEER.

C. Testing Schedule: CONTRACTOR shall provide a startup and testing schedule setting forth the sequence contemplated for performing the test work. The schedule shall be a CPM format, plotted against calendar time, shall detail the equipment and systems to be tested, and shall be coordinated with CONTRACTOR'S Progress Schedule specified in Section 01310, Progress Schedule. The schedule shall show the contemplated start date, duration of the test and completion of each test. The test schedule shall be submitted no later than four weeks in advance of the date testing is to begin. The ENGINEER will not witness any testing work for the purpose of acceptance until CONTRACTOR has submitted a test schedule and the ENGINEER approves. The test schedule shall be updated weekly, showing actual dates of test work, indicating systems and equipment testing completed satisfactorily and meeting the requirements of the Contract Documents.

2.2 SYSTEM AND EQUIPMENT PERFORMANCE TESTS

A. Each item of mechanical, electrical, instrumentation and HVAC equipment installed under this Contract shall be tested to demonstrate compliance with the performance requirements of the Contract Documents. Each electrical, instrumentation, mechanical, piping, and HVAC system installed or modified under this Contract shall be tested in accordance with the requirements of this Section.

B. Once all equipment and systems have been tested individually, CONTRACTOR shall proceed with performance testing in accordance with the requirements of Paragraph 3.3, below, simulating actual operating conditions to the greatest extent possible. CONTRACTOR shall install temporary connections, bulkheads and make other provisions to re-circulate process fluids or otherwise simulate anticipated operating conditions. During the operational testing period, CONTRACTOR'S Quality Assurance Manager and testing team shall monitor the characteristics of each machine and system and report any unusual conditions to the ENGINEER.

PART 3 - EXECUTION

3.1 GENERAL

A. CONTRACTOR shall organize teams made up of qualified representatives of equipment suppliers, subcontractors, CONTRACTOR'S independent testing laboratory, and others, as appropriate, to efficiently and expeditiously calibrate and test the equipment and systems installed and constructed under this Contract. The objective of the testing program shall be to demonstrate, to the OWNER'S and ENGINEER'S complete satisfaction, that the structures, systems, and equipment constructed and installed under this Contract meets all performance requirements and the facility is Substantially Complete and ready for the commissioning process to commence. In addition, the testing program shall produce baseline-operating conditions for the OWNER to use in a Preventive Maintenance Program. The Preventive Maintenance Program shall be provided as part of the vendor supplied equipment Operations and Maintenance Manual as required by Specification Section 01300 Submittals.

3.2 CALIBRATION OF FIXED INSTRUMENTS

A. Calibration of analysis instruments, sensors, gauges, and meters installed under this Contract shall proceed on a system-by-system basis. No equipment or system performance test shall be performed until all instruments, gauges, and meters to be installed in that particular system have been calibrated and the calibration work has been witnessed by the OWNER and ENGINEER.

3.3 PERFORMANCE TESTS

A. General: Performance tests shall consists of the following:
   1. Pressure or leakage tests.
   2. Electrical testing as specified in Division 16, Electrical.
   3. Wiring and piping, individual component, loop, loop commissioning and tuning testing, as specified in Division 17, Instrumentation.
   4. Pre-startup check out for all mechanical and HVAC equipment specified in Division 15, Mechanical. Pre-startup check out procedures shall be reviewed and accepted by the respective equipment manufacturer.
   5. Individual and system tests of all mechanical, electrical, HVAC, and instrumentation equipment and systems shall demonstrate compliance with the performance requirements of the Contract Documents.

B. Performance tests for any individual system shall be performed in the order listed above. The order may be altered only on the specific written authorization of the ENGINEER after receipt of a written request, complete with justification for the change in sequence.

C. Pressure and Leakage Tests: Pressure and leakage tests shall be conducted in accordance with applicable Sections. All acceptance tests shall be witnessed by

the ENGINEER. Evidence of successful completion of the pressure and leakage tests shall be the ENGINEER'S signature on the test forms prepared by CONTRACTOR.

D. Equipment Checkout: Prior to energization (in the case of electrical systems and equipment), all circuits shall be rung out and tested for continuity and shielding in accordance with the requirements of Division 16, Electrical.

E. Component Calibration and Loop Testing: Prior to energization (in the case of instrumentation system and equipment), all loops and associated instruments shall be calibrated and tested, as specified in Division 17, Instrumentation.

F. Electrical Resistance: Electrical resistance testing shall be in accordance with the requirements of Division 16, Electrical.

G. Pre-Start-up Tests: Pre-start-up tests shall include the following
   1. Alignment of equipment using reverse dial indicator method.
   2. Pre-operation lubrication.
   3. Tests in accordance with the manufacturers' recommendations for pre-start preparation and pre-operational check out procedures.

3.4 DISINFECTION

A. CONTRACTOR shall disinfect all new portions of the plant that are located downstream of, and including, reclaimed water pump station, backwash piping, non-potable water system, potable water system, and reclaimed water system. Disinfection shall be completed prior to bringing the specific process or component on-line. All disinfection shall be done in accordance with AWWA C-653.

B. The CONTRACTOR shall provide all chemicals, materials, equipment, and utilities to perform the disinfection.

3.5 EQUIPMENT START-UP

A. The CONTRACTOR in the presence of OWNER and ENGINEER shall place the newly installed equipment and facilities into operation and test, observe, and adjust all items until the units are properly adjusted and operating in accordance with the requirements of the manufacturer's data and the Contract Documents. After the new equipment has been put into operation, CONTRACTOR, ENGINEER, and Plant Operator shall go over in detail the standard operating procedures of the equipment. The work performed by CONTRACTOR shall include, but not be limited to, the following items:
   1. Marking and numbering all valves, gates, and equipment which have been numbered in the Contract Documents. All valves and gates shall be labeled with the appropriate equipment identification tag as shown on the Drawings and specified in Section 17454, Operations and Control Descriptions.

2. Labeling switches.
3. Testing of pumps and equipment for proper operation and verifying alignment and capacity.
4. Checking all electrical, electronic, and remotely controlled equipment for proper operation as specified under Section 01400, Quality Control.
5. Marking all new and existing exposed pipelines for identification as specified in Section 09900, Painting, and as labeled on the Drawings for pipe material, size, service, and direction of flow.
6. Testing of unit processes for proper operations.
7. Making all equipment adjustments required.

3.6 SUPERVISION OF INSTALLATION AND START-UP BY MANUFACTURER

A. An experienced, competent, and factory-employed representative of the equipment manufacturer shall visit the site of the work and inspect, check, adjust if necessary, and approve the equipment installation and shall be present when the equipment is placed in operation. The equipment manufacturer's representative shall revisit the job site as often as necessary until any trouble is corrected and the equipment installation and operation is satisfactory to the OWNER. The equipment manufacturer's representative shall furnish to OWNER a written report certifying that the equipment:
   1. Has been properly installed and lubricated.
   2. Is in accurate alignment.
   3. Is free from any undue stress imposed by connecting piping or anchor bolts.
   4. Has been operated under full load conditions and that it operated satisfactorily.

B. A resume of each factory personnel assigned to supervise installation and train OWNER'S personnel shall be submitted to the ENGINEER for approval prior to scheduling training and installing the equipment.

3.7 SYSTEM PERFORMANCE TESTS

A. General: Once all affected equipment has been subjected to the required pre-operational check out procedures and the ENGINEER has witnessed and has not found deficiencies in that portion of the Work, individual items of equipment and systems may be started and operated under simulated operating conditions to determine, as nearly as possible, whether the equipment and systems meet the requirements of these Specifications.

B. For each system performance test phase, the equipment shall be operated a sufficient period of time to determine machine operating characteristics, including noise, temperatures and vibration; to observe performance characteristics; and to permit initial adjustment of operating controls and shall last no less than seven continuous days. When testing requires the availability of auxiliary systems such as looped piping, electrical power, compressed air, control air, or instrumentation

which have not yet been placed in service, CONTRACTOR shall provide acceptable substitute sources, capable of meeting the requirements of the machine, device, or system, at no additional cost to the OWNER. Disposal methods for test media shall be subject to review and approval by the OWNER and ENGINEER. During the performance test period, CONTRACTOR shall obtain baseline-operating data on all equipment with motors greater than one horsepower to include amperage, bearing temperatures, and vibration. The baseline data shall be collected for the OWNER to enter in a Preventive Maintenance Program.

C. Test results shall be within the tolerances set forth in the detailed Specification Sections of the Contract Documents. If no tolerances have been specified, test results shall conform to tolerances established by recognized industry practice. Where, in the case of an otherwise satisfactory performance test, any doubt, dispute, or difference should arise between the ENGINEER and CONTRACTOR regarding the test results or the methods or equipment used in the performance of such test, then the ENGINEER may order the test to be repeated. If the repeat test, using such modified methods or equipment as the ENGINEER may require, confirms the previous test, then all costs in connection with the repeat test will be paid by the OWNER. Otherwise, the costs shall be borne by CONTRACTOR. Where the results of any performance test fail to comply with the contract requirements for such test, then such repeat tests as may be necessary to achieve the contract requirements shall be made by CONTRACTOR at his expense.

D. CONTRACTOR shall provide, at no expense to the OWNER, all power, fuel, compressed air supplies, water, and chemicals, all labor, temporary piping, heating, ventilating, and air conditioning for any areas where permanent facilities are not complete and operable at the time of functional tests, and all other items and work required to complete the functional tests. Temporary facilities shall be maintained until permanent systems are in service.

E. Should the testing period be halted for any reason, the operational testing program shall be repeated, until the specified continuous period has been accomplished without interruption. All process units shall be brought to full operating conditions, including temperature, pressure, flow and level.

F. Record Documents shall conform to the requirements of Section 01300, Submittals, of facilities involved shall be accepted and ready for turnover to the OWNER 72 hours prior to operational testing.

G. Phase Retesting: If under test, any portion of the Work should fail to fulfill the Contract requirements and is adjusted, altered, renewed, or replaced, tests on that portion when so adjusted, altered, removed, or replaced, together with all other portions of the Work as are affected thereby, shall, unless otherwise directed by the ENGINEER, be repeated within reasonable time and in accordance with the specified conditions. CONTRACTOR shall pay to the OWNER all reasonable

expenses incurred by the OWNER, including the costs of the ENGINEER, as a result of repeating such tests.

H. Post-Test Inspection: Once testing has been completed, all machines shall be rechecked for proper alignment and realigned, as required. All equipment shall be checked for loose connections, unusual movement, or other indications of improper operating characteristics. Any deficiencies shall be corrected to the satisfaction of the ENGINEER. All machines or devices which exhibit unusual or unacceptable operating characteristics shall be disassembled and inspected. Any defects found during the course of the inspection shall be repaired or the specific part or entire equipment item shall be replaced to the complete satisfaction of the ENGINEER, at no additional cost to the OWNER.

3.8 TRAINING

A. Provide training per requirements of specification Section 01821, Instruction of Operations and Maintenance Personnel.

++ END OF SECTION ++

SECTION 01660

FIELD TESTS OF EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION

A. In addition to testing required by this Section, CONTRACTOR shall perform all other tests required by detailed Equipment Specifications.

B. No system or subsystem shall be started up for continuous operation unless all components, including instrumentation and monitoring systems, of that system or subsystem has been tested and proven to be operable as intended by the Contract Documents.

1.2 PRELIMINARY TESTS

A. CONTRACTOR shall make preliminary field tests of all equipment as soon as conditions permit.

B. Purpose of tests is to determine if equipment is:
   1. Properly installed.
   2. In compliance with operating cycles.
   3. Operational and free from overheating, overloading, vibration, or other operating problems.

C. CONTRACTOR shall furnish all labor, materials, instruments, fuel, incidentals, and expendables required, unless otherwise provided.

D. CONTRACTOR shall make all changes, adjustments, and replacements required to place equipment in service and test it.

E. ENGINEER and OWNER shall be given sufficient notice prior to witness tests. A minimum 48 hour notice shall be given.

1.3 FINAL TESTS

A. To the maximum extent possible, CONTRACTOR shall perform final field tests of equipment prior to initial start-up and operation of the Project.

B. Purpose of the tests is to demonstrate that equipment is:
   1. Properly installed.
   2. Completely ready for operation by the OWNER.
   3. In compliance with design conditions, material specifications, and all other requirements of the Contract Documents.

C. CONTRACTOR shall furnish all fuel and energy, labor, materials, instruments, chemicals, lubricants, and expendables required for the tests, except where otherwise specified.

D. Until final field tests are completed and approved, CONTRACTOR shall make all necessary changes, adjustments, and replacements.

E. Systems or unit process, or any piece of equipment, shall not be started up without the approved Operation and Maintenance Manuals being turned over to the OWNER.

F. CONTRACTOR shall notify ENGINEER at least 48 hours prior to beginning of tests. CONTRACTOR shall keep notes and data on tests, and submit copy to the ENGINEER. ENGINEER and OWNER'S operating personnel shall witness all tests.

1.4 MANUFACTURERS' AND SUPPLIERS' FIELD AND TEST DATA

A. An experienced, competent, and authorized representative of the manufacturer or supplier of each item of equipment, as required in these Specifications, shall visit the site of the Work and inspect, check, and approve the equipment installation. In each case, the equipment supplier's representative shall be present when the equipment is placed in operation. The equipment supplier's representative shall revisit the job site as often as necessary until all trouble is corrected and the equipment installation and operation is satisfactory to the ENGINEER. Sales representatives shall not be acceptable to perform start-up and training functions.

B. One hard copy and electronic copies of all test and field data collected by the manufacturers/suppliers of equipment during installation supervision and start-up services shall be submitted to the ENGINEER within 14 calendar days after the start-up services are complete. The test and field data shall be submitted, whether specified or not, in the detailed Equipment Specifications and shall include, but are not limited to, tolerance and alignment measurements where applicable to verify equipment has been satisfactorily installed, and all other information collected by the manufacturers/suppliers to satisfy themselves that equipment has been properly installed. The manufacturer shall submit to the ENGINEER a certification on the manufacturer's letterhead stating that the equipment has been properly installed and lubricated, is in accurate alignment, is free from any undue stress imposed by connecting piping or anchor bolts; and has been operated under full load conditions and it operated satisfactorily. In cases where the manufacturer/supplier's representative believes equipment is not properly installed he shall include with this submittal a punch list detailing the problems noted which require correction. The information required under this Section shall be furnished for all equipment and devices requiring installation and start-up services, as specified in these Specifications, including the detailed Mechanical, Electrical, and Instrumentation Specifications.

C. The costs for this Work shall be included in the prices quoted by equipment suppliers. CONTRACTOR shall perform all Work required to install and place into operation the equipment in accordance with the manufacturer's recommendations.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

++ END OF SECTION ++

SECTION 01700

CONTRACT CLOSEOUT

PART 1 - GENERAL

1.1 SUMMARY

A. Tasks listed under this Section shall be completed prior to Contract closeout and approval of the CONTRACTOR'S final pay request.

1.2 RELATED SECTIONS

A. Section 01300, Submittals.

B. Section 01400, Quality Control

C. Section 01650, Starting of Systems.

1.3 CONTRACT CLOSEOUT SUBMITTALS

A. The following documents are to be submitted as specified to the ENGINEER prior to approval of the CONTRACTOR'S final pay request:
   1. Record Drawings shall be furnished by the CONTRACTOR. One set of bluelines annotated to show all changes shall be delivered by the CONTRACTOR to the ENGINEER. The Record Drawings shall reflect all changes made by change order, addenda, field order, work directive, and any other changes made and approved during the course of the Work.
   2. CONTRACTOR'S Affidavit of Payment of Debts and Claims.
   3. CONTRACTOR'S Affidavit of Release of Liens.
   4. Consent of Surety.
   5. Labor and Material Lien Waivers: These documents shall be furnished by the CONTRACTOR and all subcontractors. These lien waivers shall be attached to the CONTRACTOR'S Affidavit of Release of Liens.
   6. Copies of written warranties shall be furnished for each individual item of equipment. The names, addresses, and phone numbers of the manufacturer's representatives shall be included.
   7. Operation and Maintenance Manuals shall be furnished for each individual item of equipment as specified in Section 01300, Submittals.
   8. Equipment manufacturers' start-up reports shall be furnished as specified in Section 01400, Quality Control.
   9. The CONTRACTOR shall submit all maintenance stock items, spare parts, and special tools.
   10. All training videos shall be submitted in two (2) external hard drives in accordance with Section 01650, Starting of Systems.

1.4 SITE CONDITIONS

A. Prior to approval of the CONTRACTOR'S final pay request and after Work has been completed, the CONTRACTOR shall dispose of all waste material.

B. All areas shall be restored to a condition equal to or better than the original.

C. Site grading shall be performed to the lines and grades as shown or conforming to adjacent contours.

1.5 MAINTENANCE AND GUARANTEE

A. The CONTRACTOR shall comply with the maintenance and guarantee requirements contained in the General Conditions.

B. Replacement of earth fill or backfill, where it has settled below the required finish elevations, shall be considered as a part of such required repair work and any repair or resurfacing constructed by the CONTRACTOR which becomes necessary by reason of such settlement shall likewise be considered as a part of such required repair work, unless the CONTRACTOR shall have obtained a statement in writing from the affected private owner or public agency releasing the OWNER from further responsibility in connection with such repair or resurfacing.

C. The CONTRACTOR shall make all repairs and replacements promptly upon receipt of written order from the OWNER. If the CONTRACTOR fails to make such repairs or replacements promptly, the OWNER reserves the right to do the Work and the CONTRACTOR and his surety shall be liable to the OWNER for the cost thereof.

1.6 BOND

A. The CONTRACTOR shall provide a bond to guarantee performance of the provisions contained in Paragraph 1.5, above, and the General Conditions.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

++ END OF SECTION ++

SECTION 01710

CLEANING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section outlines requirements for cleaning of the Project Work. This Section is complementary to the General Conditions and nothing herein shall be considered to waive any requirements of the General Conditions.

1.2 REQUIREMENTS OF REGULATORY AGENCIES

A. Safety and Insurance Standards: Maintain Project in accordance with the following safety and insurance standards:
   1. State Industrial Commission of Arizona (OSHA).

B. Fire Protection: Store volatile waste in covered metal containers and remove from premises daily.

C. Pollution Control: Conduct cleanup and disposal operations to comply with local ordinances and anti-pollution laws. Burning or burying of rubbish and waste material on the Project site is not permitted. Disposal of volatile fluid waste (such as mineral spirits, oil, or paint thinner) in storm or sanitary sewer systems or into streams or waterways is not permitted.

PART 2 - PRODUCTS

2.1 CLEANING MATERIAL

A. Use only cleaning materials recommended by manufacturer of surface to be cleaned. Use cleaning materials only on surfaces recommended by cleaning material manufacturer.

PART 3 - EXECUTION

3.1 DURING CONSTRUCTION

A. During the construction period the material to be used in the Work shall be kept in an orderly manner, neatly stacked or piled.

B. Clean up frequently (at least weekly) all refuse, rubbish, scrap materials, and debris caused by operations, to the end that at all times the site of the Work shall present a neat, orderly, and workmanlike appearance. Sprinkle dusty debris with water.

C. Provide for the disposal of all waste products, trash, debris, etc., and make necessary arrangement for legal disposal of same off the site. Never throw rubbish from

windows or other parts of building. Lower waste materials in a controlled manner with as few handling as possible.

D. Remove all surplus material, false-work, temporary structures, including foundations thereof, plant of any description and debris of every nature resulting from operations and put the site in a neat, orderly condition.

E. Vacuum clean interior building areas when ready to receive finish painting and continue vacuum cleaning on an as-needed basis until building is ready for acceptance.

F. Schedule cleaning operation so that dust and other contaminants resulting from cleaning process will not fall on wet, newly painted surfaces.

G. General Contractor shall provide trash gondolas or containers for use by all trades.

3.2 FINAL CLEANING

A. Use experienced workmen or professional cleaners for final cleaning. Provide adequate ventilation during use of volatile or noxious substances.

B. Besides general broom cleaning, do following special cleaning for all trades at completion of Work:
   1. Remove putty stains from glass; wash, polish same inside and outside. Exercise care not to scratch glass.
   2. Remove marks, stains, fingerprints, other soil, dirt from painted, decorated, or stained work.
   3. Clean, polish, and wax woodwork.
   4. Clean and polish hardware for removal of stains, dust, dirt, paint, and the like.
   5. Remove spots, soil, paint from tile and similar Work; wash same.
   6. Clean fixtures, equipment; remove stains, paint, dirt, and dust.
   7. Remove temporary floor protections.
   8. Clean and polish all floors.
   9. Remove all temporary protections at the site.
   10. Clean exterior and interior metal surfaces including doors and windows of oil, stains, dust, dirt, paint and the like.
   11. Clean and vacuum all carpeted areas.

C. Make buildings ready for occupancy in all respects. Lay heavy building paper in main circulation areas to protect the floors until final inspection and acceptance.

D. All existing improvements inside or outside the property which are disturbed, damaged, or destroyed by the Work under the Contract shall be restored to the condition in which they originally were or to the satisfaction of the ENGINEER.

++ END OF SECTION ++

SECTION 01715

TESTING OF HYDRAULIC STRUCTURES

PART 1 - GENERAL

1.1 SUMMARY

A. Scope:
   1. CONTRACTOR shall provide all labor, material, tools, equipment and incidentals as shown, specified and required to clean, flush and test structures.
   2. The Work also shall include all labor and materials required to prepare a structure for testing, convey water to the testing location, perform the testing, and all labor and materials required to drain and dispose of water used for testing.

B. Hydraulic Structures Scheduled for Hydrostatic Testing: Clean and test the structures listed below. Visual tests are acceptable for existing structures. Full hydrostatic testing described in this specification section shall be conducted for all new structures.
   1. AWRF Disc Filter No. 6 (visual test acceptable).
   2. AWRF Secondary Clarifiers No. 1 through No. 4 (visual test acceptable).
   3. AWRF Aeration Basins No. 5 and No. 6 (visual test acceptable).
   4. OWRF Secondary Clarifier No. 3 (visual test acceptable).
   5. OWRF MBR Bioreactor Basins No. 1 and No. 2.

C. Water for Testing:
   1. Water for initial testing will be furnished by the OWNER.
   2. CONTRACTOR shall provide all temporary piping, hose, valves, backflow preventers, appurtenances, and services required for testing.
   3. CONTRACTOR shall convey the water to the testing location.
   4. Water for testing may be withdrawn from:
      a. Nearest fire hydrant.

D. The maximum rate at which water may be withdrawn is 100 gpm. CONTRACTOR shall provide on the withdrawal piping, downstream of the backflow preventer, a valve to control the rate of flow and a flow meter. The flow meter shall be calibrated within one year and field calibrated/verified prior to the date of its use, and its certification of calibration shall be submitted to the ENGINEER for approval.
   1. Cost of water for re-testing shall be paid by CONTRACTOR to OWNER at OWNER'S standard rates.

E. Testing of piping is specified under Section 15051, Buried Piping Installation, and Section 15052, Exposed Piping Installation.

1.2 Related Sections

A. Section 01710, Cleaning.

B. Section 03300, Cast-In-Place Concrete.

C. Section 15051, Buried Piping Installation.

D. Section 15052, Exposed Piping Installation.

1.3 DEFINITIONS

A. The term "hydraulic structures" is defined as tanks, channels, and other structures through which liquid is conveyed or that hold liquid. Hydraulic structures include structures that are open to the atmosphere and structures with closed tops. Hydraulic structures, include but are not limited to, wet wells, junction chambers equalization tanks, storage tanks, treatment process tanks such as grit chambers, clarifiers, aeration tanks, filter beds, contact tanks, and other channels or tanks as designated herein.
   1. Excluded are structures where cleaning and testing are specified under other Sections or contracts.

1.4 SUBMITTALS

A. Provide written notice of the proposed testing schedule for a given structure for review by the ENGINEER and OWNER at least 28 days prior to the scheduled testing. Include proposed plans for water conveyance, control, and disposal. Testing will not commence without approval of ENGINEER.

B. Shop Drawings: Submit for approval the following:
   1. Cleaning procedures.
   2. Hydrostatic testing procedures, methods, equipment, coordination, and schedules.
   3. Report for each test.

C. Shop Drawings: Submit for approval the following:
   1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or

services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

2. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**

PART 2 - PRODUCTS

2.1 MATERIALS

A. Temporary valves, bulkheads, and other water control equipment and materials, shall be determined by CONTRACTOR subject to the ENGINEER'S review and approval. No materials shall be used that would be injurious to the construction or its future function.

PART 3 - EXECUTION

3.1 CLEANING

A. Cleaning Requirements:
   1. Remove all scaffolding, planks, tools, rags, dirt, debris, and material not part of the structure prior to testing.
   2. Thoroughly clean the walls, floors, and operating equipment by sweeping, high-pressure wash, scrubbing, or other methods approved by ENGINEER.
   3. Remove all water, dirt, or foreign material accumulated during cleaning from the hydraulic structure. Provide temporary pumps, piping, and facilities as required to discharge water from the cleaning operation in a manner approved by ENGINEER.
   4. Do not proceed with testing until ENGINEER has approved the results of the cleaning operation.
   5. Cleaning shall conform to the requirements of Section 01710, Cleaning.

3.2 GENERAL FOR TESTING

A. The following requirements apply:
   1. Each hydraulic structure shall be tested separately.

B. Hydraulic structures shall be free of visible leakage. Repair leaks in a manner subject to ENGINEER'S approval and in accordance with the Contract Documents.

C. The structure shall be tested prior to the application of exterior coating systems and the installation of masonry block veneer, if applicable.

D. The after testing release of water from structures, shall be as approved by the ENGINEER.

3.3 HYDROSTATIC TESTING OF HYDRAULIC STRUCTURES

A. Analysis of data from hydrostatic tests of hydraulic structures shall be performed by CONTRACTOR in accordance with the requirements of ACI 350.1 and as specified herein. CONTRACTOR shall supply all materials and labor to obtain the test data.

B. Prior to the start of hydrostatic testing, the following shall be met.
   1. All elements of the structure that will resist pressure exerted by the retained liquid shall be in place and at specified strength levels. Concrete shall be fully cured.
   2. Structure walls shall not be backfilled and, if damp proofing is specified, coated with damp proofing prior to leakage testing, unless otherwise approved by ENGINEER.
   3. All valves, gates, blind flanges, and other items, other than concrete, that control the flow of or otherwise retain the liquid contents of the structure, shall be checked for water-tightness. If not watertight, CONTRACTOR shall provide measures to ensure water-tightness during the hydrostatic test.
   4. Defective concrete shall be repaired.
   5. CONTRACTOR shall notify ENGINEER and OWNER a minimum of 24 hours prior to the start of filling of the structure for hydrostatic testing.
   6. Concrete hydraulic structures shall remain filled with clean water for an initial 48 hour period to allow for adsorption. Following this initial period, CONTRACTOR shall add make-up water to fill the hydraulic structure to the specified water surface test elevation.

C. Fill the hydraulic structure with clean water to the maximum water surface test elevation specified. Where no test elevation is specified and fluid level in the structure will normally be controlled by a weir, fill the structure to an elevation 6-inch below the weir crest. Where no test elevation is indicated and the structure does not have a flow control weir, the test elevation shall be 2 feet below the top of the structure.

D. Filling Hydraulic Structures with Water:
   1. Fill the portion of the hydraulic structure to be tested at a rate not to exceed two vertical feet per hour.

2. During filling, provide a backflow preventer at the point where water is withdrawn from the existing potable water system, if applicable.

E. After water has been brought to the test elevation and the specified wetting period has elapsed, inspect the exposed surfaces of the structure for leakage. Repair locations where leakage or weeping is evident prior to the start of hydrostatic testing.

F. Hydrostatic test duration shall be determined by the ENGINEER based on ACI 350.1, but shall not be less than 24 hours.

G. Allowable Leakage:
1. Leakage is defined as the quantity of water that must be supplied to the hydraulic structure or any section thereof to maintain the water level within 3-inches of the specified water surface test elevation during the hydrostatic test, plus the amount of water required to fill the hydraulic structure to the specified water surface test elevation at the conclusion of the hydrostatic test, plus precipitation, minus an allowance for evaporation if applicable.
2. For concrete structures without lining of interior wetted surfaces, the allowable leakage is 0.075% of the volume tested per 24 hour period.
3. For concrete structures with interior wetted surfaces lined with a waterproof material, the allowable leakage is 0.050% of the volume tested per 24 hour period.

H. Measurement Locations:
1. Structures or structure cells that are less than 1,000 Sq. ft. in water surface area shall have measurements of water level taken at a minimum of two locations that are approximately 180 degrees apart.
2. Structures or structure cells that are greater than 1,000 Sq. ft. in water surface area shall have measurements of water level taken at a minimum of four locations that are approximately 90 degrees apart.
3. Each measurement location shall be marked and given a reference number. A reference point shall be marked on the face of the wall above the test water surface in a manner that will prevent movement or deterioration of the reference point mark during the test.
4. Measurement locations shall be located so that the effects of wave action and wind are minimized.

I. Evaporation and Precipitation Measurement:
1. In hydraulic structures that are open to the atmosphere, a floating, restrained, partially filled, plastic calibrated open-topped container not less than 18-inches in diameter and depth shall be floated in the tank, and held in position near each measurement location. Calibration increments shall be 0.1-inch or less.

2. Containers shall be located so that they are not shaded by the structure's walls, and are away from overhead items such as beams, pipes, and walkways.

J. Test Measurements:
   1. Do not start hydrostatic tests when severe weather conditions, such as heavy precipitation, high winds, major changes in average daily temperature, and other severe conditions are predicted.
   2. Record the following measurements at each test location at the start of the test period and at 12-hour intervals thereafter.
      a. Distance from reference point to test water surface.
      b. Depth of water in the evaporation-precipitation containers.
      c. Temperature of the test water at a point 18-inches below the water surface.
      d. Temperature of the water in the evaporation-precipitation containers at mid-depth.
   3. If the water surface is subject to wave action at the measurement location, the average water surface elevation of the wave oscillations shall be recorded as the data.
   4. The change in the water surface elevation at each measurement location shall be averaged and adjusted as follows:
      a. The total change in the hydraulic structure's water surface elevation shall be adjusted by the average change in water surface elevation in the evaporation-precipitation containers.
      b. Where the averaged water temperature measurements vary by more than three degrees from start to completion of the test period, adjustment in the test volume shall be determined by the change of the density of water resulting from the change in the average water temperature.
   5. Determination of Leakage:
      a. Provide a test container filled with a known quantity of water at the start of the test. Attach the test pump suction to the test container.
      b. Pump water from the test container into the hydraulic structure with the test pump to maintain the water level in the hydraulic structure within 3-inches of the specified test elevation for the duration of the test period.
      c. At the conclusion of the test, pump water from the container into the hydraulic structure to attain the specified test elevation.
      d. Measure the water remaining in the container and record the amount used during the test on the test report.

K. Criteria for Acceptance:
   1. The hydrostatic test will pass if the measured leakage is less than the allowable leakage and no leaks or weeping are observed.
   2. The hydrostatic test shall be considered to have failed if the allowable leakage is exceeded or if leakage or weeping is observed.
   3. If the test becomes unreliable due to excessive precipitation or other external factors, the test shall be re-started.

4. If a hydrostatic test fails, the structure may be re-tested immediately without repairs if approved by the ENGINEER. If the subsequent hydrostatic test fails, CONTRACTOR shall repair probable areas of leakage and repeat the hydrostatic test.
5. Re-test the structure until it meets the specified criteria for acceptance. Repair probable leakage areas before testing.

L. Reuse and Disposal of Water Used in Hydrostatic Tests:
1. CONTRACTOR shall obtain written approval of the ENGINEER before water used in one hydrostatic test is pumped to a different hydraulic structure for reuse in a subsequent test.

M. The hydraulic structure shall not be backfilled or damp-proofed until acceptance of the hydrostatic test by the ENGINEER.

3.4 TESTING OF APPURTENANT PIPING

A. Piping appurtenant to hydraulic structures shall be tested as specified in applicable Sections.

++ END OF SECTION ++

SECTION 01720

RECORD DOCUMENTS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Maintain and provide the ENGINEER with Record Documents as specified below, except where otherwise specified or modified in Division 2, Site Construction, through Division 17, Instrumentation.

B. Definitions
   1. Contract Documents: The contract documents include the drawings, specifications, and addenda developed and furnished to the CONTRACTOR at the beginning of construction.
   2. As-Built Drawings: As-built drawings are an annotated set of drawings prepared by the CONTRACTOR. They show, in red, as-constructed changes to the original Contract Documents that have been made during the construction process. The As-Built Drawings may include supplemental drawings to provide the necessary detail, comply with project standards or where annotation would otherwise be impractical.
   3. Record Drawings: Record Drawings are prepared by the ENGINEER and reflect as-constructed changes that the CONTRACTOR annotated in the As-Built Drawings.
   4. Record Documents: The Record Documents include Record Drawings, specifications, addenda, approved shop drawings, samples, photographs, change orders, other modifications to the Contract Documents, test records, survey data, field orders, Request for Information, submittals, Warranty certificates, and all other documents pertinent to the CONTRACTOR'S Work.

C. Maintenance of Documents:
   1. Three sets of black line sets of plans, including any Addenda, of the Drawings will be furnished to CONTRACTOR by the OWNER.
   2. Maintain in CONTRACTOR'S field office in clean, dry, legible condition complete sets of the following: Drawings, Specifications, Addenda, approved Shop Drawings, Samples, Photographs, Change Orders, other modifications of Contract Documents, test records, survey data, Field Orders, and all other documents pertinent to CONTRACTOR'S Work.
   3. Provide files and racks for proper storage and easy access. File in accordance with filing format of Construction Specification Institute (CSI), unless otherwise approved by ENGINEER.
   4. Make documents available at all times for inspection by ENGINEER and OWNER.
   5. Record Documents shall not be used for any other purpose and shall not be removed from CONTRACTOR'S office without ENGINEER'S approval.

6. Any contractually required testing provided by others shall be thoroughly documented by the CONTRACTOR and maintained with the project Record Documents. All testing results shall be maintained in their own separate log for the project; being kept current weekly and made readily available for viewing at any time.

D. Marking System: Changes, revisions, additions and deletions, to the record set of Drawings shall be marked in Red.

E. Recording:
   1. Submit as-built drawings and make a record of the locations of all work completed as part of the project. The as-builts must indicate the locations of the beginning(s) and end(s) of the construction, and all valves, fire hydrants, pipe fittings, service connections and appurtenances. They must also show locations and elevations where significant elevation changes occur or changes in direction in all pipe alignments. Their locations must be shown by stationing and dimensioning from appropriate monument lines or in their absence appropriate lot lines, property lines or easement line references.
   2. Label the Cover Sheet, Index and each supplemental sheets of each document "PROJECT RECORD" in 2-inch high printed letters.
   3. Keep the As-Built Drawings current. CONTRACTOR'S refusal, failure or neglect to maintain current As-Built Drawings shall constitute sufficient basis for the ENGINEER to recommend the withholding of some or all of any payment due.
   4. Do not permanently conceal any Work until required information has been recorded.
   5. Drawings: Legibly mark to record actual construction including:
      a. Depths of various elements of foundation in relation to datum.
      b. Horizontal and vertical location of underground utilities and appurtenances referenced to permanent surface improvements.
      c. Location of internal utilities and appurtenances concealed in construction referenced to visible and accessible features of structure.
      d. Field changes of dimensions and details.
      e. Changes made by Change Order or Field Order.
      f. Details not on original Drawings.
   6. Specifications and Addenda: Legibly mark up each Section to record:
      a. Manufacturer, trade name, catalog number, and supplier of each product and item of equipment actually installed.
      b. Changes made by Change Order or Field Order.
      c. Other matters not originally specified.

F. Record Drawings:
   1. As-Built Drawings shall be prepared for all the Work included in the Contract. On a weekly basis, furnish to the ENGINEER a full size annotated copy of the As-Built Drawings that include changes from the previous week's As-Built Drawing submittal. Annotations shall include redlined "clouds" of only those

changes from the previous week's submittal. The redlined As-Built Drawings shall show the actual in-place installation of the items installed under this Contract. The redlined As-Built Drawings shall show the Work in plan and sections as required for clarity with reference dimensions and elevations that will be used to develop complete Record Drawings.

2. Develop and furnish to the ENGINEER, redlined Instrumentation and Control and Electrical Drawings showing one line diagrams with all conduit and wire sizes shown of the distribution systems and the actual in-place grounding system, lighting arrangement, motor control centers, corrected wiring diagrams, equipment and conduit and cable plans.
    a. The Contract Drawings may be used as a starting point in developing these Instrumentation and Control and Electrical As-Built Drawings. Subcontractor and manufacturer drawings may be included in this drawing package. The drawing package must be fully integrated and include the necessary cross references between drawings. The drawing package shall include interconnection and termination details to equipment furnished under this Contract.
    b. All As-Built Drawings must be submitted on a weekly basis for approval of the ENGINEER. This shall include the following composite drawings for the system being furnished:
        1) Schematic (Elementary) Diagrams: This shall include, but not be limited to, complete schematics including items furnished by others for the following:
            a) Motor Control Circuits for Starters furnished under this Contract.
            b) HVAC Control Panels furnished under this Contract.
        2) Wiring (Connection) Diagrams: These shall be included for all pre-wired equipment furnished under this Contract.
        3) Interconnection Diagrams: These shall include all interconnections to be furnished under this Contract.
        4) Conduit and Cable Schedules: These shall include all conduit and cable furnished under this Contract.
        5) Dimension of Outline Drawings: These shall include all equipment furnished under this Contract.
        6) Power and Lighting Layout Drawings: These shall include all conduits and wiring furnished under this Contract.
3. In addition to the redlined As-Built Drawings, prepare and submit CAD ".dwg" files, version 2017 or later, for all supplemental drawings used to complete the As-Built Drawings.
4. Survey results shall be posted to the as-builts on a weekly basis.

G. Submittals:
1. Acceptance of CONTRACTOR'S monthly application for payment shall be dependent on the ENGINEER'S acceptance and agreement that CONTRACTOR'S As-Built Drawings and weekly submittals are complete, thorough and acceptable in showing all Work up through and including such

work as CONTRACTOR is claiming for completion and payment on CONTRACTOR'S application for payment. Any items which do not appear on the As-Built Drawings in complete and acceptable form shall not be paid for in CONTRACTOR'S monthly payment.

2. Examination by the ENGINEER of CONTRACTOR'S As-Built Drawings will be made on a weekly basis to determine completion for consideration of monthly pay application. Also, make available all As-Built Drawings at all times to the ENGINEER for examination.
3. Prior to Completion of the Work, deliver final As-Built Drawings to ENGINEER. Substantial completion will not be made until satisfactory final As-Built Drawings are received by ENGINEER.
4. Accompany final and weekly submittals with transmittal letter containing:
   a. Date.
   b. Project title and number.
   c. CONTRACTOR'S name and address.
   d. Title and number of each As-Built Drawings.
   e. Certification that each document as submitted is complete and accurate.
   f. Signature of CONTRACTOR, or his authorized representative.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

++ END OF SECTION ++

SECTION 01730

OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 DESCRIPTION

A. Provide Operation and Maintenance Data in the form of instructional manuals for use by the OWNER'S personnel for:
   1. All equipment and systems.
   2. All valves, pumps, and related accessories.
   3. All instruments and control devices.
   4. All electrical gear.

B. Training or start-up on any system, process, or piece of equipment shall not be allowed until Operation and Maintenance Manuals and Lesson Training Plans are approved by the ENGINEER, and the approved Operation and Maintenance Manuals have been turned over to the OWNER.

C. Definitions:
   1. Operation and Maintenance Data:
      a. The term "Operation and Maintenance Data" includes all product related information and documents which are required for preparation of the station Operation and Maintenance Manual. It also includes all data which shall accompany said manual as directed by current regulations of any participating government agency.
      b. Required Operation and Maintenance Data includes, but is not limited to, the following:
         1) Complete, detailed written operating instructions for each product or piece of equipment including equipment function; operating characteristics; limiting conditions; operating instructions for start up, normal, and emergency conditions; regulation and control; and shut down.
         2) Complete, detailed written preventive maintenance instructions as defined below.
         3) Recommended spare parts lists, by generic title and identification number, and local sources of supply for parts.
         4) Written explanations of all safety considerations relating to operation and maintenance procedures.
         5) Name, address, and phone number of manufacturer, manufacturer's local service representative, and subcontractor or installer.
         6) Copy of all approved Shop Drawings, and a copy of the warranty bond and service contract as applicable, including circuit diagrams, schematics, and functional Drawings.

7) Control Diagrams: Internal and connection wiring, including logic diagrams, wiring diagrams for control panels, ladder logic for computer based systems, and connections between existing systems and new additions, and adjustments such as calibrations and set points for relays, and control or alarm contact settings. Provide all programming/wiring documentation needed for "in-house" troubleshooting and customizing.
8) Final test data, where applicable, shall be submitted as an appendix when completed.
9) Disassembly, reassembly, installation, alignment, adjustment, and checking instructions.

2. Preventive Maintenance Instructions:
   a. The term "Preventive Maintenance Instructions" includes all information and instructions required to keep a product or piece of equipment properly lubricated, adjusted, and maintained so that the item functions economically throughout its full design life.
   b. Preventive Maintenance Instructions include, but are not limited to, the following:
      1) A written explanation with illustrations for each preventive maintenance task.
      2) Recommended schedule for execution of preventive maintenance tasks.
      3) Lubrication charts.
      4) Table of alternative lubricants.
      5) Trouble shooting instructions.
      6) List of required maintenance tools and equipment.

D. Submittals:
   1. General: Submit operations and maintenance data to the ENGINEER within 60 days after approval of Shop Drawings, unless noted otherwise.
   2. Number of Copies: One hard copy of each item.
      a. One preliminary copy of each O&M Manual shall be submitted to the ENGINEER for approval within 30 days of the approval of the Shop Drawing, which indicated further submittals are not required. The O&M Manual shall conform to the requirements as specified herein.
      b. 60 days prior to placing the equipment into service, submit one hard copies and one soft copy of the approved O&M Manual (except for field test data) to the ENGINEER.
      c. Soft copy shall be on a thumb drive and shall include all information provided in hard copy. Text shall be in ".pdf" format. Drawings and figures shall be in AutoCAD ".dwg", or bitmap ".bmp", tiff ".tif", ipeg ".jpg", gif ".gif", or pc paint brush ".pcx".
   3. Letter of Transmittal: Provide a letter of transmittal with each submittal and include the following in the letter:
      a. Date of submittal.
      b. Contract title and number.

c. CONTRACTOR'S name and address.
d. A list of the attachments and the Specification Sections to which they relate.
e. Reference to or explanation of related submittals already made or to be made at a future date.

4. Format Requirements:
   a. Use 8-1/2-inch by 11-inch paper of high rag content and quality. Larger Drawings or illustrations are acceptable if neatly folded to the specified size in a manner which will permit easy unfolding without removal from the binder. Provide reinforced punched binder tab, or provide flyleaf for each product.
   b. All text must be legible typewritten or machine printed originals or high quality copies of same.
   c. Each page shall have a binding margin of approximately 1-1/2-inches and be punched for placement in a 3-ring loose-leaf binder. Provide binders. Identify each binder with the following:
      1) Title "OPERATING AND MAINTENANCE INSTRUCTIONS".
      2) Title of Project.
      3) Identity of building or structure as applicable.
      4) Identity of general subject matter covered.
   d. Use divides and indexed tabs between major categories of information such as operating instructions, preventive maintenance instructions, or other. When necessary, place each major category in a separate binder.
   e. Provide a Table of Contents for each binder.
   f. Identify products by their functional names in the table of contents and at least once in each Chapter or Section. Thereafter, abbreviations and acronyms may be used if their meaning is explained in a table in the back of each binder. Use of model or catalog numbers or letters for identification is not acceptable.
   g. Upon completion of the installation of each item of equipment, the CONTRACTOR shall provide Drawings of the local control panel to be added to the O&M Manual.
   h. Indicate all components of the equipment on catalog pages by highlighting or some other clearly definable medium for ease of identification.
   i. Final test data determined after installation of the equipment shall be submitted as an appendix to the Operations and Maintenance Manuals.

E. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining

acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

F. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

++ END OF SECTION ++

SECTION 01750

SPARE PARTS AND MAINTENANCE MATERIALS

PART 1 - GENERAL

1.1 DESCRIPTION

A. 60 days after approval of the Shop Drawing of the equipment specified in the individual Sections, CONTRACTOR shall furnish spare parts data and maintenance material for equipment. The data shall include a complete list of parts and supplies, with current unit prices and source or sources of supply.

B. Spare parts and materials required to be supplied in the Contract Documents shall be furnished in manufacturer's unopened cartons, boxes, crates or other protective covering suitable for preventing corrosion or deterioration for the maximum length of storage that may be normally anticipated. They shall be clearly marked and identified as to the name of manufacturer or supplier, applicable equipment, part number, description and location in the equipment. All parts shall be protected and packaged for a shelf life of at least 10 years.

C. During construction, store parts in buildings or trailers with floor, roof, and closed sides and in accordance with manufacturers' recommendations. Protect from weather, condensation, and humidity.

D. Parts and materials shall be delivered to the OWNER upon Substantial Completion of the Work or start-up. CONTRACTOR shall then place them in permanent storage rooms or areas approved by the OWNER. The turnover procedures shall be developed by the ENGINEER.

E. Provide a Letter of Transmittal and Spare Parts Receiver Form including the following:
   1. Date of letter and transfer of parts and material.
   2. Contract title and number.
   3. CONTRACTOR'S name and address.
   4. Transmittal should list applicable Specification Sections for each set of spare parts supplied.
   5. Spare Parts Receiver Form.

F. CONTRACTOR shall be fully responsible for loss or damage to parts and materials until they are transmitted to the OWNER.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

SPARE PARTS RECEIVER

SPECIFICATION SECTION 01750

CONTRACTOR PLEASE FILL OUT:

MANUFACTURER:_____

ITEM DESCRIPTION:_____

COST:_____

MANUFACTURER PART NUMBER:_____

SUPPLIER:_____

CROSS REFERENCE NUMBER:_____

VENDOR INFORMATION:_____

VENDOR ORDER PART NUMBER:_____

PART TO BE USED ON WHAT EQUIPMENT:_____

EQUIPMENT NUMBER:_____

SPECIFICATION SECTION:_____

CITY PERSONNEL FILL IN:

BIN NUMBER:_____

AIMS NUMBER:_____

LOCATION IN STORES:_____

RECEIVED BY:_____

++ END OF SECTION ++

SECTION 01800

EQUIPMENT SCHEDULE

PART 1 - GENERAL

1.1 SUMMARY

A. Provides equipment as shown and mentioned in the equipment schedule.

1.2 RELATED SECTIONS

A. Section 01300, Submittals.

B. Section 01640, Materials and Equipment.

C. Section 09900, Painting.

D. Section 10400, Equipment Identification Plates.

E. Section 11218, Magnetic Drive Sealless End Suction Pumps.

F. Section 11295, Hydraulic Valves.

G. Section 11313, Low-Flow Propeller IMLR Pumps.

H. Section 11335, Secondary Clarifier Mechanism.

I. Section 11375, Aeration Systems.

J. Section 11400, Disc Filter System.

K. Section 13400, Aboveground Fuel Storage Tank,

L. Section 13447, Electric Motor Actuators.

M. Section 15050, Piping Systems.

N. Section 15067, Fiberglass Reinforced Plastic Pipe and Accessories.

O. Division 16, Electrical.

P. Section 16225, Electric Motors 250 HP or Less.

Q. Division 17, Instrumentation.

1.3 SYSTEM DESCRIPTION

A. Equipment identification numbers shall be as shown on the Drawings and as listed in this Section. Valve and gate identification numbers shall be as shown on the schedules and on the Drawings. Identification plates shall be as specified in Section 10400, Equipment Identification Plates, and Section 15050, Piping Systems. The CONTRACTOR shall install new identification plates on all new and existing equipment, valves, and gates which are numbered by the Contract Documents.

B. Individual equipment identification numbers are comprised of nine alpha-numeric characters distinguished by two dashes. The identification numbers appear in the following format: XXX-XXX-XXX.
   1. The first three (or two) characters denote the process to which the equipment pertains. These characters shall be alphabetic, as shown on the Drawings.
   2. The following three characters denote a device number, with each piece of equipment in a particular process having a unique device number. These characters shall be numeric.
   3. The final three (or two) characters denote the process equipment code which the number represents. These characters shall be alphabetic as shown on the Drawings.

1.4 EQUIPMENT SCHEDULE

A. This Equipment Schedule is provided for general information on specific items of equipment.

B. The Equipment Schedule lists new equipment installed as part of this Project. Not all equipment items appear on this table. The Equipment Schedule includes all hydraulic valves three inches or larger. Refer to Drawings for all hydraulic valves two inches or smaller.

C. Tags for hydraulic gates are provided under Section 11295, actuators are provided under Section 13447 and tags for field instruments are provided in Division 17, Instrumentation and Contract Documents.

D. In the event of discrepancies between this Schedule and the Drawings and Specifications, the information on the Drawings and Specifications shall govern. Where the Drawings and Specifications identify the equipment in only one of two or more identical basins (or other process units), the information in this schedule shall be used to identify the equipment in all such identical basins (or other process units).

Equipment Description	Equipment Number	Specification Number	Process Sheet	Status
AWRF				
LASER FLOW METER	*IPS-001-SLM*	N/A	M-01.01	PROPOSED
FINE BUBBLE AERATION DIFFUSER 5	*TBD*	11375	M-03.01	PROPOSED
FINE BUBBLE AERATION DIFFUSER 6	*TBD*	11375	M-03.01	PROPOSED
CLARIFIER #3 RAKE MECHANISM DRIVE UNIT	*SC-003-SLC*	11335	M-04.01	PROPOSED
CLARIFIER #4 RAKE MECHANISM DRIVE UNIT	*SC-004-SLC*	11335	M-04.01	PROPOSED
CLARIFIER #1 12 INCH RAS PLUG VALVE	*SC-001-ACE*	11295	M-04.01	PROPOSED
CLARIFIER #3 12 INCH RAS PLUG VALVE	*SC-003-ACE*	11295	M-04.01	PROPOSED
CLARIFIER #4 16 INCH RAS PLUG VALVE	*SC-004-ACE*	11295	M-04.01	PROPOSED
CLARIFIER #1 DRAIN LINE 4 INCH BALL VALVE 1	*TBD*	15067	M-04.01	PROPOSED
CLARIFIER #1 DRAIN LINE 4 INCH BALL VALVE 2	*TBD*	15067	M-04.01	PROPOSED
CLARIFIER #1 DRAIN LINE 4 INCH BALL VALVE 3	*TBD*	15067	M-04.01	PROPOSED
CLARIFIER #2 DRAIN LINE 4 INCH BALL VALVE 1	*TBD*	15067	M-04.01	PROPOSED
CLARIFIER #2 DRAIN LINE 4 INCH BALL VALVE 2	*TBD*	15067	M-04.01	PROPOSED

Equipment Description	Equipment Number	Specification Number	Process Sheet	Status
CLARIFIER #2 DRAIN LINE 4 INCH BALL VALVE 3	*TBD*	15067	M-04.01	PROPOSED
CLARIFIER #2 DRAIN LINE 4 INCH BALL VALVE 4	*TBD*	15067	M-4.01	PROPOSED
CLARIFIER #2 DRAIN LINE 4 INCH BALL VALVE 5	*TBD*	15067	M-04.01	PROPOSED
CLARIFIER #3 DRAIN LINE 4 INCH BALL VALVE 1	*TBD*	15067	M-04.01	PROPOSED
CLARIFIER #3 DRAIN LINE 4 INCH BALL VALVE 2	*TBD*	15067	M-04.01	PROPOSED
CLARIFIER #3 DRAIN LINE 4 INCH BALL VALVE 2	*TBD*	15067	M-04.01	PROPOSED
CLARIFIER #1 HIGH TORQUE SWITCH	*SC-XSH-050*	17150	M-04.01	PROPOSED
CLARIFIER #1 HIGH HIGH TORQUE SWITCH	*SC-XSHH-050*	17150	M-04.01	PROPOSED
CLARIFIER #2 HIGH TORQUE SWITCH	*SC-XSH-052*	17150	M-04.01	PROPOSED
CLARIFIER #2 HIGH HIGH TORQUE SWITCH	*SC-XSHH-052*	17150	M-04.01	PROPOSED
CLARIFIER #3 HIGH TORQUE SWITCH	*SC-XSH-054*	17150	M-04.01	PROPOSED
CLARIFIER #3 HIGH HIGH TORQUE SWITCH	*SC-XSHH-054*	17150	M-04.01	PROPOSED
CLARIFIER #4 HIGH TORQUE SWITCH	*SC-XSH-350*	17150	M-04.01	PROPOSED
CLARIFIER #4 HIGH HIGH TORQUE SWITCH	*SC-XSHH-350*	17150	M-04.01	PROPOSED

Equipment Description	Equipment Number	Specification Number	Process Sheet	Status
BACKWASH PUMP #6B 3-INCH GATE VALVE	*TBD*	11400	M-05.01	PROPOSED
BACKWASH PUMP #6B VACUUM GAUGE	*DSF06-VI-642*	11400	M-05.01	PROPOSED
BACKWASH PUMP #6B VACUUM TRANSMITTER	*DSF06-VT-602*	11400	M-05.01	PROPOSED
BACKWASH PUMP #6B PRESSURE GAUGE	*DSF06-VI-643*	17121	M-05.01	PROPOSED
DISC FILTER #6 LEVEL TRANSDUCER	*DSF06-LT-600*	11400	M-05.01	PROPOSED
DISC FILTER #6 4-INCH MUD VALVE	*TBD*	11400	M-05.01	PROPOSED
DISC FILTER #6 TURBIDITY PROBE	*TBD*	11400	M-05.01	PROPOSED
DISC FILTER #6 RECIRCULATION PIPE 3-INCH BALL VALVE	*TBD*	11400	M-05.01	PROPOSED
DISC FILTER #6 DRAIN PIPE 3-INCH BALL VALVE	*TBD*	11400	M-05.01	PROPOSED
MONORAIL POWER BAR	*TBD*	11400	M-05.01	PROPOSED
NHLW DISPOSAL STATION H2S SENSOR	*TBD*	17321	M-08.01	PROPOSED
NHLW DISPOSAL STATION H2S SENSOR ALARM	*TBD*	17321	M-08.01	PROPOSED
FUEL STORAGE TANK	*TBD*	13400	M-13.01	PROPOSED
FUEL DISPENSING UNIT	*TBD*	13400	M-13.01	PROPOSED

Equipment Description	Equipment Number	Specification Number	Process Sheet	Status
FUEL STORAGE SUBMERSIBLE PUMP #1	*FS-PMP-200*	13400	M-13.01	PROPOSED
FUEL STORAGE SUBMERSIBLE PUMP #2	*FS-PMP-201*	13400	M-13.01	PROPOSED
FUEL STORAGE TANK HIGH LEVEL ALARM	*TBD*	13400	M-13.01	PROPOSED
FUEL STORAGE TANK LOW LEVEL ALARM	*TBD*	13400	M-13.01	PROPOSED
FUEL STORAGE TANK LEVEL METER	*TBD*	13400	M-13.01	PROPOSED
FUEL STORAGE TANK LEVEL GAUGE	*TBD*	13400	M-13.01	PROPOSED
FUEL POLISHING UNIT	*TBD*	13400	M-13.01	PROPOSED
FUEL STORAGE TANK HIGH TEMPERATURE ALARM	*TBD*	13400	M-13.01	PROPOSED
SODIUM HYPOCHLORITE PUMP #1	*NAOCL-PMP-001*	11218	M-11.01	PROPOSED
SODIUM HYPOCHLORITE PRESSURE SWITCH HIGH #1	*NAOCL-PSH-001*	17121	M-11.01	PROPOSED
SODIUM HYPOCHLORITE PRESSURE INDICATING TRANSMITTER	*NAOCL-PIT-001*	17120	M-11.01	PROPOSED
SODIUM HYPOCHLORITE PUMP #2	*NAOCL-PMP-002*	11218	M-11.01	PROPOSED

Equipment Description	Equipment Number	Specification Number	Process Sheet	Status
SODIUM HYPOCHLORITE PRESSURE SWITCH HIGH #2	*NAOCL-PSH-002*	17121	M-11.01	PROPOSED
SODIUM HYPOCHLORITE PUMP #3	*NAOCL-PMP-003*	11218	M-11.01	PROPOSED
SODIUM HYPOCHLORITE PRESSURE SWITCH HIGH #3	*NAOCL-PSH-003*	17121	M-11.01	PROPOSED
SODIUM HYDROXIDE PUMP #1	*NAOH-PMP-001*	11218	M-11.01	PROPOSED
SODIUM HYDROXIDE PRESSURE SWITCH HIGH #1	*NAOH-PSH-001*	17121	M-11.01	PROPOSED
SODIUM HYDROXIDE PRESSURE INDICATING TRANSMITTER	*NAOH-PIT-001*	17120	M-11.01	PROPOSED
SODIUM HYDROXIDE PUMP #2	*NAOH-PMP-002*	11218	M-11.01	PROPOSED
SODIUM HYDROXIDE PRESSURE SWITCH HIGH #2	*NAOH-PSH-002*	17121	M-11.01	PROPOSED
SODIUM HYDROXIDE PUMP #3	*NAOH-PMP-003*	11218	M-11.01	PROPOSED
SODIUM HYDROXIDE PRESSURE SWITCH HIGH #3	*NAOH-PSH-003*	17121	M-11.01	PROPOSED
HEADWORKS SODIUM HYPOCHLORITE MOTOR OPERATED VALVE	*NAOCL-VLV-001*	11295	M-11.03	PROPOSED
PRESTAGE BASIN #1 SODIUM HYPOCHLORITE MOTOR OPERATED VALVE	*NAOCL-VLV-002*	11295	M-11.04	PROPOSED

Equipment Description	Equipment Number	Specification Number	Process Sheet	Status
PRESTAGE BASIN #2 SODIUM HYPOCHLORITE MOTOR OPERATED VALVE	*NAOCL-VLV-003*	11295	M-11.05	PROPOSED
HEADWORKS SODIUM HYDROXIDE MOTOR OPERATED VALVE #1	*NAOH-VLV-001*	11295	M-11.03	PROPOSED
HEADWORKS SODIUM HYDROXIDE MOTOR OPERATED VALVE #2	*NAOH-VLV-002*	11295	M-11.03	PROPOSED
PRESTAGE BASIN #1 SODIUM HYDROXIDE MOTOR OPERATED VALVE #1	*NAOH-VLV-003*	11295	M-11.04	PROPOSED
PRESTAGE BASIN #1 SODIUM HYDROXIDE MOTOR OPERATED VALVE #2	*NAOH-VLV-004*	11295	M-11.04	PROPOSED
PRESTAGE BASIN #2 SODIUM HYDROXIDE MOTOR OPERATED VALVE #1	*NAOH-VLV-005*	11295	M-11.05	PROPOSED
PRESTAGE BASIN #2 SODIUM HYDROXIDE MOTOR OPERATED VALVE #2	*NAOH-VLV-006*	11295	M-11.05	PROPOSED

OWRF				
MBR BIOREACTOR BASIN #1 IMLR PUMP	*PMP-410-101*	11313	M-23.01	PROPOSED
MBR BIOREACTOR BASIN #1 IMLR PUMP TEMPERATURE SWITCH HIGH	*TSH-410-101*	11313	M-23.01	PROPOSED
MBR BIOREACTOR BASIN #1 IMLR PUMP LEAK SWITCH	*YS-410-101*	11313	M-23.01	PROPOSED
MBR BIOREACTOR BASIN #1 IMLR PUMP DISCONNECT SWITCH	*DSC-410-101*	16440	M-23.01	PROPOSED
MBR BIOREACTOR BASIN #1 ZONE 8 MIXER	*MIX-410-181*	N/A	M-23.01	EXISTING (RELOCATE)
MBR BIOREACTOR BASIN #1 ZONE 8 MIXER MOTOR TEMPERATURE SWITCH HIGH	*TSH-410-181*	N/A	M-23.01	EXISTING (RELOCATE)
MBR BIOREACTOR BASIN #1 ZONE 8 MIXER MOTOR MOISTURE SWITCH HIGH	*MSH-410-181*	N/A	M-23.01	EXISTING (RELOCATE)
MBR BIOREACTOR BASIN #1 ZONE 8 MIXER MOTOR DISCONNECT SWITCH	*DSC-410-181*	16440	M-23.01	PROPOSED
MBR BIOREACTOR BASIN #1 IMLR PUMP 30 INCH CHECK VALVE	*TBD*	11295	M-23.01	PROPOSED
MBR BIOREACTOR BASIN #2 IMLR PUMP	*PMP-410-201*	11313	M-23.01	PROPOSED

MBR BIOREACTOR BASIN #2 IMLR PUMP TEMPERATURE SWITCH HIGH	*TSH-410-201*	11313	M-23.01	PROPOSED
MBR BIOREACTOR BASIN #2 IMLR PUMP LEAK SWITCH	*YS-410-201*	11313	M-23.01	PROPOSED
MBR BIOREACTOR BASIN #2 IMLR PUMP DISCONNECT SWITCH	*DSC-410-201*	16440	M-23.01	PROPOSED
MBR BIOREACTOR BASIN #2 ZONE 8 MIXER	*MIX-410-281*	N/A	M-23.01	EXISTING (RELOCATE)
MBR BIOREACTOR BASIN #2 ZONE 8 MIXER MOTOR TEMPERATURE SWITCH HIGH	*TSH-410-281*	N/A	M-23.01	EXISTING (RELOCATE)
MBR BIOREACTOR BASIN #2 ZONE 8 MIXER MOTOR MOISTURE SWITCH HIGH	*MSH-410-281*	N/A	M-23.01	EXISTING (RELOCATE)
MBR BIOREACTOR BASIN #2 ZONE 8 MIXER MOTOR DISCONNECT SWITCH	*DSC-410-281*	16440	M-23.01	PROPOSED
MBR BIOREACTOR BASIN #2 IMLR PUMP 30 INCH CHECK VALVE	*TBD*	11295	M-23.01	PROPOSED
ANOXIC BASIN IMLR PUMP #7	*ANX-MLR-PMP-007*	11310	M-25.01	PROPOSED
ANOXIC BASIN IMLR PUMP #7 DISCONNECT SWITCH	*ANX-MLR-PMP-DSC-007*	16440	M-25.01	PROPOSED

ANOXIC BASIN IMLR PUMP #7 LOW FLOW SWITCH	*ANX-MLR-FSL-007*	11310	M-25.01	PROPOSED
ANOXIC BASIN IMLR PUMP #7 MOTOR HIGH TEMP SWITCH	*ANX-MLR-PMP-TSH-007*	11310	M-25.01	PROPOSED
CLARIFIER #3 RAKE MECHANISM DRIVE MOTOR	*SEC-MTR-300*	11335	M-27.01	PROPOSED
CLARIFIER #3 8 INCH DRAIN PLUG VALVE	*TBD*	11295	M-27.01	PROPOSED
CLARIFIER #3 HIGH TORQUE SWITCH	*SEC-OSH-300*	17150	M-27.01	PROPOSED
CLARIFIER #3 HIGH HIGH TORQUE SWITCH	*SEC-OSHH-300*	17150	M-27.01	PROPOSED
FUEL STORAGE TANK	*TBD*	13400	M-33.01	PROPOSED
FUEL DISPENSING UNIT	*TBD*	13400	M-33.01	PROPOSED
FUEL STORAGE SUBMERSIBLE PUMP #1	*FS-PMP-200*	13400	M-33.01	PROPOSED
FUEL STORAGE SUBMERSIBLE PUMP #2	*FS-PMP-201*	13400	M-33.01	PROPOSED
FUEL STORAGE TANK HIGH LEVEL ALARM	*TBD*	13400	M-33.01	PROPOSED
FUEL STORAGE TANK LOW LEVEL ALARM	*TBD*	13400	M-33.01	PROPOSED
FUEL STORAGE TANK LEVEL METER	*TBD*	13400	M-33.01	PROPOSED
FUEL STORAGE TANK LEVEL GAUGE	*TBD*	13400	M-33.01	PROPOSED
FUEL POLISHING UNIT	*TBD*	13400	M-33.01	PROPOSED

FUEL STORAGE TANK HIGH TEMPERATURE ALARM	*TBD*	13400	M-33.01	PROPOSED

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

++ END OF SECTION ++

SECTION 01821

INSTRUCTION OF OPERATIONS AND MAINTENANCE PERSONNEL

PART 1 - GENERAL

1.1 DESCRIPTION

A. CONTRACTOR shall provide the services of factory-trained maintenance specialists to instruct OWNER'S operations and maintenance personnel in the recommended operation and the preventive maintenance procedures for equipment specified in the equipment Sections.

B. The qualifications of specialists shall be subject to approval by ENGINEER.

C. CONTRACTOR shall coordinate these services at times acceptable to OWNER and ENGINEER, with a minimum of 14 days prior notice.

D. Manufacturer shall provide a combination of classroom and field training. All training shall be conducted at the facility, unless otherwise stated in the Equipment Sections. Class size shall be limited to no more than 15 trainees. Manufacturer shall provide training for all plant shifts, or as approved by OWNER.

E. Manufacturer shall allow any and all training sessions to be videotaped by OWNER.

F. Section 01640, Materials and Equipment; Section 01650, Starting of Systems; Section 01660, Field Tests of Equipment; and, additional requirements for manufacturer's and supplier's field and test data.

G. Instruction of OWNER'S personnel shall commence only after the equipment has been started, approved Operation and Maintenance Manuals have been turned over to the OWNER, and acceptance tests have been completed according to the provisions in Section 01650, Starting of Systems.

H. CONTRACTOR shall submit a copy of this Section 01821, Instruction of Operations and Maintenance Personnel, to all manufacturers of equipment for this Contract.

1.2 SUBMITTALS

A. Manufacturer shall submit to the ENGINEER for approval the following:
   1. Proposed Lesson Plan for each scheduled instruction 28 days prior to commencement of training. Lesson plans shall be approved a minimum of 14 days prior to scheduled instruction.

2. Proposed Manufacturer's Recommended Preventive Maintenance Training Plan for each asset type a minimum of 40 days prior to scheduled instruction or coordinate with the OWNER if this will conflict with construction schedule.
3. Credentials of their designated operations and maintenance instructor shall include a brief resume and specific details of the instructor's experience pertaining to operation of, maintenance of, and training for the equipment specified.
4. Training Request Form: CONTRACTOR shall submit the Training Request Form to the ENGINEER 28 days prior to the requested training date. Form is located at the end of this Section.
5. There shall be separate "Operations" and "Maintenance" staff training if requested by OWNER.

B. Shop Drawings: Submit for approval the following:
1. Comply with the requirements of Section 01300, Submittals.
2. CONTRACTOR shall submit an electronic copy per Section 01300, Submittals.
3. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
4. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**

1.3 INSTRUCTION LESSON PLAN

A. Manufacturer's proposed Lesson Plan shall include the elements presented in the outline of Instruction Lesson Plan in Paragraph 1.3.D., below, of this Section.

Specific components and procedures shall be identified in the proposed Lesson Plan.

B. Manufacturer's proposed Lesson Plan shall detail specific instruction topics. Training aids to be utilized in the instruction shall be referenced and attached where applicable to the proposed Lesson Plan. "Hands-On" demonstrations planned for the instruction shall be described in the Lesson Plan.

C. The manufacturer shall indicate the estimated duration of each segment of the training Lesson Plan.

D. Instruction Lesson Plan shall include the following as a minimum:
   1. Equipment Operation:
      a. Describe equipment's operating (process) function.
      b. Describe equipment's fundamental operating principals and dynamics.
      c. Describe equipment's alternative operating principals and dynamics.
      d. Describe all equipment's emergency functions and procedures.
      e. Identify equipment's mechanical, electrical and electronic components and features.
      f. Identify all support equipment associated with the operation of subject equipment (e.g., air intake filters, valve actuators, motors).
      g. Recommend standard operating procedures to cover start-up, routine monitoring and shutdown of the equipment.
   2. Detailed Component Description:
      a. Identify and describe in detail each component's function.
      b. Where applicable, group related components into subsystems. Describe subsystem functions and their interaction with other subsystems.
      c. Identify and describe in detail equipment safeties and control interlocks.
      d. Identify and describe all equipment spare part inventories.
   3. Equipment Preventive Maintenance (PM):
      a. Describe PM inspection procedures required to:
         1) Perform an inspection of the equipment in operation.
         2) Spot potential trouble symptoms and anticipate breakdowns.
         3) Forecast maintenance requirements (predictive maintenance).
      b. Define the recommended PM intervals for each component.
      c. Provide lubricant and replacement part recommendations and limitations.
      d. Describe appropriate cleaning practices and recommend intervals.
      e. Identify and describe the use of special tools required for maintenance of the equipment.
      f. Describe component removal/installation and disassembly/assembly procedures.
      g. Perform at least two "hands-on" demonstrations of preventive maintenance procedures.

h. Describe recommended measuring instruments and procedures, and provide instruction on interpreting alignment measurements, as appropriate.
i. Define recommended torquing, mounting, calibration and/or alignment procedures and settings, as appropriate.
j. Describe recommended procedures to check/test equipment following a corrective repair.

4. Equipment Troubleshooting:
   a. Define recommended systematic troubleshooting procedures.
   b. Provide component specific troubleshooting checklists.
   c. Describe applicable equipment testing and diagnostic procedures to facilitate troubleshooting.

1.4 TRAINING AIDS

A. The manufacturer's instructor shall incorporate training aids as appropriate to assist in the instruction. As a minimum, the training aids shall include text and figure handouts. Other appropriate training aids are:
   1. Audio-Visual Aids (e.g., films, slides, videotapes, overhead transparencies, posters, blueprints, diagrams, catalogue sheets).
   2. Equipment cutaways and samples (e.g., spare parts and damaged equipment).
   3. Tools (e.g., repair tools, customized tools, measuring and calibrating instruments).

B. The manufacturer's instructor shall utilize descriptive class handouts during the instruction. Photocopied class handouts shall be good quality reproductions. Class handouts should accompany the instruction with frequent reference made to them. Customized handouts developed especially for the instruction are encouraged. Handouts planned for the instruction shall be attached with the manufacturer's proposed Lesson Plan.

1.5 "HANDS-ON" DEMONSTRATIONS

A. The manufacturer's instructor shall present "hands-on" demonstrations of operations and maintenance of the equipment for each scheduled group. The proposed "hands-on" demonstrations should be described in the manufacturer's proposed Lesson Plan.

1.6 TRAINING

A. The CONTRACTOR shall provide experienced, competent factory employed, trained, and certified manufacturers' employees to train OWNER'S personnel in operation and maintenance procedures for equipment items specified below during the start-up period at no additional cost to OWNER. The lesson plans for these sessions shall be reviewed with the OWNER and the ENGINEER in one meeting prior to initiating training. Lesson plans shall be submitted to the ENGINEER not less than one week prior to this meeting. CONTRACTOR will

record the manufacturers' training sessions and provide OWNER with DVD format professional quality DVDs of the training sessions. The representatives shall present training programs and on-site demonstrations designed to fully acquaint plant personnel with all equipment features, routine scheduled maintenance procedures, alternative operational modes, emergency procedures, spare parts inventories, and demonstrate performance requirements of the specifications. Representatives shall remain on-site to observe operation of the equipment and further advise plant personnel for a minimum number of days as specified below, unless specified otherwise in Equipment Specifications. The following table is not a complete list of equipment training. See individual Specifications for additional training. Sales representatives shall not be acceptable to perform start-up and training functions.

Equipment	**Additional Training Days (Day = 8 hrs minimum)**
Actuators	1 (½ day at each plant)
Hydraulic Valves	½ for each valve type listed
Hydraulic Gates	1 (½ day at each plant)
Secondary Clarifier Mechanism	1
Disc Filters	2 (1 day at each plant)
Positive Displacement Blower	1
IMLR Vertical Turbine Pump	½
Submersible Pumps for Dry Pit Application	1
Davit Crane	1
Monorail Hoist System	1
Transformers Dry Type	1
Oil Filled Substation Transformers	1
Panelboards	1
Electric Motors 250 Horsepower or less	1
Surge Protective Device	1
Customer Power Metering System	1

Equipment	Additional Training Days (Day = 8 hrs minimum)
Low-Voltage Drawout Switchgear	1
Medium-Voltage Drawout Switchgear	1
Low Voltage Circuit Breakers	½
Motor Control Centers (MCC)	1
Solid State Motor Controllers	1
Variable Frequency Drives – Low Voltage	1
Low-Flow IMLR Pumps	1
Flow Field Instruments	1
Level Field Instruments	1
Pressure Field Instruments	½
Turbidity Instrument	1 (½ day at each plant)
Aeration Systems (Fine Bubble)	½
Aeration Systems (Coarse Bubble)	½
Sump Pumps	½
Mini Power Centers	1

B. A complete schedule of representatives and dates for operator training shall be submitted to OWNER prior to commencement of the start-up period. This schedule shall be prepared to accommodate the plant staff's work schedules, including training on all shifts and staffs' flex time. The plant operators work on a shift schedule. Develop the training schedule to account for training classes for each shift.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

TRAINING REQUEST FORM
CITY OF CHANDLER
WRF IMPROVEMENTS PHASE 3

SPECIFICATION SECTION 01821
INSTRUCTION OF OPERATIONS AND MAINTENANCE PERSONNEL

Equipment Name: _____

Equipment Tag Number: _____

Equipment Description: _____

Specification Section: _____

Operations and Maintenance Data Submitted/Approved: _____

Start-up and Testing Complete/Date: _____

Lesson Plan Submitted/Approved: _____

Training Aids Submitted/Approved: _____

Hands-on Demonstration: _____

Training Schedule (Dates, Time, No. of Sessions): _____

_____

_____

_____

++ END OF SECTION ++

SECTION 02050

DEMOLITIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Scope:
   1. Provide all labor, materials, equipment, and incidentals as shown on the Drawings, specified, and required for demolitions, removal and disposal Work.
   2. Included, but not limited to, are demolition and removals of existing materials, equipment, or work necessary to install the Work as shown on the Drawings, specified, and required to connect same with existing work in an approved manner. Demolition includes structural concrete, foundations, walls, doors, windows, structural steel, metals, roofs, masonry, attachments, appurtenances, piping, electrical and mechanical equipment, paving, curbs, walks, fencing, and similar existing facilities.
   3. Demolitions and removals which may be specified under other Sections shall conform to requirements of this Section.
   4. Pay for all landfill disposal fees.

1.2 RELATED SECTIONS

A. Section 01012, Plant Operation During Construction

B. Section 02315, Earthwork, Excavation and Backfill

C. Section 03300, Cast in Place Concrete

D. Section 15050, Piping Systems

E. Section 15051, Buried Piping

1.3 SUBMITTALS

A. Schedule: Submit for approval proposed methods, equipment, and operating sequences. Include coordination for shut-off, capping, temporary services, continuation of utility services, and other applicable items to ensure no interruption of OWNER'S operations.

B. Shop Drawings: Submit for approval the following:
   1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations

from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

1.4 JOB CONDITIONS

A. Protection:
   1. Perform all demolition and removal Work to prevent damage or injury to structures, occupants thereof, and adjacent features which might result from falling debris or other causes, and so as not to interfere with the use and free and safe passage to and from adjacent structures.
   2. Closing or obstructing of roadways, sidewalks, and passageways adjacent to the Work by the placement or storage of materials will not be permitted, and all operations shall be conducted with a minimum interference to traffic on these ways.
   3. Erect and maintain barriers, lights, sidewalk sheds, and other necessary protective devices.
   4. Repair damage to facilities to remain or to any property belonging to the OWNER.

B. Scheduling:
   1. All Demolition will be performed in strict accordance with Section 01012, Plant Operation During Construction.

C. Notification:
   1. At least 48 hours prior to commencement of a demolition or removal, notify ENGINEER, in writing, of proposed schedule. OWNER will inspect the existing equipment and mark for identification those items which are to remain the property of the OWNER. Do not start removals without the permission of the ENGINEER.

D. Explosives will not be permitted.

E. Comply with NFPA 241 - Standard for Safeguarding Construction, Alterations, and Demolition Operations.

F. All operating utilities intersecting the areas of demolition shall be located and protected by the CONTRACTOR prior to commencement of Work.

1.5 EXISTING STRUCTURE CONSTRUCTION

A. CONTRACTOR shall field verify all existing conditions and notify the ENGINEER for any discrepancies before proceeding with the Work.

B. Perform the removal, cutting, drilling, etc., of existing Work with extreme care, using small tools in order not to jeopardize the structural integrity of the structure.

C. Safely shore existing construction whenever existing supports are removed to allow the installation of new Work.

D. All existing facilities in the vicinity of the construction area shall be protected in place by methods deemed necessary by the CONTRACTOR.

E. Rebuild any existing Work which has to be removed to allow the installation of new Work.

F. Perform cutting of existing concrete and masonry with saws and core drills. Do not use jack-hammers.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 GENERAL

A. All materials and equipment removed from existing Work shall become the property of CONTRACTOR, except items designated to be re-used or salvaged. All materials and equipment marked by the OWNER to remain the property of the OWNER shall be carefully removed by CONTRACTOR, so as not to be damaged, and shall be cleaned and stored on or adjacent to the site in a protected place specified by the ENGINEER or loaded onto trucks provided by the OWNER.

B. Dispose of all demolition materials, equipment, debris, and all other items not marked by the OWNER to remain off the site and in conformance with all existing applicable laws and regulations.

C. Surfaces of walls, floors, ceilings, or other areas which are exposed by any of the removals specified herein, and which will remain as architecturally finished surfaces shall be repaired and re-finished by CONTRACTOR with the same or matching materials as the existing adjacent surface or as may be otherwise approved by the ENGINEER.

D. Pollution Controls: Use water sprinkling, temporary enclosures, and other suitable methods to limit the amount of dust and dirt rising and scattering in the air to the lowest practical level. Comply with governing regulations pertaining to environmental protection.
   1. Do not use water when it may create hazardous or objectionable conditions such as ice, flooding, and pollution.
   2. Clean adjacent structures, facilities, and improvements of dust, dirt, and debris caused by demolition operations. Return adjacent areas to conditions existing prior to the start of the Work.

E. Pavement Demolition:
   1. All asphalt and concrete pavement demolition shall terminate at cut edges. All edges shall be linear and have a vertical cut face.

F. All anchor bolts for removed equipment and supports and structural steel cast in concrete shall be removed 1-1/2-inches below the surface of the concrete and the depression filled with epoxy grout flush with the concrete surface. Removal procedures will provide a 90 degree angle between the existing surface and bolt hole to minimize grout spalling.

G. All concrete saw cutting indicated on the Plans shall be done with appropriate equipment to produce a smooth, square cut. Cut surfaces shall be sealed as specified in Section 03300, Cast-In-Place Concrete. All depressions in concrete left as a result of demolition shall be repaired as specified in Section 03300, Cast-In-Place Concrete.

H. All earthen depressions, voids, and holes which are a result of demolition shall be filled. Fill material shall be native soils compacted to a uniform density as defined in Section 02315, Earthwork, Excavation and Backfill.

I. All areas of demolition shall be graded in a manner to conform to the final lines and elevations shown on the plans. Drainage shall be maintained away from all structures as defined in Section 02315, Earthwork, Excavation and Backfill.

J. Several existing structure were designed for future expansions. Several knockout walls were installed to facilitate future expansions. Remove existing knockout walls where called out on drawings. Also remove flashing installed in areas to facilitate future extensions.

3.2 STRUCTURAL REMOVALS

A. Remove structures to the lines and grades shown on the Drawings, unless otherwise directed by the ENGINEER. Where no limits are shown on the Drawings, the limits shall be 4-inches outside the item to be installed. The removal of masonry beyond these limits shall be at CONTRACTOR'S expense and these excess removals shall be reconstructed to the satisfaction of the ENGINEER, with no additional compensation to CONTRACTOR.

B. All concrete, brick, tile, concrete block, roofing materials, reinforcement, structural or miscellaneous metals, plaster, wire mesh and other items contained in or upon the structure shall be removed and taken from the site, unless otherwise approved by the ENGINEER. Demolished items shall not be used in backfill.

C. After removal of parts or all of masonry walls, slabs and like work which tie into the work or existing work, the point of junction shall be neatly repaired so as to leave only finished edges and surface exposed.

D. The jambs, sills, and heads of any windows, passageways, doors, or other openings cut into the work or existing work shall be dressed with new masonry, concrete, or metal to provide a smooth, finished appearance.

E. Where new anchoring materials, including bolts, nuts, hangers, welds, and reinforcing steel, are required to attach the work to the existing work they shall be included under this Section, except where specified elsewhere.

3.3 MECHANICAL REMOVALS

A. Mechanical removals shall consist of dismantling and removing of existing piping, pumps, motors, equipment and other appurtenances as specified, shown, or required for the completion of the Work. Mechanical removals shall include cutting, capping, and plugging as required, except that the cutting of existing piping for the purpose of making connections thereto will be included under Division 15, Mechanical.

B. Existing process, water, chemical, gas, fuel oil and other piping not required for the Work shall be removed where shown on the Drawings or where it will interfere with the Work. Piping not indicated to be removed or which does not interfere with the Work shall be removed to the nearest solid support, capped and left in place. Chemical and fuel lines and tanks shall be purged and made safe prior to removal or capping. Where piping that is to be removed passes through existing walls, it shall be cut off and properly capped on each side of the wall.

C. When underground piping is to be altered or removed, the remaining piping shall be properly capped. Abandoned underground piping shall be removed.

D. Waste and vent piping shall be removed to points shown. Pipe shall be plugged with cleanouts and plugs. Where vent stacks pass through an existing roof that is to remain, they shall be removed and the hole in the roof properly patched and made watertight.

E. Any changes to potable water piping and other plumbing and heating system work shall be made in conformance with all applicable codes and under the same requirements as other underground piping. All portions of the potable water system that have been altered or opened shall be pressure tested and disinfected in accordance with Section 15050, Piping Systems, and Section 15051, Buried Piping

Installation, and local codes. Other plumbing piping and heating piping shall be pressure tested only.

3.4 ELECTRICAL REMOVALS AND DEMOLITION

A. Electrical removals shall consist of the removal of existing transformers, distribution switchboards, control panels, motors, conduits and wires, poles and overhead wiring, panelboards, lighting fixtures, and miscellaneous electrical equipment all as shown on the Drawings, specified, or required to perform the Work.

B. All existing electrical equipment and fixtures to be removed shall be removed with such care as may be required to prevent unnecessary damage, to keep existing systems in operation and to keep the integrity of the grounding systems.

C. Motor Control Centers and Switchgear shall be removed or modified as shown on the Drawings. Motor Control Centers and Switchgear to be removed shall be disconnected and dismantled, and all components shall be disposed of off the site. Circuit breakers and other control equipment on modified Motor Control Centers and Switchgear that will no longer be used shall be removed, unless otherwise shown on the Drawings or specified. All new openings cut into the modified Motor Control Centers and Switchgear shall be cut square and dressed smooth to the dimensions required for the installation of the new equipment.

D. Motors shall be disconnected and removed where shown on the Drawings or specified. Motors not designated by the OWNER to be salvaged shall be removed from the site. Motors or other electrical gear designated for reuse shall be stored in an enclosed, temperature controlled environment.

E. Abandoned Exposed Conduit and Wire: Generally whenever a piece or groups of equipment are removed, all associated electrical power or control wiring which are no longer required shall be removed. The wire shall be removed back to the power source or control panel, ensuring that no portion of the wiring may remain energized. The conduit, unless otherwise indicated, shall be removed back to the nearest junction box or point of conduit embedment. Abandoned conduits or direct-burial cable concealed in floor or ceiling slabs, or in walls, shall be cut flush with the slab or wall at the point of entrance. The conduits shall be suitably plugged and the area repaired in a flush, smooth, approved manner. Exposed conduits and their supports shall be disassembled and removed from the site. Repair all areas of work to prevent rust spots on exposed surfaces.

F. Where shown on the Drawings or otherwise required, wiring in the underground duct or direct-burial cable system shall be removed. All such wiring shall be salvaged and stored as specified. Verify the function of all wiring via approved testing methods before disconnecting and removing it. Ducts which are not to be reused shall be plugged where they enter buildings and made watertight.

G. Existing panelboards where shown on the Drawings shall be removed and disposed of off the site. Where shown on the Drawings or specified, they shall be replaced with new panelboards at the same or adjacent locations. All cutting and patching necessary for the removal and replacement of panelboards shall be performed.

H. Existing lighting fixtures shall be removed or relocated as shown on the Drawings. Fixtures not relocated shall be removed from the site. Relocated fixtures shall be carefully removed from their present location and reinstalled where shown on the Drawings.

I. Existing wall switches, receptacles, starters and other miscellaneous electrical equipment shall be removed and disposed of off the site, as required. Care shall be taken in removing all equipment so as to minimize damage to architectural and structural members. Any damage incurred shall be repaired by CONTRACTOR to the satisfaction of the ENGINEER, at no additional cost to the OWNER.

3.5 ALTERATIONS AND CLOSURES

A. Alterations shall conform with the Contract Documents and the directions and approvals of the ENGINEER.

B. Where alterations require cutting or drilling into existing floors, walls, and roofs, the holes shall be repaired in a manner approved by the ENGINEER. Repair such openings with the same or matching materials as the existing floor, wall, or roof or as otherwise approved by the ENGINEER. All repairs shall be smoothly finished, unless otherwise approved by the ENGINEER.

C. Openings in existing concrete slabs, ceilings, masonry walls, floors and partitions shall be closed and sealed as shown on the Drawings or otherwise directed by the ENGINEER. The Work shall be keyed into the existing work in a manner approved by the ENGINEER. Reinforcing steel shall be welded to the existing reinforcing. Welding shall conform to AWS D12.1, Reinforcing Steel Welding Code. In general, use the same or matching materials as the existing adjacent surface. The finished closure shall be a smooth, tight, sealed, permanent closure acceptable to the ENGINEER.

3.6 CLEANUP

A. Remove from the site all debris resulting from the demolition operations as it accumulates. Upon completion of the Work, all materials, equipment, waste, and debris of every sort shall be removed and premises shall be left, clean, neat and orderly. Comply with requirements of Section 02315, Earthwork, Excavation and Backfill.

3.7 DEMOLITION ITEMS

A. The demolition items shall include, but are not limited to the descriptions in the following paragraphs. Further information is provided in demolition Drawings. In addition to the demolition Drawings, demolition items are also shown on: process, civil, structural, mechanical, electrical, and instrumentation Drawings.

B. Headworks (AWRF):
   1. Remove floor grating.

C. Headworks/Prestage Basins Chemical Feed/Odor Control (AWRF):
   1. Remove chemical metering pumps, feed lines, and trench.

D. Influent Pump Station (AWRF):
   1. Remove manhole #10 and Parshall flumeV.

E. Aeration Basins (AWRF):
   1. Remove Diffuser System No. 5 and No. 6.

F. Secondary Clarifiers (AWRF):
   1. Remove rake mechanism, scum box and suction pipe from Clarifier No. 1, 2, 3, and 4.
   2. Remove the underground RAS control/isolation valve from Clarifier No. 1, No. 3
   3. Remove the RAS control/isolation valve actuator from Clarifier No. 1, No. 3, and No. 4.

G. Administration Building (AWRF):
   1. Remove curbs from retaining walls for ramp and stairs leading into old UV disinfection room.
   2. Remove existing HVAC system throughout building as shown in drawings.
   3. Remove electrical panels in old UV room as shown in drawings.
   4. Remove bridge crane hoist from old UV room.

H. MBR Bioreactor Basins (OWRF):
   1. Remove Diffuser System from Zones 8 of Basin #1 & #2.
   2. Remove middle cover hatches in zone 8 as shown in drawings.

I. Aeration Basins (OWRF):
   1. Remove MCC No. 1 and No. 2.

J. Secondary Clarifiers (OWRF):
   1. Remove rake mechanism, scum box and suction pipe from Clarifier No. 3.
   2. Remove the underground RAS control/isolation valve from Clarifier No. 3.

K. Effluent Pump Station (OWRF):
   1. Remove compromised structural infrastructure in the Wet Well and Building.

2. Remove MCC No. 1 and No. 2.

L. Old Solids Handling Building (OWRF):
   1. Remove old solids conveyor, hopper and truck weigh scale.

M. South Sludge Holding Tank (OWRF):
   1. Remove MCC No. 1 and No. 2.

N. Site and Electrical:
   1. Remove 750kW MLE Generators.
   2. Demolish and dispose of existing pavement, curb and gutter, structures and landscaping as indicated in the Contract Documents.
   3. Relocate or remove and adjust light poles, electrical duct banks and wiring required for grade adjustments as indicated in the Contract Documents.
   4. The CONTRACTOR shall remove existing yard piping and as indicated in the Contract Documents.
   5. Manholes shall be completely removed and disposed off-site. Sewer pipes and wet utilities shall be abandoned or removed, as specified in the plans or directed by the ENGINEER. Pipes that are to be abandoned shall be plugged or grout filled. Fill shall be placed and compacted to match surrounding grade per Section 02315, Earthwork, Excavation and Backfill.
   6. Items to be salvaged and reused include, but are not limited to, plug valves, gate valves, flow meters, and light poles.
   7. Irrigation system and components may require removal to allow new construction. Any irrigation system removal must be restored to original operating conditions by CONTRACTOR. CONTRACTOR is responsible to ensure all landscaping receives irrigation during periods of irrigation system removal.

++ END OF SECTION ++

SECTION 02100

SITE PREPARATION

PART 1 - GENERAL

1.1 SUMMARY

A. Prepare the construction site for new construction.

1.2 SECTION INCLUDES

A. Removal of existing structures.

B. Protection of certain existing trees and vegetation.

C. Clearing and grubbing.

D. Removing above grade improvements.

E. Removing below grade improvements (including stumps).

F. Installing and maintaining barricades and warning signs.

G. All other miscellaneous items of Work required for completing the site preparation.

1.3 RELATED SECTIONS

A. Section 02050, Demolitions.

B. Section 02315, Earthwork, Excavation, and Backfill.

1.4 PROJECT CONDITIONS

A. Traffic: Conduct site-clearing operations to ensure minimum interference with roads, streets, walks, and other adjacent occupied or used facilities. Do not close or obstruct streets, walks, or other occupied or used facilities without permission from authorities having jurisdiction.

B. Protection of Existing Improvements: Provide protection as necessary to prevent damage to existing improvements indicated to remain in place.
   1. Protect improvements on adjoining properties and OWNER'S property.
   2. Restore damaged improvements to their original condition, as acceptable to OWNER.

C. Protection of Existing Trees and Vegetation:

1. Existing vegetation in the field not scheduled for removal shall be undisturbed by the CONTRACTOR. The CONTRACTOR shall not remove from the site any plants, unless specifically approved by the ENGINEER.
2. Protect existing trees and vegetation indicated to remain against unnecessary cutting, breaking, or skinning of roots, skinning or bruising of bark, smothering of trees by stockpiling construction materials, or excavated materials within drip line, excess foot or vehicular traffic or parking of vehicles within the drip line. Prior to initiating site clearing activities, the CONTRACTOR shall mark the limits of the disturbance areas either by placing lime, flags, or survey stakes at the limits shown on the Plans.
3. Do not destroy vegetation which may be naturally located in the periphery of proposed disturbed areas (within a zone ±5 foot). The ENGINEER shall be notified if existing plants are located within the fringes of the construction limits. The ENGINEER shall issue instructions at that time.
4. Adjustments may be made in the limits of construction to protect the affected plants based on a field review of the staked limits. The adjusted construction limits shall be considered the permanent construction limits for the duration of the Project. If the ENGINEER recommends that construction limits be adjusted to preserve existing plants, the CONTRACTOR, at his own option, may elect to clear the subject vegetation and re-vegetate with like-kind size and species as required herein at no additional cost to the OWNER. The CONTRACTOR shall be entirely responsible for removal, storage, and replanting of such vegetation.
5. During the Course of the Work the CONTRACTOR shall:
    a. Water trees, shrubs, and other vegetation to remain within limits of Contract Work as required to maintain their health during the course of construction operations. Other requirements for maintaining the existing vegetation are specified herein.
    b. Provide protection for roots over 1-1/2-inches in diameter that are cut during construction operations. Temporarily cover exposed roots with wet burlap to prevent the roots from drying out; cover with earth as soon as possible.
    c. Repair or replace trees and vegetation indicated to remain that are damaged by construction operations in a manner acceptable to the ENGINEER.
    d. Trees to be protected in place shall not be pruned unless limbs are damaged, or at the direction of the ENGINEER. Employ a licensed arborist to repair damaged trees and shrubs. Replace trees that cannot be repaired and restored to full-growth status, as determined by the arborist.
    e. Provide a temporary construction fence/barrier to protect trees and vegetation at the limits reviewed and approved by the ENGINEER. The barrier shall be installed and remain in place for the duration of the project or as directed by the ENGINEER.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Fencing: Any fencing removed as obstructions shall be restored to match existing.

B. Barricades, warning signs, and related equipment shall be placed as required.

C. Tree Protection Fence/Barrier: Shall be a commercially available product acceptable to the ENGINEER for its intended purpose. The barrier shall be similar to a nylon woven material or woven wire fence such as TENAX Nordic Snow Fence, or approved equal, with approved stakes approximately 36-inches in height. Submit material sample and Shop Drawings for barrier installation to the ENGINEER for approval prior to use.

PART 3 - EXECUTION

3.1 PREPARATION

A. Site Clearing:
   1. General: Remove trees, shrubs, grass, and other vegetation, improvements or obstructions, as required, to permit installation of new construction. Remove similar items elsewhere on-site or premises as specifically indicated. Removal includes digging out and off-site disposal of stumps and roots.
      a. Cut minor roots and branches of trees indicated to remain in a clean and careful manner where such roots and branches obstruct installation of new construction.
   2. Clearing and Grubbing: Within the limits of Work, clear site of trees, shrubs, and other material, except for those indicated to be left standing.
      a. Completely remove stumps, roots, and other debris protruding through the ground surface. Stump removal and backfilling of holes is required for trees indicated on the Plans to be removed.
      b. Use only hand methods for grubbing inside drip line of trees indicated to remain.
      c. Fill depressions caused by clearing and grubbing operations with satisfactory soil material, unless further excavation or earthwork is indicated.
      d. Place fill material in horizontal layers not exceeding 6-inches loose depth and thoroughly compact each layer to a density equal to adjacent original ground.
      e. No cleared or grubbed material may be used in backfills or structural embankments. Comply with requirements of Section 02315, Earthwork, Excavation, and Backfill.
   3. Removal of Improvements: Remove existing above grade and below grade improvements as indicated and necessary to facilitate new construction.
   4. Disposal of Waste Material:
      a. Burning on OWNER'S Property: Burning is not permitted on OWNER'S property.
      b. Removal from OWNER'S Property: Remove waste materials from OWNER'S property at no additional cost to the Project.
   5. Insofar as is consistent with customary construction practices, all operations shall be performed by such method as shall result in the minimum damage to

materials and construction to remain intact and in use. CONTRACTOR shall provide temporary supports and shoring as required to protect existing walls, equipment, piping, electrical conduits, etc., during periods of removal work and new construction under this Contract.

6. Designated existing structures shall be removed complete with foundations, slabs, walks, and miscellaneous items. Existing foundations outside lines of new construction shall be removed to a minimum depth of 3 feet below finished subgrade elevation and foundations within area of new construction shall be removed completely, unless otherwise shown on the Drawings. All trash, rubble, and debris shall be cleaned up, transported, and disposed of at off-site locations. Pits and other depressions shall be cleaned of all trash and decayable materials prior to backfilling, then backfilled and compacted in such a manner that no future settlement will occur.
7. All miscellaneous items not specifically mentioned or designated on the Drawings as removal items, but required for the completion of the Work, shall be removed. All such items removed shall be hauled from the site.

B. Barricades and Warning Signs:
   1. Construction sites shall be properly barricaded with appropriate warning signs affixed to prevent unauthorized access to the construction site.

3.2 TOPSOIL REMOVAL

A. Topsoil is defined as friable clay loam surface soil found in a depth of not less than 4-inches. Topsoil shall be substantially free of subsoil, clay lumps, stones, and other objects over 2-inches in diameter and without weeds, roots, and other objectionable material.

B. Strip topsoil which is satisfactory to whatever depths are encountered, and in such manner as to prevent intermingling with the underlying subsoil or other objectionable material. Remove heavy growths of grass from areas before stripping.
   1. Where trees are shown on the Drawings or as directed by the ENGINEER to be left standing, stop topsoil stripping a sufficient distance from such trees to prevent damage to the main root system.

C. Stockpile topsoil in storage piles in areas shown on the Drawings or where otherwise approved by ENGINEER. Construct storage piles to freely drain surface water. Cover storage piles, if required, to prevent windblown dust. Topsoil in excess of quantity required shall remain property of OWNER.

D. Dispose of excess topsoil as waste material off-site.

++ END OF SECTION ++

SECTION 02150

SHORING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Provide shoring and bracing for excavations and trenching, complete.

B. Work in this Section:
   1. Provide required shoring and bracing for the excavations and trenching operations to be performed.
   2. Soil stabilizer.

1.2 QUALITY ASSURANCE

A. Requirements of Regulatory Agencies: Conform to governing Federal, State, and local Construction Safety Orders; secure and pay for required permits. For off-site installation of shoring and related items, conform to requirements of the public agencies having jurisdiction; obtain and pay for required permits and inspections.

B. Design of Shoring: CONTRACTOR shall retain services of a licensed Civil Engineer in the State of Arizona to design and prepare calculations for shoring methods, bracing or tie back anchoring, wall supporting systems, and other systems to be used for protection of adjacent existing structures and improvements and for earth banks; special consideration and provisions for protection of existing columns, piers, and other items to remain shall be addressed. The CONTRACTOR shall submit the shoring drawings and calculations to the ENGINEER. The CONTRACTOR shall obtain Building Department approval prior to starting construction involving shoring and pay all fees and charges. Building Department approved Drawings and calculations are for record purposes only and not for review or approval.

1.3 JOB CONDITIONS

A. Data: Drawings, boring logs, geotechnical or foundation investigation reports and like information, not included in the Contract Documents but made available to CONTRACTOR by ENGINEER or OWNER, are for information only and the ENGINEER and OWNER assume no responsibility for any conclusions CONTRACTOR may draw from such information. CONTRACTOR shall investigate and determine existing soils and site conditions under which CONTRACTOR will operate in performing the Work.

B. Protection: Provide and maintain protection to retain earth banks and to protect adjoining grades and structures from caving, sliding, erosion, or other damage. Provide suitable protection against bodily injury. Construct bulkheads and shoring to the requirements of State and local codes and regulations. Shore vertical banks or slope banks back as required for stability and safety. Erect temporary barricades placed at least 5 feet away from top of slopes and as required by shoring design, and provide temporary berms as required to prevent slope erosion from water.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Sand: Clean sand from approved source, free from approved source, free from vegetable matter, rock, and other materials deleterious to the intended use.

B. Soil Stabilizer: The CONTRACTOR shall submit to the ENGINEER as information only, written documentation pertaining to the mix and application of sodium silicate grout, or approved equal, injected to stabilize the granular soil cut face to be excavated adjacent to the existing foundations and paving. The grout mix shall meet the manufacturer's recommendations. The purpose of this grouting is to prevent undermining and loss of ground adjacent to and/or under foundations and existing paving.

PART 3 - EXECUTION

3.1 SHORING

A. Conform to the approved shoring drawings and calculations. Maintain 5 foot wide berm at top of slopes. Frequently inspect installed shoring and bracing for deflections during construction.
   1. Tie-Back Anchors: Lag, drill, grout, preload and/or test tie-back anchors or bracing, and furnish required testing equipment as recommended and approved by the ENGINEER. Perform preloading and testing under observation of the ENGINEER.
   2. Removal: Remove shoring, sheeting, or sheet piling, and detention tieback anchors as required, unless otherwise indicated or approved. Fill voids left by removals with compacted sand or pea gravel backfill.

3.2 SOIL STABILIZATION

A. The CONTRACTOR shall take all precautions necessary to prevent any soil and pavement failure before, during, and after the grouting operation. Any additional differential settlement of pavements or foundations, or any differential settlement causing cracks, offsetting joints or reduction in slope in any utilities, shall result

in the CONTRACTOR replacing the damaged pavement and utilities to MAG Specifications at the CONTRACTOR'S expense.

B. The sodium silicate grouting must start at a maximum depth equal or greater than the excavation depth. The lateral extent to the grout curtain shall be determined by the CONTRACTOR to maintain the open cut face. Grouting must begin at this depth and, by means of pumping, should continue upward until the surface, or an obstruction, such as a slab or grade beam, is encountered. The grouting shall not be relied on to provide worker safety in trenches according with all OSHA and local agencies. Additional shoring or other measures may be required to provide for this safety.

++ END OF SECTION ++

SECTION 02315

EARTHWORK, EXCAVATION, AND BACKFILL

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
   1. Provide all labor, materials, equipment, and incidentals required to perform all excavating, backfilling, filling and grading, and disposing of earth materials as shown on the Drawings, specified, and required for construction of retaining walls, manholes, vaults, structure foundations, underground duct banks, electrical manholes and handholes, and other structures and facilities required to complete the Work in every respect.
   2. All necessary preparation of subgrade for slabs, foundations, and pavements is included.
   3. All temporary means required to prevent discharge of sediment to water courses from dewatering systems or erosion are included.
   4. On-site excavated material will be classified for use as backfill material. Excavation materials include all materials regardless of type, character, composition, moisture, or condition thereof.
   5. Perform all earthwork as specified in this Section.

B. Geotechnical Engineering Report:
   1. A draft geotechnical engineering report has been prepared by Ricker • Atkinson • McBee • Morman & Associates, Inc., dated July 21,2020, (RAMM Project No. G26695) for the Airport and Ocotillo Water Reclamation Facilities Expansion Project. The draft report is available for review from the OWNER.
   2. In the event of a conflict between the Specifications and the geotechnical report, the more restrictive requirement shall govern, unless specifically noted in this Section.

1.2 QUALITY ASSURANCE

A. Testing Services:
   1. General: Testing of materials, testing for moisture content during placement and compaction of fill materials, and of compaction requirements for compliance with technical requirements of the Specifications shall be performed by a testing laboratory as designated in Section 01451, Testing Laboratory Services Furnished by OWNER.
   2. OWNER'S Testing Agency Scope:
      a. Test CONTRACTOR'S proposed materials in the laboratory and/or field for compliance with the Specifications.
      b. Perform field moisture content and density tests to assure that the specified compaction of backfill materials has been obtained.

c. Report all test results to the ENGINEER and CONTRACTOR.

3. Authority and Duties of OWNER'S Testing Agency: Technicians representing the testing laboratory shall inspect the materials in the field and perform tests, and shall report their findings to the ENGINEER and CONTRACTOR. When the materials furnished or Work performed fails to fulfill Specification requirements, the technician will direct the attention of the ENGINEER and CONTRACTOR to such failure.
   a. The technician shall not act as foreman or perform other duties for CONTRACTOR. Work will be checked as it progresses, but failure to detect any defective Work or materials shall not in any way prevent later rejection when such defect is discovered, nor shall it obligate the ENGINEER for final acceptance. Technicians are not authorized to revoke, alter, relax, enlarge, or release any requirements of the Contract Documents, nor to approve or accept any portion of the Work.
4. Responsibilities and Duties of CONTRACTOR:
   a. The use of testing services shall in no way relieve CONTRACTOR of the responsibility to furnish materials and construction in full compliance with the Contract Documents.
   b. To facilitate testing services:
      1) Secure and deliver to the ENGINEER or to the testing agency, without cost, preliminary representative samples of the materials he proposes to use and which are required to be tested.
      2) Furnish such casual labor as is necessary to obtain and handle samples at the Work site or at other sources of material.
      3) Advise the OWNER'S testing agency at least two days in advance of any backfill operations to allow for completion of quality tests and for the assignment of personnel.
   c. Owner's testing service shall inspect and approve subgrades and fill layers before further construction work is performed thereon.
   d. Responsibility belongs to CONTRACTOR to accomplish the specified compaction for backfill, fill, and other earthwork, and to control his operations by confirmation tests to verify and confirm that CONTRACTOR has complied, and is complying at all times, with the requirements of these Specifications concerning compaction, control, and testing.
   e. The frequency of testing shall be not less than as follows; each test location for trenches shall include tests for each layer, type, or class of backfill from bedding to finish grade.
      1) Engineered backfill beneath slabs, structures, foundations, and pavements:
         a) At subgrade and at each compacted fill and backfill layer, perform at least one field in-place density test for every 1,000 sq. ft. or less of paved area or building slab, but in no case fewer than three tests.
      2) Backfill against structures:

a) In each compacted backfill layer, perform at least one field in-place density test for each 100 feet or less of wall length, but no fewer than two tests along a wall face.

3) Trench backfill:

a) In each compacted backfill layer, perform at least one field in-place density test for each 150 feet or less of trench, but no fewer than two tests.

f. Copies of the test reports shall be submitted promptly to the ENGINEER. CONTRACTOR'S tests to be performed by a soils testing laboratory acceptable to the ENGINEER.

g. Demonstrate the adequacy of compaction equipment and procedures before exceeding any of the following amounts of earthwork quantities:

1) 100 linear feet of trench backfill.
2) 10 cubic yards of structural backfill.
3) 100 cubic yards of embankment work.
4) 50 cubic yards of base material.

h. Until the specified degree of compaction on the previously specified amounts of earthwork is achieved, no additional earthwork of the same kind shall be performed.

i. Periodic compliance tests will be made by the ENGINEER to verify that compaction is conforming to the requirements previously specified. CONTRACTOR shall remove the overburden above the level at which the ENGINEER wishes to test, and shall backfill and re-compact the excavation after the test is complete.

j. If compaction fails to conform to the specified requirements, CONTRACTOR shall remove and replace the backfill at proper density or bring the density up to specified level by other means acceptable to the ENGINEER. Subsequent tests required to confirm and verify that the reconstructed backfill has been brought up to specified density shall be paid by CONTRACTOR. CONTRACTOR'S confirmation tests to be performed in a manner acceptable to the ENGINEER. Frequency of confirmation tests for remedial work shall be double the amount specified for initial confirmation tests.

B. Permits and Regulations:

1. Obtain all necessary permits for Work in roads, rights-of-way, railroads, etc. Also, obtain permits as required by local, State, and Federal agencies for discharging water from excavations.
2. Perform excavation work in compliance with applicable requirements of governing authorities having jurisdiction.

C. Reference Standards: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.

1. ASTM A36, Specification for Structural Steel.
2. ASTM A328, Specification for Steel Sheet Piling.
3. ASTM D422, Method for Particle-Size Analysis of Soils.

4. ASTM D698, Test Method for Laboratory Compaction Characteristics of Soil.
5. ASTM D1556, Test Method for Density and Unit Weight of Soil in Place by the Sand Cone Method.
6. ASTM D2166, Test Method for Unconfined Compressive Strength of Cohesive Soils.
7. ASTM D2922, Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
8. ASTM D4318, Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
9. AISC Specifications for the Design, Fabrication, and Erection of Structural Steel for Buildings.
10. OSHA Standard, Title 29, Code of Federal Regulations, Part 1926, Section 650 (Subpart P - Excavations).
11. Uniform Building Code, as supplemented by the City of Chandler.
12. Uniform Standard Specifications for Public Work Construction by the Maricopa Association of Governments (MAG) as supplemented by the City of Chandler; Section 206, Structure Excavation and Backfill; Section 604, Placement of Controlled Low Strength Material; Section 702, Base Materials; Section 725, Portland Cement Concrete; Section 728, Controlled Low Strength Material. Where there is a conflict between MAG Standard Specifications as supplemented by the City of Chandler and this Specification, provisions of this Specification shall govern.

1.3 SUBMITTALS

A. Shop Drawings: Submit for approval the following:
   1. Excavation and Backfill Submittals:
      a. Excavation Plan: Prior to start of excavation operations, a written plan shall be submitted to demonstrate compliance with OSHA Standard 29 CFR Part 1926.650. As a minimum, excavation plan shall include:
         1) Name of competent person.
         2) Excavation method(s) or protective system(s) to be used.
         3) Copies of "manufacturer's data" or other tabulated data if protective system(s) are designed on the basis of such data.
         4) Excavation and backfill requirements detailing sheeting and bracing, or other protective system(s), dewatering systems, cofferdams, and underpinning.
         5) Shop Drawings shall be prepared by a Registered Professional Engineer licensed in the State of Arizona, recognized as an expert in the specialty involved. Drawings shall be submitted to ENGINEER for record purposes only. Calculations shall not be submitted. Drawing submittals will not be checked and will not imply approval by ENGINEER of the Work involved. Sole responsibility for designing, installing, operating, and maintaining whatever system is necessary to satisfactorily accomplish all necessary sheeting, bracing, protection, underpinning, and dewatering belongs to CONTRACTOR.

6) Samples of all materials, including select backfill, general backfill, crushed stone, and sand shall be submitted to the ENGINEER and the testing service. Samples of the proposed material shall be submitted at least 14 days in advance of its anticipated use.

2. Test Reports:
   a. Testing laboratory shall submit copies of the following reports directly to ENGINEER, with copy to CONTRACTOR:
      1) Tests on borrow material.
      2) Tests on footing subgrade.
      3) Field density tests.
      4) Optimum moisture - maximum density curve for each soil used for trench and structural backfill, embankment and base material.
      5) Reports of observations for conformance of borrow material to the Project Geotechnical Report.

B. Shop Drawings: Submit for approval the following:
   1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
   2. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**

1.4 JOB CONDITIONS

A. Subsurface Information: Refer to Draft Geotechnical Engineering Report prepared by Ricker • Atkinson • McBee • Morman & Associates, Inc., dated July 21,2020, (RAMM Project No. G26695) for available data on subsurface conditions. The data is not intended as a representation or warranty of continuity of conditions between soil borings, nor of groundwater levels at dates and times other than date and time

when measured. OWNER will not be responsible for interpretations or conclusions by CONTRACTOR. Data is solely made available for the convenience of CONTRACTOR.

1. Additional test borings and other exploratory operations may be made by CONTRACTOR, at no additional cost to OWNER.
2. Refer to and comply with the requirements of Section 02050, Demolitions.

B. Existing Structures: The Drawings show certain surface and underground structures adjacent to the Work. This information has been obtained from existing records. It is not guaranteed to be correct or complete and is shown on the Drawings for the convenience of CONTRACTOR. Explore ahead of the required excavation to determine the exact location of all existing structures. Structures shall be supported and protected from damage by CONTRACTOR. If they are broken or damaged, restore them immediately at no additional cost to the OWNER.

C. Existing Utilities: Locate existing underground utilities in the areas of the Work. If utilities are to remain in place, provide adequate means of protection during all operations.

1. Should uncharted or incorrectly charted piping or other utilities be encountered during excavation, consult piping or utility owner and ENGINEER immediately for directions as to procedure. Cooperate with OWNER and utility owner in keeping services and facilities in operation. Repair damaged utilities to satisfaction of utility owner.
2. In general, small diameter service lines are not shown on the Drawings. CONTRACTOR is to protect and repair damaged utilities to the satisfaction of the OWNER.
3. Do not interrupt existing utilities serving facilities occupied and used by OWNER or others, except when permitted in writing by ENGINEER and then only after acceptable temporary utility services have been provided.
4. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies for shut-off of services if lines are active.

D. Use of Explosives:

1. The use of explosives will not be permitted.

E. Protection of Persons and Property: Barricade open excavations occurring as part of the Work and post with warning lights. Operate warning lights during hours from dusk to dawn each day and as otherwise required.

1. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.
2. Maintain security fence around all excavation, fill, and stockpile areas to prevent public access. Site security fence fulfills this requirement.

F. Dust Control: Conduct all operations meeting the requirements specified in Section 01414, Earthmoving and Dust Control.

G. Roadways and Walks: Unless otherwise approved by ENGINEER, excavated material and materials of construction shall be so deposited, and the Work shall be so conducted as to leave open and free for pedestrian traffic all crosswalks, and for vehicular traffic a roadway not less than 10 feet in width. All hydrants, valves, fire alarm boxes, letter boxes, and other facilities which may require access during construction shall be kept accessible for use. During the progress of the Work, maintain such crosswalks, sidewalks, and roadways in satisfactory condition, and the Work shall at all times be so conducted as to cause a minimum of inconvenience to public travel and to permit safe and convenient access to private and public property along the line of the Work.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. Fill and Backfill Materials:
   1. Materials acceptable for use as fill and backfill in embankments, against walls, foundations, underground duct banks, and other structures meet the following requirements:
      a. Imported materials shall meet the following requirements:
         1) Shall contain no organic matter, debris, or rubble.
         2) Shall contain no material greater than 4-inches in size.
         3) Shall have a minimum of 30% passing the No. 4 sieve.
         4) The maximum expansion shall be 1.5% as performed on a sample remolded to approximately 95% of the maximum dry density as determined in accordance with ASTM D698 at 2% below optimum moisture content under a 100 psf surcharge pressure.
      b. Site soils used as fill and backfill shall meet the following requirements:
         1) Shall contain no organic matter, debris, or rubble.
         2) Shall contain no rocks or fragments greater than 4-inches in size.
         3) Granular and clayey site soils may be used as fill and backfill.
   2. All materials for use as fill and backfill material shall be tested by the laboratory and approved by the ENGINEER.
   3. If on-site material is unsuitable as determined by the ENGINEER, engineered backfill or approved off-site fill shall be used.
   4. Fill adjacent to structures is classified as backfill to a distance measured horizontally from the structure that is equal to the depth from the finished grade. Outside these limits the fill is classified as embankments, unless otherwise specified.
   5. Refer to and comply with the requirements of Section 02319, Riprap.

B. Engineered Fill:

1. Engineered fill for use beneath structures, foundations, concrete slabs, and as a base for Portland cement concrete pavements and asphaltic pavements shall be site soils and/or imported soils as described in the Geotechnical Report.

C. Pipe Bedding:
   1. All pipe bedding material shall conform to the requirements below:
      a. Bedding material shall consist of subbase or base materials with 100% passing a 1-inch sieve and not more than 8% passing a No. 200 sieve.
         1) If on-site material can be used as bedding material, the CONTRACTOR shall take necessary steps to separate the suitable bedding material from the sandy clay and sandy silt found on-site. The bedding material must meet all requirements of this Specifications Document and MAG Standard Specification Section 601.
         2) If on-site material does not meet the bedding material requirements, the CONTRACTOR shall supply the specified bedding material at no additional cost to the OWNER.
      b. Shall be free of broken concrete, broken pavement, wood, or other deleterious material.
      c. Open graded rock shall not be used.
      d. Water consolidation shall not be used.
      e. Fill shall be placed and compacted in 4-inch lifts below the springline. Succeeding lifts shall not exceed 8-inches loose material.
      f. Extreme care shall be taken to prevent damage to or movement of the conduit by the compaction equipment.
   2. Place and compact bedding course on rock and other unyielding bearing surfaces and to fill unauthorized excavations. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.
   3. Backfill below, around, and above all pipes shall be compacted per Section 3.9.E.1.
   4. All buried piping shall be bedded 12-inches above the top of the pipe in compacted granular material as stated above, with a minimum of 4-inches of compacted bedding material below the pipe. Backfill below, around, and above all pipes shall be compacted per Section 3.9.E.1.
   5. Two-sack MAG CLSM (Section 728) backfill trenches that carry below or pass under footings and that are excavated within 18-inches of footings. Place CLSM to level of bottom of footings.
   6. Provide 4-inch thick concrete base slab support for piping or conduit less than 2 feet 6-inches below surface of roadways. After installation and testing, completely encase piping or conduit in a minimum of 4-inches of concrete before backfilling or placing roadway subbase.
   7. Coordinate backfilling with utilities testing.
   8. Fill voids with approved backfill materials as shoring and bracing, and sheeting is removed.
   9. Place and compact final backfill of satisfactory soil material to final subgrade.

10. Install warning tape directly above utilities 12-inches below finished grade, except 6-inches below subgrade under pavements and slabs.

D. Drainage Fill:
   1. Washed, uniformly graded mixture of crushed stone, or crushed or uncrushed gravel, with 100% passing a 1-1/2-inch sieve and not more than 5% passing a No. 4 sieve. Crushed stone or gravel shall be crushed rock or gravel conforming to the requirements of Section 02318, Crushed Stone, Gravel and Decomposed Granite.

E. Backfill Beneath Structures and Foundations:
   1. All pipes shall be concrete encased.
   2. Structures shall be placed on engineered fill.
   3. The void space beneath structures which have foundations at different levels shall be backfilled with CLSM. See Structural Plans for CLSM mix requirements.

PART 3 - EXECUTION

3.1 INSPECTION

A. Provide ENGINEER with sufficient notice and with means to examine the areas and conditions under which excavating, filling, and grading are to be performed. ENGINEER will notify CONTRACTOR if conditions are found that may be detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected in an acceptable manner.

3.2 SITE PREPARATION

A. Clear all areas to be occupied by permanent construction or embankments of all existing fill zones, backfill zones, unstable soils, trees, brush, roots, stumps, logs, wood, and other materials and debris. Clean and strip subgrades for fills and embankments of all existing fill zones, backfill zones, unstable soils, vegetation, sod, topsoil, and organic matter. All waste materials shall be removed from site and properly disposed of by CONTRACTOR. Burning is not permitted. Refer to and comply with the requirements of Section 02100, Site Preparation.

3.3 TEST PITS

A. General:
   1. Excavate and backfill, in advance of the construction, test pits to determine conditions or location of the existing utilities and structures. Perform all Work required in connection with excavating, stockpiling, maintaining, sheeting, shoring, backfilling, and replacing pavement for the test pits.

a. Responsibility for the definite location of each existing facility involved within the area of his excavation for Work under this Contract belongs to CONTRACTOR. Care shall be exercised during such location work to avoid damaging and/or disrupting the affected facility. Responsibility for repairing, at his expense, damage to any structure, piping, or utility caused by his Work belongs to CONTRACTOR.

B. No separate payment will be made for test pits made by CONTRACTOR for his own use.

3.4 EXCAVATION

A. Perform all excavation required to complete the Work as shown on the Drawings, specified, and required. Excavations shall include earth, sand, clay, gravel, hardpan, boulders not requiring drilling and blasting for removal, decomposed rock, pavements, rubbish, and all other materials within the excavation limits, except rock.

B. Excavations for structures and underground duct banks shall be open excavations. Provide excavation protection system(s) required by ordinances, codes, law, and regulations to prevent injury to workmen and to prevent damage to new and existing structures or pipelines. Unless shown on the Drawings or specified otherwise, protection system(s) shall be utilized under the following conditions.
   1. All excavations shall be sloped, shielded, or shored and braced.
      a. Sloped excavations shall maintain slopes of 1.5 horizontal to 1.0 vertical or flatter for near surface soils (upper 35 feet of excavation). Steeper slopes will be considered on a case-by-case basis. CONTRACTOR shall provide design of steeper slopes, stamped by an AZ registered Professional Geotechnical Engineer.
      b. Sloped excavations deeper than 35 feet shall be designed and stamped AZ registered Professional Geotechnical Engineer. Design shall be provided by CONTRACTOR.
   2. Excavation protection system(s) shall be installed and maintained in accordance with Drawings submitted under Paragraph 1.3 of this Section.

C. Where the structure or duct bank is to be placed below the ground water table, well points, cofferdams, or other acceptable methods shall be used to permit construction of said structure under dry conditions. Dry conditions shall prevail until concrete has reached sufficient strength to withstand earth and hydrostatic loads. In addition, protect excavation from flooding until all walls and floor framing up to and including grade level floors are in place and backfilling has begun. Water level shall be maintained below top of backfill at all times.

D. Pumping of water from excavations shall be done in such a manner to prevent the carrying away of unsolidified concrete materials and to prevent damage to the existing subgrade.

E. The elevation of the bottom of footings shown on the Drawings shall be considered as approximate only and ENGINEER may order such changes in dimensions and elevations as may be required to secure a satisfactory footing. All structure excavations shall be hand-trimmed to permit the placing of full widths, and lengths of footings on horizontal beds. Rounded and undercut edges will not be permitted.

F. When excavations are made below the required grades, without the written order of ENGINEER, they shall be backfilled with engineered backfill, as directed by ENGINEER at the expense of CONTRACTOR.

G. Excavations shall be extended sufficiently on each side of structures, footings, etc., to permit setting of forms, installation of shoring or bracing, or the safe sloping of banks.

H. Subgrades for roadways and structures shall be firm, dense, and thoroughly compacted and consolidated; shall be free from mud, muck, and other soft or unsuitable materials; and shall remain firm and intact under all construction operations. Subgrades which are otherwise solid, but which become soft or mucky on top due to construction operations, shall be repaired to meet desired bearing capacity. The finished elevation of stabilized subgrades shall not be above subgrade elevations shown on the Drawings. All subgrades shall be retested to confirm bearing capacity prior to placing.

I. Material Storage: Stockpile satisfactory excavated materials in approved areas until required for backfill or fill. Place, grade, and shape stockpiles for proper drainage.
   1. Locate and retain soil materials at least 15 feet away from edge of excavations.
   2. Dispose of excess soil material and waste materials as specified hereinafter.
   3. Stockpiled excavated soils for use as subsequent fill shall be classified by laboratory as on-site granular or sandy clay soils. Use and placement of fill shall be performed as specified for each class.
   4. Excess soil from excavations shall be disposed of off-site. Disposal shall be in accordance with State and local regulatory requirements.

J. Where ENGINEER considers the existing material beneath the bedding material unsuitable, CONTRACTOR shall remove same and replace it with engineered backfill.

3.5 UNAUTHORIZED EXCAVATION

A. All excavation outside the lines and grades shown on the Drawings, and which is not approved by ENGINEER, together with the removal and disposal of the associated material, shall be at CONTRACTOR'S expense. Unauthorized excavations shall be filled and compacted with engineered backfill or CLSM by CONTRACTOR at his expense. Determination of the fill material type shall be made by the ENGINEER.

3.6 DRAINAGE, EROSION CONTROL, AND DEWATERING

A. Erosion Control:
   1. In general, the construction procedures outlined herein shall be implemented to assure minimum damage to the environment during construction. Take any and all additional measures required to conform to the requirements of applicable codes and regulations, and the requirements specified in Section 01412, Stormwater Pollution Prevention Plan and Permit.
   2. Whenever possible, access and temporary roads shall be located and constructed to avoid environmental damage. Provisions shall be made to regulate drainage, avoid erosion, and minimize damage to vegetation.
   3. Where areas must be cleared for storage of materials or temporary structures, provisions shall be made for regulating drainage and controlling erosion, subject to the ENGINEER'S approval.
   4. Temporary measures shall be applied to control erosion and to minimize the silting of the existing waterways and natural ponding areas. Such measures shall include, but are not limited to, the use of berms, baled straw silt barriers, gravel or crushed stone, mulch, slope drains, and other methods. These temporary measures shall be applied to erodible materials exposed by any activities associated with the construction of this Work.
      a. Special care shall be taken to eliminate depressions that could serve as mosquito pools.
      b. Temporary measures shall be coordinated with the construction of permanent drainage facilities and other Work to the extent practicable to assure economical, effective, and continuous erosion and silt control.
      c. Provide special care in areas with steep slopes. Disturbance of vegetation shall be kept to a minimum to maintain stability.
   5. Remove only those shrubs and grasses that must be removed for construction. Protect the remainder to preserve their erosion-control value.
   6. Install erosion and sediment control practices where shown on the Drawings and according to applicable standards, codes, and Specifications. The practices shall be maintained in effective working condition during construction and until the drainage area has been permanently stabilized.
   7. Mulching is to be used for temporary stabilization.
      a. Suitable Materials for Mulching:
         1) Unrotted straw or salt hay: 1-1/2 to 2 tons/acre.
         2) Asphalt emulsion or cutback asphalt: 600 to 1,200 gal./acre.
         3) Wood-fiber or paper-fiber (hydroseeding): 1,500 lbs./acre.
         4) Mulch netting (paper, jute, excelsior, cotton, or plastic).
      b. Straw or salt hay mulches should be immediately anchored using peg and twine netting or a mulch anchoring tool or liquid mulch binders.
   8. After stabilization, remove all straw bale dikes, debris, etc., from the site.
   9. In the event of any temporary work stoppage, take steps to prevent any temporary or environmental damage to the area undergoing construction.
   10. In the event CONTRACTOR repeatedly fails to satisfactorily control erosion and siltation, the OWNER reserves the right to employ outside assistance or to

use its own forces to provide the corrective measures indicated. The cost of such work, plus engineering costs, will be deducted from monies due CONTRACTOR.

11. Prevent blowing and movement of dust from exposed soil surfaces and access roads to reduce on- and off-site damage and health hazards. Control may be achieved by irrigation in which the site shall be sprinkled with water until the surface is moist. The process shall be repeated as needed.

B. Dewatering:
   1. Prevent surface water and subsurface or groundwater from entering excavation, from ponding on prepared subgrades, and from flooding Project site and surrounding area.
   2. Protect subgrades and foundation soils from softening and damage by rain or water accumulation.

C. Disposal of Water Removed by Dewatering System:
   1. CONTRACTOR'S dewatering system will discharge to retention basins in accordance with State and Federal regulations.
   2. Dispose of all water removed from the excavation in such a manner as not to endanger public health, property, or any portion of the Work under construction or completed.
   3. Dispose of water in such a manner as to cause no inconvenience to OWNER, ENGINEER, or others involved in Work about the site.
   4. Convey water from the construction site in a closed conduit. Do not use trench excavations as temporary drainage ditches.
   5. Meter the quantity of water discharged in a manner acceptable to the Arizona Department of Water Resources.
   6. The discharged water from the dewatering system shall be purchased from the Arizona Department of Water Resources at the prevailing rate.

3.7 SHEETING, SHORING, AND BRACING FOR STRUCTURE EXCAVATIONS

A. General:
   1. Used material shall be in good condition, not damaged or excessively pitted. All steel or wood sheeting designated to remain in place shall be new. New or used sheeting may be used for temporary work.
   2. All timber used for breast boards (lagging) shall be new or used, meeting the requirements for Douglas Fir Dense Construction grade with a bending strength not less than 1,500 psi or Southern Pine No. 2 Dense.
   3. All steel work for sheeting, shoring, bracing, cofferdams, etc., shall be designed in accordance with the provisions of the "Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings", of the AISC, except that field welding will be permitted.
   4. Steel sheet piling shall be manufactured from steel conforming to ASTM A328. Steel for soldier piles, wales, and braces shall be new or used and shall conform to ASTM A36.

5. Maintain shoring and bracing in excavations regardless of time period excavations will be open. Carry down shoring and bracing as excavation progresses.
6. Unless otherwise shown on the Drawings, specified, or ordered, all materials used for temporary construction shall be removed when Work is completed. Such removal shall be made in a manner not injurious to the structure or its appearance or to adjacent Work.
7. Provide permanent steel sheet piling or pressure creosoted timber sheet piling wherever subsequent removal of sheet piling might permit lateral movement of soil under adjacent structures. Cut off tops as required, but at least 3 feet below grade, and leave permanently in place.
8. The clearances and types of the temporary structures, insofar as they affect the character of the finished Work, and the design of sheeting to be left in place, will be subject to the approval of ENGINEER; but, responsibility for the adequacy of all sheeting, shoring, bracing, coffer-damming, etc., belongs to CONTRACTOR.
9. Safe and satisfactory sheeting, shoring, and bracing shall be the entire responsibility of CONTRACTOR.
10. All Municipal, County, State, and Federal ordinances, codes, regulations, and laws shall be observed.

B. Sheeting Left in Place:
1. Steel sheet piling shown on the Drawings to be left in place shall consist of rolled sections of the continuous interlocking type, unless otherwise approved. The type and design of the sheeting and bracing shall conform to the above Specifications for all steel work for sheeting and bracing. Steel sheeting designated to be left in place shall be new.
2. Steel sheet piling to be left in place shall be driven straight to the lines and grades as shown on the Drawings or directed. The piles shall penetrate into firm materials with secure interlocking throughout the entire length of the pile. Damaged piling having faulty alignment shall be pulled and replaced by new piling.
3. The type of guide structure used and method of driving for steel sheet piling to be left in place shall be subject to the approval of ENGINEER. Jetting will not be permitted.
4. Cut-off piling left in place to the grades shown on the Drawings or directed by ENGINEER and remove the cut-offs from the site.
5. Clean wales, braces, and all other items to be embedded in the permanent structure, and ensure that the concrete surrounding the embedded element is sound and free from air pockets or harmful inclusions. Provisions shall include the cutting of holes in the webs and flanges of wale and bracing members, and the welding of steel diaphragm water stops perpendicular to the centerline of brace ends which are to be embedded.
6. Subsequent to removal of the inside face forms, and when removal of bracing is permitted, cut back steel at least 2-inches inside the wall face and patch opening

with cement mortar. Concrete shall be thoroughly worked beneath wales and braces, around stiffeners, and in any other place where voids may be formed.

7. Portions of sheeting or soldier piles and breast boards which are in contact with the foundation concrete shall be left in place, together with wales and bracing members which are cast into foundation or superstructure concrete.

C. Removal of Sheeting and Bracing:
   1. Remove sheeting and bracing from excavations, unless otherwise directed in writing by ENGINEER. Removal shall be done so as to not cause injury to the Work. Removal shall be equal on both sides of excavation to ensure no unequal loads on pipe or structure.
      a. Defer removal of sheeting and bracing, where removal may cause soil to come into contact with concrete, until the following conditions are satisfied:
      b. Concrete has cured a minimum of seven days.
      c. Wall and floor framing, up to and including grade level floors, are in place.

3.8 TRENCH SHIELDS

A. Excavation of earth material below the bottom of a shield shall not exceed the limits established by ordinances, codes, laws, and regulations.

B. When using a shield for the installation of structures, the bottom of the shield shall not extend below the top of the bedding for the structures.

C. When a shield is removed, extreme care shall be taken to prevent damage to the structures or the disturbance of the bedding for structures. Structures that are disturbed shall be removed and reinstalled as specified.

3.9 PLACEMENT OF FILL AND BACKFILL

A. General:
   1. All engineered fill and backfill required for structures, embankments, and duct banks and required to provide the finished grades shown on the Drawings and as described herein shall be furnished, placed, and compacted by CONTRACTOR. Refer to and comply with the requirements of Section 02318, Crushed Stone and Gravel.
   2. Backfill excavations as promptly as Work permits, but not until completion of the following:
      a. Acceptance by the ENGINEER of construction below finish grade, including damp proofing, waterproofing, and perimeter insulation.
      b. Inspection, testing, approval, and recording of locations of underground duct banks.
      c. Minimum of seven days cure time for all concrete.
      d. Removal of concrete formwork.
      e. Removal of shoring and bracing, and backfilling of voids with satisfactory materials.

f. Removal of trash and debris.

3. Fill containing organic materials or other unacceptable material shall be removed and replaced with approved fill material as specified.

B. Placement of Engineered Fill, Backfill, Backfill, and Fill:

1. All material shall be placed to the grades shown on the Drawings. The lift thickness and compaction moisture content range given herein are approximate. These values shall be finally determined from the laboratory test results on the fill materials. Testing requirements shall be as specified in Paragraph 3.9.E., below.
2. All engineered fill shall be placed in horizontal loose lifts, not exceeding 8-inches in thickness, and shall be mixed and spread in a manner assuring uniform lift thickness after placing. Each lift shall be compacted by not less than two complete coverages of the specified compactor. Engineered fill shall be placed to the underside of all concrete slabs. The fill material shall extend a minimum of 2 feet outside the face of each structure and be 12-inches below finished grade on all structures. The maximum slope of select backfill to the subgrade shall be one vertical to one horizontal.
3. Backfill and fill around and outside of structures and over engineered fill shall be deposited in layers not to exceed 8-inches in uncompacted thickness and mechanically compacted, using platform type tampers. Compaction of structures backfilled by rolling will be permitted provided the desired compaction is obtained and damage to the structure is prevented. Compaction by inundation with water will not be permitted. All materials shall be deposited as specified herein and as shown on the Drawings.
4. The material shall be placed at a moisture content and density as specified under Paragraph 3.9.E., below. Provide equipment capable of adding measured amounts of water to the backfill and/or engineered fill material to bring it to a condition within the range of the required moisture content. Provide equipment capable of disking, aerating, and mixing the soil to ensure reasonable uniformity of moisture content throughout the fill material and to reduce the moisture content of the borrow material by air drying, if necessary. If the subgrade or lift of earth material must be moisture conditioned before compaction, the fill material shall be sufficiently mixed or worked on the subgrade to ensure uniform moisture content throughout the lift of material to be compacted. Materials at moisture content in excess of the specified limit shall be dried by aeration or stockpiled for drying.
5. No backfill or fill material shall be placed when free water is standing on the surface of the area where the fill is to be placed. No compaction of fill will be permitted with free water on any portion of the fill to be compacted. No fill shall be placed or compacted in a frozen condition or on top of frozen material. Any fill containing organic materials or other unacceptable material previously described shall be removed and replaced with approved fill material prior to compaction.
6. Compaction shall be performed with equipment suitable for the type of fill material being placed. Select equipment that is capable of providing the

minimum density required by these Specifications. Hand operated compacting equipment shall be used within a distance of 10 feet from the wall of any completed below grade structure. Equipment shall be provided that is capable of compacting in restricted areas next to structures and around piping. The effectiveness of the equipment selected shall be tested at the commencement of compacted fill work by construction of a small section of fill within the area where fill is to be placed. If tests on this section of fill show that the specified compaction is not obtained, increase the amount of coverages, decrease the lift thicknesses, and/or obtain a different type of compactor.

7. Levels of backfill against concrete walls shall not differ by more than 2 feet on either side of walls, unless walls are adequately braced or all floor framing is in place, up to and including grade level slabs. Particular care shall be taken to compact engineered fill which will be beneath pipes, roads, or other surface construction or structures. In addition, wherever a trench passes through engineered fill, the engineered fill shall be placed and compacted to an elevation 12-inches above the top of the pipe before the trench is excavated. Compacted areas, in each case, shall be adequate to support the item to be constructed or placed thereon.
8. The compaction requirements specified are predicated on the use of normal materials and compaction equipment. In order to establish criteria for the placement of a controlled fill so that it will have compressibility and strength characteristics compatible with the proposed structural loadings, a series of laboratory compaction and/or compressive strength tests shall be performed on the samples of materials submitted by CONTRACTOR. From the results of the laboratory tests, the final values of the required percent compaction, the acceptable compaction moisture content range, and the maximum permissible lift thickness will be established for the fill material and construction equipment proposed.
9. Control the water content of fill material during placement within the range necessary to obtain the compaction specified.

TYPE	AREA OF USE	MOISTURE CONTENTS
On-site or Imported	Building, Structures, Exterior Slabs	Optimum ±3%
On-site or Imported	Pavements	2% Below Optimum or Lower
On-site or Imported	Trench/Structure Backfill	Optimum ±3%
Base Material	Structures and Pavements	Optimum ±3%

10. Perform all necessary Work to adjust the water content of the material to within the range necessary to permit the compaction specified. Do not place fill material when free water is standing on the surface of the area where the fill is

to be placed. No compaction of fill will be permitted with free water on any portion of the fill to be compacted.

11. Compact fill shall be compacted by at least two coverages of all portions of the surface of each lift by compaction equipment. One coverage is defined as the condition obtained when all portions of the surface of the fill material have been subjected to the direct contact of the compactor.
12. If the specified densities are not obtained because of improper control of placement or compaction procedures, or because of inadequate or improperly functioning compaction equipment, perform whatever Work is required to provide the required densities. This Work shall include complete removal of unacceptable fill areas, and replacement and recompaction until acceptable fill is provided.
13. If any settlement occurs, repairs will be at CONTRACTOR'S expense. Make all repairs and replacements necessary within 30 days after notice from ENGINEER or OWNER.

C. Backfill in Electrical Duct Bank Trenches:
   1. Compacted backfill shall be required for the full depth of the trench, below and above the electrical duct bank. Where the trench for one duct bank passes beneath the trench for another pipe or duct bank, engineered fill shall be placed to the level of the bottom of the upper trench.
   2. Placement and compaction of backfill in electrical duct bank trenches shall conform to the requirements of Paragraph 3.9.B., above.

D. Crushed Stone Placement:
   1. Crushed stone shall be placed where shown on the Drawings to the limits shown.
   2. Crushed stone shall be place in hand tamped lifts, not to exceed 6-inches.

E. Compaction Density Requirements:
   1. The degree of compaction required for all types of fills shall be as listed below. Material shall be moistened or aerated as necessary to provide the moisture content that will facilitate obtaining the specified compaction. Natural undisturbed soils or compacted soil subsequently disturbed or removed by construction operations shall be replaced with materials compacted as specified above.

MATERIAL	AREA OF USE	Percent Compaction
Soil	Deep fill and backfill zones (greater than 5 feet below finished grade):	100
	Below foundations and pavements:	95
	Below concrete floor slabs (above footing level):	95
Base Material	Below concrete slabs:	95
	Below flexible pavement sections:	100
	Backfill (outside of structure, exterior slab and pavement areas):	90
Trench and Structure Backfill	Below foundations and structures:	100
	Pipe and utility trenches:	100
	Subsurface wall backfill:	100

2. CONTRACTOR'S testing service shall perform tests necessary to provide data for selection of fill material and control of placement water content.
3. Field density tests, to ensure that the specified density is being obtained, shall be performed by CONTRACTOR'S testing service during each day of compaction work.
4. If the tests indicate unsatisfactory compaction, provide the additional compaction necessary to obtain the specified degree of compaction. All additional compaction work shall be performed by CONTRACTOR, at no additional cost to the OWNER, until the specified compaction is obtained. This work shall include complete removal of unacceptable (as determined by the ENGINEER) fill areas and replacement and recompaction until acceptable fill is provided.

F. Replacement of Unacceptable Excavated Materials: In cases where over-excavation for the replacement of unacceptable soil materials is required, the excavation shall be backfilled to the required subgrade with select backfill material and thoroughly compacted as specified in Paragraph 3.9.E., above. Sides of the excavation shall be sloped in accordance to the maximum inclinations specified for each structure location.

3.10 EMBANKMENTS

A. To the maximum extent available, use excess earth obtained from structure and underground duct bank excavations for construction of embankments. Obtain additional material from borrow pits as necessary. After preparation of the embankment area, level and roll the subgrade so that surface materials of the subgrade will be compact and well bonded with the first layer of the embankment. All material deposited in embankments shall be free from rocks or stones, brush, stumps, logs, roots, debris, and organic or other objectionable materials. Construct embankments in horizontal layers not exceeding 8-inches in uncompacted thickness.

Spread and level material deposited by excavating and hauling equipment prior to compaction. Thoroughly compact each layer by rolling or other method acceptable to the ENGINEER to meet the percent of the maximum density specified in Paragraph 3.9.B.9 at optimum moisture content as determined by ASTM D698. If the material fails to meet the density specified, compaction methods shall be altered. Wherever an excavation passes through a fill or embankment, the fill or embankment material shall be placed and compacted to an elevation 24-inches above the top of the trench, before trench is excavated.

3.11 GRADING

A. General: Uniformly grade areas within limits of grading under this Section, including adjacent transition areas. Smooth subgrade surfaces within specified tolerances, compact with uniform levels or slopes between points where elevations are shown on the Drawings, or between such points and existing grades.

B. Grading Outside Building Lines: Grade areas adjacent to building lines to drain away from structures and to prevent ponding. Finish surfaces free from irregular surface changes, and as follows:
   1. Turfed Areas or Areas Covered with Gravel, Stone, Wood Chips, or Other Special Cover: Finish areas to receive topsoil or special cover to within not more than 1-inch above or below the required subgrade elevations.
   2. Walks: Shape surface of areas under walks to line, grade, and cross-section with finish surface not more than 1-inch above or below the required subgrade elevation.
   3. Pavements: Shape surface of areas under pavement to line grade, and cross-section with finish surface not more than 1/2-inch above or below the required subgrade elevation.

C. Grading Surface of Fill Under Building Slabs: Grade smooth and even, free of voids, compacted as specified, and to required elevation. Provide final grades within a tolerance of 1/2-inch when tested with a 10 foot straightedge.

D. Compaction:
   1. After grading, compact subgrade surfaces to the depth and percentage of maximum density for each area classification.

3.12 PAVEMENT SUBBASE COURSE

A. Base course below all asphalt pavements shall be a minimum of 6-inches thick.
   1. Refer to Section 02500, Asphalt Pavement, for paving Specifications.

B. Grade Control: During construction, maintain lines and grades, including crown and cross-slope of subbase course.

C. Shoulders: Place shoulders along edges of base course to prevent lateral movement. Construct shoulders of acceptable soil materials, placed in such quantity to compact

to thickness of each base course layer. Compact and roll at least a 12-inch width of shoulder, simultaneously with compacting and rolling of each layer of base course.

D. Placing: Place base course material on prepared subgrade in layers of uniform thickness, conforming to indicate cross-section and thickness. Maintain optimum moisture content for compacting base material during placement operations.
   1. When a compacted base course is shown on the Drawings to be 6-inches thick or less, place material in a single layer. When shown on the Drawings to be more than 6-inches thick, place material in equal layers, except no single layer more than 6-inches or less than 3-inches in thickness when compacted.

3.13 DISPOSAL OF EXCAVATED MATERIALS

A. Material removed from the excavations which does not conform to the requirements for fill or is in excess of that required for backfill shall be hauled away from the Project site by CONTRACTOR and disposed of in compliance with ordinances, codes, laws, and regulations at no additional cost to the OWNER. Refer to and comply with the requirements of Section 02100, Site Preparation.

3.14 RESTORING AND RESURFACING EXISTING ROADWAYS AND FACILITIES

A. Place 1-1/2-inches of temporary bituminous pavement immediately after backfilling trenches in paved roadways which are to be retained for permanent use. Maintain the surface of the paved area over the trench in good and safe condition during progress of the entire Work, and promptly fill all depressions over and adjacent to the trench caused by settlement of backfilling. The permanent replacement pavement shall be equal to that of the existing roadways, unless otherwise specified.

B. Pavement, gutters, curbs, sidewalks, or roadways disturbed or damaged by the CONTRACTOR'S operations, except areas designated "New Pavement" or "Proposed Pavement", shall be restored by CONTRACTOR at his own expense to as good condition as they were previous to the commencement of the Work and in accordance with applicable local and State highway specifications.

3.15 FIELD QUALITY CONTROL

A. Refer to Paragraph 1.2.4 of this Section.

++ END OF SECTION ++

SECTION 02318

CRUSHED STONE, GRAVEL AND DECOMPOSED GRANITE

PART 1 - GENERAL

1.1 SUMMARY

A. Scope:
   1. Provide all labor, materials, equipment and incidentals required to furnish and install crushed stone, gravel and decomposed granite of the types specified at locations shown on the Drawings and as directed by the ENGINEER.

1.2 SECTION INCLUDES

A. Crushed Stone.

B. Gravel.

1.3 RELATED SECTIONS

A. Section 01300, Submittals.

B. Section 02315, Earthwork, Excavation, and Backfill

C. Section 15051, Buried Piping Installation.

D. Section 15068, Reinforced Concrete Pipe.

1.4 QUALITY ASSURANCE

A. Conform to all applicable requirements of Section 701 of the Uniform Standard Specifications for Public Works Construction by the Maricopa Association of Government (MAG) as supplemented by the City of Chandler. Where there is a conflict between MAG Standard Specifications as supplemented by the City of Chandler and these Specifications, the provisions of these Specifications shall govern.

B. Sampling and sieve analysis shall be performed in accordance with ASTM D75 and ASTM C136.

1.5 SUBMITTALS

A. Submit for approval the following:
   1. Furnish representative samples of the crushed stone and gravel to the ENGINEER and advise of the source location.

2. Test reports, including sieve analyses, showing material compliance with specified requirements.

B. Shop Drawings: Submit for approval the following:
   1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
   2. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**

PART 2 - PRODUCTS

2.1 MATERIALS

A. General:
   1. Furnish and place crushed stone or screened gravel fill under pipe or structures where shown on the Drawings in addition to that required under other Sections. Comply with requirements of Section 15051, Buried Piping Installation.
   2. Crushed stone and gravel shall be clean, hard, sound, durable, uniform in quality, and free of any detrimental quantity of soft, friable, thin elongated, or laminated pieces, disintegrated material, organic matter, oil, alkali, or other deleterious substance.
   3. The loss by abrasion in the Los Angeles abrasion machine, determine as prescribed in ASTM C131, Grading A, shall not exceed 10%, by weight, after 100 revolutions nor 40% after 500 revolutions.

B. Crushed Stone:
   1. Crushed stone shall consist of the product obtained by crushing rock, stone, or gravel so that at least 50% by weight of aggregate retained on the No. 4 sieve for

3/4-inch or larger maximum sizes, and 50% retained on the No. 8 sieve for maximum sizes less than 3/4-inch shall consist of particles which have at least one rough, angular surface produced by crushing.

2. The gradation of crushed stone shall comply with ASTM D448.

C. Gravel:
   1. Material designated herein as gravel shall be composed entirely of particles that are either fully or partially rounded and water-worn.
   2. Crushed rock obtained by crushing rock which exceeds ASTM D448 maximum gradation sizes may be combined provided it is uniformly distributed throughout and blended with the gravel. The quality and gradation requirements shall be as stated in this Specification.

D. Decomposed Granite:
   1. Decomposed granite shall be 3/4-inch minus, supplied from a single supply source, for a uniform appearance throughout the Project. It shall be free from lumps or balls of clay and shall not contain any calcareous coatings, caliches, organic matter or foreign substances.

PART 3 - EXECUTION

3.1 PLACING

A. Gravel shall be spread in layers of uniform thickness not exceeding 8-inches and shall be thoroughly compacted with suitable power driven tampers or other power driven equipment. The placing of crushed stone or gravel shall conform to applicable requirements of Section 02315, Earthwork, Excavation, and Backfill except as noted above, and Section 15068, Reinforced Concrete Pipe.

B. Prior to placing decomposed granite, all areas to receive it shall be sprayed with a pre-emergent herbicide according to the manufacturer's recommendations within Maricopa Association of Governments (civil) requirements. Do not spray herbicide on any areas designated to receive seeding. Decomposed granite shall be rolled uniformly for depth and compacted to all areas designated on the DRAWINGS to a minimum depth of 2–inches.

++ END OF SECTION ++

SECTION 02319

RIPRAP

PART 1 - GENERAL

1.1 SUMMARY

A. Scope:
   1. Provide all labor, materials, equipment and incidentals required to furnish and place riprap at locations shown on the Drawings and specified.
   2. Any existing riprap removed shall be replaced by CONTRACTOR at no additional cost to the OWNER.

1.2 SECTION INCLUDES

A. Rip Rap.

1.3 RELATED SECTIONS

A. Section 01300, Submittals.

1.4 QUALITY ASSURANCE

A. Conform to all applicable requirements of Section 703 in the Uniform Standard Specifications for Public Works Construction by the Maricopa Association of Governments (MAG) as supplemented by the City of Chandler. If there is a conflict between the MAG Standard Specifications, as supplemented by the City of Chandler, and these Specifications, the provisions in these Specifications shall govern.

1.5 SUBMITTALS

A. Shop Drawings: Submit for approval the following:
   1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with

the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

2. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**

PART 2 - PRODUCTS

2.1 MATERIAL

A. Stone for riprap shall be sound and durable, free from seams and coatings, and of such characteristics that it will not disintegrate when subjected to the action of water.

B. Riprap shall conform to the applicable requirements of ADOT Standard Specification Section 913 - Bank Protection for Dumped Riprap.

C. Riprap within the spillways shall be 6-inches nominal; no more than 50% shall be smaller than 3-inches.

D. Stones salvaged from excavation and meeting the above requirements may be used for riprap, if approved by the ENGINEER.

PART 3 - EXECUTION

3.1 PLACING

A. Areas to receive riprap shall be cleared, fine graded, and have an application of pre-emergent weed control per the manufacturer's recommendations.

B. Minimum total thickness of the riprap layer shall be 16-inches within spillways and 12-inches elsewhere, unless otherwise noted.

C. The stones shall be placed so that the weight of the stone is carried by the underlying material and not by the adjacent stones. On slopes, the largest of stones shall be at the bottom. Riprap shall be of proper size to form a compact solid blanket to protect the slopes. Rounded boulders or cobbles shall not be used on slopes steeper than 2:1, unless grouted.

D. Riprap shall be placed so as to conform as closely as practicable in size and character to existing riprap, if applicable.

E. Riprap may be placed in location by equipment; however, care shall be taken in placing to obtain a good gradation of materials so that the riprap will be firm and solid. Surfaces shall be leveled to the required alignment and slopes by hand placing the stone so as to fill large voids and to make the surface even.

F. Where riprap is adjacent to pavement, the elevation of the riprap shall meet the elevation of the pavement.

G. Apply a second application of pre-emergent herbicide in accordance with the manufacturer's recommendations.

H. All herbicide applications shall be done by a certified applicator licensed by the State of Arizona.

++ END OF SECTION ++

SECTION 02371

FILTER FABRIC FOR RIPRAP CHANNELS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes non-woven engineering fabrics (geo-textile) for riprap lined channels.

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM):
   1. D 3786 - Test Method for Mullen Burst Strength.
   2. D 1777 - Test Methods for Fabric Dimensions.
   3. D 5261 - Test Methods for Mass per Unit Area (Weight) of Non-Woven Fabric.
   4. D 4491 - Test Methods for Water Permeability of Geo-textiles by Permittivity.
   5. D 4632 - Test Method for Grab Breaking Load and Elongation of Geo-textiles.
   6. D 4833 - Test Method for Puncture Resistance of Geo-textiles.
   7. D 4533 - Test Method for Trapezoidal Tear of Geo-textiles.
   8. D 4751 - Test Methods for Apparent Opening Size of Geo-textiles.
   9. D 4355 - Test Methods for UV Resistance of Geo-textiles by Permittivity.

1.3 DEFINITIONS

A. Filter Fabric for riprap channels: Geo-textile shall be a needle punched, nonwoven fabric composed of 100 percent polyester or polypropylene filaments which are formed into a stable network such that the filaments retain their relative position. The fabric shall be inert to biological degradation and resistant to naturally encountered chemicals, alkalizes, and acids.

1.4 PROJECT CONDITIONS

A. Take field measurements to determine the exact lengths and dimension of the surfaces to receive the fabric.

1.5 SUBMITTALS

A. Product data.

B. Provide samples.

C. Quality Control Submittals:
   1. Certificates of Compliance.
   2. Manufacturer's instructions.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Storage and Protection:
   1. Furnish engineering fabrics in protective covers capable of protecting the fabric from ultraviolet rays, abrasion, and water.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. One of the following or approved equal:
   1. Mirafi S1000, by Tencate, Pendergrass, GA., (706) 693-2226
   2. Skaps GT-110 by Pendergrass, GA., 1-706-693-3440.

2.2 MATERIAL REQUIREMENTS

A. Physical Properties: Meet the following minimum requirements.

	ASTM	**Requirement**
Fabric		
Weight	D 5261	10 oz/ yd^2
Thickness	D 1777	115 mils
Apparent Opening Size	D 4751	70 (Stnd Sieve)
Grab Tensile Strength	D 4632	250 lbs
Grab Elongation	D 4632	50%
Mullen Burst Strength	D 3786	510 psi
Puncture Resistance	D 4833	130 lbs
Trapezoidal Tear	D 4533	100 lbs
UV Resistance	D 4355	70%
Water Permittivity	D 4491	1.07 sec^{-1}
Water Flow Rate	D 4491	80 gpm/ft^2

PART 3 - EXECUTION

3.1 PREPARATION

A. Surface Preparation: During grading operations, take care not to disturb or scarify the sub-grade. This may require use of lightweight dozers for low strength soils such as saturated, cohesionless, or low cohesion soils. Recompact if sub-grade is scarified.

B. Prior to placement of fabric, prepare surface to smooth conditions free of debris, depressions, or obstructions that may damage the fabric.

3.2 INSTALLATION

A. Follow manufacturer's installation instructions and as complimented herein.

B. Place the geo-textile fabric smoothly without folds or wrinkles.

C. Use special care when placing the geo-textile in contact with the soil so that no void spaces occur between the geo-textile and the prepared surface.

D. Overlap the geo-textile sheets according to manufacturer's installation.

E. Provide turndowns along the longitudinal fabric edges to utilize the surrounding soil weight for anchoring the fabric. These turndowns will extend vertically beneath the riprap sub-grade and horizontally away for a distance equal to the riprap blanket thickness or 2', whichever is greater.

F. Place drainage aggregate on the geo-textile as specified Section 02319, Riprap.

3.3 FIELD QUALITY CONTROL

A. Inspection: Before covering, the conditions of the fabric will be observed by the ENGINEER to determine that no holes or rips exist in the fabric. Repair all such occurrences by placing a new layer of fabric extending beyond the defect in all directions a distance equal to the minimum overlap required for adjacent rolls.

++ END OF SECTION ++

SECTION 02500

ASPHALT PAVEMENT

PART 1 - GENERAL

1.1 SUMMARY

A. This Section covers the asphalt concrete pavement, asphalt concrete overlay, and concrete curb.

B. Removal of existing pavement shall be at locations as shown on the Plans. The waste material shall be disposed of at approved locations obtained by the CONTRACTOR at no additional cost to the OWNER.

1.2 RELATED SECTIONS

A. Section 02050, Demolitions.

B. Section 02315, Earthwork, Excavation, and Backfill.

1.3 SUBMITTALS

A. Asphalt concrete, aggregate base and concrete curb:
   1. Letters of Certification of Compliance on materials, equipment, etc.
   2. Final Certified Drawings showing outline dimensions, foundation layout or mounting information, and other pertinent dimensions.
   3. Material gradation, design mix, job mix formula, and/or material analysis.

B. Shop Drawings: Submit for approval the following:
   1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the

specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

2. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**

PART 2 - PRODUCTS

2.1 ASPHALT CONCRETE

A. Asphalt concrete shall conform to the MAG Standard Specification Section 710; Asphalt Concrete.

B. Asphalt concrete shall be 19 mm surface course.

2.2 AGGREGATE BASE

A. Aggregate base shall conform to the MAG Standard Specification Section 702; Base Materials.

2.3 CONCRETE CURB

A. Concrete curb shall be constructed of Class "B" concrete as defined in MAG Standard Specification Section 725.

B. Concrete curbs shall conform to details called out on the Drawings.
   1. Vertical Curb and Gutter: MAG Detail 220 (Type A), H = 6-inches, 1/2-inch Batter.
   2. Roll Curb and Gutter: MAG Detail 220 (Type C), H = 4 inches, 1/2-inch Batter.
   3. Roll Curb and Gutter: MAG Detail 220 (Type D), H = 3-1/2 inches, 1/2-inch Batter.
   4. Ribbon Curb: MAG Detail 220 (Type B).

2.4 SLURRY SEAL

A. Per MAG Section 332.

PART 3 - EXECUTION

3.1 ASPHALT CONCRETE PAVING

A. Asphalt concrete paving shall be constructed per MAG Standard Specifications Section 321 - Placement of Construction of Asphalt Concrete Paving.

B. The 4-inch asphalt concrete paving shall be placed in one pass.

C. Where existing pavement is to be removed for new construction, saw cut existing pavement and replace per MAG Standard Specifications Section 336 - Pavement Matching and Surface Replacement.

D. Where new pavement meets existing pavement, the connection shall match the existing pavement's elevation and conform to MAG Standard Specifications Section 336 - Pavement Matching and Surface Replacement.

E. All new asphalt pavements shall be slurry sealed.

3.2 CONCRETE CURB AND GUTTER/ROLLED CURB

A. Concrete curb shall be placed per MAG Standard Specifications Section 340 - Concrete Curb, Gutter, Sidewalk, Driveway, and Alley Entrance.

B. Where new curb meets existing curb, the connection shall conform to the existing curb elevation.

3.3 AGGREGATE BASE

A. Aggregate base shall be placed per MAG Standard Specifications Section 310 – Placement and Construction of Aggregate Base Course.

B. The aggregate base shall be placed in two 4-inch passes.

++ END OF SECTION ++

SECTION 02580

PAVEMENT MARKINGS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section covers pavement marking requirements for striping, text, and graphics.

1.2 RELATED SECTIONS

A. Section 02050, Demolitions.

B. Section 02315, Earthwork, Excavation, and Backfill.

C. Section 02500, Asphalt Pavement.

D. Section 02751, Portland Cement Concrete Paving.

1.3 SUBMITTALS

A. Descriptive submittals shall be made in accordance with the Data Reference Symbols defined in Section 01300, Submittals.
   1. Product data.
   2. Manufacturer's instructions.

B. Shop Drawings: Submit for approval the following:
   1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

2. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Pavement Marking Paint: One of the following manufacturers or equal.
   1. Dunn-Edwards Corporation, Los Angeles, CA.
   2. Glidden Company, Cleveland, OH.
   3. Sherwin Williams Company, Cleveland, OH.

2.2 MATERIALS

A. Pavement Marking Paint, Latex Based: One of the following or equal:
   1. Dunn Edwards: No. W 801, Vin-L-Stripe, epoxy modified acrylic-latex-based paint.
   2. Glidden: 63240 Series, UltraHide Latex Traffic Paint.
   3. Sherwin Williams: Set fast acrylic water borne traffic marking paint.

B. Pavement Marking Paint, Alkyd Based: One of the following or equal:
   1. Glidden: 63220 Series, UltraHide Traffic Paint.
   2. Sherwin Williams: Promar Alkyd Traffic Marking Paint.

C. Masonry Conditions (if applicable): The following or equal:
   1. Sherwin Williams: B46WZ1000 Masonry Conditioner.

D. Colors:
   1. Text: White.
   2. Parking Dividers: White.
   3. No Parking Zone: Yellow.
   4. Paint Curb, where required: Red.
   5. Directional Arrows: White.
   6. Lane Striping: Yellow.
   7. Speed Bump: White.

PART 3 - EXECUTION

3.1 CONDITIONS

A. Apply Pavement Markings When:
   1. Pavement is thoroughly clean and dry.

2. Ambient temperature is above 40º F.
3. Precipitation is not expected within 12 hours of completion of application.

3.2 PREPARATION

A. Remove dirt, oil, grease, and other materials which may affect paint adhesion.

B. Apply masonry conditioner on weathered or sandblasted surfaces, brick, or stucco.

3.3 APPLICATION

A. Apply paint at package consistency whenever possible. Thin paint as little as possible.

B. Apply paint with specifically designed and manufactured equipment for pavement marking. Provide:
1. Uniform straight edges without overspray.
2. 4-inch wide lines, unless indicated otherwise.

C. Apply paint to obtain thickness recommended by paint manufacturer.

D. Paint traffic control markings, including striping, directional arrows, cross walks and lettering and handicap striping and symbols as indicated on the Drawings in accordance with all local governing agency standards. Use stencils for arrows, lettering, and symbols.

E. Apply 700 square inch international handicap symbol on pavement surface where indicated on the Drawings.
1. On asphalt surfaces, paint blue symbol on white square.
2. On concrete surface, paint white symbol on blue square.

3.4 QUALITY ASSURANCE

A. Applicator Qualifications: Minimum five years experience of applying traffic markings with satisfactory performance record.

B. Regulatory Requirements: Comply with applicable requirements of governmental agencies having jurisdiction, including airborne emissions and industrial waste disposal requirements.

++ END OF SECTION ++

SECTION 02751

PORTLAND CEMENT CONCRETE PAVING

PART 1 - GENERAL

1.1 SUMMARY

A. Exterior concrete sidewalks, stoops, and ramps.

1.2 REFERENCE STANDARDS

A. ACI 211.1, Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete; American Concrete Institute International; 1991 (Reapproved 2002).

B. ACI 301, Specifications for Structural Concrete for Buildings; American Concrete Institute International; 2005.

C. ACI 304R, Guide for Measuring, Mixing, Transporting, and Placing Concrete; American Concrete Institute International; 2000.

D. ACI 305R, Hot Weather Concreting; American Concrete Institute International; 1999.

E. ACI 306R, Cold Weather Concreting; American Concrete Institute International; 1988 (Reapproved 2002).

F. ASTM C33, Standard Specification for Concrete Aggregates; 2003.

G. ASTM C39/C39M, Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens; 2005.

H. ASTM C94/C94M, Standard Specification for Ready-Mixed Concrete; 2005.

I. ASTM C150, Standard Specification for Portland Cement; 2005.

J. ASTM C173/C173M, Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method; 2001.

K. ASTM C260, Standard Specification for Air-Entraining Admixtures for Concrete; 2001.

L. ASTM C309, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete; 2003.

M. ASTM C494/C494M, Standard Specification for Chemical Admixtures for Concrete; 2005a.

N. ASTM C618, Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete; 2005.

O. ASTM C685/C685M, Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing; 2001.

P. ASTM D1751, Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (nonextruding and Resilient Bituminous Types); 2004.

1.3 SUBMITTALS

A. See Section 01300, Submittals, for submittal procedures.

B. Product Data: Provide data on joint filler, admixtures, curing compound, and removable joint cap.

C. Shop Drawings: Submit for approval the following:
   1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
   2. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**

1.4 QUALITY ASSURANCE

A. Perform work in accordance with ACI 301.

B. Obtain cementitious materials from same source throughout.

C. Follow recommendations of ACI 305R when concreting during hot weather.

D. Follow recommendations of ACI 306R when concreting during cold weather.

1.5 ENVIRONMENTAL REQUIREMENTS

A. Do not place concrete when base surface temperature is less than 40º F, or surface is wet or frozen.

PART 2 - PRODUCTS

2.1 FORM MATERIALS

A. Form Materials: Conform to ACI 301.

B. Joint Filler: Non-extruding, resilient asphalt impregnated fiberboard or felt, complying with ASTM D1751, 1/2-inch thick and full depth of slab less 1/2-inch.

2.2 REINFORCEMENT

A. Unless indicated on the Drawings, reinforcement is not required for exterior paving.

2.3 CONCRETE MATERIALS

A. Cement: ASTM C150 Air-Entraining Type IA or Air-Entraining Type IIA Portland type, grey color.

B. Fine and Coarse Mix Aggregates: ASTM C33.

C. Fly Ash: ASTM C618, Class F.

D. Calcined Pozzolan: ASTM C618, Class N.

E. Water: Clean, and not detrimental to concrete.

F. Air Entrainment Admixture: ASTM C260.

G. Chemical Admixtures: ASTM C494/C494M, Type A; Water Reducing, Type C; Accelerating, and Type G; Water Reducing, High Range and Retarding.

2.4 ACCESSORIES

A. Curing Compound: ASTM C309, Type Design Professional, Class A.

B. Sealant at Joint Filler: Type ES-2 as specified in Section 07900, Joint Sealers.

C. Removable Joint Cap: Extruded plastic, 10 foot lengths; size to match width of joint filler.
   1. Product and Manufacturer: Sealtight Snap-Cap, W.R. Meadows: www.wrmeadows.com or equal.

2.5 CONCRETE MIX DESIGN

A. Proportioning Normal Weight Concrete: Comply with ACI 211.1 recommendations.

B. Concrete Strength: Establish required average strength for each type of concrete on the basis of field experience or trial mixtures, as specified in ACI 301.
   1. For trial mixtures method, employ independent testing agency acceptable to ENGINEER for preparing and reporting proposed mix designs.

C. Admixtures: Add acceptable admixtures as recommended in ACI 211.1 and at rates recommended by manufacturer.

D. Concrete Properties:
   1. Compressive Strength, when tested in accordance with ASTM C39/C39M at 28 days: 4,000 psi.
   2. Fly Ash Content: Maximum 25% - 30% of cementitious materials by weight.
   3. Calcined Pozzolan Content: Maximum 10% of cementitious materials by weight.
   4. Silica Fume Content: Maximum 5% of cementitious materials by weight.
   5. Cement Content: Minimum 429 lb per cubic yard.
   6. Water-Cementitious Ratio: Maximum 45% by weight.
   7. Total Air Content: 6% ±1%, determined in accordance with ASTM C173/C173M.
   8. Maximum Aggregate Size: 1-inch.

2.6 MIXING

A. On Project Site: Mix in drum type batch mixer, complying with ASTM C685. Mix each batch not less than 1-1/2 minutes and not more than 5 minutes.

B. Transit Mixers: Comply with ASTM C94/C94M.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify compacted subgrade is acceptable and ready to support paving and imposed loads.

B. Verify gradients and elevations of base are correct.

3.2 PREPARATION

A. Moisten base to minimize absorption of water from fresh concrete.

3.3 FORMING

A. Place and secure forms to correct location, dimension, profile, and gradient.

B. Assemble formwork to permit easy stripping and dismantling without damaging concrete.

C. Place joint filler vertical in position, in straight lines. Secure to formwork during concrete placement.

3.4 PLACING CONCRETE

A. Place concrete in accordance with ACI 304R.

B. Ensure inserts, embedded parts, formed joints are not disturbed during concrete placement.

C. Place concrete continuously over the full width of the panel and between predetermined construction joints. Do not break or interrupt successive pours such that cold joints occur.

3.5 JOINTS

A. Place 1/2-inch wide expansion joints at the following locations:
   1. To separate paving from vertical surfaces and other components
   2. At other locations indicated on the drawings.
      a. If other locations are not indicated, locate at maximum 20 foot intervals.
   3. Form joints with joint filler extending from bottom of pavement to within 1/2-inch of finished surface.
   4. Secure to resist movement by wet concrete.
   5. Install joint filler with removable joint caps. Set top of removable joint cap flush with finished paving surface. Extend joint filler to bottom of paving.
   6. Remove joint caps when paving is cured in accordance with manufacturer's recommendations. Install sealant in joint in accordance with Section 07900, Joint Sealers.

B. Provide scored joints:
   1. At locations identified as control joints.
   2. If locations are not indicated, locate at 5 foot intervals.

3.6 FINISHING

A. All paving unless noted otherwise: Light broom, texture perpendicular to pavement direction.

B. Place curing compound on exposed concrete surfaces immediately after finishing. Apply in accordance with manufacturer's instructions.

3.7 JOINT SEALING

A. See Section 07900, Joint Sealers, for joint sealer requirements.

3.8 TOLERANCES

A. Maximum Variation of Surface Flatness: 1/4-inch in 10 feet.

B. Maximum Variation From True Position: 1/4-inch.

3.9 FIELD QUALITY CONTROL

A. An independent testing agency will perform field quality control tests, as specified in Section 01400, Quality Control.
   1. Provide free access to concrete operations at project site and cooperate with appointed firm.
   2. Submit proposed mix design of each class of concrete to inspection and testing firm for review prior to commencement of concrete operations.
   3. Tests of concrete and concrete materials may be performed at any time to ensure conformance with specified requirements.

B. Compressive Strength Tests: ASTM C39/C39M. For each test, mold and cure three concrete test cylinders. Obtain test samples for every 50 cu yd or less of concrete placed.
   1. Take one additional test cylinder during cold weather concreting, cured on job site under same conditions as concrete it represents.

C. Maintain records of placed concrete items. Record date, location of pour, quantity, air temperature, and test samples taken.

3.10 PROTECTION

A. Immediately after placement, protect pavement from premature drying, excessive hot or cold temperatures, and mechanical injury.

++ END OF SECTION ++

SECTION 03100

CONCRETE FORMWORK

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
   1. Provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install concrete formwork. The Work also includes:
      a. Providing openings in formwork to accommodate the Work under this and other Sections and building into the formwork all items such as sleeves, anchor bolts, inserts and all other items to be embedded in concrete for which placement is not specifically provided under other Sections.

B. Coordination:
   1. Review installation procedures under other Sections and coordinate the installation of items that must be installed with the formwork.
   2. Coordinate formwork specifications herein with the requirements for finished surfaces specified in Section 03200, Concrete Reinforcement, and Section 03300, Cast-In-Place Concrete.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Concrete Institute (ACI):
      a. CT-13, Concrete Terminology.
      b. 117, Specification for Tolerances for Concrete Construction and Materials.
      c. 347R, Guide to Formwork for Concrete.

B. Qualifications:
   1. Formwork, shoring and reshoring to be designed by a licensed professional engineer currently registered or having a minimum of three years of experience in this type of design work.
      a. Above qualifications apply to the following:
         1) Slabs and beams not cast on the ground
         2) Wall and column placements over 15 FT in height.

C. Miscellaneous:
   1. Design and engineering of formwork, shoring and reshoring as well as its construction is the responsibility of the Contractor.
   2. Design requirements:

a. Design formwork for loads, lateral pressures and allowable stresses outlined in ACI 347R and for design considerations, wind loads, allowable stresses and other applicable requirements of the controlling local building code.
    1) Where conflicts occur between the above two standards, the more stringent requirements shall govern.
b. Design formwork to limit maximum deflection of form facing materials reflected in concrete surfaces exposed to view to 1/240 of span between structural members.

3. For slabs and beams not cast on the ground, develop a procedure and schedule for removal of shores and installation of reshores and for calculating the loads transferred to the structure during this process in accordance with ACI 347R.
    a. Perform structural calculations as required to prove that all portions of the structure in combination with remaining forming and shoring system has sufficient strength to safely support its own weight plus the loads placed thereon. Calculations shall be performed by a licensed professional engineer.
    b. When developing procedure, schedule and structural calculations, consider the following at each stage of construction:
        1) The structural system that exists.
        2) Effects of all loads during construction.
        3) Strength of concrete.
        4) Modulus of Elasticity (Young's Modulus) of the concrete at the time of shoring and form removal.
        5) The influence of deformations of the structure and shoring system on the distribution of dead loads and construction loads.
        6) The strength and spacing of shores or shoring systems used, as well as the method of shoring, bracing, shore removal, and reshoring including the minimum time intervals between the various operations.
        7) Any other loading or condition that affects the safety or serviceability of the structure during construction.

1.3 DEFINITIONS

A. Words and terms used in these Specifications are defined in ACI CT-13.

1.4 SUBMITTALS

A. Shop Drawings:
    1. See Specification Section 01300, Submittals for the requirements for the mechanics and administration of the submittal process.
    2. Product technical data including:
        a. Manufacturer and type of proposed form ties.
    3. Submit for information purposes the following:

a. Copies of manufacturer's data and installation instructions for proprietary materials, including form coatings, manufactured form systems, ties and accessories.

4. Each Shop Drawing Submittal shall include a copy of the relevant Specification Section and shall be clearly marked to indicate whether the requirements for equipment and/or services in the Specification Section are met by writing "accept" or "deviate" next to each Paragraph. If clarifications are needed to any of the Paragraphs in the Specification Sections due to deviations, they shall be addressed next to the Paragraph as such and explained further with any additional information necessary. If any exceptions and/or deviations are proposed to any of the Specifications, they shall be clearly noted as such in the Submittal, and an explanation of any deviation and/or exception shall be provided. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Forms for Surfaces Exposed to View:
   1. Wood forms:
      a. 5/8 or 3/4 IN 5-ply structural plywood of concrete form grade.
      b. Built-in-place or prefabricated type panel.
   2. Metal forms:
      a. Metal forms may be used except for aluminum in contact with concrete.
      b. Forms to be tight to prevent leakage, free of rust and straight without dents to provide members of uniform thickness.

B. Forms for Surfaces Not Exposed to View:
   1. Wood or metal sufficiently tight to prevent leakage.
   2. Do not use aluminum forms.

2.2 ACCESSORIES

A. Form Ties:
   1. Commercially fabricated for use in form construction.
      a. Field fabricated ties are unacceptable.
   2. Constructed so that ends or end fasteners can be removed without causing spalling at surfaces of the concrete.
   3. Embedded portion of ties to be not less than 1-1/2 IN from face of concrete after ends have been removed.
   4. Cone size:
      a. 3/4 IN minimum diameter cones on both ends.
      b. Depth of cone not to exceed the concrete reinforcing cover.

5. Provide ties with built-in waterstops in all walls that will be in contact with process liquid during plant operation and below grade soil.
6. Through-wall ties that are designed to be entirely removed may be used for walls that will be in contact with process liquid during plant operation provided:
    a. Tie hole is plugged with:
        1) X-Plug, by Greenstreak, Inc.
        2) Or Equal.
    b. Tie hole plugs are to be installed in strict accordance with the manufacturer's printed installation instructions.
    c. Contractor provides and follows quality control plan for verifying proper installation.

PART 3 - EXECUTION

3.1 PREPARATION

A. Form Surface Treatment:
    1. Before placing of reinforcing steel or concrete, cover surfaces of forms with an approved release material that will effectively prevent absorption of moisture and prevent bond with concrete, will not stain concrete or prevent bonding of future finishes.
        a. A field applied form release agent or sealer of approved type or a factory applied nonabsorptive liner may be used.
    2. Do not allow excess form release material to stand in puddles in forms nor in contact with hardened concrete against which fresh concrete is to be placed.

B. Provide temporary openings at base of column and wall forms and at other points where necessary to facilitate cleaning and observation immediately before concrete is placed, and to limit height of free fall of concrete to prevent aggregate segregation.
    1. Temporary openings to limit height of free fall of concrete shall be spaced no more than 8 FT apart.

C. Clean surfaces of forms, reinforcing steel and other embedded materials of any accumulated mortar or grout from previous concreting and of all other foreign material before concrete is placed.

3.2 ERECTION

A. Install products in accordance with manufacturer's instructions.

B. Tolerances:
    1. Conform to ACI 117.
    2. Variation from plumb:
        a. In lines and surfaces of columns, piers, walls, and in risers.

1) Maximum in any 10 FT of height: 1/4 IN.
2) Maximum for entire height: 1/2 IN.

b. For exposed corner columns, control-joint grooves, and other exposed to view lines:
1) Maximum in any 20 FT length: 1/4 IN.
2) Maximum for entire length: 1/2 IN.

3. Variation from level or from grades specified:
a. In slab soffits, ceilings, beam soffits and in arises, measured before removal of supporting shores.
1) Maximum in any 10 FT of length: 1/4 IN.
2) Maximum in any bay or in any 20 FT length: 3/8 IN.
3) Maximum for entire length: 3/4 IN.

b. In exposed lintels, sills, parapets, horizontal grooves, and other exposed to view lines:
1) Maximum in any bay or in 20 FT length: 1/4 IN.
2) Maximum for entire length: 1/2 IN.

4. Variation of linear structure lines from established position in plan and related position of columns, walls, and partitions:
a. Maximum in any bay: 1/2 IN.
b. Maximum in any 20 FT of length: 1/2 IN.
c. Maximum for entire length: 1 IN.

5. Variation in sizes and location of sleeves, floor openings, and wall openings:
a. Maximum of +1/2 IN.

6. Variation in horizontal plan location of beam, column and wall centerlines from required location: Maximum of +1/2 IN.

7. Variation in cross sectional dimensions of columns and beams and in thickness of slabs and walls: Maximum of -1/4 IN, +1/2 IN.

8. Footings and foundations:
a. Variations in concrete dimensions in plan: -1/2 IN, +2 IN.
b. Misplacement or eccentricity:
1) 2 PCT of footing width in direction of misplacement but not more than 2 IN.

c. Thickness:
1) Decrease in specified thickness: 5 PCT.
2) Increase in specified thickness: No limit except that which may interfere with other construction.

9. Variation in steps:
a. In a flight of stairs:
1) Rise: +1/8 IN.
2) Tread: +1/4 IN.

b. In consecutive steps:
1) Rise: +1/16 IN.
2) Tread: +1/8 IN.

10. Establish and maintain in an undisturbed condition and until final completion and acceptance of Project, sufficient control points and bench marks to be used for reference purposes to check tolerances.

11. Regardless of tolerances listed allow no portion of structure to extend beyond legal boundary of Project.
12. To maintain specified tolerances, camber formwork to compensate for anticipated deflections in formwork prior to hardening of concrete.

C. Make forms sufficiently tight to prevent loss of mortar from concrete.

D. Place 3/4 IN chamfer strips in exposed to view corners of forms to produce 3/4 IN wide beveled edges.

E. At construction joints, overlap contact surface of form sheathing for flush surfaces exposed to view over hardened concrete in previous placement by at least 1 IN.
   1. Hold forms against hardened concrete to prevent offsets or loss of mortar at construction joint and to maintain a true surface.
   2. Where possible, locate juncture of built-in-place wood or metal forms at architectural lines, control joints or at construction joints.

F. Where circular walls are to be formed and forms made up of straight sections are proposed for use, provide straight lengths not exceeding 2 FT wide.
   1. Brace and tie formwork to maintain correct position and shape of members.

G. Construct wood forms for wall openings to facilitate loosening, if necessary, to counteract swelling.

H. Anchor formwork to shores or other supporting surfaces or members so that movement of any part of formwork system is prevented during concrete placement.

I. Provide runways for moving equipment with struts or legs, supported directly on formwork or structural member without resting on reinforcing steel.

J. Provide positive means of adjustment (wedges or jacks) of shores and struts and take up all settlement during concrete placing operation.
   1. Securely brace forms against lateral deflection.
   2. Fasten wedges used for final adjustment of forms prior to concrete placement in position after final check.

3.3 REMOVAL OF FORMS

A. No construction loads shall be supported on, nor any shoring removed from, any part of the structure under construction except when that portion of the structure in combination with remaining forming and shoring system has sufficient strength to safely support its weight and loads places thereon.

B. When required for concrete curing in hot weather, required for repair of surface defects or when finishing is required at an early age, remove forms as soon as

concrete has hardened sufficiently to resist damage from removal operations or lack of support.

C. Remove top forms on sloping surfaces of concrete as soon as concrete has attained sufficient stiffness to prevent sagging.
   1. Perform any needed repairs or treatment required on such sloping surfaces at once, followed by curing specified in Specification Section 03300, Cast-in-Place Concrete.

D. Loosen wood forms for wall openings as soon as this can be accomplished without damage to concrete.

E. Formwork for columns, walls, sides of beams, and other parts not supporting weight of concrete may be removed as soon as concrete has hardened sufficiently to resist damage from removal.
   a. For walls of water containing structures, leave forms in place for a minimum of 48 HRS.

F. Where no reshoring is planned, leave forms and shoring used to support weight of concrete in place until concrete has attained its specified 28-day compressive strength and the concrete Modulus of Elasticity has reached a value of (57,000 times the square root of f'c) unless otherwise approved in writing by the Engineer.
   1. Where a reshoring procedure is planned, supporting formwork may be removed when concrete has reached the concrete strength required by the formwork designer's structural calculations.

G. When shores and other vertical supports are so arranged that non-load-carrying form facing material may be removed without loosening or disturbing shores and supports, facing material may be removed when concrete has sufficiently hardened to resist damage from removal.

3.4 RESHORING

A. No construction loads shall be supported on, nor any shoring removed from, any part of the structure under construction except when that portion of the structure in combination with remaining forming and shoring system has sufficient strength to safely support its weight and loads placed thereon.

B. While reshoring is underway, no superimposed dead or live loads shall be permitted on the new construction.

C. During reshoring do not subject concrete in structural members to combined dead and construction loads in excess of loads that structural members can adequately support.

D. Place reshores as soon as practicable after stripping operations are complete but in no case later than end of working day on which stripping occurs.

E. Tighten reshores to carry their required loads without overstressing.

F. Shoring, reshoring and supporting formwork may be removed when concrete has reached the concrete strength required by the formwork designer's structural calculations.

G. For floors supporting shores under newly placed concrete leave original supporting shores in place or reshore.
   1. Reshoring system shall have a capacity sufficient to resist anticipated loads.
   2. Locate reshores directly under a shore position above.

H. In multi-story buildings, extend reshoring over a sufficient number of stories to distribute weight of newly placed concrete, forms, and construction live loads in such a manner that design superimposed loads of floors supporting shores are not exceeded.

3.5 FIELD QUALITY CONTROL

A. Special Inspection:
   1. See Section 01416.
   2. Special Inspection is required for:
      a. Shape, location, and dimensions.
         1) Inspect in accordance with dimensions and details on Drawings
         2) Frequency: Inspect periodically, prior to each concrete pour.

++ END OF SECTION ++

SECTION 03101

QUAKEWRAP SPIRE®+ PANEL SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. This specification is intended to define the minimum requirements and properties of manufactured fiber reinforced polymer (FRP) panels for the purposes of providing impervious corrosion protection barriers plus reinforcing of the existing structure. The patented Sheet Pile Repair (SPiRe®+) system described herein is developed by QuakeWrap, Inc. of Tucson Arizona, USA, and will be referred to as SPiRe®+ hereafter.

B. The SPiRe®+ installation contractor shall provide all labor, materials, tools, and equipment required for the completion of the Work, as shown on the Contract Documents and specified herein:
   1. Prepare existing areas, as defined by these specifications and related Contract Drawings, designated to receive restoration, protection and/or strengthening.
   2. Furnish all panels and install all panels, shoring, bracing, and anchoring.
   3. Prepare installation and placement shop drawings.
   4. Prepare design drawings for shoring and bracing if required.
   5. Furnish all submittals required by this Section of the Specifications.
   6. Coordinate all work with other trades on site.

C. Engineering and design of the SPiRe®+ system shall be provided by QuakeWrap, Inc. or approved licensed civil engineer (P.E.). Engineering design calculations and installation drawings will be provided with the SPiRe®+ panel system.

D. The extent of the SPiRe®+ system covered herein is shown on the plans, elevations, sections and detailed in the Contract Documents and includes:
   1. Attachment to concrete beams
   2. Attachment of anchors through the SPiRe®+ system
   3. Attachment of shoring and bracing

E. The SPiRe®+ Contractor shall cooperate and coordinate with all other trades in executing the work described in the Contract Documents.

1.2 REFERENCES

A. The latest edition and addenda of the following publications in effect on the date of Contract Award are part of this Specification and, where referred to by title or basic designation only, are applicable to the extent indicated by the specific reference:
   1. AMERICAN CONCRETE INSTITUTE (ACI)
      ACI 116 Cement and Concrete Terminology

ACI 117	Specifications for Tolerances for Concrete Construction and Materials, and Commentary
ACI 224.1	Causes, Evaluation, and Repair of Cracks in Concrete Structures
ACI 224	Control of Cracking in Concrete Structures
ACI 440	State-of-the-Art Report on Fiber Reinforced Plastic Reinforcement for Concrete Structures
ACI 440.2	Guide for the Design and Construction of Extremely Bonded Systems for Strengthening of Concrete Structures
ACI 503	Use of Epoxy Compounds with Concrete
ACI 503.4	Standard Specifications for Repairing Concrete with Epoxy Mortars
ACI 503.5	Guide for the Use of Polymer Adhesives in Concrete
ACI 503.6	Guide for the Application of Epoxy and Latex Adhesives for Bonding Freshly Mixed and Hardened Concretes
ACI 546	Concrete Repair Guide

2. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 256	Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics
ASTM D570	Standard Test Method for Water Absorption of Plastics
ASTM D 638	Standard Test Method for Tensile Properties of Plastics
ASTM D 790	Standard Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
ASTM D2583	Standard Test Method for Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor
ASTM D2584	Standard Test Method for Ignition Loss of Cured Reinforced Resins
ASTM D3039	Test Method for Tensile Properties of Polymer Matrix Composite Materials

ASTM D3418	Test Method for Transition Temperatures of Polymers by Differential Scanning Calorimetry
ASTM D4541	Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Tester
ASTM D5224	Standard Practice for Compression Molding Test Specimens of Thermosetting Molding Compounds
ASTM D5687	Guide for Preparation of Flat Composite Panels with Processing Guidelines for Specimen Preparation
ASTM 6153	Standard Specification for Materials for Bridge Deck Waterproofing Membrane System (500 hr. Accelerated Weathering by UV Twin Carbon Arc)
ASTM 7957	Standard Specification for Solid Round Glass Fiber Reinforced Polymer Bars for Concrete Reinforcement
ASTM E 96	Standard Test Methods for Water Vapor Transmission of Materials

3. INTERNATIONAL CONFERENCE OF BUILDING OFFICIALS (ICBO)

AC125	Acceptance Criteria for Concrete and Reinforced and Unreinforced Masonry Strengthening Using Fiber-Reinforced Polymer (FRP) Composite Systems
AC178	Acceptance Criteria for Inspection and Verification of Concrete and Reinforced and Unreinforced Masonry Strengthening Using Fiber Reinforced Polymer (FRP) Composite Systems

4. INTERNATIONAL CONCRETE REPAIR INSTITUTE (ICRI)

IRCI No. 03730	Guide for Surface Preparation for the Repair of Deteriorated Concrete Resulting from Reinforcing Steel Corrosion
IRCI No. 03732	Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays
IRCI No. 03733	Guide for Selecting and Specifying Materials for Repairs of Concrete Surfaces

5. NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM (NCHRP)

NCHRP Report 514	Bonded Repair and Retrofit of Concrete Structures Using FRP Composites (Recommended Construction Specifications and Process Control Manual)

6. SOCIETY OF PROTECTIVE COATINGS (SSPC)

SSPC SP-2	Hand Tool Cleaning
SSPC-SP 6 NACE No. 3	Commercial Blast Cleaning
SSPC SP-12	WJ-2 Surface Preparation and Cleaning of Metals by Water Jetting
SSPC-SP 13/NACE No. 6	Surface Preparation of Concrete
SSPC-SP 15	Commercial Grade Power Tool Cleaning

1.3 SUBMITTALS

A. Submit test results conducted per the ASTM standards as applicable to the project.

B. Submit manufacturer's product data sheet indicating physical, mechanical, structural, and chemical characteristics of SPiRe®+ panel system.

C. Submit product data sheets, ICC ESR reports (as required in Contract Documents) and other technical data for anchors used as defined in section 2.5.

D. Design and Shop Drawings: The following information must be provided and sealed by a professional civil engineer:
   1. Details shall be carried out in accordance with the local building codes, and as shown on Contract Documents.
   2. Shop drawings detailing the SPiRe®+ panel installation and the installation of fill material to be placed in the annular space.
   3. Shop drawings and design calculations for any necessary shoring of the SPiRe®+ panel system to be used.

E. Quality Assurance Documents
   1. Daily installation reports showing air and water temperatures during the placement of the fill material.
   2. Daily installation reports showing lot numbers of FRP laminates, fill materials, and resins used.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS & COMPOSITE STRENGTHENING SYSTEM

A. Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

SPiRe®+ System

QuakeWrap, Inc

6840 S. Tucson Blvd
Tucson, AZ 85756
Phone: (866) QuakeWrap (782-5397) or (520)791-7000
Fax: (520) 791-0600
www.QuakeWrap.com

B. The FRP panel shall be the patented SPiRe®+ as trademarked by QuakeWrap, Inc. (Tucson, Arizona).

C. This will be the only systems permitted, used in accordance with the manufacturer's recommendations, subject to the requirements of the plans and this specification. Alternate systems using FRP panels would violate US patent laws.

D. Quality Control Testing and Certification: Manufacturer shall certify that the fiber reinforced panels conform to this specification and shall maintain records of testing. Each project consisting of greater than 5000 square feet of fiber reinforced panels shall have testing done for the following panel attributes:
   1. Visual Inspection for:
      a. Thickness
      b. Panel imperfections
      c. Dimensions
      d. Color
   2. Ultimate Flexural Capacity, ksi - ASTM D 796
   3. Barcol Hardness - ASTM D2583

E. Labeling, packaging, and storage shall include any health hazard warnings, precautions for handling and recommended first aid procedures in case of contact.

F. All materials used shall conform to this specification and other specifications referenced within and subject to the approval of the Engineer.

G. Design Loads: The SPiRe®+ system shall be designed for the following loads as they apply for the specific site conditions:
   1. Hydrostatic pressure of grout (cementitious and/or epoxy) placement
   2. Anchorage/connection forces
   3. Any permanent or temporary bracing required

2.2 SPiRe®+ PANEL SYSTEM

A. The FRP system shall be comprised of E-glass Fiberglass with a vinyl ester resin that provides strength in both longitudinal and transverse directions.

B. The FRP panels are designed to serve as structural reinforcement for the repair system and must be properly bonded to the fill material to serve the intended purpose. This shall be achieved by the following:
   1. The FRP panels must include T profile for mechanical locking to the fill material. The T profiles must be an integral part of the panels built monolithically during the manufacturing process. Epoxy bonding T profiles to flat panels is not permitted.
   2. The T profiles must be spaced no more than 4 in. (100 mm) apart.
   3. The flange of the T profiles shall be 1.5 in.(38mm) wide minimum to ensure adequate locking of the T profile within the filler material.
   4. The inside surface of the FRP panels and T profiles must be coated with epoxy and grit to ensure full bonding of the panel to the fill material.
   5. The T profile, being the reinforcing element for this system, its cross sectional area mut be no less than 40% of the total cross sectional area of the panel.

C. The FRP panels must include UV inhibitor in the resin matrix as an integral part of manufacturing to ensure longevity of the system. Products that are coated with a

D. The SPiRe®+ system shall have the minimum properties listed in the table below.

SPiRe®+ System Properties		
Property	**Standard**	**Value**
Panel Width		36 in. (914 mm)
Wall Thickness		0.2 in. (5mm)
Minimum Ultimate Tensile Strength (Longitudinal Direction)	ASTM D 638	30 ksi 207 MPa
Minimum Tensile Modulus of Elasticity (Longitudinal Direction), ksi	ASTM D 638	2,490 ksi 17.2 GPa
Minimum Ultimate Tensile Strength (Transverse Direction), ksi	ASTM D 638	1.9 ksi 5.5 GPa
Minimum Tensile Modulus of Elasticity (Transverse Direction), ksi	ASTM D 638	797
Barcol Hardness	ASTM D 2583	30 min.
IZOD Impact (notched), ft-lbf./in	ASTM D 256	15

Maximum Water Absorption	ASTM D 570	< 1%
Ultraviolet (UV) Accelerated Weathering Test (500 hours Twin Carbon Arc)	ASTM 6153	Pass
Standard Color (options available)		Grey

2.3 ADHESIVE RESIN

A. The adhesive resin shall be a two-component high-strength structural epoxy adhesive designed for underwater applications. It shall have an immediate high tack consistency both in air and water and shall trowel easily.

B. The adhesive resin shall be a 100% solids formulation with low toxicity and low odor during cure.

2.4 FILL MATERIAL

A. CAST-IN-PLACE CEMENTITIOUS AND EPOXY GROUT per QuakeWrap, Inc. Specification Section 03 30 12 for grouts permitted for use with the SPiRe®+ system.

2.5 ANCHORS

A. Anchors are project specific and part of the Engineering Design and shall be identified on the Contract Documents. No substitutions are permitted without approval by the design engineer and product manufacturer.

B. Anchors are used to support the panel system and shoring during construction and to create and maintain an annulus between panel and adjacent wall structure. Anchors must maintain annular space appropriate to the requirements of the fill material by using spacers additional nuts and washers appropriate for the application. Prior to installation in the field, all anchors shall be inspected to ensure the anchor is free of any damage.
   1. Threaded Steel Rod
      a. Galvanized - ASTM A320, Grade 7, hot dipped galvanized per ASTM F2329, Fy=105 ksi (720 MPa)
      b. Stainless Steel – ASTM A320, AISI SS 316, Fy=105 ksi (720 MPa)
      c. Nuts and washers shall match threaded rod specifications.
      d. Threaded steel rod set into existing concrete shall be set with an approved epoxy. See Contract Documents for additional information.
   2. Self-Tapping Steel Screws
      a. Galvanized – ASTM A449, Grade 7, hot dipped galvanized per ASTM F2329, Fy=105 ksi (720 MPa)
      b. Stainless Steel – Hex head, ASTM A193, 410 SS self-tapping screw.
      c. Washers shall be made of FRP and matching the color of the FRP panels.

d. Nuts shall match steel screw specifications.

3. Fiberglass Threaded Rod
   a. Rod shall be manufactured by a licensed ISO certified facility.
   b. Minimum properties:
      1) Compressive Strength – 60,000 psi (410 MPa) per ASTM D695
      2) Flexural Strength – 50,000 psi (345 MPa) per ASTM D790
      3) Ultimate Tension – 4,500 lbs (20 kN)
      4) Minimum diameter – ¾ inch (19mm)
   c. Nuts and washers shall match threaded rod specifications.
4. Concrete Screws
   a. Stainless Steel – Hex head, stainless steel Type 316
   b. Washers shall match concrete screw rod specifications.
   c. See Contract Documents for additional information.

2.6 REINFORCING MATERIAL

A. Fiber Reinforced Polymer (FRP) Reinforcing Bars
   1. The reinforcing fibers shall be E-CR glass fibers (corrosion resistant).
   2. The fiber content by weight shall be greater than or equal to 70% by weight per ASTM D2584.
   3. The reinforcing matrix shall be vinyl ester resin.
   4. Prior to installation in the field, all reinforcing bars shall be inspected to ensure the bar is free of any damage.

B. Reinforcing Steel
   1. The reinforcing material shall be Grade 60 steel conforming to ASTM A615
   2. The reinforcing steel shall be epoxy coated and conform to ASTM A775
   3. Prior to installation in the field, all reinforcing steel shall be inspected to ensure the epoxy coating is free of any damage.
   4. Epoxy coat the ends of rebar that have been cut in the field.

PART 3 - EXECUTION

3.1 GENERAL PROCEDURES

A. QuakeWrap, Inc. shall design the SPiRe®+ panel to meet the structural performance requirements indicated in Contract Documents. The design of the SPiRe®+ panel shall follow basic mechanics of materials principals.

3.2 SURFACE PREPARATION – GENERAL

A. The Contractor shall expose and inspect surfaces to be protected with the SPiRe®+ system. Inspection shall check the location and inspect for corrosion, deterioration, cracking and general condition of the steel, concrete, and/or wood surfaces.

B. The Contractor shall examine the existing conditions to identify potential obstructions and constraints; shall verify dimensions, geometry and access locations; and shall map all visible items of concern.

C. here an adhesive bond is required, the surface preparation shall also promote continuous intimate contact between SPiRe®+ and base material by providing a clean, and smooth surface.

D. Contractor shall notify project engineer of existing structural deterioration, apparent distress, or compromised sheet piles that exceed the scope of the repair.

3.3 SURFACE PREPARATION – MATERIAL SPECIFIC

A. Concrete Surface Preparation
   1. Contractor shall remove any marine growth or any soft surface layer that has accumulated on the concrete wall as stated below.
      a. All loose and deteriorated concrete shall be removed using hydraulic or air pressurized hand tools.
      b. The concrete surface to which SPiRe®+ panel system is to be applied should be exposed and free of loose or unsound materials.
      c. All loose deleterious material and marine growth shall be removed to a profile no greater than 1/4- inch shell base.
      d. All concrete surfaces where SPiRe®+ panels are directly epoxy bonded to the concrete, must be prepared to Concrete Surface Profile (CSP) 2 or higher.
      e. For applications where new concrete or grout will be placed in direct contact with existing concrete, AND the SPiRe®+ panels are contributing to the structural capacity of the system, the existing concrete must be prepared to a CSP-6 or higher.

B. Steel Surface Preparation
   1. Contractor shall remove any marine growth or any soft surface layer that has accumulated on the steel sheet piles as stated below.
      a. All loose and rusted steel shall be removed using hydraulic or air pressurized hand tools.
      b. All loose deleterious material and marine growth shall be removed to a profile no greater than 1/4- inch shell base.
      c. All steel surfaces receiving SPiRe®+ panel system shall be cleaned using pressure water jetting conforming to SP WJ-4 as described in SSPC-SP 12/NACE No. 5.
      d. For applications where epoxy grout will be placed in direct contact with existing steel, AND the SPiRe®+ panels are contributing to the structural capacity of the system, the steel surface shall be cleaned to SP WJ-2.

C. Wood Surface Preparation

1. Contractor shall remove any marine growth or any soft surface layer that has accumulated on the wood timber wall.
    a. All timber scheduled to receive SPiRe®+ panel system shall be cleaned using low pressure washing or other mechanical means to remove marine growth, any soft layer that has accumulated and other contaminants.
    b. Precautions must be taken to not remove any intact timber during the surface preparation.

3.4 ELAPSED TIME AFTER CLEANING

A. The elapsed time between cleaning of the surface and the installation of the SPiRe®+ panels and fill material shall not exceed 7 days unless approved by EOR or product manufacturer.

B. Contractor shall remove any marine growth that has accumulated on the surface prior to placement of fill material.

3.5 DEBRIS AND DUST CONTAINMENT

A. Proper care shall be taken to contain and remove dust and debris. Such containment and extraction shall be dictated by the specific requirements of the site. Consideration should be made for enclosed areas, areas where falling debris is possible, and areas where dust and debris may inhibit the function of adjacent equipment, processes, and/or daily practices. All areas are to be properly ventilated. Walkways and paths of ingress and egress shall be kept free of dust and debris.

3.6 STORAGE, HANDLING, AND DISPOSAL

A. Storage Requirements
    1. All components of the SPiRe®+ system must be delivered and stored in the original factory-sealed, unopened packaging or in containers on pallets with proper labels identifying the manufacturer, brand name, system identification number, and date. All components must be protected from dust, moisture, chemicals, direct sunlight, physical damage, fire, and temperatures outside the range specified in the system data sheets. Any component that has been stored in a condition different from that stated above must be disposed of, as specified in Section 3.6 G.

B. Shelf Life
    1. All resins and adhesives, that have been stored longer than the shelf life specified on the system data sheet shall not be used and must be disposed of, as specified in Section 3.6 G. All other components of the SPiRe®+ system, such as the panels, fasteners, do not have an expiration date or shelf life.

C. Handling
    1. All components of the SPiRe®+ system, especially FRP panels, must be handled with care according to the manufacturer recommendations to protect them from damage,

breakage of the panels by pulling, separating, or stacking. Panels shall be stacked dry to prevent damage. Items shall not be stacked on panels that could create bowing, cracking, indentation, damage of finish or puncture of panels.

D. Safety Hazards
   1. All components of the SPiRe®+ system, especially resins and adhesives, must be handled with care to avoid safety hazards, including but not limited to skin irritation and sensitization and breathing vapors and dusts. Mixing resins shall be monitored to avoid firming and flammable vapors, fire hazards, or violent boiling. The Contractor is responsible for ensuring that all components of the SPiRe®+ system at all stages of work conform to the local, state, and federal environmental and worker's safety laws and regulations. The Contractor is advised that a forced ventilator system may be required inside enclosed sections and that provision for ventilation, if any, shall be included in the cost of the work.

E. Safety Data Sheets
   1. The SDS for all components of the SPiRe®+ system shall be accessible to all at the project site. Specific handling hazards and disposal instructions shall be specified in the SDS. The Contractor is responsible for providing the proper means of protection for safety of the personnel and the workplace. The Contractor shall inform the personnel of the dangers of inhaling fumes of primer, putty, or resin and shall take all necessary precautions against injury to personnel. The resin mixing area shall be well vented to the outside.

F. Clean-Up
   1. The Contractor is responsible for the cleanup of the equipment and the project site from hazardous and aesthetically undesirable SPiRe®+ components using appropriate solvents, as recommended in the system data sheet.

G. Disposal
   1. Any component of the SPiRe®+ system that has exceeded its shelf life or pot life or has not been properly stored, as specified in Section 3.5 A, and any unused or excess material that is deemed waste shall be disposed of in a manner amiable to the protection of the environment and consistent with the SDS and local ordinances.

3.7 INSTALLATION OF SPiRe®+ SYSTEM

A. Surface preparation for installation of SPiRe®+ flat and formed panels shall follow the procedure outlined in Sections 3.2 and 3.3.

B. Environmental Conditions
   1. Environmental conditions for installation shall be examined before and during installation of the SPiRe®+ system to ensure conformity to the Contract Documents and manufacturer's recommendations.

C. Equipment

1. The Contractor shall provide all necessary equipment in sufficient quantities and in clean operating conditions for continuous uninterrupted SPiRe®+ installation.

D. Attaching SPiRe®+ System
   1. The system may be affixed to the surface by means of mechanical anchoring concrete screws, "J"-bolts, soil screws, or other mechanical fasteners, as indicated on the Contract Drawings and Engineering Design.
   2. If necessary, spacers can be installed against the base material surface to maintain the desired annular space between the surface and the SPiRe®+ panel.

E. Sealing SPiRe®+ System Prior to Grout Installation
   1. The SPiRe®+ system shall be sealed where required to ensure no leaks and loss of grout during grout placement and curing. Methods to seal the bottom shall be as indicated on the Contract Documents or may be an approved alternate proposed by the contractor, such as backer rod, soil embedment, or other systems. The contractor is responsible to ensure that leakage and blowout does not occur.
   2. A bottom plug shall be part of the sealing of the base of the SPiRe®+ system, with a minimum of six (6) inches (150mm) of epoxy grout or as detailed in the Contract Documents. The bottom plug shall be cured enough to support the weight of the concrete placed during the grouting sequence.

F. Shoring
   1. Proper shoring should be used to resist the force of the hydrostatic pressure from the grout (140 pcf (2240 kg/m^3) for normal weight grout) during placement. Strong backs should be designed to allow for a hydraulic head pressure to facilitate the placement of the grout in lifts not to exceed four (4) feet (1.2m) in height or as designated on the Contract Drawings. Shoring may be removed after the grout has reached the required design strength or in seven (7) days.
   2. Shoring may not be required for light-weight fill material, such as light-weight grout, or injected foams. The Contract Documents or delegated shoring design shall account for specific fill material selected.
   3. Other shoring designs provided by the Contractor or Engineer of Record shall be approved by the product manufacturer for the intended use and panel design properties.

G. Epoxy Grout
   1. CAST-IN-PLACE CEMENTITIOUS AND EPOXY GROUT per QuakeWrap, Inc. Specification Section 03 30 12 for grouts permitted for use with the SPiRe®+ system. Epoxy grout shall be placed in lifts not to exceed twelve (12) inches (300 mm) or as specified in the Contract Documents.
      1. Any mixed epoxy grout that exceeds its pot life shall be disposed of according to Section 3.6 G.
      2. Epoxy grout should be poured in lifts to ensure full encapsulation, with consideration to the alignment and flatness tolerances of the SPiRe®+ system

and capacity of the sealing system. The epoxy grout shall be allowed to cure per the manufacturer's material data sheet.

H. Grout
   1. CAST-IN-PLACE CEMENTITIOUS AND EPOXY GROUT per QuakeWrap, Inc. Specification Section 03 30 12 for grouts are permitted for use with the SPiRe®+ system. Grout shall be placed in lifts not to exceed four (4) feet (1.2 m) or as specified in the Contract Documents.

I. Damaged Panels and Products
   1. Panels or products damaged during the installation may not be installed. Handle products in a manor to protect the finishes, edges, protruding T profiles and structural integrity of the panel.

3.8 INSPECTION & QUALITY ASSURANCE (QA)

A. A project specific QA plan shall be developed from the tests identified in this section. All inspections and tests in this section will be performed by a trained inspector acting on behalf of the project owner/manager for QA of the project in the presence of the Contractor and the Engineer. The Contractor may have its own inspector for Quality Control.
   1. Inspection of Materials
      a. The manufacturer's certifications for all delivered and stored FRP components will be inspected for conformity to the contract documents before starting the project.
   2. Daily Inspection
      a. Daily inspection reports shall include date and time of installation; ambient temperature; relative humidity; general weather conditions; qualitative description of surface cleanliness; batch numbers of adhesives.
   3. Testing of the fill material materials as specified for conformance to Contract Documents.
   4. It is recommended that a manufacturer representative be retained to provide periodic site visits for the inspection of the installation for conformance to the manufacturer's specifications.

3.9 REPAIR OF DEFECTS

A. Contact the Engineer of Record and/or product manufacturer for defects that occur during installation to review specific conditions and repair options. Modifications, repairs or alterations to the products by the contractor or other persons is strictly prohibited and nullifies any warranties and/or guarantees.

3.10 PROJECT CLOSE-OUT AND MAINTENANCE

A. Documentation of the Work

1. The Owner may provide specification language requiring documentation of the work be prepared and submitted by the Contractor on completion of the work. The documentation shall include the following:
    a. Information on the products and installation method used
    b. Pre- and post-inspection results
    c. Test results
    d. Any changes or deviations from the contract documents and possible corrective work
2. Owner's Inspector may also prepare documentation of the project and include the following:
    a. Purchaser's/Inspector's tests and reports
    b. Material test reports
    c. Field test reports
    d. As-built drawings of the renewed or strengthened segments

B. Verification/Basis for Rejection
    1. Materials not complying with the requirements of this specification shall be rejected. Repairs, replacements, and retesting shall be accomplished in accordance with the Owner's documents.

C. Certificate of Compliance
    1. The Owner may require an affidavit from the Manufacturer or Contractor, as applicable, that the material provided, or the installation performed complies with the applicable requirements of the specifications provided herein.

PART 4 - WARRANTY

A. The SPiRe®+ system shall provide a two-year material warranty against defects. Extended material warranties may be available upon request provided separately by the product manufacturer for additional fees that may require periodic site inspection and/or maintenance.

B. The Contractor shall provide a one-year warranty on the labor used for installation of the SPiRe®+ system. Any defects affecting structural and hydraulic performance of the SPiRe®+ system shall be repaired by the Contractor at no cost to the Owner.

C. Cosmetic defects such as discoloration and minor undulations do not need to be repaired and are excluded from the warranty. Any damage caused by direct impact or loads that are substantially higher than the normal operation is not covered by the warranty. The Owner will provide all required access to the area to be repaired under this warranty.

++ END OF SECTION ++

SECTION 03200

CONCRETE REINFORCEMENT

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
   1. Provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install concrete reinforcement.
   2. The extent of concrete reinforcement is shown.
   3. The Work includes fabrication and placement of reinforcement including bars, ties and supports, and welded wire fabric for concrete, encasements and fireproofing.

1.2 QUALITY ASSURANCE

A. Reference Standards: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified:
   1. ASTM A82, Specification for Steel Wire, Plain, for Concrete Reinforcement.
   2. ASTM A184, Specification for Fabricated Deformed Steel Bar Mats for Concrete Reinforcement.
   3. ASTM A185, Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.
   4. ASTM A496, Specification for Steel Wire, Deformed, for Concrete Reinforcement.
   5. ASTM A497, Specification for Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement.
   6. ASTM A615, Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
   7. ASTM A706, Specification for Low-Alloy Steel Deformed Bars for Concrete Reinforcement.
   8. ASTM A775, Specification for Epoxy-Coated Reinforcing Steel Bars.
   9. ASTM A1022, Standard Specification for Deformed and Plain Stainless Steel Wire and Welded Wire for Concrete Reinforcement.
   10. ASTM A1064, Standard Specification for Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
   11. ACI 117, Specification for Tolerances for Concrete Construction and Materials.
   12. ACI 315, Manual of Standard Practice for Detailing Reinforced Concrete Structures.
   13. ACI 318, Building Code Requirements for Structural Concrete.
   14. ACI 350, Code Requirements for Environmental Engineering Concrete Structures.
   15. ACI SP66, Detailing Manual.
   16. ANSI/AWS D1.4, Structural Welding Code - Reinforcing Steel.

17. CRSI 1MSP, Concrete Reinforcing Steel Institute (CRSI) Manual of Standard Practice.

B. Allowable Placing Tolerances: Comply with ACI 350, Chapter 7 - Details of Reinforcement except as specified below:
   1. Concrete surfaces which are in contact with liquids: 2-inches minimum coverage.

1.3 SUBMITTALS

A. Shop Drawings: Submit for approval the following:
   1. Manufacturer's specifications and installation instructions for all materials and reinforcement accessories. Comply with the requirements of Section 01300, Submittals.
   2. Drawings for fabrication, bending, and placement of concrete reinforcement. Comply with ACI 315, Parts A and B. For walls, show elevations to a minimum scale of 1/4-inch to one foot. For slabs, show top and bottom reinforcing on separate plan views. Show bar schedules, stirrup spacing, diagrams of bent bars, arrangements and assemblies, as required for the fabrication and placement of concrete reinforcement unless otherwise noted. Splices shall be kept to a minimum. Splices in regions of maximum tension stresses shall be avoided whenever possible.
   3. Shop Drawings shall be in sufficient detail to permit installation of reinforcing without reference to Contract Drawings.
      a. Shop Drawings shall not be prepared by reproducing the plans and details indicated on the Contract Drawings but shall consist of completely redrawn plans and details as necessary to indicate complete fabrication and installation of all reinforcing steel.
      b. Where multiple types of supports for reinforcing steel (such as chairs, runners, bolsters, and other types of supports) will be used in the Work, clearly indicate on the Shop Drawings the support types and materials of supports.
   4. Drawings detailing the location of all construction and expansion joints as required under Section 03251, Concrete Joints, shall be submitted and approved before Shop Drawings for reinforcing steel are submitted.
   5. Description of reinforcing weld locations and weld procedures.

B. Certificates:
   1. Submit one copy of steel producer's certificates of mill analysis, tensile and bend tests for reinforcing steel.
   2. Submit certification of welders and weld procedures for splices in accordance with ANSI/AWS D1.4 requirements.

1.4 DELIVERY, HANDLING AND STORAGE

A. Deliver concrete reinforcement materials to the site bundled, tagged and marked. Use metal tags indicating bar size, lengths, and other information corresponding to

markings shown on placement diagrams. Comply with the requirements of Section 01640, Materials and Equipment.

B. Store concrete reinforcement material at the site to prevent damage and accumulation of dirt or excessive rust. Store on heavy wood blocking so that no part of it will come in contact with the ground. Comply with the requirements of 01640, Materials and Equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Reinforcing Bars: ASTM A 615, and as follows:
   1. Provide Grade 60, deformed, for all bars, unless indicated otherwise.

B. Reinforcing Bars to be Welded: ASTM A706, Grade 60, deformed.

C. Mechanical Couplers: Reinforcement bars may be spliced with a mechanical connection. This connection shall be a full mechanical connection which shall develop in tension or compression, as required, at least 125 percent of specified yield strength (fy) of the bar being spliced in accordance with ACI 318.
   1. Acceptable Manufacturers:
      a. Lenton Rebar Splicing by Erico, Inc.
      b. Richmond dowel bar splicer system by Richmond Screw and Anchor Co., Inc.
      c. Bar-Grip Systems by Barsplice Products, Inc.

D. Steel Wire: ASTM A 82.

E. Welded Wire Reinforcement: ASTM A1064 or ASTM A1022 where noted on Drawings.
   1. Furnish in flat sheets, not rolls.

F. Supports for Reinforcement: Bolsters, chairs, spacers and other devices for spacing, supporting and fastening reinforcement in place.
   1. Use wire bar type supports complying with CRSI “Manual of Standard Practice” recommendations, except as specified below. Do not use wood, brick, or other unacceptable materials.
   2. For slabs on grade, use precast concrete blocks, 4-inch square in plan, with embedded tie wire as specified by CRSI, “Manual of Standard Practice”. The precast concrete blocks shall have the same or higher compressive strength as specified for the concrete in which they are located.
   3. For all concrete surfaces, where legs of supports are in contact with forms, provide supports complying with CRSI "Manual of Standard Practice" as follows:

a. At formed surfaces in contact with soil, weather, or liquid or located above liquid, supports shall be CRSI Class 1 for maximum protection. The plastic coating on the legs shall extend at least 1/2-inch upward from the form surface.
b. At interior dry surfaces (not located above liquid), supports shall be either Class 1 or Class 2 for moderate protection.
c. At formed surfaces with an architectural finish, use stainless steel protected legs (Type B).

4. Over waterproof membranes, use precast concrete chairs.

G. Drilled Dowels

1. Drilled dowels shall consist of reinforcing bars anchored with an adhesive system into hardened concrete or grout filled masonry. The adhesive system shall use a two-component adhesive mix and shall be injected with a static mixing nozzle following manufacturer's written instructions. The embedment depth of the reinforcing bar shall provide minimum allowable bond strength no less than the allowable tensile capacity of the reinforcing bar, unless shown otherwise on the Drawings.
2. Drilled dowel anchoring systems shall have ultimate capacity no less than 125 percent of the yield strength of the reinforcing steel at an embedment of 12 bar diameters.
3. For additional information, see Section 03252, Anchorage in Concrete.
4. Product and Manufacturer: Provide one of the following:
   a. HIT-RE 500-V3 Epoxy Adhesive Anchor System, by Hilti Inc.
   b. Or equal.

2.2 FABRICATION

A. General: Fabricate reinforcing bars to conform to required shapes and dimensions, with fabrication tolerances complying with CRSI, "Manual of Standard Practice". In case of fabricating errors, do not re-bend or straighten reinforcement in a manner that will injure or weaken the material.

B. Unacceptable Materials: Reinforcement with any of the following defects will not be permitted in the Work:

1. Bar lengths, bends, and other dimensions exceeding specified fabrication tolerances.
2. Bends or kinks not shown on approved Shop Drawings.
3. Bars with reduced cross-section due to excessive rusting or other cause.

C. Ship reinforcing to jobsite with attached plastic or metal tags.

1. Place on each tag the mark number of the reinforcing corresponding to the mark number indicated on the Shop Drawing.
2. Mark numbers on tags to be so placed that the numbers cannot be removed.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine the substrate and the conditions under which concrete reinforcement is to be placed, and notify ENGINEER, in writing, of unsatisfactory conditions. Do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to ENGINEER.

3.2 INSTALLATION

A. Comply with the applicable recommendations of specified codes and standards, and CRSI, "Manual of Standard Practice", for details and methods of reinforcement placement and supports.

B. Clean reinforcement to remove loose rust and mill scale, earth, ice, and other materials which reduce or destroy bond with concrete.

C. Position, support, and secure reinforcement against displacement during formwork construction or concrete placement operations. Locate and support reinforcing by metal chairs, runners, bolsters, spacers and hangers, as required.
   1. Place reinforcement to obtain the minimum concrete coverages as shown and as specified in ACI 350. Arrange, space, and securely tie bars and bar supports together with 16 gage wire to hold reinforcement accurately in position during concrete placement operations. Set wire ties so that twisted ends are directed away from exposed concrete surfaces.
   2. Prior to placement of concrete, demonstrate to ENGINEER that the specified cover of reinforcement has been attained, by using a surveying level or string line.
   3. Reinforcing steel shall not be secured to forms with wire, nails or other ferrous metal. Metal supports subject to corrosion shall not touch formed or exposed concrete surfaces.

D. Install welded wire fabric in as long lengths as practical. Lap adjoining pieces at least one full mesh and lace splices with 16-gage wire. Do not make end laps midway between supporting beams, or directly over beams of continuous structures. Offset end laps in adjacent widths to prevent continuous laps.

E. Provide sufficient numbers of supports of strength required to carry reinforcement. Do not place reinforcing bars more than 2-inches beyond the last leg of any continuous bar support. Do not use supports as bases for runways for concrete conveying equipment and similar construction loads.

F. Lap Splices:
   1. Provide standard reinforcement splices by lapping ends, placing bars in contact, and tying tightly with wire. Comply with requirements shown for minimum lap of spliced bars, shall be as shown on the Drawings.

G. Mechanical Couplers:
   1. Mechanical butt splices shall be in accordance with the recommendation of the manufacturer of the mechanical splicing device. Butt splices shall develop 125 percent of the specified minimum yield tensile strength of the spliced bars or of the smaller bar in transition splices. Bars shall be flame dried before butt splicing. Adequate jigs and clamps or other devices shall be provided to support, align, and hold the longitudinal centerline of the bars to be butt spliced in a straight line.

H. Welded Splices
   1. When permitted by the ENGINEER, in writing, all welding of reinforcing bars shall conform to ANSI/AWS D1.4. Preheating and rate of cooling requirements shall be based on bar steel chemistry and ANSI/AWS D1.4 requirements. Welded splices shall be sized and constructed to transfer a minimum of 125 percent of the specified minimum yield tensile strength of the spliced bars or of the smaller bar in transition splices. Unless otherwise permitted by the Engineer, welding of crossing bars (tack welding) for assembly of reinforcement is prohibited.
   2. Welding of wire to wire, and of wire or welded wire fabric to reinforcing bars or structural steels, shall conform to applicable provisions of ANSI/AWS D1.4 and any supplementary requirements by the ENGINEER for the particular application.
   3. After completion of welding on coated reinforcing bars, coating damage shall be repaired as specified herein. All welds and all steel splice members when used to splice bars shall be coated with the same material used for repair of coating damage.

I. Drilled Dowels
   1. Drilled dowels shall be reinforcing dowels set in a resin adhesive in a hole drilled into hardened concrete.
   2. Holes shall be drilled to the adhesive anchor system manufacturer's recommended diameter and depth to develop the required pullout resistance but shall not be greater in diameter than 1/4-inch more than the nominal bar diameter nor less than 12 times the nominal bar diameter in depth.
   3. The hole shall be drilled by methods which do not interfere with the proper bonding of the resin. Only masonry type drill bits shall be used.
   4. Existing reinforcing steel in the vicinity of proposed holes shall be located prior to drilling. The location of holes to be drilled shall be adjusted to avoid drilling through or nicking any existing reinforcing bars only after approval by the ENGINEER.
   5. The hole shall be brushed (non-metallic bristle brush only) and blown clean with clean, dry compressed air to remove all dust and loose particles.
   6. Resin shall be injected into the hole through the injection system-mixing nozzle (and any necessary extension tubes) placed to the bottom of the hole. The discharge end shall be withdrawn as resin is placed but kept immersed to

prevent formation of air pockets. The hole shall be filled to a depth that ensures that excess material is expelled from the hole during dowel placement.

7. Dowels shall be twisted during insertion into the partially filled hole so as to guarantee full wetting of the bar surface with resin. The bar shall be inserted slowly enough to avoid developing air pockets.
8. For additional information, see Section 03252, Anchorage in Concrete.

3.3 INSPECTION OF REINFORCEMENT

A. Reinforcement Congestion and Interferences:
   1. Notify Engineer whenever the specified clearances between bars cannot be met.
   2. Do not place any concrete until the Engineer submits a solution to reinforcing congestion problem.
   3. Reinforcing may be moved as necessary to avoid interference with other reinforcing steel, conduits, or embedded items.
   4. If bars are moved more than one bar diameter, obtain Engineer's approval of resulting arrangement of reinforcing.
   5. No cutting of reinforcing shall be done without written approval of Engineer.

B. Concrete shall not be placed until the reinforcing steel is inspected and permission for placing concrete is granted by ENGINEER. All concrete placed in violation of this provision will be rejected.

C. Formwork for walls and other vertical members will not be closed up until the reinforcing steel is inspected and permission for placing concrete is granted by ENGINEER. All concrete placed in violation of this provision will be rejected.

D. Testing of Drilled Dowels:
   1. Employ the services of an independent testing laboratory to perform field quality testing of installed drilled dowels. A minimum of 10 percent (but no less than 15 dowels) shall be chosen at random by the testing laboratory and confirmed by the ENGINEER. Unless otherwise directed by the ENGINEER, drilled dowels shall be tensioned to twice the manufacturer’s rated capacity of the anchor. Where dowels are located less than eight dowel diameters from the edge of concrete the ENGINEER will determine the tensile load required for the test.
   2. Provide access for the testing agency to places where Work is being produced so that required inspection and testing can be accomplished.
   3. CONTRACTOR shall be responsible for the failure of any drilled dowel. If any dowel fails, the testing shall be increased to 100 percent.
   4. Correct improper workmanship, remove and replace, or correct as directed by the ENGINEER, all drilled dowels found unacceptable or deficient, at no additional cost to the OWNER.
   5. Pay for all corrections and subsequent tests required to confirm the integrity of the drilled dowels.

6. The independent testing and inspection agency shall complete a report for each area. The report shall summarize the observations made by the Inspector and be submitted to the ENGINEER.
7. For additional information, see Section 03252, Anchorage in Concrete.

E. Inspection of Welded Splices: Employ a testing agency to perform field quality control testing of the welded splices. All welded splices shall be visually inspected. A minimum of five percent of butt splice welds shall be radiographically tested. Any weld which is deficient in any way shall be repaired to be completely sound at the CONTRACTOR'S expense.

F. Special Inspection:
1. See Section 01416.
2. Special Inspection is required for:
   a. Reinforcing size, spacing, lap length and concrete cover.
      1) Inspect in accordance with Drawings and Specification.
      2) Frequency: Inspect prior to each concrete pour.
   b. Drilled dowel adhesive anchoring system:.
      1) Inspect in accordance with ICC-ES report.
      2) Frequency:
         a) Inspect all adhesive anchors for the first 4 HRs of installation.
         b) Inspect approximately 25 PCT of adhesive anchors thereafter.
         c) Additional inspection will be required for different installer or if the quality of installation appears to vary.
   c. Mechanical splices.
      1) Inspect in accordance with ICC-ES report.
      2) Frequency:
         a) Inspect all mechanical splices prior to placing concrete.
         b) Inspect approximately 25 PCT of mechanical splices thereafter.
         c) Additional inspection will be required for different installer or if the quality of installation appears to vary.

++ END OF SECTION ++

SECTION 03251

CONCRETE JOINTS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
   1. Provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install concrete joints.
   2. The types of concrete joints required include the following:
      a. Construction joints.
      b. Expansion joints.
      c. Control joints.
      d. Isolation joints.
      e. Waterstops.

B. General: All joints subject to hydrostatic pressure or in contact with soil, except non-water bearing slabs-on-grade, shall be provided with continuous waterstop.

1.2 QUALITY ASSURANCE

A. Standard Specifications Details:
   1. Conform all applicable requirements of Sections No. 505 and 729 of the Uniform Standard Specifications for Public Works Construction by the Maricopa Association of Governments (MAG) as supplemented by the City of Phoenix. Where there is a conflict between MAG Standard Specifications and the Project Specifications, provisions of the Project Specifications shall govern.

B. Reference Standards: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified:
   1. ACI 301, Standard Specifications for Structural Concrete.
   2. ASTM C 920, Standard Specification for Elastomeric Joint Sealants.
   3. ASTM D 412, Test Methods for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers-Tension.
   4. ASTM D 471, Standard Test Method for Rubber Property—Effect of Liquids.
   5. ASTM D 624, Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers.
   6. ASTM D 994, Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type).
   7. ASTM D 1056, Standard Specification for Flexible Cellular Materials-Sponge or Expanded Rubber.
   8. ASTM D 1751, Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).

9. ASTM D 1752, Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
10. ASTM D 2240, Test Method for Rubber Property – Durometer Hardness.
11. CRD-C572, U.S. Army Corps of Engineers Specifications for Polyvinyl-Chloride Waterstop.

C. All manufactured items shall be installed in accordance with manufacturer's instructions.

1.3 SUBMITTALS

A. Shop Drawings: Submit for approval the following:
1. Comply with the requirements of Section 01300, Submittals.
2. Manufacturer's specifications and installation instructions for all materials required.
3. Layout of all construction and expansion joint locations prior to the submittal of steel reinforcement Shop Drawings.
4. Drawing indicating location, size and type of prefabricated waterstop joints.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

A. All materials used for joints in concrete shall be stored on platforms or in enclosures and covered to prevent contact with the ground and exposure to the weather and direct sunlight. Storage and handling requirements of the manufacturer shall also be followed.

PART 2 - PRODUCTS

2.1 GENERAL

A. Subject to compliance with the Contract Documents, the manufacturers listed in this article are acceptable.

2.2 WATERSTOPS, PVC TYPE

A. Acceptable manufacturers:
1. Sika Greenstreak Plastic Products.
2. Or equal.

B. Materials:
1. Virgin polyvinyl chloride compound not containing scrap or reclaimed materials or pigment.
2. Cast-in-place type: USACE CRD-572.
3. Approved profiles as listed.
a. Construction joints:
1) Ribbed: 6 inches wide by 3/8 inch.

2) Sika Greenstreak Plastic Products Style #679, or equal.

b. Control joints:
   1) 6-inch wide by 3/8 inch thick with ribs and center bulb.
   2) Sika Greenstreak Plastic Products Style #705, or equal.

c. Expansion joints:
   1) 9 inches wide by 3/8 inch thick w/ 1 1/8" outside diameter center u-bulb (tear web).
   2) Sika Greenstreak Plastic Products Style #700, or equal.

4. Provide factory-made waterstop fabrications at all changes in direction, intersections and transitions, leaving only straight butt splices for the field. Butt welds to be a minimum six inches clear of the intersection.
5. Factory prepunched (less than 1.5 feet on centers, each edge, staggered) for wire supports.
   a. Provide hog rings or grommets at all punched holes along the length of the waterstop.
6. See Drawings for application and other requirements.

C. Waterstops, Preformed Strip Type:
1. Acceptable manufacturers:
   a. Sika Greenstreak Plastics, Inc. (Hydrotite).
   b. Or equal.
2. Hydrophilic, non-bentonite composition.
3. Manufactured solely for the purpose of preventing water from traveling through construction joints.
4. Volumetric expansion limited to three times maximum.
5. See the Drawings for applications and other requirements.

D. Water Swelling Sealant:
1. Required adhesive for use with strip-type waterstop.
2. Compatible with strip-type waterstop.
3. Single component, gun applied.
4. Moisture cured.
5. Minimum 70 percent volumetric expansion swelling capability.

E. Retrofit Waterstop Systems:
1. Use at interface between existing construction and new concrete.
2. Retrofit Waterstop System shall be supplied as a complete system and include the following components
   a. PVC waterstop profile specifically designed to be installed at interface between existing construction and new concrete.
   b. Stainless steel batten bar, Type 316.
   c. Stainless steel anchor bolts, Type 316
   d. Epoxy adhesive gel that is fully compatible with all other components of Retrofit Waterstop System.
3. Provide the following acceptable products, unless specifically noted otherwise on Drawings:

a. Construction Joints:
   1) Sika Greenstreak Plastic Products Style #655, or equal.
b. Expansion Joints:
   1) Sika Greenstreak Plastic Products Style #581, or equal.

2.3 CONCRETE CONSTRUCTION JOINT ROUGHENER

A. Provide a water-soluble non-flammable, surface-retardant roughener.

B. Product and Manufacturer: Provide one of the following:
   1. Rugasol-S, as manufactured by Sika Corporation for horizontal joints only.
   2. Concrete Surface Retarder-Formula S, as manufactured by Euclid Chemical Company, for horizontal joints only.
   3. Concrete Surface Retarder-Formula F, as manufactured by Euclid Chemical Company, for vertical joints only.
   4. Or equal.

2.4 EPOXY BONDING AGENT

A. Provide a two-component epoxy-resin bonding agent.

B. Product and Manufacturer: Provide one of the following:
   1. Sikadur 32 Hi-Mod LPL, as manufactured by Sika Corporation.
   2. Dural LPL MV, as manufactured by the Euclid Chemical Company.
   3. Or equal.

2.5 EPOXY-CEMENT BONDING AGENT

A. Provide a three-component epoxy resin-cement blended formulated as a bonding agent.

B. Product and Manufacturer: Provide one of the following:
   1. Sika Armatec 110 EpoCem, as manufactured by Sika Corporation.
   2. Duralprep AC, as manufactured by the Euclid Chemical Company.
   3. Or equal.

2.6 RUBBER BONDING AGENT

A. Product and Manufacturer: Provide one of the following:
   1. Scotch-Grip 1300 Rubber Adhesive, as manufactured by 3M Company.
   2. Or equal.

2.7 ASPHALT EXPANSION JOINT FILLERS

A. Acceptable manufacturers:
   1. W.R Meadows.
   2. J and P Petroleum Products.

3. Or equal.

B. Materials: ASTM D994.

2.8 FIBER EXPANSION JOINT FILLERS

A. Materials: ASTM D1751.

2.9 PREFORMED EXPANSION JOINT FILLER

A. Materials: ASTM D 1752, Type I (sponge rubber) or Type II (cork).

2.10 NEOPRENE EXPANSION JOINT FILLERS

A. Acceptable manufacturers:
   1. Permaglaze.
   2. Rubatex.
   3. Williams Products.
   4. Or equal.

B. Materials:
   1. Closed cell neoprene.
   2. ASTM D1056, Type 2, Class A or C.
   3. Grade: Compression deflection as required to limit deflection to 25 percent of joint thickness under pressure from concrete pour height.

2.11 JOINT SEALANT

A. Sealant used in expansion joints and other locations where it is shown and which will be subject to being submerged by water for any period of time shall be a two part polyurethane type sealant meeting the requirements of ASTM C 920, Type M, Class 25. The sealant shall be specially formulated for continuous submerged conditions. The manufacturer's recommended primer must be used with the sealant.

B. The sealant shall meet the following requirements (measured at 73 degrees F and 50 percent RH):
   1. Ultimate hardness (ASTM D 2240, Type A, Shore): 20 to 45.
   2. Tensile strength (ASTM D 412): 200 psi, minimum.
   3. Ultimate elongation (ASTM D 412): 400 percent, minimum.
   4. Tear strength (ASTM D 624, die C): 75 pounds per inch of thickness, minimum.
   5. Color: light gray.

C. Product and Manufacturer: Provide one of the following:
   1. Permapol RC-270 Reservoir Sealant, as manufactured by Products Research and Chemical Corporation.
   2. Sikaflex-2c, as manufactured by Sika Corporation.
   3. Or equal.

2.12 SEALANT ACCESSORIES

A. Backer Rod: Backer rod shall be an extruded closed-cell polyethylene foam rod. The material shall be compatible with the sealant material used and shall have a tensile strength of not less than 40 psi and a compression deflection of approximately 25 percent at 8 psi. The rod shall be 1/8-inch larger in diameter than the joint width at joints less than 3/4-inch wide and 1/4-inch larger in diameter at joints 3/4-inch and wider.

B. Bond Breaker Tape: Bond breaker shall be polyethylene or TFE-fluorocarbon self adhesive tape, as recommended by the manufacturer.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine the substrate and the conditions under which Work is to be performed and notify ENGINEER, in writing, of unsatisfactory conditions. Do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to ENGINEER.

3.2 JOINTS AND EMBEDDED ITEMS

A. Construction Joints - General:
   1. Provide joints at locations as shown or indicated on the Drawings or as shown on approved Shop Drawings approved by Engineer or in an appropriate Contract modification.
      a. Where construction joint spacing shown on the Drawings exceeds the joint spacing indicated in Paragraph B. below, submit proposed construction joint location in conformance with this Section.
   2. Unplanned construction joints are unacceptable.
      a. If concrete cannot be completely placed between planned construction joints, then it must be removed.
   3. In general, locate joints near middle of spans of slabs, beams and girders unless a beam intersects a girder at this point, in which case, offset joint in girder a distance equal to twice the width of the beam.
   4. Locate joints in walls and columns at underside of floors, slabs, beams, or girders, and at tops of foundations or floor slabs, unless shown otherwise.
      a. At Contractor's option, beam pockets may be formed into concrete walls.
      b. Size pockets to allow beam reinforcing to be placed as detailed on the Drawings.
   5. Place beams, girders, column capitals and drop panels at same time as slabs.
   6. Make joints perpendicular to main reinforcement with all reinforcement continuous across joints.
   7. Provide the following joints unless shown or indicated otherwise on the Drawings:

a. Roughen joints: horizontal and vertical construction joints.

8. Roughen construction joints:
   a. Clean the previously hardened concrete interface and remove all laitance.
   b. Intentionally roughen the interface to a full amplitude of 0.25 inch.
   c. Provide recessed flat surface as required to install strip type waterstops.
9. Minimum time before placement of adjoining concrete construction:
   a. All concrete: 60 hours, unless otherwise noted.

B. Construction Joints - Spacing Unless Otherwise Specified:
   1. Structures not intended to contain liquid:
      a. Wall vertical construction joints:
         1) 50 feet maximum on centers.
         2) At wall intersections, 4 feet minimum from corner.
      b. Base slab, floor, and roof slab construction joints:
         1) Placements to be approximately square and not to exceed 4,000 square feet.
         2) Maximum side dimension of a slab pour shall be 90 feet.

C. Construction Joints - Bonding:
   1. Obtain bond between concrete pours at construction joints by thoroughly cleaning and removing all laitance from construction joints.
   2. Before new concrete is placed, all construction joints shall be coated with cement grout, or dampened, as indicated below:
   3. Roughen construction joints:
      a. Roughen the surface of the concrete to expose the coarse aggregate uniformly with 1/4 inch minimum amplitude.
         1) Remove laitance, loosened particles of aggregate or damaged concrete at the surface.
      b. Cover the hardened concrete of horizontal joints with a coat of cement grout of similar proportions to the concrete, except provide fine aggregate in lieu of coarse aggregate.
      c. Provide 2 inches to 5 inches layer of grout in bottoms of walls with waterstops. Place grout immediately before placing concrete.
      d. Place fresh concrete before the grout has attained its initial set.
         1) Vibrate grout and first layer of concrete simultaneously to commingle the materials.
      e. At Contractor's option, 1/4 inch minimum amplitude may be created by utilizing a chemical retarder placed on the formed surface of the concrete in conjunction with power washing.
         1) See Paragraph 2.3 for product information.

D. Slab Joints:
   1. Construction joints:
      a. Locate construction and control joints in slabs on grade as shown or indicated on the Drawings.
      b. Construction joints act as control joints.

2. Control joints:
    a. Provide contraction (control) joints as indicated.
    b. If not shown, provide along column centerlines.
    c. Where column centerline spacing or spacing between column centerlines and walls exceeds 20 feet, provide an intermediate joint at intervals not exceeding 20 feet.
    d. Locate joints to produce panels that are as square as possible with length not exceeding 1.5 times width.
    e. Also provide joints where change in slab width occurs, such as at block-outs, pits, etc.
    f. If saw cut joints are required or permitted, time cutting properly with set of concrete by one of the following methods:
        1) A conventional saw, cutting as soon as possible after final finishing when cutting action will not tear, ravel, abrade, or otherwise damage surface and before concrete develops random contraction cracks. Cut to a depth of 1/4 slab thickness or 1/3 slab thickness if steel-fiber or structural synthetic macro fiber reinforcement is used.
        2) An early entry saw beginning immediately after final finishing when cutting action will not tear, ravel, abrade, or otherwise damage surface and before concrete develops random contraction cracks.
            a) Remove debris in path of cut and under skid plate before cutting. Skid plate must remain flat on surface.
            b) Use early entry saw blades and skid plates.
            c) Install early entry joint protector at saw-cut intersection prior to cross-cut.
            d) Remove dry powder without disturbing finish.
            e) Avoid traffic across saw cut until sufficient strength is gained to protect joint edges.
        3) Complete before shrinkage stresses become sufficient to produce cracking.

E. Isolation joints:
    1. Wherever a sidewalk or other slab on grade abuts a concrete structure and is not shown doweled into that structure, an isolation joint shall be provided. Such joint shall be formed by a 1/2-inch joint filler with the upper 1/2-inch of the joint filled with sealant unless otherwise indicated on the Drawings.

F. Expansion Joints:
    1. Do not allow reinforcement or other embedded metal items bonded to concrete (except smooth dowels bonded on only one side of joint) to extend continuously through an expansion joint.
    2. Use neoprene expansion joint fillers, unless shown or indicated otherwise on the Drawings.
    3. Locate and install expansion joints as shown. Install joint filler in accordance with manufacturer's instructions. Sealants shall be installed as specified herein.

G. Waterstops - General:
   1. Waterstop shall be continuous with splices in accordance with manufacturer's written instructions and create water tight joints.
   2. Do not mix different types of waterstop materials in the same structure without approval from the Engineer unless shown or indicated on the Drawings.
   3. Preformed strip type:
      a. Locate waterstop at center of wall, unless shown or indicated otherwise on the Drawings.
         1) Maintain at least three inches from edge of concrete or as recommended by manufacturer.
      b. Install in a bed of swelling sealant on smooth surface of hardened concrete by use of nails, adhesive or other means as recommended by manufacturer to prevent movement of waterstop during placement of concrete.
      c. Roughened joints shall be specially prepared during concrete placement to provide smooth surface for proper water stop installation.
      d. Use in joints against existing concrete where shown or indicated on the Drawings.
   4. PVC Waterstops:
      a. Pre-position waterstop accurately in joints, with adequate clearance from all reinforcing. Do not push waterstop into wet concrete.
      b. Secure waterstops in correct position using hog rings or grommets spaced no more than 1.5 feet maximum staggered along each edge full length and passed through the edge of the waterstop.
         1) Tie wire to adjacent reinforcing.
      c. Provide retrofit waterstops with batten bars, anchors and adhesive gel as specified by manufacturer.
      d. Hold horizontal waterstops in place with continuous supports.
      e. Install according to manufacturer's written instructions.
         1) Do not displace reinforcement from required location.
      f. Splice ends and intersections with perpendicular butt splice using electrical splicing iron in accordance with manufacturer's written instructions.
         1) Use factory fabricated "T" and corner intersection fittings.
         2) Field splice straight runs of material.
      g. Unless otherwise noted, provide for construction joints in new construction for all structures indicated on the Drawings.

H. Other Embedded Items:
   1. Place sleeves, inserts, anchors, and embedded items required for adjoining work or for its support, prior to initiating concreting.
   2. Do not route electrical conduit, drains, or pipes in concrete slabs, walls, columns, foundations, beams or other structural members unless approved by Engineer.

I. Placing Embedded Items:
   1. Support against displacement.

2. Fill voids in sleeves, inserts and anchor slots temporarily with readily removable material to prevent entry of concrete into voids.
3. Provide adequate means for anchoring waterstop in concrete.
    a. Provide means to prevent waterstops in the forms from being folded over by the concrete as it is placed.

3.3 BONDING AGENT

A. Use epoxy bonding agent for bonding of fresh concrete to concrete that has been in place for at least 60 days or to existing concrete.

B. Use epoxy-cement bonding agent for the following:
    1. Bonding toppings and concrete fill to concrete that has been in place for at least 60 days or to existing concrete.
    2. For all locations where bonding agent is required and concrete cannot be placed within the open time period of epoxy bonding agent.
    3. Bonding of horizontal construction joints where these are required by the Drawings or approved by ENGINEER for foundation mats that are five feet thick or greater.
    4. On rebar and other steel within the repair area to serve as both a bonding agent and as an anti-corrosion coating.

C. Handle and store bonding agent in compliance with the manufacturer's printed instructions, including safety precautions.

D. Mix the bonding agent in complete accordance with the written instructions of the manufacturer.

E. Before placing fresh concrete, thoroughly roughen and clean hardened concrete surfaces and coat with bonding agent not less than 1/16-inch thick. Place fresh concrete while the bonding agent is still tacky (within its open time), without removing the in-place bonding agent coat, and as directed by the manufacturer.

3.4 SEALANT INSTALLATION

A. Sealants shall be installed according to the manufacturer’s written recommendations for sealant which is to be subjected to continuous submerged conditions and the following requirements. Prior to sealant installation, arrange to have a representative of the sealant manufacturer instruct the crew doing the Work as to the proper methods of surface preparation, mixing, and application of the sealant.

B. Surfaces to receive sealant shall be cleaned of all materials which could interfere with proper bonding. Concrete surfaces shall have all fins or other defects removed or repaired and shall receive a light abrasive blasting prior to priming and sealant application. All surfaces to receive sealant shall be completely dry and shall be blown clean with oil free air.

C. Spaces to receive sealant shall be filled with joint filler as shown. Where not shown, the space shall be filled with joint filler or a backer rod so that the depth of sealant does not exceed the width of the space. Where the bottom of the space to receive sealant is formed by a material other than backer rod, a bond breaker tape shall be placed. The maximum sealant depth, at middle of the joint width, shall be 1/2-inch.

D. The primer and sealant used shall be supplied by the same manufacturer. No sealant shall be placed without the use of a primer.

E. Self-leveling sealants shall only be used in joints with a slope less than 0.5 percent and where maximum and minimum sealant depths can be maintained. Non-sag sealant shall be used at all other locations and may be used instead of self-leveling sealant. All non-sag sealant shall be tooled to a uniform concave surface before skinning and curing begins.

F. Sealant material shall be conditioned to be within the optimum temperature range recommended by the manufacturer for installation for a minimum of 16 hours prior to installation. Installation shall proceed only when the substrate is at a temperature recommended in writing by the manufacturer. Sealant shall not be placed if there is a threat of imminent rainfall. Submit a letter certifying that the applied sealants were installed in accordance with the manufacturer's written recommendations, including temperature, relative humidity, etc.

G. All joints to receive sealant shall be inspected by the ENGINEER prior to sealant placement.

H. All sealant shall achieve final cure at least seven days before the structure is filled with water.

I. Any sealant which, after the manufacturer's recommended curing time for the job conditions, fails to fully and properly cure shall be completely removed. The surfaces to receive sealant shall be completely cleaned of all traces of the improperly cured sealant and primer. The specified sealant shall then be reinstalled. All costs of such removal, surface treatment, and reinstallation shall be at the expense of CONTRACTOR.

3.5 FIELD QUALITY CONTROL

A. Special Inspection:
   1. See Section 01416.
   2. Special Inspection (non-code required) is required for:
      a. Concrete Joints:
         1) Inspect concrete joints for proper joint type, dimensions, reinforcing, dowel alignment, surface preparation and location.
         2) Frequency: Prior to each concrete pour.
      b. Waterstops:

1) Visually inspect waterstops for proper location, continuity, installation to prevent displacement, cleanliness and damage to waterstop.
2) Frequency:
   a) Prior to each concrete pour
3) Testing Waterstop Joints:
   a) Samples of field fabricated waterstop butt joints may be selected at random by the Engineer for testing by a laboratory at the Owner's expense.
      i) When tested, they shall have a tensile strength across the joints equal to at least 600 psi.

B. Supplier's Onsite Services:
   1. Waterstop manufacturer's representative shall provide on-site training of waterstop installation, field splicing, welding and inspection procedures prior to construction.

++ END OF SECTION ++

SECTION 03252

ANCHORAGE IN CONCRETE

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
   1. Provide all labor, materials, equipment and incidentals as shown on the Drawings, specified, and required to furnish and install anchor bolts, concrete anchors (adhesive and expansion anchors), and concrete inserts.

B. Coordination: This Section includes all bolts, anchors and inserts required for the Work but not specified under other Sections.

C. The types of work using anchor bolts and anchors drilled into concrete or masonry includes, but is not limited to, the following:
   1. Structural members and accessories.
   2. Metal, wood, and plastic fabrications.
   3. Equipment.
   4. Sluice and slide gates.
   5. Tanks.
   6. Piping.
   7. Grating and floor plate.
   8. Electrical, Plumbing and HVAC Work.

1.2 QUALITY ASSURANCE

A. Reference Standards: Comply with the applicable provisions and recommendations of the following, except as otherwise shown and specified.
   1. ACI 318, Building Code Requirements for Structural Concrete and Commentary.
   2. ACI 355.2, Seismic Testing of Post-Installed Concrete and Masonry Anchors in Cracked Concrete.
   3. ACI 355.4, Qualification of Post-Installed Adhesive Anchors in Concrete.
   4. American Concrete Institute/Concrete Reinforcing Steel Institute (ACI-CRSI):
      a. Adhesive Anchor Installation Certification Program: Adhesive Anchor Installer.
   5. ASTM A 36, Specification for Structural Steel.
   6. ASTM A 108, Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished.
   7. ASTM A 123, Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
   8. ASTM A 153, Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

9. ASTM A 307, Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
10. ASTM A 484/A 484M, Specification for General Requirements for Stainless and Heat-Resisting Steel Bars, Billets and Forgings.
11. ASTM A 525, Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process.
12. ASTM A 536, Specification for Ductile Iron Castings.
13. ASTM A 570/A 570M, Specification for Structural Steel, Sheet and Strip, Carbon, Hot-Rolled.
14. ASTM B 633, Specification for Electrodeposited Coatings of Zinc on Iron and Steel.
15. ASTM F 593, Specification for Stainless Steel Bolts; Hex Cap Screws, and Studs.
16. ASTM F 1554, Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.
17. ASTM F 2329, Standard Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners
18. Federal Specification, FF-S-325 for Concrete Expansion Anchors.
19. Federal Specifications, WW-H-171E for Malleable Iron.
20. ICC Evaluation Service (ICC-ES):
    a. AC193, Acceptance Criteria for Mechanical Anchors in Concrete Elements.
    b. AC308, Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements.

B. Expansion anchors and inserts shall be ICBO, UL, or FM approved.

C. Qualifications:
1. Anchor designer for Contractor-designed post-installed anchors and cast in place anchorage shall be a professional civil engineer licensed in the State of Arizona.
2. Installer for post-installed anchors shall be trained by the manufacturer or certified by a training program approved by the Engineer.
3. Installer for adhesive anchors installed in horizontal, upward incline, or overhead applications shall be certified by ACI-CRSI Adhesive Anchor Installation Certification Program.

D. Post-installed anchors and related materials shall be listed by the following agencies:
1. ICC-ES.
2. Engineer approved equivalent.

1.3 DEFINITIONS

A. Adhesive Anchors:
1. Post-installed anchors developing their strength primarily from chemical bond between the concrete and the anchor.

2. Includes anchors using acrylics, epoxy and other similar adhesives.

B. Anchor Bolt: Any cast-in-place anchorage that is made of a headed (i.e. bolt) material.

C. Anchor Rod: Any cast-in-place or post-installed anchorage made from unheaded, threaded, rod or deformed bar material.

D. Concrete Anchor: Generic term for either an anchor bolt or an anchor rod.

E. Galvanizing: Hot-dip galvanizing per ASTM A123, ASTM A153 or ASTM F2329 with minimum coating of 2.0 oz of zinc per square foot of metal (average of specimens) unless noted otherwise or dictated by standard.

F. Hardware: As defined in ASTM A153 and ASTM F2329.

G. Installer or Applicator:
1. Installer or applicator is the person actually installing or applying the product in the field at the Project site.
2. Installer and applicator are synonymous.

H. MPII: Manufacturer's printed installation instructions.

I. Mechanical Anchors:
1. Post-installed anchors developing their strength from attachment other than thru adhesives or chemical bond to concrete.
2. Includes expansion anchors, expansion sleeve, screw anchors, undercut anchors, specialty inserts and other similar types of anchorages.
3. Drop-in anchors and other similar non-ICC ES approved anchors are not allowed.

J. Post-Installed Anchor: Any adhesive or mechanical anchor installed into previously placed and adequately cured concrete.

1.4 SUBMITTALS

A. Shop Drawings: Submit for approval the following:
1. Comply with the requirements of Section 01300, Submittals.
2. Product technical data including:
   a. Acknowledgement that submitted products meet requirements of referenced standards.
   b. Manufacturer material data sheet for each anchor.
      1) Clearly indicate which products on the data sheet are proposed for use on the Project.
   c. Manufacturer's printed installation instructions.
   d. Current ICC-ES report for each post-installed anchor system indicating the following:

1) Certification that anchors meet all requirements indicated in this Specification.
2) Performance data showing that anchor is approved for use in cracked concrete.
3) Seismic design categories for which anchor system has been approved.
4) Required installation procedures.
5) Special inspection requirements for installation.

e. Contractor Designed Post-Installed Anchors:
1) Show diameter and embedment depth of each anchor.
2) Indicate compliance with ACI 318, Chapter 17.
3) Design tension and shear loads used for anchor design.
4) Engineering design calculations:
a) Indicate design load to each anchor.
b) Develop anchor forces based on Design Criteria listed herein and/or manufacturer's design information.
c) Sealed and signed by contractor's professional engineer.
d) Calculations will be submitted for information purposes only.
5) Provide torque values where pipe sleeves anchors are used.

f. Anchorage layout drawings and details:
1) Indicate anchor diameter, embedment, length, anchor type, material and finish.
2) Drawings showing location, configuration, spacing and edge distance.
3) Type of post-installed anchor system used.
a) Provide manufacturer's ICC-ES report for the following:
i) Mechanical anchorage per ICC-ES AC193.
ii) Adhesive anchorage per ICC-ES AC308.

B. Samples:
1. Representative samples of concrete anchors may be requested by Engineer. Review will be for type and finish only. Compliance with all other requirements is exclusively the responsibility of the Contractor.

C. Informational Submittals:
1. Certification of qualifications for each installer of post-installed anchors.
2. Indicate successful completion or certification for each type of approved post-installed anchor as required by the Contract Documents.
3. Provide one of the following for each type of anchor, as required by this specification section:
a. Letter from manufacturer documenting successful training completion [for mechanical anchors only].
b. Certification of completion for Engineer approved program.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to job site in manufacturer's or distributor's packaging undamaged and complete with installation instructions.

B. Store above ground on skids or other supports to keep items free of dirt and other foreign debris and to protect against corrosion.

C. Protect and handle materials in accordance with manufacturer's recommendations to prevent damage or deterioration.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cast-in-place Concrete Anchors:
   1. Building and nonbuilding structures, unless otherwise specified:
      a. ASTM F1554, Grade 36 or Grade 55 with weldability supplement S1 for galvanized or non-galvanized threaded rods.
      b. ASTM A307, Grade A for galvanized headed bolts.
      c. For Submerged or used in enclosed tankage, ASTM F593, Type 316.
   2. All other cast-in-place concrete anchors for equipment:
      a. Stainless steel with matching nut and washer.
      b. Submerged application: ASTM F593, Type 316.
      c. Non-submerged application: ASTM F593, Type 304 or Type 316 anchors and washers
      d. Nuts for non-submerged applications, ASTM563 and coated after torqued.

B. Post-Installed Mechanical and Adhesive Concrete Anchors:
   1. Stainless steel with matching nut and washer.
   2. Submerged application: ASTM F593, Type 316.
   3. Non-submerged application: ASTM F593, Type 304 or Type 316, with ASTM A563 nuts coated after torquing.

C. Reinforcement: See Section 03200.

D. Headed Studs: ASTM A108 with a minimum yield strength of 50,000 psi and a minimum tensile strength of 60,000 psi.

E. Deformed Bar Anchors: ASTM A496 with minimum yield strength of 70,000 psi and a minimum tensile strength of 80,000 psi.

F. Washers:
   1. ASTM F436 unless noted otherwise, finish to match bolt.
   2. If stainless steel anchorage is being used for cast-in-place anchorage, furnish washers of the same material and alloy as in the accompanying anchorage.
   3. Plate washers: Minimum 1/4 inches thick fabricated ASTM A36 square plates as specified or required.
   4. Follow manufacturer's requirements for all post-installed anchorage.

G. Nuts:

1. ASTM A563 for all cast-in-place anchorage.
2. If stainless steel anchorage is being used for cast-in-place anchorage in submerged or enclosed tankage, nuts shall meet ASTM F594 and be the matching material and alloy as in the accompanying anchorage.
3. Follow manufacturer's requirements if using post-installed anchorage.

H. Galvanizing Repair Paint:
1. High zinc dust content paint for regalvanizing welds and abrasions.
2. ASTM A780.
3. Zinc content: Minimum 92% in dry film.
4. ZRC "ZRC Cold Galvanizing" or Clearco "High Performance Zinc Spray."

I. Dissimilar Materials Protection: See Specification Section 09900, Painting.

2.2 CONTRACTOR DESIGNED ANCHORAGE

A. Manufacturers:
1. Post-installed anchor systems for the listed manufacturers will be considered only if a current ICC-ES evaluation report is submitted in accordance with the SUBMITTALS Article in PART 1 of this Specification Section and if the anchor system is approved by the Engineer.
   a. Hilti.
   b. Dewalt.
   c. Simpson Strong-Tie.

B. Design the anchorage when any of the following occur:
1. Design load for concrete anchorage is shown on the Drawings.
2. When specifically required by the Contract Documents.
3. When an anchorage is required but not specified in the Drawings.

C. Anchorage Design Loads:
1. Determine all of the design loads, including wind and seismic loads, per the building code. Additionally, specialty engineer is required to incorporate all static and dynamic loading forces established by the equipment manufacturer, where required for equipment.
   a. Anchorage of equipment and non-structural components: Use the actual dead and operating loads provided by the manufacturer.
2. When Contract Drawings indicate an anchor diameter or length, design shall incorporate these as "minimums." Design these anchors and provide all necessary documentation as required herein.

D. Cast-in-Place Concrete Anchors:
1. Provide the material, nominal diameter, embedment length, spacing, edge distance and design capacity to resist the calculated load based on the requirements given in the building code including ACI 318, Chapter 17.
2. Design assuming cracked concrete.

E. Post-installed Concrete Anchors:
   1. Provide the manufacturer's system name/type, nominal diameter, embedment depth, spacing, minimum edge distance, cover, and design capacity to resist the specified or calculated load based on requirements given in the building code, ACI 318, Chapter 17 and current ICC-ES report, for the anchor to be used.
   2. Design assuming cracked concrete.

2.3 ENGINEER DESIGNED ANCHORAGE

A. When the size, length and details of anchorages are shown on Contract Structural Drawings, Contractor design of anchorage is not required unless otherwise indicated.

B. Manufacturers:
   1. Additional newer post-installed anchor systems for the listed manufacturers will be considered only if a current evaluation agency report is submitted in accordance with the SUBMITTALS Article in PART 1 of this Specification Section, the anchor system is certified by ICC-ES for cracked concrete conditions, and if approved by the Engineer.
   2. Mechanical Anchors in Concrete:
      a. Hilti:
         1) Kwik Bolt TZ2 (ICC-ES ESR-4266).
   3. Adhesive Anchors in Concrete:
      a. Hilti:
         1) HIT RE 500 V3 (ICC ESR-3814).
   4. Screw Anchors in Concrete:
      a. Hilti:
         1) KH-EZ Screw (ICC-ES ESR-3027).
   5. Substitution request to indicate the proposed anchor has at least the same tension and shear strength as the specified anchor installed as indicated in the Contract Drawings.
      a. Calculations to be stamped by a Professional Engineer registered in the State of Arizona.

PART 3 - EXECUTION

3.1 GENERAL

A. Cast-in-Place Anchorage:
   1. Use where anchor rods or bolts are indicated on the Drawings, unless another anchor type is approved by the Engineer.
   2. Provide concrete anchorage as shown on the Drawings or as required to secure components to concrete.

B. Adhesive Anchorage:
   1. Use only where specifically indicated on the Drawings or when approved for use by the Engineer.

2. May be used where subjected to vibration or where buried or submerged.
3. Do not use in overhead applications or sustained tension loading conditions such as utility hangers.
4. Contact Engineer for approval when anchors will not be installed in compliance with MPII

C. Mechanical Anchorage:
1. Use only where specifically indicated on the Drawings or when approved for use by the Engineer.
2. Do not use where subjected to vibration.
3. May be used in overhead applications.
4. Contact Engineer for clarification when anchors will not be installed in compliance with manufacturer's printed installation requirements.

D. Do not use powder actuated fasteners and other types of bolts and fasteners not specified herein for structural applications unless approved by the Engineer or specified in Contract Documents.

3.2 PREPARATION

A. Provide adequate time to allow for proper installation and inspection prior to placing concrete for cast-in-place concrete anchorage.

B. Prior to installation, inspect and verify areas and conditions under which concrete anchorage is to be installed.
1. Notify Engineer of conditions detrimental to proper and timely completion of work.
2. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to the Engineer.

C. Special Inspection is required in accordance with the building code for all concrete anchorage.
1. Notify the Special Inspector that an inspection is required prior to concrete placement (or during post-installed anchorage installation).
2. See the FIELD QUALITY CONTROL Article in PART 3 of this Specification Section for additional requirements.

D. Post-installed anchor manufacturer’s representative shall demonstrate and observe the proper installation procedures for the post-installed anchors at no additional expense to the Owner.
1. Follow such procedures to assure acceptable installation.
2. Adhesive anchors must be installed in concrete aged a minimum of 21 days.

3.3 INSTALLATION

A. Tie cast-in-place anchorage in position to embedded reinforcing steel using wire.
1. Tack welding of anchorage is prohibited.

2. Chase threads as required and coat the projected portion of carbon steel anchors and nut threads with a heavy coat of clean grease after concrete has cured.
3. Anchorage location tolerance shall be in accordance with AISC 303.
4. Provide steel or durable wood templates for all column and equipment anchorage.
    a. Templates to be placed above top of concrete and not impede proper concrete placement and consolidation.

B. Unless noted or specified otherwise:
1. Connect aluminum and steel members to concrete and masonry using stainless steel cast-in-place anchorage unless shown otherwise.
2. Provide dissimilar materials protection per Specification Section 09900, Painting.
3. Provide washers for all anchorage.
4. Where exposed, extend threaded anchorage a maximum of 3/4 inches and a minimum of 1/2 inches above the top of the fully engaged nut.
    a. If anchorage is cut off to the required maximum height, threads must be dressed to allow nuts to be removed without damage to the nuts.

C. Do the following after nuts are snug-tightened down:
1. If using post-installed anchorage, follow MPII.
2. Upset threads of anchorage to prevent nuts from backing off.
    a. Provide double nut or lock nut in lieu of upset threads for items that may require removal in the future.
3. For all other cast-in-place anchorage material, tighten nuts down an additional 1/8 turn beyond snug tight to prevent nuts from backing off.
4. If two nuts are used per concrete anchor above the base plate, tighten the top nut an additional 1/8 turn to "lock" the two nuts together.
5. If using post-installed anchorage, follow MPII.

D. Assure that embedded items are protected from damage and are not filled in with concrete.

E. Secure architectural components such that it will not be aesthetically distorted and fasteners will not be overstressed from expansion, contraction, or installation.

F. Coat aluminum surfaces in contact with dissimilar materials in accordance with Specification Section 09900, Painting.

G. Repair damaged galvanized surfaces in accordance with ASTM A780.
1. Prepare damaged surfaces by abrasive blasting or power sanding.
2. Apply galvanizing repair paint to minimum 6 mils DFT in accordance with manufacturer's instructions and ASTM A780.

H. For post-installed anchors, comply with the MPII on the hole diameter and depth required to fully develop the tensile strength of the anchor or reinforcing bar.
1. Use hammer drills to create holes.

2. Properly clean out the hole per the ICC-ES reports utilizing a non-metallic fiber bristle brush and compressed air or as otherwise required to remove all loose material from the hole prior to installing the anchor in the presence of the Special Inspector.

3.4 FIELD QUALITY CONTROL

A. Special Inspection:
   1. See Section 01416.

B. Field Inspection and Testing
   1. Employ a testing laboratory to perform field quality testing of installed anchors. Field engineer is to determine the level of testing which is required for the various types of adhesive anchors and anchor bolts.
      a. Owner reserves the right to inspect and test completed anchorage at a minimum of 10% (for large quantity) to 25% (smaller quantity) to 100% (very small project quantity).
      b. Such testing shall conform to requirements of ACI 355.2 and/or ACI 355.4 as applicable.
   2. If failure of any of the tested anchors or reinforcing bars occurs, the Owner reserves the right to inspect and test all remaining anchors of the same type.
   3. The independent testing and inspection agency shall complete a report on each area of the Work where concrete anchors are installed. The report shall summarize the observations made by the inspector and be submitted to engineer.
   4. Failed anchors shall be satisfactorily replaced at no cost to Owner.

3.5 CLEANING

A. After concrete has been placed, remove protection and clean all anchorage of all concrete, dirt, and other foreign matter.

B. Provide surface acceptable to receive field applied paint coatings when specified in Specification Section 09900.

++ END OF SECTION ++

SECTION 03300

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
   1. Provide all labor, materials, equipment and incidentals as shown on the Drawings, specified and required to furnish and install cast-in-place concrete.
   2. The Work includes providing concrete consisting of portland cement, fine and coarse aggregate, water, and approved admixtures; combined, mixed, transported, placed, finished and cured. The Work also includes:
      a. Providing openings in concrete to accommodate the Work under this and other Sections and building into the concrete all items such as sleeves, frames, anchor bolts, inserts and all other items to be embedded.

B. Coordination:
   1. Review installation procedures under other Sections and coordinate the installation of items that must be installed in the concrete.

C. Classifications of Concrete:
   1. Type "1" concrete shall be steel reinforced and includes the following:
      a. All cast-in-place concrete, unless indicated otherwise.
   2. Type "2" concrete shall be placed without forms or with simple forms, with little or no reinforcing, and includes the following:
      a. Concrete fill within structures greater than or equal to 4-inches thick. Where less than 4-inches thick, provide Grout Fill topping grout in conformance with Section 03600 Grout.
      b. Duct banks.
      c. Unreinforced encasements.
      d. Curbs and gutters.
      e. Sidewalks.
      f. Thrust blocks.
   3. Type "3" concrete shall be steel reinforced and includes the following:
      a. All precast concrete, unless indicated otherwise.
   4. Type "4" concrete shall be unreinforced and used where required as concrete fill under foundations, filling abandoned piping and wherever “lean” concrete or “CLSM” is required on the Drawings. This concrete shall be one-sack Controlled Low Strength Material (CLSM) conforming to MAG Specification Section No. 728.

1.2 QUALITY ASSURANCE

A. Standard Specifications and Details:

1. Conform to all applicable requirements of Sections 505, 725, 726 and 728 of the Uniform Standard Specifications for Public Works Construction by the Maricopa Association of Governments (MAG).

B. Reference Standards: Comply with the applicable provisions and recommendations of the following, except as otherwise shown or specified.
   1. ACI 214, Recommended Practice for Evaluation of Strength Test Results of Concrete.
   2. ACI 301, Specifications for Structural Concrete (includes ASTM Standards referred to herein).
   3. ACI 304, Guide for Measuring, Mixing, Transporting and Placing Concrete.
   4. ACI 305, Hot Weather Concreting.
   5. ACI 306, Cold Weather Concreting.
   6. ACI 309, Guide for Consolidation of Concrete.
   7. ACI 311, Guide for Concrete Inspection.
   8. ACI 318, Building Code Requirements for Structural Concrete.
   9. ACI 350, Code Requirements for Environmental Engineering Concrete Structures.
   10. ANSI/NSF 61, Drinking Water System Components-Health Effects.
   11. AASHTO M 182, Burlap Cloth Made From Jute or Kenaf.
   12. AASHTO TP 23, Proposed Standard Method of Test for Water Content of Freshly Mixed Concrete Using Microwave Oven Drying.
   13. ASTM C 31, Practice for Making and Curing Concrete Test Specimens in the Field.
   14. ASTM C 33, Specification for Concrete Aggregates.
   15. ASTM C 39, Test Method for Compressive Strength of Cylindrical Concrete Specimens.
   16. ASTM C 42, Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
   17. ASTM C 94, Specification for Ready-Mixed Concrete.
   18. ASTM C109, Test Method for Compressive Strength of Hydraulic Cement Mortars.
   19. ASTM C 143, Test Method for Slump of Hydraulic- Cement Concrete.
   20. ASTM C 150, Specification for Portland Cement.
   21. ASTM C 157, Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete.
   22. ASTM C 171, Specification for Sheet Materials for Curing Concrete.
   23. ASTM C 172, Practice for Sampling Freshly Mixed Concrete.
   24. ASTM C 231, Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
   25. ASTM C 260, Specification for Air-Entraining Admixtures for Concrete.
   26. ASTM C 309, Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
   27. ASTM C 330, Specification for Lightweight Aggregates for Structural Concrete.
   28. ASTM C 494, Specification for Chemical Admixtures for Concrete.

29. ASTM C 618, Specification for Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete.
30. ASTM C 882, Test Method for Bond Strength of Epoxy-Resin Systems Used with Concrete by Slant Shear.
31. ASTM C 1240, Specification for Silica Fume for Use as a Mineral Admixture in Hydraulic-Cement Concrete, Mortar, and Grout.
32. ASTM C 1778, Standard Guide for Reducing Risk of Deleterious Alkali-Aggregate Reaction in Concrete.
33. ASTM E 154, Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover.
34. ASTM E 329, Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used for Construction.

C. Concrete Testing Service:
   1. Field testing and inspection services for concrete will be provided by OWNER. Coordinate with OWNER's testing agency.
      a. Testing agency shall meet the requirements of ASTM E 329.
      b. Selection of a testing laboratory is subject to ENGINEER'S approval.
      c. Submit a written description of the proposed concrete testing laboratory giving qualifications of personnel, laboratory facilities and equipment, and other information that may be requested by ENGINEER.
   2. Materials and installed Work may require testing and retesting, as directed by ENGINEER, at any time during the progress of the Work. Allow free access to material stockpiles and facilities at all times. Tests not specifically indicated to be done at OWNER'S expense, including the retesting of rejected materials and installed Work, shall be done at CONTRACTOR'S expense.

D. Qualifications of Concrete Admixture Manufacturer:
   1. Concrete admixtures shall be manufactured under strict quality control in facilities operated under a quality assurance program. Furnish copy of manufacturer's quality assurance handbook to document the existence of the program. Manufacturer shall maintain a concrete testing laboratory that has been approved by the Cement and Concrete Reference Laboratory at the Bureau of Standards, Washington, D.C.
   2. Provide a qualified concrete technician employed by the admixture manufacturer to assist in proportioning the concrete for optimum use of the admixture. The concrete technician shall advise on proper addition of the admixture to the concrete and on adjustment of the concrete mix proportions to meet changing jobsite conditions.

E. Laboratory Trial Batch:
   1. Each concrete mix design specified shall be verified by a laboratory trial batch, unless indicated otherwise.
   2. Each trial batch shall include the following testing:
      a. Aggregate gradation for fine and coarse aggregates.

b. Fly ash testing to verify meeting specified properties, unless the fly ash supplier provides certification by an independent testing laboratory.
c. Slump.
d. Air content.
e. Compressive strength based on three cylinders each tested at seven days and at 28 days.
f. Shrinkage test as specified herein for Type "1" concrete mix design.

3. Each trial batch shall provide the following information:
   a. Project identification name and number.
   b. Date of report.
   c. Complete identification of aggregate source of supply.
   d. Tests of aggregates for compliance with specified requirements.
   e. Scale weight of each aggregate.
   f. Absorbed water in each aggregate.
   g. Brand, type and composition of cement.
   h. Brand, type and amount of each admixture.
   i. Amounts of water used in trial mixes.
   j. Proportions of each material per cubic yard.
   k. Gross weight and yield per cubic yard of trial mixtures.
   l. Measured slump.
   m. Measured air content.
   n. Compressive strength developed at seven days and 28 days, from not less than three test cylinders cast for each seven day and 28 day test, and for each design mix.
   o. Shrinkage test results where required and as specified herein.
4. The requirement for a trial batch may be waived if the required test information has been provided in a previous laboratory trial batch run on the identical mix design within the previous two years. The same brand, type, and source of all materials must have been used.

F. Shrinkage Testing:
1. Shrinkage tests are required for mix design approval and for approval of concrete in the field.
   a. Mix design shrinkage test:
      1) The submitted mix design proportions must be the same proportions used for the laboratory mix design shrinkage test and shall indicate concrete meets the specified shrinkage limit.
      2) Compressive strength test specimens shall be taken from each concrete sample used to prepare the shrinkage specimens. These compression test specimens shall be considered as part of the normal requirements for tests on this project.
      3) Drying shrinkage for laboratory cast specimens for mix design approval shall conform to ASTM C 157, modified as follows:
         a) Curing of specimens:

i) Remove specimens from molds at an age of 23 1/2 ± 1/2 hours after the addition of water to the cement during the mixing operation.
ii) Upon removal of the specimens from the molds, immerse them in lime-saturated water maintained at 73 ± 1 degrees F for a minimum of 30 minutes.
iii) At an age of 24 ± 1/2 hours after the addition of water to the cement during the mixing operation, remove the specimens from water storage one at a time, wipe with a damp cloth, and immediately take the original length (not to be confused with "base length").
iv) After measuring the original length, store the specimens in lime-saturated water at 73 ± 3 degrees F until they have reached an age of 7 days, including the period in the molds.

b) At the end of the curing period, take a second measurement after the specimens have been brought to a more closely controlled temperature as was done prior to the first measurement. This measurement shall be the base length for shrinkage calculations ("zero" days drying age) and shall be expressed as a percentage of original length (expansion).

c) Immediately store specimens in a temperature- and humidity-controlled room maintained at 73 ± 3 degrees F and 50 ± 4 percent relative humidity, for the remainder of the test. Specimens to have a clearance of at least 1 inch on all sides.

d) Measure to determine shrinkage, expressed as percentage of base length. Compute the drying shrinkage deformation of each specimen as the difference between the base length (at "zero" days drying age) and the length after drying at each test age. Compute the average drying shrinkage deformation of the specimens to the nearest 0.0001 inch at each test age. If the drying shrinkage of any specimen departs from the average of that test age by more than 0.0004 inch, disregard the results obtained from that specimen. Report results of shrinkage tests to the nearest 0.001 percent of shrinkage;

e) Make and report shrinkage measurements separately for 7, 14, 21, and 28 days of drying after the 7-day curing period.

b. Field shrinkage tests:

1) Field test shrinkage specimens shall be taken on the first concrete placement of each class of concrete.

2) Compressive strength test specimens shall be taken from each concrete sample used to prepare the shrinkage specimens. These compression test specimens shall be considered as part of the normal requirements for tests on this project.

3) If excessive cracking or other symptoms that are potentially related to shrinkage occur during construction, Engineer may require up to

two (2) additional field shrinkage tests during construction to verify compliance with these Specifications.

4) The initial field shrinkage testing will establish a baseline for the shrinkage of the specified mixes that represents the concrete as placed and cured in the field.
5) The field cast specimens shall be transported to a facility that can provide temperature and humidity control prior to removing them from the molds.
6) Drying shrinkage for specimens cast in the field shall conform to ASTM C 157, modified as follows:
    a) Curing of specimens:
        i) Remove specimens from molds at an age of 23 1/2 ± 1/2 hours after the addition of water to the cement during the mixing operation.
        ii) Upon removal of the specimens from the molds, immerse them in lime-saturated water maintained at 73 ± 1 degrees F for a minimum of 30 minutes.
        iii) At an age of 24 ± 1/2 hours after the addition of water to the cement during the mixing operation, remove the specimens from water storage one at a time, wipe with a damp cloth, and immediately take the original length (not to be confused with "base length").
        iv) After measuring the original length, continue curing the specimens, with the same curing methods used in the field, until they have reached an age of 14 days, including the period in the molds.
    b) At the end of the curing period, store the specimens in a temperature-and humidity-controlled room maintained at 73 ± 3 degrees F and 50 ± 4 percent relative humidity, for the remainder of the test. Specimens to have a clearance of at least 1 inch on all sides.
    c) Take a second measurement immediately after the specimen's temperature has stabilized. This measurement shall be the base length for shrinkage calculations ("zero" days drying age) and shall be expressed as a percentage of original length (expansion).
    d) Measure to determine shrinkage, expressed as percentage of base length. Compute the drying shrinkage deformation of each specimen as the difference between the base length (at "zero" days drying age) and the length after drying at each test age. Compute the average drying shrinkage deformation of the specimens to the nearest 0.0001 inch at each test age. If the drying shrinkage of any specimen departs from the average of that test age by more than 0.0004 inch, disregard the results obtained from that specimen. Report results of shrinkage tests to the nearest 0.001 percent of shrinkage;

e) Make and report shrinkage measurements separately for 7, 14, 21, and 28 days of drying after the 14-day curing period.

2. Shrinkage specimens shall be fabricated, cured, dried, and measured in accordance with ASTM C 157 and as modified herein. All specimens shall 11-1/4 inch ±1/8 inch for an effective gauge length of 10 inches.
   a. Shrinkage specimens for mixes with 100 percent of the aggregate passing the 1-inch sieve shall be 3 inches by 3 inches in cross section.
   b. For mixes with aggregates larger than 1 inch and with 100 percent passing a 2-inch sieve, drying shrinkage specimens shall be 4 inches by 4 inches in cross section.
3. Report shrinkage test results at intervals as specified for the type of test, either laboratory or field, according to ASTM C 157 and the type of storage, water or air respectively.
   a. The field test shrinkage shall not exceed the laboratory mix shrinkage requirement by more than 50 percent on the initial placement of each class of concrete required to be shrinkage tested.
   b. If the required field shrinkage limitation is not met, all aspects of concrete mixing, placing, sampling and curing will be subject to review. If this review points toward a solution, participate in a solution of making changes as required to establish compliance. These changes may include, but are necessarily limited to the following:
      1) Changing the curing methods.
      2) Changing the source of aggregates.
      3) Changing the amount of crushed or fractured coarse aggregate.
      4) Changing cement quantity and/or admixtures.
      5) Use of a shrinkage reducing admixture.
      6) Reducing water/cement ratio.
      7) Making changes to sampling practices
      8) Possible consideration by the ENGINEER of modifying the field shrinkage acceptance criteria.
      9) Other actions designed to minimize shrinkage and to provide better quality assurance.
4. Once the initial field shrinkage testing requirement is met, subsequent shrinkage testing, done, if needed, during the remainder of the construction period shall use the field test result from each initial field shrinkage test as a base line for acceptance.
   a. If the base line acceptance criteria are not met, then the provisions of Article 1.2 F.3.b above shall be enacted to re-establish compliance.
5. These tests shall be considered a part of the normal compression tests for the project. Allowable shrinkage limitations shall be as specified in Part 2, herein.

G. Certification of Concrete Mix:
   1. The need for a trial batch may be waived if the following requirements are met. The compressive strength of each specified mix shall be verified by data from a series of a minimum of 30 consecutive tests that have been made within the previous 12 months. A test is defined as the average strength of all specimens

of the same age fabricated from a sample taken from a single batch of concrete. All tests shall have been made on concrete which is identical in mix design to the submitted proposed mix design, including sources of aggregate and manufacturers of cementitious materials and admixtures. The tests must average above the specified strength with no individual test falling more than 500 psi below specified strength and no three consecutive tests averaging below specified strength. In addition, the standard deviation for the series of tests shall not exceed 640 psi as defined by ACI 214.

1.3 SUBMITTALS

A. Samples: Submit samples of materials as specified and as otherwise may be requested by ENGINEER, including names, sources and descriptions.

B. Shop Drawings: Submit for approval the following:
   1. Comply with the requirements of Section 01300, Submittals.
   2. Manufacturer's specifications with application and installation instructions for proprietary materials and items, including admixtures and bonding agents.
   3. List of concrete materials and concrete mix designs proposed for use. Include the results of all tests performed to qualify the materials and to establish the mix designs.
   4. The following information, if ready-mixed concrete is used.
      a. Physical capacity of mixing plant.
      b. Trucking facilities available.
      c. Estimated average amount that can be produced and delivered to the site during a normal eight hour day, excluding the output to other customers.

C. Laboratory Test Reports: Submit copies of laboratory test reports for concrete cylinders, materials and mix design tests. ENGINEER'S review will be for general information only. Production of concrete to comply with specified requirements is the responsibility of CONTRACTOR.

D. Submit notarized certification of conformance to referenced standards when requested by ENGINEER.

E. Certification of coarse aggregate impurities as relates to alkali-silica reactivity per ASTM C33, as supplemented by ASTM C1778.

F. Certification that the aggregates to be supplied for the Project are from the same location as the aggregates represented in the following concrete mix design submittal documents:
   1. Compressive strength test reports.
   2. Certification document for the class of coarse aggregate meeting the requirements of ASTM C33 and project requirements for type and location of concrete construction.
   3. Shrinkage test reports.

G. Certification from synthetic macrofiber manufacturer indicating that proposed fiber dosage meets or exceeds the minimum specified fe3 values in accordance with ASTM C1609.

H. Delivery Tickets: Furnish to ENGINEER copies of all delivery tickets for each load of concrete delivered to the site. Provide items of information as specified in ASTM C 94, Section 16.1.
   1. Provide batch tickets for each batch of job-site mixed concrete, as specified.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

A. All materials used for concrete must be kept clean and free from all foreign matter during transportation and handling and kept separate until measured and placed in the mixer. Bins or platforms having hard clean surfaces shall be provided for storage. Suitable means shall be taken during hauling, piling and handling to ensure that segregation of the coarse and fine aggregate particles does not occur and the grading is not affected.

1.5 CONCRETE COORDINATION MEETING

A. A Concrete Coordination Meeting shall be held to review the detailed requirements of CONTRACTOR'S proposed concrete design mixes, to determine the procedures for producing proper concrete construction, and to clarify the roles of the parties involved shall be held no later than 14 days after the Notice to Proceed.

B. All parties involved in the concrete Work shall attend the conference, including but not limited to the following:
   1. CONTRACTOR'S representative.
   2. Testing laboratory representative.
   3. Concrete subcontractor.
   4. Reinforcing steel subcontractor and detailer.
   5. Concrete supplier.
   6. Admixture manufacturer's representative.
   7. ENGINEER.

C. The Concrete Coordination Meeting shall be held at a mutually agreed upon time and place. The ENGINEER shall be notified no less than five days prior to the date of the Concrete Coordination Meeting.

D. Minutes of the meeting shall be taken and distributed to all attendees and concerned parties within five days.

PART 2 - PRODUCTS

2.1 GENERAL

A. All admixtures, curing compounds, etc. used in concrete or the curing and repair of concrete, which can contact potable water, shall be certified as conforming to the requirements of ANSI/NSF 61 for contact with potable water when in the finished concrete.

B. Maximum total chloride ion content for concrete mix including all ingredients measured as a weight percent of cement in accordance with ASTM C1218:
   1. Prestressed concrete: 0.06.
   2. All other concrete: 0.10.

2.2 CEMENTITIOUS MATERIALS

A. Cement:
   1. Portland cement, ASTM C 150, Type II or V.
   2. Use Portland cement made by a well-known acceptable manufacturer and produced by not more than one plant. Alternate cement sources may be used provided that a mix design has been accepted and a trial batch verifying performance has been made.
   3. Do not use cement which has deteriorated because of improper storage or handling.

B. Fly Ash Mineral Admixture:
   1. Mineral admixtures, when used, shall meet the requirements of ASTM C 618 Class F, except as follows:
      a. The loss on ignition shall be a maximum of 4 percent.
      b. The maximum percent of sulfur trioxide (SO3) shall be 4.0.
   2. Fly ash shall be considered to be a cementitious material.
   3. Laboratory trial batches shall be tested to determine compliance with strength requirements, times of setting, slump, slump loss, and shrinkage characteristics.
   4. A substitution by weight, of the portland cement by fly ash, so that the total tricalcium aluminate content of the resulting cement plus fly ash is not greater than eight percent, will be considered. However, the fly ash shall not exceed 25 percent by weight of the cement plus fly ash.

2.3 AGGREGATES

A. General:
   1. Aggregates shall conform to the requirements of ASTM C 33 and as herein specified.
   2. Do not use aggregates containing soluble salts or other substances such as iron sulfides, pyrite, marcasite, ochre, or other materials that can cause stains on exposed concrete surfaces.

3. Do not use aggregates that may be deleteriously reactive when combined with alkalis in cement.
    a. Evaluate proposed aggregates for potential deleterious expansion due to alkali silica reactivity per ASTM C33, ASTM C227, ASTM C1260, ASTM 1293, or ASTM C1567.

B. Fine Aggregate: Clean, sharp, natural sand free from loam, clay, lumps or other deleterious substances.
    1. Dune sand, bank run sand and manufactured sand are not acceptable.

C. Coarse Aggregate: Clean, uncoated, processed aggregate containing no clay, mud, loam, or foreign matter, as follows:
    1. Crushed stone, processed from natural rock or stone.
    2. Washed gravel, either natural or crushed. Use of slag and pit or bank run gravel is not permitted.
    3. Lightweight Aggregate: ASTM C 330.

2.4 WATER

A. Water used in the production and curing of concrete shall be clean and free from injurious amounts of oils, acids, alkalis, organic materials or other substances that may be deleterious to concrete or steel.

2.5 CONCRETE ADMIXTURES

A. Provide admixtures produced by established reputable manufacturers, and use in compliance with the manufacturer's printed instructions. All admixtures shall be compatible and by a single manufacturer capable of providing qualified field service representation. To ensure quality and consistency admixture manufacturer shall have ISO 9001 Certification. Admixtures shall not contain thiocyanates nor more than 0.05 percent chloride ion, and shall be non-toxic in the concrete mix after 30 days. Do not use admixtures that have not been incorporated and tested in the accepted mixes, unless otherwise authorized in writing by ENGINEER.

B. Air-Entraining Admixtures: Provide air entraining admixtures complying with ASTM C 260, and that are vinsol resin or vinsol resin based.
    1. Product and Manufacturer: Provide one of the following:
        a. SIKA AER or SIKA AEA-15, as manufactured by Sika Corporation.
        b. MB-VR, as manufactured by BASF.
        c. Daravair 1000, as manufactured by Grace Construction Products.
        d. Eucon Series as manufactured by Euclid Chemical Company.
        e. Or equal.

C. Water-Reducing Admixture: ASTM C 494, Type A.
    1. Proportion all Type "1" “2” and “3” concrete with non-air entraining, normal setting, water-reducing, aqueous solution of a modification of the salt of

polyhydroxylated organic acids. The admixture shall not contain any lignin, nitrates or chlorides added during manufacture.

2. Product and Manufacturer: Provide one of the following:
   a. Eucon or Plastol Series, as manufactured by Euclid Chemical Company.
   b. Pozzolith series, as manufactured by Master Builders, Inc.
   c. WRDA-15, as manufactured by W.R. Grace & Company.
   d. Plastocrete 161 or Plastiment NS, as manufactured by Sika Corporation.
   e. Or equal.

D. High Range Water-Reducing Admixture (HRWR): ASTM C 494, Type F/G.
   1. High range water-reducer shall be used in classifications of concrete, where specified, and shall be permitted, at CONTRACTOR'S option, in all other classifications of concrete. It shall be added to concrete in compliance with the manufacturer's printed instructions. The specific admixture formulation shall be as recommended by the manufacturer for the project conditions. Provide one of the following:
      a. Sikament series, as manufactured by Sika Corporation.
      b. Rheobuild series, as manufactured by Master Builders, Inc.
      c. Daracem-100, as manufactured by W.R. Grace & Company.
      d. Eucon or Plastol Series, as manufactured by the Euclid Chemical Company.
      e. Or equal.

E. Set-Control Admixtures: ASTM C 494, as follows:
   1. Type B, Retarding.
   2. Type C, Accelerating.
   3. Type D, Water-reducing and Retarding.
   4. Type E, Water-reducing and Accelerating.
   5. Type F, Water-reducing, high range admixtures.
   6. Type G, Water-reducing, high range, and retarding admixtures.

F. Calcium Chloride: Calcium chloride shall not be used.

G. Shrinkage Reducing Admixture:
   1. A shrinkage reducing admixture shall be permitted to be used in the mix design where necessary to meet specified shrinkage limitations provided that specified strength requirements are met and there is no reduction in sulfate resistance and no increase in permeability.
   2. Conform to ASTM C494, Type S.
   3. Shrinkage reducing admixtures shall be one of the following:
      a. Eclipse, as manufactured by Grace Construction Products.
      b. Tetraguard AS20, as manufactured by Master Builders, Inc.
      c. Eucon SRA, as manufactured by The Euclid Chemical Company.
      d. Or equal.

H. Synthetic Macrofibers:

1. Conform to ASTM C1116, Type III
   a. Minimum length: 1.5 IN
   b. Aspect ratio: 50 to 90.
2. Acceptable manufacturers:
   a. MasterFiber MAC Series by BASF Corporation.
   b. Strux 90/40 by GCP Applied Technologies, Inc.
   c. Tuf-Strand SF by Euclid Chemical Company.
   d. Sika Fibermesh-650 by Sika Corporation.

I. If super plasticizers are used in mix designs, the mix shall be slumped at jobsite prior to addition of plasticizer.

2.6 PROPORTIONING AND DESIGN OF MIXES

A. Prepare concrete design mixes subject to the following limitations:

Classification	Coarse Aggregate	Min. Cementious (lbs/cu yd)	Max W/C	Slump	Air	Min. Comp. Strength (psi)
Type "1"	#57	564	0.42	4"	4 ½	4500
Type "2"	#8	517	0.50	6"	1 ½	3000
Type "3"	#67	611	0.42	4"	4 ½	5000
Type "4"	Any ASTM C33	No requirements				150

1. The slumps listed are prior to the addition of high range water reducer (super plasticizer).
2. Mix designs shall be made for all but Type "4", which does not require a trial batch, so that the compressive strength achieved for the laboratory trial batches will be no less than 125 percent of the specified design strength. This is to assure meeting the design strength for all concrete batched during the project.
3. The quantity of water to be used in the determination of the water-cementitious materials ratio shall include free water on aggregates in excess of SSD and the water portion of admixtures.
4. Allowable tolerance for air content at the point of delivery is +/- 1.5 percent.

B. Use an independent testing facility acceptable to ENGINEER for preparing and reporting proposed mix designs.
   1. The testing facility shall not be the same as used for field quality control testing.

C. Submit written reports of laboratory trial batch test results for proposed mixes of concrete to ENGINEER at least 15 days prior to start of Work. Do not begin concrete production until mixes have been approved by ENGINEER.

D. Adjustment to Concrete Mixes: Mix design adjustments may be requested by CONTRACTOR when characteristics of materials, job conditions, weather, test results, or other circumstances warrant; at no additional cost to the OWNER and as accepted by ENGINEER. Laboratory test data for revised mix designs and strength results must be submitted to and accepted by ENGINEER before using the revised mixes.

E. Admixtures:
   1. Use air-entraining admixture in all concrete, unless otherwise shown or specified. Add air-entraining admixture at the manufacturer's prescribed rate to result in concrete at the point of placement having air content within the prescribed limits.
   2. Use amounts of admixtures as recommended by the manufacturer for climatic conditions prevailing at the time of placing. Adjust quantities and types of admixtures as required to maintain quality control.
   3. Do not steel trowel air-entrained concrete.

F. Slump Limits with High Range Water Reducer:
   1. Slump shall not exceed 4-inches prior to adding high range water-reducer and shall not exceed 8 inches, measured at point of placement, after adding high range water reducer.

G. Synthetic Macrofibers:
   1. Dosage:
      a. All concrete members:
         1) Fiber dosage shall provide a minimum fiber required residual strength (fe3) value, as follows, in accordance with ASTM C1609:
            a) 10 IN thick element: fe3 = 170 PSI
            b) Over 10 IN thick element: fe3 = 150 PSI
         2) Under no circumstance shall dosage be less than 3 LBS per cubic yard
      b. Final dosage rates to be determined by Contractor and concrete supplier as required to meet the specified minimum average residual strength.
   2. Provide synthetic macrofibers in the following concrete members:
      a. Concrete fill.
      b. Other locations as specified on the Drawings
   3. Uniformly disperse in concrete mixtures.

H. Shrinkage Limitation:
   1. The maximum concrete shrinkage for specimens cast in the laboratory from the trial batch, as measured at 28-day drying age shall be 0.040 percent. Only use a mix design for construction that has first met the trial batch shrinkage requirements. Shrinkage limitations apply only to Type “1” concrete.

2.7 BONDING AGENT

A. Provide epoxy and epoxy-cement bonding agents as specified in Section 03251, Concrete Joints.

2.8 CONCRETE CURING MATERIALS

A. Absorptive Cover: Burlap cloth made from jute or kenaf, weighing approximately 10 ounces per square yard and complying with AASHTO M 182, Class 3.

B. Curing Mats: Curing mats shall be heavy carpets or cotton mats, quilted at 4-inches on center. Curing mats shall weigh a minimum of 12 ounces per square yard when dry.

C. Moisture Retaining Cover: One of the following, complying with ASTM C 171.
   1. Waterproof paper.
   2. Polyethylene film.
   3. White burlap-polyethylene sheet.

D. Curing Compound: ASTM C 309 Type 1-D (water retention requirements):
   1. Product and Manufacturer: Provide one of the following:
      a. Super Diamond Clear VOX, as manufactured by The Euclid Chemical Company.
      b. 1100 Clear, as manufactured by W.R. Meadows, Incorporated.
      c. Atlas Res-Cure, as manufactured by Atlas Tech Products.
      d. Or equal.
   2. Provide fugitive dye.
   3. Curing compound must be applied by roller or power sprayer.

2.9 FINISHING AIDS

A. Evaporation Retardant:
   1. Product and Manufacturer: Provide one of the following:
      a. Confilm, as manufactured by BASF.
      b. Eucobar, as manufactured by Euclid Chemical Company.
      c. SikaFilm by Sika Corporation.
      d. Or equal.

2.10 CONCRETE REPAIR MATERIALS

A. Concrete repair mortar shall be a prepackaged polymer-modified cementitious repair mortar with the following minimum properties:
   1. Compressive strength at one day: 2000 psi (ASTM C 109).
   2. Compressive strength at 28 days: 7000 psi (ASTM C 109).
   3. Bond strength at 28 days: 1800 psi (ASTM C 882 modified).

B. Concrete repair mortar shall be:

1. Five Star Structural Concrete, manufactured by Five Star Products, Inc. The formulation recommended by the manufacturer for the specific application conditions shall be used.
2. SikaTop 122 Plus, SikaTop 123 Plus, SikaTop 111 Plus, or Sikacem 133, manufactured by the Sika Corporation. The formulation, among those listed, recommended by the manufacturer for the specific application conditions shall be used.
3. Emaco S88-CA or S66-CR, manufactured by Master Builders Inc. The formulation, among those listed, recommended by the manufacturer for the specific application conditions shall be used.
4. Verticoat, Verticoat Supreme, EucoRepair V100 or EucoRepair SCC, as manufactured by the Euclid Chemical Company. The formulation, among those listed, recommended by the manufacturer for the specific application conditions shall be used.
5. Or equal.

C. Cement Mortar:
1. Speed Crete Red Line, as manufactured by The Euclid Chemical Company.
2. Or equal.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine the substrate and the conditions under which Work is to be performed and notify ENGINEER, in writing, of unsatisfactory conditions. Do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to ENGINEER.

3.2 CONCRETE MIXING

A. General:
1. Concrete may be produced at batch plants or it may be produced by the ready-mixed process. Batch plants shall comply with the recommendations of ACI 304, and shall have sufficient capacity to produce concrete of the qualities specified, in quantities required to meet the construction schedule. All plant facilities are subject to testing laboratory inspection and acceptance of ENGINEER.

B. Ready-Mix Concrete:
1. Comply with the requirements of ASTM C 94, and as herein specified. Proposed changes in mixing procedures, other than herein specified, must be accepted by ENGINEER before implementation.
   a. Plant equipment and facilities: Conform to National Ready-Mix Concrete Association "Plant and Delivery Equipment Specification".

b. Mix concrete in revolving type truck mixers that are in good condition and which produce thoroughly mixed concrete of the specified consistency and strength.
c. Do not exceed the proper capacity of the mixer.
d. Mix concrete for a minimum of two minutes after arrival at the job site, or as recommended by the mixer manufacturer.
e. Do not allow the drum to mix while in transit.
f. Mix at proper speed until concrete is discharged.
g. Maintain adequate facilities at the job site for continuous delivery of concrete at the required rates.
h. Provide access to the mixing plant for ENGINEER at all times.

2. When silica fume is used in the dry compacted form, the following mix requirements shall be followed to ensure full dispersion.
   a. For all types of mixing equipment, mix times shall be increased by 40 percent over the minimum mix time required to achieve mix uniformity as defined by ASTM C 94.
   b. For truck-mixed and central mixed concrete, maximum allowable batch size shall be 80 percent of the maximum in accordance with ASTM C 94.

C. Maintain equipment in proper operating condition, with drums cleaned before charging each batch. Schedule rates of delivery in order to prevent delay of placing the concrete after mixing, or holding dry-mixed materials too long in the mixer before the addition of water and admixtures.

3.3 TRANSPORTING CONCRETE

A. Transport and place concrete not more than 90 minutes after water has been added to the dry ingredients.

B. Take care to avoid spilling and separation of the mixture during transportation.

C. Do not place concrete in which the ingredients have been separated.

D. Do not retemper partially set concrete.

E. Use suitable and approved equipment for transporting concrete from mixer to forms.

3.4 PREPARTION FOR CONCRETING

A. All reinforcement, installation of waterstop and positioning of embedded items shall be inspected and approved by the ENGINEER a minimum of four hours prior to concrete placement.

B. Subgrade surfaces shall be thoroughly wetted by sprinkling, prior to the placing of any concrete, and these surfaces shall be kept moist by frequent sprinkling up to

the time of placing concrete thereon. The surface shall be free from standing water, mud, and debris at the time of placing concrete.

C. All reinforcing steel and embedded items shall be completely cleaned of mortar, loose rust, form release compounds, dirt, or any other substance which would interfere with proper bonding with concrete. Protective coatings on embedded aluminum items shall continuously cover the surface to be in contact with concrete. Any defects in the coating shall be repaired.

D. No concrete shall be placed in any structure until all water entering the space to be filled with concrete has been properly cut off or has been diverted by pipes, or other means, and carried out of the forms, clear of the work. No concrete shall be deposited underwater nor shall CONTRACTOR allow still water to rise on any concrete until the concrete has attained its initial set. Water shall not be permitted to flow over the surface of any concrete in such manner and at such velocity as will injure the surface finish of the concrete. Pumping or other necessary dewatering operations for removing ground water, if required, will be subject to the review of the ENGINEER.

E. Joint surfaces shall be prepared as required by Section 03251, Concrete Joints.

3.5 CONCRETE PLACEMENT

A. General: Place concrete continuously so that no concrete will be placed on concrete that has hardened sufficiently to cause the formation of seams or planes of weakness within the section. If a section cannot be placed continuously, provide construction joints as specified in Section 03251, Concrete Joints. Deposit concrete as nearly as practical in its final location to avoid segregation due to rehandling or flowing. Do not subject concrete to any procedure which will cause segregation.
   1. Screed concrete that is to receive other construction to the proper level to avoid excessive skimming or grouting.
   2. Do not use concrete which becomes non-plastic and unworkable, or does not meet the required quality control limits, or which has been contaminated by foreign materials. Do not use retempered concrete. Remove rejected concrete from the job site and dispose of it in an acceptable location.
   3. Do not place concrete until all forms, bracing, reinforcement, and embedded items are in final and secure position.
   4. Unless otherwise approved, place concrete only when ENGINEER is present.
   5. Allow a minimum of three days before placing concrete against a slab or wall already in place.

B. Bonding for Next Concrete Pour:
   1. Prepare for bonding of fresh concrete to new concrete that has set but is not fully cured, as follows:
      a. Thoroughly wet the surface, but allow no free standing water.

b. For horizontal surfaces place a 2-inch layer of mortar, one part sand and one part cement with water added to a flowable consistency, or a 6-inch layer of Construction Joint Grout, as specified in Section 03600, Grout, over the hardened concrete surface.
c. Place fresh concrete before the mortar/grout has attained its initial set.
d. If a high range water reducer is used to increase the concrete slump to at least 6-inches, the mortar/grout layer may be omitted.

2. Bonding of fresh concrete to fully-cured hardened existing concrete shall be accomplished by using a bonding agent as specified in Section 03251, Concrete Joints.

C. Concrete Conveying:
1. Handle concrete from the point of delivery and transfer to the concrete conveying equipment and to the locations of final deposit as rapidly as practical by methods that will prevent segregation and loss of concrete mix materials.
2. Provide mechanical equipment for conveying concrete to ensure a continuous flow of concrete at the delivery end. Provide runways for wheeled concrete conveying equipment from the concrete delivery point to the locations of final deposit. Keep interior surfaces of conveying equipment, including chutes, free of hardened concrete, debris, water, ice and other deleterious materials.
3. Do not use chutes for distributing concrete, unless approved in writing by ENGINEER.
a. Provide sketches showing methods by which chutes will be employed when requesting such approval.
b. Design chutes, if permitted, with proper slopes and supports to permit efficient handling of the concrete.
4. Pumping concrete is permitted, however do not use aluminum pipe for conveying.

D. Placing Concrete into Forms:
1. Deposit concrete in forms in horizontal layers not deeper than 18-inches and in a manner to avoid inclined construction joints. Where placement consists of several layers, place concrete at such a rate that concrete that is being integrated with fresh concrete is still plastic.
2. Do not permit concrete to free fall within the form from a distance exceeding four feet. Where high range water reducer is used to extend slump to at least 6- inches, the maximum free fall of concrete may be increased to six feet. If a 12-inch thick layer of construction joint grout, as specified in Section 03251, Concrete Joints, is placed on the horizontal joint, concrete with slump extended by a high range water reducer may free fall up to eight feet in walls that are 24-inches and thicker. Use "elephant trunks" to prevent free fall and excessive splashing on forms and reinforcement. Free falls in excess of four feet shall be discontinued if there is any evidence of segregation.
3. Remove temporary spreaders in forms when concrete placing has reached the elevation of such spreaders.

4. Consolidate concrete placed in forms by mechanical vibrating equipment supplemented by hand-spading, rodding or tamping. Use equipment and procedures for consolidation of concrete in accordance with the applicable recommended practices of ACI 309. Vibration of forms and reinforcing will not be permitted, unless otherwise accepted by ENGINEER.
5. Where height of concrete placement in walls exceeds 14 feet, temporary windows shall be installed in the formwork to facilitate vibration. The windows shall be properly closed when the height of concrete approaches the windows. Location, size, and spacing of the windows shall be determined by CONTRACTOR to suit equipment used.
6. Do not use vibrators to transport concrete inside of forms. Insert and withdraw vibrators vertically at uniformly spaced locations not farther than the visible effectiveness of the machine. Place vibrators to rapidly penetrate the layer of concrete and at least 6-inches into the preceding layer. Do not insert vibrators into lower layers of concrete that have begun to set. At each insertion, limit the duration of vibration to the time necessary to consolidate the concrete and complete embedment of reinforcement and other embedded items without causing segregation of the mix.
7. Do not place concrete in beam and slab forms until the concrete previously placed in columns and walls is no longer plastic.
8. Force concrete under pipes, sleeves, openings and inserts from one side until visible from the other side to prevent voids.

E. Placing Concrete Slabs:
1. Deposit and consolidate concrete slabs in a continuous operation, within the limits of construction joints, until the placing of a panel or section is completed.
2. Consolidate concrete during placing operations using mechanical vibrating equipment, so that concrete is thoroughly worked around reinforcement and other embedded items and into corners.
3. Consolidate concrete placed in beams and girders of supported slabs, and against bulkheads of slabs on ground, as specified for formed concrete structures.
4. Bring slab surfaces to the correct level. Smooth the surface, leaving it free of humps or hollows. Do not sprinkle water on the plastic surface. Do not disturb the slab surfaces prior to beginning finishing operations.
5. Where slabs are placed in conditions of high temperature or wind that could lead to formation of plastic shrinkage cracks, an evaporation retardant shall be applied in accordance with the manufacturer's recommendations, when required by the ENGINEER.

F. Quality of Concrete Work:
1. Make all concrete solid, compact and smooth, and free of laitance, cracks and cold joints.
2. All concrete for liquid retaining structures, and all concrete in contact with earth, water, or exposed directly to the elements shall be watertight.

3. Cut out and properly replace to the extent directed by ENGINEER, or repair to the satisfaction of ENGINEER, surfaces which contain cracks or voids, are unduly rough, or are in any way defective. Thin patches or plastering shall not be acceptable.
4. All leaks through concrete that exhibit any flowing water, and cracks, holes or other defective concrete in areas of potential leakage, shall be repaired and made watertight by CONTRACTOR.
5. Repair, removal, and replacement of defective concrete as directed by ENGINEER shall be at no additional cost to the OWNER.

G. Cold Weather Placing:
1. Protect all concrete Work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures, in compliance with the requirements of ACI 306 and as herein specified.
2. When the air temperature has fallen to or may be expected to fall below 40°F, provide adequate means to maintain the temperature, in the area where concrete is being placed, at between 50°F and 70°F for at least seven days after placing. Provide temporary housings or coverings including tarpaulins or plastic film. Maintain the heat and protection, if necessary, to ensure that the ambient temperature does not fall more than 30°F in the 24 hours following the seven-day period. Avoid rapid dry-out of concrete due to overheating, and avoid thermal shock due to sudden cooling or heating.
3. When air temperature has fallen to or is expected to fall below 40°F, uniformly heat all water and aggregates before mixing as required to obtain a concrete mixture temperature of not less than 55°F and not more than 85°F at point of placement.
4. Do not use salt and other materials containing antifreeze agents or chemical accelerators, or set-control admixtures, unless approved by ENGINEER, in mix designs.

H. Hot Weather Placing:
1. When hot weather conditions exist that would seriously impair the quality and strength of concrete, place concrete in compliance with ACI 305 and as herein specified.
2. When ambient air temperature is at or above 90°F, cool ingredients before mixing to maintain concrete temperature at time of placement below 80°F when the air temperature is rising and below 85°F when the air temperature is falling. Mixing water may be chilled, or chopped ice may be used to control the concrete temperature provided the water equivalent of the ice is calculated in the total amount of mixing water. In addition, the reduction in time from addition of mix water to placement or the use of a set retarding admixture may be required.
3. Cover reinforcing steel with water-soaked burlap if it becomes too hot, so that the steel temperature will not exceed the ambient air temperature immediately before embedment in concrete.
4. Wet forms thoroughly before placing concrete.

5. Do not place concrete at a temperature so as to cause difficulty from loss of slump, flash set, or cold joints.
6. Do not use set-control admixtures, unless approved by ENGINEER in mix designs.
7. Obtain ENGINEER'S approval of other methods and materials proposed for use.

3.6 FINISH OF FORMED SURFACES

A. Standard Form Finish:
   1. Standard form finish shall be basically smooth and even but shall be permitted to have texture imparted by the form material used. Defects shall be repaired as specified herein.
   2. Use standard form finish for the following:
      a. Exterior vertical surfaces from the foundation up to one foot below grade.
      b. Vertical surfaces not exposed to view.
      c. Other areas shown.

B. Smooth Form Finish:
   1. Produce smooth form finish by selecting form materials that will impart a smooth, hard, uniform texture. Arrange panels in an orderly and symmetrical manner with a minimum of seams. Repair and patch defective areas as specified herein.
   2. Use smooth form finish for the following:
      a. Exterior surfaces that are exposed to view.
      b. Surfaces that are to be covered with a coating material. The material may be applied directly to the concrete or may be a covering bonded to the concrete such as waterproofing, dampproofing, painting or other similar system.
      c. Interior vertical surfaces of liquid containers.
      d. Interior and exterior exposed beams and undersides of slabs.
      e. Surfaces to receive an abrasive blasted finish.
      f. Surfaces to receive a smooth rubbed or grout cleaned finish.
      g. Other areas shown.

C. Smooth Rubbed Finish:
   1. Provide smooth, Class A, rubbed finish to concrete surfaces, which have received smooth form finish and where all defects have been repaired, as follows:
      a. Rubbing of concrete surfaces not later than the day after form removal.
      b. Moistening of concrete surfaces and rubbing with carborundum brick or other abrasive until a uniform color and texture is produced. Do not apply cement grout other than that created by the rubbing process.
   2. Except where surfaces have been previously covered as specified above, use smooth, Class A, rubbed finish for the following:
      a. Where indicated on the Drawings.

D. Grout Cleaned Finish:
   1. Provide grout cleaned finish to concrete surfaces, which have received smooth form finish and where all defects have been repaired, as follows:
      a. Combine one part portland cement to 1-1/2 parts fine sand by volume, and mix with water to the consistency of thick paint. Blend standard portland cement and white portland cement, amounts determined by trial patches, so that the final color of dry grout will closely match adjacent concrete surfaces.
      b. Thoroughly wet the concrete surface and apply grout uniformly by brushing or spraying immediately to the wetted surfaces. Scrub surface with cork float or stone to coat surface and fill surface holes. Remove excess grout by scraping, followed by rubbing with clean burlap to remove any visible grout film. Keep grout damp during the setting period by means of fog spray at least 36 hours after final rubbing. Complete any area in the same day it is started, with the limits of any area being natural breaks in the finished surface.
   2. Except where surfaces have been previously covered as specified above, use grout cleaned finish for the following:
      a. Where indicated on the Drawings.

E. Abrasive Blasted Finish:
   1. Provide abrasive blasted finish where shown.
   2. Where abrasive blasted finish is indicated, it shall be applied to a smooth formed finish after the end of the curing period, with all defects repaired, to match the approved finish provided on the mock-up panel.
   3. Heavy Abrasive Blasted Finish: Abrasive blast to uniformly expose coarse aggregate.
   4. Light Abrasive Blasted Finish: Abrasive blast to uniformly expose fine aggregate.

F. Related Unformed Surfaces:
   1. At tops of walls, horizontal offsets, and similar unformed surfaces occurring adjacent to formed surfaces, strike off smooth and finish with a texture matching the adjacent formed surfaces. Continue the final surface treatment of formed surfaces uniformly across the adjacent unformed surfaces, unless otherwise shown.

3.7 SLAB FINISHES

A. Float Finish:
   1. After placing concrete slabs, do not work the surface further until ready for floating. Begin floating when the surface water has disappeared or when the concrete has stiffened sufficiently. Check and level the surface plane to a tolerance not exceeding 1/4-inch in ten feet when tested with a ten foot straightedge placed on the surface at not less than two different angles. Cut down high spots and fill all low spots. Uniformly slope surfaces to drains.

Immediately after leveling, refloat the surface to a uniform, smooth, granular texture.

2. Use float finish for the following:
   a. Interior exposed horizontal surfaces of liquid containers, except those to receive grout topping.
   b. Exterior below grade horizontal surfaces.
   c. Surfaces to receive additional finishes, except as shown or specified.

B. Trowel Finish:
1. After floating, begin the first trowel finish operation using a power-driven trowel. Begin final troweling when the surface produces a ringing sound as the trowel is moved over the surface.
2. Consolidate the concrete surface by the final hand troweling operation. Finish shall be free of trowel marks, uniform in texture and appearance, and with a surface plane tolerance not exceeding 1/8-inch in ten feet when tested with a ten foot straight edge. Grind smooth surface defects that would telegraph through applied floor covering system.
3. Use trowel finish for the following:
   a. Interior exposed slabs, unless otherwise shown or specified.
   b. Slabs to receive resilient floor finishes.

C. Non-Slip Broom Finish:
1. Immediately after float finishing, slightly roughen the concrete surface by brooming in the direction perpendicular to the main traffic route. Use fine fiber-bristle broom, unless otherwise directed by the ENGINEER. Coordinate the required final finish with ENGINEER before application.
2. Use Non-Slip Broom Finish for the following:
   a. Exterior exposed horizontal surfaces subject to light foot traffic.
   b. Interior and exterior concrete steps and ramps.
   c. Horizontal surfaces which will receive a grout topping or a concrete equipment base slab.

3.8 CONCRETE CURING AND PROTECTION

A. General:
1. Protect freshly placed concrete from premature drying and excessive cold or hot temperature, and maintain without drying at a relatively constant temperature for the period of time necessary for hydration of the cement and proper hardening of the concrete.
2. Start initial curing after placing and finishing concrete as soon as free moisture has disappeared from the concrete surface. Keep continuously moist for not less than 72 hours.
3. Begin final curing procedures immediately following initial curing and before the concrete has dried. Continue final curing for at least seven days and in accordance with ACI 301 procedures for a total curing period, initial plus final, of at least ten days. For concrete sections over 30-inches thick, continue final

curing for an additional seven days, minimum. Avoid rapid drying at the end of the final curing period.

B. Curing Methods:
   1. Water retaining and below grade structures shall be moist cured by the addition of water to maintain the surface in a continually wet condition. Other concrete shall be cured by moist curing, by moisture retaining cover curing, or by the use of curing compound. Use curing compound at water retaining and below grade structures only in cold weather and only when permitted by ENGINEER.
      a. For curing, use water that is free of impurities that could etch or discolor exposed, natural concrete surfaces.
   2. Provide moisture curing by any of the following methods:
      a. Keeping the surface of the concrete continuously wet by covering with water.
      b. Continuous water-fog spray.
      c. Covering the concrete surface with curing mats, thoroughly saturating the mats with water, and keeping the mats continuously wet with sprinklers or porous hoses. Place curing mats so as to provide coverage of the concrete surfaces and edges, with a 4-inch lap over adjacent mats. If necessary, the curing cover shall be weighted to maintain contact with the concrete surface.
      d. At the end of the curing period apply one coat of curing compound, unless concrete surface is to receive a topping or coating or application is waived by the ENGINEER.
   3. Provide moisture retaining cover curing as follows:
      a. Cover the concrete surfaces with the specified moisture retaining cover for curing concrete, placed in the widest practical width with sides and ends lapped at least 3-inches and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during the curing period using cover material and waterproof tape.
   4. Provide liquid curing compound as follows:
      a. Apply the specified curing compound to all concrete surfaces when permitted by ENGINEER. Slabs to receive terrazzo floors, chemical resistant heavy duty concrete topping or ceramic tile, shall not be cured with liquid curing compound, but shall be moisture cured. The compounds shall be applied immediately after final finishing in a continuous operation by power spray equipment in accordance with the manufacturer's directions. Recoat areas that are subjected to heavy rainfall within three hours after initial application. Maintain the continuity of the coating and repair damage to the coat during the entire curing period. For concrete surfaces that will be in contact with potable water, the manufacturer shall certify that the curing compound meets the requirements of ANSI/NSF 61.
      b. When curing compound is authorized for application to water retaining or below grade members, it shall be applied at the manufacturer's

recommended coverage rate and then applied again at the same rate to provide twice the recommended coverage.

c. At the end of the curing period, curing compound shall be removed where required by the ENGINEER.

C. Curing Formed Surfaces:

1. Cure formed concrete surfaces; including the undersides of girders, beams, supported slabs and other similar surfaces by moist curing with the forms in place unloosened for the full curing period or until forms are removed. Where wood forms are kept in place, water shall be added to keep the forms wet. If forms are removed, continue curing by methods specified above, as applicable.

D. Curing Unformed Surfaces:

1. Initially cure unformed surfaces, such as slabs, floor topping, and other flat surfaces by using the appropriate method specified above.
2. Final cure unformed surfaces, unless otherwise specified, by utilizing methods specified above, as applicable.

E. Temperature of Concrete During Curing:

1. When the atmospheric temperature is 40°F and below, maintain the concrete temperature between 50°F and 70°F continuously throughout the curing period. When necessary, make arrangement before concrete placing for heating, covering, insulation or housing as required to maintain the specified temperature and moisture conditions continuously for the concrete curing period. Provide cold weather protection complying with the requirements of ACI 306.
2. When the atmospheric temperature is 80°F and above, or during other climatic conditions which will cause too rapid drying of the concrete, make arrangements before the start of concrete placing for the installation of wind breaks or shading, and for fog spraying, wet sprinkling, or moisture retaining covering. Protect the concrete continuously for the concrete curing period. Provide hot weather protection complying with the requirements of ACI 305, unless otherwise specified.
3. Maintain concrete temperature as uniformly as possible, and protect from rapid atmospheric temperature changes. Avoid temperature changes in concrete which exceed 5°F in any one hour and 50°F in any 24 hour period.

F. Protection from Mechanical Injury:

1. During the curing period, protect concrete from damaging mechanical disturbances including load stresses, heavy shock, excessive vibration, and from damage caused by rain or flowing water. Protect all finished concrete surfaces from damage by subsequent construction operations.

3.9 FIELD QUALITY CONTROL

A. The OWNER shall employ a testing laboratory to perform field quality control testing. ENGINEER will direct the number of tests and cylinders required. Make standard compression test cylinders and entrained air tests as specified below, under the direct inspection by ENGINEER. Also, provide all labor, material and equipment required including, scale, glass tray, cones, rods, molds, air tester, thermometer, curing in a heated storage box, and all other incidentals required. Above will be subject to approval by ENGINEER. Furnish all necessary storage and curing, and transportation required by the testing.

B. Quality Control Testing During Construction:
   1. Perform sampling and testing for field quality control during the placement of concrete, as follows:
      a. Sampling Fresh Concrete: ASTM C 172.
      b. Slump: ASTM C 143; one test for each concrete load at point of discharge; and one for each set of compressive strength test specimens.
      c. Air Content: ASTM C 231; one for every other concrete load at point of discharge, or when required by an indication of change.
      d. Compressive Strength Tests: ASTM C 39; one set of compression cylinders for each 50 cubic yards or fraction thereof, of each mix design placed in any one day; one specimen tested at seven days, and three specimens tested at 28 days.
         1) Adjust mix if test results are unsatisfactory and resubmit for ENGINEER'S approval.
         2) Concrete that does not meet the strength requirements is subject to rejection and removal from the Work, or to other such corrective measures as directed by ENGINEER, at the expense of CONTRACTOR.
      e. Compression Test Specimens: ASTM C 31; make one set of four standard cylinders for each compressive strength test, unless otherwise directed.
         1) Cast, store and cure specimens as specified in ASTM C 31.
      f. Water Cementitious Materials Ratio: Perform one test from each sample from which compression test specimens are taken in accordance with AASHTO TP 23.
      g. Concrete Temperature: Test hourly when air temperature is 40°F and below, and when 80°F and above; and each time a set of compression test specimens is made.
   2. The testing laboratory shall submit certified copies of test results directly to ENGINEER and CONTRACTOR within 24 hours after tests are made.

C. Evaluation of Quality Control Tests:
   1. Do not use concrete delivered to the final point of placement, which has slump or total air content outside the specified values.
   2. When water content testing indicates water-cementitious materials ratio to exceed specified requirements by more than 0.02, remaining batches needed

to complete the concrete placement shall have water content decreased in the mix and water reducing admixture dosage increased as needed to bring the subsequently batched concrete within the specified water-cementitious materials ratio. Additional testing shall be done to verify compliance with the specified water-cementitious materials ratio. Concrete production for further concrete placements shall not resume until CONTRACTOR has identified the cause of the excess water in the mix and revised batching procedures and/or adjustments to mix design needed to bring water-cementitious materials ratio into conformance with specified requirements have been accepted by Engineer.

3. Compressive strength tests for laboratory-cured cylinders will be considered satisfactory if the averages of all sets of three consecutive compressive strength tests results equal or exceed the 28 day design compressive strength of the type or class of concrete; and, no individual strength test falls below the required compressive strength by more than 500 psi.
    a. Where questionable field conditions may exist during placing concrete or immediately thereafter, strength tests of specimens cured under field conditions will be required by ENGINEER to check the adequacy of curing and protecting of the concrete placed. Specimens shall be molded at the same time and from the same samples as the laboratory cured specimens.
        1) Provide improved means and procedures for protecting concrete when the 28 day compressive strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders.
        2) When laboratory-cured cylinder strengths are appreciably higher than the minimum required compressive strength, field-cured cylinder strengths need not exceed the minimum required compressive strength by more than 500 psi even though the 85 percent criterion is not met.
        3) If individual tests of laboratory-cured specimens produce strengths more than 500 psi below the required minimum compressive strength, or if tests of field-cured cylinders indicate deficiencies in protection and curing, provide additional measures to assure that the load-bearing capacity of the structure is not jeopardized. If the likelihood of low-strength concrete is confirmed and computations indicate the load-bearing capacity may have been significantly reduced, tests of cores drilled from the area in question will be required at CONTRACTOR'S expense.
    b. If the compressive strength tests fail to meet the minimum requirements specified, the concrete represented by such tests will be considered deficient in strength and subject to replacement, reconstruction or to other action approved by ENGINEER.

D. Testing Concrete Structure for Strength:
    1. When there is evidence that the strength of the in-place concrete does not meet specification requirements, employ at CONTRACTOR’S expense the services

of a concrete testing service to take cores drilled from hardened concrete for compressive strength determination. Tests shall comply with the requirements of ASTM C 42 and the following:

a. Take at least three representative cores from each member or suspect area at locations directed by ENGINEER.
b. Strength of concrete for each series of cores will be considered satisfactory if their average compressive strength is at least 85 percent and no single core is less than 75 percent of the 28 day required compressive strength.
c. Report test results to ENGINEER, in writing, on the same day that tests are made. Include in test reports, the Project identification name and number, date, name of CONTRACTOR, name of concrete testing service, location of test core in the structure, type or class of concrete represented by core sample, nominal maximum size aggregate, design compressive strength, compression breaking strength and type of break (corrected for length-diameter ratio), direction of applied load to core with respect to horizontal plane of the concrete as placed, and the moisture condition of the core at time of testing.

2. Fill core holes solid with non-shrink, high strength grout, and finish to match adjacent concrete surfaces.
3. Conduct static load test and evaluations complying with the requirements of ACI 318 if the results of the core tests are unsatisfactory, or if core tests are impractical to obtain, as directed by ENGINEER.

3.10 MISCELLANEOUS CONCRETE ITEMS

A. Temporary Openings
1. Openings in concrete walls and/or slabs required for passage of Work or installation of equipment and not shown on the Drawings shall be provided, but only with approval of the ENGINEER.
2. All temporary openings made in concrete shall be provided with waterstop in below grade or water retaining members. Continuity of required reinforcement shall be provided in a manner acceptable to the ENGINEER.
3. Temporary openings left in concrete structures shall be filled with concrete after the Work causing the need for the opening is in place, unless otherwise shown or directed. Mix, place and cure concrete as specified herein, to blend with in-place construction. Provide all other miscellaneous concrete filling shown or required to complete the Work.

B. Equipment Bases:
1. Unless specifically shown otherwise, provide concrete bases for all pumps and other equipment. Coordinate and construct bases to the dimensions shown, or as required to meet manufacturers; requirements and Drawing elevations. Where no specific elevations are shown, bases shall be 6-inches thick and extend 3-inches outside the metal equipment base or supports. Bases shall have smooth trowel finish, unless a special finish such as terrazzo, ceramic tile or

heavy duty concrete topping is required. In those cases, provide appropriate concrete finish.

2. Include all concrete equipment base work not specifically included under other Sections.
3. In general, place bases up to 1-inch below the metal base. Properly shim equipment to grade and fill 1-inch void with non-shrink grout as specified in Section 03600, Grout.

C. Curbs:
   1. Provide monolithic finish to interior curbs by stripping forms while concrete is still green and steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
   2. Exterior curbs shall have rubbed finish for vertical surfaces and a broomed finish for top surfaces.

3.11 CONCRETE REPAIRS

A. Repair of Formed Surfaces:
   1. The following defects shall be repaired in all types of formed finishes:
      a. Spalls, air bubbles, rock pockets, form depressions, and other defects that are more than 1/4-inch in depth.
      b. Holes from tie rods and other form tie systems.
      c. Fins, offsets and other projections that extend more than 1/4-inch beyond the designated member surface.
      d. Structural cracks, as defined by the ENGINEER.
      e. Non-structural cracks, as defined by the ENGINEER, which are greater than 0.010-inch wide. In water retaining members, elevated slabs subject to rainfall and washdown, and below grade members, any crack that shows any amount of leakage. Where it is not possible to verify that a crack is not leaking, it shall be repaired.
   2. The following defects shall be repaired in smooth finish surfaces, in addition to those listed above:
      a. Spalls, air bubbles, rock pockets, form depressions, and other defects which extend to more than 1/2-inch in width in any direction, no matter how deep.
      b. Spalls, air bubbles, rock pockets, form depressions, and other defects of any size that exceed three in number in a 12-inch square or 12 in number in a three foot square.
      c. Fins, offsets and other projections shall be completely removed and smoothed.
      d. Scratches and gouges in the surface.
      e. Texture and color irregularities. At water retaining surfaces, texture and color irregularities need not be repaired when greater than 12-inches below the minimum normal operating water surface, except where such defects are indicative of reduced durability.

3. Where a smooth rubbed or grout cleaned finish is specified, minor surface defects repairable by the finishing process need not be repaired prior to the finish application, when approved by the ENGINEER.

B. Method of Repair of Formed Surfaces:
   1. Repair and patch defective areas with cement mortar or concrete repair mortar immediately after removal of forms and as directed by ENGINEER. Repairs made to water bearing and buried surfaces shall be made with repair mortar only. Repairs of form tie holes on water bearing or buried surfaces shall be made with non-shrink grout as specified in Section 03600, Grout.
   2. Cut out honeycomb, rock pockets, voids, and holes left by tie rods and bolts, down to solid concrete but, in no case, to a depth of less than 1-inch for cement mortar and 1/2-inch for repair mortar. Make edges of cuts perpendicular to the concrete surface. Before placing the cement mortar, thoroughly clean and brush-coat the area to be patched with the specified bonding agent. Where concrete repair mortar is used, bonding agent shall be optional and the surface prepared and mortar placed per manufacturers recommendations.
      a. Repairs at exposed-to-view surfaces shall match the color of surrounding concrete, except color matching is not required for the interior surfaces of liquid containers up to one foot below liquid level. Impart texture to repaired surfaces to match texture of existing adjacent surfaces. Provide test areas at inconspicuous locations to verify mixture, texture and color match before proceeding with the patching. Compact mortar in place and strike off slightly higher than the surrounding surface.
   3. Structural cracks shall be pressure grouted using an injectable epoxy using a pumped pressure system. Apply in accordance with the manufacturer's directions and recommendations.
   4. Non-structural cracks shall be pressure grouted using hydrophilic resin. Apply in accordance with the manufacturer's directions and recommendations.
   5. Determination of the crack type shall be made by the ENGINEER.
   6. Fill holes extending through concrete by means of a plunger- type gun or other suitable device from the least exposed face, using a flush stop held at the exposed face to ensure completely filling. At below grade and water retaining members, fill holes with concrete repair mortar except use a color matched cement mortar for the outer 2-inches at exposed to view surfaces.
   7. Where powerwashing and/or scrubbing is not adequate, abrasive blast exposed-to-view surfaces that require removal of stains, grout accumulations, sealing compounds, and other substances marring the surfaces. Use sand finer than No. 30 and air pressure from 15 to 25 psi.

C. Repair of Unformed Surfaces:
   1. Test unformed surfaces, such as monolithic slabs, for smoothness and to verify surface plane to the tolerances specified for each surface and finish. Correct low and high areas as herein specified.

2. Test unformed surfaces sloped to drain for trueness of slope, in addition to smoothness, using a template having the required slope. Correct high and low areas as herein specified.
3. Repair finish of unformed surfaces that contain defects that adversely affect the durability of the concrete. Surface defects include crazing, cracks in excess of 0.01-inch wide, spalling, popouts, honeycomb, rock pockets, and other objectionable conditions.
4. Repair structural cracks in all structures and non-structural cracks in water-holding structures. In water-holding structures, where the dry face of the concrete member can be observed, cracks that show any rate of water flow shall be repaired. Where the dry face of the member cannot be observed, all cracks shall be repaired.

D. Methods of Repair of Unformed Surfaces:
1. Correct high areas in unformed surfaces by grinding, after the concrete has cured sufficiently so that repairs can be made without damage to adjacent areas.
2. Correct low areas in unformed surfaces during, or immediately after completion of surface finishing operations by cutting out the low areas and replacing with fresh concrete. Finish repaired areas to blend into adjacent concrete. Where the concrete has already set and repairs are required, sawcut around the perimeter of the area to be repaired to a 1/2-inch depth and remove concrete so that the minimum thickness of the repair is 1/2-inch. Apply specified concrete repair mortar in accordance with the manufacturer's directions and recommendations.
3. Repair defective areas, except random cracks and single holes not exceeding 1-inch diameter, by cutting out and replacing with fresh concrete. Remove defective areas to sound concrete with clean, square cuts, and expose reinforcing steel with at least 3/4-inch clearance all around. The minimum thickness of the repair shall be 1.5-inches. Dampen all concrete surfaces in contact with patching concrete and brush with the specified bonding agent. Place patching concrete while the bonding agent is still tacky. Mix patching concrete of the same materials and proportions to provide concrete of the same classification as the original adjacent concrete. Place, compact and finish as required to blend with adjacent finished concrete. Cure in the same manner as adjacent concrete.
4. Repair isolated random non-structural cracks (in members which are not below grade or water retaining), and single holes not over 1-inch diameter, by the dry-pack method. Groove the top of cracks, and cut out holes to sound concrete and clean of dust, dirt and loose particles. Dampen all cleaned concrete surfaces and brush with the specified bonding agent. Place dry-pack before the cement grout takes its initial set. Mix dry-pack, consisting of one part portland cement to 2-1/2 parts fine aggregate passing a No. 16 mesh sieve, using only enough water as required for handling and placing. Compact dry-pack mixture in place and finish to match adjacent concrete. Keep patched areas continuously moist for not less than 72 hours.

5. Structural cracks shall be pressure grouted using an injectable epoxy. Apply in accordance with the manufacturer's directions and recommendations.
6. Non-structural cracks in below grade and water retaining structures shall be pressure grouted using hydrophilic resin. Apply in accordance with the manufacturer's directions and recommendations.
7. Determination of the crack type shall be made by the ENGINEER.
8. Assure that surface is acceptable for flooring material to be installed in accordance with manufacturer's recommendations.

E. Other Methods of Repair:
1. Repair methods not specified above may be used if approved by ENGINEER.

++ END OF SECTION ++

SECTION 03400

PRECAST CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Precast concrete.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Concrete Institute (ACI):
      a. 318, Building Code Requirements for Structural Concrete.
   2. ASTM International (ASTM):
      a. A36, Standard Specification for Carbon Structural Steel.
      b. A108, Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished.
      c. A496, Standard Specification for Steel Wire, Deformed, for Concrete Reinforcement.
      d. A1064, Standard Specification for Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
      e. C33, Standard Specification for Concrete Aggregates.
      f. C150, Standard Specification for Portland Cement.
      g. D2240, Standard Test Method for Rubber Property-Durometer Hardness.
      h. E329, Standard Specification for Agencies Engaged in Construction Inspection and/or Testing.
   3. American Welding Society (AWS):
      a. A5.1, Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding.
      b. A5.5, Specification for Low-Alloy Steel Electrodes for Shielded Metal Arc Welding.
      c. D1.1, Structural Welding Code - Steel.
      d. D1.4, Structural Welding Code - Reinforcing Steel.
      e. D1.6, Structural Welding Code – Stainless Steel.
   4. Occupational Safety and Health Administration (OSHA).
   5. Precast/Prestressed Concrete Institute (PCI):
      a. MNL 116, Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products.
      b. MNL 120, Design Handbook - Precast and Prestressed Concrete.

B. Qualifications:
   1. Provide precast concrete units produced by an active member of PCI.

2. Plant to be certified by the Precast/Prestressed Concrete Institute, Plant Certification Program, as applicable:
    a. Certification Code C1: Precast Concrete Products.
3. Plant shall be certified by IAS and shall be acceptable to the Building Code Official to assure compliance with approved fabricator Special Inspection requirements in accordance with the building code.
    a. Plants that are not certified by IAS or not acceptable to the Building Code Official may be acceptable to work on the Project, provided:
        1) Plant meets all remaining qualifications.
        2) Contractor reimburses the Owner the cost of Special Inspection services.
4. Provide units manufactured by plant which has regularly and continuously engaged in manufacture of units of same type as those required for a minimum of three years.
5. Assure manufacturer's testing facilities meet requirements of ASTM E329.
6. Welding operators and processes to be qualified in accordance with:
    a. AWS D1.1 for welding steel shapes and plates.
    b. AWS D1.4 for welding reinforcing bars.
7. Welding operators to have passed qualification tests for type of welding required during the previous 12 months prior to commencement of welding.
8. Engineer for all precast members: Professional Engineer licensed in the State of Arizona.
    a. Engineer to have minimum five years of experience in design of precast and prestressed members with scope similar to this Project.
9. Precast erector:
    a. Minimum three years of experience with projects of similar size and complexity.

1.3 SUBMITTALS

A. Shop Drawings:
1. Comply with the requirements of Section 01300, Submittals.
2. Product technical data including:
    a. Acknowledgement that products submitted meet requirements of standards referenced.
    b. Manufacturer's installation instructions.
    c. Sizes, types and manufacturer of bearing pads.
    d. Hardware to be utilized to support suspended appurtenances.
3. Shop Drawings and erection plans for precast units, their connections and supports showing:
    a. Member size and location.
    b. Size, configuration, location and quantity of reinforcing bars.
    c. Size and location of openings verified by Contractor.
    d. Size, number, and locations of embedded metal items and connections.
    e. Required concrete strengths.

f. Identification of each unit using same standard marking numbers as used to mark actual units.

4. Calculations for members and connections designed by fabricator.
   a. Calculations to be sealed by a professional Structural Engineer registered in the State in which the Project is constructed.
   b. Perform calculations using the dead load of the members plus the superimposed uniform and concentrated loads shown on the Drawings and indicated in this Specification Section.
5. Concrete mix design(s) including submittal information defined in Specification Section 03300, Cast-in-Place Concrete.
6. Fabricator's quality control documentation for special inspections as required by the building code.
7. Copies of source quality control tests.
8. Certification of manufacturer's testing facility qualifications.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Headed studs and deformed bar anchors:
      a. Nelson Stud Welding Div., TRW, Inc.
      b. KSM Division, Omark Industries.
   2. Bearing pads:
      a. JVI, Inc.

2.2 MATERIALS

A. Embedded Steel Plates and Shapes:
   1. ASTM A36.

B. Bearing Pads:
   1. Under slabs:
      a. Plastic bearing strips.
      b. Minimum compressive strength: 8,000 psi with no fracture at 26,000 psi.
      c. Korolath of New England, Inc., or equal.
   2. For all other locations:
      a. Random, fiber-reinforced elastomeric pads.
      b. Preformed, randomly oriented synthetic fibers set in elastomer.
      c. Capable of supporting a compressive stress of 3000 psi with no cracking, splitting, excessive bulging or delaminating in the internal portions of the pad.
      d. Size pad to keep a minimum stress 200 psi under minimum dead load.
      e. Masticord as manufactured by JVI, Inc., or equal.

C. Cement:
   1. Comply with ASTM C150, Type II or V.

D. Aggregates for Normal Weight Concrete:
   1. ASTM C33 with coarse aggregate meeting the gradation for Size 67 as stated in ASTM C33.
   2. Provide aggregates approved for bridge construction by the State Highway Department in the state where the precast units are fabricated or in the state where the Project is located.
   3. All fine aggregate to be natural not manufactured.

E. Water:
   1. Potable, clean.
   2. Free of oils, acids, and organic matter.

F. Maximum total chloride ion content contributed from all ingredients of concrete including water, aggregates, cement and admixtures measured as a weight percent of cement to not exceed 0.06 for prestressed concrete and 0.10 for all other precast concrete.

G. Reinforcing Steel and Welded Wire Reinforcement: See Specification Section 03200, Concrete Reinforcement.

H. Headed Studs:
   1. ASTM A108.
   2. Minimum yield strength: 50,000 psi.
   3. Minimum tensile strength: 60,000 psi.

I. Deformed Bar Anchors:
   1. ASTM A496 or ASTM A1064.
   2. Minimum tensile strength: 80,000 psi.
   3. Minimum yield strength: 70,000 psi.

J. Electrodes:
   1. E70 series conforming to AWS A5.1/A5.1M or AWS A5.5/A5.5M for welding steel shapes and plates.
   2. E90 series conforming to AWS A5.5/A5.5M for welding rebar.

K. Concrete sand cement grout in keyways between slabs.
   1. See Specification Section 03300, Cast-in-Place Concrete.

2.3 DESIGN

A. General Design Requirements:
   1. Design units and connections in strict accordance with ACI 318 and the PCI MNL 120.

2. Design units for spans, dead load of members, dead and live loads indicated on the Drawings with concentrated loads placed in their actual locations.
    a. Verify weights and locations of concentrated loads.
3. Design units taking into account reduced cross section at openings and penetrations.
4. Provide all reinforcing in units as indicated.
    a. Where not indicated, design and provide all reinforcing subject to approval of Engineer.
5. Design connections to allow rotation and/or movement as appropriate to avoid damage to connections, supporting members, joint sealants and other building components.

2.4 MIXES

A. See Specification Section 03300, Cast-in-Place Concrete.

B. Do not begin fabrication of units until concrete mix design(s) have been approved by Engineer.

2.5 FABRICATION

A. Do not fabricate units until Shop Drawings have been approved by Engineer and returned to Contractor and support locations have been field verified by Contractor.

B. Manufacture, quality, dimensional and erection tolerances of all units to be in accordance with both PCI MNL 116 and PCI MNL 120.

C. Cast all members in smooth rigid forms which will provide straight, true members of uniform thickness and uniform color and finish.

D. Use sand cement grout mixture to fill all air pockets and voids, and to repair chipped edges.

E. Finish all repairs smooth and to match adjacent surface texture and color.

F. Cast openings larger than 6 inches SQ or 6 inches diameter in units at time of manufacture.
    1. Make smaller openings by neat cutting or neat drilling by trades requiring them.
    2. Coordinate sizes and locations of all openings before fabrication of units.

G. Automatically weld headed studs and deformed bar anchors to members to provide full penetration weld between studs, bar anchors and members they are attached to.

H. Weld steel shapes and plates per AWS D1.1 and reinforcing steel per AWS D1.4.

I. Mark each unit as indicated on the erection plans.

J. Place mark on non-exposed-to-view surface.

K. Fabricate the following types of precast and prestressed units (all units to be made with normal weight concrete unless noted otherwise on Drawings):
   1. Precast items shown on Drawings including but not limited to:
      a. Splash blocks.
      b. Precast utility vaults.
      c. Other miscellaneous precast concrete elements shown on Drawings.

2.6 SOURCE QUALITY CONTROL

A. During production of precast concrete units, conduct strength tests of concrete placed in units as required in Specification Section 03300, Cast-in-Place Concrete for concrete placed during fabrication.
   1. Results of strength tests to be sent immediately to Engineer, Contractor and Owner.
   2. Test reports to indicate units they represent.

B. When approved by Engineer, strength tests may be made by precast manufacturer after he has submitted certification that his testing facilities meet the requirements of ASTM E329.

C. Conduct tests on precast concrete using the following procedures:
   1. If the precast manufacturer's quality control program requires more frequent or more stringent testing requirements, the manufacturer's quality control program will take precedence over the specific type of test.
      a. Precast manufacturer to employ services of an independent testing laboratory to perform concrete testing for manufacturer's production procedures (not listed below) and quality control program.
   2. If the precast fabrication plant is not certified by IAS and acceptable to the Building Code Official, Owner will employ and pay for precast concrete production special inspection.
      a. Coordinate with Owner's special inspector.
         1) Provide minimum 7 calendar days notice prior to the start of fabrication.
         2) Provide minimum 24 hours notice prior to fabrication of any precast members.
   3. If precast fabrication plant is certified by IAS and acceptable to the Building Code Official, perform concrete tests as specified in Section 03300, Cast-in-Place Concrete. Frequency of tests: Per PCI MNL-116 or PCI MNL-117 as applicable.

PART 3 - EXECUTION

3.1 PREPARATION

A. Verify acceptability and location of supports to receive units.
   1. Check bearing surfaces to determine that they are level and uniform.

B. Verify compressive strengths of concrete supports.
   1. Do not start erection of units until supports have reached their 28-day required compressive strengths.

3.2 ERECTION

A. Contractor to be responsible for guying, shoring, and bracing of frame, walls and individual members as necessary to resist forces due to wind, erection, or any other source that may occur before structure is completed.

B. Use only erection equipment adequate for placing units at lines and elevations indicated on Drawings.
   1. Do not damage units or existing construction during erection.
   2. Erect units using lifting handles cast into the units.

C. Weld steel shapes and plates per AWS D1.1 and reinforcing steel per AWS D1.4.

D. Fill all keyways between slabs with concrete sand cement grout.
   1. See Specification Section 03300, Cast-in-Place Concrete.

E. After all precast units are erected and all precast unit connections have been made, coat all exposed surfaces of the connections.
   1. See Specification Section 09900, Painting.

3.3 FIELD QUALITY CONTROL

A. Testing and Special Inspections: See Section 01416, Special Inspections.

B. Causes for rejection of units include, but are not necessarily limited to the following:
   1. Cracked units.
   2. Chipped, broken, or spalled edges.
   3. Units not within allowable casting tolerances.
   4. Voids or air pockets which, in opinion of Engineer, are too numerous or too large.
   5. Non-uniform finish or appearance.
   6. Low concrete strength.
   7. Improperly placed embedded items and/or openings.
   8. Exposed wire mesh, reinforcing or prestressing strands.

++ END OF SECTION ++

SECTION 03600

GROUT

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
   1. Provide all labor, materials, equipment, and incidentals as shown, specified and required to furnish and install grout.
   2. Section includes:
      a. Requirements for the grouts, except masonry grouts, referenced on the Contract Drawings and in other Specification Sections.
      b. Types of grouts and their applications. Unless indicated otherwise, provide grouts as listed in this Section whether called for on the Drawings or not

1.2 QUALITY ASSURANCE

A. Reference Standards: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
   1. ACI 211.1, Practice for Selecting Proportions for Normal, Heavy-Weight and Mass Concrete.
   2. ACI 301, Specification for Structural Concrete (Includes ASTM Standards referred to herein).
   3. ASTM C 33, Specification for Concrete Aggregates.
   4. ASTM C 109, Test Method for Compressive Strength of Hydraulic Cement Mortars (using 2-in. or 50 mm. Cube Specimens).
   5. ASTM C 150, Specification for Portland Cement.
   6. ASTM C 230, Specification for Flow Table for use in Tests of Hydraulic Cement.
   7. ASTM C 531, Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical- Resistant Mortars, Grouts, and Monolithic Surfacings.
   8. ASTM C 579, Test Method for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings and Polymer Concretes.
   9. ASTM C 827, Test Method for Early Volume Change of Cementitious Mixtures.
   10. ASTM C 882, Test Method for Bond Strength of Epoxy-Resin Systems Used with Concrete.
   11. ASTM C 937, Specification for Grout Fluidifier for Preplaced-Aggregate Concrete.
   12. ASTM C 939, Test Method for Flow of Grout for Preplaced-Aggregate Concrete (Flow Cone Method).
   13. ASTM C 942, Standard Test Method for Compressive Strength of Grouts for Preplaced-Aggregate Concrete in the Laboratory.

14. ASTM C 1107, Specification for Packaged Dry, Hydraulic-Cement Grout (Non-shrink).
15. ASTM C 1181, Test Method for Compressive Creep of Chemical-Resistant Polymer Machinery Grouts.
16. ASTM D 696, Test Method for Coefficient of Linear Thermal Expansion of Plastics.

B. Field Tests:
1. Compression test specimens will be taken during construction from the first placement of each type of grout, and at intervals thereafter as selected by the ENGINEER to ensure continued compliance with these specifications. The specimens will be made by the ENGINEER or its representative.
2. Compression tests and fabrication of specimens for non-shrink grout will be performed as specified in ASTM C 109 at intervals during construction as selected by the ENGINEER. A set of three specimens will be made for testing at seven days, 28 days, and each additional time period as appropriate.
3. Compression tests and fabrication of specimens for epoxy grout will be performed as specified in ASTM C 579, Method B, at intervals during construction as selected by the ENGINEER. A set of three specimens will be made for testing at seven days, and each earlier time period as appropriate.
4. The cost of all laboratory tests on grout will be borne by the OWNER, but CONTRACTOR provide assistance to the ENGINEER in obtaining specimens for testing. However, the cost of any additional tests and investigation on work performed which does not conform to the requirements of the specifications belongs to CONTRACTOR. Supply all materials necessary for fabricating the test specimens.

1.3 SUBMITTALS

A. Shop Drawings, submit for approval the following:
1. Comply with the requirements of Section 01300, Submittals.
2. For Grout Fill and Construction Joint Grout, copies of grout design mix and laboratory test reports for grout strength tests.
3. Each Shop Drawing Submittal shall include a copy of the relevant Specification Section and shall be clearly marked to indicate whether the requirements for equipment and/or services in the Specification Section are met by writing "accept" or "deviate" next to each Paragraph. If clarifications are needed to any of the Paragraphs in the Specification Sections due to deviations, they shall be addressed next to the Paragraph as such and explained further with any additional information necessary. If any exceptions and/or deviations are proposed to any of the Specifications, they shall be clearly noted as such in the Submittal, and an explanation of any deviation and/or exception shall be provided. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected.

B. Reports and Certificates, submit for approval the following:

1. For proprietary materials, submit copies of manufacturer's certification of compliance with the specified properties for Class I, II, and III grouts.
2. Submit certified testing lab reports for ASTM C 1107 (as revised herein) requirements for Class I and II grouts tested at a fluid consistency for temperatures of 45, 73.4, 90°F with a pot life of 30 minutes at fluid consistency.
3. Submit certification that materials meet specification requirements for nonproprietary materials.
4. Submit certifications that all grouts used on the project are free of chlorides or other chemicals causing corrosion.
5. Manufacturer's written specifications and installation instructions for all proprietary materials.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery of Materials: Grout materials from manufacturers shall be delivered in unopened containers and shall bear intact manufacturer's labels.

B. Storage and Handling of Materials:
1. Grout materials shall be stored in a dry shelter and shall be protected from moisture.
2. Store and precondition all grout and grout materials per grout manufacturer requirements. Provide air conditioned storage facility as may be required.
3. Store grout materials in undamaged condition with seals and labels intact as packaged by the manufacturer.

PART 2 - PRODUCTS

2.1 CEMENT BASED NON-SHRINK GROUTS

A. General:
1. Non-shrink grout shall be a prepackaged, inorganic, non-gas-liberating, cement-based grout requiring only the addition of water. Manufacturer's instructions shall be printed on each bag or other container in which the materials are packaged. The specific formulation for each type of non-shrink grout specified herein shall be that recommended by the manufacturer for the particular application.
2. Provide grout that meets the performance requirements of ASTM C 1107.
3. Use hydraulic cement complying with ASTM C 150, Type I for exposures not in contact with sewage or soils, and Type II (sulfate resistant) for exposures in contact with sewage or soils.
4. Do not add other materials to the grout with the exception of aggregate only as recommended by the manufacturer.
5. The non-shrink property must not be based on a chemically generated gas or gypsum expansion or corrosion expansion.
6. The grout when tested shall not bleed at maximum allowed water.
7. Volume change:

a. The length change from placement to time of final set shall not have a shrinkage greater than the amount of expansion measured at 3 or 14 days. The expansion at 3 or 14 days shall not exceed the 28-day expansion.
b. Range: 0.0 to 0.3 percent when tested in accordance with ASTM C1090.

8. Provide Non-Shrink Non-Metallic Grout wherever "non-shrink grout" is referenced on the Drawings, unless noted otherwise.

B. Non-Shrink Metallic Precision Grout:
1. Application: Use for precision grouting where non-shrink reliability for optimum bearing, high strength, high impact resistance, non-raveling edges, and fluid consistency are required. Not intended for exposures where submerged in water for extended periods of time. Example applications are as follows.
a. Heavy duty machinery and equipment.
b. Bearing plates.
c. Structural base plate or precast concrete bearing for greater than 2 stories.
2. Aggregate: internally reinforced with metallic aggregate.
3. Compressive Strength: Tested per ASTM C 109 or ASTM C 942.
a. Flowable Consistency at 28 days: 9000 psi.
b. Fluid Consistency at 28 days: 7000 psi.
4. Consistency: Shall meet the requirements of ASTM C 1107 (as modified below) when tested using the amount of water required to achieve the following properties:
a. Fluid consistency (20 to 30 seconds) in accordance with ASTM C 939.
b. At temperatures of 45, 73.4, and 95°F.
5. Product and Manufacturer: Provide one of the following:
a. Embeco 885, as manufactured by BASF Construction Chemicals, LLC.
b. Hi-Flow Metallic Grout, as manufactured by the Euclid Chemical Company.
c. Or equal.

C. Non-Shrink Non-Metallic Precision Grout:
1. Application: Use for precision grouting where positive expansion for optimum bearing, high strength, and fluid consistency are required. Example applications are as follows.
a. Machinery and equipment.
b. Bearing plates.
c. Structural steel or precast concrete bearing.
d. Anchor bolts and dowels.
e. Storage tanks and vessels.
2. Aggregate: Provide mineral, non-metallic aggregate.
3. Compressive Strength: Tested per ASTM C 109 or ASTM C 942.
a. Flowable Consistency at 28 days: 9000 psi.
b. Fluid Consistency at 28 days: 7000 psi.
4. Consistency: Shall meet the requirements of ASTM C 1107 (as modified below) when tested using the amount of water required to achieve the following properties:

a. Fluid consistency (20 to 30 seconds) in accordance with ASTM C 939.
b. At temperatures of 45, 73.4, and 95°F.

5. Acceptable Product and Manufacturer:
   a. Masterflow 928, as manufactured by BASF Construction Chemicals, LLC.
   b. NS Grout, as manufactured by the Euclid Chemical Company.
   c. Five Star High Strength Grout, as manufactured by Five Star Products, Inc.
   d. Or equal.

D. Non-Shrink Non-Metallic Grout:
1. Application: Use for general construction grouting where non-shrink, high strength, and flowable to damp pack consistency are required. Example applications are as follows.
   a. Bedding grout for precast panels.
   b. Base plates.
   c. Low-rise Structural steel or precast concrete bearing.
   d. Anchor bolts and dowels.
   e. Damp pack applications.
   f. Filling blocked out spaces for embedded items such as railing posts, gate guide frames, etc.
2. Aggregate: Provide mineral, non-metallic aggregate.
3. Compressive Strength: Tested per ASTM C 109 or ASTM C 942.
   a. Flowable Consistency at 28 days: 7000 psi.
   b. Damp Pack at 28 days: 8000 psi.
4. Consistency: Shall meet the requirements of ASTM C 1107 Grade C and B (as modified below) when tested using the amount of water required to achieve the following properties:
   a. Flowable consistency (125 to 145 percent flow on flow table, ASTM C 230, five drops in 30 seconds.)
   b. Flowable for at least 30 minutes.
5. Product and Manufacturer: Provide one of the following:
   a. Construction Grout, as manufactured by BASF Construction Chemicals, LLC.
   b. Five Star Grout, as manufactured by Five Star Products, Inc.
   c. NC Grout, as manufactured by the Euclid Chemical Company.
   d. Or equal.

2.2 EPOXY GROUTS

A. Non-Shrink Epoxy Grout:
1. Application: Use for high performance grouting under conditions of heavy impact, dynamic, and vibratory loading. Example applications are as follows.
   a. High performance machinery grouting,
   b. Reciprocating engines,
   c. Crane rail grouting,
   d. Precision seating and alignment generators, pumps, and electric motors,
   e. Grouted anchors, bars and dowels.

2. Epoxy grout shall be a pourable, non-shrink, 100 percent solids system. The epoxy grout system shall have three components: resin, hardener, and specially blended aggregate, all premeasured and prepackaged. The resin component shall not contain any non-reactive diluents. Resins containing butyl glycidyl ether (BGE) or other highly volatile and hazardous reactive diluents are not acceptable. Variation of component ratios is not permitted, unless specifically recommended by the manufacturer. Manufacturer's instructions shall be printed on each container in which the materials are packaged. The following properties shall be attained with the minimum quantity of aggregate allowed by the manufacturer.
3. The vertical volume change at all times before hardening shall be between 0.0 percent shrinkage and 4.0 percent expansion when measured according to ASTM C 827 (modified for epoxy grouts by using an indicator ball with a specific gravity between 0.9 and 1.1). Alternately, epoxy grouts which maintain an effective bearing area of not less than 95 percent are acceptable.
4. The length change after hardening shall be negligible (less than 0.0006 in/in) and the coefficient of thermal expansion shall be less than 0.00003 in/in/F when tested in accordance to the requirements of ASTM C 531.
5. The compressive creep at one year shall be negligible (less than .001 in/in) when tested under a 400 psi constant load at 140°F in accordance to the requirements of ASTM C 1181.
6. The seven day compressive strength shall be a minimum of 14,000 psi when tested in accordance to the requirements of ASTM C 579.
7. The grout shall be capable of maintaining at least a flowable consistency for a minimum of 30 minutes at 70°F.
8. The shear bond strength to portland cement concrete shall be greater than the shear strength of the concrete when tested in accordance to the requirements of ASTM C 882.
9. The effective bearing area shall be a minimum of 95 percent.
10. Product and Manufacturer: Provide one of the following:
    a. E3-Flowable, High Performance Flowable Epoxy Grout System, as manufactured by The Euclid Chemical Company.
    b. Sikadur 42 Grout Pak, as manufactured by Sika Corporation.
    c. Five Star Epoxy Grout, as manufactured by Five Star Products, Incorporated.
    d. Masterflow 648 CP, as manufactured by BASF Construction Chemicals, LLC.
    e. Or equal.

2.3 CONCRETE GROUTS

A. Grout Fill, Topping Grout:
1. Grout for topping of slabs and concrete fill for built-up surfaces of tank, channel, and basin bottoms shall be composed of cement, fine aggregate, coarse aggregate, water, and admixtures proportioned and mixed as specified herein.

All materials and procedures specified for normal concrete in Section 03300, Cast-In-Place Concrete, shall apply except as noted otherwise herein.

2. Topping grout and concrete fill shall contain a minimum of 564 pounds of cement per cubic yard with a maximum water cement ratio of 0.45. Where concrete fill is thicker than 4-inches, Type "1" concrete, as specified in Section 03300, Cast-In-Place Concrete, may be used when accepted by the ENGINEER.
3. Coarse aggregate shall be graded as follows:

U.S. STANDARD SIEVE SIZE	PERCENT BY WEIGHT PASSING
1/2-inch	100
3/8-inch	90-100
No. 4	20-55
No. 8	5-30
No. 16	0-10
No. 30	0

4. Final mix design shall be as determined by trial mix design under supervision of the approved testing laboratory.
5. Strength: Minimum compressive strength of Grout Fill at the end of 28 days shall be 4000 psi.

B. Construction Joint Grout:
   1. Construction Joint Grout approximates Type "1" concrete, as specified in Section 03300, Cast-In-Place Concrete, with aggregate coarser than 1/2-inch removed. The mix is to be designed as flowable with a high mortar content. It is intended to be placed over construction joints and mixed with Type "1" concrete as specified in Section 03300, Cast-In-Place Concrete. The mix requirements are as follows:
      a. Compressive Strength: 4,500 psi minimum at 28-days.
      b. Maximum Water-Cement Ratio: 0.45 by weight.
      c. Coarse Aggregate: ASTM C33, No. 8 size.
      d. Fine Aggregate: ASTM C33, approximately 60 percent by weight of total aggregate.
      e. Air Content: 8±1 percent.
      f. Minimum Cement Content: 752 pounds per cubic yard.

C. Requirements for Grout Fill and Construction Joint Grout:
   1. Proportion mixes by either laboratory trial batch or field experience methods, using materials to be employed on the Project for grout required. Comply with ACI 211.1 and report to ENGINEER the following data:
      a. Complete identification of aggregate source of supply.
      b. Tests of aggregates for compliance with specified requirements.
      c. Scale weight of each aggregate.
      d. Absorbed water in each aggregate.

e. Brand, type and composition of cement.
f. Brand, type and amount of each admixture.
g. Amounts of water used in trial mixes.
h. Proportions of each material per cubic yard.
i. Gross weight and yield per cubic yard of trial mixtures.
j. Measured slump.
k. Measured air content.
l. Compressive strength developed at seven days and 28 days, from not less than three test specimens cast for each seven day and 28-day test, and for each design mix.

2. Submit written reports to ENGINEER of proposed mix of grout at least 30 days prior to start of Work. Do not begin grout production until mixes have been approved by ENGINEER.
3. Laboratory Trial Batches: When laboratory trial batches are used to select grout proportions, prepare test specimens and conduct strength tests as specified in ACI 301, Section 4 - Proportioning. However, mixes need not be designed for greater than 125 percent of the specified strength, regardless of the standard deviation of the production facility.
4. Field Experience Method: When field experience methods are used to select grout proportions, establish proportions as specified in ACI 301, Section 4.
5. Admixtures: Use air-entraining admixture in all grout. Use amounts of admixtures as recommended by the manufacturer for climatic conditions prevailing at the time of placing. Adjust quantities and types of admixtures as required to maintain quality control. Do not use admixtures which have not been incorporated and tested in the accepted design mix, unless otherwise authorized in writing by ENGINEER.

2.4 CURING MATERIALS

A. Curing materials shall be as specified in Section 03300, Cast-in-Place Concrete, and as recommended by the manufacturer of prepackaged grouts.

2.5 CONSISTENCY

A. The consistency of grouts shall be that necessary to completely fill the space to be grouted for the particular application. Dry pack consistency is such that the grout is plastic and moldable but will not flow. Where "dry pack" is called for in the Contract Documents, it shall mean a grout of that consistency; the type of grout to be used shall be as specified herein for the particular application.

B. The slump for topping grout and grout fill shall be adjusted to match placement and finishing conditions, but shall not exceed 4-inches.

C. The slump for Construction Joint Grout shall be 7 ± 1-inches.

2.6 MATERIALS

A. Aggregate:
   1. Provide aggregate that conforms to the material requirements of Section 03300 Cast-In-Place Concrete, and the grout manufacturer's requirements.
   2. Store and precondition aggregate per grout manufacturer's requirements.

B. Water:
   1. Potable quality water that is free from deleterious amounts of acids, alkalis, and organic substances.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine the substrate and conditions under which grout is to be placed and notify ENGINEER, in writing, of unsatisfactory conditions. Do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to ENGINEER.

3.2 INSTALLATION

A. General:
   1. Place grout as shown and in accordance with manufacturer's written instructions. If manufacturer's instructions conflict with the Specifications do not proceed until ENGINEER provides clarification.
   2. Manufacturers of proprietary products shall make available upon 72 hours notification the services of a qualified, full time employee to aid in assuring proper use of the product under job conditions.
   3. Placing grout shall conform to temperature and weather limitations in Section 03300, Cast-In-Place Concrete.
   4. Grout shall be cured following manufacturer's written instructions for prepackaged grout and the requirements in Section 03300, Cast-In-Place Concrete, for grout fill and topping grout.

B. Columns, Beams and Equipment Bases:
   1. Epoxy grout: After shimming equipment to proper grade, securely tighten anchor bolts. Properly form around the base plates, allowing sufficient room around the edges for placing the grout. Adequate depth between the bottom of the base plate and the top of concrete base must be provided to assure that the void is completely filled with the epoxy grout.
   2. Non-shrink, non-metallic grout: After shimming columns, beams and equipment to proper grade, securely tighten anchor bolts. Properly form around the base plates allowing sufficient room around the edges for placing the grout. Adequate depth between the bottom of the base plate and the top of concrete

base must be provided to assure that the void is completely filled with the non-shrink, non-metallic grout.

C. Handrails and Railings:
   1. After posts have been properly inserted into the holes or sleeves, fill the annular space between posts and sleeve with the non-shrink, non-metallic grout. Bevel grout at juncture with post so that moisture flows away from post.

D. Construction Joints:
   1. Place a 6-inch minimum thick layer of Construction Joint Grout over the contact surface of the old concrete at the interface of horizontal construction joints as specified in Section 03251, Concrete Joints, and Section 03300, Cast-In-Place Concrete.

E. Topping Grout:
   1. All mechanical, electrical, and finish work shall be completed prior to placement of topping grout. The base slab shall be given a roughened textured surface by sandblasting or hydroblasting exposing the aggregates to ensure bonding to the base slab.
   2. The minimum thickness of grout topping shall be 1-inch.
   3. The base slab shall be thoroughly cleaned and wetted prior to placing topping and fill. No topping concrete shall be placed until the slab is complete free from standing pools or ponds of water. A thin coat of neat Type II cement slurry shall be broomed into the surface of the slab and topping or fill concrete shall be placed while the slurry is still wet. The topping and fill shall be compacted by rolling or tamping, brought to established grade, and floated. Grouted fill for tank and basin bottoms where scraping mechanisms are to be installed shall be screeded by blades attached to the revolving mechanism of the equipment in accordance with the procedures outlined by the equipment manufacturer after the grout is brought to the established grade.
   4. Topping grout placed on sloping slabs shall proceed uniformly from the bottom of the slab to the top, for the full width of the placement.
   5. The surface shall be tested with a straight edge to detect high and low spots which shall be immediately eliminated. When the topping has hardened sufficiently, it shall be steel troweled to a smooth surface free from pinholes and other imperfections. An approved type of mechanical trowel may be used as an assist in this operation, but the last pass over the surface shall be by hand-troweling. During finishing, no water, dry cement or mixture of dry cement and sand shall be applied to the surface.
   6. Cure and protect the grout topping as specified in Section 03300, Cast-In-Place Concrete.

F. Grout Fill:
   1. All mechanical, electrical, and finish work shall be completed prior to placement of grout fill. Grout fill shall be mixed, placed, and finished as required in Section 03300, Cast-In-Place Concrete.

2. The minimum thickness of grout fill shall be 1-inch. Where the finished surface of grout fill is to form an intersecting angle of less than 45 degrees with the concrete surface it is to be placed against, a key shall be formed in the concrete surface at the intersection point. The key shall be a minimum of 3-1/2-inches wide by 1-1/2-inches deep.
3. The surface shall be tested with a straight edge to verify that the surface slopes uniformly to drain and to detect high and low spots which shall be immediately eliminated. When the grout fill has hardened sufficiently, it shall be steel troweled to a smooth surface free from pinholes and other imperfections. During finishing, no water, dry cement or mixture of dry cement and sand shall be applied to the surface.

++ END OF SECTION ++

SECTION 03930

CONCRETE REPAIR AND REHABILITATION

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
   1. Provide all labor, materials, equipment and incidentals as shown, specified and required to repair or rehabilitate all existing concrete members and surfaces identified in the Contract Documents.
   2. Repair all damage to new concrete construction as specified herein, except that where such repairs are specified in Section 03300, Cast-in-Place Concrete.

B. Coordination:
   1. Review installation procedures in the following Section and coordinate the installation of items that must be included with the repair and rehabilitation of concrete.

1.2 QUALITY ASSURANCE

A. Reference Standards: Comply with the applicable provisions and recommendations of the following, except as otherwise shown or specified:
   1. ASTM C 109, Test Method for Compressive Strength of Hydraulic Cement Mortars.
   2. ASTM C 157, Test Method for Length Change of Hardened Cement Mortar and Concrete.
   3. ASTM C 882, Test Method for Bond Strength of Epoxy-Resin Systems Used with Concrete.
   4. ASTM D 412, Test Methods for Vulcanized and Thermoplastic Rubbers and Thermoplastic Elastomers - Tension.
   5. ASTM D 624, Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers.
   6. ASTM D 903, Test Method for Peel or Stripping Strength of Adhesive Bonds.
   7. ASTM G 109, Test Method for Determining the Effects of Chemical Admixtures on the Corrosion of Embedded Steel Reinforcement in Concrete Exposed to Chloride Environments.

B. Construction Tolerances: Construction tolerances shall be as specified in Section 03300, Cast-in-Place Concrete, except as specified herein and elsewhere in the Contract Documents.

1.3 SUBMITTALS

A. Shop Drawings: Submit for approval the following:
   1. Submit manufacturer's product information and recommended placement procedures for all repair materials.
   2. Submit Shop Drawings, when requested by ENGINEER, to show all methods for supporting existing structures, pipes, etc., during demolition and repair activities. Comply with the requirements of Section 01300, Submittals.
   3. Copies of certificates that show that the repair materials are approved by the National Sanitation Foundation (NSF) for use on surfaces, which are in contact with potable water.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery of Materials:
   1. Deliver all materials to the job site in original, new and unopened packages and containers bearing manufacturer's name and label, and the following information.
      a. Name or title of material.
      b. Manufacturer's stock number and date of manufacture.
      c. Manufacturer's name.

B. Storage of Materials:
   1. Storage only acceptable project materials on project site.
   2. Store in a suitable location approved by ENGINEER. Keep area clean and accessible.
   3. Restrict storage to repair materials and related equipment.
   4. Comply with health and fire regulations including the Occupational Safety and Health Act of 1970.

C. Handling of Materials:
   1. Handle materials carefully to prevent inclusion of foreign materials.
   2. Do not open containers or mix components until necessary preparatory Work has been completed and application Work will start immediately.

PART 2 - PRODUCTS

2.1 REPAIR MORTAR

A. Repair mortar shall be a prepackaged cement-based product specifically formulated for the repair of concrete surface defects. The repair mortar shall be a two-component polymer-modified, portland cement, fast setting, trowel-grade mortar. The repair mortar shall be enhanced with a penetrating corrosion inhibitor and shall have the following properties:

Physical Property	Value	ASTM Standard
Compressive Strength (minimum)		C 109
at 1 day	2000 psi	
at 28 days	6000 psi	
Bond Strength (minimum)		C 882*
at 28 days	1800 psi	

* Modified for use with repair mortars.

B. Where the least dimension of the placement in width or thickness, exceeds 4-inches, the repair mortar shall be extended by addition of aggregate as recommended by the manufacturer.

C. Product and Manufacturer: Provide one of the following:
   1. SikaTop 122 Plus, SikaTop 123 Plus, or SikaTop 126 Plus, as manufactured by Sika Corporation.
   2. Or equal.

2.2 JOINT REPAIR SYSTEM

A. Joint Repair System: The joint repair system shall consist of two components, an epoxy resin adhesive and hypalon sheeting.
   1. Epoxy Resin Adhesive: Provide a two-component epoxy resin as follows:
      a. Component A shall be a modified epoxy resin of the epichlorohydrin bisphenol A type containing suitable viscosity control agents and pigments. It shall not contain butyl glycidyl ether.
      b. Component B shall be primarily a reaction product of a selected amine blend with an epoxy resin of the epichlorohydrin bisphenol A type containing suitable viscosity control agents, pigments and accelerators.
   2. Hypalon Sheeting: Provide Hypalon sheeting as follows:
      a. Hypalon sheeting shall consist of Hypalon rubber. It shall be perforated along the bonding edge to provide a mechanical key. It shall have the ability to be vulcanized with hydrocarbon solvent to permit its adhesion to an epoxy resin adhesive.
      b. The sheeting shall be provided in 12-inch width with a thickness of 40 mils.
      c. The sheeting shall be able to be lapped or seamed by heat or by anaromatic hydrosolvent strip.
      d. The sheeting shall be supplied with a removable center expansion strip.
   3. Product and Manufacturer: Provide one of the following:
      a. Sikadur Combiflex, as manufactured by Sika Corporation.
      b. Or equal.

2.3 EXPOSED REBAR REPAIR

A. The exposed reinforcing repair system shall consist of two components, a first application of a corrosion inhibitor and then a final application of a protective slurry mortar.

B. Corrosion Inhibitor:
   1. The corrosion inhibitor shall penetrate the hardened concrete surface and form a protective layer on the reinforcement. It shall have the following properties:
      a. The product shall not change the substrate's color, appearance, or texture.
      b. Penetration (SNMS Analysis): 1/10 to 4/5 inches/day.
      c. Coating thickness (XPS and SIMS Analysis): 100 to 1000 angstroms.
      d. Corrosion Current Reduction (ASTM G 109): 65 percent at one year.
      e. Chloride Displacement (XPS and SIMS Analysis): Passes.
      f. Effectiveness in Carbonated Conditions (Electrochemical): passes.
      g. The product must not form a vapor barrier.
      h. The product must be environmentally sound.
      i. Post-application verification (Chromatography Plate Test): Passes.
      j. Longevity (Ten Year Accelerated Weather Testing): Passes.
   2. Product and Manufacturer: Provide one of the following:
      a. Sika FerroGard 903, as manufactured by Sika Corporation.
      b. Or equal.

C. Protective Slurry Mortar:
   1. Protective slurry mortar shall be a two-component, polymer-modified, cementitious waterproofing and protective slurry mortar. Provide two coats at a rate of 50 sq. ft./gal./coat.
   2. Product and Manufacturer: Provide one of the following:
      a. Sikatop Seal 107, as manufactured by Sika Corporation.
      b. Or equal.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which repair Work is to be installed, and notify ENGINEER, in writing, of conditions detrimental to proper and timely completion of Work. Do not proceed with Work until unsatisfactory conditions have been corrected in a manner acceptable to ENGINEER.

3.2 GENERAL

A. Surface Preparation:
   1. The entire area to be repaired shall have all laitance, foreign material, and unsound concrete removed by chipping, abrasive blasting or hydroblasting. The surface shall be further roughened as specified herein. Where non-shrink grout or repair mortar is used, any additional surface preparation steps recommended by the manufacturer shall be performed.
   2. Where repair concrete, shotcrete, or cement grout is used, and a bonding agent is not required, or where the repair mortar or non-shrink grout

manufacturer recommends a wet or saturated surface, water shall be delivered to the surface continuously for a minimum of four hours. Where large surface areas are to be repaired, fog spray nozzles mounted on stands shall be provided in sufficient numbers such that the entire surface to be repaired is in contact with the fog spray cloud. The concrete shall be prevented from drying until after the repair operation is completed. Unrepaired surfaces shall be rewetted by water spray on at least a daily basis. Should more than four days elapse without rewetting the unrepaired surfaces, the original saturating procedure shall be repeated. All standing water in areas to be repaired shall be removed prior to placement of repair material. Means to remove excess water from the structure shall be provided.

3. Where the repair material manufacturer recommends the use of an epoxy-bonding agent, the recommendations of both the repair material and bonding agent manufacturers shall be followed.

B. Care shall be taken to fully consolidate the repair material, completely filling all portions of the area to be filled.

C. The repair surface shall be brought into alignment with the adjacent existing surfaces to provide a uniform, even surface. The repair surface shall match adjacent existing surfaces in texture and shall receive any coatings or surface treatments which had been provided for the existing surface.

D. Curing:
   1. Curing of repair mortar and non-shrink grout shall be according to the manufacturer's recommendations except that the minimum cure period shall be three days.
   2. Curing of other materials shall be according to Section 03300, Cast-in-Place Concrete.

3.3 TREATMENT OF SURFACE DEFECTS

A. Surface defects are depressions in a concrete surface which do not extend all the way through the member. The depressions can result from the removal of an embedded item, the removal of an intersecting concrete member, physical damage, unrepaired rock pockets created during original placement, or spalls from corroded reinforcing steel or other embeds.

B. Preparation:
   1. All loose, damaged concrete shall be removed by chipping to sound material.
   2. Where existing reinforcing bars are exposed, concrete shall be removed to a minimum of 1-inch all around the bars. If the existing bars are cut through, cracked, or the cross sectional area is reduced by more than 25 percent, the ENGINEER shall be notified immediately.
   3. The perimeter of the damaged area shall be score cut to a minimum depth of 0.5-inch and a maximum depth to not cut any existing reinforcing steel.

Existing concrete shall be chipped up to the score line so that the minimum thickness of repair mortar is 0.5-inch.

C. Repair Material:
   1. Repair of surface defects in members, which are normally in contact with water or soil, or in the interior surfaces of enclosed chambers that contain water shall be made only with repair mortar.
   2. Repair of other surface defects may be by the application of repair mortar, repair concrete, shotcrete, or cement grout, as appropriate.

3.4 PATCHING OF HOLES IN CONCRETE

A. For holes larger than 48-inches, refer to the Drawings for reinforcement details.

3.5 PATCHING OF LINED HOLES

A. This Section applies to those openings which have embedded material over all or a portion of the inside edge. Unless indicated to remain in place on the Drawings or by the ENGINEER, such embedded materials shall be removed and the remaining hole repaired as specified above. The requirements for repairing holes in concrete specified above shall apply as modified herein.

B. Where embedded material is allowed to remain, it shall be trimmed back a minimum of 2-inches from the concrete surface. The embedded material shall be roughened or abraded to promote good bonding to the repair material. Any substance that interferes with good bonding shall be completely removed.

C. Any embedded item that is not securely and permanently anchored into the concrete shall be completely removed.

D. Embedded items which are larger than 12-inches in their least dimension shall be completely removed, unless they are composed of a metal to which reinforcing steel can be welded. Where reinforcement is required, it shall be welded to the embedded metal.

E. The following additional requirements apply to concrete members which are in contact with water or soil.
   1. Lined openings, which are less than 4-inches in their least dimension, shall be filled with epoxy grout.
   2. Lined openings which are greater than 4-inches, but less than 12-inches in their least dimension, shall be coated with an epoxy bonding agent prior to being filled with Class I non-shrink grout.
   3. Lined openings which are greater than 12-inches in their least dimension shall be coated with an epoxy bonding agent and shall have a hydrophilic rubber waterstop or bead of hydrophilic sealant installed to the interior of the opening at the wall centerline, as required by Section 03251, Concrete Joints, prior to being filled with any approved repair material.

3.6 REPAIR OF DETERIORATED CONCRETE

A. This Section pertains to concrete which has been damaged due to corrosion of reinforcing steel, physical damage due to abrasion, and damage due to chemical attack. The only material acceptable for surface repair is repair mortar as specified herein. Where the repaired surface is to be subsequently covered with a PVC liner material, the finishing details shall be coordinated with the requirements of installing the liner material.

B. Surface Preparation:
   1. All loose, broken, softened, and acid contaminated concrete shall be removed by abrasive blasting and chipping down to sound, uncontaminated concrete.
   2. When the removal of deteriorated concrete is completed, CONTRACTOR to notify the ENGINEER, in writing. Two weeks shall be scheduled for the ENGINEER to inspect the surface, perform testing for acid contamination, determine if additional concrete must be removed, and to develop any special repair details that may be required. Should it be determined that additional concrete must be removed to reach sound, uncontaminated material, another two week period shall be scheduled for further evaluation after the end of the additional removal.
   3. Additional surface preparation shall follow the recommendations of the repair mortar manufacturer.
   4. Isolated areas of exposed reinforcing bars shall be treated as required for repair of surface defects. If extensive areas of reinforcement are uncovered after removal of deteriorated concrete, repair methods shall be as determined by the ENGINEER.

C. Repair Mortar Placement:
   1. The procedures recommended by the manufacturer for the mixing and placement of the repair mortar shall be followed.
   2. After the initial mixing of the repair mortar, additional water shall not be added to change the consistency should the mix begin to stiffen.
   3. Repair mortar shall be placed to a minimum thickness as recommended by the manufacturer, but not less than 0.50-inch. Where removal of deteriorated concrete results in a repair thickness of less than 0.5-inch to return to original concrete surface location in isolated areas totaling less than ten percent of the total repair area, additional concrete shall be removed to obtain the 0.5-inch thickness. Where the area with repair thickness of less than 0.5-inch exceeds ten percent of the total repair area, notify the ENGINEER. In any case, repair mortar shall be added so that the minimum cover over existing reinforcing steel is 2-inches. Do not place repair mortar so as to create locally raised areas. Where there is a transition with wall surfaces which are not in need of repair, the repair mortar shall not be feathered at the transition. A score line shall be sawcut to not less than the minimum repair mortar depth and concrete chipped out to it to form the transition. Care shall be taken to not cut or otherwise damage any reinforcing steel.

4. The repair mortar shall be placed to an even, uniform plane to restore the member to its original surface. Tolerance for being out of plane shall be such that the gap between a 12-inch straight edge and the repair mortar surface does not exceed 0.125-inch and the gap between a 48-inch straight edge and the repair mortar surface does not exceed 0.25-inch. This shall apply to straight edges placed in any orientation at any location.

D. Finishing:
   1. The repair mortar shall receive a smooth, steel trowel finish.
   2. When completed, there shall be no sharp edges. All exterior corners, such as at penetrations, shall be made with a 1-inch radius. All interior corners shall be square except corners to receive PVC lining shall be made with a 2-inch repair mortar fillet.

E. Curing:
   1. Curing shall be performed as recommended by the repair mortar manufacturer, except that the cure period shall be at least 24 hours and shall be by means of a continuous fog spray. If the manufacturer recommends the use of a curing compound, no material shall be used that would interfere with the bond of the protective coating system or adhesive used for placing PVC lining, where required.

3.7 TREATMENT OF EXPANSION JOINT REPAIR

A. Surfaces to be repaired shall have all laitance, foreign material, and unsound concrete removed by chipping, abrasive blasting or hydroblasting.

B. Follow all other surface preparation and application specifications as recommended by manufacturer.

3.8 EXPOSED REBAR REPAIR

A. The entire area to be repaired shall have all corrosion, foreign materials, and unsound concrete by means of abrasive blasting or hydroblasting.

B. Surface shall be visually dry before application of the corrosion inhibitor. The corrosion inhibitor shall be placed liberally to achieve 100 sq ft/gal coverage in two or more coats by allowing it to soak into the substrate. The re-coat time between coats shall be a minimum of one hour. Apply by use of rollers, brushes, or hand-pressure spray equipment.

C. After the last coat of the corrosion inhibitor is applied, a minimum curing time of 24 hours is required.

D. High Pressure Wash all surfaces to remove filmy residue that is left on the surface by the corrosion inhibitor. Residue acts like bond breaker and must be removed before mortar coating.

E. For mortar coating, refer to Paragraph 3.6.C, Repair Mortar Placement, Paragraph 3.6.D, Finishing, and Paragraph 3.6.E, Curing.

3.9 FIELD QUALITY CONTROL

A. OWNER will employ a testing laboratory to perform field quality control testing. ENGINEER will direct the CONTRACTOR on the number of standard compression tests and specimens required as specified below, under the direct inspection by ENGINEER. Furnish all necessary assistance required by ENGINEER. Provide all labor, material and equipment required including rods, molds, thermometer, curing in a heated storage box, and all other incidentals required. Above will be subject to approval by ENGINEER. Furnish all necessary storage, curing, and transportation required by the testing.

B. Field tests of cement-based grouts and repair mortar:
   1. Compression test specimens will be taken during construction from the first placement of each type of mortar or grout, and at intervals thereafter as selected by the ENGINEER to ensure continued compliance with these specifications. The specimens will be made by the ENGINEER or its representative.
   2. Compression tests and fabrication of specimens for repair mortar and non-shrink grout will be performed as specified in ASTM C 109. A set of three specimens will be made for each test. Tests shall be made at 7 days, 28 days, and additional time periods as appropriate.
   3. All material, already placed, which fails to meet the requirements of these specifications, is subject to removal and replacement at the cost of CONTRACTOR.
   4. The cost of all laboratory tests on mortar and grout will be borne by the OWNER, however CONTRACTOR provide assistance to the ENGINEER in obtaining specimens for testing. The cost of any additional tests and investigation on Work performed which does not conform to the requirements of the specifications will be the CONTRACTOR's responsibility. Supply all materials necessary for fabricating the test specimens.

C. Repair Concrete: Repair concrete shall be tested as required in Section 03300, Cast-in-Place Concrete.

++ END OF SECTION ++

SECTION 04220

SINGLE-WYTHE UNIT MASONRY

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Concrete masonry units.

B. Pre-faced unit masonry.

C. Reinforcement, anchorage, and accessories.

1.2 RELATED REQUIREMENTS

A. Section 07900 - Joint Sealants: Sealing control and expansion joints.

1.3 REFERENCE STANDARDS

A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.

B. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2024.

C. ASTM A641/A641M - Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire; 2019 (Reapproved 2025).

D. ASTM A951/A951M - Standard Specification for Steel Wire for Masonry Joint Reinforcement; 2022.

E. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete; 2024.

F. ASTM C90 - Standard Specification for Dry-Cast Loadbearing Concrete Masonry Units; 2024a.

1.4 SUBMITTALS

A. Product Data: Provide data for decorative and pre-faced masonry units and fabricated wire reinforcement.

B. Samples: Submit two samples of decorative block and pre-faced units to illustrate color, texture and extremes of color range.

C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

1.5 QUALITY ASSURANCE

A. Comply with provisions of TMS 402/602, except where exceeded by requirements of Contract Documents.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver, handle, and store masonry units by means that will prevent mechanical damage and contamination by other materials.

1.7 FIELD CONDITIONS

A. Cold and Hot Weather Requirements: Comply with requirements of TMS 402/602 or applicable building code, whichever is more stringent.

PART 2 - PRODUCTS

2.1 CONCRETE MASONRY UNITS

A. Concrete Block: Comply with referenced standards and as follows:
   1. Size: Standard units with nominal face dimensions of 16 x 8 inches (400 x 200 mm) and nominal depth of 8 inches (200 mm).
   2. Load-Bearing Units: ASTM C90, normal weight.
      a. Hollow block.
      b. Exposed Faces: Special color, texture, and pattern, as follows: To match existing.

2.2 REINFORCEMENT AND ANCHORAGE

A. Manufacturers:
   1. 3GEN Masonry Products: www.3genmp.com.
   2. Blok-Lok Limited: www.blok-lok.com/#sle.
   3. Hohmann & Barnard, Inc: www.h-b.com/#sle.
   4. Or Equal.

B. Reinforcing Steel: ASTM A615/A615M, Grade 40 (40,000 psi) (280 MPa) yield strength, deformed billet bars; galvanized.

C. Single Wythe Joint Reinforcement: ASTM A951/A951M.
   1. Type: Truss or ladder.
   2. Material: ASTM A1064/A1064M steel wire, mill galvanized to ASTM A641/A641M Class 3.

3. Size: 0.1483 inch (3.8 mm) side rods with 0.1483 inch (3.8 mm) cross rods; width as required to provide not less than 5/8 inch (16 mm) of mortar coverage on each exposure.

D. Strap Anchors: Bent steel shapes configured as required for specific situations, 1-1/4 in (32 mm) width, 0.105 in (2.7 mm) thick, lengths as required to provide not more than 1 inch (25 mm) and not less than 1/2 inch (13 mm) of mortar coverage from masonry face, corrugated for embedment in masonry joint, hot dip galvanized to ASTM A153/A153M Class B.

2.3 ACCESSORIES

A. Joint Filler: Closed cell polyvinyl chloride; oversized 50 percent to joint width; self expanding; ___inch (__mm) wide x by maximum lengths available.
   1. Manufacturers:
      a. Hohmann & Barnard, Inc: www.h-b.com/#sle.
      b. WIRE-BOND: www.wirebond.com/#sle.
      c. Or Equal.
      d. Substitutions: See Section 01600 – General Equipment Provisions.

PART 3 - EXECUTION

3.1 COURSING

A. Establish lines, levels, and coursing indicated. Protect from displacement.

B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.

C. Concrete Masonry Units:
   1. Bond: To match existing.
   2. Coursing: To match existing.
   3. Mortar Joints: To match existing.

3.2 PLACING AND BONDING

A. Lay hollow masonry units with face shell bedding on head and bed joints.

3.3 REINFORCEMENT AND ANCHORAGE

A. Fasten anchors to structural framing and embed in masonry joints as masonry is laid. Space anchors at maximum of 24 inches (600 mm) horizontally and 16 inches (400 mm) vertically.

3.4 CONTROL AND EXPANSION JOINTS

A. Do not continue horizontal joint reinforcement through control or expansion joints.

B. Size control joints as indicated on drawings; if not shown, 3/4 inch (19 mm) wide and deep.

3.5 CLEANING

A. Remove excess mortar and mortar smears as work progresses.

B. Replace defective mortar. Match adjacent work.

C. Use non-metallic tools in cleaning operations.

++ END OF SECTION ++

SECTION 05120

STRUCTURAL STEEL

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
   1. Provide all labor, materials, equipment, and incidentals as shown on the Drawings, specified and required to furnish and install structural steel, including surface preparation and shop priming.
   2. Structural steel is that Work defined in AISC "Code of Standard Practice", Section 2, and as shown on the Drawings. The Work also includes:
      a. Providing openings in and attachments to structural steel to accommodate the Work under this and other Sections and providing for the structural steel all items such as anchor bolts, studs and all items required for which provision is not specifically included under other Sections.

B. Coordination:
   1. Review installation procedures under other Sections and coordinate the Work that must be installed with or attached to the structural steel.

1.2 QUALITY ASSURANCE

A. Reference Standards and Codes: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified:
   1. ASTM A 36, Specification for Carbon Structural Steel.
   2. ASTM A 108, Specification for Steel Bars, Carbon, Cold Finished, Standard Quality.
   3. ASTM A 307, Specification for Carbon Steel Bolts and Stubs, 60,000 psi Tensile Strength.
   4. ASTM A 490, Specification for Heat-Treated Steel Structural Bolts.
   5. ASTM A 992, Specification for Structural Steel Shapes.
   6. ASTM A 500, Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes. Grade B or C.
   7. ASTM F 3125, Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 KSI (830 MPa) and 150 KSI (1040 MPa)
   8. Minimum Tensile Strength, Inch and Metric Dimensions.
   9. AWS D1.1, Structural Welding Code.
   10. AREA, Manual of Railway Engineering.
   11. AISC, Manual of Steel Construction.
   12. AISC, Code of Standard Practice for Steel Buildings and Bridges.

13. AISC, Specifications for the Design, Fabrication, and Erection of Structural Steel for Buildings and including the Commentary and Supplements thereto as issued.
14. AISC, Specifications for Structural Joints using ASTM F 3125 Bolts, approved by the Research Council on Riveted and Bolted Structural Joints (RCRBSJ) of the Engineering Foundation.

B. Design of Members and Connections:
   1. All details shown on the Drawings are typical; similar details apply to similar conditions, unless otherwise shown on the Drawings or specified. Verify dimensions at the site without causing delay in the Work.
   2. Examine conditions under which structural steel is to be provided, and notify ENGINEER, in writing, of unsatisfactory conditions existing or whenever design of members and connections may not be clearly shown on the Drawings. Do not proceed with the Work until unsatisfactory conditions or deficiencies have been corrected in a manner acceptable to ENGINEER.

C. Source Quality Control:
   1. Materials and fabrication procedures shall be subject to inspection and tests in the mill, shop, and field, conducted by a qualified inspection agency. Such inspections and tests will not relieve CONTRACTOR of responsibility for providing materials and fabrication procedures in compliance with specified requirements.
   2. Fabrication shall be performed by a structural steel fabricating plant possessing a current certificate from AISC stating that the plant satisfies the requirements for certification for Category II of the AISC Quality Certification Program. The plant shall maintain this certification for the entire time fabrication for this project is being performed.

D. Qualifications:
   1. Steel fabricator:
      a. Minimum of 10 years of experience in fabrication of structural steel or participate in the AISC Certification program and is designated an AISC Certified Plant, Category BU (formally known as STD), SBR at time of bid.
      b. Fabricator plant quality control and inspection program: Meet requirements of the building code and/or be an Approved Fabricator.
      c. c. Plants that are not an Approved Fabricator may be acceptable, provided:
         1) Plant meets all remaining qualifications.
         2) Contractor reimburses the Owner the cost of required Special Inspection services.
   2. Steel erector:
      a. Minimum of 10 years of experience in erection of structural steel similar in the scope of this project or certified as CSE under the AISC Quality Certification Program.

b. With an active and enforced quality assurance program in place, as described in the applicable Codes.

3. Welding Work:
   a. Qualify welding processes and welding operators in accordance with AWS "Structural Welding Code" D1.1, Section 5, Qualification.
   b. Provide certification that all welders employed on or to be employed for the Work have satisfactorily passed AWS qualification tests within the previous 12 months. Ensure that all certifications are kept current.
   c. All welds will be subject to visual inspection. Where visually deficient welds are observed, the welds will be tested using non-destructive methods by a certified testing laboratory. If welds are found to be satisfactory, OWNER will pay for testing. Where welds are found unacceptable or deficient, pay for testing, correct improper workmanship, remove and replace, or correct as instructed, all welds found unacceptable or deficient. Responsibility belongs to CONTRACTOR to pay for all corrections and subsequent tests required to confirm the integrity of the weld.

1.3 SUBMITTALS

A. Shop Drawings: Submit for approval the following:
   1. Comply with the requirements of Section 01300, Submittals.
   2. Complete details and schedules for fabrication and shop assembly of members and details, schedules, procedures and diagrams showing the sequence of erection.
      a. Include details of cuts, connections, camber, holes, and other pertinent data. Indicate welds by standard AWS symbols, and show size, length, and type of each weld.
      b. Provide setting drawings, templates, and directions for the installation of anchor bolts and other anchorages.
   3. Copies of manufacturer's specifications and installation instructions for products listed below. Include laboratory test reports and other data as required to show compliance with the Contract Documents.
      a. Structural steel of each type, including certified copies of mill reports covering the chemical and physical properties.
      b. High-strength bolts of each type, including nuts and washers.
      c. Unfinished bolts and nuts.
      d. Shop primer and touch-up field primer paint in accordance with Section 09900, Painting.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver materials to the site at such intervals to ensure uninterrupted progress of the Work.
   1. Deliver anchor bolts and anchorage devices, which are to be embedded in cast-in-place concrete or masonry, in ample time to not delay that Work.

2. Comply with the requirements of Section 03252, Anchorage in Concrete.

B. Store materials to permit easy access for inspection and identification. Keep steel members off the ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration.
   1. Do not store materials on the structure in a manner that might cause distortion or damage to the members or the supporting structures. Repair or replace damaged materials or structures as directed.
   2. Comply with the requirements of Section 01640, Materials and Equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Steel, Structural Shapes and Plate (unless noted otherwise on Drawings):
   1. All W-shapes and WT-shapes: ASTM A 992.
   2. All other plates, bars and rolled shapes: ASTM A36.

B. Pipe: ASTM A53/A53M, Grade B (Type E or S) (Fy=35).

C. Hollow Structural Sections (HSS):
   1. Round: ASTM A500, Grade B (Fy=42).
   2. Square or rectangular: ASTM A500, Grade C (Fy=46).

D. Headed Stud Type Shear Connectors: ASTM A 108, Grades 1010-1020, with dimensions complying with AISC Specifications, or equal.

E. Unfinished Threaded Fasteners: ASTM A 307, Grade A, regular low- carbon steel bolts and nuts.
   1. Provide hexagonal heads and nuts for all connections.

F. High-Strength Bolts, Nuts and Washers:
   1. ASTM F3125, Grade A325 with ASTM A563 nuts galvanized:
   2. High-strength bolts:
      a. Provide two ASTM F436 washers for all bolts galvanized.
      b. Provide beveled washers at connections of sloped/tapered sections.
   3. High-strength bolts with compressible washer type direct tension indicators (DTI), ASTM F959.
      a. Provide at Contractor's option and subject to approval of Engineer.
   4. Alternate high-strength design: Provide at Contractor's option and subject to approval of Engineer.

G. Electrodes for Welding: E70XX complying with AWS D1.1, Design of New Buildings, Section 8. AWS D1.1.

H. Surface Preparation and Shop Priming: All structural steel shall be primed in the shop. Surface preparation and shop priming requirements are included herein, but are specified in Section 09900, Painting.

I. Refer to and comply with the requirements of Section 03600, Grout.

2.2 FABRICATION

A. Shop Fabrication and Assembly:
   1. General:
      a. Fabricate and assemble structural assemblies in the shop to the greatest extent possible. Fabricate items of structural steel in accordance with AISC, Manual of Steel Construction, and as shown on the Shop Drawings. Provide camber in structural members as shown on the Drawings.
      b. Properly mark and match-mark materials for field assembly. Fabricate for delivery sequence, which will expedite erection and minimize field handling of materials.
      c. Where finishing is required, complete the assembly, including welding of units, before start of finishing operations. Provide finish surfaces of members exposed in the final structure free of markings, burrs, and other defects.
      d. Comply with the requirements of Section 05501, Miscellaneous Metal Fabrications.

B. Connections:
   1. Shop Connections:
      a. Unless otherwise shown on the Drawings, shop connections may be welded or high strength bolted and all welds shall be 1/4-inch minimum.
      b. Wherever reaction values of a beam are not shown on the Drawings, the connections shall be designed to support the total uniform load capacity tabulated in the AISC tables for allowable loads on beams for the given shape, span, and steel specified for the beam in question.
      c. Shop welded connections shall be designed to eliminate or minimize eccentricity. The size, extent, location and type of all shop welds shall be clearly shown on the Shop Drawings by use of AWS standard notations and symbols.
      d. End connection angles fastened to the webs of beams and girders and the thickness of the angles, size and extent of fasteners or shop welds shall conform to tables of "Framed Beam Connections" in the AISC Manual. All connections shall be two sided, unless otherwise shown on the Drawings.
   2. Field Connections:
      a. All field connections, unless otherwise specified below or noted, shall be made with high strength bolts, and shall be bearing type connections.
      b. Common bolts may be used for beam to beam, and beam to girder connections.

c. Field welding may be used only where noted or approved by ENGINEER.

3. High-Strength Bolted Construction:
   a. Install high-strength threaded fasteners in accordance with AISC "Specifications for Structural Joints using ASTM F 3125 Bolts" (RCRBSJ).
   b. High strength bolt design shear values shall be as specified in the AISC Manual for bolts with threads in the shear plane.
   c. The minimum size of bolts shall be 3/4-inch diameter, unless otherwise noted.
4. Welded Construction: Comply with AWS Code for procedures, appearance and quality of welds, and methods used in correcting welding work.
   a. Assemble and weld built-up sections by methods which will produce true alignment of axes without warp.
5. Where rigid connections are required by the stresses shown on the Drawings, web shear reinforcement and stiffeners in accordance with AISC Specifications shall be provided.
6. Shear Connectors: Install stud shear connectors in accordance with AWS D1.1 Section 4, and as recommended by the manufacturer.

C. Structural Tubing: Structural tubing shall be properly sealed to protect the internal surfaces.

D. Holes and Appurtenances for Other Work:
   1. Provide holes required for securing other work to structural steel framing, and for the passage of other work through steel framing members, as shown on the Shop Drawings. If large block-outs are required and approved by the Engineer, the webs shall be reinforced to develop specified shears. Provide threaded nuts welded to framing, and other specialty items as shown on the Drawings to receive other work.
   2. Cut, drill, or punch holes perpendicular to metal surfaces. Do not flame cut holes or enlarge holes by burning. Drill holes in bearing plates.
   3. Refer to Paragraph 1.1.B, above, for the requirements of coordination with others.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which structural steel Work is to be installed, and notify ENGINEER, in writing, of conditions detrimental to proper and timely completion of Work. Do not proceed with Work until unsatisfactory conditions have been corrected in a manner acceptable to ENGINEER.

3.2 ERECTION

A. General: Comply with the AISC Specifications and Code of Standard Practice, and as herein specified.

B. Surveys: Provide services of a registered surveyor to check lines and elevations of concrete and masonry bearing surfaces, and locations of anchor bolts and similar devices before steel erection proceeds. Discrepancies shall be reported immediately to ENGINEER, in writing. Do not proceed with erection until corrections have been made, or until compensating adjustments to the structural steel Work have been agreed upon with ENGINEER.

C. Temporary Shoring and Bracing: Provide temporary shoring and bracing members with connections of sufficient strength to bear imposed loads. Remove temporary members and connections when permanent members are in place and final connections are made. Provide temporary guy lines to achieve proper alignment of the structures as erection proceeds.

D. Temporary Planking: Provide temporary planking and working platforms as necessary to effectively complete the Work. Provide sufficient planking to comply with OSHA requirement of a tightly planked substantial floor within two stories or 30 feet, whichever is less, below each tier of steel beams on which Work is performed.

E. Anchor Bolts: Furnish anchor bolts and other connectors required for securing structural steel to foundations and other in-place Work.
   1. Furnish templates and other devices as necessary for presetting bolts and other anchors to accurate locations.
      a. Refer to Section 03252, Anchorage in Concrete, of these Specifications for anchor bolt installation requirements.

F. Setting Bases and Bearing Plates: Clean concrete and masonry bearing surfaces of bond-reducing materials and roughen to improve bond to surfaces. Clean the bottom surface of base and bearing plates.
   1. Set loose and attached base plates and bearing plates for structural members on steel wedges or other adjusting devices.
   2. Tighten the anchor bolts after the supported members have been positioned and plumbed. Do not remove wedges or shims, but if protruding, cut off flush with the edge of the base or bearing plate prior to packing with grout.
   3. Place grout between bearing surfaces and bases or plates as specified in Section 03600, Grout. Finish exposed surfaces, protect installed materials, and allow curing in strict compliance with the manufacturer's instructions, or as otherwise required.
   4. Leveling plates and wood wedges will not be permitted.

G. Field Assembly: Set structural frames accurately to the lines and elevations as shown on the Drawings. Align and adjust the various members forming a part of a

complete frame or structure before permanently fastening. Clean bearing surfaces and other surfaces, which will be in permanent contact before assembly. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

1. Level and plumb individual members of the structure within tolerances as specified in AISC Manual. For members requiring accurate alignment, clip angles, lintels and other members shall be provided with slotted holes for horizontal adjustment at least 3/8-inch in each direction, or more when required.
2. Splice members only where shown on the Drawings or specified.

H. Erection Bolts: On exposed welded construction, remove erection bolts, fill holes with plug welds and grind smooth at exposed surfaces.

I. Comply with AISC Manual for bearing, adequacy of temporary connections, alignment, and the removal of paint on surfaces adjacent to field welds.
   1. Do not enlarge unfair holes in members by burning or by the use of drift pins, except in secondary bracing members. Ream holes that must be enlarged to admit bolts.

J. Gas Cutting: Do not use gas cutting torches for correcting fabrication errors in the structural framing. Cutting will be permitted only on secondary members, which are not under stress, as acceptable to ENGINEER. Finish gas-cut sections equal to a sheared appearance when permitted.

K. Touch-Up Painting:
   1. Unless otherwise specified below, comply with all requirements of touch-up painting specified in Section 09900, Painting.
   2. Immediately after erection, clean field welds, bolted connections, and all damaged and abraded areas of the shop paint. Apply paint to all exposed areas with the same material as used for shop painting. Apply by brush or spray to provide a minimum dry film thickness as specified in Section 09900, Painting.

3.3 FIELD QUALITY CONTROL

A. Engage an independent testing and inspection agency to inspect high- strength bolted connections and welded connections and to perform tests and prepare test reports.
   1. The testing agency shall conduct and interpret the tests and state in each report whether the test specimens comply with the requirements, and specifically state all deviations.
   2. Provide access for the testing agency to places where structural steel Work is being fabricated or produced so that required inspection and testing can be accomplished.
   3. The testing agency may inspect structural steel at the plant before shipment; however, ENGINEER reserves the right, at any time before Final Acceptance, to reject material not complying with specified requirements.

B. Correct deficiencies in structural steel Work that inspection and laboratory test reports indicate do not comply with the Specifications. Perform additional tests, as may be required to reconfirm any non-compliance of the original Work, and as may be required to show compliance of corrected Work.

C. Special Inspection:
   1. See Section 01416.
   2. Special Inspection to be in accordance with the building code.
   3. Special Inspection is required for:
      a. Material verification of high-strength bolts, nuts, and washers.
         1) Verify proper identification markings for high-strength bolts, nuts, and washers per applicable standards.
         2) Frequency: All high-strength bolts, prior to being covered up or substantial completion.
      b. Inspection of high-strength bolting:
         1) Inspect high-strength bolting in accordance with the RCSC Specification for Structural Joints Using High-Strength Bolts, Section 9.
            a) Verify proper pretension for slip-critical bolted connection only.
            b) Verify direct tension indicator gaps for slip-critical bolted connection only.
         2) Frequency:
            a) All high-strength bolts, prior to being covered up or substantial completion.
            b) Pretensioned and slip-critical joints using turn-of-nut without match marking or calibrated wrench methods of installation require continuous inspection.
      c. Material verification of structural steel.
         1) Frequency: Prior to being covered up or substantial completion,
      d. Material verification of weld filler materials.
         1) Frequency:
            a) Prior to welding on site.
            b) Randomly thereafter.
      e. Inspection of welding.
         1) Frequency:
            a) Visually inspect all welds.
            b) In addition to visual inspection, test 50 PCT of complete joint penetration welds and 20 PCT of fillet welds with liquid dye penetrant or magnetic particle testing.
            c) Test 10 PCT of complete joint penetration welds with ultrasonic or radiographic testing.
            d) Test 100 PCTall of complete full joint penetration welds with ultrasonic testing at the following locations:
               (1) Locations specifically noted on Drawings.
      f. Inspect structural steel which has been erected.

1) Frequency: Prior to members being covered up or substantial completion.

g. Inspect stud welding in accordance with AWS D1.1/D1.1M, Section 7.8.

++ END OF SECTION ++

SECTION 05500

METAL FABRICATIONS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Shop fabricated steel items.

1.2 REFERENCE STANDARDS

A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.

B. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength; 2021.

C. ASTM A501/A501M - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing; 2021.

D. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2020.

E. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification; 2021, with Errata (2023).

F. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; 2004.

1.3 SUBMITTALS

A. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.
   1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.

B. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1/B2.1M and dated no more than 12 months before start of scheduled welding work.

PART 2 - PRODUCTS

2.1 MATERIALS - STEEL

A. Steel, Structural Shapes and Plate:
   1. All W-shapes: ASTM A992.

2. All other plates, bars and rolled shapes: ASTM A36.

B. Steel Tubing: ASTM A501/A501M, Grade B hot-formed structural tubing.

C. Mechanical Fasteners: Same material as or compatible with materials being fastened; type consistent with design and specified quality level.

D. High-Strength Bolts, Nuts and Washers:
   1. ASTM F3125, Grade A325 with ASTM A563 nuts, plain.
      a. Provide two ASTM F436 washers for all bolts, plain.
      b. Provide beveled washers at connections of sloped/tapered sections.

E. Electrodes for Welding: E70XX complying with AWS D1.1, Design of New Buildings, Section 8. AWS D1.1.

F. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.

2.2 MISCELLANEOUS METAL ITEMS

A. Miscellaneous Framing and Supports:
   1. Provide miscellaneous metal framing and supports, which are not a part of the structural steel framework and are required to complete the Work.

B. Modular Framing System:
   1. Materials:
      a. Stainless steel: ASTM A666.
   2. Channels and inserts:
      a. Stainless steel: Minimum 12 GA.
      b. Channels to have one side with a continuous slot with in-turned lips.
         1) Width: 1-5/8 IN.
         2) Depth and configuration as necessary for loading conditions.
   3. Fittings: Same material as system major components.
   4. Fasteners:
      a. Nuts: Toothed groves in top of nuts to engage the in-turned lips of channel.
      b. Bolts: Hex-head cap screws.
      c. Same material as system major components.
   5. End caps:
      a. At each exposed end of each piece mounted on walls, or guardrails, or suspended from framing 7 FT or less above the floor or platform.
         1) Plastic for all exposed ends 7 FT or more above floor or platform.
         2) Plastic or metallic for all other exposed ends.
   6. Unistrut Building Systems, or approved equal.

2.3 FABRICATION

A. Fit and shop assemble items in largest practical sections, for delivery to site.

B. Fabricate items with joints tightly fitted and secured.

C. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

D. Furnish components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.4 FINISHES - STEEL

A. Prime paint steel items.

B. Prime Painting: One coat.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work.

3.2 PREPARATION

A. Furnish setting templates to the appropriate entities for steel items required to be cast into concrete or embedded in masonry.

3.3 INSTALLATION

A. Install items plumb and level, accurately fitted, free from distortion or defects.

B. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.

C. Obtain approval prior to site cutting or making adjustments not scheduled.

++ END OF SECTION ++

SECTION 05501

MISCELLANEOUS METAL FABRICATIONS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
   1. Provide all labor, materials, equipment and incidentals as shown on the Drawings, specified and required to furnish miscellaneous metal fabrications, including surface preparation and shop priming.

B. The extent of miscellaneous metal fabrications Work is shown on the Drawings and includes items fabricated from iron, steel and aluminum shapes, plates, bars, castings and extrusions, which are not a part of the structural steel or other metal systems covered by other Sections of these Specifications.

1.2 QUALITY ASSURANCE

A. Reference Standards: Comply with the applicable provisions and recommendations of the following, except as otherwise shown and specified:
   1. ASTM A 36, Specification for Carbon Structural Steel.
   2. ASTM A 53, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
   3. ASTM A 153, Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
   4. ASTM A 240, Specification for Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels.
   5. ASTM A 269, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
   6. ASTM A 276, Standard Specification for Stainless Steel Bars and Shapes.
   7. ASTM A 312, Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes.
   8. ASTM A 320, Specification for Alloy Steel Bolting Material for Low Temperature Service.
   9. ASTM A 500, Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes, Grade B or C.
   10. ASTM A 554, Standard Specification for Welded Stainless Steel Mechanical Tubing.
   11. ASTM A 666, Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
   12. ASTM A 992, Rolled W-Structural Steel Shapes.
   13. ASTM B 209, Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

14. ASTM B 211, Specification for Aluminum and Aluminum-Alloy Bars, Rods and Wire.
15. ASTM B 221, Specification for Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes and Tubes.
16. AWS D1.1, Structural Welding Code.
17. AWS D1.6, Structural Welding Code – Stainless Steel.
18. NAAMM, Metal Finishes Manual.
19. OSHA.
20. IBC 2024, International Building Code.

B. Field Measurements:
   1. Take field measurements where required prior to preparation of Shop Drawings and fabrication to ensure proper fitting of the Work.

C. Shop Assembly:
   1. Preassemble items in the shop to the greatest extent possible, so as to minimize field splicing and assembly of units at the project site. Disassemble units only to the extent necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

D. Qualifications:
   1. Qualify welding procedures and welding operators in accordance with AWS.
   2. Fabricator shall have minimum of 10 years of experience in fabrication of metal items specified.

1.3 SUBMITTALS

A. Shop Drawings: Submit for approval the following:
   1. Comply with the requirements of Section 01300, Submittals.
   2. Fabrication and erection details of all assemblies of miscellaneous metal Work. Include plans, elevations, and details of sections and connections. Show anchorage and accessory items. Include setting drawings and templates for location and installation of miscellaneous metal items and anchorage devices.
   3. Copies of manufacturer's specifications, load tables, dimension diagrams, anchor details, and installation instructions for products to be used in miscellaneous metal Work.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Steel:
   1. Structural:
      a. W-shapes and WT-shapes: ASTM A 992, Grade 50.
      b. All other plates and rolled sections: ASTM A 36.
   2. Pipe: ASTM A 53, Types E or S, Grade B or ASTM A501.

3. Structural tubing:
    a. ASTM A 500, Grade B (46 KSI minimum yield).
4. Welding electrodes: AWS D1.1, E70 Series.

B. Stainless Steel:
1. Stainless steel in welded applications: Low carbon 'L' type.
2. Minimum yield strength of 30,000 PSI and minimum tensile strength of 75,000 PSI.
    a. Bars, shapes: ASTM A276, Type 316.
    b. Tubing and pipe: ASTM A269, ASTM A312 or ASTM A554, Type 316.
    c. Strip, plate and flat bars: ASTM A 666, Type 316.
    d. Bolts and nuts: ASTM F 593, Type 316.
    e. Washers: ASTM A 320, Type 316.
3. Minimum yield strength of 25,000 PSI and minimum tensile strength of 70,000 PSI.
    a. Strip, plate and flat bar for welded connections, ASTM A 666, Type 316L.
4. Welding electrodes: In accordance with AWS for metal alloy being welded.

C. Aluminum:
1. Alloy 6061-T6, 32,000 PSI tensile yield strength minimum.
    a. ASTM B221 and ASTM B308 for shapes including beams, channels, angles, tees and zees.
    b. Weir plates, baffles and deflector plates, ASTM B209.
2. Alloy 6063-T5 or T6, 15,000 PSI tensile yield strength minimum.
    a. ASTM B221 and ASTM B429 for bars, rods, wires, pipes and tubes.
3. ASTM B26 for castings.
4. ASTM F468, alloy 2024 T4 for bolts.
5. ASTM F467, alloy 2024 T4 for nuts. Zinc Coated Hardware: ASTM A 153.
6. Electrodes for welding aluminum: AWS D1.2, filler alloy 4043 or 5356.

D. Surface Preparation and Shop Priming: Refer to Section 09900, Painting. All steel shall be primed in the shop. Surface preparation and shop priming requirements are included herein, but are specified in Section 09900.

2.2 MISCELLANEOUS METAL ITEMS

A. Bollards: Provide 8-inch diameter, Schedule 40 black steel pipe, 4-feet-0-inches above grade, 4-feet-0-inches below grade. Fill with concrete and mound top. Bollards shall be primed in the shop. Surface preparation and painting shall conform to the requirements of Section 09900, Painting.

B. Ladders:
1. General:
    a. Fully welded type.
        1) All welds to be full penetration welds, unless otherwise specified.

b. All ladders of a particular material shall have consistent construction and material shapes and sizes unless noted otherwise on the Drawings.

2. Material:
    1) As indicated on the Drawings.
3. Rails:
    a. Section:
        1) As indicated on the Drawings.
    b. Spacing:
        1) Minimum clear distance between rails to be 18 IN.
        2) Step-through ladder extensions: 29 IN, clear.
    c. Provide cap at exposed top and bottom of side rails, as applicable.
    d. Extend side rails of step-through ladders a minimum of 42 IN above the landing.
4. Rungs:
    a. Minimum 1 IN DIA or 1 IN square solid bar.
        1) Integral non-slip finish on all sides.
            a) Non-slip finish: Coarse knurling or extruded serrations.
            b) Shop or field-applied grit tape and cap type non-slip finishes are not acceptable.
    b. Rungs shall penetrate inside wall of side rails.
        1) Do not extend rungs beyond the outside face of the side rail.
        2) Provide fillet weld all around rung at inside face of side rail and plug weld at outside face of side rail, as applicable.
    c. Rung spacing:
        1) Equally spaced not less than 10 IN and not more than 14 IN as measured between the centerlines of the rungs.
        2) Top rung shall be level with landing or platform.
5. Brackets:
    a. Angle or bent plate brackets bolted to side rails:
        1) 3/8 IN by 4 IN by length required.
        2) Provide punched holes for 3/4 IN bolts or anchors.
        3) Minimum distance from centerline of rung to wall or any obstruction: 7 IN.
        4) Maximum spacing: 4 FT OC, unless otherwise noted on the Drawings.
    b. For floor supported ladders, provide base support as indicated on the Drawings with punched holes for 3/4 IN bolts.
6. Ladder safety gate:
    a. Provide as indicated on the Drawings.
    b. PS Safety Access "EdgeHalt" system.
        1) Part Number LSG-2030-PCY
            a) Provide manufacturer’s mounting bracket appropriate for installation condition.
            b) Gate swing direction: Toward upper landing.
            c) Finish: “Safety Yellow” powder coat.

2) Install in accordance with manufacturer's printed installation instructions.
3) Or approved equal

C. Miscellaneous Framing and Supports:
1. Provide miscellaneous metal framing and supports, which are not a part of the structural steel framework and are required to complete the Work.
2. Fabricate miscellaneous units to the sizes, shapes and profiles shown on the Drawings or, if not shown on the Drawings, of the required dimensions to receive adjacent grating, plates, tanks, doors, or other work to be retained by the framing. Except as otherwise shown on the Drawings, fabricate from structural shapes, plates, and bars, of all welded construction using mitered corners, welded brackets and splice plates and a minimum number of joints for field connection. Cut, drill and tap units to receive hardware and similar items to be anchored to the Work.
3. Equip units with integrally welded anchors for casting into concrete. Furnish inserts if units must be installed after concrete is placed.
a. Except as otherwise shown on the Drawings, space anchors, 24-inches on centers, and provide units the equivalent of 1-1/4 by 1/4 by 8-inch strips.
b. Galvanize exterior miscellaneous frames and supports.
c. Galvanize miscellaneous frames and supports where indicated.

D. Modular Framing System:
1. Materials:
a. Stainless steel: ASTM A666.
2. Channels and inserts:
a. Stainless steel: Minimum 12 GA.
b. Channels to have one side with a continuous slot with in-turned lips.
1) Width: 1-5/8 IN.
2) Depth and configuration as necessary for loading conditions.
3. Fittings: Same material as system major components.
4. Fasteners:
a. Nuts: Toothed groves in top of nuts to engage the in-turned lips of channel.
b. Bolts: Hex-head cap screws.
c. Same material as system major components.
5. End caps:
a. At each exposed end of each piece mounted on walls, or guardrails, or suspended from framing 7 FT or less above the floor or platform.
1) Plastic for all exposed ends 7 FT or more above floor or platform.
2) Plastic or metallic for all other exposed ends.
6. Unistrut Building Systems, or approved equal.

E. Fasteners and Fittings: Provide Type 316 stainless steel, for all aluminum fabrications, and zinc coated hardware for all galvanized fabrications, unless otherwise shown on the Drawings or specified.

F. Surface Preparation and Shop Priming: All miscellaneous metal fabrications, except aesthetic steel artforms, shall be primed in the shop. Surface preparation and shop priming requirements are included herein, but are specified in Section 09900, Painting.

G. Aluminum Finish: Provide an Architectural Class 1 anodized finish, AA-M32C22-A41, as specified in NAAMM Manual.

2.3 FABRICATION

A. Verify field conditions and dimensions prior to fabrication.

B. Form materials to shapes indicated with straight lines, true angles, and smooth curves.
   1. Grind smooth all rough welds and sharp edges.
      a. Round all corners to approximately 1/32 - 1/16 IN nominal radius.

C. Provide drilled or punched holes with smooth edges.
   1. Punch or drill for field connections and for attachment of work by other trades.

D. Weld Shop Connections:
   1. Welds to be continuous fillet type unless indicated otherwise.
   2. Weld structural steel in accordance with AWS D1.1 using Series E70 electrodes conforming to AWS A5.1/A5.1M.
   3. Weld aluminum in accordance with AWS D1.2.
   4. Weld stainless steel in accordance with AWS D1.6 and NiDI 11 007.
      a. Treat all welded areas in accordance with ASTM A380.
   5. All headed studs to be welded using automatically timed stud welding equipment.
   6. Grind smooth welds that will be exposed.

E. Passivate stainless steel items and stainless steel welds after they have been ground smooth.
   1. ASTM A380.

F. Conceal fastenings where practicable.

G. Fabricate work in shop in as large assemblies as is practicable.

H. Tolerances:
   1. Rolling:
      a. ASTM A6.
      b. When material received from the mill does not satisfy ASTM A6 tolerances for camber, profile, flatness, or sweep, the Contractor is permitted to perform corrective work by the use of controlled heating and mechanical straightening, subject to the limitations of the AISC Specification.

2. Fabrication tolerance:
    a. Member length:
        1) Both ends finished for contact bearing: 1/32 IN.
        2) Framed members:
            a) 30 FT or less: 1/16 IN.
            b) Over 30 FT: 1/8 IN.
    b. Member straightness:
        1) Compression members: 1/1000 of axial length between points laterally supported.
        2) Non-compression members: ASTM A6 tolerance for wide flange shapes.
    c. Specified member camber (except compression members):
        1) 50 FT or less: -0/+1/2 IN.
        2) Over 50 FT: -0/+1/2 IN (+1/8 IN per 10 FT over 50 FT).
        3) Members received from mill with 75 PCT of specified camber require no further cambering.
        4) Beams/trusses without specified camber shall be fabricated so after erection, camber is upward.
        5) Camber shall be measured in fabrication shop in unstressed condition.
    d. At bolted splices, depth deviation shall be taken up by filler plates.
        1) At welded joints, adjust weld profile to conform to variation in depth.
        2) Slope weld surface per AWS requirements.
    e. Finished members shall be free from twists, bends and open joints.
        1) Sharp kinks, bends and deviation from above tolerances are cause for rejection of material.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Set miscellaneous metal fabrications accurately in location, alignment and elevation, plumb, level, true and free of rack, measured from established lines and levels. Brace temporarily or anchor temporarily in formwork where fabrications are to be built into concrete, masonry or similar construction.

B. Anchor securely as shown on the Drawings or as required for the intended use, using concealed anchors wherever possible.

C. Fit exposed connections accurately together to form tight hairline joints. Weld steel connections, which are not to be left as exposed joints, but cannot be shop welded because of shipping size limitations. Grind steel joints smooth and touch up shop paint coat. Do not weld, cut or abrade the surfaces of exterior units, which have been hot-dip galvanized after fabrication, and are intended for bolted or screwed field connections.

D. Protection of Aluminum from Dissimilar Materials:
   1. Coat all surfaces of aluminum in contact with dissimilar materials, such as concrete, masonry and steel conforming to the requirements of Section 09900, Painting.

E. Unless noted or specified otherwise:
   1. Connect steel members to steel members with 3/4 IN DIA ASTM F3125, Grade A325 high strength bolts.
   2. Connect aluminum to aluminum with 3/4 IN DIA stainless bolts.
   3. Connect aluminum to structural steel using 3/4 IN DIA stainless steel bolts.
      a. Provide dissimilar metals protection.
   4. Connect aluminum and steel members to concrete and masonry using stainless steel mechanical anchor bolts or adhesive anchor bolts unless shown otherwise.
      a. Provide dissimilar materials protection.
   5. Provide washers for all bolted connections.
   6. Where exposed, bolts shall extend a maximum of 3/4 IN and a minimum of 1/2 IN above the top of installed nut.
      a. If bolts are cut off to required maximum height, threads must be dressed to allow nuts to be removed without damage to the bolt or the nuts.

F. Install and tighten ASTM F3125, Grade A325 high-strength bolts in accordance with the AISC 325, Allowable Stress Design (ASD).
   1. Provide hardened washers for all Grade A325 bolts.
      a. Provide the hardened washer under the element (nut or bolt head) turned in tightening.

G. After bolts are tightened, upset threads of ASTM A307 bolts or anchor bolts to prevent nuts from backing off.

H. Install bollards as detailed on Drawings.
   1. Fill pipe with concrete and round off at top.

I. Repair damaged galvanized surfaces in accordance with ASTM A780.
   1. Prepare damaged surfaces by abrasive blasting or power sanding.
   2. Apply galvanizing repair paint to minimum 6 mils DFT in accordance with manufacturer's instructions.

3.2 FIELD QUALITY CONTROL

A. Tolerances shall meet structural requirements of Specification Section 05120, Structural Steel, for erecting items of structural nature.

B. Tolerances (unless otherwise noted on the Drawings):
   1. Frame placement, after assembly and before welding or tightening.
      a. Deviation from plumb, level and alignment: 1 IN 500, maximum.

b. Displacement of centerlines of columns: 1/2 IN maximum, each side of centerline location shown on Drawings.

C. Special Inspection:
1. See Section 01416 and Section 05120.

3.3 CLEANING

A. After fabrication, erection, installation or application, clean all miscellaneous metal fabrication surfaces of all dirt, weld slag and other foreign matter.

B. All stainless steel products in addition to Paragraph A. above:
1. Remove all heat tint, rusting, discoloration by passivation, ASTM A380, or other acceptable means as listed in NiDI 11 007 as approved by the Engineer.

C. Provide surface acceptable to receive field applied paint coatings specified in Specification Section 09900.

++ END OF SECTION ++

SECTION 05510

METAL STAIRS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:
   1. Design of systems and components, including but not limited to:
      a. Structural steel stair framing and supports.
      b. Landings.
      c. Elevated Platforms.
      d. Open grating stair treads, checkered plate stair treads, and pan treads to receive concrete fill, and landings.
      e. Integral balusters and handrails.
      f. Handrails at walls and guards.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. ASTM A653, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
   2. ASTM A1008, Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
   3. ASTM E985, Standard Specification for Permanent Metal Railing Systems and Rails for Buildings.
   4. NAAMM AMP 510, Metal Stairs Manual; The National Association of Architectural Metal Manufacturers; 1992, Fifth Edition.
   5. NAAMM MBG 531, Metal Bar Grating Manual; The National Association of Architectural Metal Manufacturers.

B. Qualifications:
   1. Fabricator Qualifications:
      a. Firm experienced in producing metal stairs similar to those indicated for this Project with a record of successful in-service performance and with sufficient production capacity to produce required units without delaying the Work.
   2. Installer Qualifications:
      a. Arrange for metal stair installation specified in this Section by the same firm that fabricated them.
   3. Engineer Qualifications:
      a. A Registered Professional Engineer legally authorized to practice in jurisdiction where Project is located and experienced in providing

engineering services of the kind indicated that have resulted in the installation of metal stairs (including foundations, framing, handrails and railing systems) similar to this Project in material, design, and extent and that have a record of successful in-service performance.

4. Welding Standards:
   a. Comply with applicable provisions of AWS D1.1 "Structural Welding Code Steel" and AWS D1.3 "Structural Welding Code Sheet Steel".
   b. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

1.3 DESIGN CRITERIA

A. Code Compliance:
   1. Metal stairs shall comply with the General Requirements, All Classes of Stairs, in Section 1 of the NAAMM, "Metal Stairs Manual."
   2. Sizes of miscellaneous items such as carrier angles, anchors, fasteners, inserts and platform stiffeners, and design stresses shall be as recommended in Section 4 of the "Metal Stairs Manual," unless more stringent requirements are required by governing authorities.

B. Structural Performance: Engineer, fabricate, and install metal stair systems to withstand the following structural loads without exceeding the allowable design working stress of the materials involved, including anchors and connections. Apply each load to produce the maximum stress in each component of steel stair system.
   1. Treads of Steel Stairs:
      a. Capable of withstanding a uniform load of 100 lbf per sq. ft. or a concentrated load of 300 lbf on an area of 4 sq. inches located in the center of the tread, whichever produces the greater stress.
   2. Platforms of Steel Stairs:
      a. Capable of withstanding a uniform load of 100 lbf per sq. ft.
   3. Stair Framing:
      a. Capable of withstanding stresses resulting from loads specified above as well as stresses resulting from railing system loads.
   4. Top Rail of Guardrail Systems:
      a. Capable of withstanding the following live loads applied as indicated:
         1) Concentrated load of 200 lbf applied at any point and in any direction.
         2) Uniform load of 50 lbf per linear foot applied horizontally and concurrently with uniform load of 100 lbf per linear foot applied vertically downward.
         3) Concentrated and uniform loads above need not be assumed to act concurrently.
   5. Handrails Not Serving as Top Rails:
      a. Capable of withstanding the following live loads applied as indicated:

1) Concentrated load of 200 lbf applied at any point and in any direction.
2) Uniform load of 50 lbf per linear foot applied in any direction.
3) Concentrated and uniform loads above need not be assumed to act concurrently.

6. Infill Area of Guardrail Systems:
   a. Capable of withstanding a horizontal concentrated live load of 200 lbf applied to one sq. ft. at any point in the system including panels, intermediate rails, balusters, or other elements composing the infill area.
      1) Above load need not be assumed to act concurrently with loads on top rails of railing systems in determining stress on guard.

1.4 SUBMITTALS

A. Comply with the requirements of Section 01300, Submittals.

B. Product data for metal stairs, stair treads, metal grating for landings, paint products, and grout.

C. Contractor designed systems and components:
   1. Shop Drawings detailing fabrication and installation of metal stair systems. Include plans, elevations, sections, and details for all components and connections of the metal stair systems as defined herein. Show foundation designs, framing, anchorage and accessory items. Provide templates for anchors and bolts specified for installation under other sections.
   2. Engineering design calculations:
      a. Indicate design live loads.
      b. Sealed by a licensed professional engineer, registered in the State of Arizona.
      c. ENGINEER will review for general compliance with Contract Documents.

D. Welder certificates signed by CONTRACTOR certifying that welders comply with requirements specified Paragraph 1.3.

E. Qualification data for firms and persons specified in Paragraph 1.3 to demonstrate their capabilities and experience. Include list of completed projects with project names, addresses, names of architects and owners, and other information specified.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Steel, Structural Shapes and Plate:
   1. See Section 05120, Structural Steel.

2. Finish: Galvanized.

B. Hollow Structural Sections (HSS):
   1. See Section 05120, Structural Steel and Framing.
   2. Finish: Galvanized.

C. Ungalvanized Steel Sheet:
   1. ASTM A1008, Designation SS, Grade 33, Type 1.

D. Galvanized Steel Sheet:
   1. ASTM A653, Structural Steel (SS), Grade 33/230, with G40/Z120 coating.

E. Steel Bars for Gratings: ASTM A569 or ASTM A36.
   1. Finish: Galvanized.

F. Wire Rod for Grating Cross Bars: ASTM A510.
   1. Finish: Galvanized.

G. Galvanized Steel Sheet: Quality as follows:
   1. Commercial Quality: ASTM A526, G90 (Z275) coating designation, unless otherwise indicated.

H. Welding Rods and Bare Electrodes: Select according to AWS Specifications for the metal alloy to be welded.

I. High-Strength Bolts, Nuts, and Washers:
   1. See Section 05120, Structural Steel and Framing.
   2. Galvanized to ASTM A153 where connecting galvanized components.

J. Anchor Bolts:
   1. See Section 03252, Anchorage in Concrete.

K. Fasteners
   1. General:
      a. Provide plated fasteners complying with ASTM B633, Class Fe/Zn 25 for electrodeposited zinc coating, for exterior use or where built into exterior walls. Select fasteners for the type, grade, and class required.
      b. Exposed mechanical fastenings shall be flush countersunk screws or bolts; consistent with design of stair structure.
   2. Bolts and Nuts:
      a. Regular hexagon head type, ASTM A307, Grade A (ASTM F568, Property Class 4.6), with hex nuts, ASTM A563, and, where indicated, flat washers.
   3. Machine Screws:
      a. ANSI B18.6.3 (ANSI B18.6.7M).
   4. Plain Washers:
      a. Round, carbon steel, ANSI B18.22.1 (ANSI B18.22M).

5. Lock Washers:
    a. Helical, spring type, carbon steel, ANSI B18.21.1.

2.2 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide stair systems by one of the following:
    1. Alfab, Inc.
    2. American Stair Corp., Inc.
    3. Or approved equal

2.3 PAINT

A. Galvanizing Repair Paint: High zinc dust content paint for regalvanizing welds in galvanized steel, with dry film containing not less than 94% zinc dust by weight, and complying with DODP21035 or SSPC Paint 20.

B. Bituminous Paint: Cold applied asphalt mastic complying with SSPC Paint 12, except containing no asbestos fibers.

2.4 GROUT

A. Non-shrink, Non-metallic Grout:
    1. See Section 03600, Grout.

2.5 FABRICATION AND SHOP ASSEMBLY

A. General:
    1. Use welding for joining pieces together, unless otherwise shown on the Drawings or specified. Welding to comply with the applicable provisions of AWS D1.1. Fabricate units so that bolts and other fastenings do not appear on finish surfaces. Make joints true and tight, and make connections between parts light proof tight. Provide continuous welds, ground smooth where exposed.
    2. Construct metal stair units to conform to sizes and arrangements as shown on the Drawings. Provide metal framing, hangers, columns, struts, clips, brackets, bearing plates and other components for the support of stairs and platforms. Erect metal stair Work to line, plumb, square, and true with runs registering level with floor and platform levels.
    3. Provide brackets and bearing surfaces as detailed and as required to anchor and contain the stairs on the supporting structure.
    4. Where masonry or concrete walls support the metal stair work provide temporary supporting struts, designed for the erection of stair components before installation of masonry or concrete.

B. Stair Framing:

1. Fabricate stringers of structural steel channels, or plates, or a combination thereof, for the general configurations shown on the Drawings. Provide closures for exposed ends of stringers.
2. Construct platforms of structural steel channel headers and miscellaneous framing members, as shown on the Drawings. Bolt or weld headers to stringers. Bolt or weld framing members to strings and headers.
3. Comply with "Recommended Voluntary Minimum Standards for Fixed Metal Stairs" in NAAMM "Metal Stair Manual" for class of stair designated, except where more stringent requirements are indicated.
    a. Industrial class, unless otherwise indicated.

C. Metal Safety Nosings in Concrete Landings:
1. Provide cast metal, abrasive non-skid type nosings, 4-inches wide by full length of step between stringers, unless otherwise shown on the Drawings. Fabricate in thickness, profile, and surface pattern as shown on the Drawings or, if not shown on the Drawings, as selected from manufacturer's standard patterns. Equip each nosing with integral or applied anchors for embedding in concrete, spaced not more than 4-inches from each end and not more than 15-inches on centers.
2. Products and Manufacturers: Provide one of the following:
    a. American Abrasive Metals Company.
    b. Wooster Products, Inc.
    c. Or approved equal.

D. Floor Grating Treads and Platforms:
1. Comply with NAAMM "Metal Bar Grating Manual". Pattern, spacing, and bar sizes shall be as shown on the Drawings.
    a. Fabricate treads from punched (ventilated) extruded plank, with serrated, slip-resistant surface.
        1) Finish: Galvanized.
2. Fabricate grating treads with abrasive nosing on one edge and with steel angle or steel plate carrier at each end for stringer connections. Secure treads to stringers with bolts.
3. Fabricate grating platforms, with nosing matching that on grating treads, at all landings. Provide toe plates at open sided edges of floor grating fastened to platform framing members.

E. Stair Handrails: Handrails are specified in other Sections of the Specifications as follows:
1. See Section 05522, Aluminum Handrails and Railings.

F. Surface Preparation and Shop Priming: The metal stairs shall be primed in the shop. Surface preparation and shop priming requirements are included herein, but are specified in Section 09900, Painting.

2.6 FINISHING

A. Metal Surfaces, General:
   1. For surfaces exposed to view in the completed Work, provide materials selected for their surface flatness, smoothness, and freedom from surface blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, roughness, or, for steel sheet, variations in flatness exceeding those permitted by referenced standards for stretcher leveled sheet.

B. Do not factory prime metal stairs. Prime and finish coats will be field-applied directly to bare metal.

C. Galvanizing: Hot dip galvanize items indicated to be galvanized to comply with applicable standard listed below:
   1. ASTM A153 for galvanizing iron and steel hardware.
   2. ASTM A123 for galvanizing both fabricated and unfabricated iron and steel products made of uncoated rolled, pressed, and forged shapes, plates, bars, and strip 0.0299-inch thick and heavier.
   3. Fill vent and drain holes that will be exposed in the finished work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive Work.

3.2 PREPARATION

A. Coordinate and furnish anchorages, setting drawings, diagrams, templates, instructions, and directions for installing anchorages, including concrete inserts, weld plates, and anchor bolts. Coordinate delivery of such items to Project site.

3.3 INSTALLATION

A. Fastening to In Place Construction:
   1. Provide anchorage devices and fasteners where necessary for securing metal stairs to in place construction; including, threaded fasteners for concrete and masonry inserts, toggle bolts, through bolts and other connectors, as required. The anchorage devices and fasteners shall be Type 316 stainless steel.

B. Cutting, Fitting and Placement:
   1. Perform cutting, drilling and fitting required for the installation of the metal stairs. Set the stairs accurately in location, alignment and elevation, plumb,

level, true and free of rack, measured from established lines and levels. Provide temporary bracing or anchors in formwork for items, which are to be built into concrete, masonry or similar construction.

2. Fit exposed connections accurately together to form tight hairline joints. Weld connections, which are not to be left as exposed joints, but cannot be shop welded because of shipping size limitations. Grind joints smooth and touch up shop paint coat.

C. Field Welding:
   1. Comply with the applicable provisions of AWS D1.1 for the procedures of manual shielded metal arc welding, the appearance and quality of welds made, and the methods used in correcting welding.

D. Touch Up Painting:
   1. Unless otherwise specified below, comply with all requirements of touch-up painting specified in Section 09900, Painting.
   2. Immediately after erection, clean field welds, bolted connections, and abraded areas of the shop paint. Apply paint to all exposed areas with the same material as used for shop painting. Apply by brush or spray to provide a minimum dry film thickness as specified in Section 09900, Painting.

E. Protection of Aluminum from Dissimilar Materials:
   1. Coat all surfaces of aluminum in contact with dissimilar materials such as concrete, masonry and steel as conforming to the requirements of Section 09900, Painting.

F. Concrete fill, where required, is specified in Section 03300, Cast-in-Place Concrete. At exposed connections, finish exposed welds and surfaces smooth and blended so that no roughness shows after finishing, and welded surface matches contours of adjoining surfaces.

++ END OF SECTION ++

SECTION 05522

ALUMINUM RAILINGS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
   1. Provide all labor, materials, tools, equipment and incidentals as shown on the Drawings, specified and required to furnish and install aluminum railing systems. The Work also includes:
      a. Providing openings in, and attachments to, aluminum railing systems to accommodate the Work under this and other Sections and providing for the aluminum railing systems all items such as anchor bolts, fasteners, studs and all items required for which provision is not specifically included under other Sections.
   2. Extent of aluminum railing systems is shown on the Drawings and specified.
   3. Types of products required include the following:
      a. Top, bottom, and two intermediate horizontal railing system.
      b. Handrail system.
      c. Toeboards.
      d. Anchors and fasteners.
      e. Sleeves, castings, reinforcing inserts, wall brackets, gates, gate latches, stops and hinges, chains, and other miscellaneous accessories.
      f. Class I anodized finish for all system components.

B. Coordination:
   1. Review installation procedures under this and other Sections and coordinate the Work that must be installed with, before or attached to the aluminum handrails and railings Work.
   2. Coordinate all handrail and railing locations as required for Work meeting all governing authorities.

1.2 SYSTEM DESCRIPTION

A. Aluminum handrail and railing system shall consist of four equally spaced horizontal rails with standard rivets and adhesively bonded components fastened to posts spaced not more than 5 feet-0 inches on center and a system of handrails supported from adjacent construction by mounting brackets spaced at not more than 5 feet-0 inches on center.

B. Aluminum handrail and railing system shall include all components and features shown on the Drawings and specified and all system components and features available from specified manufacturers necessary to provide a complete aluminum handrail and railing system complying with these Specifications.

1.3 QUALITY ASSURANCE

A. Fabricator's Qualifications:
   1. Engage a single firm, with undivided responsibility for performance of handrail and railing systems Work.
   2. Engage a firm, which can show five years previous successful experience in the fabrication of handrail and railing systems of scope and type similar to the required Work.
   3. Materials and fabrication procedures shall be subject to inspection and tests in the mill, shop, and field, conducted by a qualified inspection agency. Such inspections and tests shall not relieve CONTRACTOR of responsibility for providing materials and fabrication procedures in compliance with specified requirements.

B. Installer Qualifications :
   1. Engage a single installer skilled, trained and with a record of successful experience in the installation of aluminum railing systems and who has a successful record of performing Work in accordance with the approved recommendations and requirements of the fabricator or who can submit evidence in writing of being acceptable to the fabricator; and who agrees to employ only tradesmen with specific skill and successful experience in this type of Work. Submit names and qualification to ENGINEER along with the following information on a minimum of three successful projects:
      a. Names and telephone numbers of owner, architects or engineers responsible for projects.
      b. Approximate contract cost of the railings.
      c. Amount of area installed.

C. Codes:
   1. Comply with the applicable requirements of OSHA and the approved International Building Code as amended by the City, Building Construction Code.
   2. If there is a conflict between the OSHA requirements and the approved International Building Code as amended by the City, Building Construction Code comply with whichever requirement is more stringent.

D. Allowable Tolerances:
   1. Limit variation of cast-in-place inserts, sleeves and field-drilled anchor and fastener holes to the following:
      a. Spacing: ±3/8-inch.
      b. Alignment: ±1/4-inch.
      c. Plumbness: ±1/8-inch.
   2. Minimum Railings Systems Plumb Criteria:
      a. Limit variation of completed railing system alignment to 1/4-inch in 12 feet - 0 inches with posts set plumb to within 1/16-inch in 3 foot - 0 inches.

b. Align rails so variations from level for horizontal members and from parallel with rake of stairs and ramps for sloping members do not exceed 1/4-inch in 12 feet - 0 inches.

3. Provide “pencil-line” thin butt joints.

E. Source Quality Control:
1. Obtain all railings systems components and accessories from the same manufacturer.

F. Reference Standards: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
1. ASTM B 26, Specification for Aluminum and Aluminum-Alloy Sand Castings.
2. ASTM B 117, Practice for Operating Salt Spray (Fog) Apparatus.
3. ASTM B 136, Method for Measurement of Stain Resistance of Anodic Coatings on Aluminum.
4. ASTM B 137, Test Method for Measurement of Coating Mass Per Unit Area of Anodically Coated Aluminum.
5. ASTM B 210, Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes.
6. ASTN B 221, Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles and Tubes.
7. ASTM B 241, Specification for Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube.
8. ASTM B 244, Test Method for Measurement of Thickness of Anodic Coatings on Aluminum and of Other Nonconductive Coatings on Nonmagnetic Basis Metals with Eddy-Current Instruments.
9. ASTM B 247, Specification for Aluminum and Aluminum-Alloy Die Forgings, Hand Forgings, and Rolled Ring Forgings.
10. ASTM B 429, Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.
11. ANSI A1264.1, Safety Requirements for Workplace Floor and Wall Openings, Stairs and Railing Systems.
12. The Aluminum Association, AA ASD-1, Aluminum Standards and Data.
13. The Aluminum Association, AA SAA-46, Standards for Anodized Architectural Aluminum.
14. The Aluminum Association, AA DSA-45, Designation System for Aluminum Finishes.
15. Architectural Metal Products Division of the National Association of Architectural Metal Manufacturers, AMP/NAAMM, Pipe Railing Manual.
16. Architectural Metal Products Division of The National Association of Architectural Metal Manufacturers, AMP 501, Finishes for Aluminum.
17. OSHA, Title 29 Code of Federal Regulations Part 1910.23 - Guarding Floor and Wall Openings and Holes.
18. The Americans with Disabilities Act of 1990 (Public Law 101-336), Appendix A to Title 28 Code of Federal Regulations Part 36 (Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities - ADAAG.

19. American National Standard Institute, A117.1, Accessible and Usable Buildings and Facilities.
20. International Building Code.

G. Field Measurements: Take field measurements, where required, prior to preparation of Shop Drawings and fabrication to ensure proper fitting of the Work.

H. Shop Assembly: Preassemble items in the shop to the greatest extent possible, so as to minimize field splicing and assembly of units at the site. Disassemble units only to the extent necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinate installation.

1.4 SUBMITTALS

A. Drawings for the fabrication and erection of handrail and railing systems with sizes of members, components and anchorage devices, all based on specified requirements. Include copies of manufacturer's specifications, standard and custom detail drawings and installation instructions for handrail and railing systems. Include all plans and elevations identifying the location of all handrail and railing systems, and details of sections and connections. Show all anchorage items.

B. Profiles of handrail and railing systems components, and the details of forming, jointing, sections, connection, internal supports, trim, and accessories. Provide details drawn at 1-1/2-inch scale.

C. All calculations for complete structural analysis of the handrail and railing systems including calculations showing compliance with system performance criteria specified. The calculations shall be prepared, signed and sealed by a Registered Professional Engineer licensed in the State of Arizona.

D. Manufacturer's catalogs showing complete selection of standard and custom components and miscellaneous accessories for selection by ENGINEER.

E. Maintenance Manuals: Upon completion of the Work, furnish five copies of detailed maintenance manual including the following information:
1. Product name and number.
2. Name, address, e-mail address and telephone number of fabricator and manufacturer’s local distributor.
3. Detailed procedures for routine maintenance and cleaning, including cleaning materials, application methods and precautions as to use of materials that may be detrimental to finish when improperly applied.

F. Refer to and comply with the requirements of Section 01300, Submittals.

G. Maintenance Stock:

1. After completion of the Work deliver to the site and store as directed by ENGINEER 4 of each railing system component used in the Work as manufactured by the same manufacturers performing the Work of this Section.
2. Label each piece or sealed container of pieces with name and product number.
3. Supply 2 copies of railings systems manufacturer's current catalog to OWNER.

H. Certification: Submit for approval the following:
1. Copies of material purchase receipts indicating actual materials purchased for this job, signed by a certified and licensed Notary Public, verifying that material purchased for the Work complies with material designations specified as confirmed by approved Shop Drawings.
2. Manufacturer's certificate on results of load testing the completed railing systems, demonstrating compliance with all applicable OSHA, ANSI and International Building Code requirements and the system performance criteria specified for superimposed loadings and deflection limitations.
3. Finish: Furnish a written certificate confirming specified anodized coating film thickness, coating weight, sealing treatment and stain test performance.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery of Materials:
1. Deliver railings and all accessories dry and undamaged, with manufacturer's protective coating intact, bearing original intact factory labels identifying component's location and use within the completed systems.
2. Railing systems components, which are damaged during delivery or while being unloaded, shall not be stored on site. Remove such units from site and replace with new, undamaged material.

B. Storage of Materials:
1. Store railing systems components and accessory materials in a dry location and in a manner that will protect strippable coating from exposure to sun and condensation; with good air circulation around each piece and with protection from wind blown rain.
2. Store railing systems components and accessory materials under tarpaulin covers and in an area protected from dirt, damage, weather and from the construction activities of all contractors. Do not store outside or allow items to become wet or soiled in any way while on site.
3. Do not store in contact with concrete, earth or other materials that might cause corrosion, staining, scratching or damage to finish. Do not install system components, which become dented, scratched or damaged in any way. Remove such components from site and replace with new, undamaged material.

C. Handling of Materials:
1. Do not subject railing systems components and accessory materials to bending or stress.

2. Do not damage edges or handle material in a manner that will cause scratches, warps or dents.
3. Keep on-site handling to a minimum.
4. Maintain protective covering on railings. All surface protective coverings such as nonadhesive papers, adhesive papers and strippable plastic films shall be removed after receipt at the site as soon as there is no longer a need for the protection.

1.6 JOB CONDITIONS

A. Protection: Protect cast-in-place sleeves from debris and water intrusion by use of temporary covers or removable foam inserts.

PART 2 - PRODUCTS

2.1 SYSTEM PERFORMANCE

A. Performance Criteria:
   1. Maintain the visual design concept shown on the Drawings, and the technical requirements specified, including modules, profiles, alignment of components and requirements for finish.
   2. Provide railing systems that conform to the International Building Code and OSHA, Part 1910.23, including the 200 pound loading requirement. In addition, the system shall conform to the following requirements:
      a. Completed railing systems shall withstand a uniform lateral force of 40 pounds per linear foot and a vertical uniform force of 50 pounds per linear foot, both applied simultaneously at the top of the railing.
      b. Intermediate and bottom rails shall withstand simultaneously applied lateral uniform forces of 40 pounds per linear foot and a vertical load of 50 pounds per linear foot, however, lateral and vertical loads on intermediate and bottom railings need not be considered in the detailing and fabrication of posts and anchorages.
      c. For railings having panels, the panels shall be detailed and fabricated to withstand a uniform lateral load of twenty pounds per square foot.
      d. Concentrated 200 pound load and uniform force conditions shall not be applied simultaneously.
      e. Other pertinent requirements ceded to ICC/ANSI 117.1.
      f. Bending stresses shall not exceed 60 percent of the yield stress of the material. Applied loads shall not produce permanent deflection in the completed Work when loads are removed.
      g. Select schedule of pipe using alloys, minimum diameter, loadings and maximum post spacing specified in order to limit deflection in each single-span of railing to 1.5-inches maximum and on railing posts to 1.4-inches maximum and with a safety factor of 1.65:1 for all Work.
      h. Load test completed railing systems and submit results to ENGINEER. Provide written report identifying and documenting the testing methods

used, the loads superimposed and how and where they were applied, and the results of such tests on actual complete railing systems including all anchors and fasteners to be used in the Work. The written report shall be signed and sealed by a Registered Professional Engineer licensed in the State of Arizona. Testing setup shall simulate actual conditions of installation to be used in the Work.

3. Thermal Control: Provide adequate expansion within fabricated systems that allows for a thermal expansion and contraction caused by a material temperature change of 140°F to -20°F without warp or bow of system components. Distance between expansion joints shall be based on providing a 1/4-inch wide joint at 70°F, which accommodates a movement of 150 percent of the calculated amount of movement for the specified temperature range.
4. Provide expansion joints in railing systems where systems cross expansion joints in structure.
5. Provide railing systems as shown on the Drawings. Where railing systems are required by either the governing authority or the Occupational Safety and Health Act of 1970, or the Americans with Disabilities Act of 1990, aluminum railing systems of the type specified herein shall be provided.
6. Configuration of all railing systems components shall be as shown on the Drawings. Verify dimensions at the site without causing delay in the Work.
7. Except where detailed dimensions are shown on the Drawings, indicate required locations for posts, space posts maximum 72 inches on centers.
8. Where details show post location requirements at or near end of runs, uniformly space intermediate posts as required to meet loading and deflection criteria specified, but not greater than maximum spacing specified. Where posts are shown at straight walkways and other locations where railing is provided on each side, locate railing system posts opposite each other; do not stagger.
9. Comply with handrail and railing systems details shown on the Drawings. Provide fabricator's standard details for conditions not shown on the Drawings and for general system assembly, unless otherwise specified. All details shown on the Drawings are typical; similar details apply to similar conditions, unless specifically otherwise shown on the Drawings.
10. Fabricator is responsible for structural analysis and detailing of railings systems. Provide complete structural calculations and verification of other system performance criteria and Shop Drawings for all railing members, anchors and all other support system components prepared, signed and stamped with the seal of a Licensed Professional Engineer licensed to practice in the State of Arizona and recognized as an expert in the specialty involved.

B. Fasteners and Supports:
   1. Provide the size, length and load carrying capacity required to carry the specified loadings required by performance criteria times a minimum safety factor of four.
   2. Where sizes are shown on the Drawings, the sizes shown shall be considered minimum. Increase size to comply with required system performance criteria loadings and minimum safety factor specified.

3. All railing system posts shall be provided with a circular profile solid reinforcing bar with outside diameter equal to inside diameter of post. Each post shall receive one reinforcing bar.

2.2 MATERIALS

A. Aluminum Forgings: ASTM B 247.

B. Extruded or Drawn Aluminum Pipe and Tube:
   1. ASTM B 429 or ASTM B 241, Alloy 6063-T5, 6063-T52 or 6063-T832 as required by loadings, deflections and post spacings specified.
   2. Provide Schedule 40 pipe minimum, unless conditions of detail and fabrication require extra heavy pipe to comply with performance criteria specified.
   3. Provide all rails and posts with minimum outside diameter of 1.900-inches.

C. Reinforcing Bars: Solid, circular profile, 24-inch long, 6061-T6 aluminum reinforcing bars with same outside diameter as inside diameter of post.

D. Toe boards:
   1. Provide extruded ASTM 6063-T5 or T52 alloy aluminum toe boards, unless railing is mounted on curbs or other construction of sufficient height and type to meet the requirements of OSHA 1910.23. Bars or plates are not acceptable.
   2. Unless otherwise specified, toe boards shall meet requirements of OSHA Part 1910.23, Section (e).

E. Anchors and Fastenings:
   1. Type 316 stainless steel; minimum 1/2-inch diameter.
   2. Provide minimum of four bolt fasteners for each post where surface mounted posts are shown on the Drawings. Components shall be in accordance with manufacturer's recommendations and as acceptable to ENGINEER as shown on approved Shop Drawings.
   3. Concrete and Masonry Anchors: As specified in Section 03252, Anchorage in Concrete.
   4. Bolting Materials: As specified in Section 03252, Anchorage in Concrete.

F. Castings:
   1. Provide high strength aluminum alloy brackets, flanges and fittings suitable for anodizing as specified.
   2. Aluminum-Alloy Sand Castings: ASTM B 26.

G. Connector Sleeves: Schedule 40, 5-inches long by 1.610-inches diameter.

H. Brackets and Flanges: Provide manufacturer's complete selection of standard and custom brackets and flanges for railing system posts.

I. Sockets: Provide 6-inch deep by 2-1/2-inch outside diameter aluminum sockets with 3-1/2-inch wide socket cover on bottom of all sockets and on top and bottom of removable post sockets.

J. Hinges: Provide two self-closing aluminum hinges for each railing system gate shown on the Drawings.

K. Latches and Stops: Provide one latch and stop with rubber bumper and 1-inch diameter plastic knob for each railing system gate shown on the Drawings.

L. Chain, Snaps and Eye Bolts: Provide oblong 0.250-inch welded link, Type 316 stainless steel chain weighing 57 pounds per cubic foot, each link 1-1/8-inch by 7/16-inch. Provide stainless steel eyebolts, 1/4-inch stainless steel threaded quick links and heavy-duty swivel snaps with spring-loaded latch.

M. System Components and Miscellaneous Accessories: Provide a complete selection of manufacturer's standard and custom aluminum railing systems components and miscellaneous accessories as may be required based on conditions and requirements shown on the Drawings, including, but not limited to, fascia flanges, and post brackets for selection by ENGINEER including clamps, channel adapters, end caps, post caps, adapters, and accessories. Show the type and location of all such items on Shop Drawings.

N. Custom Cover Flanges: 1/4-inch high by 4-inch diameter; aluminum.

O. Adhesive: Two part waterproof epoxy-type as recommended by railing systems manufacturer.

P. Non-Shrink, Non-Metallic Grout:
   1. Pre-mixed non-staining cementitious grout requiring only the addition of water.
   2. Product and Manufacturer: Provide one of the following:
      a. Euco N-S by The Euclid Chemical Company.
      b. Masterflow 713 by Master Builders Company.
      c. Or Approved equal.

2.3 FABRICATION

A. General: Unless otherwise shown on the Drawings or specified in the Contract Documents provide typical non-welded construction details and fabrication techniques as recommended by AMP/NAAMM publications specified.

B. Form exposed Work true to line and level with accurate angles, surfaces and straight edges. Fabricate all corners without the use of fittings.

C. Form bent-metal corners to the radius shown on the Drawings without causing grain separation or otherwise impairing the Work. Use radius bends to form all changes in direction of railing systems. Form elbow bends and wall returns to uniform radius,

free from buckles and twists, with smooth finished surfaces, or use prefabricated bends. Provide not less than 4-inch outside radius.

D. Provide chains across openings in railings where shown on the Drawings. Attach one end of each chain to a 1/4-inch eye bolt in the post and the other end attached by means of an approved heavy stainless steel swivel eye snap hook to a similar eye bolt in the opposite post.

E. Remove burrs from all exposed edges.

F. Locate intermediate rails equally spaced between top rail and finished floor.

G. Close aluminum pipe ends by using prefabricated fittings.

H. Weep Holes:
   1. Fabricate joints, which will be exposed to the weather so as to exclude water.
   2. Provide 15/64-inch diameter weep holes at the lowest possible point on all railing systems posts.
   3. Provide pressure relief holes at closed ends of railing systems.

I. Toe boards:
   1. Provide manufacturer's toe board detail, which accommodates movement, caused by thermal change specified without warping or bowing toe boards.
   2. Provide manufacturer’s toe board detail, which accommodates storage for removable socket covers.
   3. Coordinate and cope toe board as required to accommodate cover flanges at posts.
   4. Toe boards shall follow curvature of railing. Where railing is shown on the Drawings to have curved contours at corners, or other locations, the toe board shall likewise be curved to follow line of railing system.

J. Reinforcing Bars: Provide reinforcing bar friction-fitted at all railing system posts. Extend reinforcing bars or tubes 6-inches into cast-in-place sleeves or other types of supporting brackets.

K. Pipe Handrail and Railing:
   1. Use a non-welded pipe handrail and railing system with posts, top and intermediate rail(s), and flush joints.
   2. Provide a top and two intermediate horizontal rails, equally spaced.
   3. Stainless steel Type 304/305 blind rivets and stainless steel Type 304/305 self-tapping screws shall be used to assemble all components of the Work.
   4. Products and Manufacturers: Provide one of the following:
      a. Wesrail by Moultrie Manufacturing Company.
      b. Crane Veyor CV 4300 Pipe Rail by Crane Veyor, Corporation.
      c. Or Approved equal.

2.4 ALUMINUM COATINGS

A. General:
   1. Prepare surfaces for finishing in accordance with recommendations of the aluminum producer and the finisher or processor.
   2. Adjust and control the direction of mechanical finishes specified to achieve the best overall visual effect in the Work.
   3. Color and Texture Tolerance: Provide uniform color and continuous mechanical texture for all aluminum components. ENGINEER reserves the right to reject aluminum materials because of color or texture variations, which are visually objectionable, but only where the variation exceeds the range of variations established by the manufacturer prior to fabrication, by means of range samples which have been accepted by ENGINEER.
   4. Anodize all aluminum components of the Work.

B. Mechanically finish aluminum by wheel or belt polishing with aluminum oxide grit of 180 to 220 size, using peripheral wheel speed of 6,000 feet per minute; Aluminum Association Designation - M32 Medium Satin Directional Texture.
   1. Hand Rubbed Finish: Where required to complete the Work and provide uniform, continuous texture, provide hand rubbed finish to match medium satin directional texture specified in order to even out and blend in satin finishes produced by other means.

C. Provide non-etching chemical cleaning by immersing the aluminum in an inhibited chemical solution, as recommended by the coating applicator, to remove all lard oil, fats, mineral grease and other contamination detrimental to providing specified finishes.
   1. Clean and rinse with water between steps as recommended by the aluminum manufacturer.

D. Exposed Aluminum Anodic Coating: Provide anodic coatings as specified, which do not depend on dyes, organic or inorganic pigments, or impregnation processes to obtain color. Apply coatings using only the alloy, temperature, current density and acid electrolytes to obtain specified colors in compliance with the designation system and requirements of the Aluminum Association and AMP 501 of AMP/NAAMM. Comply with the following:
   1. Provide Architectural Class I high density anodic treatment by immersing the components in a tank containing a solution of 15 percent sulfuric acid at 70°F with 12 amperes per square foot of direct current for minimum of sixty minutes; Aluminum Association Designation A41 Clear.
   2. Physical Properties:
      a. Anodic Coating Thickness, ASTM B 244: Minimum of 0.7 mils thick.
      b. Anodic Coating Weight, ASTM B 137: Minimum of 32 mg/sq. in.
      c. Resistance to Staining, ASTM B 136: No stain after five minutes dye solution exposure.

d. Salt Spray, ASTM B 117: 30,000 hours exposure with no corrosion or shade change.

3. Seal finished anodized coatings using deionized boiling water to seal the pores and prevent further absorption.
4. Product and Manufacturer: Provide one of the following:
   a. Alumilite 215 Clear by Aluminum Company of America, Incorporated.
   b. Or Approved equal.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine the substrate and conditions under which the aluminum railings systems Work is to be performed and notify ENGINEER, in writing, of unsatisfactory tolerances which exceed specified limits and other conditions detrimental to proper and timely completion of the Work. Do not proceed with installation until unsatisfactory conditions have been corrected in a manner acceptable to ENGINEER.

B. Verify to ENGINEER gage of aluminum pipe railing posts and rails brought to the site by actual measurement of on-site material in the presence of ENGINEER.

3.2 INSTALLATION

A. General:
   1. Do not erect components, which have become scarred, dented, chipped, discolored or otherwise damaged or defaced. Railing system components, which have holes, cuts, gouges, deep scratches or dents of any kind, shall be removed from the site before installation. Repairs to correct such Work will not be approved by ENGINEER. Remove and replace with new material.
   2. Comply with installation and anchorage recommendations of AMP/NAAMM publications specified in addition to the requirements specified and approved Shop Drawings.

B. Fastening to In-Place Construction:
   1. Remove protective plastic immediately before installation.
   2. Adjust railings prior to securing in place, to ensure proper matching at butting joints and correct alignment throughout their length. Plumb posts in each direction. Secure posts and rail ends to building construction as follows:
      a. Anchor posts in concrete by means of sockets set and anchored into the concrete floor slab. Provide closure secured to the bottom of sleeve. Before installing posts remove all debris and water from sleeves. Verify that reinforcing bars have been inserted into posts before installation. Do not install posts without reinforcing bar. For all non-removable railing systems sections, after the posts have been inserted into the sockets, fill the annular space between posts and sockets solid with grout as specified in Section 03600, Grout. Crown grout and slope it to drain away from posts.

b. Anchor posts to stair stringers with stringer or support flanges, angle type or floor type as required by conditions, shop-connected to posts and bolted to the steel supporting members. Flanges shall be as recommended by manufacturer. Verify that reinforcing bars have been inserted into posts before installation. Do not install posts without reinforcing bar.
c. Side mount posts by fastening them securely in brackets attached to steel or concrete fascia as shown on the Drawings and in accordance with approved Shop Drawings.
d. Provide removable railing sections where shown on the Drawings. Removable railing system posts shall be provided with friction fitted reinforcing bar in each post. Provide sockets with socket covers stored in extruded toeboard. Provide aluminum pipe collars for all removable posts. Accurately locate sleeves to match post spacings.
e. All posts set in concrete shall be provided with an aluminum floor cover flange.

3. Use devices and fasteners recommended by the railing systems manufacturer and as shown on the approved Shop Drawings.

C. Cutting, Fitting and Placement:
1. Perform cutting, drilling and fitting required for installation. Set the Work accurately in location, alignment and elevation, plumb, level, true and free of rack, measured from established lines and levels.
2. Fit exposed connections accurately together to form tight hairline joints. Do not cut or abrade the surfaces of units, which have been finished after fabrication, and are intended for field connections.
3. Permanent field splice connections shall be made using stainless steel blind rivets, 5-inch minimum length connector sleeves and epoxy adhesive. Tight press-fit all field splice connectors and install in accordance with manufacturer's written instructions. Install two blind rivets per joint on 180 degree centers. Follow epoxy manufacturer’s recommendations for requirements of installation and condition of use.
4. Make all splices as near as possible to posts but not exceeding 12-inches from nearest post.
5. Field welding will not be permitted. Make all splices using a pipe splice lock employing a single allen screw to lock joint.
6. Provide hinged railings sections as shown on the Drawings. Provide hinges and latch for connection to adjacent railing.
7. Provide chain sections as shown on the Drawings. Provide one chain length with fastening accessories for top and each intermediate rail.
8. Secure handrails to walls with wall brackets and end fittings as shown on the Drawings. Locate brackets as shown on the Drawings or, if not shown on the Drawings, at not more than 5 feet-0 inches on centers.
9. Provide flush-type wall return fittings with the same projection as that shown on the Drawings for wall brackets. Drill wall plate portion of the bracket to receive one bolt, unless otherwise shown on the Drawings.
a. For concrete anchorage, use adhesive anchors.

10. Secure wall brackets to building construction as follows:
    a. For concrete and solid masonry anchorage, use anchor bolt expansion shields and lag bolts.
11. Securely fasten toeboards in place with not more than 1/4-inch clearance above floor level.
12. Drill one 15/64-inch diameter weep hole not more than 1/4-inch above the top of location of solid reinforcing bar in each post.

D. Fastening to Existing Construction:
    1. Provide heavy duty floor flange and anchorage devices and fasteners where necessary for securing railing systems components to existing construction; including stainless steel threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts and other connectors as required.
    2. Use devices and fasteners recommended by the railing systems manufacturer and as shown on approved Shop Drawings.

E. Expansion Joints:
    1. Provide slip joint with internal sleeve extending 2-inches minimum beyond joint on each side.
    2. Construct expansion joints as for field splices, except fasten internal sleeve securely to one side of rail only.
    3. Locate joints within 6-inches of posts.
    4. Submit locations and details of all expansion joints to ENGINEER.

F. Protection from Dissimilar Materials:
    1. Coat all surfaces of aluminum in contact with dissimilar materials such as concrete, masonry and steel as specified in Section 09900, Painting.
    2. Do not extend coating beyond contact surfaces. Remove coating where exposed-to-view in the finished Work.

3.3 CLEANING AND REPAIRING

A. Cleaning: Installer shall clean exposed surfaces of railing systems of every substance after completion of installation. Comply with recommendations of both the railing, and finish manufacturer. Do not use abrasives or non-approved solvent cleaners. Test cleaning techniques on an un-used section of railing before employing cleaning technique.
    1. Remove all stains, dirt, grease or other substances by washing railings systems thoroughly using clean water and soap; rinse with clean water.
    2. Do not use acid solution, steel wool or other harsh abrasives.
    3. If stain remains after washing remove defective sections and replace with new material conforming to the requirements of the Specification.

B. Leave railings, free from dents, burrs, scratches, holes and other blemishes. Replace damaged or otherwise defective Work with new material that conforms to the Specification requirements at no additional cost to OWNER.

C. At the completion of Work, replace adjacent work, marred by the Work of this Section.

++ END OF SECTION ++

SECTION 05532

ALUMINUM GRATING AND CHECKER PLATE

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
   1. Provide all labor, materials, equipment and incidentals as shown on the Drawings, specified and required to furnish aluminum grating, grating stair treads, frames and checker plate.
   2. The types of grating required shall be the following:
      a. Riveted.
      b. Pressure locked.
         1) Rectangular section.
         2) I-bar section.
   3. The Work also includes:
      a. Providing openings in grating to accommodate the Work under this and other Sections and attaching to the grating all items such as sleeves, bands, studs, fasteners and all items required for which provision is not specifically included under other Sections.

B. Coordination:
   1. Review installation procedures under other Sections and coordinate the Work that must be installed with or attached to the grating or checker plate.

1.2 QUALITY ASSURANCE

A. Reference Standards: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
   1. ASTM B 209, Specification for Aluminum and Aluminum - Alloy Sheet and Plate.
   2. ASTM B 210, Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes.
   3. ASTM B 221, Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes and Tubes.
   4. NAAMM, Metal Finishes Manual, and Metal Bar Grating Manual.
   5. Aluminum Association Standards.

B. Field Measurements:
   1. Take field measurements prior to preparation of Shop Drawings and fabrication, where required, to ensure proper fitting of the Work.

1.3 SUBMITTALS

A. Samples: Submit for approval the following:
   1. Representative samples of grating, appurtenances and other finished products requested by ENGINEER. ENGINEER'S review will be for type and finish only. Compliance with all other requirements is the exclusive responsibility of CONTRACTOR.

B. Shop Drawings: Submit for approval the following:
   1. Fabrication and erection of all Work. Include plans, elevations, and details of sections and connections. Show anchorage and accessory items.
   2. Setting drawings and templates for location and installation of anchorage devices.
   3. Manufacturer's specifications, load tables, dimension diagrams, anchor details and installation instructions.
   4. Refer to and comply with the requirements of Section 01300, Submittals.

PART 2 - PRODUCTS

2.1 PERFORMANCE CRITERIA

A. General:
   1. Design Loads: Uniform live load or a concentrated load on any area 30-inches square, whichever gives the greatest stresses.

Live Load	Concentrated Load
100 psf	1000 lbs

   2. Maximum Clear Span Deflection: 1/180 of span or 1/4-inch, whichever is less, under live load of 100 psf
   3. Maximum Fiber Stress: 12,000 psi.
   4. Bearing bars shall be a maximum of 1-3/16 inches on center and 3/16-inches minimum thickness.
   5. Cross bars or bent connecting bars shall not exceed 7-inches on center.

B. The Manufacturer shall furnish removable checkered plate or plank grating to conform to the following, unless otherwise shown on the Drawings:
   1. Aluminum Checkered Plate:
      a. Minimum thickness: 1/2-inch.
      b. Design Uniform Load: Same as grating above, unless otherwise shown on the Drawings.
      c. Maximum clear span deflection: 1/180th of the span or 1/4-inch, whichever is less, under 100 psf.
   2. Aluminum Plank Grating and Stair Treads:
      a. Minimum depth: 1-1/2-inch.
      b. Design Uniform Load: Same as grating, unless otherwise shown on the Drawings.

c. Maximum clear span deflection: 1/180th of the span or 1/4-inch, whichever is less, under 100 psf.
d. Plank grating to be banded on all external edges.

2.2 MATERIALS

A. Bearing Bars: Alloy 6061-T6 or Alloy 6063-T6, conforming to ASTM B 221.

B. Cross Bars or Bent Connecting Bars: Alloy conforming to either ASTM B 221 or ASTM B 210.

C. Aluminum Checkered Plate:
1. Provide aluminum checkered plate as shown on the Drawings and specified. Plate to conform to ASTM B 209. Provide anodized finish.
2. Raised Pattern Floor Plate: Provide pattern standard with the manufacturer. Alloy and temper to be Alloy 6061-T6.

D. Aluminum Plank Grating and Stair Treads:
1. Provide aluminum plank grating as shown on the Drawings and specified (aluminum plank grating is an alternate to 1/2-inch checkered plate.)
2. Top surface shall be plain unpunched and have continuous raised longitudinal ridges for skid resistance.
3. Material shall be provided with anodized finish. Alloy and temper to be Alloy 6061-T6.
4. Product and Manufacturer: Provide one of the following:
a. IKG, Style P, Unpunched.
b. Klemp, Duo-grip, Unpunched by AMICO-Klemp.
c. Or Approved equal.

2.3 FABRICATION

A. Use materials of the minimum size and thickness as specified above unless otherwise shown on the Drawings. Work to the dimensions shown on approved Shop Drawings.

B. Grating and stair treads shall be as shown on the Drawings and shall comply with the NAAMM "Metal Bar Grating Manual", except as specified herein.
1. Cross Bars: Perpendicular to bearing bars, secured by mechanical locking.
a. Traffic Surface: Serrated.
2. Fabricate grating treads with abrasive nosing on one edge and with steel angle or steel plate carrier at each end for stringer connections. Secure treads to stringers with bolts.
3. Fabricate grating platforms, with nosing matching that on grating treads, at all landings. Provide toe plates at open sided edges of floor grating fastened to platform framing members.

C. Type of Finish: Clear anodized with a minimum coating of 0.0008-inch in accordance with Aluminum Association Standard A41.

D. Provide grating sections with end-banding bars welded about 4-inches on centers for each panel, four saddle clip or flange block anchors designed to fit two bearing bars, and four stainless steel stud or machine bolts with washers and nuts, unless otherwise shown on the Drawings.

E. Cut gratings for penetrations as indicated. Layout units to allow grating removal without disturbing items penetrating grating.
   1. For openings in grating separated by more than four bearing bars, provide banding of same material and size as bearing bars, unless otherwise shown on the Drawings. Weld band to each bearing bar.
   2. Notching of bearing bars at supports to maintain elevations will not be permitted.

F. Weld stainless steel stud bolts to receive saddle clip or flange block anchors to supporting steel members. Drill for machine bolts when supports are aluminum.

G. In wet conditions, provide gratings in concrete with AISI 316 stainless steel angle frames having mitered corners and welded joints. Grind exposed joints smooth. Frames shall have welded anchors set into concrete. Angle size shall match grating depth selected to assure flush fit.

H. Provide gratings in concrete with aluminum angle frames having mitered corners and welded joints. Grind exposed joints smooth. Frames shall have welded anchors set into concrete. Angle size shall match grating depth selected to assure flush fit.

I. Provide gratings attached to existing concrete, masonry or steel with aluminum bearing angles fastened with anchors as shown on the Drawings or otherwise approved by ENGINEER.

J. Gratings in concrete floors shall be removable or hinged and shall be arranged in sizes to be readily lifted. Provide gratings in concrete with aluminum angle frames having mitered corners and welded joints. Grind exposed joints smooth. Frames shall have welded anchors set into concrete. Angle size shall match grating depth selected to assure flush fit.

2.4 CHECKERED PLATES AND ALUMINUM PLANK GRATING

A. Provide removable checkered plates and aluminum plank grating in the locations and sizes shown on the Drawings. Also, provide perforated plates where shown on the Drawings.

B. Each checkered plate or plank section shall be provided with four lifting handles as recommended by the manufacturer. The lifting handles shall be of the recessed, drop

handle type. Maximum weight of checkered plate or plank section shall be 150 pounds.

C. Checkered plates shall have a checkered, nonslip surface.

D. The aluminum plates and planks shall have an anodized finish. Protect finish with a factory-applied coating of lacquer standard with the manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Fastening to In-Place Construction:
   1. Use anchorage devices and fasteners to secure grating to supporting members or prepared openings, as recommended by the manufacturer.

B. Cutting, Fitting and Placement:
   1. Perform all cutting, drilling and fitting required for installation. Set the Work accurately in location, alignment and elevation, plumb, level, true and free of rack. Do not use wedges or shimming devices.
   2. Wherever gratings are penetrated by pipes, ducts, and structural members, cut openings neatly and accurately to size and attach a strap collar not less than 1/8-inch thick to the cut ends of the bars.
   3. Divide the panels into sections only to the extent required for installation wherever grating is to be placed around previously installed pipe, ducts, and structural members.

C. Protection of Aluminum from Dissimilar Materials: Coat all aluminum surfaces in contact with dissimilar materials such as concrete, masonry, steel and other metals as specified in Section 09900, Painting.

D. Removable aluminum checkered plate or aluminum plank grating shall be fastened to secure checker plate or plank grating to supporting members, as recommended by the manufacturer. Fastening system for the checker plate or plank grating shall be removable.

++ END OF SECTION ++

SECTION 05581

FLOOR ACCESS HATCH COVERS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
   1. Provide all labor, materials, equipment and incidentals as shown on the Drawings, specified and required to furnish hinged floor access hatch covers.
   2. The types of floor access hatch covers include the following:
      a. Aluminum covers with frames for drainage.
      b. Aluminum covers with standard angle frame.
      c. Stainless steel covers with frames for drainage.

1.2 QUALITY ASSURANCE

A. Manufacturer: All floor covers for the project shall be the product of a single manufacturer. Covers from more than one manufacturer will not be permitted.

B. Reference Standards: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
   1. ASTM B 209, Specification for Aluminum and Aluminum Alloy Sheet and Plate.
   2. ASTM B 210, Specification for Aluminum and Aluminum Alloy Drawn Seamless Tubes.
   3. ASTM B 221, Specification for Aluminum and Aluminum Alloy Extruded Bars, Rods, Wire, Shapes and Tubes.
   4. NAAM, Metal Finishes Manual and Metal Box Grating Manual.
   5. Aluminum Association Standards.

1.3 SUBMITTALS

A. Shop Drawings: Submit for approval the following:
   1. Dimensional plans of all floor covers, quantity schedule, details of fabrication and erection, and anchorage.

1.4 GUARANTEE

A. Furnish a written guarantee obtained from the manufacturer. Guarantee shall state the following:
   1. Floor covers are to operate properly and be free of defects in material and workmanship for a period of five years from date of purchase.

2. Should any part fail to function, or break in normal use during this period, manufacturer shall furnish a new part at no additional cost to OWNER.

PART 2 - PRODUCTS

2.1 MATERIALS AND FABRICATION

A. General:
   1. Provide manufacturer's standard fabricated units, modified, if necessary, to comply with the requirements of the Contract Documents. Where standard units are not available for the sizes and types required, custom fabricate units to match manufacturer's similar units.
   2. Fabricate each unit in the shop, complete with anchors, gaskets, hardware and accessory items, as required.

B. Covers with Frames for Drainage:
   1. Provide covers, with frames for drainage, designed to withstand loadings of 300 pounds per square foot.
   2. Both frames and door leaves shall be 1/4-inch thick, minimum.
   3. Furnish Type 316 stainless steel hinges and hardware for aluminum doors.
   4. Product and Manufacturer: Provide one of the following:
      a. Double leaf door covers fabricated of aluminum. Sizes as shown on the Drawings.
         1) Type GT, as manufactured by Babcock-Davis Associates Incorporated.
         2) Type JD, as manufactured by the Bilco Company.
         3) Or equal.
      b. Single leaf door covers fabricated of (--1--). Sizes as shown on the Drawings.
         1) Type AM, as manufactured by Babcock-Davis Associates Incorporated.
         2) Type J, as manufactured by The Bilco Company.
         3) Or equal.

C. Aluminum Covers with Standard Frame:
   1. Provide aluminum covers, with standard angle frame, designed to withstand loadings of 300 pounds per square foot.
   2. Provide Type 316 stainless steel hinges and hardware.
   3. Product and Manufacturer: Provide one of the following:
      a. Double leaf door covers of sizes shown on the Drawings.
         1) Type FC, as manufactured by Babcock-Davis Associates Incorporated.
         2) Type KD, as manufactured by The Bilco Company.
         3) Or equal.
      b. Single leaf door covers of sizes shown on the Drawings.
         1) Type FC, as manufactured by Babcock-Davis Associates.

2) Type K, as manufactured by The Bilco Company.
3) Or equal.

D. Stainless Steel Covers with Frames for Drainage:
1. Provide Type 316 stainless steel dual door covers, frames, hinges and hardware where shown on the Drawings.
2. Design units to withstand AASHTO H2O wheel load.
3. Product and Manufacturer: Provide one of the following:
a. Babcock-Davis Associates, Incorporated.
b. The Bilco Company.
c. Or equal.

E. Door leaves shall be checkered or diamond plate, or other approved non-slip surface.

F. Frames shall have anchor flanges or strap anchors.

G. Door shall have hold-open devices.

H. Door leaves ten square feet and larger shall have torsion bars, springs or other approved means, for counterbalanced operation.

I. Covers shall have flush exterior locking device with removable handle, and interior turn handle.

J. All aluminum covers shall be mill finished. Protect finish with a factory applied coating of lacquer standard with the manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install doors in accordance with approved Shop Drawings and manufacturer's instructions.

B. Set doors plumb, level and true to line or grade, without warp or rack, for anchoring under other Sections of these Specifications.

C. Protection of Aluminum from Dissimilar Materials: Coat all surfaces of aluminum in contact with dissimilar materials such as concrete, masonry, steel and other metals as specified in Section 09900, Painting.

++ END OF SECTION ++

SECTION 05600

EXTRUDED FLAT PANEL COVERS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This Section defines the design requirements for flush mounted flat cover structures, as described in the Contract Drawings and Documents.

1.2 SUBMITTALS

A. Drawings describing the completed structure and all its components shall be submitted, complete with materials of construction and typical details and accompanied by a Certificate of Design.

B. Records certifying the satisfactory inspection of all structural welds of aluminum components shall be submitted prior to delivery of the fabricated materials.

C. Design calculations verifying conformance to deflection limits shall be submitted. Deflection calculations are required for structural members, as well as walking surface.

D. Calculations: Signed by qualified Registered Professional Engineer in the State of Arizona.

1.3 REFERENCES

A. The following codes and standards form a part of this Section to the extent specified herein:
   1. ASTM C864-90, Standard Specifications for Preformed Gasket and Sealing Material.
   2. Aluminum Association Specifications for Aluminum Structures.
   3. Aluminum Association Aluminum Design Manual; Specifications and Guidelines for Aluminum Structures.
   4. ASCE 8-90, Specification for the Design of Cold-Formed Stainless Steel Structural Members.
   5. ASTM F593, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
   6. AASHTO, Division 2, Section 25, Elastomeric Bearings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Extruded Flat Panel Covers:
   1. CST Industries, CA.
   2. Conservatek Industries, Inc. Conroe, TX.
   3. Or approved equal.

B. The naming of a manufacturer in this Specification is not an indication that the manufacturer's standard equipment is acceptable in lieu of the specified component features. Naming is only an indication that the manufacturer may have the capability of engineering and supplying a system as specified.

2.2 DESCRIPTION

A. The flat cover shall be clear span and self-supporting from the peripheral structure. The use of structural members in contact with the contents of the tank is expressly prohibited. The flat cover shall consist of removable panels each weighing no more than 150 lbs. The required lifting force per panel shall not exceed the dead weight of the panel. Each panel must be able to be removed without needing to remove more than the two adjacent panels. The need for removing flashing or "hold-down" extrusion longer than the width of the panel is prohibited. The flat cover shall have an integral bi-directional slip resistant surface which extends a minimum of 0.1-inch above the panel surface. Raised surfaces without the use of texturing to achieve slip resistance is not acceptable. The use of checkered plate, paint, tape, sandblasting, or other applied systems to achieve the slip resistant surface is expressly prohibited.
   1. All metal components of the flat cover structure shall be aluminum or 300 Series stainless steel. No galvanized, painted, or plated steel shall be used. Dissimilar materials in the supporting structure shall be isolated from the aluminum flat cover by means of a compatible elastomeric gasket.

B. Cover configuration: Free-standing, flat, 1-piece, interlocking, supported at each end only, without intermediate supports, removable, arranged as indicated on the Drawings, with flat, planar surface exposed and welded reinforcing ribs and stiffeners facing downward toward water surface.

C. The design shall prevent water pooling, which may result in over-stressing the flat cover.

D. The aluminum cover manufacturer must coordinate with the membrane equipment system supplier for design of the coves, design of supporting structural members, and coordination of cover cutouts to accommodate membrane equipment system piping. The membrane basin aluminum cover design must be

fully integrated with the membrane equipment system design and with existing aluminum covers.

E. Cover manufacturer shall provide access hatches, gravity vents, and pipe penetrations as shown on the Drawings.

2.3 EXPERIENCE

A. No equipment shall be supplied by any manufacturer not regularly engaged in the manufacturing and production of flat covers in the size and character herein specified.

2.4 MATERIALS

A. The following is a summary of approved materials and/or material specifications. All aluminum alloys shall be as defined by the Aluminum Association and published in the Aluminum Standards and Data.
   1. Bolts and Fasteners: All bolts and fasteners shall be 2024-T4 or 7075-T73 aluminum, or Series 300 stainless steel.
   2. Structural Shapes: Aluminum structural shapes shall be Alloy 6061-T6, 6005A-T6, or 6063-T6. Load supporting surfaces shall be 0.1-inch minimum thickness.
   3. Miscellaneous Shapes: Miscellaneous aluminum shapes shall be Alloy 6061-T6, 6005A-T6, or 6063-T6.
   4. Gaskets: All gaskets shall be neoprene conforming to ASTM C864-90, resistant to ozone and shielded from exposure to ultraviolet light.
   5. Sealant: All sealants shall be resistant to ozone and ultraviolet light and conform with Federal Specification TT-S-00230C.

2.5 DESIGN LOADS

A. The entire flat cover shall be designed to sustain the loads specified herein, within the stress limitations of the Aluminum Association Specifications for Aluminum Structures.

B. The load cases to be considered shall be as described.
   1. Dead Load: The dead load shall be defined as the weight of the structure and all material permanently attached to and supported by the structure.
   2. Live Load: The uniform live load shall be the greater of 20 psf or the live load specified by the purchaser.
   3. Wind Load: The wind load shall be the greater of 10 psf or the wind load specified by the purchaser.
   4. Vacuum/Pressure Load: As specified by the purchaser.
   5. Panel Design Load: In addition to the above mentioned loads, the aluminum panels shall be designed for a 400 lb load distributed over 1 square foot at any location and a 40 psf load distributed over the entire area of any given

panel. These loads are to be taken as acting separately from one another and not simultaneously with other design loads.

6. Load Combinations: The loads described above shall be applied to the flat cover in the following combinations:
   a. Dead Load, Uniform Live Load, and Vacuum Load.
   b. Dead Load, Unbalanced Live Load, and Vacuum Load.
   c. Dead Load, Wind Load, and Pressure Load.
   d. Dead Load, Uniform Live Load, and Wind Load.
   e. Dead Load, Unbalanced Live Load, and Wind Load.
7. Deflections: For the above loads and load combinations, the deflection of all components (structural and cladding) shall not exceed L/240 with L equal to the short span of the component. This deflection limit applies not only to the flat cover as a whole, but also to the skin of the cover spanning between the supporting edges of each panel or module. Calculations stamped by a Registered Professional Engineer shall be provided at the time of submittal to endure that this requirement has been met.
8. Temperature: The load combinations listed above shall be considered for a temperature change of 100° F below the installation temperature and 100° F above the installation temperature, and for a material temperature range of 40° F below zero to 160° F above zero.
9. The use of structural members in contact with the contents of the tank is prohibited.
10. The design shall prevent water pooling.
11. The flat cover system shall be designed to be substantially air and watertight under the specified design loading conditions.
12. 100% PT of structural welds on aluminum shall be performed to confirm the weld quality.
13. Bird screen shall be used to close off any open-ended tubular members.
14. Support beams shall not be utilized above the walking surface unless freeboard is an issue.
15. All panel planks or interlocking deck slats that are less than 3-inches deep shall not span more than 48-inches without support.
16. Access hatches shall not weigh more than 50 pounds.

2.6 CONNECTIONS

A. In no case shall a joint be designed to sustain a greater total resultant shear force than that which would be allowed by summing the allowable shear force of the individual fasteners, based on their net cross-section areas through the shear plane and the allowable shear stress of the material. The use of manufacturers' test data to rationalize an increase in assumed fastener strengths is prohibited. In no case shall values greater than those published by the Aluminum Association and ASTM F593 for aluminum and stainless steel fasteners, respectively, be used. The allowable stresses are summarized below:

Fastener Material	Allowable Shear Stress
Series 300 Stainless Steel	20% of Minimum Tensile Strength, as published in ASTM F593
6061-T6 Aluminum	11 ksi
7075-T73	18 ksi

PART 3 - EXECUTION

3.1 INSTALLATION

A. All Work shall be executed by skilled mechanics with a supervisor experienced in the erection of flat covers. The flat cover shall be erected plumb and level and in proper alignment.

3.2 WARRANTY

A. The flat cover manufacturer shall warrant that the Work described herein shall be free from defects, workmanship, and material. The flat cover manufacturer shall replace or repair only faulty workmanship or defective material furnished by it that is reported to it within one year from the date of completion of this Scope of Work.

++ END OF SECTION ++

SECTION 06410

ARCHITECTURAL WOOD CASEWORK

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Specially fabricated cabinet units.

B. Hardware.

1.2 RELATED REQUIREMENTS

A. Section 12360 - Countertops.

1.3 REFERENCE STANDARDS

A. ANSI A208.1 - American National Standard for Particleboard; 2022.

B. ANSI A208.2 - Medium Density Fiberboard (MDF) for Interior Applications; 2022.

C. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition; 2014, with Errata (2016).

D. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards; 2021, with Errata.

E. BHMA A156.9 - Cabinet Hardware; 2020.

F. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.

1.4 SUBMITTALS

A. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.

B. Product Data: Provide data for hardware accessories.

C. Samples: Submit actual sample items of proposed pulls, hinges, shelf standards, and locksets, demonstrating hardware design, quality, and finish.

1.5 QUALITY ASSURANCE

A. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of experience.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect units from moisture damage.

1.7 FIELD CONDITIONS

A. During and after installation of custom cabinets, maintain temperature and humidity conditions in building spaces at same levels planned for occupancy.

PART 2 - PRODUCTS

2.1 CABINETS

A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.

B. Plastic Laminate Faced Cabinets: Custom grade.

C. Breakroom Cabinets: Plastic laminate faced, Custom grade.

2.2 WOOD-BASED COMPONENTS

A. Wood fabricated from old growth timber is not permitted.

2.3 PANEL CORE MATERIALS

A. Particleboard: Composite panel composed of cellulosic particles, additives, and bonding system; comply with ANSI A208.1.

B. Medium Density Fiberboard (MDF): Composite panel composed of cellulosic fibers, additives, and bonding system; cured under heat and pressure; comply with ANSI A208.2.

2.4 THERMALLY FUSED LAMINATE PANELS

A. Thermally Fused Laminate (TFL): Melamine- or polyester-resin-saturated decorative papers; for fusion to composite wood substrates under heat and pressure.
   1. Test in accordance with NEMA LD 3 Section 3.
   2. Panel Core Substrate: Particleboard.
   3. Color: White.
   4. Products:
      a. Roseburg Forest Products; Thermally Fused Laminate: www.roseburg.com/#sle.
      b. Wilsonart LLC; Thermally Fused Laminate Panels: www.wilsonart.com/#sle.

2.5 LAMINATE MATERIALS

A. Manufacturers:
   1. Formica Corporation: www.formica.com/#sle.
   2. Wilsonart LLC: www.wilsonart.com/#sle.
   3. Or Approved Equal.

B. Provide specific types as indicated.
   1. Horizontal Surfaces: HGS, 0.048 inch (1.22 mm) nominal thickness, through color, color as selected, finish as indicated.
   2. Vertical Surfaces: VGS, 0.028 inch (0.71 mm) nominal thickness, through color, color as selected, finish as indicated.
   3. Laminate Backer: BKL, 0.020 inch (0.51 mm) nominal thickness, undecorated; for application to concealed backside of panels faced with high pressure decorative laminate.

2.6 ACCESSORIES

A. Adhesive: Type recommended by fabricator to suit application.

B. Plastic Edge Banding: Extruded PVC, convex shaped; smooth finish; self locking serrated tongue; of width to match component thickness.
   1. Color: As selected by Architect from manufacturer's standard range.
   2. Use at all exposed shelf edges.

C. Fasteners: Size and type to suit application.

D. Bolts, Nuts, Washers, Lags, Pins, and Screws: Of size and type to suit application; galvanized or chrome-plated finish in concealed locations and stainless steel or chrome-plated finish in exposed locations.

E. Concealed Joint Fasteners: Threaded steel.

F. Grommets: Standard plastic, painted metal, or rubber grommets for cut-outs, in color to match adjacent surface.

2.7 HARDWARE

A. Cabinet Hardware: Comply with BHMA A156.9 for hardware types and grades indicated below:
   1. Hardware Types: as required for function indicated..
   2. Product Grade: Grade 2.

B. Adjustable Shelf Supports: Standard side-mounted system using recessed metal shelf standards or multiple holes for pin supports and coordinated self rests, polished chrome finish, for nominal 1 inch (25 mm) spacing adjustments.

C. Countertop Support Brackets: Fixed, L-shaped, face-of-stud mounting.
   1. Materials: Steel; T-shape cross-section.
   2. Finish: Manufacturer's standard, factory-applied, powder coat.

D. Drawer and Door Pulls: "U" shaped wire pull, steel with chrome finish, 4 inch centers ("U" shaped wire pull, steel with chrome finish, 100 mm centers).

E. Keyed Cabinet Locks: Keyed cylinder, two keys per lock, master keyed, steel with chrome finish.

F. Drawer Slides:
   1. Type: Full extension.
   2. Static Load Capacity: Commercial grade.
   3. Mounting: Side mounted.
   4. Stops: Integral type.
   5. Features: Provide self closing/stay closed type.

G. Hinges: European style concealed self-closing type, steel with nickel-plated finish.

2.8 FABRICATION

A. Assembly: Shop assemble cabinets for delivery to site in units easily handled and to permit passage through building openings.

B. Edging: Fit shelves, doors, and exposed edges with specified edging. Do not use more than one piece for any single length.

C. Fitting: When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide matching trim for scribing and site cutting.

D. Plastic Laminate: Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners. Slightly bevel arises. Locate counter butt joints minimum 2 feet from sink cut-outs. (Locate counter butt joints minimum 600 mm from sink cut-outs.)
   1. Apply laminate backing sheet to reverse side of plastic laminate finished surfaces.
   2. Cap exposed plastic laminate finish edges with material of same finish and pattern.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify adequacy of backing and support framing.

B. Verify location and sizes of utility rough-in associated with work of this section.

3.2 INSTALLATION

A. Install work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade indicated.

B. Set and secure custom cabinets in place, assuring that they are rigid, plumb, and level.

C. Use fixture attachments in concealed locations for wall mounted components.

D. Use concealed joint fasteners to align and secure adjoining cabinet units.

E. Carefully scribe casework abutting other components, with maximum gaps of 1/32 inch (0.79 mm). Do not use additional overlay trim for this purpose.

F. Secure cabinets to floor using appropriate angles and anchorages.

3.3 ADJUSTING

A. Adjust installed work.

B. Adjust moving or operating parts to function smoothly and correctly.

3.4 CLEANING

A. Clean casework, counters, shelves, hardware, fittings, and fixtures.

++ END OF SECTION ++

SECTION 06611

FIBERGLASS REINFORCED PLASTIC FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Fiberglass reinforced plastic (FRP) fabrications including but not limited to:
      a. Solid plate.
      b. Railings.
      c. Modular framing system.
      d. Grating.
      e. Stairs.
      f. Ladders.
      g. Structural members.
      h. Supporting structure design.

B. Related Specification Sections include but are not necessarily limited to:
   1. Section 05501, Miscellaneous Metal Fabrications.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American National Standards Institute (ANSI):
      a. A14.3, Safety Requirements for Fixed Ladders and Workplace Surfaces
   2. ASTM International (ASTM):
      a. E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
   3. Occupational Safety and Health Administration (OSHA):
      a. 29 CFR 1910, Occupational Safety and Health Standards, referred to herein as OSHA Standards.

B. Source Quality Control:
   1. Obtain all gratings, handrails, and railing systems components and accessories from the same manufacturer.

C. Qualifications:
   1. FRP gratings, handrails, railings, structural shapes, and all related accessories shall be manufactured and fabricated in North America and the manufacturers should have at least 5 years of experience in manufacturing the FRP products.

D. Field Measurements: Take field measurements prior to preparation of Shop Drawings and fabrication where required, to ensure proper fitting of the Work.

1.3 DEFINITIONS

A. Skid-resistant:
   1. Manufacturer's standard applied abrasive grit coating.
   2. Abrasive coated tape is not acceptable.

B. FRP: Fiberglass Reinforced Plastic.

C. Guardrail: A system of building components located near the open sides of elevated walking surfaces for the purpose of minimizing the possibility of an accidental fall from the walking surface to the lower level.

D. Handrail: A railing provided for grasping with the hand for support.

E. Railing: A generic term referring to guardrail, handrail and/or stair rails.

F. Stair Rail: A guardrail, installed at the open side of stairways with either a handrail mounted to the inside face of the guardrail, or where allowed by applicable codes, with the top rail mounted at handrail height and serving the function of a handrail.

1.4 SUBMITTALS

A. Shop Drawings:
   1. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of standards referenced.
      b. Manufacturer's installation instructions.
      c. Manufacturer's recommendations on reinforcing field cut openings.
   2. Fabrication and/or layout drawings.
      a. Plan showing profile, location, section and details of each item including anchorage or support system(s).
      b. Locations and type of expansion joints.
      c. Materials of construction including shop applied coatings.
      d. Listing of all accessory items being provided indicating material, finish, etc.
   3. Certifications:
      a. Certification of registered professional engineer's qualifications.
      b. Certification that all components and systems have been designed and fabricated to meet the loading requirements specified.
   4. Manufacturer's full line of colors available for each component.

B. Informational Submittals:
   1. Complete design calculations of all supporting structure and fastening conditions.
      a. Design calculations to be for information only.
      b. Engineer will not review or take any action on submittal.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver and handle each item to preclude damage.

B. Store all items on skids above ground.
   1. Keep free of dirt and other foreign matter which will damage items or finish and protect from corrosion and UV exposure.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Railings:
      a. Enduro Composites.
      b. Fibergrate Composite Structures, Inc.
      c. Seasafe, Inc.
      d. Strongwell Corporation.
   2. Grating and solid plate:
      a. Enduro Composites.
      b. Fibergrate Composite Structures, Inc.
      c. Seasafe, Inc.
      d. Strongwell Corporation.
   3. Stairs:
      a. Enduro Composites.
      b. Fibergrate Composite Structures, Inc.
      c. Seasafe, Inc.
      d. Strongwell Corporation.
   4. Ladders:
      a. Enduro Composites.
      b. Fibergrate Composite Structures, Inc.
      c. Seasafe, Inc.
      d. Strongwell Corporation.
   5. Structural shapes:
      a. Enduro Composites.
      b. Fibergrate Composite Structures, Inc.
      c. Strongwell Corporation.
   6. Modular framing system:
      a. Enduro Composites.
      b. Seasafe, Inc.
      c. Unistrut by Atkore International, Inc.

2.2 MATERIALS

A. Fiberglass Reinforced Plastic (FRP):
   1. Flame Retardant Vinyl Ester Resin System.

2. Resin type shall be confirmed and certified by manufacturer to be appropriate for in-place chemical exposure.
3. Color: To be selected by Engineer when more than one color is available for any one component.

B. Fasteners, Clips, Saddles, and Miscellaneous Components:
1. Fiberglass where possible.
2. Stainless steel may be used if fiberglass component is not available.

C. Adhesive: Recommended by manufacturer.

D. Skid-resistant Surfacing: Manufacturer-applied abrasive grit coating.

E. All pultruded grating shall be constructed of strand roving, transverse mat, and a synthetic surface veil, including ultraviolet (UV) light inhibitors.

F. Gratings shall be reinforced with continuous strand roving, not to exceed 35% of grating weight in order to provide optimal corrosion resistance and impact strength.

2.3 FABRICATION

A. General:
1. Verify field conditions and dimensions prior to fabrication.
2. Chemical resistance.
a. System shall be capable of withstanding splash and spillage of the following chemicals:
1) Hydrogen Sulfide Dry/Wet Gas at 115 deg F.
3. Preassemble items in shop to greatest extent possible.
4. All components shall be treated with UV inhibitor.
5. Drill or punch holes with smooth edges.

B. Railings:
1. Custom fabricate handrail and guardrail to profiles and dimensions indicated on Drawings.
2. Where not indicated on Drawings, set intermediate horizontal rails to requirements of the building code.
3. Minimum 2-in. square x 0.187-in. tube.
4. Kickplate:
a. 4 x 1/2-in. (corrugated) x 0.125 in. thick.
b. Provide at all elevated platforms and where required by OSHA Standards.
5. Provide handrail supports at 4 ft maximum spacing for wall brackets and 4 ft maximum spacing for posts.
a. Provide vertical supports at 4 ft maximum spacing on all inclined rail sections.
b. Provide brackets which provide a 1-1/2 in. projection from finish wall surface or guardrail to wall or guardrail side of rail.
c. Handrails shall not project more than 4-1/2 in. into required stairway width.

6. Fit exposed ends of guardrails and handrails with solid terminations.
    a. Return ends of handrail to wall but do not attach end to wall.
    b. Where guardrail terminates at a wall or other obstruction, provide a vertical support post located 4 in. off wall or obstruction to center of post.
7. Design railings to resist loading as required by the building code.
8. Form connections with flush, smooth, hairline joints.
    a. Provide concealed splice fitting at all connections.
    b. Top rail splices and expansion joints shall be located within 8 in. of support.
9. Fabricate items free of blemishes, seam marks, roller marks, rolled trade names and roughness.
10. Provide removable railing where indicated.
11. Provide weeps to drain moisture from hollow railing sections at exterior and in high humidity areas.
    a. 1/4-in. weep hole in railing 1 in. above walkway surface at bottom of posts set in concrete or otherwise closed at bottom, and at other low points where moisture can collect.

C. Grating and Solid Plate Material:
1. Design live load (unless noted otherwise on Drawings):
    a. 150 PSF uniform live load.
    b. 1,000 LBS concentrated load.
    c. Maximum deflection of l/300 of span or 1/4 in., whichever is greater, under superimposed live load.
    d. Design for the most severe loading condition noted above.
2. Minimum grating depth: 1-1/2 in.
3. Bar span: Maximum of 2 in. center to center.
4. Walking surface: Manufacturer's standard applied abrasive grit coating.

D. Embedded Grating Supports:
1. Fiberglass.
2. Size to suit depth of grating.
3. Provide leg or strap for embedding and anchoring into concrete.
4. Similar to Strongwell "Duradek Fiberglass Curb Angle" or Fibergrate Composite Structures “EZ Angle”.

E. Stairs:
1. Fabricated to profiles indicated.
2. Treads: Grating with integral 1-in. skid-resistant nosing.
    a. Provide center reinforcing for treads over 36 in. wide.
3. Risers:
    a. Solid plate material to match treads.
    b. Provide center vertical reinforcing for risers over 36 in. wide.
4. Landings:
    a. Grating with manufacturer's standard applied skid-resistant abrasive grit coating.
        1) Provide skid-resistant nosing on leading edge of stairs.
    b. Provide intermediate support as required to meet loading requirements.

5. Design and fabricate stair, platforms and landings, and all connections to support a 100 PSF uniform live load or a 300 LB concentrated load.
6. Provide railing per this Specification Section.

F. Ladders:
1. Design in accordance with ANSI A14.3, OSHA Standards and building code requirements unless noted otherwise below.
2. Ladders shall be designed to support a minimum 300 LB concentrated vertical load with 150 LB concentrated horizontal load without failure or permanent set.
   a. Maximum lateral deflection: Side rail span/300.
3. Rungs:
   a. 1-1/4-in. diameter fluted tube with skid-resistant surface on all sides.
   b. Uniform maximum spacing of 12 in.
   c. Top rung level with top of platform.
   d. Rungs shall not extend beyond the outside face of the ladder side rail.
4. Rails:
   a. 1-3/4 in. x 1/4 in. thick minimum square tube.
   b. Provide minimum 3/8 in. x 3 in. x 7-7/8 in. x length required standoff brackets on each side rail with punched holes for 3/4 in. anchors.
      1) Maximum vertical spacing: 5 ft on centers.
   c. The side rails of through ladder extensions shall extend 42 in. above the top rung or landing and shall flare out on each side to provide a clearance of 24 in. between the rails.
5. Minimum distance from centerline of rungs to wall or obstruction shall be 7 in.

G. Modular Framing System:
1. Material: Heavy duty pultruded.
2. Shapes as required for condition.
3. Fasteners: Stainless steel or fiberglass.
4. Provide end caps for all exposed terminations.

H. Structural Members:
1. Provide structural members having the same resin composition as the item being supported.
2. Factory fabricate with all required connection holes and holes for work of other trades.

PART 3 - PART 3 - EXECUTION

PART 4 - 3.1 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Set work accurately in location, alignment and elevation, plumb, level, and true.
1. Measure from established lines and levels.
2. Provide temporary bracing or anchors in formwork for items which are to be built into concrete, masonry or similar construction.

3. Tolerances:
    a. Maximum variation from plumb in vertical line: 1/8 in. in 3 ft.
    b. Maximum variation from level of horizontal line: 1/4 in. in 20 ft.
    c. Maximum variation from plan location: 1/4 in. in 20 ft.

C. Railings:
1. Adjust railings prior to securing in place to ensure proper matching at butting joints and correct alignment throughout their length.
    a. Plumb posts in each direction.
2. Provide posts with floor flange, attached to post and with predrilled holes for bolting to stringer, floor or beam.
3. Anchor handrails to walls or guardrails with brackets designed for condition.
    a. For concrete and solid masonry anchorage, use stainless steel adhesive anchors with stainless steel bolts with hex nuts.
    b. Anchor size and embedment to be designed by component fabricator.
        1) Provide minimum of 1/2 in. anchor bolts.

D. Coat all exposed surfaces of stainless steel fasteners with minimum 15 MIL gel coating to match component being anchored.

E. Fasten railings to beams and stair stringers with stainless steel bolts, nuts and washers.
1. Provide two washers for each bolt.

F. Attach grating to each end and intermediate support clip or saddle with bolts, nuts and washers.
1. Maximum spacing: 2 ft on centers with minimum of two per side.
2. Attach clips or saddles to bearing bars only.
3. Reinforce all field cut openings in accordance with manufacturer's recommendations.

G. Attach stair treads at ends to stair stringer with hold-down clips, bolts, nuts, and washers.
1. Minimum two clips per end.

H. File cut ends of all fiberglass to a 1/32 in. radius.

I. Seal cut ends of all items with catalyzed resin as recommended by manufacturer.
1. Provide same resin used in fabrication of item as a minimum.

J. Provide all modular framing components as required to suit condition.
1. Install in accordance with manufacturer's recommendations.

++ END OF SECTION ++

SECTION 07210

THERMAL INSULATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Board insulation and integral vapor retarder at exterior wall behind gypsum board wall finish.

B. Batt insulation in exterior roof construction.

1.2 REFERENCE STANDARDS

A. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2024.

B. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board; 2025.

C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.

D. ASTM E136 - Standard Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750 Degrees C; 2024c.

1.3 SUBMITTALS

A. Product Data: Provide data on product characteristics, performance criteria, and product limitations.

PART 2 - PRODUCTS

2.1 APPLICATIONS

A. Insulation on Inside of Concrete and Masonry Exterior Walls: Polyisocyanurate board.

B. Insulation underside of coreslab Roof Deck: Batt insulation .

2.2 FOAM BOARD INSULATION MATERIALS

A. Polyisocyanurate (ISO) Board Insulation: Rigid cellular foam, comply with ASTM C1289.
   1. Classifications:
      a. Type I: Faced with aluminum foil on both major surfaces of the core foam.

1) Class 1 - Non-reinforced core foam.
2) Compressive Strength: 16 psi (110 kPa), minimum.
3) Thermal Resistance: R20 minimum for 3" thickness.

2. Board Size: 48 inch by 96 inch (1220 mm by 2440 mm).
3. Board Thickness: 3.0 inch (76 mm).
4. Products:
   a. Johns Manville; AP Foil-Faced: www.jm.com/#sle.
   b. Sika R-Max.

2.3 MINERAL FIBER BLANKET INSULATION MATERIALS

A. Flexible Glass Fiber Blanket Thermal Insulation: Preformed insulation, complying with ASTM C665; friction fit.
   1. Flame Spread Index: 75 or less, when tested in accordance with ASTM E84.
   2. Smoke Developed Index: 450 or less, when tested in accordance with ASTM E84.
   3. Combustibility: Non-combustible, when tested in accordance with ASTM E136, except for facing, if any.
   4. Thermal Resistance: R-value (RSI-value) of 38 (6.7).
   5. Thickness: 10-1/2 inch (266 mm).
   6. Facing: Aluminum foil, flame spread 25 rated; one side.

2.4 ACCESSORIES

A. Tape: Reinforced polyethylene film with acrylic pressure sensitive adhesive.
   1. Application: Sealing of interior circular penetrations, such as pipes or cables.
   2. Width: Are required for application.

B. Gas-Actuated Insulation Fasteners: Galvanized steel pins driven through polypropylene anchor with 2-1/4-inch (57 mm) diameter washer head; suitable for fastening insulation to concrete, CMU, or steel studs, length to suit insulation thickness and substrate, capable of securely and rigidly fastening insulation in place.

C. Insulation Fasteners: Impaling clip of galvanized steel and perforated base with washer retainer, to be adhered to surface to receive insulation, length to suit insulation thickness and substrate, capable of securely and rigidly fastening insulation in place.
   1. AGM "Tactoo" Insulation Hangers or equal.

D. Adhesive: Type recommended by insulation manufacturer for application.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation.

B. Verify substrate surfaces are flat, free of irregularities or materials or substances that may impede adhesive bond.

3.2 BOARD INSTALLATION AT EXTERIOR WALLS

A. Adhere 6 inches (152 mm) wide strip of polyethylene sheet over expansion joints with double beads of adhesive each side of joint.
   1. Tape seal joints between sheets.
   2. Extend sheet full height of joint.

B. Apply adhesive to back of boards:
   1. Three continuous beads per board length.

C. Install boards vertically on walls lapped with Z furring stris specified in other sections.
   1. Butt edges and ends tightly to adjacent boards and protrusions.

D. Extend boards over expansion joints, unbonded to wall on one side of joint.

E. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

3.3 BATT INSTALLATION

A. Install insulation and vapor retarder in accordance with manufacturer's instructions.

B. Install in exterior ceiling spaces without gaps or voids. Do not compress insulation.

C. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.

D. Fit insulation tightly in cavities and tightly to exterior side of mechanical and electrical services within the plane of the insulation.

E. Retain insulation batts in place with spindle fasteners at 12 inches (305 mm) on center.

F. Tape seal butt ends, lapped flanges, and tears or cuts in membrane.

3.4 PROTECTION

A. Do not permit installed insulation to be damaged prior to its concealment.

++ END OF SECTION ++

SECTION 07620

SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Fabricated sheet metal items, including flashings and counterflashings.

B. Sealants for joints within sheet metal fabrications.

1.2 REFERENCE STANDARDS

A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc- Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.

B. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018 (Reapproved 2024).

C. ASTM D4586/D4586M - Standard Specification for Asphalt Roof Cement, Asbestos-Free; 2007 (Reapproved 2024).

D. CDA A4050 - Copper in Architecture - Handbook; Current Edition.

E. SMACNA (ASMM) - Architectural Sheet Metal Manual; 2012.

1.3 SUBMITTALS

A. Shop Drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.

1.4 QUALITY ASSURANCE

A. Perform work in accordance with SMACNA (ASMM) and CDA A4050 requirements and standard details, except as otherwise indicated.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Stack material to prevent twisting, bending, and abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.

B. Prevent contact with materials that could cause discoloration or staining.

PART 2 - PRODUCTS

2.1 SHEET MATERIALS

A. Galvanized Steel: ASTM A653/A653M, with G90/Z275 zinc coating; minimum 24-gauge, 0.0239-inch (0.61 mm) thick base metal.

2.2 FABRICATION

A. Form sections true to shape, accurate in size, square, and free from distortion or defects.

B. Form pieces in longest possible lengths.

C. Hem exposed edges on underside 1/2 inch (13 mm); miter and seam corners.

D. Form material with flat lock seams, except where otherwise indicated; at moving joints, use sealed lapped, bayonet-type or interlocking hooked seams.

E. Fabricate corners from one piece with minimum 18-inch (450 mm) long legs; seam for rigidity, seal with sealant.

F. Fabricate flashings to allow toe to extend 2 inches (50 mm) over roofing surface. Return and brake edges.

2.3 ACCESSORIES

A. Fasteners: Galvanized steel, with soft neoprene washers.

B. Primer Type: Zinc chromate.

C. Concealed Sealants: Non-curing butyl sealant.

D. Exposed Sealants: ASTM C920; elastomeric sealant, with minimum movement capability as recommended by manufacturer for substrates to be sealed; color to match adjacent material.

E. Asphalt Roof Cement: ASTM D4586/D4586M, Type I, asbestos-free.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify roof openings, curbs, pipes, sleeves, ducts, and vents through roof are solidly set, reglets in place, and nailing strips located.

B. Verify roofing termination and base flashings are in place, sealed, and secure.

3.2 PREPARATION

A. Install starter and edge strips, and cleats before starting installation.

B. Back paint concealed metal surfaces with protective backing paint to a minimum dry film thickness of 15 mil, 0.015 inch (0.38 mm).

3.3 INSTALLATION

A. Comply with drawing details.

B. Secure flashings in place using concealed fasteners, and use exposed fasteners only where permitted.

C. Apply plastic cement compound between metal flashings and felt flashings.

D. Fit flashings tight in place; make corners square, surfaces true and straight in planes, and lines accurate to profiles.

E. Seal metal joints watertight.

++ END OF SECTION ++

SECTION 07900

JOINT SEALANTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Nonsag gunnable joint sealants.

B. Self-leveling pourable joint sealants.

C. Joint backings and accessories.

1.2 RELATED REQUIREMENTS

A. Section 09260 - Gypsum Board Assemblies: Sealing acoustical and sound-rated walls and ceilings.

B. Section 09300 - Tiling: Sealant between tile and plumbing fixtures and at junctions with other materials and changes in plane.

1.3 REFERENCE STANDARDS

A. ASTM C661 - Standard Test Method for Indentation Hardness of Elastomeric-Type Sealants by Means of a Durometer; 2015 (Reapproved 2022).

B. ASTM C834 - Standard Specification for Latex Sealants; 2017 (Reapproved 2023).

C. ASTM C919 - Standard Practice for Use of Sealants in Acoustical Applications; 2024.

D. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018 (Reapproved 2024).

E. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2025.

F. ASTM C1248 - Standard Test Method for Staining of Porous Substrate by Joint Sealants; 2022.

G. ASTM D2240 - Standard Test Method for Rubber Property--Durometer Hardness; 2015 (Reapproved 2021).

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's technical datasheets for each product to be used; include the following:

1. Physical characteristics, including movement capability, VOC content, hardness, cure time, and color availability.
2. List of backing materials approved for use with the specific product.
3. Backing material recommended by sealant manufacturer.
4. Substrates that product is known to satisfactorily adhere to and with which it is compatible.
5. Substrates the product should not be used on.
6. Substrates for which use of primer is required.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Nonsag Sealants:
   1. Dow: www.dow.com/#sle.
   2. Sika Corporation: usa.sika.com/#sle.
   3. Tremco Commercial Sealants & Waterproofing: www.tremcosealants.com/#sle.
   4. W. R. Meadows, Inc: www.wrmeadows.com/#sle.

2.2 JOINT SEALANT APPLICATIONS

A. Scope:
   1. Interior Joints:
      a. Seal the following joints:
         1) Joints between door frames and window frames and adjacent construction.
         2) In sound-rated wall and ceiling assemblies, gaps at electrical outlets, wiring devices, and piping penetrations.
   2. Do Not Seal:
      a. Intentional weep holes in masonry.
      b. Joints indicated to be covered with expansion joint cover assemblies or other covering devices.
      c. Joints where sealant installation is specified in other sections.
      d. Joints between suspended ceilings and walls.
      e. Interior door and window drywall frames using snap-on moldings for final closure.

B. Exterior Joints: Use nonsag nonstaining silicone sealant, unless otherwise indicated.
   1. Lap Joints in Sheet Metal Fabrications: Butyl rubber, noncuring.

C. Interior Joints: Use nonsag polyurethane sealant, unless otherwise indicated.
   1. Wall and Ceiling Joints in Nonwet Areas: Acrylic emulsion latex sealant.
   2. Joints between Tile in Wet Areas and Floors, Walls, and Ceilings: Mildew-resistant silicone sealant; white.

3. In Sound-Rated Assemblies: Acrylic emulsion latex sealant.
4. Narrow Control Joints in Interior Concrete Slabs: Self-leveling polyurea sealant.

D. Interior Wet Areas: restrooms and kitchens; fixtures in wet areas include plumbing fixtures and countertops.

E. Sound-Rated Assemblies: Walls and ceilings identified as STC-rated, sound-rated, or acoustical.

2.3 JOINT SEALANTS - GENERAL

A. Colors: Match adjacent finished surfaces.

2.4 NONSAG JOINT SEALANTS

A. Nonstaining Silicone Sealant: ASTM C920, Grade NS, Uses M, A, G, and O; not expected to withstand continuous water immersion or traffic.
1. Movement Capability: Plus and minus 25 percent, minimum.
2. Nonstaining to Porous Stone: Nonstaining to light-colored natural stone when tested in accordance with ASTM C1248.
3. Dirt Pick-Up: Reduced dirt pick-up compared to other silicone sealants.
4. Hardness Range: 15 to 35, Shore A, when tested in accordance with ASTM C661.
5. Color: Match adjacent finished surfaces.
6. Service Temperature Range: Minus 20 to 180 degrees F (Minus 29 to 82 degrees C).

B. Mildew-Resistant Silicone Sealant: ASTM C920, Grade NS, Uses M and A; single component, mildew resistant; not expected to withstand continuous water immersion or traffic.
1. Color: White.

C. Polyurethane Sealant: ASTM C920, Grade NS, Uses M and A; single or multi-component; not expected to withstand continuous water immersion or traffic.
1. Movement Capability: Plus and minus 50 percent, minimum.

D. Acrylic Emulsion Latex: Water-based; ASTM C834, single component, nonstaining, nonbleeding, nonsagging; not intended for exterior use.
1. Color: Standard colors matching finished surfaces, Type OP (opaque).
2. Grade: ASTM C834; Grade NF.

E. Noncuring Butyl Sealant: Solvent-based, single component, nonsag, nonskinning, nonhardening, nonbleeding; nonvapor permeable; intended for fully concealed applications.

2.5 SELF-LEVELING JOINT SEALANTS

A. Semi-Rigid Self-Leveling Polyurea Joint Filler: Two-component, 100 percent solids; intended for filling cracks and control joints not subject to significant movement; rigid enough to support concrete edges under traffic.
   1. Durometer Hardness, Type A: 75, minimum, after seven days when tested in accordance with ASTM D2240.
   2. Color: Concrete gray.
   3. Joint Width, Minimum: 1/8 inch (3 mm).
   4. Joint Width, Maximum: 1/2 inch (12 mm).
   5. Joint Depth: Provide product suitable for joints from 1/8 inch (3 mm) to 1 inch (25.4 mm) in depth excluding space for backer rod.

2.6 ACCESSORIES

A. Sealant Backing Materials, General: Materials placed in joint before applying sealants; assists sealant performance and service life by developing optimum sealant profile and preventing three-sided adhesion; type and size recommended by sealant manufacturer for compatibility with sealant, substrate, and application.

B. Backing Tape: Self-adhesive polyethylene tape with surface that sealant will not adhere to and recommended by tape and sealant manufacturers for specific application.

C. Masking Tape: Self-adhesive, nonabsorbent, nonstaining, removable without adhesive residue, and compatible with surfaces adjacent to joints and sealants.

D. Joint Cleaner: Noncorrosive and nonstaining type, type recommended by sealant manufacturer; compatible with joint forming materials.

E. Primers: Type recommended by sealant manufacturer to suit application; nonstaining.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that joints are ready to receive work.

B. Verify that backing materials are compatible with sealants.

C. Verify that backer rods are of the correct size.

3.2 PREPARATION

A. Remove loose materials and foreign matter that could impair adhesion of sealant.

B. Clean joints, and prime as necessary, in accordance with manufacturer's instructions.

C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.

D. Mask elements and surfaces adjacent to joints from damage and disfigurement due to sealant work; be aware that sealant drips and smears may not be completely removable.

3.3 INSTALLATION

A. Install this work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.

B. Provide joint sealant installations complying with ASTM C1193.

C. Install acoustical sealant application work in accordance with ASTM C919.

D. Measure joint dimensions and size joint backers to achieve width-to-depth ratio, neck dimension, and surface bond area as recommended by manufacturer, except where specific dimensions are indicated.

E. Install bond breaker backing tape where backer rod cannot be used.

F. Install sealant free of air pockets, foreign embedded matter, ridges, and sags, and without getting sealant on adjacent surfaces.

G. Do not install sealant when ambient temperature is outside manufacturer's recommended temperature range, or will be outside that range during the entire curing period, unless manufacturer's approval is obtained and instructions are followed.

H. Nonsag Sealants: Tool surface concave, unless otherwise indicated; remove masking tape immediately after tooling sealant surface.

I. Concrete Floor Joint Filler: After full cure, shave joint filler flush with top of concrete slab.

++ END OF SECTION ++

SECTION 08110

HOLLOW METAL FRAMES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Non-fire-rated hollow metal frames for non-hollow metal doors at the Airport Water Reclamation Facility (AWRF) Administration Building.

B. Sound-rated hollow metal frames for non-hollow metal doors at the AWRF Administration Building.

C. Interior glazed borrowed lite frames at the AWRF Administration Building.

1.2 RELATED REQUIREMENTS

A. Section 08710 - Door Hardware: Hardware, silencers, and weatherstripping.

B. Section 08800 - Glazing: Glazed borrowed lites.

1.3 REFERENCE STANDARDS

A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.

B. ANSI/SDI A250.6 - Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames; 2024.

C. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100); 2023.

D. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc- Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.

E. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable; 2023, with Editorial Revision.

F. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2023.

G. BHMA A156.115 - Hardware Preparation in Steel Doors and Frames; 2016.

H. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.

I. NAAMM HMMA 830 - Hardware Selection for Hollow Metal Doors and Frames; 2002.

J. NAAMM HMMA 831 - Hardware Locations for Hollow Metal Doors and Frames; 2011.

K. NAAMM HMMA 840 - Guide Specifications for Receipt, Storage and Installation of Hollow Metal Doors and Frames; 2024.

L. NAAMM HMMA 861 - Guide Specifications for Commercial Hollow Metal Doors and Frames; 2014.

M. SDI 117 - Manufacturing Tolerances for Standard Steel Doors and Frames; 2023.

1.4 SUBMITTALS

A. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes; and one copy of referenced grade standard.

B. Samples: Submit one sample of frame metal, 2 by 2 inches (50 by 50 mm), showing factory finishes, colors, and surface textures.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store in accordance with applicable requirements and in compliance with standards and/or custom guidelines as indicated.

B. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Hollow Metal Frames with Applied Casings, Prefinished:
   1. Dunbarton Corporation; RediFrame: www.dunbarton.com/#sle.
   2. IDP - International Door Products Corp; F Series Standard Steel Door Frame: www.idpframes.com/#sle.
   3. Timely Industries, Inc: www.timelyframes.com/#sle.

2.2 PERFORMANCE REQUIREMENTS

A. Door Frame Type: Provide hollow metal door frames with integral casings.

B. Steel Sheet: Comply with one or more of the following requirements; galvannealed steel complying with ASTM A653/A653M, cold-rolled steel complying with ASTM A1008/A1008M, or hot-rolled pickled and oiled (HRPO) steel complying with ASTM A1011/A1011M, commercial steel (CS) Type B, for each.

C. Accessibility: Comply with ICC A117.1 and ADA Standards.

D. Glazed Lights: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings. Style: Manufacturers standard.

E. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with the specified requirements for each type; for instance, an exterior frame that is also indicated as being sound-rated must comply with the requirements specified for exterior frames and for sound-rated frames; where two requirements conflict, comply with the most stringent.

F. Hardware Preparations, Selections and Locations: Comply with BHMA A156.115, NAAMM HMMA 830, NAAMM HMMA 831 or ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.

G. Frames for Interior Glazing or Borrowed Lites: Construction and face dimensions to match door frames, and as indicated on drawings.

2.3 HOLLOW METAL DOOR FRAMES WITH APPLIED CASINGS

A. Frame Type: Knockdown, slip-on drywall frames; separate jambs and head with separate snap-on casings both sides; factory-applied finish on exposed surfaces.
   1. Frame Material: Cold-rolled steel complying with ASTM A1008/A1008M.
   2. Casing Material: Formed steel.
   3. Casing Profile: As indicated.
   4. Finish: Factory-applied baked enamel finish, or electrostatically applied water-based paint.
      a. Color: As selected from manufacturer's full line.

B. Interior Door Frames, Non-Fire-Rated:
   1. Frame Metal Thickness: 18 gauge, 0.042 inch (1.0 mm), minimum.

C. Sound-Rated Door Frames: Provide sound gasketing at jambs and head and adjustable door bottom device.
   1. Sound Rating: Tested with the door to achieve the rating specified for door opening.

2.4 ACCESSORIES

A. Silencers: Resilient rubber, fitted into drilled hole; provide three on strike side of single door, three on center mullion of pairs, and two on head of pairs without center mullions.

B. Removable Stops: Formed sheet steel, mitered or butted corners; prepared for countersink style tamper proof screws.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that opening sizes and tolerances are acceptable.

C. Verify that finished walls are in plane to ensure proper door alignment.

3.2 INSTALLATION

A. Install frames in accordance with manufacturer's instructions and related requirements of specified frame standards or custom guidelines indicated.

B. Install casings of prefinished frames after painting and wall finishes are complete.

C. Coordinate frame anchor placement with wall construction.

D. Comply with glazing installation requirements of Section 08800.

E. Install door hardware as specified in Section 08710.
   1. Comply with recommended practice for hardware placement of doors and frames in accordance with ANSI/SDI A250.6 or NAAMM HMMA 861.

F. Touch up damaged factory finishes.

3.3 TOLERANCES

A. Clearances Between Door and Frame: Comply with related requirements of specified frame standards or custom guidelines indicated in accordance with SDI 117 or NAAMM HMMA 861.

B. Maximum Diagonal Distortion: 1/16 inch (1.5 mm) measured with straight edges, crossed corner to corner.

3.4 SCHEDULE

A. Refer to Door and Frame Schedule on the drawings.

++ END OF SECTION ++

SECTION 08113

HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Thermally insulated hollow metal doors with frames for the new electrical buildings at Ocotillo Water Reclamation Facility (OWRF).

1.2 RELATED REQUIREMENTS

A. Section 08710 - Door Hardware.

1.3 REFERENCE STANDARDS

A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.

B. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors; 2024.

C. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100); 2023.

D. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames; 2025.

E. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2025.

F. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable; 2024.

G. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2023.

H. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic-Cement Concrete; 2020.

I. ASTM C476 - Standard Specification for Grout for Masonry; 2023.

J. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.

K. BHMA A156.115 - Hardware Preparation in Steel Doors and Frames; 2016.

L. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.

M. NAAMM HMMA 830 - Hardware Selection for Hollow Metal Doors and Frames; 2002.

N. NAAMM HMMA 831 - Hardware Locations for Hollow Metal Doors and Frames; 2024.

O. NAAMM HMMA 840 - Guide Specifications for Receipt, Storage and Installation of Hollow Metal Doors and Frames; 2024.

1.4 SUBMITTALS

A. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes; and one copy of referenced standards/guidelines.

B. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and any indicated finish requirements.

C. Shop Drawings: Submit for approval the following:
   1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (P) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
   2. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE**

WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Comply with NAAMM HMMA 840 or ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.

B. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion and adverse effects on factory applied painted finish.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Hollow Metal Doors and Frames:
   1. Ceco Door, an Assa Abloy Group company: www.assaabloydss.com/#sle.
   2. Curries, an Assa Abloy Group company: ww.assaabloydss.com/#sle.
   3. Republic Doors, an Allegion brand: www.republicdoor.com/#sle.
   4. Steelcraft, an Allegion brand: www.allegion.com/#sle.

2.2 PERFORMANCE REQUIREMENTS

A. Requirements for Hollow Metal Doors and Frames:
   1. Steel Sheet: Comply with one or more of the following requirements; galvannealed steel complying with ASTM A653/A653M, cold-rolled steel complying with ASTM A1008/A1008M, or hot-rolled pickled and oiled (HRPO) steel complying with ASTM A1011/A1011M, commercial steel (CS) Type B, for each.
   2. Accessibility: Comply with ICC A117.1 and ADA Standards.
   3. Exterior Door Top Closures: Flush end closure channel, with top and door faces aligned.
   4. Door Edge Profile: Beveled, both sides.
   5. Typical Door Face Sheets: Flush.
   6. Hardware Preparations, Selections and Locations: Comply with NAAMM HMMA 830 and NAAMM HMMA 831 or BHMA A156.115 and ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.
   7. Zinc Coating for Typical Interior and/or Exterior Locations: Provide metal components zinc-coated (galvanized) and/or zinc-iron alloy-coated (galvannealed) by the hot-dip process in accordance with ASTM A653/A653M, with manufacturer's standard coating thickness, unless noted otherwise for specific hollow metal doors and frames.
      a. Based on SDI Standards: Provide at least A40/ZF120 (galvannealed) when necessary, coating not required for typical interior door applications, and at least A60/ZF180 (galvannealed) for corrosive locations.

B. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with the specified requirements for each type; for instance, an exterior door that is also indicated as being sound-rated must comply with the requirements specified for exterior doors and for sound-rated doors; where two requirements conflict, comply with the most stringent.

2.3 HOLLOW METAL DOORS

A. Exterior Doors: Thermally insulated.
   1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
      a. Level 1 - Standard-duty.
      b. Physical Performance Level C, 250,000 cycles; in accordance with ANSI/SDI A250.4.
      c. Model 1 - Full Flush.
      d. Door Face Metal Thickness: 20 gauge, 0.032 inch (0.8 mm), minimum.
      e. Zinc Coating: A60/ZF180 galvannealed coating; ASTM A653/A653M.
   2. Door Core Material: Polystyrene, 1 lbs/cu ft minimum density.
      a. Foam Plastic Insulation: Manufacturer's standard board insulation with maximum flame spread index (FSI) of 75, and maximum smoke developed index (SDI) of 450 in accordance with ASTM E84, and completely enclosed within interior of door.
   3. Door Thickness: 1-3/4 inches (44.5 mm), nominal.
   4. Door Finish: Factory primed and field finished.

2.4 HOLLOW METAL FRAMES

A. Comply with standards and/or custom guidelines as indicated for corresponding door in accordance with applicable door frame requirements.

B. Exterior Door Frames: Face welded type.
   1. Galvanizing: Components hot-dipped zinc-iron alloy-coated (galvannealed) in accordance with ASTM A653/A653M, with A40/ZF120 coating.
   2. Frame Metal Thickness: 18 gauge, 0.042 inch (1.0 mm), minimum.
   3. Frame Finish: Factory primed and field finished.
   4. Weatherstripping: Separate, see Section 08710.

2.5 FINISHES

A. Primer: Rust-inhibiting, complying with ANSI/SDI A250.10, door manufacturer's standard.

2.6 ACCESSORIES

A. Silencers: Resilient rubber, fitted into drilled hole; provide three on strike side of single door, three on center mullion of pairs, and two on head of pairs without center mullions.

B. Temporary Frame Spreaders: Provide for factory- or shop-assembled frames.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that opening sizes and tolerances are acceptable.

C. Verify that finished walls are in plane to ensure proper door alignment.

3.2 INSTALLATION

A. Install doors and frames in accordance with manufacturer's instructions and related requirements of specified door and frame standards or custom guidelines indicated.

B. Coordinate frame anchor placement with wall construction.

C. Install door hardware as specified in Section 08710.

3.3 TOLERANCES

A. Maximum Diagonal Distortion: 1/16 inch (1.6 mm) measured with straight edge, corner to corner.

3.4 ADJUSTING

A. Adjust for smooth and balanced door movement.

3.5 SCHEDULE

A. Refer to Door and Frame Schedule on the drawings.

++ END OF SECTION ++

SECTION 08211

FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Flush wood doors; flush configuration; non-rated.

1.2 RELATED REQUIREMENTS

A. Section 08110 - Hollow Metal Frames.

B. Section 08710 - Door Hardware.

1.3 REFERENCE STANDARDS

A. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition; 2014, with Errata (2016).

B. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards; 2021, with Errata.

1.4 SUBMITTALS

A. Product Data: Indicate door core materials and construction; veneer species, type and characteristics.

B. Shop Drawings: Show doors and frames, elevations, sizes, types, swings, undercuts, beveling, blocking for hardware, factory machining, factory finishing, cutouts for glazing and other details.

C. Samples: Submit two samples of door veneer, 6 by 6 inches (150 by 150 mm) in size illustrating wood grain, stain color, and sheen.

D. Specimen warranty.

E. Warranty, executed in Owner's name.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Package, deliver and store doors in accordance with specified quality standard.

B. Accept doors on site in manufacturer's packaging, and inspect for damage.

C. Protect doors with resilient packaging sealed with heat shrunk plastic; do not store in damp or wet areas or areas where sunlight might bleach veneer; seal top and bottom edges with tinted sealer if stored more than one week, and break seal on site to permit ventilation.

1.6 WARRANTY

A. Manufacturer Warranty: Provide manufacturer's warranty on interior doors for the life of the installation. Complete forms in Owner's name and register with manufacturer.
   1. Include coverage for delamination of veneer, warping beyond specified installation tolerances, defective materials, and telegraphing core construction.

PART 2 - PRODUCTS

2.1 DOORS

A. Doors: See drawings for locations and additional requirements.
   1. Quality Standard: Custom Grade, Standard Duty performance, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.
   2. Wood Veneer Faced Doors: 5-ply unless otherwise indicated.

B. Interior Doors: 1-3/4 inches (44 mm) thick unless otherwise indicated; flush construction.
   1. Provide solid core doors at each location.
   2. Wood veneer facing with factory transparent finish.

2.2 DOOR AND PANEL CORES

A. Non-Rated Solid Core and 20 Minute Rated Doors: Type particleboard core (PC), plies and faces as indicated.

2.3 DOOR FACINGS

A. Veneer Facing for Transparent Finish: White birch, veneer grade in accordance with quality standard indicated, plain sliced (flat cut), with book match between leaves of veneer, running match of spliced veneer leaves assembled on door or panel face.
   1. Vertical Edges: Any option allowed by quality standard for grade.

2.4 DOOR CONSTRUCTION

A. Fabricate doors in accordance with door quality standard specified.

B. Cores Constructed with stiles and rails:

1. Provide solid blocks at lock edge for hardware reinforcement.
2. Provide solid blocking for other throughbolted hardware.

C. Factory machine doors for hardware other than surface-mounted hardware, in accordance with hardware requirements and dimensions.

D. Factory fit doors for frame opening dimensions identified on shop drawings, with edge clearances in accordance with specified quality standard.

E. Provide edge clearances in accordance with the quality standard specified.

2.5 FINISHES - WOOD VENEER DOORS

A. Finish work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), Section 5 - Finishing for grade specified and as follows:
1. Transparent:
a. System - 1, Lacquer, Nitrocellulose.
b. Sheen: Semigloss.

B. Factory finish doors in accordance with approved sample.

C. Seal door top edge with color sealer to match door facing.

2.6 ACCESSORIES

A. Hollow Metal Door Frames: See Section 08110.

B. Door Hardware: See Section 08710.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that opening sizes and tolerances are acceptable.

C. Do not install doors in frame openings that are not plumb or are out-of-tolerance for size or alignment.

3.2 INSTALLATION

A. Install doors in accordance with manufacturer's instructions and specified quality standard.

B. Factory-Finished Doors: Do not field cut or trim; if fit or clearance is not correct, replace door.

C. Use machine tools to cut or drill for hardware.

D. Coordinate installation of doors with installation of frames and hardware.

3.3 TOLERANCES

A. Comply with specified quality standard for fit and clearance tolerances.

B. Comply with specified quality standard for telegraphing, warp, and squareness.

3.4 ADJUSTING

A. Adjust doors for smooth and balanced door movement.

B. Adjust closers for full closure.

3.5 SCHEDULE - SEE DRAWINGS

++ END OF SECTION ++

SECTION 08331

OVERHEAD COILING DOORS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Overhead coiling doors, operating hardware, non-fire-rated and exterior; manually or electrically operated.

1.2 REFERENCE STANDARDS

A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.

B. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2015.

C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.

D. UL 325 - Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems; Current Edition, Including All Revisions.

1.3 SUBMITTALS

A. Product Data: Provide general construction, electrical equipment, and component connections and details.

B. Shop Drawings: Indicate pertinent dimensioning, anchorage methods, hardware locations, and installation details.

C. Maintenance Data: Indicate lubrication requirements and frequency and periodic adjustments required.

1.4 QUALITY ASSURANCE

A. Products Requiring Electrical Connection: Listed and classified by testing firm acceptable to authorities having jurisdiction as suitable for purpose specified.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Overhead Coiling Doors:

1. Basis of Design Manufacturer: Wayne-Dalton, a Division of Overhead Door Corporation; Product Model 625: www.wayne-dalton.com.
2. Additional acceptable manufacturers, subject to meeting specification requirements:
   a. Cornell Iron Works, Inc: www.cornelliron.com/#sle.
   b. Raynor Garage Doors: www.raynor.com/#sle.
   c. The Cookson Company: www.cooksondoor.com/#sle.
3. Substitutions: See Section 01640 - Materials and Equipment.

2.2 COILING DOORS

A. Exterior Coiling Doors: Steel slat curtain.
   1. Capable of withstanding positive and negative wind loads of 20 psf (940 Pa), without undue deflection or damage to components.
   2. Sandwich slat construction with insulated core of foamed-in-place polyurethane insulation; minimum R-value of 8.1 (RSI-value of 1.43).
   3. Nominal Slat Size: 0-3/4 inches (19 mm) wide by required length.
   4. Finish: Factory painted, white color.
   5. Guide, Angles: Galvanized steel.
   6. Hood Enclosure: Manufacturer's standard; primed steel.
   7. Mounting: Surface mounted.
   8. Locking Devices: Lock and latch handle on outside.
   9. Door shall be manually operated by chain hoist.

2.3 MATERIALS AND COMPONENTS

A. Metal Curtain Construction: Interlocking slats.
   1. Slat Ends: Alternate slats fitted with end locks to act as wearing surface in guides and to prevent lateral movement.
   2. Curtain Bottom for Slat Curtains: Fitted with angles to provide reinforcement and positive contact in closed position.
   3. Weatherstripping for Exterior Doors: Moisture and rot proof, resilient type, located at jamb edges, bottom of curtain, and where curtain enters hood enclosure of exterior doors.
   4. Steel Slats: Minimum thickness, 24 gage, 0.02 inch (0.635 mm); ASTM A653/A653M galvanized steel sheet.
      a. Galvanizing: Minimum G90 (Z275) coating.

B. Guides - Angle: ASTM A36/A36M metal angles, size as required for wind loading.
   1. Hot-dip galvanized in compliance with ASTM A123/A123M.

C. Hood Enclosure and Trim: Internally reinforced to maintain rigidity and shape.
   1. Minimum thickness; 24 gage, 0.02 inch (0.635 mm).

D. Lock Hardware:
   1. Cylindrical Locking Mechanism: Latchset lock cylinder, specified in Section 08710.

2. Latching Mechanism: Inside mounted, adjustable keeper, spring activated latch bar feature to keep in locked or retracted position.
3. Latch Handle: Manufacturer's standard.

E. Roller Shaft Counterbalance: Steel pipe and helical steel spring system, capable of producing torque sufficient to ensure smooth operation of curtain from any position and capable of holding position at mid-travel; with adjustable spring tension; requiring 25 lb (10 kg) nominal force to operate.

2.4 MANUAL OPERATION

A. Manual Operator:
1. Type: Hand chain hoist or push-up operation, as scheduled.
2. Chain Hoist:
a. Galvanized steel hand chain.
b. Enclosed gearbox designed for overhead coiling door service.
c. Operation Force: Maximum 25 lb (10 kg) nominal operating force.
d. Locking: Provide integral manual locking device compatible with specified lock hardware.

PART 3 - PRODUCTS

3.1 EXAMINATION

A. Verify that opening sizes, tolerances and conditions are acceptable.

3.2 INSTALLATION

A. Install units in accordance with manufacturer's instructions.

B. Use anchorage devices to securely fasten assembly to wall construction and building framing without distortion or stress.

C. Securely and rigidly brace components suspended from structure. Secure guides to structural members only.

D. Fit and align assembly including hardware; level and plumb, to provide smooth operation.

E. Install enclosure and perimeter trim.

3.3 TOLERANCES

A. Maintain dimensional tolerances and alignment with adjacent work.

B. Maximum Variation From Plumb: 1/16 inch (1.6 mm).

C. Maximum Variation From Level: 1/16 inch (1.6 mm).

D. Longitudinal or Diagonal Warp: Plus or minus 1/8 inch per 10 feet (3.2 mm per 3 m) straight edge.

3.4 ADJUSTING

A. Adjust operating assemblies for smooth and noiseless operation.

3.5 CLEANING

A. Clean installed components.

B. Remove labels and visible markings.

++ END OF SECTION ++

SECTION 08360

ACCORDION FOLDING DOORS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Acoustical accordion folding doors.

1.2 REFERENCE STANDARDS

A. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2023.

B. ASTM E413 - Classification for Rating Sound Insulation; 2022.

1.3 SUBMITTALS

A. Product Data: Provide data on door operation, hardware and accessories, colors and finishes available.

B. Shop Drawings: Indicate opening sizes, details of track and required supports, static and dynamic loads, adjacent construction and finish trim, and stacking sizes.

C. Samples: Submit two samples of full manufacturer's color range for selection of colors.

D. Samples: Submit two samples of surface finish, 12 x 12 inches (300 x 300 mm) size, illustrating quality, colors selected, texture, and weight.

E. Operation and Maintenance Data: Manufacturer's written operation and maintenance data.

F. Executed warranty.

G. Specimen warranty.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to project site in original packaging.

B. Store products under cover and elevated above grade.

1.5 WARRANTY

A. Manufacturer Warranty: Provide 2-year manufacturer warranty against manufacturing defects. Complete forms in Owner's name and register with manufacturer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Modernfold, dormakaba Group; product: Soundmaster #8: www.modernfold.com/#sle.

2.2 ACCORDION FOLDING DOORS

A. Accordion Door Construction: Acoustical.
   1. Frame: steel hinge plates welded to 3/16-inch (5mm) diameter vertical steel rods, with a single row of plates at the bottom and top with intermediate rows at approximately 42-inch (1067mm) on center. A high tensile alloy steel trolley yoke, functioning as a hinge pin at required intervals, supports the frame assembly.
   2. Opening Height: As indicated on drawings.
   3. Opening Width: As indicated on drawings.
   4. Surfacing: Acoustical, non-woven needle punch carpet, with fused fibers to prevent unraveling or fray of material.
   5. Internal air release mechanism.
   6. Acoustic seals at top, meeting mullions, and jambs; retractable bottom seals.
   7. Sound Transmission Class (STC): 39, calculated in accordance with ASTM E413, based on tests performed in accordance with ASTM E90, on panel size of 100 sq ft (9.3 sq m).

2.3 SUSPENSION SYSTEM

A. Manufacturer's standard suspension system, applicable for specified accordion folding doors and indicated configuration; capable of supporting imposed loads and with stiffness limiting deflection to 1/360 of span.

B. Material and Color: Manufacturer's standard material for specified door.

C. Mounting Application: Surface-mounted; straight.

D. Suspension System Support, Lateral Bracing, and Mounting Surface for Tracks:

2.4 DOOR FRAMING COMPONENTS

A. Fixed Components:

1. Manufacturer's standard full-height jamb units.
2. Finish: Manufacturer's standard material and finish.

B. Movable Components:
1. Manufacturer's standard sliding jamb panels.
2. Finish: Manufacturer's standard material and finish.

C. Framed Opening Trim:
1. Fabricated from aluminum sheet.
2. Finish: As selected from manufacturer's standard selection.

D. Trim: Aluminum moldings, clear anodized.
1. Finish: As selected by Architect from manufacturer's standard selection.

2.5 DOOR HARDWARE

A. Panel Hinge Assembly: Manufacturer's standard hinge assembly for specified door.

B. Securing Devices:
1. Latching Devices:
a. Type: Thumb piece with deadlatch.
b. Finish: Manufacturer's standard for specified folding doors.

C. Operating Trim:
1. Operating Handle:
a. Type: Manufacturer's standard for specified partition.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify existing conditions permit proper installation of accordion folding doors.

B. Verify field measurements.

3.2 INSTALLATION

A. See drawings for installation of overhead structural support and bracing of partition suspension systems.

B. Install doors in accordance with manufacturer's written instructions.

C. Install doors level and plumb.

3.3 ADJUSTING

A. Adjust door assembly to provide smooth operation from stacked to fully open position.

B. Visually inspect fully expanded door for light leaks; identify potential acoustical leaks; adjust to achieve light-tight seals.

3.4 CLEANING

A. Clean door surfaces and other door components in accordance with manufacturer's written cleaning instructions.

3.5 CLOSEOUT ACTIVITIES

A. Demonstrate operation of door and identify potential operational problems.

++ END OF SECTION ++

SECTION 08381

FLEXIBLE STRIP DOOR

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes: Flexible strip doors.

1.2 SYSTEM DESCRIPTION

A. Design requirements:
   1. Compatibility with space and service requirements:
      a. Doors and equipment items provided shall be compatible with space limitations specified and indicated on the Drawings.
      b. Make modifications to doors and equipment items necessary to conform with space limitations or with utility services specified for rough-in.
      c. Provide items complete including all necessary ancillary equipment as may be required for complete and trouble-free operation.
   2. Maintenance requirements:
      a. Provide each door assembly as complete unit produced or supplied by a single manufacturer, including frames, sections, brackets, operating mechanisms, hardware, except hardware items specified in Section 08710, and all necessary accessories for installation of complete in openings indicated.
      b. Unless otherwise specified, all doors of particular type throughout the entire project shall be as manufactured or supplied by a single manufacturer.

1.3 SUBMITTALS

A. Product data:
   1. General: Submit data completely describing products, including rough-in diagrams.

B. Shop drawings:
   1. Drawings showing complete installation details, required clearances, relation to building structure fabrication details and anchorage.
   2. Show location and size of access doors required to perform maintenance on doors and auxiliary equipment.
   3. A copy of this specification section, and all referenced and applicable sections, each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If

deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

C. Samples: Submit samples of strips.

D. Quality control submittals:
   1. Manufacturer's instructions:
      a. Furnish installer copy of diagrams and installation instructions.
      b. Manufacturer’s storage and handling instructions.

E. Contract closeout submittals:
   1. Project record documents:
      a. Warranty: Provide manufacturer's standard warranty.
      b. Cleaning and Maintenance instructions.

1.4 QUALITY ASSURANCE

A. Qualifications:
   1. Manufacturer Qualifications: Regular manufacturer of flexible strip doors for at least five years.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store per manufacturer’s recommendation until ready for use.

B. Deliver materials only after proper facilities are available. Provide clean dry surfaces or platform as required and protect from deterioration and foreign matter.

1.6 PROJECT CONDITIONS

A. Field measurements: Field verify all opening dimensions and clearances prior to fabricating doors. Fitting strips to the ceiling is the responsibility of the CONTRACTOR.

1.7 SEQUENCING AND SCHEDULING

A. Inserts and anchorages: Furnish inserts and anchoring devices which must be set or anchored into concrete. Provide setting drawings, templates, and directions for installation of anchorage devices. Coordinate delivery with other work to avoid delay to the Contract.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

A. Acceptable Manufacturer: One of the following or equal:
   1. Aleco Division E.S. Robbins Corp.
   2. Chase Doors.

2.2 COMPONENTS

A. Strips:
   1. Formulation: Standard PVC.
   2. Color: Clear
   3. Type: Scratch Guard
   4. Size / Overlap: 12” x 0.120 / 33%

2.3 ACCESSORIES

A. Fasteners: Sizes and types as recommend by reviewed door manufacturer.

B. Offset Bracket Kit.

C. Horizontal Slide Kit

D. Guides and Bracket Plates:
   1. Stainless steel: per plans and manufacturer’s recommendation.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of conditions: Examine openings to receive strip doors and verify:
   1. Dimensions and correctness of backing or support conditions.
   2. Absence of defects that would adversely affect installation.

B. Do not start the work until unsatisfactory conditions are corrected.

C. Commencement of work by installer is acceptance of opening conditions.

3.2 PREPARATION

A. Verify dimensions and design for each opening.

B. Coordinate details with other work supporting or adjoining stripdoors.

C. Furnish fastening devices as required to mount doors properly.

3.3 INSTALLATION

A. Install doors in strict accordance with manufacturer's installation instructions, unless specifically otherwise indicated on the Drawings.

B. Install assemblies plumb, square, and level at their proper elevations and in their proper planes.

C. Interface with other products: Separate or isolate dissimilar metals with neoprene gaskets, sleeves, or washers, or with an acceptable coating.

3.4 ADJUSTING

A. Align strips to ensure most effective seal; field adjust and modify as required for proper fit.

3.5 CLEANING

A. Thoroughly clean surfaces of grease, oil, and other impurities as recommended by manufacturer.

B. Remove surplus materials and debris from site.

3.6 PROTECTION

A. Protect installed doors from damage until final acceptance.

++ END OF SECTION++

SECTION 08710

DOOR HARDWARE

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Hardware for wood doors.

B. Thresholds.

C. Weatherstripping and gasketing.

1.2 RELATED REQUIREMENTS

A. Section 06410 - Architectural Wood Casework.

B. Section 08110 - Hollow Metal Frames.

C. Section 08211 - Flush Wood Doors.

1.3 REFERENCE STANDARDS

A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.

B. BHMA (CPD) - Certified Products Directory; Current Edition.

C. BHMA A156.1 - Standard for Butts and Hinges; 2021.

D. BHMA A156.4 - Door Closers and Pivots; 2024.

E. BHMA A156.6 - Standard for Architectural Door Trim; 2021.

F. BHMA A156.7 - Template Hinge Dimensions; 2022.

G. BHMA A156.13 - Mortise Locks & Latches Series 1000; 2022.

H. BHMA A156.16 - Standard for Auxiliary Hardware; 2023.

I. BHMA A156.18 - Standard for Materials and Finishes; 2020.

J. BHMA A156.21 - Thresholds; 2025.

K. BHMA A156.22 - Standard for Gasketing; 2021.

L. BHMA A156.115 - Hardware Preparation in Steel Doors and Frames; 2016.

M. BHMA A156.115W - Hardware Preparation in Wood Doors with Wood or Steel Frames; 2006.

N. DHI (LOCS) – Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames; 2004.

O. DHI (H&S) - Sequence and Format for the Hardware Schedule; 2019.

P. DHI WDHS.3 - Recommended Locations for Architectural Hardware for Flush Wood Doors; 1993; also in WDHS-1/WDHS-5 Series, 1996.

Q. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordinate the manufacture, fabrication, and installation of products that door hardware is installed on.

B. Furnish templates for door and frame preparation to manufacturers and fabricators of products requiring internal reinforcement for door hardware.

C. Keying Requirements Meeting:
   1. Schedule meeting at project site prior to Contractor occupancy.
   2. Attendance Required:
      a. Contractor.
      b. Owner.
   3. Agenda:
      a. Establish keying requirements.
      b. Verify locksets and locking hardware are functionally correct for project requirements.
      c. Verify that keying and programming complies with project requirements.
      d. Establish keying submittal schedule and update requirements.
   4. Record minutes and distribute copies within two days after meeting to participants, with copies to Architect, Owner, participants, and those affected by decisions made.
   5. Deliver established keying requirements to manufacturers.

1.5 SUBMITTALS

A. Product Data: Manufacturer's catalog literature for each type of hardware, marked to clearly show products to be furnished for this project, and includes construction details, material descriptions, finishes, and dimensions and profiles of individual components.

B. Shop Drawings - Door Hardware Schedule: Submit detailed listing that includes each item of hardware to be installed on each door. Use door numbering scheme as included in Contract Documents.

1. Prepared by or under supervision of Architectural Hardware Consultant (AHC).
2. Comply with DHI (H&S) using door numbers and hardware set numbers as indicated in construction documents.
3. List groups and suffixes in proper sequence.
4. Provide complete description for each door listed.
5. Provide manufacturer name, product names, and catalog numbers; include functions, types, styles, sizes and finishes of each item.
6. Include account of abbreviations and symbols used in schedule.
7. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
8. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE**

C. Maintenance Data: Include data on operating hardware, lubrication requirements, and inspection procedures related to preventative maintenance.

D. Keying Schedule:
1. Submit three (3) copies of Keying Schedule in compliance with requirements established during Keying Requirements Meeting unless otherwise indicated.

E. Specimen warranty.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Package hardware items individually; label and identify each package with door opening code to match door hardware schedule.

1.7 WARRANTY

A. Manufacturer's Warranty: Provide warranty against defects in material and workmanship for period indicated. Complete forms in Owner's name and register with manufacturer.
   1. Closers: Five years, minimum.
   2. Exit Devices: Three years, minimum.
   3. Locksets and Cylinders: Three years, minimum.
   4. Other Hardware: Two years, minimum.

PART 2 - PRODUCTS

2.1 DESIGN AND PERFORMANCE CRITERIA

A. Provide specified door hardware as required to make doors fully functional, compliant with applicable codes, and secure to extent indicated.

B. Provide individual items of single type, of same model, and by same manufacturer.

C. Provide door hardware products that comply with the following requirements:
   1. Applicable provisions of federal, state, and local codes.
   2. Accessibility: ADA Standards and ICC A117.1.
   3. Listed and certified compliant with specified standards by BHMA (CPD).
   4. Auxiliary Hardware: BHMA A156.16.
   5. Hardware Preparation for Steel Doors and Steel Frames: BHMA A156.115.
   6. Hardware Preparation for Wood Doors with Wood or Steel Frames: BHMA A156.115W.

D. Lock Function: Provide lock and latch function numbers and descriptions of manufacturer's series. See Door Hardware Schedule.

E. Lock Cores: Comply with City of Chandler facility standards for lock types, including keyway and interchangeable cores.

F. Fasteners:
   1. Provide fasteners of proper type, size, quantity, and finish that comply with commercially recognized standards for proposed applications.
      a. Aluminum fasteners are not permitted.
      b. Provide phillips flat-head screws with heads finished to match door surface hardware unless otherwise indicated.
   2. Provide machine screws for attachment to reinforced hollow metal and aluminum frames.
      a. Self-drilling (Tek) type screws are not permitted.
   3. Provide wall grip inserts for hollow wall construction.
   4. Provide stainless steel machine screws and lead expansion shields for concrete and masonry substrates.

5. Provide wall grip inserts for hollow wall construction.

2.2 HINGES

A. Hinges: Comply with BHMA A156.1, Grade 1.
   1. Butt Hinges: Comply with BHMA A156.1 and BHMA A156.7 for templated hinges.
      a. Provide hinge width required to clear surrounding trim.
   2. Provide hinges on every swinging door.
   3. Provide five-knuckle full mortise butt hinges unless otherwise indicated.
   4. Provide ball-bearing hinges at each door with closer.
   5. Provide following quantity of butt hinges for each door:
      a. Doors up to 60 inches (1.5 m) High: Two hinges.
      b. Doors From 60 inches (1.5 m) High up to 90 inches (2.3 m) High: Three hinges.
      c. Doors 90 inches (2.3 m) High up to 120 inches (3 m) High: Four hinges.

2.3 MORTISE LOCKS

A. Mortise Locks: Comply with BHMA A156.13, Grade 1, Security, 1000 Series.
   1. Latchbolt Throw: 3/4 inch (19 mm), minimum.
   2. Deadbolt Throw: 1 inch (25.4 mm), minimum.
   3. Backset: 2-3/4 inch (70 mm) unless otherwise indicated.
   4. Strikes: Provide manufacturer's standard strike for each latchset or lockset with strike box and curved lip extending to protect frame in compliance with indicated requirements.
      a. Finish: To match lock or latch.

2.4 CLOSERS

A. Closers: Comply with BHMA A156.4, Grade 1.
   1. Type: Surface mounted to door.
   2. At corridor entry doors, mount closer on room side of door.

2.5 PROTECTION PLATES

A. Protection Plates: Comply with BHMA A156.6.

B. Metal Properties: Stainless steel material.

C. Edges: Beveled, on four sides unless otherwise indicated.

D. Fasteners: Countersunk screw fasteners.

2.6 KICK PLATES

A. Kick Plates: Provide along bottom edge of push side of every door with closer, except aluminum storefront and glass entry doors, unless otherwise indicated.
   1. Size: 8 inch (203 mm) high by 2 inch (51 mm) less door width (LDW) on push side of door.

2.7 FLOOR STOPS

A. Floor Stops: Comply with BHMA A156.16, Grade 1 and Resilient Material Retention Test as described in this standard.
   1. Provide floor stops when wall surface is not available; be cautious not to create a tripping hazard.
   2. Type: Manual hold-open, with pencil floor stop.
   3. Material: Aluminum housing with rubber insert.

2.8 WALL STOPS

A. Wall Stops: Comply with BHMA A156.16, Grade 1 and Resilient Material Retention Test as described in this standard.
   1. Provide wall stops to prevent damage to wall surface upon opening door.
   2. Type: Bumper, concave, wall stop.
   3. Material: Stainless steel housing with rubber insert.

2.9 THRESHOLDS

A. Thresholds: Comply with BHMA A156.21.
   1. Provide threshold at interior doors for transition between two different floor types, unless otherwise indicated.
   2. Type: Flat surface.
   3. Material: Aluminum.
   4. Threshold Surface: Fluted horizontal grooves across full width.
   5. Field cut threshold to profile of frame and width of door sill for tight fit.
   6. Provide non-corroding fasteners at exterior locations.

2.10 WEATHERSTRIPPING AND GASKETING

A. Weatherstripping and Gasketing: Comply with BHMA A156.22.
   1. Head and Jamb Type: Adjustable.
   2. Door Sweep Type: Encased in retainer.
   3. Material: Aluminum, with neoprene weatherstripping.
   4. Provide sound-rated gasketing and automatic door bottom on doors indicated as "Sound- Rated", "Acoustical", or with "Sound Transmission Class (STC) rating"; fabricate as continuous gasketing, do not cut or notch gasketing material.

2.11 SILENCERS

A. Silencers: Provide at equal locations on door frame to mute sound of door's impact upon closing.

B. Single Door: Provide three on strike jamb of frame.

C. Pair of Doors: Provide two on head of frame, one for each door at latch side.

D. Material: Rubber, gray color.

2.12 FINISHES

A. Finishes: Provide door hardware of same finish, unless otherwise indicated in Door Hardware Schedule.
   1. Finish: 630; satin stainless steel, with stainless steel 300 series base material (former US equivalent US32D); BHMA A156.18.
   2. Exceptions:
      a. Where base material metal is specified to be different, provide finish that is an equivalent appearance in accordance with BHMA A156.18.
      b. Door Closer Covers and Arms: Color as selected by Architect from manufacturer's standard colors unless otherwise indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that doors and frames are ready to receive this work; labeled, fire-rated doors and frames are properly installed, and dimensions are as indicated on shop drawings.

3.2 INSTALLATION

A. Install hardware in accordance with manufacturer's instructions and applicable codes.

B. Use templates provided by hardware item manufacturer.

C. Do not install surface mounted items until application of finishes to substrate are fully completed.

D. Door Hardware Mounting Heights: Distance from finished floor to center line of hardware item. As indicated in following list; unless noted otherwise in Door Hardware Schedule or on drawings.
   1. For Wood Doors: Install in compliance with DHI WDHS.3 recommendations.
   2. For Steel Doors and Frames: Install in compliance with DHI (LOCS) recommendations.

3. Flush Wood Doors: See Section 08211.
4. Mounting heights in compliance with ADA Standards:
    a. Locksets: 40-5/16 inch (1024 mm).
    b. Push Plates/Pull Bars: 42 inch (1067 mm).
    c. Deadlocks (Deadbolts): 48 inch (1219 mm).
    d. Exit Devices: 40-5/16 inch (1024 mm).

E. Set exterior door thresholds with full-width bead of elastomeric sealant at each point of contact with floor providing a continuous weather seal; anchor thresholds with stainless steel countersunk screws.

3.3 ADJUSTING

A. Adjust hardware for smooth operation.

B. Adjust gasketing for complete, continuous seal; replace if unable to make complete seal.

3.4 CLEANING

A. Clean finished hardware in accordance with manufacturer's written instructions after final adjustments have been made.

B. Clean adjacent surfaces soiled by hardware installation.

C. Replace items that cannot be cleaned to manufacturer's level of finish quality at no additional cost.

3.5 PROTECTION

A. Do not permit adjacent work to damage hardware or finish.

++ END OF SECTION ++

SECTION 08800

GLAZING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Glazing units.

1.2 RELATED REQUIREMENTS

A. Section 08110 - Hollow Metal Frames.

1.3 REFERENCE STANDARDS

A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials; Current Edition.

B. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test; 2015 (Reaffirmed 2020).

C. ASTM C864 - Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers; 2005 (Reapproved 2019).

D. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2025.

E. BS EN 14179-1 - Glass in Building - Heat Soaked Thermally Toughened Soda Lime Silicate Safety Glass - Part 1: Definition and Description; 2016.

F. GANA (GM) - GANA Glazing Manual; 2022.

G. GANA (SM) - GANA Sealant Manual; 2008.

1.4 SUBMITTALS

A. Product Data on Glazing Unit Glazing Types: Provide structural, physical and environmental characteristics, size limitations, special handling and installation requirements.

B. Product Data on Glazing Compounds and Accessories: Provide chemical, functional, and environmental characteristics, limitations, special application requirements, and identify available colors.

1.5 QUALITY ASSURANCE

A. Perform work in accordance with GANA (GM) and GANA (SM) for glazing installation methods.

1.6 WARRANTY

A. Heat Soaked Tempered Glass: Provide a five (5) year manufacturer warranty to include coverage for spontaneous breakage of fully tempered glass caused by nickel sulfide (NiS) inclusions.

PART 2 - PRODUCTS

2.1 GLASS MATERIALS

A. Float Glass: Provide float glass based glazing unless otherwise indicated.
   1. Kind FT - Fully Tempered Type: Complies with ASTM C1048.
   2. Fully Tempered Safety Glass: Complies with ANSI Z97.1 or 16 CFR 1201 criteria for safety glazing used in hazardous locations.
   3. Heat-Soak Testing (HST): Provide HST of fully tempered glass used on canopy, point- supported, spider wall, high-risk, sloping overhead, horizontal overhead, free-standing glass protective barrier, or other demanding applications of project, to reduce risks of spontaneous breakage due to nickel sulfide (NiS) induced fractures in accordance with BS EN 14179-1.

2.2 GLAZING UNITS

A. Monolithic Interior Vision Glazing:
   1. Applications: Interior glazing unless otherwise indicated.
   2. Glass Type: Fully tempered float glass.
   3. Tint: Clear.
   4. Thickness: 1/4 inch (6.4 mm), nominal.

2.3 ACCESSORIES

A. Setting Blocks: Silicone, with 80 to 90 Shore A durometer hardness; ASTM C864 Option II. Length of 0.1 inch for each square foot (25 mm for each square meter) of glazing or minimum 4 inch (100 mm) by width of glazing rabbet space minus 1/16 inch (1.5 mm) by height to suit glazing method and pane weight and area.

B. Glazing Gaskets: Resilient silicone extruded shape to suit glazing channel retaining slot; ASTM C864 Option II; color black.

PART 3 - EXECUTION

3.1 VERIFICATION OF CONDITIONS

A. Verify that openings for glazing are correctly sized and within tolerances, including those for size, squareness, and offsets at corners.

B. Verify that the minimum required face and edge clearances are being provided.

C. Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and support framing is ready to receive glazing system.

D. Proceed with glazing system installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Install glazing in compliance with written instructions of glass, gaskets, and other glazing material manufacturers, unless more stringent requirements are indicated, including those in glazing referenced standards.

B. Do not exceed edge pressures around perimeter of glass lites as stipulated by glass manufacturer.

C. Set glass lites of system with uniform pattern, draw, bow, and similar characteristics.

D. Prevent glass from contact with any contaminating substances that may be the result of construction operations such as, and not limited to the following; weld splatter, fire-safing, plastering, mortar droppings, and paint.

3.3 INSTALLATION - DRY GLAZING METHOD (GASKET GLAZING)

A. Application - Exterior and/or Interior Glazed: Set glazing infills from either the exterior or the interior of the building.

B. Place setting blocks at 1/4 points with edge block no more than 6 inch (152 mm) from corners.

C. Rest glazing on setting blocks and push against fixed stop with sufficient pressure on gasket to attain full contact.

D. Install removable stops without displacing glazing gasket; exert pressure for full continuous contact.

3.4 CLEANING

A. Remove excess glazing materials from finish surfaces immediately after application using solvents or cleaners recommended by manufacturers.

B. Remove nonpermanent labels immediately after glazing installation is complete.

C. Clean glass and adjacent surfaces after sealants are fully cured.

D. Clean glass on both exposed surfaces not more than 4 days prior to Date of Substantial Completion in accordance with glass manufacturer's written recommendations.

3.5 PROTECTION

A. After installation, mark pane with an 'X' by using removable plastic tape or paste.

B. Remove and replace glass that is damaged during construction period prior to Date of Substantial Completion.

++ END OF SECTION ++

SECTION 09050

COMMON WORK RESULTS FOR FLOORING PREPARATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. This section applies to floors identified in Contract Documents that are receiving the following types of floor coverings:
   1. Carpet tile.
   2. Thin-set ceramic tile and stone tile.

B. Removal of existing floor coverings.

C. Preparation of new and existing concrete floor slabs for installation of floor coverings.

D. Testing of concrete floor slabs for moisture and alkalinity (pH).

E. Remediation of concrete floor slabs due to unsatisfactory moisture or alkalinity (pH) conditions.
   1. Contractor shall perform all specified remediation of concrete floor slabs. If such remediation is indicated by testing agency's report and is due to a condition not under Contractor's control or could not have been predicted by examination prior to entering into the contract, a contract modification will be issued.

F. Patching compound.

G. Remedial floor treatment.

1.2 RELATED REQUIREMENTS

A. Section 03300 - Cast-in-Place Concrete: Moisture emission reducing curing and sealing compound for slabs to receive adhered flooring, to prevent moisture content-related flooring failures; to remain in place, not to be removed.

B. Section 03300 - Cast-in-Place Concrete: Limitations on curing requirements for new concrete floor slabs.

1.3 REFERENCE STANDARDS

A. ASTM C109/C109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 50 mm [2 in.] Cube Specimens); 2024.

B. ASTM C472 - Standard Test Methods for Physical Testing of Gypsum, Gypsum Plasters, and Gypsum Concrete; 2020.

C. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2022.

D. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride; 2023.

E. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes; 2019a.

F. RFCI (RWP) - Recommended Work Practices for Removal of Resilient Floor Coverings; 2018.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordinate scheduling of cleaning and testing, so that preliminary cleaning has been completed for at least 24 hours prior to testing.

1.5 SUBMITTALS

A. Visual Observation Report: For existing floor coverings to be removed.

B. Floor Covering and Adhesive Manufacturers' Product Literature: For each specific combination of substrate, floor covering, and adhesive to be used; showing:
   1. Moisture and alkalinity (pH) limits and test methods.
   2. Manufacturer's required bond/compatibility test procedure.

C. Remedial Materials Product Data: Manufacturer's published data on each product to be used for remediation.

D. Testing Agency's Report:
   1. Description of areas tested; include floor plans and photographs if helpful.
   2. Summary of conditions encountered.
   3. Moisture and alkalinity (pH) test reports.
   4. Copies of specified test methods.
   5. Recommendations for remediation of unsatisfactory surfaces.
   6. Submit report not more than two business days after conclusion of testing.

E. Adhesive Bond and Compatibility Test Report.

1.6 QUALITY ASSURANCE

A. Contractor may perform adhesive and bond test with Contractor's own personnel or hire a testing agency.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, handle, and protect products in accordance with manufacturer's instructions and recommendations.

B. Deliver materials in manufacturer's packaging; include installation instructions.

C. Keep materials from freezing.

1.8 FIELD CONDITIONS

A. Maintain ambient temperature in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 65 degrees F (18 degrees C) or more than 85 degrees F (30 degrees C).

B. Maintain relative humidity in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 40 percent and not more than 60 percent.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Patching Compound: Floor covering manufacturer's recommended product, suitable for conditions, and compatible with adhesive and floor covering. In the absence of any recommendation from flooring manufacturer, provide a product with the following characteristics:
   1. Cementitious moisture-, mildew-, and alkali-resistant compound, compatible with floor, floor covering, and floor covering adhesive, and capable of being feathered to nothing at edges.
   2. Compressive Strength: 3000 psi, minimum, after 28 days, when tested in accordance with ASTM C109/C109M or ASTM C472, whichever is appropriate.

B. Remedial Floor Treatment: Penetrating, spray-applied, silicate-based product intended by its manufacturer to resist water vapor transmission to degree sufficient to meet flooring manufacturer's emission limits, resistant to the level of alkalinity (pH) found, and suitable for adhesion of flooring without further treatment.

PART 3 - EXECUTION

3.1 CONCRETE SLAB PREPARATION

A. Perform following operations in the order indicated:
   1. Existing concrete slabs (on-grade and elevated) with existing floor coverings:

a. Visual observation of existing floor covering, for adhesion, water damage, alkaline deposits, and other defects.
b. Removal of existing floor covering.

2. Preliminary cleaning.
3. Moisture vapor emission tests; 3 tests in the first 1000 square feet (100 square meters) and one test in each additional 1000 square feet (100 square meters), unless otherwise indicated or required by flooring manufacturer.
4. Internal relative humidity tests; in same locations as moisture vapor emission tests, unless otherwise indicated.
5. Alkalinity (pH) tests; in same locations as moisture vapor emission tests, unless otherwise indicated.
6. Specified remediation, if required.
7. Patching, smoothing, and leveling, as required.
8. Other preparation specified.
9. Adhesive bond and compatibility test.
10. Protection.

B. Remediations:
1. Active Water Leaks or Continuing Moisture Migration to Surface of Slab: Correct this condition before doing any other remediation; re-test after correction.
2. Excessive Moisture Emission or Relative Humidity: If an adhesive that is resistant to the level of moisture present is available and acceptable to flooring manufacturer, use that adhesive for installation of the flooring; if not, apply remedial floor coating or remedial sheet membrane over entire suspect floor area.
3. Excessive Alkalinity (pH): If remedial floor coating is necessary to address excessive moisture, no additional remediation is required; if not, if an adhesive that is resistant to the level present is available and acceptable to the flooring manufacturer, use that adhesive for installation of the flooring; otherwise, apply a skim coat of specified patching compound over entire suspect floor area.

3.2 REMOVAL OF EXISTING FLOOR COVERINGS

A. Comply with local, State, and federal regulations and recommendations of RFCI (RWP), as applicable to floor covering being removed.

B. Dispose of removed materials in accordance with local, State, and federal regulations and as specified.

3.3 PRELIMINARY CLEANING

A. Clean floors of dust, solvents, paint, wax, oil, grease, asphalt, residual adhesive, adhesive removers, film-forming curing compounds, sealing compounds, alkaline salts, excessive laitance, mold, mildew, and other materials that might prevent adhesive bond.

B. Do not use solvents or other chemicals for cleaning.

3.4 MOISTURE VAPOR EMISSION TESTING

A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.

B. Where this specification conflicts with the referenced test method, comply with the requirements of this section.

C. Test in accordance with ASTM F1869 and as follows.

D. Plastic sheet test and mat bond test may not be substituted for the specified ASTM test method, as those methods do not quantify the moisture content sufficiently.

E. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if test values exceed 3 pounds per 1000 square feet (1.4 kg per 93 square meters) per 24 hours.

F. Report: Report the information required by the test method.

3.5 INTERNAL RELATIVE HUMIDITY TESTING

A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.

B. Where this specification conflicts with the referenced test method, comply with the requirements of this section.

C. Test in accordance with ASTM F2170 Procedure A and as follows.

D. Testing with electrical impedance or resistance apparatus may not be substituted for the specified ASTM test method, as the values determined are not comparable to the ASTM test values and do not quantify the moisture content sufficiently.

E. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if any test value exceeds 75 percent relative humidity.

F. Report: Report the information required by the test method.

3.6 ALKALINITY TESTING

A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.

B. The following procedure is the equivalent of that described in ASTM F710, repeated here for the Contractor's convenience.
   1. Use a wide range alkalinity (pH) test paper, its associated chart, and distilled or deionized water.
   2. Place several drops of water on a clean surface of concrete, forming a puddle approximately 1 inch (25 mm) in diameter. Allow the puddle to set for approximately 60 seconds, then dip the alkalinity (pH) test paper into the water, remove it, and compare immediately to chart to determine alkalinity (pH) reading.
   3. Use of a digital pH meter with probe is acceptable; follow meter manufacturer's instructions.

C. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if alkalinity (pH) test value is over 10.

3.7 PREPARATION

A. See individual floor covering section(s) for additional requirements.

B. Comply with requirements and recommendations of floor covering manufacturer.

C. Fill and smooth surface cracks, grooves, depressions, control joints and other non-moving joints, and other irregularities with patching compound.

D. Do not fill expansion joints, isolation joints, or other moving joints.

3.8 ADHESIVE BOND AND COMPATIBILITY TESTING

A. Comply with requirements and recommendations of floor covering manufacturer.

3.9 APPLICATION OF REMEDIAL FLOOR TREATMENT

A. Comply with requirements and recommendations of treatment manufacturer.

3.10 PROTECTION

A. Cover prepared floors with building paper or other durable covering.

++ END OF SECTION ++

SECTION 09260

GYPSUM BOARD ASSEMBLIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Performance criteria for gypsum board assemblies.

B. Metal stud wall framing.

C. Metal furring strips.

D. Metal channel ceiling framing.

E. Acoustic insulation.

F. Gypsum wallboard.

G. Joint treatment and accessories.

H. Textured finish system.

1.2 REFERENCE STANDARDS

A. AISI S100 - North American Specification for the Design of Cold-Formed Steel Structural Members; 2016, with Supplement (2020).

B. AISI S220 - North American Standard for Cold-Formed Steel Nonstructural Framing; 2020.

C. AISI S240 - North American Standard for Cold-Formed Steel Structural Framing; 2015, with Errata (2020).

D. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc- Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.

E. ASTM A1003/A1003M - Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members; 2015.

F. ASTM C1007 - Standard Specification for Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories; 2020 (Reapproved 2024).

G. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board; 2017 (Reapproved 2022).

H. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2024.

I. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2020.

J. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board; 2024.

K. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2022.

L. ASTM C1047 - Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base; 2019.

M. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2024.

N. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2023.

O. ASTM E413 - Classification for Rating Sound Insulation; 2022.

P. GA-216 - Application and Finishing of Gypsum Panel Products; 2024.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate the installation of gypsum board assemblies with size, location, and installation of service utilities.

1.4 SUBMITTALS

A. Product Data:
   1. Provide data on metal framing, gypsum board, accessories, and joint finishing system.
   2. Provide manufacturer's data on partition head to structure connectors, showing compliance with requirements.

B. Samples: Submit two samples of gypsum board finished with proposed texture application, 12 by 12 inches (300 by 300 mm) in size, indicating finish color and texture.

C. Installer's Qualification Statement.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store gypsum products and accessories indoors and keep above freezing. Elevate boards above floor, on nonwicking supports, in accordance with manufacturer's recommendations.

B. Store metal products to prevent corrosion.

PART 2 - PRODUCTS

2.1 GYPSUM BOARD ASSEMBLIES

A. Provide completed assemblies complying with ASTM C840 and GA-216.

B. Interior Partitions, Indicated as Acoustic: Provide completed assemblies with the following characteristics:
   1. Acoustic Attenuation: STC of 40 calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.

2.2 METAL FRAMING MATERIALS

A. Steel Sheet: ASTM A1003/A1003M, subject to the ductility limitations indicated in AISI S220 or equivalent.

B. Nonstructural Framing System Components: AISI S220; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 for the spacing indicated, with maximum deflection of wall framing of L/120 at 5 psf (L/120 at 240 Pa).
   1. Studs: C-shaped with knurled or embossed faces.
   2. Runners: U shaped, sized to match studs.
   3. Wall Furring Members: Zee-shaped sections, minimum depth of 3 inch (76 mm).

C. Partition Head to Structure Connections: Provide mechanical anchorage devices that accommodate deflection and prevent rotation of studs while maintaining structural performance of partition.
   1. Structural Performance: Maintain lateral load resistance and vertical movement capacity required by applicable code, when evaluated in accordance with AISI S100.
   2. Material: ASTM A653/A653M steel sheet, SS Grade 50/340, with G60/Z180 hot-dipped galvanized coating.

D. Non-structural Framing Accessories:
   1. Ceiling Hangers: Type and size as specified in ASTM C754 for spacing required.
   2. Framing Connectors: ASTM A653/A653M G90 galvanized steel clips; secures cold rolled channel to wall studs for lateral bracing.

E. Grid Suspension Systems: Steel grid system of main tees and support bars connected to structure using hanging wire.
   1. Products:
      a. CertainTeed Corporation: www.certainteed.com/ceilings-and-walls/#sle.
      b. USG Corporation; Drywall Suspension System: www.usg.com/#sle.

2.3 BOARD MATERIALS

A. Gypsum Wallboard: Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
   1. Application: Use for vertical surfaces, unless otherwise indicated.
   2. Thickness:
      a. Vertical Surfaces: 5/8 inch (16 mm).

2.4 GYPSUM BOARD ACCESSORIES

A. Acoustic Insulation: ASTM C665; preformed mineral-fiber, friction fit type, unfaced; thickness 2 inches (50.8 mm).

B. Acoustic Sealant: Acrylic emulsion latex or water-based elastomeric sealant; do not use solvent-based non-curing butyl sealant.

C. Finishing Accessories: ASTM C1047, extruded aluminum alloy (6063 T5) or galvanized steel sheet ASTM A924/A924M G90, unless noted otherwise.
   1. Types: As detailed or required for finished appearance.

D. Joint Materials: ASTM C475/C475M and as recommended by gypsum board manufacturer for project conditions.
   1. Joint Compound: Drying type, vinyl-based, ready-mixed.

E. Textured Finish Materials: Latex-based compound; plain.
   1. Products:
      a. CertainTeed Corporation; Extreme Texture Coat/Acrylic Texture with M2Tech: www.certainteed.com/#sle.
      b. Sherwin-Williams; Tuff Surface Premium Texture Finish: www.sherwin-williams.com/#sle.

F. Screws for Fastening of Gypsum Panel Products to Cold-Formed Steel Studs Less than 0.033 inches (0.84 mm) in Thickness and Wood Members: ASTM C1002; self-piercing tapping screws, corrosion-resistant.

G. Anchorage to Substrate: Tie wire, nails, screws, and other metal supports, of type and size to suit application; to rigidly secure materials in place.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that project conditions are appropriate for work of this section to commence.

3.2 FRAMING INSTALLATION

A. Metal Framing: Install in accordance with ASTM C1007AISI S220 and manufacturer's instructions.

B. Suspended Ceilings and Soffits: Space framing and furring members as indicated.

C. Studs: Space studs as indicated.
   1. Extend partition framing to structure where indicated and to ceiling in other locations.
   2. Partitions Terminating at Ceiling: Attach ceiling runner securely to ceiling track in accordance with manufacturer's instructions.
   3. Partitions Terminating at Structure: Attach top runner to structure, maintain clearance between top of studs and structure, and connect studs to track using specified mechanical devices in accordance with manufacturer's instructions; verify free movement of top of stud connections; do not leave studs unattached to track.

D. Openings: Reinforce openings as required for weight of doors or operable panels, using not less than double studs at jambs.

E. Standard Wall Furring: Install at masonry walls scheduled to receive gypsum board, not more than 4 inches (100 mm) from floor and ceiling lines and abutting walls. Secure in place on alternate channel flanges at maximum 24 inches (600 mm) on center.
   1. Orientation: Vertical.
   2. Spacing: As indicated.

3.3 ACOUSTIC ACCESSORIES INSTALLATION

A. Acoustic Insulation: Place tightly within spaces, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions.

B. Acoustic Sealant: Install in accordance with manufacturer's instructions.
   1. Place one bead continuously on substrate before installation of perimeter framing members.
   2. Place continuous bead at perimeter of each layer of gypsum board.
   3. Seal around all penetrations by conduit, pipe, ducts, and rough-in boxes, except where firestopping is provided.

3.4 BOARD INSTALLATION

A. Comply with ASTM C840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.

B. Single-Layer Nonrated: Install gypsum board in most economical direction, with ends and edges occurring over firm bearing.
   1. Exception: Tapered edges to receive joint treatment at right angles to framing.

C. Installation on Metal Framing: Use screws for attachment of gypsum board.

3.5 INSTALLATION OF TRIM AND ACCESSORIES

A. Control Joints: Place control joints consistent with lines of building spaces and as indicated.

B. Corner Beads: Install at external corners, using longest practical lengths.

C. Edge Trim: Install at locations where gypsum board abuts dissimilar materials.

3.6 JOINT TREATMENT

A. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
   1. Level 4: Walls and ceilings to receive paint finish or wall coverings, unless otherwise indicated.
   2. Level 2: In utility areas, behind cabinetry, and on backing board to receive tile finish.
   3. Level 1: Wall areas above finished ceilings, whether or not accessible in the completed construction.

B. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
   1. Feather coats of joint compound so that camber is maximum 1/32 inch (0.8 mm).
   2. Taping, filling, and sanding are not required at surfaces behind adhesive applied ceramic tile and fixed cabinetry.

3.7 TEXTURE FINISH

A. Apply finish texture coating by means of spraying apparatus in accordance with manufacturer's instructions and to match approved sample.

3.8 TOLERANCES

A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet (3 mm in 3 m) in any direction.

3.9 PROTECTION

A. Protect installed gypsum board assemblies from subsequent construction operations.

++ END OF SECTION ++

SECTION 09300

TILING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Tile for floor applications.

B. Tile for wall applications.

C. Stone thresholds.

D. Ceramic trim.

1.2 RELATED REQUIREMENTS

A. Section 07900 - Joint Sealants: Sealing joints between tile work and adjacent construction and fixtures.

1.3 REFERENCE STANDARDS

A. ANSI A108/A118/A136 - American National Standard Specifications for the Installation of Ceramic Tile (Compendium); 2024.

B. ANSI A108.19 - American National Standard Specifications for Interior Installation of Gauged Porcelain Tiles and Gauged Porcelain Tile Panels/Slabs by the Thin-Bed Method Bonded with Modified Dry-Set Cement Mortar or Improved Modified Dry-Set Cement Mortar; 2020.

C. ANSI A108.20 - American National Standard Specifications for Exterior Installation of Gauged Porcelain Tiles and Gauged Porcelain Tile Panels/Slabs; 2020.

D. ANSI A118.4 - American National Standard Specifications for Modified Dry-Set Cement Mortar; 2023.

E. ANSI A118.6 - American National Standard Specifications for Standard Cement Grouts for Tile Installation; 2019.

F. ANSI A137.1 - American National Standard Specifications for Ceramic Tile; 2022.

G. ASTM C373 - Standard Test Methods for Determination of Water Absorption and Associated Properties by Vacuum Method for Pressed Ceramic Tiles and Glass Tiles and Boil Method for Extruded Ceramic Tiles and Non-tile Fired Ceramic Whiteware Products; 2018 (Reapproved 2023).

H. TCNA (HB) - Handbook for Ceramic, Glass, and Stone Tile Installation; 2025.

I. TCNA (HB-GP) - Handbook for Gauged Porcelain Tiles and Gauged Porcelain Tile Panels/Slabs Installation; 2023.

1.4 SUBMITTALS

A. Product Data: Provide manufacturers' data sheets on tile, mortar, grout, and accessories. Include instructions for using grouts and adhesives.

B. Shop Drawings: Indicate tile layout, perimeter conditions, junctions with dissimilar materials, and thresholds.

C. Samples: Mount tile and apply grout on two plywood panels, minimum 18 by 18 inches (457 by 457 mm) in size illustrating pattern, color variations, and grout joint size variations.

D. Maintenance Data: Include recommended cleaning methods, cleaning materials, and stain removal methods.

E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. Extra Tile: 1 percent of each size, color, and surface finish combination, but not less than 10 of each type.

1.5 QUALITY ASSURANCE

A. Installer Qualifications:
   1. Company specializing in performing tile installation, with minimum of five years of documented experience.
   2. Installer Certification:
      a. Ceramic Tile Education Foundation (CTEF): Certified Tile Installer (CTI).

1.6 MOCK-UPS

A. Construct tile mock-up incorporating components specified for location.
   1. Locate where directed by Architect.
   2. Mock-up may remain as part of work.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect adhesives from freezing or overheating in accordance with manufacturer's instructions.

1.8 FIELD CONDITIONS

A. Do not install solvent-based products in an unventilated environment.

B. Maintain ambient and substrate temperature above 50 degrees F (10 degrees C) and below 100 degrees F (38 degrees C) during installation and curing of setting materials.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Tile:
   1. Dal-Tile Corporation: www.daltile.com/#sle.

B. Setting Materials:
   1. Custom Building Products: www.custombuildingproducts.com/#sle.
   2. LATICRETE International, Inc: www.laticrete.com/#sle.
   3. Mapei Corporation: www.mapei.com/#sle.

C. Grout:
   1. Custom Building Products: www.custombuildingproducts.com/#sle.
   2. LATICRETE International, Inc: www.laticrete.com/#sle.
   3. Mapei Corporation: www.mapei.com/#sle.

2.2 TILE

A. Glazed Wall Tile: ANSI A137.1 standard grade.
   1. Products:
      a. Dal-Tile Corporation: www.daltile.com/#sle.

B. Porcelain Tile: ANSI A137.1 standard grade.
   1. Moisture Absorption: 0 to 0.5 percent as tested in accordance with ASTM C373.
   2. Size: 12 by 24 inch (305 by 610 mm), nominal.
   3. Thickness: 5/16 inch (8 mm).
   4. Edges: Square.
   5. Surface Finish: Non-slip.
   6. Color: Beige.
   7. Trim Units: Matching surface bullnose shapes in sizes coordinated with field tile.
   8. Products:
      a. Dal-Tile Corporation; "Rekindle" RK11: www.daltile.com/#sle.

2.3 TRIM AND ACCESSORIES

A. Ceramic Trim: Matching bullnose ceramic shapes in sizes coordinated with field tile.
   1. Applications:
      a. Open Edges: Bullnose.

b. Inside Corners: Jointed.
c. Floor to Wall Joints: Straight base.

2. Manufacturers: Same as for tile.

B. Thresholds: 2 inches (51 mm) wide by full width of wall or frame opening; beveled edge on both long edges; without holes, cracks, or open seams.
1. Thickness: 1/2 inch (12.7 mm).
2. Material: Marble, honed finish.
3. Applications:
a. At doorways where tile terminates.

2.4 SETTING MATERIALS

A. Provide setting and grout materials from same manufacturer.

B. Latex-Portland Cement Mortar Bond Coat: ANSI A118.4.
1. Applications: Use where indicated on drawings and where no other type of bond coat is indicated.
2. Products:
a. Custom Building Products; ProLite Premium Rapid Setting Large Format Tile Mortar, with Multi-Surface Bonding Primer: www.custombuildingproducts.com/#sle.
b. LATICRETE International, Inc; TRI-LITE: www.laticrete.com/#sle.
c. Mapei Corporation; Adesilex P10 Mosaic & Glass Tile: www.mapei.com/#sle.

2.5 GROUTS

A. Provide setting and grout materials from same manufacturer.

B. Standard Grout: ANSI A118.6 standard cement grout.
1. Applications: Use where indicated on drawings and where no other type of grout is indicated.
2. Use sanded grout for joints 1/8 inch (3.2 mm) wide and larger; use unsanded grout for joints less than 1/8 inch (3.2 mm) wide.
3. Color: As selected by Architect from manufacturer's full line.
4. Products:
a. Custom Building Products; Polyblend Non-Sanded Grout: www.custombuildingproducts.com/#sle.
b. LATICRETE International, Inc; LATICRETE 1500 Sanded Grout: www.laticrete.com/#sle.
c. Mapei Corporation; Flexcolor CQ: www.mapei.com/#sle.

2.6 MAINTENANCE MATERIALS

A. Tile Sealant: Two-component, semi-rigid, 100 percent epoxy sealant; resistant to rolling loads.

1. Applications: Nonmoving and saw-cut control and construction joints in tile flooring.
2. Color: As selected by Architect from manufacturer's full line.

B. Grout Sealer: Liquid-applied, moisture and stain protection for existing or new Portland cement grout.
1. Composition: Water-based colorless silicone.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify subfloor surfaces are smooth and flat within tolerances specified for that type of work and are ready to receive tile.

B. Verify wall surfaces are smooth and flat within tolerances specified for that type of work, are dust-free, and are ready to receive tile.

C. Verify that subfloor surfaces are dust free and free of substances that could impair bonding of setting materials to subfloor surfaces.

D. Cementitious Subfloor Surfaces: Verify that substrates are ready for tiling installation by testing for moisture and alkalinity (pH).
1. Obtain instructions if test results are not within limits recommended by tiling material manufacturer and setting material manufacturer.
2. Follow moisture and alkalinity remediation procedures in Section 09050, Common Work Results for Flooring Preparation.

3.2 PREPARATION

A. Vacuum clean surfaces and damp clean.

B. Seal substrate surface cracks with filler.

3.3 INSTALLATION - GENERAL

A. Install tile and thresholds and grout in accordance with applicable requirements of ANSI A108/A118/A136, manufacturer's instructions, and TCNA (HB) or TCNA (HB-GP) recommendations, as applicable.

B. Lay floor tile in diagonal basketweave pattern. Do not interrupt tile pattern through openings.

C. Lay wall tile in pattern indicated.

D. Cut and fit tile to penetrations through tile, leaving sealant joint space. Form corners and bases neatly. Align floor and base joints.

E. Place tile joints uniform in width, subject to variance in tolerance allowed in tile size. Make grout joints without voids, cracks, excess mortar or excess grout, or too little grout.

F. Form internal angles square and external angles bullnosed.

G. Install thresholds where indicated on drawings.

H. Sound tile after setting. Replace hollow sounding units.

I. Keep control and expansion joints free of mortar, grout, and adhesive.

J. Prior to grouting, allow installation to completely cure; minimum of 48 hours.

K. Grout tile joints unless otherwise indicated on drawings. Use standard grout unless otherwise indicated on drawings.

L. At changes in plane and tile-to-tile control joints, use tile sealant instead of grout, with either bond breaker tape or backer rod as appropriate to prevent three-sided bonding.

3.4 INSTALLATION - FLOORS - THIN-SET METHODS

A. Over interior concrete substrates, install in accordance with TCNA (HB) Method F113, dry-set or latex-Portland cement bond coat, on ground, with standard grout, unless otherwise indicated on drawings.

B. Install tile-to-tile floor movement joints in accordance with TCNA (HB) Method EJ171F.

3.5 INSTALLATION - WALL TILE

A. Over gypsum wallboard on wood or metal studs, install in accordance with TCNA (HB) Method W243, thin-set with dry-set or latex-Portland cement bond coat.

3.6 CLEANING

A. Clean tile and grout surfaces.

3.7 PROTECTION

A. Do not permit traffic over finished floor surface for 4 days after installation.

++ END OF SECTION ++

SECTION 09511

ACOUSTICAL CEILINGS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Suspended metal grid ceiling system.

B. Acoustical units.

1.2 REFERENCE STANDARDS

A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc- Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.

B. ASTM C635/C635M - Standard Specification for Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings; 2022.

C. ASTM C636/C636M - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels; 2019 (Reapproved 2025).

D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.

E. ASTM E580/E580M - Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions; 2024a.

F. ASTM E1264 - Standard Classification for Acoustical Ceiling Products; 2023.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Sequence work to ensure acoustical ceilings are not installed until building is enclosed, sufficient heat is provided, dust generating activities have terminated, and overhead work is completed, tested, and approved.

B. Do not install acoustical units until after interior wet work is dry.

1.4 SUBMITTALS

A. Shop Drawings: Indicate grid layout and related dimensioning.

B. Product Data: Provide data on suspension system components and acoustical units.

C. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01600 – General Equipment Provisions, for additional provisions.
   2. Extra Acoustical Units: Quantity equal to 5 percent of total installed.

1.5 FIELD CONDITIONS

A. Maintain uniform temperature of minimum 60 degrees F (16 degrees C), and maximum humidity of 40 percent prior to, during, and after acoustical unit installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acoustic Tiles/Panels:
   1. Armstrong World Industries, Inc: www.armstrongceilings.com/#sle.
   2. Certainteed Architectural: www.certainteed.com/ceilings-and-walls/#sle.
   3. USG Corporation: www.usg.com/#sle.

B. Suspension Systems:
   1. Same as for acoustical units.

2.2 PERFORMANCE REQUIREMENTS

A. Surface Burning Characteristics: Class A in accordance with ASTM E84.

2.3 ACOUSTICAL UNITS

A. Acoustical Units - General: ASTM E1264, Class A.

B. Acoustical Panels: Painted mineral fiber, with the following characteristics:
   1. Classification: ASTM E1264 Type A.
      a. Form: A1.2, wet formed.
      b. Pattern: E - lightly textured.
   2. Size: 24 by 24 inches (610 by 1219 mm).
   3. Thickness: 5/8 inch (16 mm).
   4. Light Reflectance: 80 percent, determined in accordance with ASTM E1264.
   5. NRC Range: .55 to .65, determined in accordance with ASTM E1264.
   6. Panel Edge: Square.
   7. Color: White.
   8. Suspension System: Exposed grid.
   9. Products:

a. Armstrong World Industries, Inc; Cortega: www.armstrongceilings.com/#sle.
b. Design intent is to match existing. If existing product differs, notify Architect.

2.4 SUSPENSION SYSTEMS

A. Metal Suspension Systems - General: Complying with ASTM C635/C635M; die cut and interlocking components, with perimeter moldings, hold-down clips, stabilizer bars, clips, and splices as required.
   1. Materials:
      a. Steel Grid: ASTM A653/A653M, G30 coating, unless otherwise indicated.

B. Exposed Suspension System: Hot-dipped galvanized steel grid with steel cap.
   1. Structural Classification: Intermediate-duty, when tested in accordance with ASTM C635/C635M.
   2. Profile: Tee; 15/16 inch (24 mm) face width.
   3. Finish: Baked enamel.
   4. Color: White or as required to match existing.
   5. Products:
      a. Armstrong World Industries, Inc; Prelude XL: www.armstrongceilings.com/#sle.
      b. Certainteed Architectural; 15/16" EZ Stab Classic System: www.certainteed.com/ceilings-and-walls/#sle.
      c. USG Corporation; Donn Brand ZXLA 15/16 inch Acoustical Suspension System: www.usg.com/#sle.

2.5 ACCESSORIES

A. Support Channels and Hangers: Galvanized steel; size and type to suit application, seismic requirements, and ceiling system flatness requirement specified.

B. Hanger Wire: 12 gauge, 0.08 inch (2 mm) galvanized steel wire.

C. Perimeter Moldings: Same metal and finish as grid.
   1. Angle Molding: L-shaped, for mounting at same elevation as face of grid.

D. Touch-up Paint: Type and color to match acoustical and grid units.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that layout of hangers will not interfere with other work.

3.2 PREPARATION

A. Install after major above-ceiling work is complete.

B. Coordinate the location of hangers with other work.

3.3 INSTALLATION - SUSPENSION SYSTEM

A. Install suspension system in accordance with ASTM C636/C636M, ASTM E580/E580M, and manufacturer's instructions, as supplemented in this section.

B. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360.

C. Locate system on room axis according to reflected plan.

D. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions.
   1. Use longest practical lengths.
   2. Overlap and rivet corners.

E. Suspension System, Non-Seismic: Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.

F. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.

G. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.

H. Support fixture loads using supplementary hangers located within 6 inches (152 mm) of each corner, or support components independently.

I. Do not eccentrically load system or induce rotation of runners.

3.4 INSTALLATION - ACOUSTICAL UNITS

A. Install acoustical units in accordance with manufacturer's instructions.

B. Fit acoustical units in place, free from damaged edges or other defects detrimental to appearance and function.

C. Fit border trim neatly against abutting surfaces.

D. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.

E. Cutting Acoustical Units:
   1. Cut to fit irregular grid and perimeter edge trim.
   2. Make field cut edges of same profile as factory edges.

3.5 TOLERANCES

A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet (3 mm in 3 m).

B. Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.

3.6 CLEANING

A. Clean surfaces.

B. Replace damaged or abraded components.

++ END OF SECTION ++

SECTION 09680

TILE CARPETING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Carpet tile, fully adhered.

1.2 RELATED REQUIREMENTS

A. Section 03300 - Cast-in-Place Concrete: Restrictions on curing compounds for concrete slabs and floors to receive adhesive-applied flooring.

B. Section 09050 - Common Work Results for Flooring Preparation: Removal of existing floor coverings, cleaning, and preparation.

C. Section 09050 - Common Work Results for Flooring Preparation: Concrete slab moisture and alkalinity testing and remediation procedures.

1.3 SUBMITTALS

A. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns, colors available, and method of installation.

B. Samples: Submit two carpet tiles illustrating color and pattern design for each carpet color selected.

C. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. Extra Carpet Tiles: Quantity equal to 5 percent of total installed of each color and pattern installed.

1.4 FIELD CONDITIONS

A. Store materials in area of installation for minimum period of 24 hours prior to installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Tile Carpeting:
   1. J + J Flooring: www.jjflooring.com.

2.2 MATERIALS

A. Tile Carpeting: Fusion bonded, manufactured in one color dye lot.
   1. Product: Urban Avenue 1843 Modular manufactured by J + J Flooring.
   2. Tile Size: 24 by 24 inch (600 by 600 mm), nominal.
   3. Thickness: 0.205 inch (5 mm).
   4. Color: As selected .
   5. Maximum Electrostatic Charge: 3 Kv. at 20 percent relative humidity.
   6. Light Fastness: 4.0 min.
   7. Primary Backing Material: polyester felt cushion.
   8. Total Weight: 40.5 - 46.8 oz/sq yd (1373 - 1586 g/sq m).

2.3 ACCESSORIES

A. Subfloor Filler: White premix latex; type recommended by flooring material manufacturer.

B. Base Cap: aluminum channel type, clear anodized finish, color as selected by Architect.

C. Edge Strips: Embossed aluminum, color as selected by Architect.

D. Adhesives:
   1. Compatible with materials being adhered; maximum VOC content to comply with County requirements.

E. Carpet Tile Adhesive: Recommended by carpet tile manufacturer; releasable type.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that subfloor surfaces are smooth and flat within tolerances specified for that type of work and are ready to receive carpet tile.

B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive carpet tile.

C. Verify that subfloor surfaces are dust-free and free of substances that could impair bonding of adhesive materials to subfloor surfaces.

D. Cementitious Subfloor Surfaces: Verify that substrates are ready for flooring installation by testing for moisture and alkalinity (pH).
   1. Obtain instructions if test results are not within limits recommended by flooring material manufacturer and adhesive materials manufacturer.

2. Follow moisture and alkalinity remediation procedures in Section 09050, Common Work Results for Flooring Preparation.

3.2 PREPARATION

A. Prepare floor substrates for installation of flooring in accordance with Section 09050, Common Work Results for Flooring Preparation.

3.3 INSTALLATION

A. Starting installation constitutes acceptance of subfloor conditions.

B. Install carpet tile in accordance with manufacturer's instructions.

C. Blend carpet from different cartons to ensure minimal variation in color match.

D. Cut carpet tile clean. Fit carpet tight to intersection with vertical surfaces without gaps.

E. Lay carpet tile in square pattern, with pile direction alternating to next unit, set parallel to building lines.

F. Fully adhere carpet tile to substrate.

G. Adhere carpet tile as base finish up vertical surfaces to form base. Terminate top of base with cap strip.

H. Trim carpet tile neatly at walls and around interruptions.

I. Complete installation of edge strips, concealing exposed edges.

3.4 CLEANING

A. Remove excess adhesive without damage, from floor, base, and wall surfaces.

B. Clean and vacuum carpet surfaces.

++ END OF SECTION ++

SECTION 09900

PAINTING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes surface preparation and field painting of the following:
   1. Exposed exterior items and surfaces.
   2. Exposed interior items and surfaces.
   3. Surface preparation, priming, and finish coats specified in this Section are in addition to shop priming and surface treatment specified in other Sections.

B. This Section does NOT cover architectural painting systems. For architectural painting system, refer to Specification Section 09900.1, Interior Painting.

C. Paint exposed surfaces, except where the paint schedules indicate that a surface or material is not to be painted or is to remain natural. If the paint schedules do not specifically mention an item or a surface, paint the item or surface the same as similar adjacent materials or surfaces, whether or not schedules indicate colors. If the schedules do not indicate color or finish that is mentioned, the ENGINEER will select from standard colors and finishes available.
   1. Painting includes field painting of exposed bare and covered pipes and ducts (including color coding), hangers, exposed steel and iron work, and primed metal surfaces of mechanical and electrical equipment.

D. Unless indicated otherwise, do not paint prefinished items, concealed surfaces, finished metal surfaces, operating parts, and labels.
   1. Prefinished items include, but are not limited to, the following factory-finished components:
      a. Architectural woodwork and casework.
      b. Motor nameplates.
      c. Instrumentation and electrical mounting hardware such as nuts, bolts, screws, U-bolts, handles, latches, and hinges.
      d. Analyzers, probes, nuts, bolts, and screws or any mounting hardware.
      e. Metal toilet enclosures.
      f. Acoustical ceiling panels.
      g. Metal lockers.
      h. Ceramic tile, windows, glass, resilient flooring; other architectural features, such as "finish" hardware, furnished in aluminum, bronze or plated ferrous metal, prefinished panels, or other items installed prefinished.
      i. Finished mechanical and electrical equipment, except as indicated in the Specifications or on the Plans.
      j. Light fixtures.

k. Interior distribution cabinets and switch gear, except as indicated.

2. Concealed surfaces include walls or ceilings in the following generally inaccessible spaces:
   a. Foundation spaces, unless noted otherwise.
   b. Surfaces behind furred areas.
   c. Ceiling plenums.
   d. Utility tunnels.
   e. Pipe spaces.
   f. Duct shafts.
3. Finished metal surfaces include the following:
   a. Stainless steel or chromium plated items.
   b. Chromium plate.
   c. Copper.
   d. Bronze and brass.
   e. Buried cast and ductile iron pipe encased with a protective polyethylene sleeve.
   f. Anodized aluminum, aluminum gratings, and floor plates.
      1) Paint aluminum surfaces in contact with concrete, grout, masonry, wood, or dissimilar materials as described below:
         a) Surface must be clean, dry, and free of oil, grease, and other contaminants. Surface preparation with SSPC-SP7 brush-off abrasive blast cleaning. Apply two coats of Tnemec Series 20 Pota-Pox or approved equal; each coat shall be 3-5 mils. Coating must be NSF 61 approved.
   g. Prefinished louvers, except those in doors, unless otherwise noted and acoustical ceiling panels.
4. Operating parts include moving parts of operating equipment and the following:
   a. Valve and damper operators or handles.
   b. Linkages.
   c. Sensing devices.
   d. Motor and fan shafts.
5. Labels: Do not paint over Underwriters Laboratories (UL), Factory Mutual (FM), fire rating labels, equipment serial number and capacity labels, or other code-required labels or equipment name, identification, performance rating, nomenclature plates, and equipment identification plates.

1.2 RELATED SECTIONS

A. Division 1, General Requirements, Specification Sections, apply to this Section.

1.3 SECTION INCLUDES

A. Surface preparation.

B. Field application of paints and other coatings.

C. Pipe identification markers.

D. Surfaces to Be Finished are provided in the schedule at end of Section and in the Contract Documents.

1.4 REFERENCES

A. ANSI A13.1, Scheme for the Identification of Piping Systems; 1981 (revised 1993).

B. ASTM D16, Standard Terminology Relating to Paint, Varnish, Lacquer, and Related Products; 1995.

C. OSHA 1910.144, Code of Federal Regulations (CFR) Title 29.

D. SSPC (PM2), Steel Structures Painting Manual, Vol. 2, Systems and Specifications; Steel Structures Painting Council; 1995.

1.5 DEFINITIONS

A. General: Standard coating terms defined in ASTM D16 apply to this Section.
   1. "Flat" refers to a lusterless or matte finish with a gloss range below 15 when measured at an 85 degree meter.
   2. "Eggshell" refers to low-sheen finish with a gloss range between 5 and 20 when measured at a 60-degree meter.
   3. "Satin" refers to low-sheen finish with a gloss range between 15 and 35 when measured at a 60 degree meter.
   4. "Semi-gloss" refers to medium-sheen finish with a gloss range between 30 and 65 when measured at a 60 degree
   5. meter.
   6. "Full gloss" refers to high-sheen finish with a gloss range more than 65 when measured at a 60 degree meter.
   7. "Buried" refers to covered with earth.
   8. "Exposed" or "exposed surfaces" refers to areas visible when permanent or built-in fixtures, grilles, and similar components are in place. Extend coatings in these areas, as required, to maintain the system integrity and provide desired protection.
   9. "Submerged" refers to materials which are permanently or intermittently below the maximum water or liquid surface elevation in open top structures, unless otherwise noted or otherwise shown; materials within liquid or residual solids carrying structures that are covered, including materials on the underside of the covers, whether in contact with liquids or not, unless otherwise noted or otherwise shown; materials within an enclosed process structure, whether in contact with liquids or not.

1.6 SUBMITTALS

A. See Section 01300, Submittals, for submittal procedures.

B. Product Data: For each paint system specified. Include block fillers and primers.
   1. Material List: Provide an inclusive list of required coating materials. Indicate each material and cross-reference specific coating, finish system, and application. Identify each material by manufacturer's catalog number and general classification.
   2. Manufacturer's Information: Provide manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each coating material proposed for use.
      a. Identify manufacturer's recommended, published spreading rate, and dry film thickness of each coating material proposed for use.
      b. Indicate manufacturer's instructions on surface and special surface preparation procedures.
      c. Include the following: Mixing instructions, shelf life, method of application, recommended number of coats, drying time of each coat including prime coat, required prime coat, compatible and non-compatible prime coats, and recommended thinners when required.

C. Pipe Identification Markers: Submit product data and marker sample for each type of pipe identification required.

D. Maintenance Data: Submit data on cleaning, touch-up, and repair of painted and coated surfaces.

E. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors available for each type of finish-coat material indicated. Submit two paper chip samples, 3-inch by 3-inch in size.

F. Before supplying any material to the site, the painting subcontractor and the paint manufacturer's area representative shall prepare a complete schedule showing the materials proposed to be used for each treatment specified, and submit same to ARCHITECT and ENGINEER for review/approval.

G. Paint colors will be specified by the ARCHITECT for the architectural paint system specified herein, who, before any Work is done, will furnish color chips and schedule showing where the various colors shall go.

H. Qualification Data: For firms and persons specified in Paragraph 1.9 to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of Engineers or Architects and Owners, and other information specified.

I. Manufacturer's Certification: Submit in accordance with Paragraph 3.8 at the completion of the Work.

J. Shop Drawings: Submit for approval the following:

1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
2. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**

1.7 REGULATORY REQUIREMENTS

A. Conform to applicable code for flame and smoke rating and VOC requirements for products and finishes.

B. Lead, heavy metals, cadmium, and chromate content of painting materials shall not exceed amount permitted by Federal, State, and local authorities.

C. Coatings for surfaces in contact with potable water or water being treated for potable use shall not impart any taste or odor to the water or result in any organic or inorganic content in excess of the maximum contaminant level established by applicable laws or regulations.

D. Comply with governing code requirements for air quality and material disposal regulations.

1.8 MOCK-UP

A. Provide stepped-down job mock-ups for all painting and coating systems showing all components of the preparation and installation before any Work shall commence. Verify all dry film thicknesses, surface preparations, and methods of installation in addition to color and texture of the finished work.

B. Provide mock-ups for each of the following substrates, illustrating painting and coating colors and finishes:
   1. Ferrous Metal: Provide panel equal to 4 square feet in size for each color and finish.
   2. Provide door and frame assembly for each paint coating color and finish.

C. Locate where directed by ENGINEER.

D. Mock-up(s) may remain as part of the Work.

E. Work advanced without approved job mock-ups shall be completely removed and re-installed without additional compensation to the OWNER.

1.9 QUALITY ASSURANCE

A. Applicator Qualifications: Engage an experienced applicator who has completed painting system applications similar in material and extent to that indicated for this Project with a record of successful in-service performance.

B. Source Limitations: Obtain block fillers, primers, and undercoat materials for each coating system from the same manufacturer as the finish coats.

C. Products shall be of best grade or first line.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to the Project site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label, and the following information:
   1. Product name or title of material.
   2. Product description (generic classification or binder type).
   3. Manufacturer's stock number, lot number, brand code, and date of manufacture.
   4. Contents by volume for pigment and vehicle constituents.
   5. Thinning instructions.
   6. Application instructions.
   7. Coverage and surface preparation.
   8. Drying time.
   9. Cleanup requirements.
   10. Instructions for mixing and reducing.
   11. Color name and number.
   12. Material Safety Data Sheets.

B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45º F (7º C). Maintain containers used in storage in a clean condition, free of foreign materials and residue.

1. Protect from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily. Take necessary measures to ensure that workers and work areas are protected from fire and health hazards resulting from handling, mixing, and application.
2. Provide fire extinguishers and post caution signs warning against smoking and open flame when working with flammable materials.

C. Protect work of other trades, whether being painted or not, against damage by painting. Correct damage by cleaning, repairing, or replacing and repainting, as approved by the ENGINEER. Provide "Wet Paint" signs to protect newly painted finishes. Remove temporary protective wrappings provided by others to protect their work after completing painting operations.

1.11 PROJECT CONDITIONS

A. Apply water-based paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 50º F and 120º F (10º C and 48.9º C).

B. Apply solvent-thinned paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 45º F and 120º F (7.2º C and 48.9º C).

C. Provide lighting level of 80 foot candles measured mid-height at substrate surface.

D. Do not apply paint in snow, rain, fog, or mist; or when the relative humidity exceeds 85%; or at temperatures less than 5º F (3º C) above the dew point; or to damp or wet surfaces.
1. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by manufacturer during application and drying periods.

1.12 UNUSED MATERIALS

A. Furnish unused materials in unopened or opened and resealed containers for storage and identify with labels describing contents. Deliver materials to the OWNER.

1.13 EXTRA MATERIALS

A. Supply one gallon of each color; store where directed.

B. Label each container with color in addition to the manufacturer's label.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products listed in the paint schedules.

B. Manufacturers Names: The following manufacturers are referred to in the paint schedules by use of shortened versions of their names, which are shown in parentheses:
   1. Benjamin Moore & Co. (Moore).
   2. PPG Industries, Inc. (PPG).
   3. Tnemec Co. (Tnemec).
   4. Frazee Paint.
   5. Ameron.
   6. Valspar.

2.2 PAINT MATERIALS, GENERAL

A. Paint exposed surfaces, except as indicated in Paragraph 1.4 and/or in Drawings/Specifications. If an item or surface is not specifically mentioned, paint the item or surface the same as similar adjacent materials of surfaces whether or not the schedule indicates color(s). If the schedule does not indicate color(s) or finish(es), the ENGINEER will select from standard colors and finishes available.

B. Equipment supplied with a finished coat by the manufacturers shall be touched-up by the CONTRACTOR.

C. Paints and Coatings: Ready mixed, except field-catalyzed coatings. Prepare pigments:
   1. To a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating.
   2. For good flow and brushing properties.
   3. Capable of drying or curing free of streaks or sags.

D. Metals encased in concrete shall only receive a primer compatible with the covering material.

E. All items under and around the metal canopies shall be considered exterior and painted with materials conforming to those specified in this Specification.

F. Material Compatibility: Provide block fillers, primers, undercoats, and finish coat materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.

G. Material Quality: Provide manufacturer's best-quality paint material of the various coating types specified. Paint-material containers not displaying manufacturer's product identification will not be acceptable.
   1. Proprietary Names: Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Furnish manufacturer's material data and certificates of performance for proposed substitutions.

H. Color Coding: Unless otherwise specified, all color coding of piping, ducts, and equipment shall comply with applicable standards of the following:
   1. ANSI A13.1.
   2. OSHA 1910.144.

I. At completion of construction activities of other trades, touch-up and restore damaged or defaced painted surfaces.

J. Architectural Color Schedule: Colors indicated are by Tnemec Company, Inc.: www.tnemec.com.
   1. Shading Devices: Match existing colors at existing Administration Building located on site.
   2. Exterior Hollow Metal Doors and Frames: Match existing colors at existing Administration Building located on site.
   3. Exposed CMU, Interior: 11WH White.
   4. Interior Hollow Metal Doors and Frames: 33GR Grey.
   5. Exposed Gypsum Board, Interior: 07WH Winter Mist.

K. Colors: All colors as selected by ENGINEER from manufacturer's standards except as follows:
   1. Color of safety stripe at bollards match PPG 6-330 Safety Yellow.

2.3 PAINT SYSTEMS - INTERIOR AND EXTERIOR

A. Field Primed Steel and Ferrous Metal:
   1. Exterior Exposure, Hot Air Carbon Steel Pipe:
      a. Surface Preparation: SSPC-SP6/NACE 3 Commercial Blast Cleaning with a minimum angular anchor profile of 1.5 mils.
      b. Prime Coat: Prime Coat: Series 69-1255 (beige) H.B. Epoxoline II; one coat; 4-6 mils DFT (dry film thickness).
      c. Finish Coat: Series 75 Endura-Shield II; one coat; 3-5 mils DFT.
   2. Exterior Exposure:
      a. Surface Preparation: SSPC SP6 Commercial Abrasive Blast Cleaning.
      b. Prime Coat: Series 69-1255 (beige) H.B. Epoxoline II; one coat; 4-6 mils DFT (dry film thickness).
      c. Finish Coat: Series 73 Endura-Shield; one coat; 3-4 mils DFT.
   3. Interior Exposure:
      a. Surface Preparation: SSPC SP6 Commercial Abrasive Blast Cleaning.

b. Prime Coat: Series 69-1255 (beige) H.B. Epoxoline II; one coat; 3-5 mils DFT.
c. Finish Coat: Series 69 H.B. Epoxoline; one coat; 4-6 mils DFT.

4. Immersion or Partial Immersion Exposure:
   a. Surface Preparation: SSPC SP10 Near-White Metal Abrasive Blast Cleaning.
   b. Prime Coat: Series 66 H.B. Epoxoline; one coat; 4-6 mils DFT.
   c. Finish Coat: Series 69 H.B. Epoxoline II; one coat; 4-6 mils DFT.

B. Shop and Factory Primed Steel:
1. Exterior Exposure:
   a. Field Prime Coat (over factory prime coat): Series 135 (beige) Chembuild; one coat; 3-4 mils DFT.
   b. Finish Coat: Series 73 Endura-Shield; one coat; 3-4 mils DFT.
2. Interior Exposure:
   a. Field Prime Coat (over factory prime coat): Series 135 (beige) Chembuild; one coat; 3-4 mils DFT.
   b. Finish Coat: Series 69 H.B. Epoxoline; one coat; 4-6 mils DFT.
3. Immersion or Partial Immersion Exposure:
   a. Surface Preparation: Brush off abrasive blast cleaning if required for recoat of the shop primer. Coating surface to be clean, dry, and free of contaminants prior to application of the field coats.
   b. Prime Coat: Series 66 H.B. Epoxoline; one coat; 2.5-3 mils DFT.
   c. Finish Coat: Series 69 H.B. Epoxoline II; one coat; 4-6 mils DFT.

C. Galvanized Steel and Non-Ferrous Metals:
1. Exterior Exposure:
   a. Surface Preparation: Brush-off abrasive blast cleaning.
   b. Prime Coat: Series 69-1255 (beige) H.B. Epoxoline II; one coat; 3-4 mils DFT.
   c. Finish Coat: Series 73 Endure-Shield; one coat; 3-4 mils DFT.
2. Interior Exposure:
   a. Surface Preparation: Clean, dry and free of contaminants.
   b. Prime Coat: Series 135 (beige) Chembuild; one coat; 3-4 mils.
   c. Finish Coat: Series 69 H.B. Epoxoline II; one coat; 4-6 mils DFT.
3. Immersion or Partial Immersion Exposure:
   a. Surface Preparation: Brush-off abrasive blast cleaning.
   b. Prime Coat: Series 66 H.B. Epoxoline; one coat; 4-6 mils DFT.
   c. Finish Coat: Series 69 H.B. Epoxoline II; one coat; 4-6 mils DFT.

D. Ductile and Cast Iron:
1. Exterior Exposure:
   a. Surface Preparation: Solvent scrub with stiff bristle brush, followed by brush-off abrasive blast cleaning to a minimum surface profile depth of 1.5 mils DFT.

b. Prime Coat: Series 69-1255 (beige) H.B. Epoxoline II; one coat; 3-5 mils DFT.
c. Finish Coat: Series 73 Endura-Shield; one coat; 3-4 mils DFT.

2. Interior Exposure:
   a. Surface Preparation: Clean, dry, and free of contaminants.
   b. Prime Coat: Series 135 Chembuild; one coat; 4-6 mils DFT.
   c. Finish Coat: Series 69 H.B. Epoxoline II; one coat; 4-6 mils DFT.
3. Buried:
   a. Surface Preparation: Solvent scrub with stiff bristle brush followed by brush-off abrasive blast cleaning to a minimum surface profile depth of 1.5 mils DFT.
   b. Prime Coat: Series 69-1255 (beige) H.B. Epoxoline II; one coat; 3-5 mils DFT.
   c. Finish Coat: Series 69 H.B. Epoxoline II; one coat; 4-6 mils DFT.
4. Immersion:
   a. Surface Preparation: Solvent scrub with stiff bristle brush, followed by brush-off abrasive blast cleaning to a minimum surface profile depth of 1.5 mils.
   b. Prime Coat: Series 66 H.B. Epoxoline; one coat; 4-6 mils DFT.
   c. Finish Coat: Series 69 H.B. Epoxoline II; one coat; 4-6 mils DFT.

E. PVC:
1. Exterior Exposure:
   a. Surface Preparation: Clean, dry, and free of contaminants.
   b. Prime Coat: Series 66 H.B. Epoxoline; one coat; 3-5 mils DFT.
   c. Finish Coat: Series 73 Endure-Shield; one coat; 3-4 mils DFT.
2. Interior Exposure:
   a. Surface Preparation: Clean, dry, and free of contaminants.
   b. Finish Coat: Series 66 H.B. Epoxoline; two coats; 3-5 mils DFT per coat.

F. Wood (Except Preservative-Treated Wood):
1. Interior and Exterior Exposure:
   a. Surface Preparation: Clean, dry, and free of contaminants.
   b. Prime Coat: Series 36 Undercoater; one coat; 2-3.5 mils DFT.
   c. Finish Coat: Series 23 Enduratone; two coats; 1.5-3.5 mils DFT per coat.

2.4 PIPE IDENTIFICATION MARKERS

A. Manufacturers: Provide products by one of the following:
1. Seton Name Plate Company.
2. W.H. Brady Company.
3. Or equal.

B. General: The size of lettering and marker shall conform to ANSI A13.1.

C. Provide brass tags for pipes under 3/4-inch outside diameter. Provide plastic pipe markers for pipes over 3/4-inch.

D. Plastic Pipe Markers: Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.
   1. Markers for piping up to 6-inch diameter shall be preformed to completely wrap around the pipe requiring no adhesive. Markers for pipes over 6-inch diameter shall be preformed to the contour of the pipe and attached with stainless steel spring fasteners.

E. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2-inch diameter with smooth edges.

PART 3 - EXECUTION

3.1 INSPECTION

A. Inspect substrates, areas, and conditions, with the applicator present, under which painting will be performed for compliance with paint application requirements. Verify that surfaces are ready to receive work as instructed by the product manufacturer.
   1. Do not begin to apply paint until unsatisfactory conditions have been corrected and surfaces receiving paint are thoroughly dry.
   2. Start of painting will be construed as the applicator's acceptance of surfaces and conditions within a particular area.

B. Coordination of Work: Review other Sections in which primers are provided to ensure compatibility of the total system for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.
   1. Notify the ENGINEER about anticipated problems using the materials specified over substrates primed by others.

3.2 PREPARATION

A. Perform all preparation and cleaning procedures as specified herein and in strict accordance with the paint manufacturer's instructions for each particular substrate and atmospheric condition.

B. Clean surfaces to be painted before applying paint or surface treatments. Remove oil and grease with clean cloths and cleaning solvents prior to mechanical cleaning. Program the cleaning and painting so that dust and other contaminants from the cleaning process will not fall in wet, newly painted surfaces.

C. Furnish sufficient drop cloths, shields, and protective equipment to prevent spray or droppings from fouling surfaces not being painted and, in particular, surfaces within storage and preparation area.

D. Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted. If removal is impractical or impossible because of the size or weight of the item, provide surface-applied protection before surface preparation and painting.
   1. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved.

E. Surfaces: Correct defects and clean surfaces which affect Work of this Section. Remove or repair existing coatings that exhibit surface defects.

F. Marks: Seal marks which may bleed through surface finishes with barrier coat compatible with paint.

G. Impervious Surfaces: Remove mildew in accordance with paint manufacturer's recommendations.

H. Cleaning: Before applying paint or other surface treatments, clean the substrates of substances that could impair the bond of the various coatings. Remove oil and grease before cleaning.
   1. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.

I. Surface Preparation: Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition and as specified.
   1. Provide barrier coats over incompatible primers or remove and reprime.
   2. Cementitious Materials: Prepare concrete, concrete masonry block, cement plaster, and mineral fiber-reinforced cement panel surfaces to be painted. Remove stains, loose mortar, scale, salt, efflorescence, chalk, dust, dirt, grease, oils, release agents, and other foreign matter in accordance with paint manufacturers' recommendations. Do not use wire brushes for preparation or cleaning. Roughen as required to remove glaze. If hardeners or sealers have been used to improve curing, use mechanical methods of surface preparation.
      a. Use abrasive blast cleaning methods if recommended by paint manufacturer.
      b. Determine alkalinity and moisture content of surfaces by performing appropriate tests. If surfaces are sufficiently alkaline to cause the finish paint to blister and burn, correct this condition before application. Do not paint surfaces where moisture content exceeds that permitted in manufacturer's written instructions.
      c. Clean concrete floors to be painted with a 5% solution of muriatic acid or other etching cleaner. Flush the floor with clean water to remove

acid, neutralize with ammonia, rinse, allow to dry, and vacuum before painting.

3. Wood: Clean surfaces of dirt, oil, and other foreign substances with scrapers, mineral spirits, and sandpaper, as required. Sand surfaces exposed-to-view smooth and dust off.
   a. Scrape and clean small, dry, seasoned knots, and apply a thin coat of white shellac or other recommended knot sealer before applying primer. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood filler. Sand smooth when dried.
   b. Seal pitch streaks and sappy sections with sealer. Seal cracks, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks with caulking compound after prime coat has been applied; sand between coats. Back prime concealed surfaces before installation.
   c. Prime, stain, or seal wood to be painted immediately on delivery. Prime edges, ends, faces, undersides, and backsides of wood, including cabinets, counters, cases, and paneling.
   d. When transparent finish is required, back prime with spar varnish.
   e. Seal tops, bottoms, and cutouts of unprimed wood doors with a heavy coat of varnish or sealer immediately on delivery.
4. Gypsum Board Surfaces to Be Painted: Fill minor defects with filler compound. Spot prime defects after repair.
5. Zinc Coated Surfaces: Remove surface contamination and oils and prepare for priming in accordance with metal manufacturer's recommendations.
6. Plaster Surfaces to Be Painted: Allow new plaster surfaces to cure 28 days. Remove grease, dirt, loose mortar, scale or alkali powder, high alkali surfaces, and other foreign matter in accordance with paint manufacturer's recommendation. Fill hairline cracks, small holes, and imperfections with patching plaster that is compatible with paint. Make smooth and flush with adjacent surfaces. Do not use wire brushes for preparation or cleaning.
7. Aluminum: Remove surface contamination by steam or high pressure water. Remove oxidation with acid etch and solvent washing.
8. Copper: Remove surface contamination by steam or high pressure water.
9. Ferrous Metals: Clean and remove oil, grease, dirt, loose mill scale, and other foreign substances from ungalvanized ferrous metal surfaces that have not been shop coated as outlined in Paragraph 2.3. Use solvent or mechanical cleaning methods that comply with the Steel Structures Painting Council's (SSPC) recommendations.
   a. Blast steel surfaces clean, as recommended by paint system manufacturer.
   b. Touch-up bare areas and shop applied prime coats that have been damaged. Wire brush, clean with solvents recommended by paint manufacturer, and touch-up with the same primer as the shop coat.
   c. For shop-primed ferrous metal surfaces, clean and prepare in accordance with manufacturer's recommendations. Feather edges to make touch-up patches inconspicuous. Prime bare steel surfaces. Provide barrier coat over entire shop primed items.

10. Galvanized Surfaces: Clean galvanized surfaces with nonpetroleum-based solvents so surface is free of oil and surface contaminants. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods.
11. Ductile Iron Pipe: All new ductile iron pipe (DIP) intended for immersion service shall be prepared per coating manufacturer's specifications and as specified herein.
    a. Remove grease, rust scale, rust and touch-up any chipped or abraded areas on items that have been shop coated. Items intended for immersion service that have not been shop coated shall be sandblasted to "Near White Blast Cleaning" condition per SSPC SP-10 prior to receiving coating.
    b. All new DIP intended for non-immersion service shall be sandblasted to "Commercial Blast Cleaning" condition per SSPC SP-6 prior to receiving coating.

J. Materials Preparation: Mix and prepare paint materials according to manufacturer's written instructions.
1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.
2. Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.
3. Use only thinners approved by paint manufacturer and only within recommended limits.

K. Tinting: Tint each undercoat a lighter shade to simplify identification of each coat when multiple coats of the same material are applied. Tint undercoats to match the color of the finish coat, but provide sufficient differences in shade of undercoats to distinguish each separate coat.

3.3 APPLICATION

A. General: Apply paint according to manufacturer's written instructions. Use applicators and techniques best suited for substrate and type of material being applied.
1. Any spot measurement found below the required minimum dry film thickness shall be repainted by the CONTRACTOR in accordance with the manufacturer's instructions, at no additional cost to the OWNER.
2. Do not apply finishes on surfaces that are not sufficiently dry. Allow each coat of finish to dry before following coat is applied, unless directed otherwise by the manufacturer.
3. Where adjacent sealant is to be painted, do not apply finish coats until sealant is applied.
4. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.

5. Install piping identification markers after painting has been completed according to the color coding schedule indicated.
6. Paint colors, surface treatments, and finishes are indicated in the schedules located at the end of this Section.
7. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.
8. Provide finish coats that are compatible with primers used.
9. Finish edges, tops and bottoms of all doors the same as door faces. Both sides and all edges of doors to be finished simultaneously.
10. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, convector covers, covers for finned-tube radiation, grilles, and similar components are in place. Extend coatings in these areas, as required, to maintain the system integrity and provide desired protection.
11. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before the final installation of movable equipment, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
12. Paint interior surfaces of ducts with a flat, nonspecular black paint where visible through registers or grilles.
13. Finish exterior doors on tops, bottoms, and side edges the same as exterior faces.
14. Finish interior of wall and base cabinets and similar field-finished casework to match exterior.
15. Sand lightly between each succeeding enamel or varnish coat.

B. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pre-treated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.
   1. The number of coats required are the same regardless of application method. Do not apply succeeding coats until the previous coat has cured, as recommended by the manufacturer. If sanding is required to produce a smooth, even surface according to manufacturer's written instructions, sand between applications.
      a. Apply each coat in film thicknesses as recommended by the manufacturer.
   2. Unless recommended by the manufacturer, omit primer on factory finished metal surfaces indicated to be field painted or metal surfaces that have been shop primed and touch-up painted.
   3. If undercoats, stains, or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance. Give special attention to ensure edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.
   4. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until paint has dried to where it feels firm, does not

deform or feel sticky under moderate thumb pressure, and where application of another coat of paint does not cause the undercoat to lift or lose adhesion.

C. Application Procedures: Apply paints and coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions.
   1. Brushes: Use brushes best suited for the type of material applied. Use brush of appropriate size for the surface or item being painted.
   2. Rollers: Use rollers of carpet, velvet back, or high-pile sheep's wool, as recommended by the manufacturer for the material and texture required.
   3. Spray Equipment: Use airless spray equipment with orifice size and pressure, as recommended by the manufacturer for the material and texture required.

D. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate. Provide the total dry film thickness of each coat and of the entire system as recommended by the manufacturer.

3.4 FINISHING MECHANICAL AND ELECTRICAL EQUIPMENT

A. Electrical and mechanical items to be painted include the following, whether factory prefinished or not, with color selected by the ENGINEER:
   1. Exterior mechanical and electrical equipment and accessories including, but not limited to, the following:
      a. Electrical and instrument panels, motor control centers, and switch gear.
      b. Electrical conduit and accessories.
      c. Transformers.
      d. Brackets.
      e. Meter enclosures.
      f. Conduit.
      g. Components that are visible or exposed to the weather.
      h. Exhaust fans and blowers.
   2. Exterior roof mounted mechanical and electrical equipment, any component of which is above adjacent parapets, including but not limited to, the following:
      a. Roof mounted HVAC units.
      b. Exhaust stacks, blowers, vents, etc.
      c. Miscellaneous steel support components for mechanical equipment screens.

B. Paint interior factory finished mechanical and electrical components selected by the ENGINEER from the manufacturer's standards, including, but not limited to, the following:
   1. Piping (per color code and schedule), pipe hangers, and supports.
   2. Duct work.

3. Duct throats behind grilles, registers, louvers, baffles, etc., shall be given one coat of flat acrylic latex (copolymer) black paint wherever visibility of the interior of the duct is allowed.
4. Switchboards.
5. Disconnect switches.
6. Pumps, motors, and mechanical equipment.
7. Gear reducers.
8. Accessory items.
9. Conduit and fittings (per color code and schedule).
10. Switchgear.
11. Panelboards.

C. Block Fillers: Apply block fillers to concrete masonry block at a rate to ensure complete coverage with pores filled.

D. Prime Coats: Before applying finish coats, apply a prime coat of material, as recommended by the manufacturer, to material that is required to be painted or finished and that has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn through or other defects due to insufficient sealing.

E. Pigmented (Opaque) Finishes: Completely cover surfaces as necessary to provide a smooth, opaque surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.

F. Transparent (Clear) Finishes: Use multiple coats to produce a glass smooth surface film of even luster. Provide a finish free of laps, runs, cloudiness, color irregularity, brush marks, orange peel, nail holes, or other surface imperfections.

G. Provide satin finish for final coats.

H. Stipple Enamel Finish: Roll and redistribute paint to an even and fine texture. Leave no evidence of rolling, such as laps, irregularity in texture, skid marks, or other surface imperfections.

I. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.

J. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

K. Paint both sides and edges of plywood backboards for electrical equipment before installing backboards and mounting equipment on them.

L. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with requirements.

3.5 FINISHING PROCESS EQUIPMENT AND FACILITIES

A. The following process equipment and facilities shall be painted according to this Specification, including, but not limited to, the following:
   1. Headworks Building: Paint control panels, disconnects, transmitters, all new above ground, buried, and immersed piping and fittings, all new valves, pipe supports, exposed ductwork, interior CMU walls, gypsum board walls and ceilings, ladders, hallow metal doors and frames, etc.
   2. Headworks odor control scrubber: Paint all new above ground, buried, and immersed piping and fittings, all new valves, and pipe supports, etc.
   3. Chemical storage and containment area: Paint new above ground, buried and immersed piping and fittings, all new valves and pipe supports, chemical metering pumps and appurtenances, etc.

3.6 CLEANING

A. Cleanup: At the end of each workday, remove empty cans, rags, rubbish, and other discarded paint materials from the site.
   1. After completing painting, clean glass and paint-spattered surfaces. Remove spattered paint by washing and scraping. Be careful not to scratch or damage adjacent finished surfaces.

3.7 PROTECTION

A. Protect work of other trades, whether being painted or not, against damage by painting. Correct damage by cleaning, repairing, or replacing and repainting, as approved by ENGINEER.

B. Provide "Wet Paint" signs to protect newly painted finishes. Remove temporary protective wrappings provided by others to protect their work after completing painting operations.
   1. At completion of construction activities of other trades, touch-up and restore damaged or defaced painted surfaces. Comply with procedures specified in PDCA P1.

3.8 FIELD QUALITY CONTROL

A. CONTRACTOR shall provide a written report from the manufacturer certifying that paint has been applied in accordance with the manufacturer's requirements

B. Provide ENGINEER with suitable testing materials in order for ENGINEER to carry out alkalinity and moisture tests prior to preparation and application.

C. Provide ENGINEER with the following testing equipment, accurately calibrated, for use by the ENGINEER prior to surface preparation and application.
   1. Tinker and Rasor Model M-1, K-D "Bird Dog", or equal, holiday detector, complete with necessary accessories.
   2. Microtest, Elcometer, or equal, magnetic dry film thickness gauge.
   3. Wet mil paint gauge for use during application.

D. The ENGINEER reserves the right to test surfaces, film thicknesses, and paint products at any time and as often as the ENGINEER deems necessary during the period when paint is being applied.
   1. Any spot measurement found below the required minimum dry film thickness shall be repainted by the CONTRACTOR in accordance with the manufacturer's instructions, at no additional cost to the OWNER.
   2. Do not paint unsatisfactory surfaces until they have been corrected and are in accordance with paint manufacturer's recommendations.

3.9 PIPE COLOR CODING AND IDENTIFICATION SCHEDULE

A. Install plastic pipe markers in accordance with manufacturer's instructions.

B. Install tags with corrosion resistance chain.

C. Locate identification markers and tags at the following locations:
   1. At each branch and riser takeoff.
      a. At each pipe passage through a wall, floor, or ceiling.
      b. On each horizontal and vertical pipe run at 25 foot intervals.

D. Exposed, non-submerged, interior piping shall be color coded and provided with identification markers as follows, unless directed otherwise by the ENGINEER.

Pipe Service	Color of Pipe	Color of Label Background	Color of Label Letters
Air Piping:	John Deere Green 364C (AWRF)	N/A	Black 35GR (AWRF)
Water Lines: Water - Potable Water - Non-Potable	 Clear Sky 26BL Pantone 512 (AWRF) Pantone 512 (OWRF)	 N/A	 Black 35GR Black 35GR (AWRF) White 00WH (OWRF)
Exposed Electrical Conduits: 120 V / 480 V / 4,160 V (no label)	 N/A	 N/A	 None
Fire Quenching Materials: Water, Foam, CO2, Halon, Fire Hydrants, including sections of potable water for Fire Dept. access (no label)	Candy Apple Red/Safety Red 06SFA	N/A	None
HVAC Duct Work:	Determined by Architect	N/A	None
Sample Lines Piping:	Match Flow Designation	N/A	Black 35GR
Piping: IMLR Return Activated Sludge Odor Control Piping Backwash Washwater Tank Drain / Sump Drain	 Desert Sands 04BR (OWRF) Mesquite 41BR (OWRF) White 00WH (OWRF) Dark Brown 15SF (OWRF) Gray 33GR (AWRF) Gray 33GR (OWRF)	 N/A	 Black 35GR (OWRF) White 00WH (OWRF) Black 35GR (OWRF) White 00WH (OWRF) White 00WH (AWRF) White 00WH (OWRF)
Chemical Piping: 2” Sodium Hypochlorite 2” Sodium Hydroxide 1/2” Sodium Hypochlorite 1/2” Sodium Hydroxide	 Safety Yellow 02SF (AWRF) Pantone 802C (AWRF) Safety Yellow 02SF (AWRF) Pantone 802C (AWRF)	 N/A N/A Safety Yellow 02SF (AWRF) School Zone Yellow 01SF (AWRF)	 Black 35GR (AWRF) Black 35GR (AWRF) Black 35GR (AWRF) Black 35GR (AWRF)

E.

E. Exposed piping, as defined earlier in this Specification, shall be color coded as listed above, except submerged pipes and pipes less than 3/8-inch diameter shall be painted the same as the wall or piece of equipment to which it is attached.

F. Positive identification of the contents of a piping system shall be lettered legibly, giving the name of the contents in full or abbreviated form at no greater than 25 foot intervals between markings. Arrows shall be used to indicate direction of flow at no greater than 10 foot intervals. Contents shall be identified by additional details required by the ENGINEER, such as temperature, pressure, etc., as necessary to identify the hazard.

G. Legend shall be brief and applied close to valves or flanges and adjacent to changes in direction, branches, and where pipes pass through walls or floors.

H. Where two or more pipes run parallel, markings shall be applied in the same relative location on each as to be in vertical or horizontal line and present a neat appearance.

I. In case a pipe is in such location that it can be seen only from one direction, such as pipes near a wall, two sets of the code designation shall be applied at each location, placed in two visible quadrants with respect to normal viewing positions.

Minimum Letter Sizes	
O.D. of Pipe (inches)	Height of Letters (inches)
3/4 - 1-1/4	1/2
1-1/2 - 2	z3/4
2-1/2 - 6	1-1/4
8 - 10	2-1/2
Over 10	3-1/2

++ END OF SECTION ++

SECTION 09900.1

INTERIOR PAINTING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Surface preparation.

B. Field application of paints.

C. Scope: Finish interior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated.
   1. Both sides and edges of plywood backboards for electrical and telecom equipment before installing equipment.
   2. Mechanical and Electrical:
      a. In finished areas, paint insulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, mechanical equipment, and electrical equipment, unless otherwise indicated.
      b. Paint interior surfaces of air ducts and convector and baseboard heating cabinets that are visible through grilles and louvers with one coat of flat black paint to visible surfaces.

D. Do Not Paint or Finish the Following Items:
   1. Items factory-finished unless otherwise indicated; materials and products having factory- applied primers are not considered factory finished.
   2. Items indicated to receive other finishes.
   3. Items indicated to remain unfinished.
   4. Fire rating labels, equipment serial number and capacity labels, bar code labels, and operating parts of equipment.
   5. Stainless steel, anodized aluminum, bronze, terne-coated stainless steel, and lead items.
   6. Floors, unless specifically indicated.
   7. Ceramic and other tiles.
   8. Brick, architectural concrete, cast stone, integrally colored plaster, and stucco.
   9. Glass.
   10. Acoustical materials, unless specifically indicated.
   11. Concealed pipes, ducts, and conduits.

1.2 RELATED REQUIREMENTS

A. Section 05500 - Metal Fabrications: Shop-primed items.

1.3 DEFINITIONS

A. Comply with ASTM D16 for interpretation of terms used in this section.

1.4 REFERENCE STANDARDS

A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; Current Edition.

B. ASTM D16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications; 2024.

C. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Based Materials; 2020.

D. MPI (APL) - Master Painters Institute Approved Products List; Master Painters and Decorators Association; Current Edition.

E. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual; Current Edition.

F. SSPC-SP 1 - Solvent Cleaning; 2015, with Editorial Revision (2016).

G. SSPC-SP 6/NACE No.3 - Commercial Blast Cleaning; 2006.

1.5 SUBMITTALS

A. Product Data: Provide complete list of products to be used, with the following information for each:
   1. Manufacturer's name, product name and/or catalog number, and general product category (e.g., "alkyd enamel").
   2. MPI product number (e.g., MPI #47).
   3. Cross-reference to specified paint system products to be used in project; include description of each system.
   4. Manufacturer's installation instructions.
   5. If proposal of substitutions is allowed under submittal procedures, explanation of substitutions proposed.

B. Samples: Submit two painted samples, illustrating selected colors and textures for each color and system selected with specified coats cascaded. Submit on tempered hardboard, 8x10 inch (200 x 250 mm) in size.

C. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. Extra Paint and Finish Materials: 1 gal (4 L) of each color; from the same product run, store where directed.

2. Label each container with color in addition to the manufacturer's label.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.

B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

C. Paint Materials: Store at minimum ambient temperature of 45 degrees F (7 degrees C) and a maximum of 90 degrees F (32 degrees C), in ventilated area, and as required by manufacturer's instructions.

1.7 FIELD CONDITIONS

A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.

B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.

C. Provide lighting level of 80 fc (860 lux) measured mid-height at substrate surface.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Provide paints and finishes used in any individual system from the same manufacturer; no exceptions.

B. Paints:
1. Base Manufacturer: Dunn-Edwards.
2. Dunn-Edwards Corporation: www.dunnedwards.com/#sle.
3. Pittsburgh Paints: www.pittsburghpaintsco.com/#sle.
4. Sherwin-Williams Company: www.sherwin-williams.com/#sle.

2.2 PAINTS AND FINISHES - GENERAL

A. Paints and Finishes: Ready-mixed, unless intended to be a field-catalyzed paint.
1. Where MPI paint numbers are specified, provide products listed in Master Painters Institute Approved Product List, current edition available at www.paintinfo.com, for specified MPI categories, except as otherwise indicated.

2. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
3. Provide materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
4. For opaque finishes, tint each coat including primer coat and intermediate coats, one-half shade lighter than succeeding coat, with final finish coat as base color.
5. Supply each paint material in quantity required to complete entire project's work from a single production run.
6. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.

B. Volatile Organic Compound (VOC) Content:
1. Provide paints and finishes that comply with the most stringent requirements specified in the following:
   a. 40 CFR 59, Subpart D--National Volatile Organic Compound Emission Standards for Architectural Coatings.
   b. Architectural coatings VOC limits of Maricopa County.
2. Determination of VOC Content: Testing and calculation in accordance with 40 CFR 59, Subpart D (EPA Method 24), exclusive of colorants added to a tint base and water added at project site; or other method acceptable to authorities having jurisdiction.

C. Flammability: Comply with applicable code for surface burning characteristics.

D. Sheens: Provide the sheens specified; where sheen is not specified, sheen will be selected later by Architect from the manufacturer's full line.

E. Colors: To be selected from manufacturer's full range of available colors.
1. Selection to be made by Architect after award of contract.
2. Allow for minimum of three colors for each system, unless otherwise indicated, without additional cost to Owner.
3. Extend colors to surface edges; colors may change at any edge as directed by Architect.
4. In finished areas, finish pipes, ducts, conduit, and equipment the same color as the wall/ceiling under which they are mounted.

2.3 PAINT SYSTEMS - INTERIOR

A. Interior Surfaces to be Painted, Unless Otherwise Indicated: Including gypsum board, wood, uncoated steel, and shop primed steel.
1. Two top coats and one coat primer.
2. Top Coat(s): Institutional Low Odor/VOC Interior Latex; MPI #143, 144, 145, 146, 147, or 148.

a. Products:
1) Dunn-Edwards Corporation; Spartawall Interior Eggshell Paint. (MPI #145)

3. Top Coat Sheen:
a. Eggshell: MPI gloss level 3; use this sheen at all locations.
4. Primer: As recommended by top coat manufacturer for specific substrate.

B. Medium Duty Door/Trim: For surfaces subject to frequent contact by occupants, including metals and wood:
1. Medium duty applications include doors and door frames.
2. Two top coats and one coat primer.
3. Top Coat(s): High Performance Architectural Interior Latex; MPI #138, 139, 140, 141, or 142.
a. Products:
1) Dunn-Edwards Corporation; Suprema Interior Semi-Gloss. (MPI #141)
4. Primer: As recommended by top coat manufacturer for specific substrate.

2.4 PRIMERS

A. Primers: Provide the following unless other primer is required or recommended by manufacturer of top coats.
1. Interior Latex Primer Sealer; MPI #50.
a. Products:
1) Dunn-Edwards Corporation; Vinylastic Premium Interior Wall Sealer. (MPI #50)
2. Interior Rust-Inhibitive Water Based Primer; MPI #107.
a. Products:
1) Dunn-Edwards Corporation; Enduraprime Interior/Exterior Acrylic Rust Preventative Metal Primer. (MPI #107)

2.5 ACCESSORY MATERIALS

A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.

B. Patching Material: Latex filler.

C. Fastener Head Cover Material: Latex filler.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Do not begin application of paints and finishes until substrates have been adequately prepared.

B. Verify that surfaces are ready to receive work as instructed by the product manufacturer.

C. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.

D. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

E. Test shop-applied primer for compatibility with subsequent cover materials.

F. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces is below the following maximums:
   1. Gypsum Wallboard: 12 percent.
   2. Interior Wood: 15 percent, measured in accordance with ASTM D4442.

3.2 PREPARATION

A. Clean surfaces thoroughly and correct defects prior to application.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Remove or repair existing paints or finishes that exhibit surface defects.

D. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.

E. Seal surfaces that might cause bleed through or staining of topcoat.

F. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.

G. Gypsum Board: Fill minor defects with filler compound. Spot prime defects after repair.

H. Ferrous Metal:
   1. Solvent clean according to SSPC-SP 1.

2. Shop-Primed Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces. Re-prime entire shop-primed item.
3. Remove rust, loose mill scale, and other foreign substances using methods recommended in writing by paint manufacturer and blast cleaning in accordance with SSPC-SP 6/NACE No.3. Protect from corrosion until coated.

I. Wood Surfaces to Receive Opaque Finish: Wipe off dust and grit prior to priming. Seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after primer has dried; sand between coats. Back prime concealed surfaces before installation.

J. Metal Doors to be Painted: Prime metal door top and bottom edge surfaces.

3.3 APPLICATION

A. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.

B. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".

C. Where adjacent sealant is to be painted, do not apply finish coats until sealant is applied.

D. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.

E. Apply each coat to uniform appearance in thicknesses specified by manufacturer.

F. Dark Colors and Deep Clear Colors: Regardless of number of coats specified, apply as many coats as necessary for complete hide.

G. Sand wood and metal surfaces lightly between coats to achieve required finish.

H. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.

I. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.4 CLEANING

A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.5 PROTECTION

A. Protect finishes until completion of project.

B. Touch-up damaged finishes after Substantial Completion.

++ END OF SECTION ++

SECTION 09920

COATING SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Scope:
   1. This Section specifies the coating system used for following areas:
      a. All sanitary sewer manhole bases, barrels, and cones.
   2. The coating shall yield a hard, durable chemical resistant coating and shall be specifically designed to be applied on a dry surface. The finished coating shall provide a watertight seal and shall adhere to PVC and other components of the pipeline liner systems.

B. Definitions:
   1. Specific coating terminology used in this Section is in accordance with definitions contained in ASTM Dl6, ASTM D3960, and the following definitions:
      a. Dry Film Thickness (DFT): The thickness of one fully cured continuous application of coating.
      b. Field Coat: The application or the completion of application of the coating system after installation of the surface at the site of the Work.
      c. Shop Coat: One or more coats applied in a shop or plant prior to shipment to the site of erection or fabrication, where the field or finishing coat is applied.
      d. Tie Coat: An intermediate coat used to bond different types of paint coats. Coatings used to improve the adhesion of a succeeding coat.
      e. Photochemically Reactive Organic Material: Any organic material that will react with oxygen, excited oxygen, ozone, or other free radicals generated by the action of sunlight on components in the atmosphere giving rise to secondary contaminants and reaction intermediates in the atmosphere which can have detrimental effects.
      f. Volatile Organic Compound (VOC) Content: The portion of the coating that is a compound of carbon, is photochemically reactive, and evaporates during drying or curing; expressed in grams per liter or pounds per gallon.
      g. Touch-Up Painting: The application of a paint on areas of painted surfaces to repair marks, scratches, and areas where the coating has deteriorated to restore the coating film to an unbroken condition.

1.2 REFERENCES

A. References:

1. This Section contains references to the following documents. They are a part of this Section as specified and modified. In case of conflict between the requirements of this Section and those of the listed documents, the requirements of this Section shall prevail.
    a. ASTM D16 - Standard Terminology for Paint, Related Locations, Material and Applications Relating to Paint, Varnish, Lacquer, and Related Products.
    b. ASTM D3359 - Standard Test Methods for Measuring Adhesion by Tape Test.
    c. ASTM D3960 - Standard Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings.
    d. F 595 B - Federal Standard Colors.

1.3 DELIVERY AND STORAGE

A. Materials shall be delivered to the job site in their original, unopened containers. Each container shall bear the manufacturer's name, coating type, batch number, date of manufacture, storage life, and special directions.

B. Materials shall be stored in enclosed structures and shall be protected from weather and excessive heat or cold. Flammable materials shall be stored in accordance with State and local codes. Materials exceeding storage life recommended by the manufacturer shall be removed from the site.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Standardization:
    1. Materials and supplies provided shall be the standard products of manufacturers. Materials in each coating system shall be the products of a single manufacturer.

B. Coating:
    1. The coating shall be Sauereisen Sewergard Lining No. 210 as manufactured by Sauereisen Cements, Pittsburgh, PA; The coating shall be Sewergard Beige in color. (OR)
    2. The coating shall be Sewer Shield 150 Epoxy Lining as manufactured by Environmental Coatings, Mesa, AZ.

C. Primer:
    1. Primer shall be as recommended by the manufacturer for each application.

D. Defect Filler:
    1. Defect filler shall be as recommended by the manufacturer for each application.

2.2 PRODUCT DATA

A. Before materials are delivered to the job site, the CONTRACTOR shall provide the following information in accordance with Section 01300, Submittals:
   1. For the filler, primer, and finish coating, the CONTRACTOR shall furnish a Material Safety Data Sheet (MSDS).
   2. For the filler and finish coating, the CONTRACTOR shall provide the manufacturer's application instructions, which shall include the following:
      a. Surface preparation recommendations.
      b. Primer type, where required.
      c. Maximum dry and wet mil thickness per coat.
      d. Minimum and maximum curing time between coats, including atmospheric conditions for each.
      e. Curing time before submergence in liquid.
      f. Thinner to be used with coating material.
      g. Ventilation requirements.
      h. Minimum atmospheric conditions during which the coating shall be applied.
      i. Allowable application methods.
      j. Maximum allowable moisture content.
      k. Maximum storage life.
   3. List of materials proposed to be used under this Section and manufacturer's data for each material.

PART 3 - EXECUTION

3.1 COATINGS

A. General:
   1. Coating products shall not be used until the ENGINEER has inspected the materials and the coating manufacturer's technical representative has instructed the CONTRACTOR and ENGINEER in the surface preparation, mixing, and application of the coating. The coating manufacturer's technical representative must be a factory representative, not a local representative or an affiliate of the CONTRACTOR.

B. Coating Systems:
   1. Field coats shall consist of one or more finish coats to build up the coating to the specified dry film thickness. Unless otherwise specified, finish coats shall not be applied until other Work in the area is complete and until all previous coats have been inspected.

C. Coating Requirements:
   1. All items of equipment, or parts and surfaces of equipment, which are immersed when in service, with the exception of pumps and valves, shall have all surface preparation and coating work performed in the field.

3.2 PREPARATION

A. General:

1. Concrete surfaces to receive protective coating shall be cast with rough form finish. Surfaces shall not be rubbed, troweled or otherwise finished in any manner that will obscure or cover the firm substrate surface. All subsequent surface washing, abrasive blasting, grinding, patching, filling and preparation shall be completed by the applicator in accordance with the protective coating manufacturer's recommendations. The CONTRACTOR shall examine all surfaces to be coated and shall correct all surface defects as specified in Paragraph 3.6 before application of any coating.
2. All concrete shall cure for 28 days before protective coating system is installed, unless otherwise recommended by the applicator or system manufacturer.
3. Substrate: Concrete surfaces to be coated shall be free of curing compounds and form release agents, laitance and foreign particles that may inhibit bonding. Prior to start of protective coating systems application, broom clean, vacuum, hydroblast or abrasive blast surfaces to be coated as required, and inspect the substrate. Start of application operations shall indicate acceptance of substrate conditions and full responsibility for the completed Work. Surface preparation procedures shall be in accordance with ICRI (International Concrete Repair Institute) Guideline No. 03732, or comparably approved method. Surface preparation requirement is to expose aggregate and obtain a uniform surface texture resembling an, ICRI CSP # 4-6 comparators.
4. Level or grind concrete substrates to manufacturer's recommended tolerances and to produce a smooth, uniform installation, including removal of all sharp edges, ridges or depressions.
5. New Concrete Application: New concrete voids and depressions shall be filled with underlayment material, re-establishing plan finished grades and surface profiles.
6. Existing Concrete Application: Existing concrete structures to receive protective coating system must be capable of withstanding imposed loads. All oil, grease and chemical containments must be removed from the surface of concrete by chemical cleaning. Surfaces must be firm, free of standing water, laitance, form release agents, and be structurally sound as determined by ARCHITECT/ENGINEER. Suitable surface preparation methods include shotblasting, abrasive blasting, or water jetting. Surface preparation procedures shall be in accordance with ICRI Guideline No. 03732. Surface preparation requirement is to expose aggregate and obtain a uniform surface texture resembling an, ICRI CSP # 4-6 comparators.
7. The CONTRACTOR shall perform an adhesion test after proper cure in accordance with ASTM D3359 to demonstrate that one the specified field coatings adhere to the substrate. Test results showing an adhesion rating of 5A on immersed surfaces and 4A or better on all other surfaces shall be considered acceptable. Where unacceptable test results are obtained, the

CONTRACTOR shall be responsible for removing and reapplying the specified coatings at no expense to the OWNER.

8. Steps within existing manholes shall be removed prior to surface preparation.
9. Manhole channels and benches shall be re-built through application of grout prior to coating and following surface preparation.

B. Detailed Surface Preparation:
   1. Surface preparations for each type of surface shall be in accordance with the specific requirements of the coating specification sheet (COATSPEC).

3.3 APPLICATION

A. Workmanship:
   1. Coated surfaces shall be free from runs, drops, ridges, waves, laps, and brush marks. Coats shall be applied so as to produce an even film of uniform thickness, completely coating corners and crevices. Painting shall be done in accordance with the requirements of SSPC Paint Application Specification No. 1.
   2. The CONTRACTOR'S equipment shall be designed for application of the materials specified. The coating shall be applied using a trowel suitable for obtaining the proper thickness and surface characteristics as recommended by the coating manufacturer.
   3. Each coat shall be applied evenly and sharply cut to line. Care shall be exercised to avoid over-coating or spattering on surfaces not to be coated.

B. Atmospheric Conditions:
   1. Coatings shall be applied only to surfaces that are dry and only under conditions of evaporation rather than condensation. Coatings shall not be applied during rainy, misty weather or to surfaces upon which there is frost or moisture condensation. During damp weather, when the temperature of the surface to be coated is within 10° F of the dew point, the surfaces shall be heated to prevent moisture condensation thereon. During coating and for a period of at least eight hours after the coating has been applied the temperature of the surfaces to be coated, the coated surfaces, and the atmosphere in contact shall be maintained at or above 40° F and 10° F above the dew point. Paint, when applied, shall be approximately the same temperature as that of the surface on which it is applied. Fans or heaters shall be used inside enclosed areas where conditions causing condensation are severe.

C. Protection of Coated Surfaces:
   1. Items which have been coated shall not be handled, worked on, or otherwise disturbed until the coating is completely dry and hard.

D. Film Thickness and Continuity:
   1. Coating system thickness is the total thickness of finish coats.

2. The surface area covered for various types of surfaces shall not exceed those recommended by the manufacturer. Coatings shall be applied to the thickness specified and in accordance with these Specifications.
3. In testing for continuity of coating about welds, projections (such as bolts and nuts), and crevices, the ENGINEER will determine the minimum conductivity for smooth areas of like coating where the dry mil thickness has been accepted. This conductivity shall then be taken as the minimum required for these rough or irregular areas. Pinholes and holidays shall be repainted to the required coverage.

E. Safety and Ventilation Requirements:
1. Requirements for safety and ventilation shall be in accordance with SSPC Paint Application Guide No. 3.

3.4 CLEANUP

A. Upon completion of coating, the CONTRACTOR shall remove surplus materials, protective coverings, and accumulated rubbish, and thoroughly clean all surfaces and repair any overspray or other paint-related damage.

3.5 COATING SYSTEM SPECIFICATION SHEETS COATSPEC - ALTERNATIVE 1)

A. Surfaces shall be coated in accordance with the COATSPEC to the system thickness specified.
1. Coating System Identification: Sewer Shield 150 Epoxy Lining.
2. Surface: Concrete/masonry.
3. Surface Preparation: Hydroblast abrasive blasting.
4. Concrete: Except as otherwise specified, loose concrete, form oils, surface hardeners, curing compounds, and laitance shall be removed from surfaces by abrasive blasting and chipping, and voids and cracks shall be repaired as specified in Paragraph 3.9 and as indicated by the underlayment paragraph. All active hydrostatic leaks must be stopped by use of a water stop, waterproofing, or urethane grout, as recommended by the manufacturer.
5. Underlayment: Holes and any other defects up to 4-inches deep shall be filled with C120 manufactured by Environmental Coatings. If the defects are larger than 4-inches deep, a high early cement fill shall be used. Loose or splattered underlayment shall be removed by scraping and chipping. The C120 and high early cement fill shall be applied as recommended by the manufacturer.
6. Application:
   a. Underlayment shall dry a minimum of five hours at 70° F prior to application of Sewer Shield 150.
   b. Coating shall be applied as recommended by the manufacturer, provided the coating as applied complies with prevailing air pollution control regulations.

c. Drying time between coats shall be as recommended by coating manufacturer.

7. System Thickness: 250 mils dry film.
8. Coatings: Coat at manufacturer's recommended dry film thickness per coat to the specified system thickness.

3.6 COATING SYSTEM SPECIFICATION SHEETS (COATSPEC - ALTERNATIVE 2)

A. Surfaces shall be coated in accordance with the COATSPEC to the system thickness specified.
   1. Coating System Identification: Sauereisen SewerGard No. 210 Trowelable.
   2. Surface: Concrete/masonry.
   3. Surface Preparation: Abrasive blasting or hydroblasting.
   4. Concrete: Except as otherwise specified, loose concrete, form oils, surface hardeners, curing compounds, laitance oils, grease, dust, chemical contaminants, and any previously applied coatings shall be removed from surfaces by abrasive blasting or hydroblasting, and voids and cracks shall be repaired as specified in Paragraph 3.9 and as indicated by the underlayment paragraph. After blasting, concrete should be detergent washed to remove all oil, grease, and other contaminants. All active hydrostatic leaks must be stopped by use of an appropriate Sauereisen water stop, waterproofing, or urethane grout, as recommended by the manufacturer.
   5. Underlayment: Sauereisen No. F-120 Trowelable shall be used to fill holes and any other defects. Loose or splattered underlayment shall be removed by scraping and chipping. Sauereisen No. F-120 Trowelable shall be applied as recommended by the manufacturer.
   6. Application:
      a. Underlayment shall dry a minimum of five hours at 70° F prior to the application of SewerGard No. 210 Trowelable. Underlayment must be cured by means of fog spray, wet burlap, or appropriate Sauereisen curing compound. The CONTRACTOR shall follow coating manufacturer's requirements for bonding the coating systems to the installed sewer liner.
      b. Coating shall be applied as recommended by the manufacturer, provided the coating as applied complies with prevailing air pollution control regulations. Only one coat should be applied to obtain the system thickness. The CONTRACTOR shall follow coating manufacturer's requirements for bonding the coating system to the installed liner.
   7. System Thickness: 125 mils dry film.
   8. Coatings: Coats at manufacturer's recommended dry film thickness per coat to the specified system thickness.

3.7 SPARK TEST

A. All coated surfaces shall be spark tested for holes. The spark tester used shall provide 15,000 to 20,000 volts. If pinholes are found, the CONTRACTOR shall repair the coating as recommended by the manufacturer and retest. All testing and repair work shall be at the CONTRACTOR'S expense.

3.8 DEFECT REPAIR OF CONCRETE SURFACE

A. All surface defects, including tie holds, minor honeycombing, or otherwise defective concrete, shall be repaired. All voids, holes, rough, or irregular concrete shall be filled.

B. The CONTRACTOR shall use the repair and fill material recommended by the coating manufacturer to repair or fill all defects. Areas to be patched shall be cleaned. Minor honeycombed or otherwise defective areas shall be cut out to solid concrete to a depth of at least 1-inch. The edges of the cut shall be perpendicular to the surface of the concrete. Patches on exposed surfaces shall be finished to match the adjoining surfaces after they have set. Finishes shall be equal in workmanship, texture, and general appearance to that of the adjacent concrete. Concrete with honeycombing, which exposes the reinforcing steel, or with defects which affect the structural strength, shall be corrected.

3.9 WARRANTY

A. The coating applicator shall supply a five year warranty on workmanship of installation. The warranty shall state, at a minimum, that the coating is applied in accordance with the manufacturer's instruction and that the coating will not fail for a period of five years. The definition of coating failure is that blistering, cracking, embrittlement, or softening of the coating is starting to occur. The warranty shall be unconditional in nature covering any type of failure in the coating and agree to repair or replace it at no cost to OWNER at any point during this five year period. The warranty shall cover all costs, but not be limited to the cost of coating replacement, including the material costs and the labor costs associated with surface preparation and installing the replacement coating.

B. The coating applicator shall also supply a warranty from the coating manufacturer to warrant the product from failure for a period of five years. The definition of coating failure is that blistering, cracking, embrittlement, or softening of the coating is starting to occur.

++ END OF SECTION ++

SECTION 10400

EQUIPMENT IDENTIFICATION PLATES

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish and install equipment identification plates on all equipment listed in Section 01800, Equipment Schedule; Section 13447, Electric Motor Actuators; and all valves listed in Section 11295, Hydraulic Valves. Install one identification plate as specified herein on each piece of equipment and each valve in a prominent, visible location.

B. The CONTRACTOR shall provide all labor, materials, equipment, and incidentals as specified and required to furnish and install an equipment tag system and Warning Signs.

C. The equipment tag system shall consist of equipment number and equipment description as specified herein.

D. The type of equipment tag system includes, but is not necessarily limited to, the following:
   1. Device tags.
   2. Signal tags.
   3. Miscellaneous mechanical fasteners.

1.2 RELATED SECTIONS

A. Section 01800, Equipment Schedule.

B. Division 11, Equipment.

C. Section 11295, Hydraulic Valves.

D. Section 13447, Electric Motor Actuators.

1.3 SUBMITTALS

A. Samples: Submit for approval samples of materials and accessories required for the equipment tag system.
B. Shop Drawings: Submit for approval the following:
   1. Anchorage and accessory items.
   2. Samples of actual equipment tags for five devices.

3. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
4. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**

1.4 QUALITY ASSURANCE

A. Source Quality Control: Provide equipment tags by a single manufacturer.

PART 2 - PRODUCTS

2.1 EQUIPMENT IDENTIFICATION PLATE

A. Equipment identification plates shall be manufactured from Type 316 stainless steel material with raised numbers and letters. Equipment identification plates shall include equipment number and the equipment description consisting of three or four lines. Numbers and letters shall be 3/16-inch in height and centered on the identification plate.

B. Equipment identification plates shall be fastened with Type 316 stainless steel pins, rivets, bands, or screws as approved by the ENGINEER. Equipment identification plates shall be fixed to the piece of equipment in a permanent manner. Type 316 stainless steel chain connection may be acceptable only if permanent mounting is not possible.

2.2 WARNING SIGNS

A. Provide Danger, Caution, Notice, and Safety Instructional Signs as specified herein. Signs shall meet OSHA specifications. Provide hazardous material warning signs as required in Uniform Fire Code Article 80 and NFPA 704. A maximum of 50 warning signs shall be provided by the CONTRACTOR. The CONTRACTOR shall coordinate with the ENGINEER in determining the location and legend of the following sign types outlined below:
   1. Sign Material: Aluminum.
   2. Size: 10-inches by 14-inches.
   3. Thickness: 0.10-inch
   4. Fabrication:
      a. Rounded corners.
      b. Drilled holes in corners with grommets.
   5. Mount: Sign shall be wall or handrail mounted depending on location and as recommended by the manufacturer.
   6. Letters:
      a. 2-inches for words "DANGER", "CAUTION", "NOTICE", or "SAFETY FIRST".
      b. 3/4-inch for other text.
         1) Danger Signs:
            a) White background.
            b) White letters for word "DANGER" placed on standard red oval with black panel.
            c) Additional letters: Black
            d) Background: White
            e) Additional text: CONTRACTOR to coordinate with ENGINEER
         2) Caution Signs:
            a) Yellow background.
            b) Yellow letters for word "CAUTION" placed on black panel.
            c) Additional letters: Black
            d) Background: Yellow
            e) Additional text: CONTRACTOR to coordinate with ENGINEER
         3) Warning Signs:
            a) Orange background.
            b) Orange letters for word "WARNING" placed on black panel.
            c) Additional letters: Black
            d) Background: Orange
            e) Additional text: CONTRACTOR to coordinate with ENGINEER
         4) Notice Signs:
            a) White background.
            b) White letters for word "NOTICE" placed on blue panel.
            c) Additional letters: Black

d) Background: White
e) Additional text: CONTRACTOR to coordinate with ENGINEER.

5) Safety instruction signs:
a) White background.
b) White letters for word "SAFETY FIRST" placed on black panel.
c) Additional letters: Black
d) Background: White
e) Additional text: CONTRACTOR to coordinate with ENGINEER.

B. In addition to the 50 signs as described in Paragraph 2.2.A, CONTRACTOR shall also provide non-potable water yard hydrant and hose bibb signs. All non-potable water hose bibs and yard hydrants shall have a CAUTION sign with the following text: "NON-POTABLE WATER, DO NOT DRINK". The sign shall be either wall mounted or handrail mounted depending on the location. Sign shall be mounted where it is clearly visible and as close to the hose bibb or yard hydrant as possible. Sign shall have the following characteristics outlined below and as shown on the Drawings.
1. Sign Type: Caution sign.
2. Additional Text: NON-POTABLE WATER, DO NOT DRINK (in two lines).
3. Additional Text Size: 3/4-inch.
4. Mounting: Wall or handrail mounting based on location and as recommended by the manufacturer.
5. Letter Color: Black.
6. Back Panel Color: Yellow.
7. Back Panel Material: Aluminum sheet.
8. Back Panel Size: 10-inches by 14-inches.

PART 3 - EXECUTION

3.1 INSPECTION

A. CONTRACTOR and their installer shall examine the substrates and conditions under which the equipment tags are to be installed and notify ENGINEER, in writing, of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to ENGINEER.

3.2 INSTALLATION

A. Install equipment tags and components at the locations as directed by ENGINEER; securely mount with concealed theft-resistant fasteners. Install

equipment tags after all equipment has been painted, equipment tags shall not be painted.

B. Use Type 316 stainless steel fasteners.

C. Install level, plumb, and at the proper height. Repair or replace damaged units as directed by ENGINEER.

END OF SECTION

SECTION 10440

FIRE PROTECTION SPECIALTIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Fire extinguishers.

1.2 REFERENCE STANDARDS

A. NFPA 10 - Standard for Portable Fire Extinguishers; 2026.

1.3 SUBMITTALS

A. Product Data: Provide extinguisher operational features.

PART 2 - PRODUCTS

2.1 FIRE EXTINGUISHERS

A. General Requirements: Comply with product requirements of NFPA 10 and applicable codes, whichever is more stringent.

B. Multipurpose Dry-Chemical-Type Fire Extinguishers: Carbon steel tank, with pressure gauge.
   1. Class: A:B:C.
   2. Size: 5 lb (2.26 kg).
   3. Finish: Baked polyester powder coat; color as selected by Architect.
   4. Temperature Range: Minus 65 to 120 degrees F (Minus 54 to 49 degrees C).

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

++ END OF SECTION ++

SECTION 10811

BIRD CONTROL DEVICES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Bird deterrents.

1.2 SUBMITTALS

A. Product Data: Submit for all equipment under this section.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Bird Barrier of America: www.birdbarrier.com/#sle.

2.2 BIRD DETERRENTS

A. Primary Device: "“Eagle Eye,” silver color. Provide wind powered kit model EE-1WS, mounting pole EE-XP6.

B. Secondary Device: “Pro-Peller”: Silver color, model EE-PPS.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install bird deterrents in accordance with manufacturer's written instructions.

++ END OF SECTION ++

SECTION 11218

MAGNETIC DRIVE SEALLESS END SUCTION PUMPS AND APPURTENANCES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
   1. Provide all labor, materials, services, equipment and incidentals required to furnish and install magnetic drive sealless end suction pumps, complete and operational, with motors and accessories as shown on the Drawings and specified. This Section includes, but is not limited to the following:
      a. Chemical Feed Pumps, Sodium Hydroxide (NaOH) 25%
      b. Chemical Feed Pumps, Sodium Hypochlorite (NaOCl) 15%
      c. Pump appurtenances.

1.2 QUALITY ASSURANCE

A. Manufacturer's Qualifications:
   1. Manufacturer shall have a minimum of five years of experience producing substantially similar equipment and shall be able to show evidence of at least five installations in satisfactory operation for at least five years.

B. Component Supply and Compatibility:
   1. Obtain all equipment included in this section regardless of the component manufacture

C. Reference Standards: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
   1. American Society for Testing and Materials (ASTM).
   2. American National Standards Institute (ANSI).
   3. The American Society of Mechanical Engineers.
   4. National Electrical Code (NEC) current adoption.
   5. City of Phoenix – Amendments to the National Electrical Code.
   6. Standards of National Electrical Manufacturers Associations (NEMA).
   7. Anti-Friction Bearing Manufacturers Association (AFBMA).
   8. Standards of American Water Works Association (AWWA).
   9. Institute of Electrical and Electronic Engineers (IEEE).
   10. American Gear Manufacturer's Association (AGMA).

D. Shop Tests:
   1. Each pump casing shall be hydrostatically tested to twice the discharge head or 1-1/2 times the shutoff head, whichever is greater.

2. Running Test: Each pump assembly shall be operated from zero to maximum capacity as shown on the approved pump curve. Results of the test shall be shown in a plot of test curves showing head, flow, horsepower, efficiency, current and NPSH. Readings shall be taken at a minimum of five evenly spaced capacity points including shut-off, design point and minimum head for which pump is designed to operate.
3. Each test shall be witnessed by a Registered Professional Engineer who may be an employee of the manufacturer. The Professional Engineer shall sign and seal all copies of curves and shall certify that hydrostatic tests were performed. Tests shall be conducted in conformance with the Standards of the Hydraulics Institute.
4. Pumps shall not be shipped until the ENGINEER has approved the test reports.

E. Unit Responsibility: Assign Unit Responsibility as specified in Section 01600, General Equipment Provision, to the manufacturer or supplier for the equipment specified in this Section. A Certificate of Unit Responsibility shall be provided.

1.3 SUBMITTALS

A. Each pump shall have no less than 2 years of warranty.

B. Shop Drawings: Submit for approval the following:
1. Manufacturer's literature, illustrations, paint certification, specifications and engineering data including dimensions, materials, list of wetted components, compatibility with chemical, size, weight, performance data and curves showing overall pump efficiencies, required net positive suction head, allowable suction lift, flow rate, head, brake horsepower, motor horsepower, speed and shut-off head.
2. Shop Drawings Showing: Fabrication, assembly, installation and wiring diagrams.
3. An electronic copy of certified pump curves and tests for each pump. Provide one for approval and for documentation.
4. Motor test and data as described in Part 2.
5. Control panels shall be furnished in accordance with the requirements as shown on the Drawings and as specified in Division 16, Sections 16050 and 16161, and Division 17, Sections 17000, 17452, 17456, and 17461.

C. Operation and Maintenance Manuals:
1. Submit complete installation, operation and maintenance manuals including test reports, pump curves, maintenance data and schedules, description of operation and spare parts information.
2. Furnish Operation and Maintenance Manuals in conformance with the requirements of Section 01730 Operation and Maintenance Data.

D. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each

paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

E. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**

1.4 AMBIENT CONDITIONS

A. Motors shall operate successfully under running conditions at rated load with +/- 10-percent of rated voltage with rated frequency or +/- 5-percent of rated frequency with rated voltage.

B. Unless specified otherwise, motors shall be suitable for continuous operation at an elevation of approximately 1,000 feet above sea level. Motors to be installed outdoors, exposed to the weather, shall be suitable for continuous operation in a 50° C ambient temperature; motors to be installed indoors shall be suitable for continuous operation in 50° C ambient temperature, unless otherwise noted.

PART 2 - PRODUCTS

2.1 SERVICE CONDITIONS

A. General:
   1. All wetted surfaces of the pumps and appurtenances and all sealing gaskets shall be suitable for continuous exposure to the chemical service and concentration shown on the schedule.
   2. All wetted surfaces shall be of materials suitable for contact with chemicals in service and shall not leach out any organic or inorganic constituent which is not permitted by local or federal regulations.

B. Pumps shall be of close coupled, end suction, side discharge (rotated 90 degrees) back pullout design, magnetic drive sealless design with separate motor. Pumps shall be specially designed, constructed and installed for the service intended and shall comply with the conditions as shown on the following schedule:

MAGNETIC DRIVE SEALLESS END SUCTION PUMPS SCHEDULE

Chemical Service	**NaOH**	**NaOCl**
Chemical concentration:	25%	15%
Specific gravity (68°F):	1.25	1.2
Liquid Temperature Range: °F	40-120	40-120
Quantity of Pumps:	3	3
Pump Designation:	1 Duty, 2 Stand-by	1 Duty, 2 Stand-by
Location:	Chemical Storage Facility	Chemical Storage Facility
Design Flow: gpm	20	20
Design Discharge Head: ft. *	38	38
Flow at Second Design Point: gpm (Minimum)	25	25
Head at Second Design Point: ft.* (Minimum)	36	36
Shutoff Head: ft. *	45	45
Pump Speed: RPM (Maximum)	3450	3450
Efficiency at Design: %	55	55
Motor: Hp	0.3	0.3
Motor: Volts/Phase/Hertz	120v/1/60Hz	120v/1/60Hz
Seal Type	EPDM	FKM

* Ft. of Chemical in service.

	Fluid Level System Curve NaOH and NaOCl	
	Flow (gpm)	Head (ft)
System Point No. 1	3	25.71
System Point No. 2	8	28.00
System Point No. 3	13	31.89
System Point No. 4	18	36.00
System Point No. 5	23	41.80

1. Backpressure for loop shall be maintained by an anticipated range of 10-15 psi ± 5.

C. Product and Manufacturer: Provide pumps by one of the following:
   1. Sodium Hydroxide (NaOH)
      a. Finish Thompson, Inc.
         i. Model DB8, 3.5-in impeller, 3-phase, 208–230 V, 60 Hz.
      b. March Pumps.
         i. Model TE-6K-MD, 3.250-in impeller, 3-phase, 208–230 V, 60 Hz.
      c. Or Approved Equal.
   2. Sodium Hypochlorite (NaOCl)
      a. Finish Thompson, Inc.
         i. Model DB8, 3.5-in impeller, 3-phase, 208–230 V, 60 Hz.
      b. March Pumps.
         i. Model TE-6K-MD, 3.250-in impeller, 3-phase, 208–230 V, 60 Hz.
      c. Or Approved Equal.

2.2 DETAILS OF CONSTRUCTION

A. Dimension Interchangeableness:
   1. Sealless magnetically driven pumps shall conform to all dimension standards of ASME Specification B 73.3. The sealless pumps shall be dimensionally interchangeable with the standard sealed ASME pump of the same size designation.

B. Pump Materials of Construction:
   1. The outer bearing system for frame-mounted pumps shall consist of two interchangeable ball bearings, oil lubricated by a constant level oiler. The outer bearing housing shall be sealed from the elements by spring loaded lip seals on both the outboard and inboard ends to keep oil spray out of the magnet drive area of the pumps. The outer bearing housing shall be capable of oil mist lubrication, as required. The bearings shall have a minimum B-10 life of 100,000 hours.

2. The outer bearing housing for frame-mounted pumps shall be constructed of ductile iron material free from blowholes and leaks. The outer shaft shall be one piece, and the outer magnet carrier shall be attached by threading against rotation into the outer shaft or keyed.
3. The magnetic drive system shall consist of an outer and inner permanent magnet drive system, separated by a containment shell and air and liquid gaps. Magnets shall be rare earth and made of Neodymium Iron Boron and shall be designed for zero slippage for full range of operation.
4. Outer Magnet Carrier: The outer magnet carrier shall be made of carbon steel and shall be spin balanced after the magnets are installed. The magnet shall be attached to the outer magnet carrier by high temperature epoxy for pump temperatures anticipated. Magnets shall be covered by a stainless steel cup and not exposed to the atmosphere.
5. Magnets: The magnets shall be of suitable materials for operating fluid temperatures less than 250°F, and shall be entirely suitable for the load at any point on the pump operating curve when pumping the chemical indicated on the Magnetic Drive Sealless End Suction Pump Schedule.
    a. The containment shell shall be furnished in a nonmetallic material selected for the service. Containment shell shall be made to have a maximum operating pressure of 300 psi and a design pressure of 275 psi. Containment shell shall be designed to eliminate any energy loss in the magnet coupling. Rear casing shall be rated to a minimum 900 psi burst pressure.
    b. The liquid gap between the containment shell and the inner magnet encapsulation shall be no less than 0.045-inch on a side or 0.090-inch diametral clearance.
    c. The containment shell shall be attached to the rear casing cover with stainless steel cap screws. Provide O-ring seal between the containment shell and the casing cover that is compatible with the pumped fluid. Welding the containment shell to the casing cover is unacceptable.
6. Inner Bearings:
    a. The inner bearing system shall be product lubricated as standard. The lubrication path shall minimize pressure drop and shall always remain under pressure greater than suction pressure to prevent flashing in the bearing system under low NPSHA operating conditions.
7. Impeller:
    a. Type: The impeller shall be of enclosed design.
    b. Construction: Shaft shall be non-rotating and supported on both ends to prevent overhung loads. Material shall be suitable for the service and no smaller than 1-1/4-inch in diameter. A groove, minimum 1/16-inch along length of shaft, or bypass channels in the impeller shall be provided for passage of occasional solids.
    c. Materials: The impeller material shall be suitable for the service and shall be non-metallic.
    d. A silicon carbide fiber reinforced mouth ring shall be provided with the impeller. The mouth ring shall be removable and replaceable.

8. Casing:
    a. Construction: Pump casing shall be furnished with a minimum of 150-pound ANSI flanges. Casing material and lining shall be suitable for the service intended.
    b. Assembly: The casing shall provide for back pullout maintainability without disconnecting the suction or discharge flanges.
    c. Casing shall be provided with a drain.
    d. Provide a removable silicon carbide thrust ring and press fit into the casing.
    e. Casing must be able to be rotated in such a way that allows for side discharge.
9. Bedplate:
    a. Fiberglass reinforced vinylester (FRP) composite or Type 316 stainless steel bedplate shall be provided. Bedplate shall be provided with molded-in stainless steel hardware complete with devices to prevent those devices from spinning when the bolting is tightened. Provide Type 316 stainless steel anchor bolts and hardware.

C. Motors:
1. General:
    a. Motors shall conform to requirements of Section 11100, Electric Motors.
    b. Provide a standard NEMA frame, TEFC, severe duty, horizontal, electric motor. Motors shall be 120 Volt, 1 phase, 60 hertz with a minimum service factor of 1.15. Motor shall be sized to be non-overloading at any point on the pump-operating curve when pumping the chemical indicated in the schedule.
    c. Unless otherwise specified, motors less than 1/2 horsepower shall be squirrel cage, single phase, capacitor start, induction run type. Details of Construction features listed in Paragraph 2.2, above, shall be as normally supplied by the equipment manufacturer. Single phase motors shall have Class B insulation, minimum. Small fan motors may be split phase or shaded pole type. Windings shall be copper.
2. Rating:
    a. Unless otherwise specified, motors shall be rated for operation at 120 volts, single phase, 60 Hz, and shall be continuous time rated in conformance with NEMA Standard MG 1, Paragraph 10.35. Dual voltage (115/230) rated motors are acceptable if all leads are brought out to the conduit box. Motors shall be non-overloaded at all points of the equipment operation.
3. Enclosures:
    a. Unless otherwise specified, motors shall have totally enclosed fan cooled or totally enclosed non-ventilated enclosures.

2.3 PRESSURE GAUGES

A. General:
    a. Pressure gauges shall be selected so that the normal operating pressure falls between 50% and 80% of full scale. The face shall be 4-1/2-inches in

diameter, 270 degree movement, 1% accuracy, full-scale, and suitable for bottom stem mounting.

b. Gauges shall have a Type 316 stainless steel bourdon tube, 300 Series stainless steel case, Type 316 stainless steel socket, shatterproof glass, and 1/4-inch bottom connection.

c. Gauges shall be a premium grade, heavy-duty bourdon-tube unit with pulsation dampening system. Snubbers or orifices shall not be utilized. Gauges shall be Ashcroft General Service Gauge, Type 1009, or approved equal. Gauges shall have diaphragm seals with 1/2-inch process connection, Titanium housing, and Titanium diaphragm. The fill fluid shall be silicone. Diaphragm seal shall be Ashcroft Type 101 or approved equal.

2.4 CONTROLS

A. Provide pump controls as shown on the Drawings and specified in Division 16, Sections 16050 and 16161, and Division 17, Sections 17000, 17452, 17456, and 17461.

B. Pumps shall be furnished with the following controls:
   1. See Section 17454, Operations and Control Descriptions.

2.5 TOOLS, SPARE PARTS AND MAINTENANCE MATERIALS

A. Each pump shall be furnished with the following spare parts.
   1. Recommended spare parts kit.
   2. One set of special tools required for maintenance or operations.

B. Spare parts shall be packed in sturdy containers with clear indelible identification markings and shall be stored in a dry, warm location until transferred to the OWNER at the completion of the project. Comply with the requirements of Section 01750, Spare Parts and Maintenance Materials.

2.6 SURFACE PREPARATION AND SHOP PAINTING

A. Pumps, motors, drives, frames, baseplates, appurtenances, etc., shall receive shop primer and shop finish coating conforming to the requirements of Section 09900, Painting. If any damage to the paint system occurs, the equipment shall be repainted as directed by the ENGINEER.

B. Surface preparation and painting shall conform to the requirements of Section 09900, Painting.

C. All gears, bearing surfaces, machined surfaces and other surfaces which are to remain unpainted shall receive a heavy application of grease or other rust-resistant coating. This coating shall be maintained during storage and until the equipment is placed into operation.

C. Certify, in writing, that the shop primer and shop finish paint system conforms to the requirements of Section 09900, Painting.

2.7 PRE-CAST POLYMER CONCRETE TRENCH

A. General:
   a. For Pre-cast Polymer Concrete Trench Insert: Refer to Section 13213, Pre-cast Polymer Concrete Trench Insert.
   b. For Trench Encasement: Refer to Section 03300, Cast-In-Place Concrete.

2.8 CPVC PIPING

A. General:
   a. For CPVC Piping: Refer to Section 15065, Thermoplastic Pipe and Accessories.

PART 3 - EXECUTION

3.1 INSPECTION

A. Inspect all equipment immediately upon delivery to site. All surfaces shall be smooth, free of voids and porosity, without dry spots, crazes or unreinforced areas. If damaged, notify ENGINEER and manufacturer immediately. All damaged equipment shall be replaced.

3.2 INSTALLATION

A. Prior to installation as shown in the Drawings. The pumps outlined in this section shall be temporarily installed as described in Section 01012, Plant Operation During Construction.

B. Equipment shall be installed in accordance with manufacturer's instructions and recommendations and the approved Shop Drawings.

C. Pump shall be installed on existing concrete base, secured with anchor bolts, and grouted with non-shrink grout conforming to Section 03600, Grout. Refer to and comply with the requirements of Section 03300, Cast-In-Place Concrete and Section 03252, Anchorage in Concrete.

D. Installation shall include furnishing and applying an initial supply of grease and oil, recommended by the manufacturer.

E. Support piping independent of pump.

F. Check and align all pump motors and shafting.

3.3 START-UP AND TEST

A. Make adjustments required to place system in proper operating condition. Field test and calibrate the equipment to assure that the system operates in accordance with these Specifications, Operations and Control Descriptions, and to the satisfaction of the ENGINEER.

B. After completion of installation, the system shall be completely tested to ensure compliance with the operating requirements as specified and indicated on the Drawings.

3.4 MANUFACTURER'S SERVICES

A. A factory-trained representative shall be provided for installation supervision, start-up and test services and operation and maintenance personnel training services. The representative shall make multiple scheduled visits to the site. The first visit shall be for assistance in the installation of equipment. The second visit shall be to check the completed installation and start-up of the system. The third visit shall be as described under Section 01821, Instruction of Operations and Maintenance Personnel. Manufacturer's representative shall test operate the system in the presence of the ENGINEER and verify that the pumps conform to requirements. Representative shall revisit the job site as often as necessary until all trouble is corrected and the installation is entirely satisfactory.

B. All costs, including travel, lodging, meals and incidentals, shall be considered as included in CONTRACTOR'S bid price.

++ END OF SECTION ++

SECTION 11295

HYDRAULIC VALVES

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish and install all valves and valve accessories for surface water, potable water, chemicals, air, as indicated in the Drawings and as specified herein, including all appurtenances required for a complete and operational installation.

1.2 SECTION INCLUDES

A. Butterfly valves.

B. Check valves.

C. Needle valves.

D. Ball valves.

E. Pressure Regulating valves.

F. High Flow Backpressure Regulator valves.

G. High Pressure Safety Relief valves.

H. Flow Control valves.

I. Valve appurtenances.

1.3 RELATED SECTIONS

A. Section 01300, Submittals.

B. Section 01640, Materials and Equipment.

C. Section 01650, Starting of Systems.

D. Section 09900, Painting.

E. Section 13447, Electric Motor Actuators.

F. Section 15050, Piping Systems.

1.4 REFERENCES

A. AWWA C500, Metal Seated Gate Valves For Water Supply Service.

B. AWWA C504, Rubber Seated Butterfly Valves.

C. AWWA C510, Double Check Valve Backflow Prevention Assembly.

D. ASME B16.1, Gray Iron Pipe Flanges and Flanged Fittings.

E. ASME B46.1, Surface Texture (Surface Roughness, Waviness, and Lay).

F. ASME A126, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.

G. ASTM A269, Standard Specification for Seamless and Welded Austenitic Stainless-Steel Tubing for General Service.

H. ASTM A48, Standard Specification for Gray Iron Castings.

I. ASTM A536, Standard Specification for Ductile Iron Castings.

J. ASTM A582, Standard Specification for Free-Machining Stainless Steel Bars.

K. ASTM B271, Standard Specification for Copper-Base Alloy Centrifugal Castings.

L. ASTM D429, Standard Test Methods for Rubber Property—Adhesion to Rigid Substrates.

M. ASTM D1784, Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.

N. ASTM F439. Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.

O. All other applicable ASTM and ANSI Standards.

1.5 SUBMITTALS

A. Descriptive submittals shall be made in accordance with the Data Reference Symbols defined in Section 01300, Submittals.
   1. All Valves: Shop Drawings and O&M Manuals:
      a. Final Certified Drawings showing outline dimensions, foundation layout or mounting information, and other pertinent dimensions.
      b. Field erection instructions, assembly drawings and/or diagrams, detailed reference drawing lists, lists of erection details, and list of spare parts supplied with equipment.

c. Shop Detail Drawings showing individual sub- assemblies and fabricated pieces with material specifications and other applicable data.
d. Installation instructions, operating and/or service manuals, and all other data pertinent to operating or servicing the complete apparatus. Preventative maintenance instructions and recommended frequency.
e. General bulletins and catalog cuts describing complete apparatus, including operating principles and fundamentals.
f. Service data sheets showing design performance, utility requirements, etc., as applicable to the specific duty for which the equipment is furnished.
g. Materials of construction of all components.
h. Renewal parts list with diagrammatic or cross-section drawings showing part identification. Material analysis or trades designation for each significant part is to be noted on parts lists or on a separate sheet.
i. Stuffing box sizes; packing sizes; specifications and arrangement; and mechanical seal details, specifications, etc., if furnished in equipment.
j. Bearing manufacturer's standard identification and/or interchangeable number for all anti-friction bearings in the equipment proper and its accessory items.

B. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

C. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**

PART 2 - PRODUCTS

2.1 GENERAL

A. All buried valves shall be provided with a valve box and extension stem per City of Chandler standard detail C-406.

B. All valves shall have a warranty of no less than 2 years.

2.2 BUTTERFLY VALVES

A. Butterfly valves – AWWA C504

1. Butterfly valves shall be tight-closing, rubber-seat type with rubber seats that are securely fastened to the valve body or valve disc. No metal-to-metal seating surfaces shall be permitted. Valves shall be bubble-tight at rated pressures with flow in either direction and shall be satisfactory for applications involving valve operation after long periods of inactivity. Valve disc shall rotate 90 degrees from the full open position to the tight shut position. The handwheel operators shall be traveling nut, self-locking type and shall be designed to hold the valve in any intermediate position between fully open and fully closed without creeping or fluttering. Valve operators shall be equipped with mechanical stop-limiting devices to prevent over-travel of the disc in the open and closed positions. Valves shall close with a clockwise rotation. Operators shall conform to the requirements of AWWA C504.
2. Valve bodies shall be constructed of cast iron ASTM A48, Class 40, or ASTM A126, Class B. Two trunnions for shaft bearings shall be integral with each valve body. Minimum body shell thicknesses shall be in strict accordance with AWWA Standard C504.
3. Valve disc shall be constructed of ductile iron ASTM A536, Grade 65-45-12, or cast iron ASTM A48, Class C.
4. Shafts of all valves shall be turned, ground, and polished. Valve shafts shall be constructed of 18-8 Type 316 stainless steel. Shaft diameters must meet minimum requirements established by AWWA Standard C504 for Class 150B.
5. Valve seats shall be Buna-N for water and EPDM for air service at conditions up to 250º F. Valves shall have seats that are bonded or mechanically retained to the valve body or valve disc.
6. Valves shall be fitted with sleeve-type bearings. Bearings shall be corrosion resistant and self-lubricating. Bearing load shall not exceed 20% of the compressive strength of the bearing or shaft material. Bearings shall be high temperature for air valves.
7. Packing shall be Chevron V-type adjustable for above ground service and non-adjustable wear compensating for submerged or buried service.
8. Valves shall be provided with torque tube pedestal assemblies where indicated on the Plans. Assemblies shall consist of a torque tube extension or a pedestal.

Torque tubes shall be designed for a maximum deflection of no more than 0.75 degrees when measured at the disc edge. The pedestal shall be made of high strength cast iron and shall support the full weight of the extension rod by use of corrosion resistant thrust bearings located in the pedestal. Torque tube shall be made of carbon steel. Design of a torque tube shall allow ±2-inches of free movement along the tube longitudinal axis. Pedestal or torque tube extension shall have a height of 3 feet above the operating floor. Torque tube or pedestal assemblies shall be factory assembled as integral units where applicable.

9. All above ground butterfly valves shall have handwheel/lever/t-handle geared operators or electric actuators as specified in the Equipment Schedule or as shown on the Drawings. All buried valves shall be equipped with valve box and extension stem per City of Chandler standard details and either a handwheel and pedestal, actuator and pedestal, or with operating nut, as specified in the Equipment Schedule or as shown on the Drawings. Valves specified with an operating nut shall be installed with a ground level valve position indicator.
10. All buried butterfly valves shall be side mounted with a buried service gear operator and extended nut as specified in this Section.
11. Certified Drawing and Material Specifications shall be furnished by the manufacturer through the CONTRACTOR covering all items included in Sections 1 and 2 of AWWA C504. Butterfly valves shall be as manufactured by Bray, DeZurik, Henry Pratt Company, Mueller, Val-Matic, or equal.

2.3 CHECK VALVES

A. CPVC Ball Check Valves (CKB):

1. Ball check valves shall be self-contained, straight-through designed, automatic valves which prevent reversal of flow direction. Ball check valves shall ensure a positive seal to prevent reversal of flow, with extremely low back pressure.
2. Ball shall be supported by a system of guide ribs to full flow with minimum turbulence and chatter.
3. Valves shall be 150 psi at 75° F. Valves shall be able to operate in horizontal and vertical position and shall be thermoplastic construction in CPVC. Valves shall contain the following seals for the following chemicals.
    a. Teflon or EPDM for NaOH – 25%, sodium hydroxide.
    b. Teflon or FKM for NaOCl – 12.5%, sodium hypochlorite.
4. Ball check valves shall be as manufactured by Hayward, Watts Regulator or approved equal.

B. Swing Check Valves (CKS):

1. Swing check valves shall be of the spring-loaded, non-slamming type. Swing check valves for wastewater or sludge pumping shall be designed to operate in the horizontal position. Valves shall have manual spring-loaded operators outside the valve body for backflushing. Valves shall be Series 6000 CLS, as

manufactured by APCO, or approved equal. All materials of construction shall be certified in writing to conform to ASTM Specifications as follows:

a. Body, Cover: Cast iron, ASTM A126, Grade B.
b. Disc, Disc Arm: Ductile iron, ASTM A536.
c. Seat: Stainless steel, ASTM B148.
d. Disc Seat: Buna-N.
e. Pivot Shaft: Stainless steel, Type 17-4 PH.

2.4 NEEDLE VALVES

A. CPVC Needle Valves:

1. Needle valves on CPVC piping shall be manufactured of chlorinated polyvinyl chloride (CPVC) material with seats and seals which are compatible with the process fluid.
2. CPVC shall be Type 4, Grade 1, in accordance with the requirements of ASTM D 1784.
3. Valves shall be true union type or flanged, rated for 150 psi service minimum, and shall be suitable for installation in either the horizontal or vertical plane.
4. Product and Manufacturer: Provide one of the following:
    a. Marquest Scientific.
    b. Hayward Manufacturing Company.
    c. ASAHI/America
    d. Or Approved Equal.

2.5 BALL VALVES

A. CPVC Ball Valves:

1. Ball valves on CPVC piping shall be manufactured of chlorinated polyvinyl chloride (CPVC) material with seats and seals which are compatible with the process fluid.
    a. Teflon or FKM for NaOCl – 12.5%, sodium hypochlorite.
    b. Teflon or EPDM for NaOH – 25%, sodium hydroxide.
2. CPVC shall be Type 4, Grade 1, in accordance with the requirements of ASTM D 1784.
3. Valves shall be true union type and rated for 150 psi service.
4. Ball valves shall be equipped with a drilled ball chamber.
5. CPVC ball valves shall be as manufactured by Hayward, Nibco Incorporated, Manufacturing Company, ASAHI/America, Spears or approved equal.

2.6 PRESSURE REGULATING VALVES

A. Pressure regulators for pressure gage flushing connections, chemical dosage, seal water connections and elsewhere shown or required shall be of CPVC or other

compatible material construction or equivalent seals, and shall have adjustable downstream pressure suitable for the service intended.

B. Seals and Diaphragms:
   1. Teflon or EPDM for NaOH – 25%, sodium hydroxide.
   2. Teflon or FKM for NaOCl – 12.5%, sodium hypochlorite.

C. Pressure regulators shall be manufactured by Hayward, Watts Regulators, Mueller Company, or equal.

D. Manufacturer:
   1. Pressure relief valves shall be supplied by Hayward, Griffco Valve, Inc. or approved equal.

2.7 HIGH FLOW BACKPRESSURE REGULATOR VALVES

A. General:
   1. Each chemical feedline shall include a backpressure valve, as shown on the Drawings. The backpressure valve shall provide sufficient backpressure to accurately operate the chemical feed loop.

B. Materials of Construction:
   1. Valve Body: CPVC
   2. Diaphragm: Teflon Faced
   3. All exposed materials shall be compatible with 25% Sodium Hydroxide and 12.5% Sodium Hypochlorite.

C. Features:
   1. Valve pressure setting shall be factory set and field adjustable without disconnecting the valve from the line.
   2. Size: As shown in the Drawings.
   3. Capacity: Equal to or greater than pumping head capacity at set pressure.

D. Product and Manufacturer: Provide the following:
   1. Griffco Valve, BPG
   2. Or Approved Equal.

2.8 HIGH PRESSURE SAFETY RELIEF VALVES

A. General:
   1. The pump discharge line shall include an external diaphragm type pressure relief valve to protect piping systems from over-pressures, as shown on the Drawings.

B. Materials of Construction:
   1. Valve Body: Type IV, Grade 1, CPVC.
   2. Seals:
      a. Teflon or EPDM for NaOH – 25%, sodium hydroxide.
      b. Teflon or FKM for NaOCl – 12.5%, sodium hypochlorite.
   3. Diaphragm:

a. Teflon or EPDM for NaOH – 25%, sodium hydroxide.
b. Teflon or FKM for NaOCl – 12.5%, sodium hypochlorite.

C. Features:
1. Valve pressure setting shall be factory set and field adjustable without disconnecting the valve from the line.
2. Size: As shown in the Drawings.
3. Capacity: Equal to or greater than pumping head capacity at set pressure.
4. Set pressure: Per pump manufacturer.

D. Manufacturer:
1. Pressure relief valves shall be supplied by Hayward, Griffco Valve, Inc. or approved equal.

2.9 FLOW CONTROL VALVES

A. Globe type 1 flow control valves for 25% Sodium Hydroxide and 12.5% Sodium Hypochlorite Feed Injection Points shall be furnished and installed.

B. Valves shall be calibrated for the chemical conveyed. The valves shall be sized appropriately for the chemical and for the operating conditions of the pressurized feed loop.
1. NaOH – 12 gph
2. NaOCl – 24 gph

C. The chemical properties of Sodium Hydroxide are provided below:
1. Viscosity: 2.2 cPs
2. Specific Gravity: 1.25

D. The chemical properties of Sodium Hypochlorite are provided below:
1. Viscosity: 1.7 cPs
2. Specific Gravity: 1.2

E. Manufacturers:
1. Badger Valve
2. Flow Service
3. Or Approved Equal

F. Type:
1. Globe style control valve to be electrical motor actuated with a 4-20 mA signal.

G. Materials:
1. Body: PVDF
2. Valve Plug: PTFE
3. Seat Ring: PVDF
4. Stem: PVDF
5. Packing: PTFE

6. Bellows Seal: PTFE seamless
7. Body Gaskets: FEP sheathed Viton O-rings
8. Body Bolts: 304 Stainless Steel
9. Maximum Working Pressure: 10 – 15 psi ± 5
    a. Maximum working pressure shall match pump high pressure relief valve maximum pressure per manufacturer.
10. End Connection: ANSI Flanges Class 150.

H. Start-up:
1. Provide the services of qualified factory service technicians/engineers to check and approve the installation of all Flow control valves
2. The factory service technicians/engineers shall be provided for installation supervision, initial setting setup for torque, position signals and limit switches, start-up, testing services and training of the city personnel. The representative shall make a minimum of 3 visits for a total of 8 days to the site to approve the completed installation and to perform start-up testing of the equipment. The duration for each visit will be determined by the CITY/ENGINEER. Each visit will be no less than 4 hours. The representative shall coordinate each visit with the ENGINEER prior to arrival on the site. The representative shall test operate the system in the presence of the ENGINEER and verify that the equipment conforms to the performance requirements of the specifications. The representative shall revisit the job site as often as necessary until the installation and testing are entirely satisfactory.
3. The factory trained service technicians/engineers shall be provided for operation and maintenance personnel training services. The representative shall make a minimum of 2 visits to the site to perform the services as described under Section 01821, Instruction of Operations and Maintenance personnel. The representative shall coordinate each visit with the ENGINEER prior to arrival on the site.
4. For the factory service representative, all costs, including travel, lodging, meals and incidentals, shall be considered as included in the bid price.

I. Flow Control Valve Electric Actuator:
1. Provide electrical actuator with positioner and manual override handwheel.
2. Electric actuator shall have no Bluetooth connection capability.
3. Actuator Model: EVA-1.
4. Position input signal: 4-20 mA.
5. Power Supply: 120 VAC, 1-phase, 60 Hz.
6. Position output signal: 4-20 mA
7. Additional details on actuators can be found in Section 13447, Electric Motor Actuators.

2.10 VALVE APPURTENANCES

A. Extension Stems, Stem Guides, Wrenches, and Keys:
1. Provide intermediate stem guide for extensions more than 7 feet long.

2. Stem brackets and guides shall be made of cast iron and have fully adjustable bronzed bushed guide block. Fasten brackets to walls with approved expansion bolts.
3. Operating nuts about 2-inches square shall be included with each extension stem and located in floor box or grating recess, as required.
4. Provide operating key or wrench of suitable length and size for each valve that is not readily accessible to direct operation.

B. Floor Boxes:
1. Provide cast iron floor boxes for all valves which are to be operated from floor above valve. Boxes shall be equal in depth to floor slab. Boxes shall have cast iron covers and shall be fitted with bronze bushing.

C. Valve Boxes:
1. Provide each buried valve with a valve box as follows:
2. Made of heavy pattern cast iron construction with two-piece adjustable telescoping type.
3. Lower section shall enclose operating nut and stuffing box and rest on bonnet.
4. Inside diameter shall be at least 4-1/2-inches.
5. Provide extension stem and operating nut.
6. Cover shall be heavy-duty cast iron with direction to open arrow cast in.
7. Provide ground level valve position indicator for all buried valves.

D. Handwheels:
1. Conform to the applicable AWWA Standards.
2. Material of Construction: Ductile iron or cast aluminum.
3. Arrow indicating direction of opening and word "OPEN" shall be cast on the trim of the handwheel.
4. Maximum Handwheel Diameter: 30-inches.

2.11 SHOP PAINTING

A. The manufacturer shall paint all CPVC valves to be installed in exterior exposure as follows:
1. Surface Preparation: Clean, dry, and free of contaminants.
2. Prime Coat: Series 66 H.B Epoxoline; one coat, 3-5 mils DFT.
3. CONTRACTOR shall determine the quantity of each type of valve to the manufacturer.
4. CONTRACTOR shall provide finished coat per Section 09900, Painting. Final color selection shall be approved by ENGINEER prior to application.

B. Valves, appurtenances, etc., shall receive shop primer and shop finish coating conforming to the requirements of Section 09900, Painting. If any damage to the paint system occurs, the equipment shall be repainted as directed by the ENGINEER.

C. Surface preparation and painting shall conform to the requirements of Section 09900, Painting.

D. All gears, bearing surfaces, machined surfaces and other surfaces which are to remain unpainted shall receive a heavy application of grease or other rust-resistant coating. This coating shall be maintained during storage and until the equipment is placed into operation.

E. Certify, in writing, that the shop primer and shop finish coating system conforms to the requirements of Section 09900, Painting.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Workmanship shall be of the highest grade throughout and in accordance with the best standard practice for this type of equipment.

B. Valves of the various types and pattern shall be installed at the respective locations as shown on the Drawings, listed in the Equipment Schedule, and specified herein. All appurtenances required for operation and control of the valves shall be included. Joints and connections shall be made in accordance with applicable requirements for pipe line or pipe joints. Valve stems shall be plumb and vertical unless otherwise specifically shown. Each valve shall be adjusted for smooth and easy operation and shall be watertight when placed in operation under maximum working pressure.

3.2 MANUFACTURER'S FIELD SERVICE

A. Equipment Start-up: A factory trained representative of the manufacturer shall visit the site and provide installation and start-up services as specified in Section 01650, Starting of Systems. Sales representatives shall not be acceptable to perform start-up and training functions.

B. Training: A factory employed representative of the manufacturer shall visit the site and provide operator training services, in addition to equipment start-up services, as specified in Section 01650, Starting of Systems.

++ END OF SECTION ++

SECTION 11310

VERTICAL TURBINE PUMPS

PART 1 - GENERAL

1.1 SUMMARY

A. CONTRACTOR shall furnish and install one (1) vertical turbine pump with axial type impellers and motor drivers as scheduled. The pump is to be installed in a wet well configuration, and capable of pumping mixed liquor suspended solids (MLSS) from the Aeration Basin Effluent Channel to the IMLR Discharge Channel.

1.2 SECTION INCLUDES

A. Vertical turbine pump.

B. Motor.

1.3 RELATED SECTIONS

A. Division 1, General Requirements.

B. Section 01300, Submittals.

C. Section 01640, Materials and Equipment.

D. Section 01650, Starting of Systems.

E. Section 09900, Painting.

F. Section 11295, Hydraulic Valves.

G. Division 13, Special Construction.

H. Division 16, Electrical.

I. Section 16225, Electric Motors 250 Horsepower or Less.

1.4 REFERENCES

A. ANSI/AWWA E103-21, Horizontal and Vertical Line-Shaft Pumps.

1.5 REFERENCE STANDARDS

A. Comply with applicable provisions and recommendations of the following, except as shown otherwise.
   1. Standards of the Hydraulic Institute.

2. Standards of the American Water Works Association.
3. National Electrical Code.
4. Standards of National Electrical Manufacturers Association.
5. Institute of Electrical and Electronic Engineers.
6. American Gear Manufacturers Association.
7. American National Standards Institute.
8. Anti-Friction Bearing Manufacturers Association.

1.6 SUBMITTALS

A. Descriptive submittals shall be made in accordance with the Data Reference Symbols defined in Section 01300, Submittals.
   1. Shop Drawings:
      a. Letters of Certification of Compliance on materials, equipment, etc.
      b. Final Certified Drawings showing outline dimensions, foundation layout or mounting information, and other pertinent dimensions.
      c. Field erection instructions, assembly drawings and/or diagrams, detailed reference drawing lists, lists of erection details, and list of spare parts supplied with equipment.
      d. Shop Detail Drawings showing individual sub-assemblies and fabricated pieces with material specifications and other applicable data.
      e. Installation instructions, operating and/or service manuals, and all other data pertinent to operating or servicing the complete apparatus. Preventative maintenance instructions and recommended frequency.
      f. Schematic and wiring diagrams of power, control, and piping systems. A detailed description of operation shall be included for each diagram to describe all modes of operation of the system indicated. Where the integrated system requires interlocking and control of other components in normal operation, these components shall be included in the description of operation.
      g. General bulletins and catalog cuts describing complete apparatus, including operating principles and fundamentals.
      h. Service data sheets showing design performance, utility requirements, etc., as applicable to the specific duty for which the equipment is furnished.
      i. Certified head and capacity curves for pumps. Impeller size furnished and maximum size available shall be noted on these data sheets.
      j. Curves and/or data for overall range of operation from minimum to maximum capacity or load, showing capacity or load, utilities motive medium required, total or incremental differential head, and other pertinent information applicable to the equipment or its component assemblies.
      k. Materials of construction of all components.
      l. Renewal parts list with diagrammatic or cross-section drawings showing part identification. Material analysis or trades designation for each significant part is to be noted on parts lists or on a separate sheet.
      m. Stuffing box sizes; packing sizes; specifications, and arrangement; and mechanical seal details, specifications, etc., if furnished in equipment.

n. Bearing manufacturer's standard identification and/or interchangeable number for all anti-friction bearings in the equipment proper and its accessory items.
o. Material gradation, design mix, job mix formula, and/or material analysis.

2. O&M Manuals:
   a. Final Certified Drawings showing outline dimensions, foundation layout or mounting information, and other pertinent dimensions.
   b. Field erection instructions, assembly drawings and/or diagrams, detailed reference drawing lists, lists of erection details, and list of spare parts supplied with equipment.
   c. Shop Detail Drawings showing individual sub-assemblies and fabricated pieces with material specifications and other applicable data.
   d. Installation instructions, operating and/or service manuals, and all other data pertinent to operating or servicing the complete apparatus. Preventative maintenance instructions and recommended frequency.
   e. Schematic and wiring diagrams of power, control, and piping systems. A detailed description of operation shall be included for each diagram to describe all modes of operation of the system indicated. Where the integrated system requires interlocking and control of other components in normal operation, these components shall be included in the description of operation.
   f. General bulletins and catalog cuts describing complete apparatus, including operating principles and fundamentals.
   g. Service data sheets showing design performance, utility requirements, etc., as applicable to the specific duty for which the equipment is furnished.
   h. Certified head and capacity curves for pumps. Impeller size furnished and maximum size available shall be noted on these data sheets.
   i. Curves and/or data for overall range of operation from minimum to maximum capacity or load, showing capacity or load, utilities motive medium required, total or incremental differential head, and other pertinent information applicable to the equipment or its component assemblies.
   j. Materials of construction of all components.
   k. Renewal parts list with diagrammatic or cross-section drawings showing part identification. Material analysis or trades designation for each significant part is to be noted on parts lists or on a separate sheet.
   l. Stuffing box sizes; packing sizes; specifications, and arrangement; and mechanical seal details, specifications, etc., if furnished in equipment.
   m. Bearing manufacturer's standard identification and/or interchangeable number for all anti-friction bearings in the equipment proper and its accessory items.
   n. Material gradation, design mix, job mix formula, and/or material analysis.

3. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the

specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

4. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**

1.7 QUALITY ASSURANCE

A. Component Supply and Compatibility:
   1. Obtain new vertical turbine pump and the equipment for the new pump included in this Specification, regardless of the component manufacturer, from a single pump manufacturer.
   2. The pump manufacturer shall review and approve or shall prepare all Shop Drawings and other submittals for all components furnished under this Specification.
   3. All components shall be specifically designed for pumping service and shall be integrated into the overall equipment design by the pump manufacturer.

B. Shop Tests:
   1. All pumps shall be shop performance tested.
   2. All tests shall be witnessed by a Registered Professional Engineer, who may or may not be an employee of the manufacturer. The Registered Professional Engineer shall sign and seal all copies of curves and shall certify that hydrostatic tests were performed. The State of registration, registration number, and his name on the seal shall be clearly legible. Tests shall be conducted in conformance with the methods described in Section 5 of AWWA E103-21.
   3. Hydrostatic Test: All pump discharge heads and bowl assemblies shall be hydrostatically tested to twice the total head or 1-1/2 times the shutoff head, whichever is greater.
   4. Performance Test Requirements:
      a. Pump bowl assembly shall be operated from zero to maximum capacity as shown on the approved curve. Results of the test shall be shown in a plot of test curves showing head, flow, horsepower, efficiency, and current drawn. Readings shall be taken at a minimum of seven evenly spaced

capacity points, including shutoff, design point, and 125% of flow at best efficiency point (BEP).

b. Tests shall be run in the shop utilizing either the job motor or a calibrated shop motor. If a calibrated shop motor is used, the wire-to-water efficiency of the pump and motor shall be based on the job drive motor efficiency data determined during the motor shop performance tests. The tests shall be run using the complete bowl assembly and shall be conducted with the manufacturer's recommended minimum submergence of water above the bottom of the suction bell.

c. Curves shall be corrected for column and discharge head losses, shaft friction loss, and operating speed to show the anticipated field performance of the complete pump assembly.

d. Performance of the pumping units shall be at a minimum, within the following tolerance of test acceptance grade 2B as specified in the Hydraulics Institute Standard, latest revision, when operated at design speed and capacity.

e. The pump shall be run for at least 30 minutes at the design point before any readings are obtained.

f. Should the test results indicate that the pumping unit does not meet the above requirements, it shall be modified at no additional cost to the OWNER and retested until full compliance with specified performance can be demonstrated.

g. OWNER and/or ENGINEER shall be permitted to witness the retest.

5. All test measurements shall be taken with properly calibrated instruments and all procedures shall conform to the test code of the Hydraulics Institute, unless modified herein.

6. Pumps shall not be shipped until the ENGINEER has approved the test reports and test curves.

7. Job Motor Shop Tests:
   a. Each motor shall be given a complete initial shop test.
   b. Tests shall provide the following minimum information:
      1) Starting torque.
      2) Efficiency at 1/2, 3/4, and full load.
      3) Power factor at 1/2, 3/4, and full load.
      4) Percent slip.
      5) No load, running light, full load, and locked rotor current.
      6) Current balance check.
      7) Test curves for current, voltage, brake horsepower, and power factor.
      8) Full load heat run.
      9) Vibration check (one test for each size motor).
      10) Temperature rises and results of dielectric test.
      11) Motor type and frame size.
      12) Bearing type and lubrication medium.
      13) Insulation and enclosure type.
   c. If the shop tests results indicate that a motor does not conform to specified or performance as stated herein, the motor shall be modified and retested,

at no additional cost to the OWNER, until full compliance with specified and guaranteed performance can be demonstrated. OWNER and ENGINEER shall be permitted to witness the retest.

d. No motor shall be shipped from the motor manufacturer's plant until all test data have been approved by the ENGINEER.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer shall have a minimum of five years of experience in the production of substantially similar equipment with similar usage and shall show evidence of satisfactory operation in at least five installations for a period of at least three years. Manufacturer shall provide references to the ENGINEER with contact names and telephone numbers for at least three facilities with similar usage. The above information is to enquire the operation of the pumps in these installations.

B. The vertical turbine pumps shall be as manufactured by one of the following (Manufacturers listed in alphabetical order):
   1. Cascade
   2. Fairbanks Morse
   3. Or Approved Equal

2.2 SERVICE CONDITIONS

A. Pumps shall be vertical line-shaft type suitable for MLSS up to a concentration of 3300 mg/L at water temperatures varying from 50° F to 85° F.

B. The characteristic curve of the pump shall rise from minimum head condition to shutoff without dips. The complete pumping unit consisting of the pump and respective motor shall be suitable in all respects for continuous, stable performance when operating at any point on the characteristic curve between not greater than 25% of flow at best efficiency point and minimum head condition (flow 25% greater than flow at best efficiency point) without cavitation and in accordance with the vibration criteria specified herein.

C. Pumps shall be specially designed, constructed, and installed for the service specified and shall comply with the design conditions as specified herein.

2.3 MATERIALS

A. General: Materials shall be the type and grade as specified as the following:
   1. Cast iron: ASTM A 48, Class 30 minimum.
   2. Nickel cast iron: ASTM A 48, minimum Class 30, cast iron with 3 percent nickel.
   3. Gray iron casting: ASTM A 278, Class 30.

4. Iron-chromium alloy: ASTM A 743, Grade CA40; ASTM A 276, Type 420 Stainless Steel may be substituted; Brinell Hardness Number of 350 to 380.
5. Leaded tin bronze: ASTM B 505, Alloy C92700.
6. Bronze or bismuth bronze: ASTM B 584, Alloy C89835.
7. Leaded red brass: ASTM B 584, Alloy C90300, leaded red brass.
8. 416 stainless: ASTM A 582, Type 416 Stainless Steel.
9. Neoprene: Polychloroprene rubber.
10. Steel: ASTM A 283, Grade D or ASTM A36
11. Steel pipe: ASTM A 53, Grade B.
12. Aluminum bronze: ASTM B 148.

2.4 COMPONENTS

A. General Pump Construction:
   1. Type: Industrial, heavy duty, vertical turbine type pumps meeting performance requirements and features as scheduled and as specified.
   2. Discharge flange: ASME B16.1 or B16.5 drilled; rated for 1.2 times the pump shutoff head at 150 degrees Fahrenheit.
   3. Discharge nozzles: Provide 1/2-inch NPT taps for pressure gauges; install nipple and gauge with block valve.
   4. Bearings:
      a. Design driver/motor bearings to support the line shaft assembly and rated for ABMA L10 life of 40,000 hours at Design Rated Point flow and head in accordance with ABMA 9 or ABMA 11.
      b. Design motor to withstand continuous duty full load thrust and momentary upthrust that may occur during pump on/off or other operations.
   5. Fasteners: Provide Type 316 stainless steel fasteners in accordance with ASTM F 593 or ASTM F 594.

B. Pump Suction Assembly:
   1. Pump suction assembly: Provide suction bell. Provide anti-vortex baffles or strainer when scheduled.
   2. Design suction bells and provide strainers and anti-vortex baffles to minimize solids plugging and vortex formation. Screens to have a flow area at least 4 times the suction pipe area. The installation of the anti-vortex device shall not require complete drainage of the wet well.
   3. Materials:
      a. Pump suction bell: As scheduled.
      b. Pump suction bell bearing: As scheduled.

C. Pump Impeller Bowl Assembly:
   1. Pump impeller assembly:
      a. Type: As scheduled.
      b. Maximum number of vanes: As scheduled.
      c. Number of stages: As scheduled.

d. Required balance: Vibration limits shall be in accordance with the Hydraulic Institute Standards. Field vibration tests shall be performed after installation of all equipment in the pumping system. Vibration analysis shall be conducted for the entire pumping system. The analysis shall be conducted after obtaining all the information from individual component manufacturers. The analysis shall incorporate pump and motor manufacturer and an overall vibration analysis shall be performed. Calculations shall be prepared, stamped, and signed by a Registered Professional Engineer who is regularly involved with this type of work. Calculations shall be submitted to the ENGINEER for record purposes only. The submittals will not imply review or approval by the ENGINEER of the analysis involved. CONTRACTOR shall be solely responsible for analyzing and installing a vibration free installation of the pumping system.
e. Method of securing impellers to shafts: Keyed and secured by a bronze nut locked in place or locked by other methods acceptable to the Engineer.
f. Provide any special tools required for removal and installation of pump impellers.
g. Provisions for adjustment of axial clearance: Make such adjustment through use of motor adjusting nut or adjustable coupling.
h. Impeller thrust: When appropriate for the specified impeller type, provide hydraulically balanced impeller to minimize down thrust.

2. Intermediate and discharge impeller cases:
   a. Material: As scheduled.
   b. Attached with bolting.
3. Pump impeller bowl bearings: Provide bearing for each impeller; material as scheduled.
4. Diffusion vanes: Provide vanes cast into bowl.

D. Line Shafts:
1. Enclosed line shaft, water flush lubricated:
   a. Shaft and couplings: Provide flanged shaft couplings with key or set screw locking of shaft couplings.
2. Shaft bearings: Provide bearings as scheduled, but not to exceed 10 feet.
3. Enclosing tube: Schedule 80 steel pipe, coated on the outside.
4. Materials: As scheduled; when not scheduled provide:
   a. Shaft and couplings: ASTM Type 416 stainless steel.
   b. Shaft bearings: Provide bearings as scheduled, but not to exceed 10 feet.
   c. Enclosing tube: Steel pipe, ASTM A 53, Grade B unless scheduled otherwise, coated on the outside.
   d. Lineshaft bearing and discharge bowl bushing shall be lubricated by a pressured water flush system provided by plan water. An external stainless steel line connected at the pump baseplate shall lubricate the suction bow bushing. Lubrication water shall be connected to the packing box and fitting at the pump baseplate using 1/4” NPT fittings.

5. Design strength: Able to withstand minimum 1.5 times maximum operating torque and other loads.
6. Resonant frequency: Ensure there are no natural resonant frequencies within 25 percent above or below the operating rotational frequencies or multiples of the operating rotational frequencies that may be excited by the equipment design.
7. Sleeves: Provide shafting with Type 316 stainless steel sleeve or hardened sleeves where shafts pass through bearings or stuffing boxes as scheduled; Brinell 550 or higher for hardened shaft; when the specified mechanical seals cannot be installed on a hardened shaft, hardened shafts are not required in the area of the mechanical seal.
8. Design pump line shafting in interchangeable lengths as scheduled, but not to exceed 10 feet; shaft lengths to match scheduled pump column lengths.
9. Coupling strength: Design driver to pump line shaft coupling of sufficient length and strength to maintain line shaft alignment.
10. Adjustment:
    a. Design a means to adjust shaft position to adjust impeller position.
    b. For motor driven units with solid shaft motors, design driver to pump line shaft coupling to allow adjustment of the impeller position.
    c. For motor driven units with hollow shafts, an adjusting nut may be provided at the top of the motor shaft.
11. Spacer coupling: When mechanical seals are scheduled, provide an adjustable spacer coupling to allow removal of the seal without driver removal.

E. Pump Column Pipe:
1. Pump column pipe: Thickness and material as scheduled.
2. Head connection: Design with flanged and bolted connection to discharge head and flanged and bolted connection to impeller assembly to permit removal of impeller bowl assembly without disturbing the column or discharge connections.
3. Design Working Pressure: Design to withstand a design working pressure not less than 1.20 times the maximum shutoff total dynamic head with the maximum diameter impeller at the maximum operating speed plus the maximum suction static head.
4. Pressure test: Design to withstand a 5 minute hydrostatic test pressure not less than 1.5 times the design working pressure; perform test at source.
5. Lengths and connections: Design with maximum 10 foot length, or less if scheduled, interchangeable column sections with flanged or threaded with registered fit screwed connections as scheduled.
6. Diameter: Design column inside diameter for no more than 4 feet of fluid friction loss per 100 feet of column length.

F. Pump Discharge Head Assembly:
1. Design the discharge head for above or base discharge as scheduled.
2. Design the discharge vertical to horizontal flow transition as a smooth pipe elbow or from a minimum of 3 pipe pieces mitered to form the elbow.
3. Design discharge head to mate with the driver as scheduled.

4. Head and base plate construction: Sufficient strength, weight, and thickness to provide accurate alignment, prevent excessive deflection and support the drive motor.
5. Discharge head shall be designed to support the drive unit and entire pump assembly as shown per the drawings. The discharge head shall be manufactured by the pump original equipment manufacturer (OEM.) Discharge heads purchased or manufactured from a source other than the pump OEM shall not be acceptable.
6. Stuffing box and seal:
    a. Design the discharge head with a stuffing box to accommodate packing or mechanical seals as scheduled.
    b. Packing: When packing scheduled, provide stuffing box arranged for packing (sized for bronze lantern ring and 6 packing rings minimum); provide hollow shaft motor with top adjusting nut.
    c. Mechanical seal: When scheduled, provide stuffing box suitable for the specified seal and provide solid shaft motor with spacer coupling.
    d. Additional seal or packing requirements: As specified in Section 15050.
    e. Drain: Provide drain, minimum 3/4 inch size, for pump stuffing box leakage, together with drain line to the pump can or wet well or to nearest equipment drain as indicated on the Drawings.
7. Discharge vent: Vendor to provide ¾ NPT fitting. See Section 15120, Piping Specialties and Accessories, for pipe nipple. See Section 11295, Hydraulic Valves, for gate valve.
8. Materials: As scheduled; when not scheduled, provide:
    a. Pump discharge head/driver stand: Steel, ASTM A 283, Grade B and/or ASTM A 53, Grade B; or Cast iron, ASTM A 48, Class 30 minimum.
    b. Pump discharge head sleeve bearing: ASTM B 584, Alloy C89835, bismuth bronze.
    c. Stuffing box and seal: Container and gland, Cast iron, ASTM A 48, Class 30 minimum; Neoprene top shaft seal.

G. Equipment Guards:
1. Provide equipment safety guards as recommended by pump manufacturer and specified herein.
2. Coupling guards shall be 16 gage stainless steel expanded metal and connected to the discharge head with stainless steel hinges.

H. Drivers:
1. Horsepower:
    a. As scheduled.
    b. Listed driver horsepower is the minimum to be supplied.
        1) Increase driver horsepower if required to prevent driver overload while operating at any point of the supplied pump operating head-flow curve including runout.
        2) When scheduled driver is a motor, increase motor horsepower if required to prevent operation in the service factor.

3) Make all structural, mechanical, and electrical changes required to accommodate increased horsepower.

I. Motors: Provide motors as specified in Section 16225, Electric Motors 250 Horsepower or Less, and as specified in this Section:
   a. RPM: As scheduled.
   b. Enclosure: As scheduled.
   c. Electrical characteristics: As scheduled.
   d. Efficiency, service factor, insulation, and other motor characteristics: As specified in Section 16225, Electric Motors 250 Horsepower or Less.
   e. Motor accessories: As specified in Section 16225, Electric Motors 250 Horsepower or Less, and in this Section.
   f. Coordinate motors with the variable frequency drive manufacturer to ensure compatibility between the motor and variable frequency drive.
2. Other drivers: As scheduled and as specified in sections listed in the Schedule.
3. Non-reverse ratchets: When scheduled, provide driver with nonreverse ratchets or pin mechanism to prevent reverse rotation of the pump and driver in the event of discharge valve failure.

J. Supports:
1. Strength: Design pump discharge head and driver (motor or engine) supports to withstand a minimum of 1.5 times the maximum imposed operating loads or the imposed seismic loads, whichever is greater.
2. Resonant frequency: Design supports in conjunction with the pump, shafting, drivers, bearings, and other components to avoid natural resonant frequencies, either torsional, radial, or axial as specified below:
   1) Test requirement:
      a) Measure filtered vibration spectra versus frequency and measure vibration phase in 3 perpendicular planes at each normally accessible bearing housing on the driven equipment, any gears and on the driver; 1 plane of measurement to be parallel to the axis of rotation of the component; measure actual rotational speeds for each vibration spectra measured using photometric or other tachometer input connected directly to the vibration data collector.
      b) Vibration spectra versus frequency shall be in accordance with Vibration Acceptance Criteria.
   c) Equipment operating condition: Repeat test requirements at design specified maximum speed and at minimum speed for variable speed equipment.
   d) Natural frequency test of field installed equipment:
      e) Excite the installed equipment and support system in 3 perpendicular planes, use same planes as operating vibration measurement planes, and determine the as-installed natural resonant frequency of the driven equipment, the driver, gears and supports.

f) Perform test at each bearing housing, at each support pedestal, and for pumps on the suction and discharge piping.
g) Perform with equipment and attached piping full of intended service or process fluid.

3. Coordinate pump and drive system supports with the foundation designs as indicated on the Drawings.
4. Anchor bolts: As specified in Section 03252.

2.5 DESIGN CRITERIA

A. Pump Schedule:

General Characteristics	
Service	Mixed Liquor Return
Quantity	1
Maximum Noise, dBA at 3 feet	85
Minimum Pumped Fluid Degrees Fahrenheit	50
Normal Pumped Fluid Degrees Fahrenheit	70
Maximum Pumped Fluid Degrees Fahrenheit	85
Pump Characteristics	
Number of Stages	Per Manufacturer
Impeller Type	Axial Flow
Impeller, Maximum Number of Vanes	Per Manufacturer
Pass Minimum Sphere Size, Inch	3.5
Pump Impeller Bowl Bearing Lubrication	Water Flush
Suction Bowl bearing Lubrication	Water Flush
Suction Strainer or Suction Cone	Required, By Vendor. See Section 2.4.B
Line Shaft Type	Enclosed
Maximum Line Shaft Bearing Spacing, Feet	10
Line Shaft Lubrication	Water Flush
Discharge Shaft Seal Type	Single Mechanical
Column Connection Type	Flanged
Column Diameter, Inch	20
Maximum Column Section Lengths, Feet	10
Discharge Arrangement	Above Base

Coupling Type	Spacer
Speed Control	Variable Frequency Drive (VFD)
Maximum Pump RPM	1200
Rated Design Point (at Maximum Revolutions per Minute)	
Flow, gpm	8,500
Head, Feet	18
Pump Discharge Centerline Elevation, Feet	1199.35
Minimum Pump Efficiency, Percent	79
Pump Materials	
Suction Bell	Cast Iron
Suction Bell Bearing	High Lead Tin Bronze
Impeller Cases	Cast Iron
Impeller	Aluminum Bronze
Impeller Bearing	Bronze
Impeller Shaft Key	Type 416 Stainless Steel
Line Shaft and Coupling	Type 416 Stainless Steel
Line Shaft Bearings	Bronze
Shaft Enclosing Tube	Steel Pipe, 3/8" or 0.01x Pipe ID or Schedule 80
Shaft Sleeve	N/A
Column Material and Thickness, Inch	Steel Pipe, 3/8"
Discharge Head/Driver Stand	Fabricated Steel
Discharge Head Bearing	Bismuth Bronze
Discharge Stuffing Box	Cast Iron
Driver Characteristics	
Driver Type	Motor
Driver Arrangement	Vertical, Coupled
Non-Reverse Ratchets	Required
Maximum Driver Horsepower	60
Maximum Driver RPM	1,200

Inverter Duty Rated	Yes
Motor Voltage/Phases/Hertz	460/3/60
Enclosure Type	TEFC

2.6

2.6 SOURCE QUALITY CONTROL TESTING

A. Pump Performance Test
   1. Test 2 hours minimum for flow and head at the rated condition; for factory testing, testing may be at reduced speeds with flow and head corresponding to the rated condition when adjusted for speed using the appropriate affinity laws.
   2. Use of a test driver is permitted for factory tests when actual driver is given a separate test at its point of manufacture as specified in Section 16225. Use actual driver for field tests.
   3. Test for flow and head at 2 additional conditions; 1 at 25 percent below the rated flow and 1 at 10 percent above the rated flow.
   4. Record measured flow, suction pressure, discharge pressure, and observations on bearing temperatures and noise levels at each condition.

B. Noise Test
   1. Measure unfiltered overall A-weighted sound pressure level in dBA at 3 feet horizontally from the surface of the equipment and at a mid-point of the equipment height.

2.7 FIELD QUALITY CONTROL TESTING

A. Pump Performance Test
   1. Measure flow and head while operating at or near the rated condition; for factory testing, testing may be at reduced speeds with flow and head corresponding to the rated condition when adjusted for speed using the appropriate affinity laws.
   2. Use of a test driver is permitted for factory tests when actual driver is given a separate test at its point of manufacture as specified in Section 16225 or the applicable equipment section. Use actual driver for field tests.
   3. Record measured flow, suction pressure, discharge pressure, and observations on bearing temperatures and noise levels.

B. Vibration Test
   1. Test requirement:
      a. Measure filtered vibration spectra versus frequency and measure vibration phase in 3 perpendicular planes at each normally accessible bearing housing on the driven equipment, any gears and on the driver; 1 plane of measurement to be parallel to the axis of rotation of the component; measure actual rotational speeds for each vibration spectra measured using

photometric or other tachometer input connected directly to the vibration data collector.

b. Vibration spectra versus frequency shall be in accordance with Vibration Acceptance Criteria.

2. Equipment operating condition: Repeat test requirements at design specified maximum speed and at minimum speed for variable speed equipment.

3. Test requirement:

a. Excite the installed equipment and support system in 3 perpendicular planes, use same planes as operating vibration measurement planes, and determine the as-installed natural resonant frequency of the driven equipment, the driver, gears and supports.

b. Perform test at each bearing housing, at each support pedestal, and for pumps on the suction and discharge piping.

c. Perform with equipment and attached piping full of intended service or process fluid.

C. Noise Test:

1. Measure unfiltered overall A-weighted sound pressure level in dBA at 3 feet horizontally from the surface of the equipment and at a mid-point of the equipment height.

2.8 COATING AND FINISHING

A. Prepare surfaces and apply protective coatings as specified in Section 09900, Painting.

2.9 SPARE EQUIPMENT

A. Deliver the following spare parts to Owner; pack and label for storage.

1. Line shaft bronze bearings: 1 set for each type pump.
2. Mechanical seal: 1 complete seal of each type.
3. Motor/gear thrust bearing set: 1 for each type of pump.
4. Motor radial bearing set: 1 for each size of motor (if specified).

PART 3 -

PART 3 - EXECUTION

3.1 INSTALLATION

A. Pump shall be accurately aligned as specified by the use of steel shims or other approved methods so no binding in any moving parts or distortion of any member occurs before equipment is finally secured in place. After completion of alignment, equipment shall be carefully secured in place by anchor bolts.

B. All items of equipment shall be thoroughly lubricated in accordance with the manufacturer's recommendations.

C. When all items of equipment have been properly installed, the CONTRACTOR shall carefully start equipment, operate and adjust it through a sufficient number of cycles to demonstrate to the satisfaction of the OWNER that all items meet requirements of the Specification in all respects and are suitable for performing the Work intended under all possible operating conditions.

3.2 FACTORY CERTIFIED TEST

A. A factory performance test shall be performed on each pump in accordance with the Hydraulic Institute Standards. The ENGINEER shall review and approve results of test prior to shipment of pump.

B. All costs, including travel, lodging, meals, and incidentals, shall be considered in the CONTRACTOR'S lump sum bid.

3.3 FIELD TEST

A. After all preliminary tests and adjustments have been completed each motor and pump shall be given a continuous test run of not less than two hours. During test periods, head conditions, time, and flow meter readings shall be carefully logged for the pump to determine actual quantities produced. Results are to be compared to a certified pump curve.

B. The CONTRACTOR shall provide the services of an Engineer to conduct the vibration tests. The Engineer shall be recognized as an expert in the field of vibration analysis and control and shall have qualifications acceptable to the ENGINEER.

C. Field performance tests shall be performed in the presence of the ENGINEER.

D. CONTRACTOR shall verify that structures, pipes, and equipment are compatible.

3.4 MANUFACTURER'S FIELD SERVICE

A. Equipment Start-up: A factory employed representative of the manufacturer shall visit the site and provide installation and start-up services, as specified in Section 01650, Starting of Systems. Installation and start-up service shall be for a period of four days (eight hours/day). Two field trips shall be included. Sales representatives shall not be acceptable to perform start-up and training functions.

B. Training: A factory employed representative of the manufacturer shall visit the site and provide operator training services, in addition to equipment start-up services, as specified in Section 01821, Instructions of Operations and Maintenance Personnel . A minimum of a four hour time period is required for training services.

++ END OF SECTION ++

SECTION 11313

LOW-FLOW PROPELLER (IMLR) PUMPS

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish and install a total of two (2) submersible horizontal propeller Internal Mixed Liquor Return (IMLR) pumps in the existing MBR Bioreactors No. 1 & No. 2. In addition, the CONTRACTOR shall furnish and deliver a third IMLR pump to the facility staff to store as a spare unit.

1.2 SECTION INCLUDES

A. Low-flow propeller pump.

1.3 RELATED SECTIONS

A. Section 01300, Submittals.

B. Section 01640, Materials and Equipment.

C. Section 01650, Starting of Systems.

D. Division 16, Electrical.

1.4 SUBMITTALS

A. Descriptive submittals shall be made in accordance with the Data Reference Symbols defined in Section 01300, Submittals.
   1. Low-Flow Propeller Pump Shop Drawings:
      a. Letters of Certification of Compliance on materials, equipment, etc.
      b. Final Certified Drawings showing outline dimensions, foundation layout or mounting information, and other pertinent dimensions sealed by Professional Engineer registered in the State of Arizona.
      c. Calculations to be signed and sealed by a Professional Engineer registered in the State of Arizona.
      d. Field erection instructions, assembly drawings and/or diagrams, detailed reference drawing lists, lists of erection details, and list of spare parts supplied with equipment.
      e. Shop Detail Drawings showing individual sub- assemblies and fabricated pieces with material specifications and other applicable data.
      f. Installation instructions, operating and/or service manuals, and all other data pertinent to operating or servicing the complete apparatus. Preventative maintenance instructions and recommended frequency.

g. Schematic and wiring diagrams of power, control, and piping systems. A detailed description of operation shall be included for each diagram to describe all modes of operation of the system indicated. Where the integrated system requires interlocking and control of other components in normal operation, these components shall be included in the description of operation.
h. General bulletins and catalog cuts describing complete apparatus, including operating principles and fundamentals.
i. Service data sheets showing design performance, utility requirements, etc., as applicable to the specific duty for which the equipment is furnished.
j. Certified head and capacity curves for pumps. Impeller size furnished and maximum size available shall be noted on these data sheets.
k. Curves and/or data for overall range of operation from minimum to maximum capacity or load, showing capacity or load, utilities motive medium required, total or incremental differential head, and other pertinent information applicable to the equipment or its component assemblies.
l. Materials of construction of all components.
m. Renewal parts list with diagrammatic or cross-section drawings showing part identification. Material analysis or trades designation for each significant part is to be noted on parts lists or on a separate sheet.
n. Stuffing box sizes; packing sizes; specifications and arrangement; and mechanical seal details, specifications, etc., if furnished in equipment.
o. Bearing manufacturer's standard identification and/or interchangeable number for all anti-friction bearings in the equipment proper and its accessory items.

2. Low-Flow Propeller Pump: O&M Manuals:
a. Final Certified Drawings showing outline dimensions, foundation layout or mounting information, and other pertinent dimensions.
b. Field erection instructions, assembly drawings and/or diagrams, detailed reference drawing lists, lists of erection details, and list of spare parts supplied with equipment.
c. Shop Detail Drawings showing individual sub- assemblies and fabricated pieces with material specifications and other applicable data.
d. Installation instructions, operating and/or service manuals, and all other data pertinent to operating or servicing the complete apparatus.
e. Preventative maintenance instructions and recommended frequency.
f. Schematic and wiring diagrams of power, control, and piping systems. A detailed description of operation shall be included for each diagram to describe all modes of operation of the system indicated. Where the integrated system requires interlocking and control of other components in normal operation, these components shall be included in the description of operation.
g. General bulletins and catalog cuts describing complete apparatus, including operating principles and fundamentals.
h. Service data sheets showing design performance, utility requirements, etc., as applicable to the specific duty for which the equipment is furnished.

i. Certified head and capacity curves for pumps. Impeller size furnished and maximum size available shall be noted on these data sheets.
j. Curves and/or data for overall range of operation from minimum to maximum capacity or load, showing capacity or load, utilities motive medium required, total or incremental differential head, and other pertinent information applicable to the equipment or its component assemblies.
k. Materials of construction of all components.
l. Renewal parts list with diagrammatic or cross-section drawings showing part identification. Material analysis or trades designation for each significant part is to be noted on parts lists or on a separate sheet.
m. Stuffing box sizes; packing sizes; specifications and arrangement; and mechanical seal details, specifications, etc., if furnished in equipment.
n. Bearing manufacturer's standard identification and/or interchangeable number for all anti-friction bearings in the equipment proper and its accessory items.

3. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
4. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**

1.5 WARRANTY

A. The pump manufacturer shall warrant the units being supplied to the OWNER against defects in workmanship and material for a period of five years under normal use, operation, and service. The warranty shall cover parts and labor and shall be in printed form and apply to all similar units.

PART 2 - PRODUCTS

2.1 QUALITY ASSURANCE - REFERENCE STANDARDS

A. American Iron and Steel Institute (AISI).

B. American Society for Testing and Materials (ASTM).

C. Factory Mutual (FM).

D. National Fire Protection Agency (NFPA).

E. National Electric Code (NEC).

F. National Electrical Manufacturers Association (NEMA).

G. Anti-Friction Bearing Manufacturers Association (AFBMA).

H. International Standards Organization (ISO)-ISO9001.

2.2 MANUFACTURERS

A. Acceptable Manufacturers:
   1. ITT Flygt.
   2. Grundfos.
   3. Approved equal.

2.3 DESIGN CRITERIA

A. Low-Flow Propeller (IMLR) Pump Design Criteria:

<table>
<tr><th>DESCRIPTION</th><th>NO. OF PUMPS
VFD</th><th colspan="2">OPERATING CONDITIONS</th></tr>
<tr><td rowspan="16">MBR Bioreactors</td><td rowspan="16">3</td><td colspan="2">See system head curve for design rated point. The pump specified shall be capable of pumping the required flow along the entire system head curve. One pump in operation shall operate at full speed around 11,389 gpm at a TDH of 3.9 feet. In addition to the above, one pump in operation shall be capable of pumping 5,700 gpm to 11,389 gpm between a speed of 40 Hz and 60 Hz, respectively.</td></tr>
<tr><td colspan="2">The pump shall operate at the following Rated Design Point:</td></tr>
<tr><td>Flow (gpm)</td><td>Total Dynamic Head (feet)</td></tr>
<tr><td>11,389</td><td>3.4</td></tr>
<tr><td colspan="2">The pump shall operate along a pump curve at the specified points:</td></tr>
<tr><td>Flow (gpm)</td><td>Head (feet)</td></tr>
<tr><td>5,700</td><td>1.0</td></tr>
<tr><td>11,389</td><td>3.4</td></tr>
<tr><td colspan="2">Minimum Overall Pump Efficiency at Rated Design Point - 44%</td></tr>
<tr><td colspan="2">Motor Efficiency: 82%</td></tr>
<tr><td colspan="2">Pump Efficiency at Rated Design Point: 50%</td></tr>
<tr><td colspan="2">Minimum Shutoff Head: 10 feet</td></tr>
<tr><td colspan="2">Maximum Motor HP: 30</td></tr>
<tr><td colspan="2">Maximum Speed: 440 rpm</td></tr>
<tr><td colspan="2">Voltage, Volts: 460</td></tr>
<tr><td colspan="2">Power Phases: 3</td></tr>
<tr><td colspan="2">Power Frequency, Hz: 60</td></tr>
<tr><td colspan="2">Minimum Power Cable Length: 60 feet</td></tr>
<tr><td colspan="2">Pipe Mount Discharge Connection Size: 30-inches</td></tr>
</table>

2.4 MATERIALS (MINIMUM MATERIAL SPECIFICATIONS)

A. Major pump components shall be ASTM Type 316 stainless steel construction.

B. Propeller: Stainless steel, ASTM A276 Type 316.

C. Stationary Pump Mounting Flange (Pipe Mount Discharge Connection): The pump shall be supplied with a 30-inch diameter stainless steel, ASTM A276 Type 316 SST discharge connection.

D. Pump Casing Ring and Supports: Stainless steel, ASTM A276 Type 316.

E. Propeller Drive Shaft: Stainless steel, ASTM A286 Type 420.

F. Motor Shaft: Stainless steel, ASTM A286 Type 420.

G. O-Rings: Fluorinated rubber (Viton).

H. Fasteners: Stainless steel, ASTM A276 Type 316T.

I. Outer Seal Faces: Tungsten Carbide/Tungsten Carbide (WCCR).

J. Inner Seal Faces: Tungsten Carbide/Tungsten Carbide (WCCR).

K. Guide Rail and Upper Support Brackets: Each pump shall be provided with the proper length of 2-inch Schedule 40 guide rail and upper guide rail bracket. The material shall be Type 316 stainless steel.

L. Lifting Chain or Cable: Each pump shall be fitted with 40 feet (minimum) of stainless steel, ASTM A276 Type 316 lifting cable to permit lifting and lowering of the pump.

M. Oil (Seal Lubrication): Ecologically safe, mineral base.

N. Power/Control Cable Jacket: Chloroprene rubber jacketed.

O. The pump manufacturer shall provide a lighting handle for each IMLR pump.

2.5 DESIGN

A. The pumps shall be capable of handling raw, screened sewage. The pumps shall be able to be raised and lowered and shall be easily removed for inspection or service without the need for personnel to enter the MBR Bioreactors. The pump will be used with a VFD to control the return flows in the MBR Bioreactors. The pump, appurtenances, and cable, shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of 130 feet. All exposed nuts and bolts shall be of stainless steel.

B. All metal surfaces coming into contact with the pumped media, other than stainless steel, shall be protected by a factory applied spray coating of acrylic dispersion zinc phosphate primer with plaster resin paint finish on the exterior of the pump. The pump casing shall be an adequately reinforced fabricated ring, sized as shown on the

Drawings. Integral to the casing shall be mounting clips, to hold the pump casing in place in the permanent mounting flange, and a single tubular support arm for the motor/propeller assembly.

C. Pump manufacturer shall review the MBR Bioreactors drawings and pump's proximity to MBR Bioreactors diffusers. Pumps shall be able to operate in the location shown on the Drawings and as specified, without air carry over into zone 1. If the pump manufacturer requires more space from the aeration diffusers, the manufacturer shall submit the request and backup information to the ENGINEER for review and approval.

2.6 PROPELLER

A. The propeller shall be of Type 316 stainless steel dynamically balanced, non-clogging backward curved design. Each blade shall be laser cut and welded to the hub and tested to ensure that the propeller is properly balanced. The propeller shall be capable of handling solids, fibrous materials, heavy sludge, and other matter found in normal sewage applications.

2.7 SHAFT

A. Provide propeller shaft of sufficient size to transmit full driver output with a maximum deflection 0.002-inch measured at the outer mechanical seal.

2.8 SHAFT SEAL

A. Provide two totally independent mechanical shaft seals, installed in tandem, each with its own independent spring system acting in a common direction. Install the inner seal in an oil-filled chamber with drain and inspection plug (with positive anti-leak seal) for easy access from external to the mixer.

2.9 BEARINGS

A. All bearings shall have a minimum B-10 rated life of 100,000 hours. The outboard propeller bearing shall be an angular contact bearing. The motor shaft end shall be supported by two bearings. A roller bearing shall take up the radial loads, while an angular contact bearing shall take up the axial loads.

2.10 THERMAL SENSORS

A. Thermal sensors shall be used to monitor stator temperatures. The stator shall be equipped with three thermal switches embedded in the end coils of the stator winding. These shall be used in conjunction with, and supplemental to, external motor overload protection, and wired to the control panel.

2.11 SHROUD ASSEMBLY

A. The pump assembly shall incorporate a bell shaped inlet shroud, 360 degrees around the propeller.

2.12 LUBRICANT HOUSING

A. The lubricant housing shall contain two compartments consisting of an inner and an outer section with four ports to connect and facilitate lubricant flow. In the event that the mixed media bypasses the outer seal, this design will allow the outer compartment to collect the heavier (denser) fluids by means of the simple process of gravity. The seal lubricant shall be FDA approved non-toxic.

2.13 MECHANICAL SEALS

A. Each pump shall be provided with two sets of lapped end face type mechanical seals running in lubrication reservoirs for cooling and lubrication. The mechanical seals shall contain both stationary and positively driven rotary tungsten carbide face rings of the outer seal assembly and its retaining clips shall be exposed to the mixed media. All other components shall be contained in the lubricant housing. All seal faces must be solid material capable of being re-lapped. The seals shall require neither maintenance nor adjustment, but shall be easy to check and replace.

2.14 MOTOR

A. The multi-pole motor shall be directly connected to the propeller (gearbox designs are not acceptable) to produce a maximum propeller speed of 440 rpm. The pump motor shall be squirrel cage, induction, shell type design, housed in an air filled, watertight chamber. The stator winding shall be insulated with moisture resistant Class F insulation which will resist a temperature of 155° C (311° F). Pump shall be rated for a 40° C with a service factor of 1.15. The stator shall be dipped and baked three times in Class H varnish. The motor shall be designed for continuous duty, capable of sustaining a maximum of at least 10 evenly spaced starts per hour. The rotor bars and short circuit rings shall be made of aluminum.

B. Provide a leakage and over-temperature protection system which shall consist of leakage and over-temperature sensors at the motor and a control module which shall be remotely located.

C. Control module shall be Flygt Mini-CASII, or equal and compatible with motor sensors. See Division 16, Electrical, for Motor Specifications.

2.15 ELASTOMERS

A. All mating surfaces, where watertight sealing is required, shall be machined and fitted with Nitrile rubber or Viton O-rings. Fitting shall be such that sealing is accomplished by metal-to-metal contact between machined surfaces. This will result

in controlled compression of the O-rings without requiring a specific torque limit. No secondary sealing compounds, rectangular gaskets, elliptical O-rings, grease, or other devices shall be used.

2.16 CABLE ENTRY

A. The cable entry housing shall be an integral part of the back plate. The cable entry shall have a double set of elastomer grommets in order to ensure a redundant system in the event of a cable entry seal failure. Single sealing systems will not be deemed acceptable. The cable entry shall be comprised of two cylindrical elastomer grommets, each flanged by washers and a ferrule designed with close tolerance fit against the cable outside diameter and the entry inside diameter. This will provide a leak-proof, torque-free seal at the cable entrance. The assembly shall bear against a shoulder in the stator casing opening and be compressed by a gland nut threaded into it. Interaction between the gland nut and the ferrule should move the grommet along the cable axially instead of with a rotary motion. The junction chamber and motor compartment shall be separated by a terminal board, which shall protect the motor interior from foreign material gaining access into the pump top. Connection between the threaded compressed type binding posts permanently affixed to the terminal board and, thus, perfectly leak proof. Epoxies, silicones, or other secondary sealing systems shall not be considered acceptable.

2.17 IMLR PUMP MOUNT ASSEMBLY

A. Each IMLR pump shall be mounted in the proposed MBR Bioreactors as shown on the Drawings. IMLR pumps shall be removable without requiring entry into the basin. Refer to Section 2.4 for appurtenant information regarding the IMLR pump mount assembly materials not specified in this Section.

B. A stainless steel pump mast assembly shall be supplied by the pump manufacturer to mount the mixer during operation and to guide the unit during installation and removal from service. The assembly shall consist of an upper guide bar bracket made of Type 316 stainless steel and shall be mounted to the MBR Bioreactors walkway, as shown on the Drawings.

C. A field adjustable Type 316 stainless steel support cable shall be supplied. Guide rail shall securely interface with the pump manufacturer's upper guide bar bracket and pipe flange mount connection by integrating in such a way to securely support the pump during operation. All support bracket assemblies shall be supplied by the pump manufacturer only in order to ensure the integrity of the system under operational loads.

D. The assembly shall also be provided with cable holders to secure the mixer electric power cable (one every 5 feet). Their purpose shall be to prevent the electric cable from becoming entangled in the pump propeller during operation.

PART 3 - EXECUTION

3.1 PUMP TEST (FACTORY)

A. The pump manufacturer shall perform the following inspection and tests on each pump before shipment from the factory:
   1. Propeller(s), motor rating(s), and electrical connection(s) were checked for compliance to the purchase order.
   2. All pumps are vacuum tested to establish sealing integrity. All pumps are momentarily energized to determine correct rotation and current draw (prior to immersion).
   3. All pumps are run dry and/or immersed to determine correct shaft rotation, and power consumption.
   4. After immersion test(s), all pumps are inspected for lubricant seepage and/or water infiltration, insulation defect(s), and resistance (Ohms).

B. Verification of Performance (Field):
   1. Field test all pumps after installation to demonstrate satisfactory operation with output flow, power use, and discharge pressure within specified conditions and without excessive noise, vibration, cavitation, or over-heating. Any pump which fails to meet any of the Contract Specifications will be modified, repaired, or replaced by the CONTRACTOR at no additional cost to the OWNER.

C. Inspections and tests performed shall confirm the pump(s) listed have met all established quality assurance standards set for similar materials. All pumps shall be warranted against defects in design, workmanship, and material (with validation being the warranty card(s) shipped with the product(s)).

D. A written report stating the foregoing steps have been done and is required with each pump at the time of shipment.

3.2 INSTALLATION

A. The pumps and accessories shall be installed in accordance with the manufacturer's recommendations.

3.3 MANUFACTURER FIELD SERVICE

A. Equipment Start-up: A factory employed representative of the manufacturer shall visit the site and provide installation and start-up services as specified in Section 01650, Starting of Systems.

B. Training: A factory employed representative of the manufacturer shall visit the site and provide operator training services, in addition to equipment start-up services, as specified in Section 01650, Starting of Systems. A minimum of eight hours of training will be required.

C. All costs, including travel, lodging, meals, and incidentals, shall be considered as included in the CONTRACTOR'S lump sum bid price.

++ END OF SECTION ++

SECTION 11335

SECONDARY CLARIFIER MECHANISM

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish and install a total of five new secondary clarifier mechanisms- one 100-foot diameter clarifier and three 75-foot diameter clarifiers at the Chandler Airport Water Reclamation Facility (AWRF), and one 100-foot diameter clarifier at the Ocotillo Water Reclamation Facility (OWRF). The four clarifiers at AWRF shall be replace-in-kind spiral rake mechanism to spiral rake mechanism, and the clarifier at OWRF will be retrofitted from a suction-type mechanism to a spiral rake mechanism. All new installations shall be of center-column, bottom feed, peripheral overflow with a center drive mechanism rotating a suspended cage with two spiral sludge scraper rake arms, and two rotating scum skimming arms attached.

B. The equipment furnished for the secondary clarifier mechanisms shall include, but not limited to, column support structure, walkway bridge and surface, walkway handrails, stairs, center platform and surface, center platform handrails, provisions for supporting wiring on the walkway, center drive assembly, flocculation well cylinder, energy dissipating outlet, spiral secondary clarifier arms, scum skimmer and scum trough, scum box sprayer and flushing system, launder brushes, flocculation well supports, torque cage, effluent weir plates, scum baffles, Stamford baffle, drive assembly control panel with on/off controls and alarm, and all necessary assembly and anchor bolts as specified herein.

1.2 REFERENCES

A. ASTM A36/A36M, Standard Specification for Carbon Structural Steel.

B. ANSI/ABMA 9-2015, Load Ratings and Fatigue Life for Ball Bearings.

C. ANSI/AGMA 2001-B88, Fundamental Rating Factors and Calculation Methods for Involute Spur and Helical Gear Teeth.

D. AGMA 6019-E, Gearmotors Using Spur, Helical, Herringbone, Straight Bevel or Spiral Bevel Gears.

E. ANSI/AGMA 6034-C21, Practice for Enclosed Cylindrical Wormgear Speed Reducers and Gearmotors.

F. ASTM A48/A48M-22, Standard Specification for Gray Iron Castings.

G. ASTM F3125/F3125M-22, Standard Specification for High Strength Structural Bolts and Assemblies.

H. ASTM A536, Standard Specification for Ductile Iron Castings..

I. ASTM B247, Standard Specification for Aluminum and Aluminum-Alloy Die Forgings, Hand Forgings, and Rolled Ring Forgings.

J. ASTM E18, Standard Test Methods for Rockwell Hardness of Metallic Materials.

K. AISI 4142, Alloy Steel.

L. AGMA 2001-C95, Fundamental Rating Factors And Calculation Methods for Involute Spur and Helical Gear Teeth.

M. AWS, American Welding Society Current Standards.

N. ASTM A283C, Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates.

O. NEMA, Motor Design Standards and Enclosure Standards.

P. NEC, National Electrical Code.

Q. ASTM B187/B187M-20, Standard Specification for Copper, Bus Bar, Rod, and Shapes and General Purpose Rod, Bar, and Shapes.

R. NACE, National Association of Corrosion Engineers.

S. ANSI/AWWA D104, Automatically Controlled, Impressed-Current Cathodic Protection for the Interior Submerged Surfaces of Steel Water Storage Tanks..

1.3 DEFINITIONS

A. Continuous Operating Torque: The continuous operating torque is defined as the AGMA design torque which is the torque load that is assumed to be continuously applied on the drive system through a 24 hour operating period, 365 days per year, for a 20 year life.

B. Alarm Torque: The torque at which an alarm sounds to serve as a warning of increased torque loading. The alarm torque is defined to be equal to 100% of the continuous operating torque.

C. Cutout Torque: The torque load at which a motor cutout switch is activated to shut down the unit. The cutout torque is defined to be 125% of the continuous operating torque.

D. Momentary Peak Torque: The maximum or peak torque of the drive unit is assumed to be equal to twice the calculated AGMA torque rating of the spur gear set or three times calculated AGMA torque rating of the worm gear set, whichever is lower.

1.4 RELATED SECTIONS

A. Section 01300, Submittals.

B. Section 01640, Materials and Equipment.

C. Section 01650, Starting of Systems.

D. Section 05522, Aluminum Handrails and Railings.

E. Section 09900, Painting.

F. Section 15064, Copper Pipe.

G. Section 16161, Control Panels.

H. Section 16225, Electric Motors 250 Horsepower or Less.

I. Section 17000, Instrumentation

J. Section 17454, Operations and Control Descriptions.

1.5 SUBMITTALS

A. Descriptive submittals shall be made in accordance with the Data Reference Symbols defined in Section 01300, Submittals.
   1. Secondary Clarifier Mechanism:
      a. Shop Drawings:
         1) Letters of Certification of Compliance on materials, equipment, etc.
         2) Final Certified Drawings showing outline dimensions, foundation layout or mounting information, and other pertinent dimensions.
         3) Field erection instructions, assembly drawings and/or diagrams, detailed reference drawing lists, lists of erection details, and list of spare parts supplied with equipment.
         4) Shop Detail Drawings showing individual sub- assemblies and fabricated pieces with material specifications and other applicable data.
         5) Installation instructions, operating and/or service manuals, and all other data pertinent to operating or servicing the complete apparatus. Preventative maintenance instructions and recommended frequency.
         6) Schematic and wiring diagrams of power, control, and piping systems. A detailed description of operation shall be included for each diagram to describe all modes of operation of the system indicated. Where the integrated system requires interlocking and control of other components in normal operation, these components shall be included in the description of operation.

7) General bulletins and catalog cuts describing complete apparatus, including operating principles and fundamentals.
8) Service data sheets showing design performance, utility requirements, etc., as applicable to the specific duty for which the equipment is furnished.
9) Materials of construction of all components.
10) Renewal parts list with diagrammatic or cross-section drawings showing part identification. Material analysis or trades designation for each significant part is to be noted on parts lists or on a separate sheet.
11) Stuffing box sizes; packing sizes; specifications and arrangement; and mechanical seal details, specifications, etc., if furnished in equipment.
12) Bearing manufacturer's standard identification and/or interchangeable number for all anti-friction bearings in the equipment proper and its accessory items.
13) Material gradation, design mix, job mix formula, and/or material analysis.

b. O&M Manuals:
1) Letters of Certification of Compliance on materials, equipment, etc.
2) Samples.
3) Final Certified Drawings showing outline dimensions, foundation layout or mounting information, and other pertinent dimensions.
4) Field erection instructions, assembly drawings and/or diagrams, detailed reference drawing lists, lists of erection details, and list of spare parts supplied with equipment.
5) Shop Detail Drawings showing individual sub- assemblies and fabricated pieces with material specifications and other applicable data.
6) Installation instructions, operating and/or service manuals, and all other data pertinent to operating or servicing the complete apparatus. Preventative maintenance instructions and recommended frequency.
7) Schematic and wiring diagrams of power, control, and piping systems. A detailed description of operation shall be included for each diagram to describe all modes of operation of the system indicated. Where the integrated system requires interlocking and control of other components in normal operation, these components shall be included in the description of operation.
8) General bulletins and catalog cuts describing complete apparatus, including operating principles and fundamentals.
9) Service data sheets showing design performance, utility requirements, etc., as applicable to the specific duty for which the equipment is furnished.
10) Data for overall range of operation from minimum to maximum , showing capacity, load, torque, and other pertinent information applicable to the equipment or its component assemblies.
11) Materials of construction of all components.

12) Renewal parts list with diagrammatic or cross-section drawings showing part identification. Material analysis or trades designation for each significant part is to be noted on parts lists or on a separate sheet.
13) Stuffing box sizes; packing sizes; specifications and arrangement; and mechanical seal details, specifications, etc., if furnished in equipment.
14) Bearing manufacturer's standard identification and/or interchangeable number for all anti-friction bearings in the equipment proper and its accessory items.
15) Material gradation, design mix, job mix formula, and/or material analysis.

B. The Shop Drawings shall include the following:
1. Drawings showing secondary clarifier mechanisms indicating dimensions, member thickness, welds and connection details.
2. Design information clearly describing the sizes, dimensions and arrangement of all major drive components. Design information shall be supplied for all gears except those contained in the gear motor speed reducer. The following minimum data shall be supplied for each gear:
   a. Number of teeth.
   b. Net face width.
   c. Outside diameter (external gears).
   d. Inside diameter (internal gears).
   e. Normal diameter pitch (or axial pitch for worms).
   f. Normal generating pressure angle.
   g. Lead angle (for worms).
   h. Operating center distance.
   i. Quality number.
   j. Material alloy.
   k. Type of heat treatment.
   l. Tooth surface hardness.
   m. Tooth care hardness.
   n. NSF lubricant type (mineral/synthetic/EP).
   o. NSF lubricant viscosity.
3. Directions for the installation of anchor bolts and other anchorages.
4. Control system data, control panel layout, schematics, and wiring diagrams.
5. Include the following calculations performed and certified by a Registered Professional Engineer:
   a. Structural calculations demonstrating compliance with structural criteria specified in this section.
   b. Substantiation of the output torque rating and the overload torque rating of all components of the drive mechanism.
   c. Demonstration that all bearings in the drive mechanism meet the life requirements of this Specification.
   d. Gear calculations demonstrating the ratings, stresses, and factor of safety in accordance with AGMA as specified below.

6. Manufacturer's installation instructions. Proposed on-site testing and start-up procedures, including sketches and calculations for torque testing as specified in Section 3.2.

C. Shop Drawings: Submit for approval the following:
   1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
   2. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**

1.6 AWRF SYSTEM DESCRIPTION

A. Design Requirements
   1. Secondary Clarifier Mechanism (assuming 7 out of 8 clarifiers in service):
      a. Secondary Clarifiers No. 1 – No. 3:
         1) Clarifier Effluent (per each, MGD):
            a) Average: 3.5.
            b) Peak: 6.11.
         2) RAS flow out of Clarifier (per each, MGD):
            a) Average: 1.05.
            b) Peak: 1.80.
         3) MLSS concentration = 3,400mg/L.
         4) Operating Torque:
            a) Continuous Operating Torque, min. (ft-lbs AGMA): 35,000 .
            b) Momentary Peak Torque (ft-lbs): 70,000 .
         5) Sludge Collector Rotational Speed (fpm):
            a) 4-10
      b. Secondary Clarifier No. 4:

1) Clarifier Effluent (per each, MGD):
    a) Average: 6.21.
    b) Peak: 10.74.
2) RAS flow out of Clarifier (per each, MGD):
    a) Average: 1.85.
    b) Peak: 3.20.
3) MLSS concentration = 3,400 mg/L.
4) Operating Torque:
    a) Continuous Operating Torque, min. (ft-lbs AGMA): 66,000.
    b) Momentary Peak Torque (ft-lbs): 132,000.
5) Sludge Collector Rotational Speed (fpm):
    a) 4-10

B. Configuration:
1. Secondary Clarifiers No. 1 – No. 3:
    a. Internal Tank Diameter: 75 feet.
    b. Nominal Side Water Depth: 13 feet.
    c. Bottom Floor Slope: 1:4 slope.
2. Secondary Clarifier No. 4:
    a. Internal Tank Diameter: 100 feet.
    b. Nominal Side Water Depth: 14 feet.
    c. Bottom Floor Slope: 1:4 slope.

1.7 OWRF SYSTEM DESCRIPTION

A. Design Requirements
1. Secondary Clarifier Mechanism (assuming 3 out of 4 clarifiers in service):
    a. Secondary Clarifier No. 3:
        1) Clarifier Effluent (per each, MGD):
            a) Average: 5.
            b) Peak: 10.
        2) RAS flow out of Clarifier (per each, MGD):
            a) Average: 1.9.
            b) Peak: 3.3.
        3) MLSS concentration = 3,300mg/L
        4) Operating Torque:
            a) Continuous Operating Torque, min. (ft-lbs AGMA): 66,000 .
            b) Momentary Peak Torque (ft-lbs): 132,000 .
        5) Sludge Collector Rotational Speed (fpm):
            a) 4-10

B. Configuration:
1. Secondary Clarifier No. 3:
    a. Internal Tank Diameter: 100 feet.
    b. Nominal Side Water Depth: 14 feet.
    c. Bottom Floor Slope: 1:12 slope.

1.8 QUALITY ASSURANCE

A. The complete secondary clarifier mechanism shall be of sufficient strength to screed the 2-inch grout on the tank bottom under its own power. Such grouting shall be done in strict accordance with the manufacturer's instruction.

B. Manufacturers regularly engaged in the manufacture of the secondary clarifier mechanism equipment as specified herein and who can demonstrate equipment of this specified design, in actual service for not less than five years will be considered as acceptable manufacturers.

C. The intermediate worm gear unit and the final gear reduction unit shall be the product of the equipment manufacturer. Units purchased from a third party manufacturer will not be acceptable.

D. The rated torque of the drive shall be the lowest rating of the worm gear, spur gear, or pinion based on AGMA 2001 and 6034, and shall be greater or equal to the reference torque specified in Paragraphs 1.6 and 1.7.. The continuous output torque rating and the allowable stress values used in the design of the intermediate worm gear reduction unit and the final gear reduction unit shall be in strict conformance with the latest revision of the following standards:
   1. Worm and Worm Gearing: ANSI/AGMA 6034-C21.
   2. Spur and Pinion Gearing: ANSI/AGMA 2001-C95.

E. Welder qualifications must be certified in accordance with AWS D1.1.

F. For structural members the maximum allowable stress in any member shall not be exceeded as a result of the cutout torque test.

G. CONTRACTOR shall verify all dimensions shown in Manufacturer shop drawings and shall coordinate with Manufacturer prior to fabrication of secondary clarifier mechanism.

H. CONTRACTOR shall field verify location of existing equipment, pipe sizes, and fittings prior to installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. The secondary clarifier mechanism equipment shall be as manufactured by (listed in alphabetical order):
   1. Ovivo
   2. Walker Process Equipment
   3. WesTech
   4. Or approved equal.

B. Density current baffles (Stamford Baffles) shall be as manufactured by:
   1. NEFCO, Inc.
   2. Palm Beach Gardens, FL
   3. Or approved equal.

C. Launder brushes shall be as manufactured by:
   1. Ford Hall Company, Inc.
   2. Lexington, KY
   3. Or approved equal.

D. The Energy-Dissipating Inlets (EDI) shall be Type II LA-EDI™, designed by the former U.S. Patent Holder, CPE, Inc. of Enfield, NH; no approved equal.

E. The naming of a manufacturer in this Specification is not an indication that the manufacturer's standard equipment is acceptable in lieu of the specified component features. Naming is only an indication that the manufacturer may have the capability of engineering and supplying a system as specified.

2.2 WARRANTY

A. The secondary clarifier mechanism manufacturer shall provide a two years warranty of the equipment against defects in design, material, and workmanship from equipment start-up.

2.3 MATERIALS

A. All structural steel shall be 304SS with 316SS hardware. All structural steel shall conform to requirements of AISC "Specifications for the Design, Fabrication, and Erection of Structural Steel for Buildings." Maximum allowable stresses on structural steel under continuous operating torque loading shall be two thirds of those permitted in the AISC specifications. All welds to be continuous seal weld type.

B. Welding shall conform to AWS D1.1, Structural Welding Code.

C. Unless otherwise shown on the Drawings or specified, all stainless steel shall have a minimum thickness of 1/4-inch. Thickness of center feedwell stainless steel shall be 3/16 inches minimum. All bolts shall be a minimum diameter of 5/8 inch, Type 316 stainless steel.

D. Gears used in the center mechanism and drive shall conform to standards as follows:
   1. Spur and Pinion Gears: AGMA 908-B89, AGMA 240.01 and AGMA 2001-C95.
   2. Worm Gears: AGMA 6034-C21.

E. Iron castings, where used, shall conform to ASTM A48.

F. Anti-friction bearings shall have minimum B-10 life rating of 200,000 hours.

G. All field welding shall be done by a certified welder.

2.4 GENERAL

A. Secondary clarifier mechanism shall be of the center-drive type, supported on a stationary influent column, with the flow entering from the bottom of the influent column into the inner EDI. The secondary clarifier spiral scraper blades shall be designed to move sludge uniformly to the center of the tank.

2.5 CENTER ASSEMBLY

A. General:
   1. The collector rotational speed shall be as specified above in Paragraphs 1.6 and 1.7.
   2. The center drive mechanism shall be completely factory assembled consisting of an integral motor and primary speed reducer coupled through a roller chain and sprocket to a secondary worm/worm gear reducer driving the main gear through a pinion, and an overload protection system.
   3. The drive shall be designed to allow removal and replacement of internal gear, balls and strip liners without raising the walkway. Anti-friction bearings shall have a minimum B-10 life of 20 years, unless otherwise stated.
   4. All gear housings shall be constructed using proper wall thickness to resist the full drive peak loads without any deflections.
   5. The complete drive shall be assembled in the secondary clarifier manufacturer shop and tested to assure the drive is running properly and to calibrate the drive control. A complete test report shall be sent to the ENGINEER verifying that the drive meets the quality assurance of the manufacturer and the ENGINEER.

B. Drive Motor:
   1. The electric motors shall be totally enclosed and sealed for operation in a moisture-laden atmosphere and suitable for wash down and outdoor severe duty. Conduit boxes shall be gasketed with neoprene or an equivalent material to prevent moisture from entering the stator through the conduit box. Drain holes shall be placed in suitable positions to prevent accumulation of moisture in the motor housing. Sealed, grease lubricated ball or roller bearings shall be provided. The motor shall conform to NEMA Standards.
   2. Secondary Clarifier Drive Motor Characteristics:
      a. Horsepower: 1-1.5.
      b. Volts: 460.
      c. Phase: 3.
      d. Frequency, Hz: 60.
      e. Insulator: Class H.
      f. Service Factor: 1.15.
      g. Maximum Ambient Temperature: 50° C.
      h. Enclosure: TEFC.

3. At OWRF Secondary Clarifier No. 3, a variable frequency drive (VFD) shall be provided inside the control panel and be rated for a minimum of 3 HP.
4. The CONTRACTOR shall be responsible for necessary changes, wiring, conduit, and any other necessary appurtenances if motor horsepower specified above varies from equipment supplied.

C. Primary Gear Reducer:
1. The primary gear reducer shall be of either cylindrical-worm gear, helical-worm gear, or helical gear construction with gears manufactured from case hardened steel and bearing the AGMA nameplate. Planetary gear units are not acceptable. The primary reducer shall be designed in accordance with AGMA 6034-C21. The primary gear reducer shall drive the main gear reducer through a chain and sprocket arrangement. The primary gear reducer service factor shall be a minimum 2.0 (based on the specified continuous operating torque). The primary gear reducer shall be supported by high capacity, anti-friction bearings submerged in oil and splash lubricated. The primary gear housing shall be cast iron, complete with oil fill, oil level sight gauge, and drain plugs.

D. Chain Drive:
1. The chain drive shall be a standard roller chain conforming to ANSI B29.1 and shall be used to connect the drive sprocket of the primary gear reducer to the intermediate gear set. The chain drive shall be designed to permit plant operators to change speed with minimum disassembly and adjustment, without need to break chain. The roller chain sprocket shall be steel. The roller chain and sprocket enclosure shall be weatherproof, constructed of a minimum 14 gauge hot-dip galvanized steel and provided with service openings. The chain guard enclosure shall meet OSHA requirements. The power rating of chain shall be in excess of transmitted power by minimum 1.5. The tensile strength of the chain shall be a minimum of four times chain pull based on a momentary peak torque minimum 200% of specified continuous operating torque. Drives utilizing horizontal chains or open, grease lubricated gearing will not be permitted.

E. Intermediate Gear Reduction Unit and Spur Pinion:
1. The intermediate gear set shall be worm/worm gear or helical type. Planetary gears are not acceptable. The intermediate gear reducer shall be constructed using ASTM A48 Class 40 minimum cast iron housing with a minimum pitch diameter worm gear of 18-inches. The worm gear shall be high strength centrifugally cast manganese bronze or ductile (nodular) iron. The worm shall be made of AISI 4142 heat treated steel, ground and polished. The worm and worm gear shall be designed based upon the requirements of AGMA Standard 6034-C21 for the torque specified, bearing the AGMA nameplate. The worm shaft shall be supported by anti-friction bearings or a combination of anti-friction bearings and a bronze bushing. The worm gear shaft shall be supported by anti-friction bearings. The worm and worm gear shaft anti-friction bearings

shall have a minimum B-10 life of 20 years based upon the specified continuous operating torque.

2. The spur pinion shall be constructed of ductile (nodular) iron conforming to ASTM A536 or heat treated alloy forged steel, precision cut to provide adequate tooth mesh for the values used in the calculations. The pinion must rotate in a lower taper or lower roller bearing assembly and similar upper bearing encasement machined into the worm gear or intermediate reducer housing. The lower bearing pocket shall not be the collection point for condensation. Pinion shafts shall be one piece extending through the worm gear without intermediate couplings or coupled to the cycloidal reducer output shaft. The spur pinion shall be integral with its shaft or keyed to a heat treated alloy steel shaft. No welding shall be acceptable. Undercut gear teeth shall not be acceptable. If spur pinion has keyway, wall thickness about the keyway equal to one tooth whole depth minimum.

F. Main Gear Set:

1. The momentary peak strength (bending strength) of the main gear set shall be minimum 200% of the continuous operating torque. The main gear set service factor shall be minimum 1.25 based on the continuous operating torque. The power rating of the gear set shall be the lower of the pitting resistance and the bending strength power ratings for the pinion and gear based on continuous 24 hour/day service and 20 year design life. The load capacity of the main gear set shall be rated according to AGMA 2001-C95.
2. The main gear set shall be one piece or split internal spur gear, allowing maintenance without removal of bridge. The main gear shall be ductile (nodular) iron conforming to ASTM A536, Grade 120-90-02 minimum, cast steel conforming to ASTM A148 or AISI 1050, 4135, or forged 4140 heat treated alloy steel and rotated upon the main bearing. The main gear shall have a minimum pitch diameter of 40 inches for mechanisms serving 75-foot diameter clarifiers and 60 inches for mechanisms serving 100-foot diameter clarifiers, or as otherwise required to meet the specified torque requirements.
3. The main gear bearing shall be radial-thrust type ball bearing with renewable strip liner races. The strip liner design shall be such that the B-10 life of the linear is a minimum of 20 years based on the specified mechanism speed and a uniformly distributed load on the rotating mechanism. Round bar of hardened, bearing steel which meet the inclusion requirement of ASTM A148 without being vacuum degassed, carbon deoxidized, or carbon corrected are also permitted. Races shall be hardened to 39-43 Rc to avoid cold forming or fatigue cracking.
4. The main gear and worm assembly shall be enclosed in a ASTM A48 cast iron upper and lower housing and provided with adequate seals to protect the interior of the housing. Housing shall be designed such that gears and bearing are oil bath lubricated. For spur gear teeth which are not fully submerged in oil, the tooth mesh shall be designed to force lubricant to the upper portion of the tooth face. Housing must be provided with oil level sight gauges, oil fill and valved drain connections and valved condensate drain connections from the low points

of the oil reservoir. The main gear housing shall be bolted to the top of the stationary influent column and shall be capable of transmitting the mechanical design strength. The rotating center cage to which the rake arms are attached shall be bolted to the main gear.

5. The final gear housing shall be designed with a condensate collection sump located beneath the main bearing assembly. The sump shall be the collection point for sediment, filings, condensate, and other contaminants.

G. Turntable Base:

1. The turntable base shall be ductile (nodular) iron, ASTM A536, or cast iron, ASTM A48, Class 40 minimum; able to be bolted to center column and to provide support for internal spur gear, the entire rotating collector mechanism and flocculator unit (Wash Water Clarifiers) and one end of the access bridge. Fabricated steel bases shall not be acceptable.
2. The gear housing (turntable base) shall be designed with an integral, composite, side wall. The turntable side wall shall be built up sufficiently to ensure a secure oil bath compartment. A hardened raceway assembly, bolted to a flat plate shall not serve as the oil containment barrier.
3. Before assembly, the base shall be thoroughly inspected for seep holes or inclusions and given a full hydrostatic test to ensure no leaks in the oil containment area. Copies of material certification sheets for the drive materials, as well as records of shop inspections shall be made available to the ENGINEER for review.

2.6 CONTROL PANEL

A. See Section 16161, Control Panels.

B. Furnish a control panel for the secondary clarifier drive unit. Mount the control panel adjacent to the drive unit as shown on the Drawings, elevated on support legs from the walkway, or provide support brackets from the hand railing. Panel construction shall be NEMA 4X stainless steel panel.

C. Factory test the control panel prior to shipment. Size the panel to include, but not be limited to, the following instruments and/or devices:

1. Two-position, On-Off selector switch for control of the secondary clarifier drive motor.
2. Motor overload reset push buttons.
3. Common Fault reset push buttons.
4. Run-Stop status indicating lights with dry contacts for remote indication.
5. Common Fault Beacon with dry contacts for remote alarm activation.
6. Potentiometer for local VFD speed control.
7. Cutout torque dry contacts for remote alarm activation.
8. Main panel disconnect switch.
9. Variable Frequency Drive fault alarm light.
10. Torque indication.

11. High Torque Warning and High-High Torque alarm lights with dry contacts for remote indication.
12. All required wiring, inter-locks, relays, and other miscellaneous devices required for the functions as described herein.

D. A strobe light shall be provided with the equipment by the manufacturer. See Division 17, Instrumentation, Specifications and Instrumentation Drawings.

E. A strobe light shall be installed on top of the control panel and be enclosed in a weatherproof housing with a non-corrodible industrial-type relay and reset button. The alarm unit shall be wired for operation on 120/240 volt, single-phase alternating current.

2.7 OVERLOAD PROTECTION

A. The drive unit shall be equipped with a mechanical overload control device with a visual load indicator. An overload release clutch, as manufactured by the Centric Clutch Company, or approved equal, shall be provided as an overload protection device. A separate indicating device suitable for indoor or outdoor mounting shall be provided to indicate mechanism loading torque at all times during operation. The device shall utilize a load cell to measure the torque of the worm shaft. The system shall include two electrical relays with normally open contacts to sound an alarm at the central monitoring panel and to cut out the motor at shut down torque. A signal conditioner shall be programmed with the specified alarm and motor cut out set points. The unit shall be capable of sending a 4-20 mA torque signal to plant SCADA.

B. The alarm and motor cut-out switches in the control device shall be factory calibrated and set to the required torque. The setting shall be as follows:
1. Alarm torque set at 100% of continuous operating torque.
2. Motor cut-out set at 125% of continuous operating torque and actuate the local alarm and at the central monitoring panel.
3. Motor back-up safety switch set at 175 % of continuous operating torque.

C. The pointer, control switches, and electrical terminals shall be mounted in a NEMA 4X rated enclosure. The enclosure shall be sealed to prevent moisture from entering either the overload device or drive unit. Amperage and current sensing devices will not be considered equal to the overload device specified.

2.8 WALKWAY AND DRIVE PLATFORM

A. Access to the center operating platform surrounding the drive assembly shall be provided by means of stairs and a walkway with a minimum clear open width of 3 feet 6-inches extending from the tank wall to the center platform, as shown on the Drawings. The walkway shall extend past the tank wall, as shown on the Plans. Access walkway bridge support shall be provided by two welded steel trusses or channel construction members laterally braced together. The access walkway bridge

shall be properly designed for all dead loads, plus minimum walkway live load of 100 lbs per square foot with a deflection of maximum L/360 of span for dead load, plus live loads.

1. The walkway at AWRF Clarifier No. 2 shall span the entire diameter of the clarifier, providing access to the center platform from the north and south sides of the tank wall. Access walkway bridge support as described above shall be provided for the walkway on either side of the center platform.

B. The walkway horizontal deflection shall be limited to 1/360th of the bridge span for all dead loads, plus a live load of 100 lbs per square foot.

C. The walkway surface shall be 1-1/4-inch by 3/16-inch aluminum I bar grating.

D. The bridge bearing at tank wall shall have a Teflon or high-density polyethylene lining. The clarifier manufacturer or CONTRACTOR shall provide metal stairs per Section 05510, Metal Stairs, and as shown on the Drawings for AWRF Clarifier No. 2.

E. The center drive platform shall be provided and supported at the center turntable platform at one end and the concrete wall at the other end. The platform shall be a minimum of 12 feet square and shall provide a minimum clearance of 2 feet 6-inches around the drive mechanisms for maintenance and service. It shall consist of 1/4-inch checkered steel floor plate attached to a 1/4-inch structural steel frame, with accessory stiffeners and supports, resting on the center assembly and provided with connections to the walkway.

F. Provide handrails with toe plates on both sides of the walkway and around the center drive platform per OSHA requirements and in accordance with Section 05522, Aluminum Handrails and Railings. Provisions for thermal expansion shall be made in the toe plate allowing a small gap between toe plate sections that meets OSHA requirements.

2.9 CENTER CAGE

A. The center cage shall be of steel box truss construction, a minimum of 4 feet 11-inches square. It shall be provided with connections for the two sludge removal rake arms and feedwell supports. The cage top shall be bolted to the main gear which shall rotate the cage with the attached arms and feedwell. The minimum structural angle size used for the cage and rake arms shall be 2-1/2-inches by 2-1/2-inches by 1/4-inch.

B. The manufacturer shall provide design calculations and sketches substantiating the design capacity of the torque cage and rake arm structure. The structural calculations shall include an analysis of the torsional load from the rake arm blade. The center cage shall encompass the center column and shall be sufficient strength to transmit and/or carry all loads and stresses associated with 200% of the continuous operating torque.

2.10 CENTER COLUMN

A. The center column shall be made of Type 304 stainless steel and able to support the entire secondary clarifier mechanism including inboard end(s) of access bridge; sized and designed by collector manufacturer. A minimum inside diameter of 30-inches for the 75-foot diameter clarifiers, a minimum inside diameter of 36 inches for the 100-foot clarifiers, and a minimum wall thickness of 3/8-inch for all clarifiers.

B. The bottom of the column shall have a support flange 1-1/4-inch minimum thickness for bolting to the concrete tank; with a minimum of 12 1-1/2-inch diameter Type 316 stainless steel anchor bolts and a similar flange at the top of the column for supporting the center assembly. The manufacturer shall provide a template to accurately locate anchors and allow for grout beneath the pier after final plumbing.

C. Provide a watertight seal between the center column and the influent feed pipe at the influent discharge location.

2.11 RAS ADAPTER (OWRF ONLY):

A. A collection drum with sludge collection port(s) shall be provided to collect settled solids raked to the center by the rotating spiral blades. The port(s) shall be sized to collect thickened sludge from the bottom most dense sludge layer to maximize underflow solids concentration.

B. The drum shall be constructed of ¼ inch steel plate. A neoprene seal shall be provided to seal against the center column. A stainless steel seal shall be provided to seal against the center column. The seal shall not obstruct sludge from reaching the drainage sump and shall allow for complete drainage of the clarifier.

C. A stationary influent/RAS adapter device shall be furnished which shall serve as both a support base for the center influent column and an inlet manifold for the existing sludge return pipe. The RAS adapter shall be designed by the manufacturer to connect the existing 14-inch RAS/WAS pipe to the new sludge collection system. The manufacturer shall provide drawings showing dimensions, orientation and installation of the RAS adapter.

D. CONTRACTOR to cut existing vertical RAS pipe to required elevation to perform coupling. Clarifier manufacturer shall provide a fitting to transition from the RAS adapter device to the existing RAS pipe. Coupling of RAS pipe to adapter shall be accomplished with Fernco type coupling.

2.12 INFLUENT FEEDWELL

A. The influent feedwell shall be welded steel, minimum 3/16-inch thick, concentric with center column, supported by center cage. The influent feedwell reinforcing rim angles, angle stiffeners and supporting brackets shall be structural steel members a minimum of 1/4-inch. The top edges shall be approximately 3-inches above tank

water surface, project at least 6 feet below liquid level and minimum diameter of 24 feet.

B. The influent feedwell shall include four equally spaced scum ports at liquid level to permit removal of floating material in well. The scum ports shall be 4-inches high and 16-inches long. The scum ports shall extend 2-inches below low water level with steel support members located on outside of feedwell to facilitate tangential motion within feedwell.

2.13 ENERGY DISSIPATING INLET (Type II LA-EDI™)

A. Each clarifier shall be provided with a dedicated Energy-Dissipating Inlet (EDI). The EDI shall combine the processes of dissipating the energy of the jets from the inlet ports and enhancing the flocculation of sludge particles. The dispersion well shall be designed to create a swirling action within the EDI tube which encourages the collision of flocculent particles in the opposing jets, creating a more controlled mixing in the zone surrounding the opposing jets. The EDI shall eliminate the uneven settling due to turbulence in the area below the EDI; optimize the separation and settling of suspended particles; minimize the carry-over of solids ordinarily transported by density currents; and enhance the uniform formation of the sludge blanket.

B. The EDI and influent feedwell shall be combined into a single structure.

C. The EDI shall be fabricated of not less than ¼-inch thick 304 stainless steel plate with adequate thickness for support. The EDI shall be supported from the center cage and provided with a steel bottom plate to within one inch of the center column.

D. The EDI shall be designed to dissipate the energy of the incoming flow by way of multiple baffled inlet ports equally spaced around the dispersion well. The well shall be equipped with multiple wing-type outlet nozzles attached to the bottom of the feedwell. The nozzle ports shall be arranged in an opposing jet configuration to create flow impingement to dissipate energy and promote flocculation.

E. The EDI shall have a minimum of four (4) 6-inch by 18-inch scum ports, spaced at 90-degree intervals to allow for the passage of scum. The invert of the scum ports shall be 1-inch below the invert of the v-notch effluent weir, or as recommended by the manufacturer. The number of scum ports shall be increased as required and necessary for the proper operations or function of the unit.

F. The EDI and feedwell shall be designed by the former U.S. Patent Holder of the EDI. The integrated influent feedwell and EDI design including dimensions and details shall be provided by the former U.S. Patent Holder of the EDI to ensure proper performance. The clarifier manufacturer shall incorporate the EDI design from the former U.S. Patent Holder into the overall design and layout of the clarifier mechanism. Design information and drawings as well as a notarized signed design letter from the former U.S. Patent Holder shall be submitted as proof of proper

coordination and system design. The clarifier manufacturer shall include all design fees within their bid price.

2.14 EFFLUENT WEIRS AND SCUM BAFFLE

A. Contractor shall utilize existing effluent weirs at AWRF and OWRF.
   1. Effluent weirs consist of 1 foot deep by 1/4-inch thick FRP sections with 3-inches deep 90 degree V-notches at 9-inches intervals. The weir section is fastened to the tank wall with FRP washers, Type 316 stainless steel anchor bolts and hex nuts to allow vertical adjustment. All joints between walls and weirs are given a seal coat of suitable waste resistant mastic by the erection the CONTRACTOR to prevent leakage.

B. Contractor shall utilize the existing scum baffles at AWRF and OWRF, but shall replace the scum baffle support brackets.
   1. The scum baffles consist of sections of 12-inches deep at AWRF Clarifiers No. 1-3, 20-inches deep at AWRF Clarifier No. 4, and 14-inches deep at OWRF Clarifier No. 3. All scum baffles at AWRF and OWRF are made of FRP and 1/4-inch thick. The scum baffles are continuous around the circumference of the basins on the inboard side of the effluent weir.
   2. Scum baffles shall be attached to the tank wall by FRP angle brackets, 316 stainless steel anchor bolts, and hex nuts to enable vertical and radial adjustment. The upper brackets shall be L-shaped to allow cleaning of the baffle and weir.

2.15 ROTATING RAKE ARMS AND SCRAPERS

A. General:
   1. Each rake arm shall be designed for its own dead load, plus 120% of its proportionate share of design total torque. The loading used to produce design total torque shall be assumed to be distributed uniformly along each rake arm.
   2. The rake arms shall conform to the slope of the tank floor and be of structural steel triangular or rectangular box truss design attached rigidly to the center cage. Support tie rods in the rake arm design will not be allowed. The width of the rake arms shall be the same as the center cage. The minimum angle size of the rake arms shall be 2-1/2-inches by 2-1/2-inches by 1/4-inch. The structural calculations for the rake arm shall include an analysis of the torsional loads from the spiral curve blade.
   3. The horizontal and vertical deflection at the ends of the rake arms shall not exceed a deflection equal to the length of the rake arm divided by 1,000. The deflection shall not be exceeded for an equal distribution of the design total torque. The deflection of the rake arms may be checked using the full member thickness.
   4. The scraper rake blades shall be equipped with stainless steel squeegees with 2-inch adjustment.

a. The scrapers shall be spiral type, with two spiral scrapers per rake arm. The scraper blades for the 100-foot diameter clarifiers shall be tapered uniformly from 8-inches deep minimum at 50 foot radius to 24-inches deep minimum at 6-1/2 foot radius. The scraper blades for the 75-foot diameter clarifiers shall be tapered uniformly from 8-inches deep minimum at 37-1/2 foot radius to 24-inches deep minimum at 6-1/2 foot radius.
b. Blade shape shall be such that every tangent to the spiral shall make an angle of 30 degrees with a radial line to that point.
c. The rake arms shall be of steel box or triangular truss construction, supporting the spiral scraper blades without any peripheral support members.

2.16 SKIMMERS AND SCUM BOXES:

A. General

1. Provide a rotating 304 stainless steel skimming mechanism to collect and move skimmings outward to the scum baffle. Two main skimmer blades shall sweep the water surface of the clarifier from the feedwell to the scum boxes. The blades shall be configured as shown on the Drawings. The main blades shall be supported from the two full diameter sludge collector arms. Do not support skimmer from scum baffle. The blade shall be fabricated of stainless steel plate, reinforced for rigidity. One hinged skimming blade shall be supported from each arm.
2. Provide a scum box with shelf for each basin. The hinged blade shall be made of stainless steel, and shall be the width of the scum box with a stainless steel wearing plate on its outer edge and neoprene strips on the bottom and inner edges, to seal the entrapped scum and water when discharging into the box. The hinged blade wiper strip shall be constantly forced against the scum baffle by a dual stainless steel spring arrangement to keep the scum box scraped clean.
3. Design the hinged blade so that it is carried across the opening of the scum box without resting on the bottom neoprene strip. The hinged blade shall be adjustable to vary the quantity of liquid discharged with the scum. Also, movement in vertical plane shall be feasible so that the bottom edge of the blade is always in contact with the scum box, even if the arm is not horizontal. Design the hinged blade so that it can be raised and held inactive above the water level when skimming is not required.
4. The hinged blade shall trail the main blade and shall be designed to sweep the scum up the beach plate and into the scum box. The hinged blade shall have replaceable neoprene wipers to maintain contact with the perimeter scum baffle, the beach plate, and the inner edge of the scum box. Fasteners for the wipers shall be Type 316 stainless steel. The hinged blade shall be adjustable to correct for irregular alignment. The hinged blade mechanism shall be provided with break away hardware should this arm become hung up at the scum beach. Provide a hinged mechanism or safety chain on the break away mechanism to prevent the arm from falling to the bottom of the tank.

5. Fabricate the scum boxes and shelves from 1/4-inch thick 304 stainless steel plate, of welded construction, and rigidly supported from the tank wall. The scum boxes and shelves shall be as shown on the Drawings, but in no case less than 5-feet wide.
6. The scum boxes shall include a 2-inch diameter hole which shall be placed in the end of the box to permit continuous flush of the trough. Provide four 2-inch wide blade guides over trough. This outer wall of the scum box running between the two weir plates shall extend vertically above the beach sufficiently to prevent scum from dripping over this wall and out to the effluent. The inner wall shall have a tapered leading edge to reduce chance of hanging up of the arm.
7. Furnish spray water piping and nozzles with each scum box.
8. Provide Type 316 stainless steel anchor bolts in accordance with the manufacturer's recommendations.

2.17 LAUNDER BRUSHES

A. Launder brushes shall be custom designed to clean both sides of scum baffle, and V-notch weirs, inner launder wall, launder bottom. Brushes shall be attached to the skimmer arm.

B. The launder brush shall be designed to work off the power of the clarifier drive motor. The unit shall be designed with an engaged position for cleaning and a disengaged position allowing the system to ride idle around the tank.

C. Clarifier manufacturer and the launder brush manufacturer shall make sure that there is no interference with others' equipment.

D. The attachment assembly shall be made of 304 stainless steel. Main frame, brush arm, and brush bridge shall be constructed of Type 304 stainless steel. The system shall be flexible to clean surfaces within a 4-inches radial variance. Brush holder shall be adjustable to provide maximum number of brush arm adjustment. Brush arm shall have enough power to clean the surfaces of algae and debris. In order to balance the skimmer arms 1/2 set of brushes shall be mounted on each arm. The launder brush manufacturer is responsible for dividing the brushes into two 1/2 sets for balancing the loads and providing effective cleaning.

2.18 PERIPHERAL DENSITY CURRENT BAFFLE (STAMFORD BAFFLE)

A. Contractor shall reuse existing Stamford baffles at AWRF Clarifiers No. 1-4.

B. Contractor shall install Stamford Baffle at OWRF Clarifier No. 3 as follows:
1. Density current baffle system shall consist of a series of baffle panels which are attached to the knee of the inboard launder and form an inclined, shelf like surface. The panel shall follow the curvature of the clarifier and extend inward at a 45 degree angle toward the center of the tank. Each baffle panel shall be molded of fiberglass reinforced plastic. The resins and fiberglass reinforcing

material shall be consistent with the environmental conditions and structural requirements.

2. The baffle or the attached and/or supporting brackets shall not interfere with any of the fixed or moving secondary clarifier mechanisms. The supporting bracket shall be appropriately spaced and adequately sized such that the baffles can withstand buoyant force equal to the weight of the water displaced. The size of the baffle shall be as shown on the Drawing. Provision shall be made to vent gases from beneath the baffle. All the installation fasteners shall be Type 316 stainless steel.
3. Baffle supplier shall expressly warrant the baffles to be free of defects in materials and workmanship for a period of five years from the date of installation. Baffle walls shall be black in color.

2.19 PAINTING AND SURFACE PREPARATION

A. All non-submerged steel shall be sandblasted to SSPC-SP-6 and given one coat of Tnemec Series 135 Chembuild, 3-4 mils dry film thickness (DFT). All submerged steel shall be sandblasted to SSPC-SP-10 and given one coat of Tnemec Series 91-H20 Hydro-Zinc, 3-4 mils DFT. All cast iron surfaces shall be solvent scrubbed with stiff bristle brush followed by brush-off abrasive blast cleaning to a minimum surface profile depth of 1.5 mils and given one coat of Tnemec Series 69-1255 H.B. Epoxoline, 3-4 mils DFT.

B. All non-submerged steel shall be given a final coat of Series 1075 Endura-Shield II; one coat, 3-4 mils DFT. All submerged steel shall be given a final coat of Tnemec Series WH02 (tank white Potapox; one coat, 4-6 mils DFT. All cast iron surfaces shall be given one final coat of Tnemec Series 1075 Endura-Shield II; one coat, 3-4 mils thick. Manufacturer shall provide two 2-gallon containers of each final coat with the equipment for field touch-up. Color selection shall be approved by ENGINEER prior to application.

C. Prior to assembly of the drive unit, the castings shall have been sandblasted and thoroughly cleaned to remove any foreign particles in the drive base. After assembly, the drive mechanism shall be solvent cleaned and power wire brushed as needed prior to application of manufacturer's standard primer.

D. Gear motors shall be furnished with manufacturer's standard enamel.

2.20 SPARE PARTS

A. The following parts are to be furnished:
   1. All sight glasses and oil gauges.
   2. One set of seals for each secondary clarifier mechanism.
   3. One set of overload control device switches.
   4. One set of squeegees for each mechanism.
   5. A quantity of fasteners equal to 10% of each type of fastener used with exception of anchor bolts.

6. A drive main bearing complete with all liners, balls, and drive seals if less than 200,000 hour design.
7. One set of seals for each wash water flocculation arm drive unit.
8. Any additional spare parts recommended by the manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

A. The equipment shall be erected in strict accordance with manufacturer's recommendations. A 2-inch layer of grout shall be applied to the tank floor, using screens attached to the rake arms. The mechanism shall screed the grout, consisting of a mixture of sand and cement accepted by the ENGINEER, under its own power.

3.2 TESTS

A. The clarifier mechanism shall be field torque tested. The testing shall be carried out under the supervision of the equipment manufacturer before the mechanisms are approved and placed into operation.

B. The torque test shall consist of securing the rake arms by cables to anchor bolts installed by the CONTRACTOR in the tank floor at locations recommended by the manufacturer and the ENGINEER. A torque load shall be applied to the scraper arm by means of a ratchet lever and cylinder connected to the cable assembly.

C. The magnitude of the applied load shall be measured by calculating the torque from the distance of the line of action of each cable to the center line of the mechanism. Readings shall be taken at 100%, 125%, and 175% of design torque value. The test load shall be applied and noted on the torque overload device.

D. The manufacturer's service technician shall certify that the alarm and motor cutout torque of the drives as calibrated in the manufacturer's shop are in proper operation to shut down the units as specified.

E. All equipment required for the test shall be provided by the manufacturer. After the successful test the equipment shall be returned to the equipment manufacturer.

3.3 MANUFACTURERS' FIELD SERVICE

A. Equipment Start-up: A factory employed representative of the manufacturer shall visit the site and provide installation and start-up services as specified in Section 01650, Starting of Systems. A total of two visits shall be included for a total time of three days (eight hrs/day) for start-up services.

B. Training: A factory employed representative of the manufacturer shall visit the site and provide operator training services, in addition to equipment start-up services, as

specified in Section 01650, Starting of Systems. Provide eight hours of training by factory employed personnel.

++ END OF SECTION ++

SECTION 11375

AERATION SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Chandler Airport WRF: Furnish and install, ready for operation, new diffusers and to replace the existing fine bubble membrane disc aeration systems for two (2) aeration basins as shown on the Drawings and specified herein. Work includes furnishing and installing new diffusers, new diffuser laterals, base plates and diffuser manifolds in aeration basins 5 & 6 as shown on Drawings.

B. Chandler Ocotillo WRF: Furnish and install, ready for operation, new diffusers and to replace the existing fine bubble membrane disc aeration systems in Zone 8 of the two (2) bioreactors as shown on the Drawings and specified herein. Work includes furnishing and installing new diffusers, new diffuser laterals, base plates and diffuser manifolds in Zone 8 of MBR Bioreactor basins No. 1 & 2 as shown on Drawings

1.2 SECTION INCLUDES

A. Air distribution manifolds.

B. Air distribution laterals.

C. Supports.

D. Fine bubble air diffusers.

E. Welding and corrosion protection.

1.3 REFERENCES

A. All applicable ANSI, ASME, AWWA, and ASTM Standards.

1.4 SUBMITTALS

A. Descriptive submittals shall be made in accordance with the Data Reference Symbols defined in Section 01300, Submittals.
   1. Fine Bubble Aeration Equipment:
      a. Shop Drawings:
         1) Letters of Certification of Compliance on materials, equipment, etc.
         2) Final Certified Drawings showing outline dimensions, foundation layout or mounting information, and other pertinent dimensions.

3) Field erection instructions, assembly drawings and/or diagrams, detailed reference drawing lists, lists of erection details, and list of spare parts supplied with equipment.
4) Shop Detail Drawings showing individual sub- assemblies and fabricated pieces with material specifications and other applicable data.
5) Installation instructions, operating and/or service manuals, and all other data pertinent to operating or servicing the complete apparatus. Preventative maintenance instructions and recommended frequency.
6) Schematic and wiring diagrams of power, control, and piping systems. A detailed description of operation shall be included for each diagram to describe all modes of operation of the system indicated. Where the integrated system requires interlocking and control of other components in normal operation, these components shall be included in the description of operation.
7) General bulletins and catalog cuts describing complete apparatus, including operating principles and fundamentals.
8) Materials of construction of all components.
9) Renewal parts list with diagrammatic or cross-section drawings showing part identification. Material analysis or trades designation for each significant part is to be noted on parts lists or on a separate sheet.
10) Stuffing box sizes; packing sizes; specifications and arrangement; and mechanical seal details, specifications, etc., if furnished in equipment.

2. Shop Drawings: Submit for approval the following:
   a. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
   b. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE**

WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.

c. O&M Manuals:
   1) Final Certified Drawings showing outline dimensions, foundation layout or mounting information, and other pertinent dimensions.
   2) Field erection instructions, assembly drawings and/or diagrams, detailed reference drawing lists, lists of erection details, and list of spare parts supplied with equipment.
   3) Shop Detail Drawings showing individual sub- assemblies and fabricated pieces with material specifications and other applicable data.
   4) Installation instructions, operating and/or service manuals, and all other data pertinent to operating or servicing the complete apparatus. Preventative maintenance instructions and recommended frequency.
   5) Schematic and wiring diagrams of power, control, and piping systems. A detailed description of operation shall be included for each diagram to describe all modes of operation of the system indicated. Where the integrated system requires interlocking and control of other components in normal operation, these components shall be included in the description of operation.
   6) General bulletins and catalog cuts describing complete apparatus, including operating principles and fundamentals.
   7) Materials of construction of all components.
   8) Renewal parts list with diagrammatic or cross-section drawings showing part identification. Material analysis or trades designation for each significant part is to be noted on parts lists or on a separate sheet.
   9) Stuffing box sizes; packing sizes; specifications and arrangement; and mechanical seal details, specifications, etc., if furnished in equipment.

B. Complete headloss calculations for the aeration equipment from the manufacturer's point responsibility. Headloss calculations shall be derived using air at standard conditions and at a design maximum air flow rate per diffuser.

1.5 RELATED SECTIONS

A. Section 01300, Submittals.

B. Section 01640, Materials and Equipment.

C. Section 01650, Starting of Systems.

1.6 QUALITY ASSURANCE

A. The manufacturer shall have experience in the design, manufacturing, supplying, and commissioning of fine bubble membrane disc aeration system specified for this project. The equipment quoted shall be of a proven design and shall be referenced by

at least five installations of similar size or larger, that have operated successfully for at least 5 years.

B. Fine bubble membrane disc diffusers shall have a minimum oxygen transfer rate (SOTE) of 32% at an air flow rate of 2 scfm per diffuser.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Aquarius Technologies, LCC, Saukville, WI.

B. Sanitaire Division of Water Pollution Control Corporation, Milwaukee, WI.

C. Stamford Scientific International, Inc., Poughkeepsie, NY.

D. Environmental Dynamics International, Inc., Columbia, MO.

2.2 DESIGN CRITERIA

A. Chandler Airport WRF:
   1. The design criteria for the Aeration Basins is as follows: Ultimate capacity of the treatment plant is 33 MGD average design flow. The current design is for an average flow of 27 MGD and a peak flow of 33 MGD.
   2. 27 MGD Condition:
      a. Total Number of Basins: 2.
      b. Air Requirement/Basin.: 5640 scfm
      c. Zone 1, Anoxic Zone with Submersible Mixers.
      d. Zone 2 - Dropleg -1 (peak day/average day): 900/815 scfm.
      e. Zone 2 - Dropleg -2 (peak day/average day): 993/902 scfm.
      f. Zone 2 - Dropleg -3 (peak day/average day): 1,490/1357 scfm.
      g. Zone 3 - Dropleg -1 (peak day/average day): 1,521/1382 scfm.
      h. Zone 4 - Dropleg -1 (peak day/average day): 367/334 scfm.
      i. Zone 4 - Dropleg -2 (peak day/average day): 367/334 scfm.
      j. Maximum Anticipated Water Depth: 20 feet 9-inches.
      k. Depth of Water From Top of Diffuser Plate: 19 feet 6-inches.
   3. Location of Internal Mixed Liquor Return (Anoxic Internal Recycle) pump and pipe (BNR process) are shown on process drawings. The diffuser manufacturer shall take the location of all equipment, and its effects on the aeration system into account. If necessary, the diffuser manufacturer shall contact other equipment manufacturer(s) for further information.
      a. Average of Water Temperature Expected: 60° F - 90° F.
      b. Range of Ambient Air Temperature Expected: 20° F - 120° F.
      c. Elevation, above mean sea level: 1,209.0.
   4. The lateral spacing shown on the Drawings is final. Where space for future laterals is provided the diffuser spacing shall be such that future lateral and

diffusers can be installed with same diffuser spacing as adjacent laterals. Minimum diffuser spacing for each zone is shown on the Drawings. Any new layout, if different from the one showed on the Plan, shall be submitted to the ENGINEER for approval. The decision on the new layout is entirely up to the ENGINEER.

5. Available headloss through the dropleg, distribution manifold, distribution laterals, diffuser, and orifice shall not exceed 21-1/2-inches of water column at an airflow rate of 2 scfm per diffuser and 28-inches of water column at an air flow rate of 3 scfm per diffuser for any droplegs shown on the Drawings.

B. Chandler Ocotillo WRF:
   1. The design criteria for the Bioreactors is as follows: rerated plant capacity is 8.2 MGD.
   2. 8.2 MGD Condition:
      a. Total Number of Basins: 2.
      b. Zone 8 - Dropleg -1 (peak day/average day): 450/267 scfm.
      c. Maximum Anticipated Water Depth: 17.3 ft.
      d. Depth of Water From Top of Diffuser Plate: 16.38 feet.
   3. Location of Internal Mixed Liquor Return (Anoxic Internal Recycle) pump and pipe (BNR process) are shown on process drawings. The diffuser manufacturer shall take the location of all equipment, and its effects on the aeration system into account. If necessary, the diffuser manufacturer shall contact other equipment manufacturer(s) for further information.
      a. Average of Water Temperature Expected: 60° F - 90° F.
      b. Range of Ambient Air Temperature Expected: 20° F - 120° F.
      c. Elevation, above mean sea level: 1,174.5.
   4. The lateral spacing shown on the Drawings is final. Where space for future laterals is provided the diffuser spacing shall be such that future lateral and diffusers can be installed with same diffuser spacing as adjacent laterals. Minimum diffuser spacing for each zone is shown on the Drawings. Any new layout, if different from the one showed on the Plan, shall be submitted to the ENGINEER for approval. The decision on the new layout is entirely up to the ENGINEER.

2.3 MATERIALS

A. All materials used in the manufacturing of this equipment shall be new and of the best quality used for the purpose of commercial practice.

2.4 COMPONENTS

A. Air Distribution Manifolds:
   a. Fine Bubble Aeration System:
      1) Chandler Airport WRF
         a) Provide new Sch 80 PVC manifolds downstream of all droplegs of Aeration Basins 5 & 6.

2) Chandler Ocotillo WRF
   a) Provide new Sch 80 PVC manifolds downstream of all droplegs in Zone 8 of MBR Bioreactors 1 & 2.

B. Air Distribution Laterals:
   1. Fine Bubble Aeration System:
      a. The air distribution laterals shall be Sch 40 PVC. The air distribution laterals shall connect to the air distribution manifold at the connections provided for that purpose with a fixed joint. The air distribution laterals shall be fabricated in sections not to exceed 20 feet in length. Joints between sections shall be of the expansion or fixed type and shall permit rotation of each section independently. All pipe and fittings shall be designed to be field installed with no solvent welding.
      b. Provisions shall be made for expansion/contraction of the distribution laterals resulting from temperature change. Expansion joints shall be provided for longitudinal expansion and contraction over temperatures ranging from 40° F to 120° F. Pipe couplings if required by the manufacturer shall incorporate a mechanical expansion joint. It is the responsibility of the diffuser manufacturer to determine whether expansion joints are required for laterals. If required, the location shall be determined by the diffuser manufacturer.

C. Supports:
   1. Fine Bubble Aeration System:
      a. Each air distribution lateral shall be anchored in place by supports as required. The supports shall be designed and furnished by the diffuser manufacturer. Spacing and location shall be as required by the diffuser manufacturer. These supports shall withstand all environmental, hydraulic, and pneumatic conditions in the aeration basin. Anchors shall be epoxy type anchor bolts and shall have a minimum factor of safety of four.
      b. The diffuser manufacturer shall review all drawings related to the aeration basins and shall be aware of all other equipment in the aeration basin, and design supports to withstand the effects of that equipment, including, but not limited to submersible mixers, and anoxic internal recycle pumps. The diffuser manufacturer shall review all pertinent construction documents on the project to determine potential loadings on the supports.
      c. All pipe supports shall be designed to withstand all loads described above and worst-case scenario flows at ultimate capacity as tabulated in Paragraph 2.2.

D. Air Diffusers:
   1. Fine Bubble Aeration System:
      a. The CONTRACTOR shall supply fine bubble diffusers in the aeration basins as shown on the Drawings. Diffuser assemblies shall consist of a nominal 9-inch diameter, EPDM membrane diffuser with integral O-ring, a PVC retainer ring and a diffuser support piece. Diffusers shall be

composed of EPDM elastomer and shall be resistant to attack by common municipal wastewater. EPDM material shall meet the requirements of ASTM D573. No other size diffusers are allowed.

b. Diffusers shall be free of voids, tears, bubbles, creases, or other structural defects.

c. Diffusers shall have a uniform distribution of air release across the entire surface area of the diffuser except for the center 1-inch diameter which shall not be perforated. The non-perforated center of the diffuser shall provide the necessary sealing capabilities and backflow prevention when air supply to the diffuser is interrupted. The center shall be thickened to prevent ballooning and air abrasion where the air is released under the diffuser.

d. Diffusers shall be disc-shaped with a 9-inch nominal diameter and an integral O-ring seal molded into the diffuser assembly. The diffuser cross-section shall be thickened at the center as noted above and at the periphery near the O-ring to resist stretching.

e. Diffuser material shall have a durometer of 55±5, Shore A, with a minimum tensile strength of 1,200 psi, and a minimum elongation of 350% at break.

f. After 72 hours at 70° C of oven age, testing the diffuser shall be 50 Shore A, tensile strength of 1,200 psi and elongation of 400%. The durometer shall not change more than 10 units. Tensile strength and elongation shall not change more than -25% after oven testing, per ASTM D573. Compression set after 22 hours at 70° C should be less than 5%.

g. The diffuser shall be perforated with uniform slits of a shape and size to prevent tearing or lengthening of the slits during operation.

h. The diffuser shall exhibit uniform distribution of air across the entire surface area when submerged and operating at 1.0 CFM per diffuser.

i. Dynamic wet pressure of the diffuser element shall be between 13-inches and 14-inches of water column at an air flow rate of 2 scfm per diffuser, and 14-inches and 15-inches of water column at an air flow rate of 3 scfm per diffuser. Dynamic wet pressure is the pressure required to operate the diffuser in tap water at the specified flow rates minus any loss for submergence and flow control devices.

j. The following provides information regarding the number of diffuser holders and diffuser elements that need to be supplied in the existing basins of Chandler Airport WRF & Ocotillo WRF.

    1) Chandler Airport WRF Aeration Basins No. 5 & No.6: Provide the following number of membrane diffusers per basin:

        a) Zone 1 - Anoxic Zone - This area has no diffuser elements.

        b) Zone 2 - Dropleg -1:

            i) Total Number of Laterals: 18.

            ii) Total Diffuser Holders: 488.

            iii) Total Diffuser Elements: = 462.

        c) Zone 2 - Dropleg -2:

            i) 10-inch diameter manifold.

ii) Total Number of Laterals: 18.
iii) Total Diffuser Holders: 536.
iv) Total Diffuser Elements: 509.

d) Zone 2 - Dropleg -3:
i) 12-inch diameter manifold.
ii) Total Number of Laterals: 34.
iii) Total Diffuser Holders: 788.
iv) Total Diffuser Elements: 763.

e) Zone 3 - Dropleg -1:
i) 12-inch diameter manifold.
ii) Total Number of Laterals: 19.
iii) Total Diffuser Holders: 802.
iv) Total Diffuser Elements: 780.

f) Zone 4 - Dropleg -1:
i) 6-inch diameter manifold.
ii) Number of Laterals: 8.
iii) Total Diffuser Holders: 216.
iv) Total Diffuser Elements: 188.

g) Zone 4 - Dropleg -2:
i) 6-inch diameter manifold.
ii) Total Number of Laterals: 8.
iii) Total Diffuser Holders: 218.
iv) Total Diffuser Elements: 188.
v) Total Diffuser Holders per Basin: 3,048.
vi) Grand Total New Diffuser Holders: 6,096.
vii) Total Diffusers per Basin: 2,890.
viii) Sub-total Diffusers = 2 x 2,890: 5,780 diffusers.
ix) Grand Total Diffusers (AWRF): 5,780 diffusers.

2) Chandler Ocotillo WRF MBR Bioreactors No. 1 & No. 2: Provide the following number of membrane diffusers per basin:

a) Zone 8 - Dropleg -1:
i) 4-inch diameter manifold.
ii) Total Number of Laterals: 12.
iii) Total Diffuser Holders: 245.
iv) Total Diffuser Elements: 220.
v) Sub-total Diffusers = 2 x 220: 440 diffusers.
vi) Grand Total Diffusers (OWRF): 440 diffusers.

E. Retainer Rings:

1. Fine Bubble Aeration Basin:

a. The retainer ring shall be made of PVC with a minimum of 1-1/2% of Ti02 added for ultra-violet protection. The retainer ring shall have a minimum of 2-1/2 complete threads for effective sealing. The threads shall be buttress-type or square-type for maximum holding strength and to minimize stress concentration.

F. Diffuser Baseplates:
1. Fine Bubble Aeration System:
a. Each diffuser baseplate shall be factory solvent welded to the PVC diffuser lateral and shall be manufactured of PVC with 1-1/2% Ti02 added for ultraviolet protection. The welding contact area between the baseplate and the distribution lateral shall be a minimum of 17 square inches to provide a structurally sound connection.
b. Angular variation of all the baseplates on a distribution lateral shall not exceed ±1.0 degree.
c. The baseplate shall be centered on the crown of the pipe.
d. Each base plate shall be the manufacturer's standard product.
e. Each baseplate shall incorporate a factory-drilled orifice sized to give minimum headloss while assuring uniform air distribution. Headloss through orifice should not exceed 6-inches to 7-inches of water column at an air flow rate of 2 scfm per diffuser and 11-inches to 12-inches of water column at an air flow rate of 3 scfm per diffuser. The control orifice shall be factory drilled. Designs requiring field drilling of the orifice shall not be acceptable. The air release of the orifice shall be designed to provide even air distribution under the horizontal surface of the diffuser element. The orifice shall be 1/4-inch diameter (unless otherwise noted).
1) Plugs (for the blank diffuser baseplates):
a) Fine Bubble Aeration System:
i) Blank or spare diffuser baseplates which will not be provided with diffusers shall be plugged with a 1/2-inch diameter polypropylene tapered pipe plug. Plugs relying solely on friction to remain in place shall not be acceptable. Alternative designs are acceptable provided that the alternative plug can withstand 30 psi.

G. Elastomeric Gaskets:
1. Fine Bubble Aeration System:
a. The following gaskets shall be provided for the aeration system.
1) Expansion joint gaskets - 4.50-inches I.D.
b. Expansion joint gaskets shall be composed of solid neoprene rubber and shall conform to ASTM D2000. Gaskets shall be suitable for withstanding the effects of wastewater and for temperatures up to 250° F
c. Expansion joint gaskets shall have a durometer of 40 ±5.

H. Purge Systems:
1. Fine Bubble Aeration System:
a. The following purge system shall be provided for the aeration system.
1) Manual Valve Assembly.
b. The manual purge system shall use an eductor line that extends from the grid to above the water surface and terminate at a manual ball valve. The system shall include a sump and evacuation pipe.
c. For in-line manifolds, the sump shall be built into the manifold pipe.

d. For raised manifolds, the sump shall be installed between air distributor or drainline sections.

2.5 SPARE EQUIPMENT

A. Provide the following spare parts:
   1. 10% of the number of installed diffusers, including retainer rings and diffuser support plates.
   2. 1% of the total number of pipe supports, including anchor bolts.
   3. 1% of each type of diffuser lateral.
   4. 50% of the installed number of plugs for blank baseplates (including all required gaskets and accessory equipment).

B. The above spare parts shall be provided strictly for the OWNER'S inventory.

PART 3 - EXECUTION

3.1 INSTALLATION

A. The aeration systems shall be installed in accordance with the manufacturer's recommendations

3.2 MANUFACTURERS' FIELD SERVICE

A. Equipment Start-up: The Airport WRF and Ocotillo WRF are operating treatment facilities. Each aeration basin will be taken out of service at a time and diffusers will be installed and the basin will be brought back in service before installation of diffusers in another basin. Field tests shall be performed to one basin at a time and work within basins will be accepted one at a time. A factory employed representative of the manufacturer shall visit the site and provide installation and start-up services as specified in Section 01650, Starting of Systems, per each basin. A total of four trips are required to provide this assistance. At least one day (eight hours) of field service is required per trip.

B. Training: A factory employed representative of the manufacturer shall visit the site and provide operator training services, in addition to equipment start-up services, as specified in Section 01821, Instructions of Operations and Maintenance Personnel. Training shall be for a period for four hours.

3.3 FACTORY CERTIFIED TESTS

A. The manufacturer shall perform tests to the diffuser elements to ensure proper permeability, uniformity, strength, and dimensions.

B. The aeration system manufacturer shall furnish to the OWNER, through the ENGINEER, a written report confirming that the diffusers have met all established quality assurance standards.

3.4 FIELD TESTS

A. After installation, the diffuser equipment shall be tested for mounting, levelness, air uniformity, and leakage as specified herein. Prior to initiating any field testing, all piping shall be inspected for proper joints, supports and tie downs, and plugs and drain relief valves.

B. Each tank shall be flooded with water to the top of the diffusers. The level of the diffusers shall then be checked to insure that they are at the same elevation within 1/4-inch of a common horizontal plane for the aeration basin and within 3/8-inch for the sludge holding tank.

C. The basins will then be filled with water to 3-inches above the diffusers. Air shall then be released through the diffusers, and operation of the diffusers shall be checked. The surface of the water above the diffusers shall then be visually inspected to insure that air flow is uniformly distributed across the tank, as well as uniformly distributed across the surface of each diffuser. The air manifold, moisture blowoff, and drop piping above the water surface shall be checked for leaks with soap suds. The piping shall be inspected for leaks. All leaks shall be fixed and subject to approval by the ENGINEER.

D. The CONTRACTOR shall notify the ENGINEER at least one week prior to the schedule testing date and shall confirm the testing schedule at least two days prior to the testing date, to allow the OWNER or his representatives to witness the field testing. The aeration equipment manufacturer shall provide a field service engineer to monitor the installation, leveling, and testing of the aeration equipment.

3.5 WARRANTY

A. As a condition precedent to final acceptance of the Work, the CONTRACTOR shall certify that the equipment included under this Section has been properly installed, aligned, tested, and placed into operation. The certification shall warrant that the equipment and its installation are free from defects, and suitable for trouble-free operation for a period of one year after the start-up. Furnish replacement parts to the OWNER for any items found to be defective within the warranty period.

++ END OF SECTION ++

SECTION 11400

DISC FILTER SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. The CONTRACTOR shall supply all tools, equipment, materials, and supplies, and shall perform all labor required to complete the installation of Disc Filter Unit No. 6 as indicated on the Contract Drawings and specified herein to provide a fully operational Disc Filter System. The complete Disc Filter System (5 existing + 1 new) shall be rated for an average flow of 27 MGD with a peak flow of 33 MGD.

B. Filter units to be installed in existing concrete tank(s) as shown on the Drawings and/or specified within include the following components:
   1. Disc Filter System including, but not limited to, the following:
      a. Centertube Assembly with Cloth Media Discs.
      b. Drive Assembly.
      c. Influent Weir.
      d. Basin Mounting Brackets and Hardware.
      e. Electrical Controls and Internal Components.
   2. Filter Backwash and Solids Wasting Assembly including, but not limited to, the following:
      a. Backwash/Solids Waste Pump Assembly.
      b. Valves.
      c. Pressure Gauges.
      d. Float Switch.
      e. Vacuum Gauges and Transmitters.
      f. Vendor Control Panel.

1.2 RELATED SECTIONS

A. Section 01010, Summary of Work.

B. Section 01300, Submittals.

C. Section 01640, Materials and Equipment.

D. Section 01650, Starting of Systems.

E. Section 01660, Field Tests of Equipment.

F. Section 11295, Hydraulic Valves.

G. Section 13447, Electric Motor Actuators.

H. Division 16, Electrical.

I. Section 16225, Electric Motors 250 Horsepower or Less

J. Division 17, Instrumentation.

K. Section 17454, Operation and Control Description.

1.3 REFERENCES

A. Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
   1. American Gear Manufacturers Association (AGMA).
   2. Institute of Electrical and Electronic Engineers (IEEE):
      a. 841 – IEEE Standard from Petroleum and Chemical Industry – Severe Duty Totally Enclosed Fan-Cooled (TEFC) Squirrel Cage Induction Motors – Up to and Including 370 kW (500 hp).
   3. National Electrical Manufacturer's Association (NEMA).

1.4 SYSTEM DESCRIPTION

A. Provide a Disc Filter System that operates with an outside-in flow pattern to remove solids from the incoming secondary effluent wastewater stream. The filter unit shall be capable of performing the backwash cycle without interrupting the filtration process. The filter unit shall consist of the filter centertube and disc assembly, filter drive assembly, two backwash/solids waste pumps, vendor supplied control panel, and necessary valves, piping, and other appurtenances.

1.5 SUBMITTALS

A. Shop Drawings: Submit for approval the following:
   1. Letters of Certification of Compliance on materials, equipment, etc.
   2. Detailed specifications and drawings as specified in Section 01300, Submittals, containing complete piping and flow diagrams of the proposed installation, including dimensions, weights, and complete parts lists. Drawings shall show proposed anchorage of equipment and appurtenances and equipment relationship to other parts of the work including clearances for installation.
   3. Field assembly instructions, assembly drawings and/or diagrams, detailed reference drawing lists, and lists of assembly details.
   4. List of materials, list of equipment (with model number, size, weight), including a complete list of parts and supplies with current unit prices and sources of supply. List of parts recommended by the Manufacturer to be replaced after 1 and 3 year(s) service. List of special tools for each type of equipment furnished including special tools necessary for adjustment, operation, maintenance, and disassembly.

5. Wiring and control schematics and control logic diagrams for all electrical and control components furnished.
6. A complete process description detailing all process parameters.
7. Documentation that the manufacturer has produced, supplied, and placed into satisfactory service, equipment similar to that specified herein.
8. Recommended list of spare parts and safety equipment, along with price and ordering information.
9. Complete data sheet (ISA data sheet) for each instrument supplied.
10. Process and instrumentation diagrams (P&IDs) of the cloth media disc filter system.
11. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
12. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**

B. Seismic structural calculations:
   1. Submit seismic structural calculations in conformance with the following requirements:
      a. Design spectral acceleration at short periods. SDS = 0.19.
      b. Design spectral acceleration at period of 1-second, SD1 = 0.09.
      c. Risk Category: III
      d. Component amplification factor, ap = in accordance with ASCE 7, Tables 13.5-1 and 13.6-1.
      e. Component response modification factor, Rp = in accordance with ASCE 7, Tables 13.5-1 and 13.6-1.
      f. Component importance factor, Ip = in accordance with ASCE 7 Chapter 13.

g. Seismic Design Category: Category B.
h. The calculations shall be prepared and stamped by a structural engineer registered in the State of Arizona.

C. Manufacturer's installation instructions:
1. Installation and checkout instructions including lubrication and initial start-up procedures.
2. Do not install equipment until all installation instructions have been supplied.

D. No equipment shall be shipped until the ENGINEER approves the Shop Drawings.

E. Shop Test Results: Submit results of routine factory motor tests.

F. Field Test Results: Submit a written report giving the results of the required field tests.

G. Manufacturer's Reports: Submit written report of the results of each visit by a manufacturer's serviceman, including purpose and time of visit, personnel present, tasks performed, and results obtained.

H. Operation and Maintenance Manuals: Submit complete Operation and Maintenance Manuals in conformance with the Operation and Maintenance Manuals Section of Section 01300, Submittals.

I. The MANUFACTURER shall provide a written guarantee detailing filtrate quality. This guarantee shall be based upon laboratory filtration test, and past operating experience. The guarantee is based on past operating experience; documentation of that experience shall be submitted with the proposal.

1.6 QUALITY ASSURANCE

A. Manufacturer: Company specializing in the manufacture of products specified in this Section with minimum five years documented experience and at least 15 similar-sized filtration installations in service.

B. Inspection and Testing Requirement: The ENGINEER reserves the right to reject delivery of any or all pieces of equipment found, upon inspection, to have any or all of the following: tear, cracks, chips, rust, foreign matter, non-standard welding.

C. Shop Tests:
1. Motor Tests: Perform a routine test on each drive motor at the manufacturer's factory. The test shall consist of: Running Light Current; Locked Rotor Current; Winding Resistance; High Potential; and Bearing Inspection.

D. Responsibility: To ensure that all the equipment required for the installation of the Disc Filter System is properly coordinated and will function as a unit in accordance with the intent of these Specifications, the CONTRACTOR shall obtain all the equipment specified under this Section, from a single supplier in whom the responsibility for the proper function of all the equipment, regardless of manufacturer, as an integrated and coordinated system shall be vested. The intent of this paragraph is to establish unit responsibility for all the equipment with the Disc Filter equipment supplier. The use of the word "responsibility" relating to the equipment supplier is in no way intended to relieve the CONTRACTOR'S ultimate responsibility for equipment coordination, installation, operation, and guarantee.

E. The CONTRACTOR shall guarantee the Disc Filter System as required under the General Conditions, and as specified herein. If, during the guarantee period, the Disc Filter System fails or does not meet any of the specified requirements or test criteria herein, the CONTRACTOR shall correct such deficiencies as may be necessary to meet these requirements and criteria, and at no additional cost to the OWNER. The ENGINEER must first review any proposed remedial measures before any work is done.

1.7 WARRANTY

A. The manufacturer shall warrant the Disc Filter System being supplied to the OWNER against defects in workmanship and material for a period of one year under normal use, operation, and service after acceptance of the system installation by the OWNER. The warranty shall cover parts and labor and shall be in printed form.

PART 2 - PRODUCTS

2.1 GENERAL

A. The Disc Filter System equipment covered by these Specifications shall call attention to certain features but may not cover all details of the construction of the media filter system. Ancillary and accessory devices, within the confines of the manufacturer's scope, necessary for the treatment system performance shall be included by the manufacturer whether specified or not.

B. Concrete tanks as shown on the Drawings and/or specified within.

C. All structural steel shall conform to "Standard Specifications for Structural Steel of the A.S.T.M.".

D. All equipment shall be designed for continuous, 24 hour operation, and all parts of the mechanism shall be amply proportioned for all stresses, which may occur during fabrication, assembly, and operation.

E. All anchor bolts shall be 316 SS stainless steel and shall be of ample size and strength of the purpose intended. The disc filter manufacturer shall furnish with the equipment all anchor bolts. The CONTRACTOR shall install the anchor bolts in accordance with the manufacturer's instructions.

F. All wetted parts to be 316 stainless steel, FRP, polyacetal, or polypropylene. No carbon steel allowed.

G. All parts above the water line associated with the support steel, platforms, and handrails to be aluminum. No painted carbon steel allowed.

H. Aluminum grating and Aluminum Checker Plate shall conform to Sections 05532 Aluminum Grating and Checker Plate.

2.2 MANUFACTURERS

A. Acceptable Manufacturers:
   1. Aqua-Aerobic Systems, AquaDisk® Cloth Media Filter
   2. Five Star Filtration,
   3. Or approved equal.

B. The naming of a manufacturer in this Specification is not an indication that the manufacturer's standard equipment is acceptable in lieu of the specified component features. Naming is only an indication that the manufacturer may have the capability of engineering and supplying a system as specified.

2.3 DESIGN CRITERIA & REQUIREMENTS

A. Design Criteria:
   1. Treatment capacity:

Parameter	
Number of Units	5 (existing) +1 (new)
Total Average Daily Flow (MGD)	27
Total Peak Hourly Flow (MGD)	33
Rated Peak Flow for Each Unit (MGD)	6.6
Capacity per Filter:	
a) Average Daily Flow (MGD)	5.4
b) Peak Hourly Flow (MGD)	6.6
Filter Loading Rate:	
a) Average Hydraulic Loading (gpm/ft2)	4.98
b) Peak Hydraulic Loading (gpm/ft2)	6.1
Maximum Headloss through Filter (in.)	18

2. Influent Characteristics:

Parameter	
Maximum Total Suspended Solids (mg/l)	20
Average Total Suspended Solids (mg/l)	10

3. Effluent Characteristics:
   a. The effluent characteristics from the Disc Filter units shall meet the following average day limit under stated treatment capacity and influent characteristic conditions:
      1) State of Arizona Class A+ Reclaimed Water.
      2) 24-hour composite average turbidity: 2 NTU or less.
      3) Anytime Maximum Turbidity: 5 NTU.
      4) Total suspended solids: 5 milligrams per liter or less (24-hour composite average).

B. Design Requirements:
   1. Manufacturer will provide the following components as listed in his proposal. The CONTRACTOR shall provide any additional items required for a complete functioning filters.

Component	
Center Tube Assemblies	1
Drive System Assemblies	1
Cloth Filter Media Assemblies	1
Influent Weir Boxes	1
Backwash Pumps, vacuum gauge and transducer, pressure gauge, 3-inch ball valves	2
Backwash System Assemblies	1
External Piping Assembly Kits	1
Pressure Transducer Assemblies	1
Float Switch and Brackets	1
Backwash Valves with Electric Actuators	7
Solids Valves with Electric Actuators	2
Vendor Control Panels	1
Vendor Power Panels	1

2. Additional equipment and appurtenances required by the manufacturer.
3. Fit in space as indicated on the Drawings.
4. Align with piping as indicated on the Drawings.
5. All components shall be suitable for outdoor installation, including, but not limited to, controls, wiring and electrical devices, valve operators, materials, piping, and valves.

C. Prefabrication:
   1. Manufacturer and CONTRACTOR shall coordinate all instrumentation and other device supports to be fabricated with the cloth media filter system and include these supports on the submittal drawings to the ENGINEER.
   2. Submittal shall include preliminary program sequences for PLC as described herein. Final program sequences shall be submitted for acceptance prior to installation.

D. Provide supports for piping, instrumentation, and other equipment mounted within, against or adjacent to the cloth disc filter units. Piping supports external to the filter units shall be provided by the CONTRACTOR.

2.4 COMPONENTS OF CLOTH MEDIA DISC FILTER SYSTEM

A. Material:
   1. Stainless steel components shall be 316 stainless steel as specified in this Section. Use 316L for welded stainless steel.
   2. Surface treatment of stainless steel: All stainless steel components and subassemblies shall be acid passivated after fabrication and welding per Section 05501, Miscellaneous Metal Fabrications for corrosion resistance and to provide a superior finish.

B. Drive assembly:
   1. The drive assembly shall consist of gearbox, drive sprocket, drive chain, and a chain guard. Belt drive systems or systems with multiple drive units per filter shall not be acceptable.
   2. Gearbox: Parallel in-line helical-type, AGMA Class I drive motor rated for 460 volt, 3 phase, 60 Hertz. See table below and Refer to Section 16225, Electric Motors 250 Horsepower or Less for additional motor requirements.

Gearbox Parameter	
Power (HP)	1
Output Speed (RPM)	4.4

   3. Drive sprocket: Nylon.
   4. Chain: Acetal with Type 316 stainless steel link pins.
   5. Chain guard: Type 316L stainless steel.

C. Centertube assembly:
   1. Each center tube assembly shall include a Type 316L minimum 3/16-inch thick stainless steel center tube weldment, driven sprocket, wheel assemblies, and frame and cloth assemblies.
   2. Effluent port seal: Include a chlorine resistant Viton V-ring effluent port seal, or equal.
   3. Drive sprocket: Multi-segment U.H.M.W. polyethylene.
   4. Fasteners: Type 316 stainless steel.

D. Mounting brackets and hardware:
   1. Each filter basin shall be fitted with Type 316 stainless steel mounting brackets to accommodate attachment of the filter components to the basin.

2. All mounting brackets shall be attached to the basin wall with Type 316 stainless steel adhesive anchors and hardware.
3. Through-the-wall spool piping and all filter external piping shall be provided by the CONTRACTOR.

E. Filter cloth assemblies:
   1. General:
      a. The filter basin shall include 14 disc assemblies.
      b. Each cloth disc assembly shall be comprised of 6 individual segments; each consisting of a cloth media sock supported by an injection molded polypropylene co-polymer frame.
      c. During filtration, the filter assemblies shall operate in a static condition with no moving parts. The filter system shall provide for the collection of filtered solids on the outside of the cloth media surface to allow for the direct contact of cleaning systems. Filtered effluent shall be used for backwash. The filter flow path shall be from the outside of the disc to the inside. Systems with flow paths from the inside to the outside of the disc that collect filtered solids and plastic debris on the interior surfaces of the disc will not be acceptable.
   2. Cloth/frame assemblies:
      a. Shall be constructed such that each segment is easily removable from the center tube, without special tools, to allow for removal and replacement of the cloth at the point of installation. Systems requiring special tools and/or the return of media segments to the factory for replacement shall not be considered.
      b. Each cloth disc assembly shall have a minimum of 53.8 square feet of effective submerged filtration area. Each filter unit shall have a total of 753.2 square feet of minimum effective submerged filtration area.
      c. Effluent filtration area is defined as only the portion of the disc that is submerged during filtration. Any disc area that is not submerged shall not be considered as effective area.
      d. Each disc shall be divided into no more than 6 segments and shall be easily removable for service.
   3. Cloth Media:
      a. Cloths shall be of chlorine-resistant polyester (PES) fiber pile construction with polyester backing material having a nominal filtration rating of 10 microns to withstand a sodium hypochlorite dosage of 10 milligrams per liter. Granular media and screens having structured identical openings shall not be allowed.
      b. The cloth media shall have an active filter depth of 3 to 5 millimeters to provide additional collisions between solids particles and the media within the media depth, resulting in capture of solids across a broader particle range. The cloth depth shall also provide storage of captured solids, reducing backwash volumes while maintaining an operational headloss. Woven mesh or microstrainer type disc media with no filtration depth are not acceptable.

F. Influent Weir Box:
   1. Each filter shall include a Type 316 stainless steel influent weir box. The weir box shall be mounted to the filter basin interior using Type 316 stainless steel wedge anchors and hardware. The basin wall must be smooth and plumb to facilitate a quality installation.

G. Backwash/Solids Wasting Assembly:
   1. General:
      a. The backwash function shall incorporate a pump that draws filter effluent through the cloth, thereby removing accumulated solids from the cloth surface.
      b. Each backwash/sludge discharge assembly shall include a backwash system assembly, an external piping assembly, and 2 backwash pumps.
   2. Backwash System Assembly:
      a. Number: 1 assembly per filter.
      b. Each assembly includes.
         1) Backwash shoe assemblies.
         2) Backwash shoe support weldment(s).
         3) 1-1/2-inch wire reinforced flexible hose.
         4) Stainless steel backwash shoe springs.
         5) Stainless steel hose clamps.
         6) Type 316 stainless steel backwash collection manifolds.
         7) Type 316 stainless steel threaded unions.
         8) CPVC sludge collection manifolds.
         9) Type 316 stainless steel backwash floor plate(s).
   3. External Piping Assembly:
      a. Number: 1 assembly per filter.
      b. The external piping assembly shall include:
         1) 0 to 15 psi pressure gauge(s).
         2) 0 to 30 inches mercury vacuum gauge(s) and transducer(s).
         3) Throttling gate valve(s).
         4) 2-inch manual ball valve(s).
   4. Backwash Pumps:
      a. Manufacturer: Gorman Rupp, model G-R 12B20-B, approved or equal.
      b. Type: Externally mounted centrifugal pump.
      c. Quantity: 2 per filter, & one (1) spare
      d. Pump shall be provided with a 2 horsepower, 460 volt, 3 phase, 60 Hertz TEFC motor, and operate at maximum 1,740 revolutions per minute.
      e. Pump shall be rated for 130 gallons per minute at 23 feet total dynamic head.

H. Backwash Valves and Sludge Valve(s):
   1. The 2-inch backwash valves shall be 2 piece, flanged end, ASTM A351 Grade CF8M stainless steel body, 316 stainless steel ball and stem, fullport, with a 115 volt, single phase, 60 Hz, open / close service electric actuator. Valve / actuator combination shall be TCI / RCI (RCI, a division of Rotork),

Nibco, or equal. Valve actuator shall include a compartment heater and limit switch feedback to the microprocessor in both the open and closed positions

2. The 2-inch solids waste valve(s) shall be 2 piece, flanged end, ASTM A351 Grade CF8M stainless steel body, 316 stainless steel ball and stem, fullport, with a 115 volt, single phase, 60 Hz, open / close service electric actuator. Valve / actuator combination shall be TCI / RCI (RCI, a division of Rotork), Nibco, or equal. Valve actuator shall include a compartment heater and limit switch feedback to the microprocessor in both the open and closed positions.

I. Throttling Gate Valve(s)
   1. Gate valves installed in the disc filter system shall conform to industry standard MSS SP-80.
   2. Bronze gate valves shall be class 125, screw-in bonnet, non-rising stem, solid wedge.
   3. All valves shall have a counterclockwise opening direction
   4. Materials:
      a. Body: Bronze ASTM B-62
      b. Bonnet: Bronze ASTM B-62
      c. Stem: Silicon Bronze ASTM B-371 Alloy C6940 or ASTM B99 Alloy C65100
      d. Packing: Aramid Fibers with Graphite
      e. Wedge: Bronze ASTM B-62
   5. Product and Manufacturer:
      a. NIBCO, T-113 Threaded
      b. Or approved equal

J. Anchor Bolts:
   1. The CONTRACTOR shall provide anchor bolt calculations per Section 03252, Anchorage in Concrete.
   2. The CONTRACTOR shall provide and install anchor bolts for the filters and backwash pumps. Anchor bolts shall be Type 316 stainless steel and conform to Section 03252, Anchorage in Concrete.

K. Piping:
   1. Provide all piping, supports, bracing and fitting as required and as shown on submittal Drawings.
   2. Piping shall conform to Section 15065 Thermoplastic Pipe and Accessories requirements.

L. Finishes:
   1. CONTRACTOR shall provide field finishes under provision of Section 09900, Painting.

2.5 VENDOR POWER PANEL (VPP) and VENDOR CONTROL PANEL (VCP)

A. Each VPP shall be powered from a separate 480 volt, 3-phase 60 Hertz power source.

1. VPP shall be rated to withstand the available fault current as indicated on the Single Line Diagrams and the power system study provided by the CONTRACTOR in accordance with Section 16951, Short Circuit, Coordination, and Arc-Flash Hazard Report.

B. VPP Components:
   1. Circuit Breakers and Motor Circuit Protectors:
      a. In accordance with Section 16476, Low Voltage Circuit Breakers and 16474, Motor Control Equipment (Separately Mounted).
   2. Enclosure and associated components:
      a. In accordance with Section 16160, Enclosures.
      b. NEMA Type 4X enclosure, stainless steel:
         1) Enclosure shall be suitable for floor mounting.
      c. Provide flange-mounted disconnect handle:
         1) Door-mounted rotary handle disconnects are not acceptable.
      d. Provide a 480V/120V 1ph control power transformer (CPT) rated for the applicable loads.
         1) Control power transformer shall be the source of power for the Vendor Control Panel (VCP).
      e. Doors shall have corrosion resistant hinges and latches.
      f. Starter shall be in accordance with Section 16482, Solid State Motor Controllers.
      g. Provide heat load calculations for the VPP enclosure. Derate all components as required by the calculations.

C. The VCP shall be powered from the control power transformer installed in the VPP.
   1. Rated to withstand the available fault current as indicated in the power system study provided by the CONTRACTOR in accordance with Section 16951, Short Circuit, Coordination, and Arc-Flash Hazard Report.
      a. Assume a minimum available short circuit current of 10kA.
      b. Provide heat load calculations for the VCP enclosure. Derate all components as required by the calculations.

D. VCP Components:
   1. Front panel controls: Refer to P&IDs
      a. Provide in accordance with Section 16161, Control Panels.
      b. HAND/OFF/AUTO switches.
      c. START and STOP pushbuttons.
      d. RESET pushbuttons.
      e. Status and Alarm pilot lights.
      f. Elapsed Time Meters.
   2. Provide a Modicon M340 Programmable Logic Controller (PLC) or approved equal. Submit the following for the proposed PLC system:
      a. Modbus TCP/IP addressing scheme.
      b. PLC I/O and communication configuration.

1) System interconnection diagram drawing for PLCs, Modbus Plus data highway, Ethernet data highway, and field instrumentation.
2) The ladder logic control programs shall reside in the PLCs. The program shall consist of software relay and attendant logic control

c. Panel and enclosure plans, sections, and details.
d. Access opening locations and required clearances for each panel and enclosure.
e. Mounting plates and details for input and output chassis.
f. Enclosure internal wiring and terminal blocks.
1) Tabular Input and Output (I/O) listing, including the following data:
a) Each I/O point, chassis number, module number, module I/O point number, name of I/O device.
b) Instrumentation tag number of the I/O device in the Contract Documents.
c) Electrical characteristics of the I/O signal.
d) PLC internal address of each I/O.

3. I/O Expansion Modules:
a. Per signal requirements shown in the P&IDs, submit details of required quantities of DI, DO, AI & AO expansion modules.
b. Analog inputs shall have a minimum of 12 bits resolution. Analog outputs
c. Shall have a minimum of 12 bits resolution. Analog input modules shall be configurable for 4 to 20 mA DC, or 1 to 5 VDC signals. Analog output modules shall be selectable for 4 to 20 mA DC, or 1 to 5 volt DC signals. Provide external or user power as needed.
d. Provide a minimum of 10% spare I/O of each type connected to terminals for future expansion.
4. Power Supply: The power supply shall provide power for the processor and I/O modules.
a. Power Supply shall be rated for (100-240) VAC, 60 Hz.
b. Based on the heat load calculations of the VCP enclosure submit derating calculations of the power supply module.
c. Power supply module shall be rated for a minimum inrush current of 25A for 8ms @ 120VAC, and 40A for 4ms @240VAC.
d. The power supply shall have a hold-up time (the time the system is operational during a brief power loss), typically between 20 milliseconds and 3 seconds.
5. Provide a Modicon Magelis HMIGTO5310, or approved equal Operator Interface Terminal (OIT). For the OIT, submit the following:
a. Manufacturer's literature showing:
1) Physical characteristics, dimensions, and weights.
2) Mounting and installation requirements.
3) Wiring information including power requirements and communication capabilities and cabling information.
4) Available memory and screen storage information.
5) Recommended spare parts.

6) OIT screen development software information including:
a) Minimum computer memory requirements for installation and use.
b) Communication ports and cables to download OIT programs.

b. Proposed OIT screens showing the following:
1) Number of proposed screens.
2) Proposed color and graphics standards for OIT screen development.
3) Menu tree showing how the operator will access all screens.
4) Description of each screen listing control and display points and indicating what actions the operator may perform on the screen.

6. Circuit Breakers and Motor Circuit Protectors:
a. In accordance with Section 16476, Low Voltage Circuit Breakers and 16474, Motor Control Equipment (Separately Mounted).

7. Enclosure and associated components:
a. In accordance with Section 16160, Enclosures
b. NEMA Type 4X enclosure, stainless steel.
1) Enclosure shall be suitable for wall mounting.
c. Provide flange-mounted disconnect handle:
1) Door-mounted rotary handle disconnects are not acceptable.
d. Doors shall have corrosion resistant hinges and latches.

8. Remote monitoring and control. Refer to P&IDs for additional requirements.
a. Provide isolated 120VAC dry relay contact outputs for the following:
1) Filter Drive Unit.
2) Backwash Pumps.
3) Backwash Valves Open & Close Commands
4) Solids Waste Valves Open & Close Commands
b. Accept 120VAC inputs for the following:
1) Filter Drive Unit Statuses and Alarms.
2) Backwash Pump Statuses and Alarms.
3) Valve Statuses.
4) Filter Basin Level High.
5) Inlet Gate Closed.
6) Filter Turbidity Level High
c. Accept 4-20 mA inputs for the following:
1) Filter Basin Level.
2) Filter Turbidity Level.
3) Backwash Pumps Inlet Pressure

9. Storage and Downloading of PLC Programs:
a. The PLC shall be programmable through an USB port or Ethernet/IP connected to a personal computer through a standard cable. The PLC programming software shall be provided to the OWNER with the user's manuals, original diskettes, and licensing agreement for registration. Cables, adapters, connectors, or other hardware required to connect to the PLC shall be provided to the OWNER.
b. The PLC programming software shall enable the user to write the PLC

c. program on-line or off-line. The software shall include utilities to manage PLC program files, document and print the programs, configure the programming environment, monitor and force the PLC addresses while on-line, and configure the PLC memory and addressing structure.
d. Provide software support and debugging time for a period of 30 days after start-up of the equipment under PLC control.

2.6 INSTRUMENTATION

A. Manufacturer shall furnish the following components as a part of the Disc Filter System:
1. Pressure based level transducer (1 per filter): Manufacturer standard supply.
2. High-level float (1 per filter): Manufacturer standard supply.
3. Pressure gauge (2 each per filter): Manufacturer standard supply.
4. Vacuum gauge and transducer (2 each per filter): Manufacturer standard supply.

2.7 CONTROLS

A. The cloth media disc filter system vendor supplied control panel(s) shall be supplied by the cloth media disc filter system manufacturer, conform to the requirements of Section 16161, Control panels, provide for the functionality described in Section 17454 Operation and Control Descriptions and as shown on the Electrical and Instrumentation sheets, and conform to the requirements as described herein.
1. Dry contacts shall be provided for the signals as shown on the control schematics in the electrical sheets.
2. Provide six additional spare dry contacts.
3. Provide main breaker disconnect, fuse, fuse block, and starters.
4. Provide engraved nameplates for all devices on each vendor supplied control panel.
5. Provide an engraved nameplate that identifies each local control panel with the panel name and equipment number as listed in Section 01800, Equipment Schedule.
6. Provide engraved nameplates that identify each piece of equipment to be controlled by each local control panel, with the name and equipment number as listed in Section 01800, Equipment Schedule.
7. The Disc Filter System manufacturer shall submit, during Shop Drawing review, an engraved nameplate legend that must be approved by the ENGINEER. The ENGINEER shall approve or reject the nameplate legend at the ENGINEER'S discretion.
8. Provide all required wiring, electrical interlocks, relays, and other miscellaneous devices.

B. The vendor supplied control panel shall be factory tested prior to shipment.

C. The Disc Filter System vendor supplied control panels shall be mounted at locations in accordance with the Electrical Drawings.

D. Provide the following panel drawing documentation:
   1. Provide drawing copies in the following format:
      a. Hard Copy - B Size - 11" X 17".
      b. Soft Copy in .DWG.
   2. The panel drawing documentation package consists of the following drawings types arranged in the following order.
      a. Cover Sheet.
      b. Symbols and Legends 1 – Exterior and Interior Panel Symbols.
      c. Symbols and Legends 2 – Schematic Symbols.
      d. Front Panel Elevation.
      e. Interior/Sub Panel Layout.
      f. Terminal Strip Drawings.
      g. Control Schematics.
      h. Analog Loop Diagrams.
      i. Point to Point Discrete Wiring Diagrams.
   3. Drawing Scale:
      a. Provide Front Elevation and Interior/Sub Panel Layout Drawings proportionately correct and to scale. Create all drawings on a D Size layout.
   4. Border and Title Block:
      a. Provide each drawing with a border and title block information.

2.8 DELIVERY, STORAGE, AND HANDLING

A. Materials are to be marked or tagged with part number and order number for field assembly requirements.

B. All supports, members, and miscellaneous parts shall be packaged for shipment in such manner to prevent abrasion or scratching.

2.9 SPARE PARTS

A. Furnish and deliver the following spare parts to each facility, carefully boxed or packaged and plainly marked for reordering:
   1. Two filter frame and cloth assemblies.
   2. One backwash/solids waste valve and actuator.
   3. One backwash pump
   4. One Viton V-ring effluent port/center tube seal, or equal.
   5. One of each PLC I/O module.
      a. One of each:
         1) Fuse.
         2) Control Relay.
         3) Indicating Light Replacement Bulb.

B. Special tools: The Manufacturer shall provide special tools if required for normal operation and maintenance.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install Disc Filter System equipment in complete accordance with the manufacturer's instructions and recommendations.

B. The Disc Filter Systems shall be installed under the direction of the system Supplier in strict conformance with the manufacturer's installation instructions and with favorable review of shop drawings. An authorized representative of the Manufacturer shall perform final installation inspection, start-up, calibration, and instruction of operating personnel.

C. The manufacturer shall inspect the installation of all equipment in this Section before start-up in order to verify that the equipment has been properly installed and operates properly as a system and individually. The CONTRACTOR shall coordinate with manufacturer the scheduling of this activity.

D. Installation of all conduits and related components shall adhere to Section 16111, Conduits.

E. Make up piping with a sufficient number of unions to permit ready breaking of lines for maintenance.

F. Support and brace plastic pipe to prevent sagging or overstressing of pipe and connections, and, furthermore, support piping so that no item of piping system transfers load or strain to equipment.

G. Adequately support piping so that operation of valves will not cause pipe to show appreciable movement.

H. Field coat as specified in Section 09900, Painting.

I. Furnish and install all required oil and grease for initial operation.

J. Inspection and testing:
   1. Upon completion of equipment installation by the CONTRACTOR, and prior to equipment testing and start-up, the Manufacturer shall inspect the equipment installation and provide the Owner a letter of certification stating that the equipment has been installed in accordance with manufacturer instruction and recommendations.

3.2 FIELD TESTS

A. After CONTRACTOR and ENGINEER have mutually agreed that the equipment installation is complete, cleaned, and ready for continuous operation, CONTRACTOR and a qualified field service representative of the manufacturer shall conduct a running test of the equipment and controls in the presence of the ENGINEER to demonstrate that the units and their controls will function correctly.

B. All testing shall be performed under the supervision of the Disc Filter System manufacturer's representative. The CONTRACTOR shall conduct all specified tests and shall furnish all power, material, instrumentation, equipment, personnel, etc., for conducting tests as specified herein. The CONTRACTOR shall give the ENGINEER sufficient advance notice of the testing to enable the ENGINEER to witness the tests.

C. The CONTRACTOR shall submit to the ENGINEER a minimum of 14 days prior to the proposed testing date, testing procedures for all tests describing the type of test, test set-ups, procedures, instrumentation, flow rates and all other data and information necessary to describe proposed testing plan.
   1. Running Tests:
      a. Field test each unit together with its controls. Test shall demonstrate to ENGINEER that each part and all parts together function in the manner intended. All necessary testing equipment and manpower shall be provided by CONTRACTOR at his expense.
      b. Prior to applying electrical power to any motor driven equipment, the drive motor shall be rotated by an external source to demonstrate free operation of all mechanical parts.
      c. In the event that CONTRACTOR is unable to demonstrate to ENGINEER that his equipment meets the requirements of the above described test, the equipment will be rejected and CONTRACTOR shall adjust and/or modify and retest the equipment as often as necessary to meet the specified requirements, including but not limited to:
         1) Repair any visible leaks.
         2) Test and calibrate all controls, switches, automatic valves, and other instrumentation and control equipment associated with the cloth media filter units as specified in this Section, in accordance with the Manufacturer's printed instruction over the full operating range of the equipment.
      d. After equipment, piping, and other necessary incidentals are completed, conduct functional testing and operational testing of the system as specified in Section 01650, Starting of Systems and provide certified test report. Performance test includes:
         1) Demonstrate filters performance per Performance Design Criteria. The sampling information and results shall include the influent characteristics (TSS and NTU) and effluent characteristics (TSS

and NTU) to demonstrate that the equipment meets the required performance.

e. Do not affect warranty of the systems by testing.
f. Coordinate testing with functional testing of other equipment.

D. Verify networking communication between the OWNER's control system and the filter network.

E. Upon completion of testing, the CONTRACTOR shall submit to the ENGINEER one digital copy of full and complete test reports for all tests. Reports shall include description of the units tested, test procedures, test flow rates, backwash cycles, levels and all other data and results as required demonstrating that all items tested meet specified requirements.

F. Compliance with the performance requirements shall be demonstrated through a performance test of 48 hours minimum duration. The test shall be performed with all discs on-line and hydraulic loading rates specified herein. Any filter that fails to operate continuously during the 48 consecutive hour period because of malfunction shall be retested until it completes a continuous 48 hour test.

3.3 MANUFACTURER'S FIELD SERVICE

A. A factory employed and trained representative shall be provided for installation supervision, start-up and test services and operation and maintenance personnel training services. The representative shall make a minimum of three visits. The first visit shall be a minimum of one day (8 hours on site), for sampling, testing and classifying filter effluent prior to installation of the disc filter equipment. The representative shall bring their own portable composite sampler. The second visit shall be a minimum of two days (8 hours each day), for assistance in the installation of equipment and provide written certification that the installation meets the manufacturer’s recommendations. The third visit shall be a minimum of three days (8 hours each day), for checking the completed installation and start-up of the system and one full day for instruction of operations and maintenance personnel. The third visit shall also include sampling, testing and classifying filter effluent after start-up and commissioning of the Disc Filter System to illustrate conformance to the performance requirements identified in this Specification under Section 2.3. Manufacturer's representative shall test operate the system in the presence of the ENGINEER and verify that the Disc Filter System, and Backwash/Solids Waste Assembly conform to requirements. Manufacturer's representative shall revisit the job site as often as necessary until all trouble is corrected and the installation is entirely satisfactory leading to compliance of performance requirements. Sales representatives shall not be acceptable to perform start-up and training functions.

B. Reports: Submit report by manufacturer of each visit to the site that provides complete information on time, schedule, tasks performed, persons contacted,

problems corrected, test results, training, instruction, and all other pertinent information.

C. All costs, including travel, lodging, meals, and incidentals shall be considered as included in the CONTRACTOR'S bid price.

++ END OF SECTION ++

SECTION 11520

PROJECTION SCREENS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Front projection screen assemblies.

1.2 SUBMITTALS

A. Product Data: Manufacturer's catalog cuts and descriptive information on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation methods.

B. Operation and Maintenance Data: Provide manufacturer's operation and maintenance instructions.

C. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Deliver projection screens to project site in manufacturer's original unopened packaging, and inspect for damage and proper size before accepting delivery.

B. Store in a protected, clean, dry area with temperature maintained above 50 degrees F (10 degrees C), and stack in accordance with manufacturer's recommendations.

C. Acclimate screens to building temperatures for 24 hours prior to installation, in accordance with manufacturer's recommendations.

PART 2 - PRODUCTS

2.1 FRONT PROJECTION SCREENS

A. Manufacturers:
   1. Bretford: www.bretford.com/#sle.
   2. Da-Lite Screen Company: www.da-lite.com/#sle.
   3. Draper, Inc: www.draperinc.com/#sle.
   4. Stewart Filmscreen Corporation: www.stewartfilmscreen.com/#sle.

B. Front Projection Screens: Factory assembled unless otherwise indicated.

1. Located in Conference Room: Manual, light refracting glass beaded screen, horizontally tensioned, wall mounted.
    a. Screen Viewing Area: 60 inch high by 80 inch wide (1520 mm high by 2030 mm wide).

C. Masking Borders: Black, on four sides.

D. Exposed Screen Cases: Steel, with integral roller brackets.
1. Finish: Baked enamel.
2. Color: White.
3. End Caps: Steel; finished to match case.
4. Provide wall valance to hide screen case when not in use.
5. Mounting: Wall.

E. Manually-Operated Screens:
1. Roller: 1-3/4 inch (44 mm) aluminum; spring loaded with locking device.
2. Screen Pull: Ring on bottom bar.
3. Vertical Tensioning: Screen fabric weighted at bottom with steel bar and plastic end caps.
4. Horizontal Tensioning: Tab-guided cable system.

F. Provide mounting hardware, brackets, supports, fasteners, and other mounting accessories required for a complete installation, in accordance with manufacturer's recommendations for specified substrates and mountings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that substrate is finished and ready to accept screen installation.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

C. Do not install projection screens until climate control systems are in place and interior painting and other finishes are completed.

3.2 PREPARATION

A. Coordinate screen installation with installation of projection systems.

B. Coordinate installation with adjacent construction and fixtures, including ceilings, walls, lighting, fire suppression, and registers and grilles.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions, using manufacturer's recommended hardware for relevant substrates.

B. Do not field cut screens.

C. Install screens in mountings as specified and as indicated on drawings.

D. Install plumb and level.

E. Adjust projection screens and related hardware in accordance with manufacturer's instructions for proper placement and operation.

3.4 PROTECTION

A. Protect installed products until completion of project.

B. Touch up, repair, or replace damaged products before Date of Substantial Completion.

++ END OF SECTION ++

SECTION 12360

COUNTERTOPS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Countertops for architectural cabinet work.

B. Wall-hung counters and vanity tops.

1.2 RELATED REQUIREMENTS

A. Section 06410 - Architectural Wood Casework: Custom cabinets supporting countertops.

1.3 REFERENCE STANDARDS

A. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition; 2014, with Errata (2016).

B. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards; 2021, with Errata.

C. ISFA 2-01 - Classification and Standards for Solid Surfacing Material; 2013.

D. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.

1.4 SUBMITTALS

A. Shop Drawings: Complete details of materials and installation ; combine with shop drawings of cabinets and casework specified in other sections.

B. Selection Samples: For each finish product specified, color chips representing manufacturer's full range of available colors and patterns.

C. Verification Samples: For each finish product specified, minimum size 6 inches (150 mm) square, representing actual product, color, and patterns.

D. Test Reports: Chemical resistance testing, showing compliance with specified requirements.

E. Maintenance Data: Manufacturer's instructions and recommendations for maintenance and repair of countertop surfaces.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.6 FIELD CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

PART 2 - PRODUCTS

2.1 COUNTERTOPS

A. Solid Surfacing Countertops: Solid surfacing sheet or plastic resin casting over continuous substrate.
   1. Flat Sheet Thickness: 1/2 inch (12 mm), minimum.
   2. Solid Surfacing Sheet and Plastic Resin Castings: Complying with ISFA 2-01 and NEMA LD 3; polyester resin, mineral filler, and pigments; homogenous, non-porous and capable of being worked and repaired using standard woodworking tools; no surface coating; color and pattern consistent throughout thickness.
      a. Manufacturers:
         1) Dupont: www.corian.com/#sle.
      b. Finish on Exposed Surfaces: Semi-gloss, gloss rating of 25 to 50.
      c. Color and Pattern: As selected by Architect from manufacturer's price group A, B or C line.
   3. Other Components Thickness: 1/2 inch (12 mm), minimum.
   4. Exposed Edge Treatment: Built up to minimum 1-1/4 inch (32 mm) thick; radiused edge; use marine edge at sinks.
   5. Back and End Splashes: Same sheet material, radiused top; minimum 4 inches (102 mm) high.
   6. Skirts: As indicated on drawings.
   7. Fabricate in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), Section 11 - Countertops, Premium Grade.

2.2 FABRICATION

A. Fabricate tops and splashes in the largest sections practicable, with top surface of joints flush.
   1. Join lengths of tops using best method recommended by manufacturer.
   2. Fabricate to overhang fronts and ends of cabinets 1 inch (25 mm) except where top butts against cabinet or wall.

a. Rout a 1/8 inch (3 mm) drip groove at underside of exposed overlapping edges, set back 1/2 inch (13 mm) from face of edge.

3. Prepare all cutouts accurately to size; replace tops having improperly dimensioned or unnecessary cutouts or fixture holes.

B. Provide back/end splash wherever counter edge abuts vertical surface unless otherwise indicated.
   1. Secure to countertop with concealed fasteners and with contact surfaces set in waterproof glue.
   2. Height: 4 inches (102 mm), unless otherwise indicated.

C. Solid Surfacing: Fabricate tops up to 144 inches (3657 mm) long in one piece; join pieces with adhesive sealant in accordance with manufacturer's recommendations and instructions.

D. Wall-Mounted Counters: Provide skirts, brackets, and braces as indicated on drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

C. Verify that wall surfaces have been finished and mechanical and electrical services and outlets are installed in proper locations.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

A. Install vanities in accordance with manufacturer’s instructions and approved shop drawings

B. Securely attach countertops to cabinets using concealed fasteners. Make flat surfaces level; shim where required.

C. Seal joint between back/end splashes and vertical surfaces.

3.4 TOLERANCES

A. Variation From Horizontal: 1/8 inch in 10 feet (3 mm in 3 m), maximum.

B. Offset From Wall, Countertops: 1/8 inch (3 mm) maximum; 1/16 inch (1.5 mm) minimum.

C. Field Joints: 1/8 inch (3 mm) wide, maximum.

3.5 CLEANING

A. Clean countertops surfaces thoroughly.

3.6 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

++ END OF SECTION ++

SECTION 13213

PRECAST POLYMER CONCRETE TRENCH INSERT

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
   1. This specification covers a polymer concrete trench insert intended for a chemical piping trench corrosion resistance is required. This fabricated insert shall be installed into cast-in-place concrete, as shown in the Drawings.

1.2 REFERENCES

A. Reference Standards: All applicable ANSI, ASME, AWWA, and ASTM Standards

B. Related Sections
   1. Section 03300, Cast-In-Place Concrete.

1.3 SUBMITTALS

A. Shop Drawings: Submit for approval the following:
   1. Manufacturer's literature, illustrations, paint certification, specifications and engineering data including dimensions, materials, and compatibility with chemical.
   2. Shop Drawings Showing: Fabrication, assembly, installation, and other diagrams. Grates and other accessories as required by design.
   3. Proof of independent chemical resistance testing conducted in accordance with California Greenbook, Section 211-2.
   4. An electronic copy of summary of criteria used in design of structures including, at minimum, material properties, loading criteria, and dimensions assumed. Include certification from manufacturer that polymer concrete design meets or exceeds the load and strength requirements.
   5. Current ISO 9001:2015 Certification for the facility where the polymer concrete structures are manufactured for the project.

B. Quality Control:
   1. Certificates of Compliance.
   2. Manufacturer’s Instructions.
   3. Sealing and Primer Information.

C. References of 10 similar previous polymer concrete trench insert projects including scope in the last 5 years performed with both OWNER and CONTRACTOR contact information for reference and review by OWNER. References for projects not being done by current company shall not be allowed.

D. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance with the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

E. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**

PART 2 - PRODUCTS

2.1 PRECAST POLYMER CONCRETE TRENCH INSERT

A. General:
   1. The material covered by these Specifications shall be furnished by a reputable and qualified manufacturer of proven ability who has regularly engaged in the manufacture and installation of pre-cast polymer concrete trench. Manufacturer of the polymer concrete trench shall have a minimum five years of experience with Projects similar in scope to this Project.
   2. Pre-cast polymer concrete trench manufacturer shall be experienced in successfully producing polymer drainage fabrications similar to those indicated in the Drawings, with sufficient production capacity to produce required units without causing delay in the Work.

3. Pre-cast polymer concrete trench shall be designed to withstand Loading Class D per DIN 19580. Grating shall be designed to withstand Loading Class E per DIN 19580.
4. Pre-cast polymer concrete trench shall have a neutral slope with minimum 4-inch depth. Grating shall not include any perforations or slots to allow water to mitigate thrzzough.

B. Materials of Construction:
   1. Trench Insert: Pre-cast polyester polymer concrete utilizing vinyl ester resin.
   2. Grating: Ductile iron load class E with solid surface.

C. Manufacturer of Trench Insert:
   1. DS300 Utility Trench ACO Polymer Products, Chardon, OH
   2. Or Approved Equal.

D. Features:
   1. Cover:
      a. Shall be provided by the manufacturer and attached to the trench utilizing stainless steel lock down bolts and bars.
      b. Provide cover sections in lengths to match trench insert sections.
      c. Cast Iron Frame and Solid Covers to be H-20 traffic rated with cast iron lifting handle as manufactured by Neenah R-4990 Series or Equal
      d. Top of each channel, which meets with the cover surface, shall include a stainless steel backing plate extending over the top of the trench to prevent chipping.
   2. Manufacturer shall provide end caps and transition pieces for female-to-female connections and male-to-male connections for a complete installation.
   3. Manufacturer shall provide a 2-part rigid resin glue and used to bond cut surfaces together to properly seal joints.
   4. Provide a polymer concrete sump box at the lowest elevation of trenches crossing a roadway.
      a. Manufacturer of Sump Box:
         1) OldCastle Infrastructure.
         2) Or Approved Equal.

2.2 DESIGN CRITERIA

A. Each polymer concrete trench insert section shall be free of all defects, including indentations, cracks, foreign inclusions, foam voids or blockouts, and resin starved areas that, due to their nature and degree or extent, detrimentally affect the strength and serviceability of the component part. Cosmetic defects may be cause for rejection. The nominal internal length of trench insert shall not vary more than 2%.

B. Marking and Identification: Each structure shall be marked with the following information:
   1. Manufacturer's name or trademark.
   2. Manufacturer's location.
   3. Production Date.

C. All joints shall be sealed and shall be free of dents, gouges and other surface irregularities that would affect joint integrity.

2.3 FABRICATION

A. Shop Assembly:
   1. Forms:
      a. Make forms watertight, accurate, and true to measurement as indicated on the Drawings.
      b. Thoroughly clean forms before each usage and coat contact surface thoroughly with form release compound so that no bond occurs between concrete and form.
   2. Curing: Water cure precast concrete for not less than 7 days and 7 nights, except that after 24 hours of water curing, steam curing may be substituted at ratio of 1 hour of steam curing for 3 hours of water curing.
   3. Removal from Forms: Do not remove any precast unit from form or otherwise handled until adequate strength has been acquired, and in no case less than 24 hours after casting.

PART 3 - EXECUTION

3.1 PREPARATION

A. The CONTRACTOR shall review the Drawings and installation instructions before installation.

B. Install precast polymer concrete trench into cast-in-place concrete, as shown on the Drawings.

3.2 ERECTION

A. CONTRACTOR shall follow manufacturer's installation instructions.

B. Sealants and primers required for leak containment shall be provided as required by the manufacturer at connections between sections.

C. Connections to cast-in-place structures shall provide leak containment.

D. Install precast polymer concrete trench into cast-in-place concrete, as shown on the Drawings Install precast polymer concrete trench into cast-in-place concrete, as shown on the Drawings.

3.3 ADJUSTING

A. General:
   1. Remove any precast unit cracked or otherwise structurally damaged in handling from any cause from project site and replace with structurally sound unit.

++ END OF SECTION ++

SECTION 13300

METAL BUILDING SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Manufacturer-engineered, shop-fabricated structural steel building frame.

B. Metal wall and roof panels including gutters and downspouts.

1.2 REFERENCE STANDARDS

A. AISC 360 - Specification for Structural Steel Buildings; 2022, with Errata (2025).

B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.

C. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength; 2021.

D. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2023.

E. ASTM A501/A501M - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing; 2021.

F. ASTM A529/A529M - Standard Specification for High-Strength Carbon-Manganese Steel of Structural Quality; 2019.

G. ASTM A792/A792M - Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process; 2023.

H. ASTM C991 - Standard Specification for Flexible Fibrous Glass Insulation for Metal Buildings; 2025a.

I. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink); 2020.

J. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi, 144 ksi, and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength; 2025.

K. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2025.

L. MBMA (MBSM) - Metal Building Systems Manual; 2024.

M. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic); 2019.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene one week before starting work of this section.

1.4 SUBMITTALS

A. Product Data: Provide data on profiles, component dimensions, fasteners.

B. Shop Drawings: Indicate assembly dimensions, locations of structural members, connections; wall and roof system dimensions, panel layout, general construction details, anchors and methods of anchorage, and installation; framing anchor bolt settings, sizes, locations from datum, and foundation loads; indicate welded connections with AWS A2.4 welding symbols; indicate net weld lengths; provide professional seal and signature.

C. Shop Drawings: Submit for approval the following:
   1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
   2. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**

D. Samples: Submit two samples of precoated metal panels for each color selected, 6 by 6 inch (152.4 by 152.4 mm) in size illustrating color and texture of finish.

E. Project Record Documents: Record actual locations of concealed components and utilities.

1.5 QUALITY ASSURANCE

A. Designer Qualifications: Design structural components, develop shop drawings, and perform shop and site work under direct supervision of a Professional Structural Engineer experienced in design of this type of work.
   1. Design Engineer Qualifications: Licensed in the State in which the Project is located.
   2. Comply with applicable code for submission of design calculations as required for acquiring permits.
   3. Cooperate with regulatory agency or authorities having jurisdiction (AHJ), and provide data as requested.

B. Perform work in accordance with AISC 360 and MBMA (MBSM).

C. Manufacturer Qualifications: Company specializing in the manufacture of products similar to those required for this project.

D. Welder Qualifications: Welding processes and welding operators qualified in accordance with AWS D1.1/D1.1M and no more than 12 months before start of scheduled welding work.

1.6 WARRANTY

A. Correct defective Work within a five year period after Date of Substantial Completion.

B. Provide 35 year manufacturer warranty for high performance coatings.
   1. Include coverage for exterior pre-finished surfaces to cover pre-finished color coat against chipping, cracking or crazing, blistering, peeling, chalking, or fading. Include coverage for weather tightness of building enclosure elements after installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Metal Buildings Systems:
   1. Acceptable manufacturers, subject to Contractor coordination of required detail modifications compared to those indicated in drawings:
   2. Butler Manufacturing Company: www.butlermfg.com/#sle.
   3. Nucor Building Systems: www.nucorbuildingsystems.com/#sle.
   4. VP Buildings: www.vp.com/#sle.

2.2 ASSEMBLIES

A. Single span rigid frame.

B. Primary Framing: Rigid frame of rafter beams and columns, canopy beams, and wind bracing.

C. Secondary Framing: Purlins, and other items detailed.

D. Variation from the structural layouts, clearances, and spacings indicated on drawings, including addition of elements such as portal frames or additional bracing, may be allowable but are considered a substitution subject to review and approval.

2.3 PERFORMANCE REQUIREMENTS

A. Energy performance: Comply with 2024 IECC requirements for thermal envelope, using either the U value or the R value methods. Requirements for R-value method are as follows. Provide thermal spacer blocks if using these values.

B. Installed Thermal Resistance of Wall System: R-value of 13 + R6.5 continuous insulation.

C. Installed Thermal Resistance of Roof System: R-value of 19 + R11 liner system.

D. Design structural members to withstand dead load, and design loads due to pressure and suction of wind calculated in accordance with applicable code.

E. Provide drainage to exterior for water entering or condensation occurring within wall or roof system.

F. Permit movement of components without buckling, failure of joint seals, undue stress on fasteners or other detrimental effects, when subject to temperature range of 100 degrees F (56 degrees C).

G. Size and fabricate wall and roof systems free of distortion or defects detrimental to appearance or performance.

2.4 MATERIALS - FRAMING

A. Structural Steel Members: ASTM A529/A529M Grade 50.

B. Structural Tubing: ASTM A500/A500M Grade B cold-formed.

C. Plate or Bar Stock: ASTM A529/A529M, Grade 50.

D. Anchor Bolts: ASTM A307, Grade A, with hot dip type for protective coatings.

E. Bolts, Nuts, and Washers: ASTM F3125/F3125M, Type 1; galvanized to ASTM A153/A153M.

F. Welding Materials: Perform in accordance with AWS D1.1/D1.1M.

G. Primer: SSPC-Paint 20 zinc rich.

H. Grout: ASTM C1107/C1107M; Non-shrink; premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents.
   1. Minimum Compressive Strength at 48 Hours: 2,400 pounds per square inch (17 MPa).
   2. Minimum Compressive Strength at 28 Days: 7,000 pounds per square inch (48 MPa).

2.5 MATERIALS - WALLS AND ROOF

A. Steel Sheet: ASTM A792/A792M aluminum-zinc alloy coated to AZ50/AZM150.

B. Insulation: ASTM C991 Type I; 6-3/8 inches (162 mm) thick at walls, 9-1/4 inches (235 mm) thick at roofs.
   1. Facing: Sheet vinyl, 0.0032 inch (0.081 mm) thick, white.

C. Joint Seal Gaskets: Manufacturer's standard type.

D. Fasteners: Manufacturer's standard type, galvanized to comply with requirements of ASTM A153/A153M, finish to match adjacent surfaces when exterior exposed.

E. Trim, Closure Pieces, Caps, Flashings, Gutters, Downspouts, Fascias: Same material, thickness and finish as exterior sheets; brake formed to required profiles.

2.6 COMPONENTS

A. Doors and Frames: See Section 08113, Hollow Metal Doors and Frames.

2.7 FABRICATION - FRAMING

A. Fabricate members in accordance with AISC 360 for plate, bar, tube, or rolled structural shapes.

B. Anchor Bolts: Formed with bent shank, assembled with template for casting into concrete.

2.8 FABRICATION - WALL AND ROOF PANELS

A. Siding: Minimum 0.0179 inch (0.454 mm) (26 gauge) metal thickness, "PBR" profile, 1-1/4 inch (32 mm) deep, lapped edges fitted with continuous gaskets.

B. Roofing: Minimum 0.0179 inch (0.454 mm) (26 gauge) metal thickness, "PBR" profile, lapped edges fitted with continuous gaskets.

C. Liner: Minimum 0.0149 inch (0.378 mm) (28 gauge) metal thickness, manufacturer standard profile indicated, lapped V edges fitted with continuous gaskets.

D. Girts/Purlins: Rolled formed structural shape to receive siding, roofing and liner sheet.

E. Internal and External Corners: Same material thickness and finish as adjacent material, profile brake formed to required angles. Back brace mitered internal corners with 0.0179 inch (0.454 mm) (26 gauge) thick sheet.

F. Flashings, Closure Pieces, Fascia: Same material and finish as adjacent material, profile formed as detailed.

G. Fasteners: To maintain load requirements and weather tight installation, same finish as cladding, non-corrosive type.

2.9 FABRICATION - GUTTERS AND DOWNSPOUTS

A. Fabricate of same material and finish as roofing metal.

B. Form gutters and downspouts and scuppers of square profile and size indicated to collect and remove water. Fabricate with connection pieces.

C. Form sections in maximum possible lengths. Hem exposed edges.

D. Fabricate support straps of same material and finish as roofing metal, color as selected.

2.10 FINISHES

A. Framing Members: Clean, prepare, and shop prime.

B. Exterior Surfaces of Wall Components and Accessories: Precoated enamel on steel of modified silicone finish, color as selected from manufacturer's standard range.

C. Interior Surfaces of Wall Components and Accessories: Precoated enamel on steel of modified silicone finish, white color.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that foundation, floor slab, mechanical and electrical utilities, and placed anchors are in correct position

3.2 ERECTION - FRAMING

A. Erect framing in accordance with AISC 360.

B. Provide for erection and wind loads. Provide temporary bracing to maintain structure plumb and in alignment until completion of erection and installation of permanent bracing. Locate braced bays as indicated.

C. Set column base plates with non-shrink grout to achieve full plate bearing.

D. Do not field cut or alter structural members without approval.

E. After erection, prime welds, abrasions, and surfaces not shop primed.

3.3 ERECTION - WALL AND ROOF PANELS

A. Install in accordance with manufacturer's instructions.

B. Exercise care when cutting prefinished material to ensure cuttings do not remain on finish surface.

C. Fasten cladding system to structural supports, aligned level and plumb.

D. Locate end laps over supports. End laps minimum 2 inches (50 mm). Place side laps over bearing.

E. Provide expansion joints where indicated.

F. Use concealed fasteners.

G. Install insulation and vapor retarder utilizing panels for attachment. Place wire mesh under vapor retarder for support between framing members.

H. Install sealant and gaskets, providing weather tight installation.

3.4 ERECTION - GUTTERS AND DOWNSPOUTS

A. Rigidly support and secure components. Join lengths with formed seams sealed watertight. Flash and seal gutters to downspouts.

B. Slope gutters minimum 1/8 inch/ft (10 mm/m).

C. Install splash pads under each downspout.

3.5 ERECTION - SKYLIGHTS

A. Install in accordance with manufacturer's instructions.

B. Coordinate with installation of roofing system and related flashings.

C. Seal between skylight units and roof system, providing weather tight installation.

3.6 TOLERANCES

A. Framing Members: 1/4 inch (6 mm) from level; 1/8 inch (3 mm) from plumb.

B. Siding and Roofing: 1/8 inch (3 mm) from true position.

++ END OF SECTION ++

SECTION 13400

ABOVEGROUND FUEL STORAGE TANK

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
   1. Provide all labor, materials, equipment and incidentals as shown on the Drawings, specified and required to furnish and install a screw conveyor system and control panel complete and operational in conformance with the requirements of this Section and as shown on the Drawings.
   2. Section includes: complete fuel storage tank system including filling, dispensing and accessories. Fuel storage tank system shall include:
      a. Fuel Storage Tank (10,000-gallon for OWRF, 12,000-gallon for AWRF)
      b. Fuel Dispensing Systems
      c. Tank Filling Station
      d. Fuel Polishing System
      e. Stairs/ladder for top access
      f. Local Control Panel & alarms
   3. The fuel storage tank supplier shall also be responsible for the following items:
      a. Operation and Maintenance (O&M) Manuals
      b. Warranty
      c. Installation and coordination

1.2 REFERENCE STANDARDS

A. UL 2085 - Aboveground Storage Tanks for Flammable and Combustible Liquids, Protected Type

B. UL 752 – Standard for Bullet Resisting Equipment

C. NFPA 30 - Flammable and Combustible Liquids Code, 2024

D. NFPA 70E – Standard for Electrical Safety in the Workplace, 2024

E. NFPA 780 - Standard for the Installation of Lightning Protection Systems, 2024

F. UFC 79-7 - Requirements for Protected Aboveground Tanks, 2024

1.3 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene one week before starting work of this section.

1.4 SUBMITTALS

A. Shop Drawings: Submit for approval the following:
   1. Manufacturer's literature, illustrations, specifications and engineering data including: materials, dimensions, weights, performance data and part lists for all components furnished.
   2. Drawings and information for control panels and instruments in accordance with Section 16050, General Provisions, and Division 17000, Sections 17051, 17052, 17053, 17226 and 17260.
   3. Drawings showing fabrication methods, assembly, accessories, installation details and wiring diagrams. Comply with the requirements of Section 01332, Shop Drawing Procedures and Section 01731, Installation Data.

B. Shop Drawings: Submit for approval the following:
   1. Letters of Certification of Compliance on materials, equipment, etc.
   2. Detailed specifications and drawings as specified in Section 01300 containing complete piping and flow diagrams of the proposed installation, including dimensions, weights, and complete parts lists. Drawings shall show proposed anchorage of equipment and appurtenances and equipment relationship to other parts of the work including clearances for installation.
   3. Field assembly instructions, assembly drawings and/or diagrams, detailed reference drawing lists, and lists of assembly details.
   4. List of materials, list of equipment (with model number, size, weight), including a complete list of parts and supplies with current unit prices and sources of supply. List of parts recommended by the Manufacturer to be replaced after 2 and 5 year(s) service. List of special tools for each type of equipment furnished including special tools necessary for adjustment, operation, maintenance, and disassembly.
   5. Wiring and control schematics and control logic diagrams for all electrical and control components furnished.
   6. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be

sufficient cause for rejection of the entire submittal with no further consideration.

7. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**

C. Unit Responsibility: Assign Unit Responsibility as specified in Section 01600, General Equipment Provisions, and herein to the manufacturer or supplier for the equipment specified in this Section. All equipment specified under this section shall be provided by the fuel storage tank manufacturer, who shall be fully responsible for the engineering, design, selection, and operation of all systems and components furnish therewith. The systems and components furnished shall be integrated into a complete and functional unit meeting all specified design and performance requirements. A certificate of unit responsibility shall be executed by the fuel storage tank manufacturer. The shop drawing submittal/review process will commence only after an acceptable certificate of unit responsibility is provided by the fuel storage tank manufacturer.

D. Operation and Maintenance Manuals: Submit complete Operation and Maintenance Manuals in conformance with the Operation and Maintenance Manuals Section of Section 01300, Submittals. O&M Manuals shall include the following:

   a. Letters of Certification of Compliance on materials, equipment, etc.
   b. Final Certified Drawings showing outline dimensions, foundation layout or mounting information, and other pertinent dimensions.
   c. Shop Detail Drawings showing individual sub- assemblies and fabricated pieces with material specifications and other applicable data.
   d. Installation instructions, operating and/or service manuals, and all other data pertinent to operating or servicing the complete apparatus. Preventative maintenance instructions and recommended frequency.
   e. Schematic and wiring diagrams of power, control, and piping systems. A detailed description of operation shall be included for each diagram to describe all modes of operation of the system indicated. Where the integrated system requires interlocking and control of other components in normal operation, these components shall be included in the description of operation.
   f. General bulletins and catalog cuts describing complete apparatus, including operating principles and fundamentals.
   g. Service data sheets showing design performance, utility requirements, etc., as applicable to the specific duty for which the equipment is furnished.
   h. Materials of construction of all components.

i. Renewal parts list with diagrammatic or cross-section drawings showing part identification. Material analysis or trades designation for each significant part is to be noted on parts lists or on a separate sheet.

1.5 QUALITY ASSURANCE

A. Designer Qualifications: Design structural components, develop shop drawings, and perform shop and site work under direct supervision of a Professional Structural Engineer experienced in design of this type of work.

B. Cooperate with regulatory agency or authorities having jurisdiction (AHJ), and provide data as requested.

C. Manufacturer Qualifications:
   1. The manufacturer shall have a minimum of ten years of experience in the manufacture of substantially similar equipment and shall show evidence of satisfactory operation in at least five installations of similar application.

1.6 WARRANTY

A. The tank system shall be warranted by the manufacturer against defects in material or workmanship for 30 years following the delivery of the tank. Warranties that limit such coverage for shorter periods and/or limit the primary tank warranty to failure solely due to non-corrosion related cracking, breakup or collapse will not be permitted.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Fuel Storage Tank:
   1. Acceptable manufacturers, subject to Contractor coordination of required detail modifications compared to those indicated in drawings:
      a. Envirosafe by Memco,
      b. Highland Tanks,
      c. Core Engineered Solutions,
      d. Watco Tanks,
      e. Or approved equal.

B. The naming of a manufacturer in this Specification is not an indication that the manufacturers standard equipment is acceptable in lieu of the specified component features. Naming is only and indication that the manufacturer may have the capability of engineering and supplying a system as specified.

2.2 MATERIALS

A. Fuel Storage Tank System:
   1. The Fuel Storage Tank System shall be manufactured, tested and labeled in conformance with Underwriters Laboratories' UL-2085 Standard for Protected Aboveground Tanks for Flammable and Combustible Liquids, Double-wall Construction.
   2. The primary tank shall be listed per UL Standard 142.
   3. The Fuel Storage Tank System shall consist of either:
      a. A FireGuard tank per the Steel Tank Institute with primary steel tank, insulating thermal layer, and secondary containment steel tank, OR
      b. A ConVault Tank with a primary steel tank, insulating thermal layer, polymer-based secondary containment, and steel reinforced concrete encasement
   4. Steel tank thickness shall be 3/16" thick (7 gauge) minimum. Welds shall be continuous on all sides and exterior seams, conforming to the American Welding Society Standard for continuous weld.
   5. The primary steel tank shall be pressure tested at 5 psig for a minimum of 24 hours. All openings shall be from the top only.

B. Emergency Vent:
   1. The primary steel tanks shall have an "emergency vent" system as per NFPA 30 Code requirements.
   2. Tank shall be supplied with emergency vents for the primary and the secondary containment tanks.

C. Secondary Containment and Corrosion Protection:
   1. The tank system shall include secondary containment. The secondary containment shall include insulation material to protect the primary tank from extreme temperatures and contain leaks. The secondary containment shall be resistant to corrosion.

D. Fire, Ballistics, High Explosive (HE) Blast Resistance:
   1. The tank system shall be designed and tested to provide 2 hour fire protection for the primary tank as per UL 2085 2-hour furnace fire test and 2 hour simulated pool fire test.
   2. Tank shall comply with the latest edition of National Fire Protection Association NFPA 30 Flammable and Combustible Liquids Code.
   3. The tank system shall also meet or exceed the requirements of:
      a. 1997 Uniform Fire Code (UFC) "Protected" AST criteria as per Appendix II-F, including ballistics protection
      b. International Fire Code
   4. The tank shall be ballistic resistant against high velocity rifle fire.

E. Leak Monitoring:

1. The tank shall be equipped with a thru-tank leak detection monitoring tube terminating between the primary tank and the secondary containment or a leak detection sensor that detects infiltration of liquids between the primary tank and the secondary containment.
2. The leak monitoring system provided shall connect to the control panel and alert operators if a leak is detected.

F. Spill/Overfill Containment:
1. The tank system shall include a UL listed spill/overfill container with a minimum volume of 7 gallons manufactured as a part of the primary tank, surrounding the fill pipe, and protected by 2 hour fire rating of the enclosure.
2. The spill/overfill container shall include a stick port and normally closed drain valve to release spilled product into the main tank. Exterior steel shall be anti-oxidant powder coated to inhibit rust.

G. Overfill Protection:
1. Overfill protection shall be provided by the following methods:
   a. direct reading level gauge visible from fill pipe access, AND
   b. valve rated for pressurized delivery located within fill pipe to close automatically at 95% full level, AND
   c. high level alarm.

H. Level Monitoring:
1. The fuel storage tank system shall be equipped with two (2) level monitoring devices:
   a. A level monitoring device with free-floating mechanism and direct reading gauge visible from fill pipe access. This device shall have a brass or stainless steel fitting, a PVC suspension cable and a Polypropylene encased microswitch.
   b. A submersible level transmitter that shall conform to the following:
      1) ±1% FS Total Error Band,
      2) Guaranteed lighting protection,
      3) 2 year warranty,
      4) Stainless steel construction.

I. Temperature Monitoring:
1. Fuel storage tank system shall be equipped with Thermocouple for product temperature measurement.
2. Temperature shall be displayed and visible to the operator from the fuel dispenser.

J. Stairway or Ladder Assembly:
1. The Fuel Storage Tank shall be furnished with a stairway or ladder assembly to access the top of the tank.
2. Assembly shall comply with all OSHA safety requirements for ladders or stair assemblies.

K. Mechanical Fuel Dispenser:
   1. The Fuel Storage Tank system shall be furnished with a mechanical fuel dispenser that conforms to the following:
      a. The fuel dispenser shall be compatible with diesel fuel.
      b. The fuel dispenser shall have a flow rate of minimum 40 GPM.
      c. The fuel dispenser shall be pedestal mounted and the nozzle shall be at a height that maximizes user convenience and meets the American Disabilities Act (ADA) requirements.
      d. The fuel dispenser shall have a 7-digit electromechanical non-resettable totalizer that displays the volume of fuel dispensed in gallons.
      e. The fuel dispenser shall have a 2-piston positive displacement fuel meter with integral intelligent pulser.
      f. The fuel dispenser shall have an internal filter and strainer. The filter shall strain particulates down to 10 micron.
      g. The fuel dispenser shall have a lane-oriented, vapor recovery nozzle boot connected to a hose with a minimum length of 75 ft.
      h. The fuel dispenser shall be equipped with an electric rewind hose reel mounted to the tank or to a pedestal to keep the hose off the ground when idle.
      i. The fuel dispenser shall have a working pressure of up to 50 psi.

L. Inlet fill station
   1. The fill station shall be equipped with a 3-inch female Camlock fitting (Type D), which is an industry-standard for fuel delivery hoses.
   2. A dust cap shall be provided to protect the Camlock fitting from dirt, debris, and contamination when not in use.
   3. The fill station shall be mounted within a spill containment box with a minimum capacity of 5 gallons. The containment box shall corrosion-resistant and include a drain with a manual shut-off valve for emptying.

M. Submersible Turbine Pumps:
   1. The Tank shall be equipped with two submersible turbine pumps, one for the fuel dispensing system for vehicles and another one for the fuel outlet station to a hose connection. The pumps shall have the following characteristics:
      a. ¾ HP
      b. 0.56 KW
      c. 6.5A Max
      d. Voltage: 208-240V
      e. Single-phase

N. Fuel Polishing System
   1. The tank system shall be equipped with a programable, fully automated Fuel Polishing System that removes water, sludge and other contaminants from the fuel in the storage tank. The system shall have the following characteristics:
      a. Pump nominal flow rate: 10 GPM
      b. Pump Horsepower: ¾ HP

c. Primary filter: 30 µm filter cartridge or better
d. Secondary filter: 5 µm fine filter or better
e. Ports: 1" Diameter
f. Plumbing: Iron
g. System Enclosure: NEMA 4X rated
h. Fuel Conditioner: Inline Magnetic Conditioner

2. The Fuel Polishing System shall also include an automatic pump shut down feature, built-in leak detection and a pressure gauge.

PART 3 - EXECUTION

3.1 INSTALLATION

A. The tank system shall be handled, lifted, stored and installed in accordance with the manufacturer's instructions on a reinforced concrete base slab designed to support the fully loaded tank. Protective bollards shall be installed where required by state and local codes. Tanks shall be marked on all sides with warning signs and product identification as required by applicable codes.

B. The tank system shall be grounded in accordance with NFPA 780 and all electrical work shall be in accordance with applicable codes.

++ END OF SECTION ++

SECTION 13447

ELECTRIC MOTOR ACTUATORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes: Electric motor-driven actuators for valves and gates as identified in the valves and gate schedule as MOV or EDR (Electric Discrete Run Open / Run Close Valve Actuator), except for specialty actuators specified with individual valves.

B. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the Contractor's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of Contractor's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the Contractor to see that the completed Work complies accurately with the Contract Documents.
      a. Section 11295 - Hydraulic Valves.
      b. Section 11400 - Disc Filters.
      c. Section 16225 – Electric Motors 250 Horsepower or Less.
      d. Section 09900 - Painting.
      e. Section 17454 – Operations and Control Descriptions.

1.2 REFERENCES

A. American Water Works Association (AWWA):
   1. AWWA C504 - Rubber-Seated Butterfly Valves.
   2. AWWA C542 - Electric Motor Actuators for Valves and Slide Gates.

B. FM Global (FM).

C. National Electrical Manufacturers Association (NEMA):
   1. MG-1 Standard for Electrical motors.

D. Underwriters Laboratories (UL) - UL 674, UL 1004.

1.3 DEFINITIONS

A. NEMA:
   1. Type 4 enclosure in accordance with NEMA 250.

2. Type 4X enclosure in accordance with NEMA 250.
3. Type 7 enclosure in accordance with NEMA 250.

1.4 SUBMITTALS

A. Product data:
   1. Electrical ratings:
      a. Voltage and number of phases.
      b. Starting and running current.
      c. Voltage levels and source for control and status.
   2. Description of integral control interface.
   3. Integral and remote control station components.
   4. Environmental ratings, including NEMA enclosure rating and submergence capabilities.
   5. Gear ratios for both manual and motorized actuation.
   6. Opening and closing directions.
   7. Allowable starts per hour.
   8. List of all included options and accessories.
   9. Full travel times.
   10. Gearbox data including gear ratio, and gearbox efficiency.
   11. Affidavit in accordance with AWWA C542.

B. Shop drawings:
   1. Wiring diagrams:
      a. Include all options and expansion cards furnished with each actuator.
   2. Dimensioned drawings of each valve and actuator combination.
   3. Dimensioned drawings of each valve gearbox.
   4. Electric motor data.

C. Calculations: Submit the following for each valve/gate size and class:
   1. Operating torque calculations.
   2. Maximum torque calculations for seating and unseating.
   3. Maximum operating torque at starting and normal operation.
   4. Indicate factor of safety for all torque calculations.

D. Test reports:
   1. Factory test report and certificate.

E. Manufacturer's instructions:
   1. Include manufacturer's instructions, description of system operation, start-up data and troubleshooting check lists.

F. Operations and maintenance data:
   1. Include manufacturer's literature; cleaning procedures, replacement part lists, wiring diagrams, and repair data.
   2. Include a list of all configurable parameters, and the final values for each.
   3. List of recommended spare parts.

4. List of special tools necessary for proper operation and/or maintenance.
5. Exploded view drawings that illustrate all assemblies, sub-assemblies, and components.
6. Routine test procedures for all electronic and electrical circuits.
7. Troubleshooting chart covering the complete valve and controls/electrical power systems, showing description of trouble, probable cause, and suggested remedy.
8. Certified factory and field-test results.

G. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

H. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**

1.5 QUALITY ASSURANCE

A. Obtain required information from the valve/gate supplier, including but not limited to:
   1. Interface to gate or valve.
   2. Operating range:
      a. Quarter turn or multi-turn.
      b. Required turns for full travel on multi-turn applications.
   3. Direction of rotation for opening and closing.
   4. Maximum and normal torque requirements.

B. All motorized, intelligent actuators shall be the product of a single manufacturer for all valve and gate applications on this project, regardless of gate or valve type, manufacturer, or supplier.

1.6 WARRANTY

A. Refer to Contract Documents.

1.7 SPARE PARTS

A. Provide the following spare parts (minimum 10 percent of total number of actuators of each model type furnished, but not less than 1 for each model of actuator furnished):
   1. Stem nut.
   2. Worm shaft subassembly.
   3. Drive sleeve subassembly.
   4. Complete actuator seal kit.
   5. Actuator gearbox oil (sufficient quantity to fill 4 gearboxes).
   6. Encoder.
   7. Control module.

B. Provide 1 spare motor for each size motor furnished.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable manufacturers for lines 3 inches and smaller:
   1. Hayward:
      a. Series ECP (quarter-turn).
   2. RCI:
      a. RCEL-005L, with Receptacle (quarter-turn)
   3. Rotork:
      a. ROM Series (quarter turn).
   4. Rotork:
      a. CVA Series (multi- turn).
   5. Badger Meter
      a. SEVA Series

B. Acceptable Manufacturers for lines 4 inches and larger:
   1. Rotork Controls, Inc.:
      a. IQ (multi-turn).
      b. IQT (quarter-turn).
   2. Limitorque Corporation:
      a. Accutronix MX (multi-turn).
      b. Accutronix QkX (quarter-turn).

3. Auma:
    a. SA /SAR (multi-turn) with Aumatic AC controls.
    b. SG (quarter-turn) with Aumatic AC controls.
4. EIM Corporation.

2.2 MANUFACTURED UNITS

A. Actuators for valves 3 inches and smaller:
    1. Provide actuators complete and operable with all components and accessories required for operation.
    2. See Section 17454, Operations and Control Descriptions in addition to the project drawings for more detail.
    3. Power supply:
        a. 120 VAC.
        b. Valve motion independent of power supply phase rotation.
    4. Size actuator to move valves from full open to closed position within the time indicated in the Motorized Actuator Schedule:
        a. If an operating time is not indicated on the Schedule, size the actuator to move valves at minimum 12 inches per minute under maximum load. Measure rate of closure for valves at maximum diameter of disc, plug, or ball.
    5. Control inputs for Chemical Loop Dosing Valve Actuators:
        a. Capable of using discrete 120 VAC.
        b. Isolated inputs capable of operating from external control voltage source
        c. Provide for the following control inputs:
            1) AUTO.
            2) OFF.
        d. Hand operation can be executed for any number of actuators using the OFF mode and using the manual override on the respective actuator(s).
    6. Status outputs for Chemical Loop Dosing Valve Actuators:
        a. Dry contact outputs configured for the functions indicated on the Drawings. Provide the following outputs for all actuators:
            1) FULLY CLOSED.
            2) FULLY OPEN.
        b. All output contacts rated for minimum 3 amps, 120 VAC.
    7. Analog input for Chemical Loop Dosing Valve Actuators:
        a. Provide a 4-20 milliamp analog input from CMS for analog modulating valves when indicated on the Drawings.
        b. Modulate valve to maintain position based on analog input value.
        c. Maximum input impedance 250 ohms.
    8. Analog output for Chemical Loop Dosing Valve Actuators:
        a. Provide an isolated 4-20 milliamp analog output to CMS for each actuator as indicated in the Drawings.
    9. Materials:
        a. Construct motorized actuators of materials suitable for the environment in which the valve or gate is to be installed.

10. Components:
    a. Motors:
        1) Specifically designed for valve actuator service with high starting torque, totally enclosed non-ventilated construction.
        2) Torque ratings equal to or greater than that required for valve seating and dynamic torques with a 25 percent factor of safety.
        3) Rated for operating under the following conditions without exceeding temperature limits with ambient temperature of 40 degrees Celsius.
            a) Continuous operation for 15 minutes or twice the open-to-close operating time (whichever is greater) at normal operating torque or 33 percent of maximum torque (whichever is greater).
            b) 60 starts per hour for open/close service or 1,200 starts per hour for modulating service.
    b. Enclosures:
        1) Actuator housing ratings as indicated in the Motorized Actuator Schedule.
        2) Stainless steel external fasteners.
        3) Provide the following minimum enclosure ratings:
            a) NEMA Type 4X for outdoor, wet or corrosive area applications.
    c. Manual Override for Chemical Loop Dosing Valve Actuators:
        1) Hand operated dial.
    d. Gearing: Hardened alloy steel spur or helical gears and self-locking, alloy bronze worm gear set:
        1) Accurately cut to assure minimum backlash.
    e. Bearings:
        1) Anti-friction bearing with caged balls or rollers throughout.
        2) Sealed-for-life type thrust bearings housed in a separate thrust base.
    f. Drive bushing:
        1) Easily detachable for machining to suit the valve stem or gearbox input shaft.
        2) Positioned in a detachable base of the actuator.

B. Actuators for valves 4 inch and larger:
    1. Provide actuators complete and operable with all components and accessories required for operation.
    2. Power supply:
        a. Voltage and phases as indicated on the Valve and Gate Actuator Schedule.
        b. Valve or gate motion independent of power supply phase rotation.
    3. Size actuator to move gates or valves from full open to closed position within the time indicated in the Valve and Gate Actuator Schedule:
        a. If an operating time is not indicated on the Schedule, size the actuator to move gates or valves at minimum 12 inches per minute under maximum load.
        b. Measure rate of closure for valves at maximum diameter of disc, plug, or ball.

4. Control interface:
    a. Configuration:
        1) Provide a non-intrusive, non-contacting interface for configuring all input and output settings, control values, ranges, torque switch settings, valve positions switch settings, and options.
            a) Configurable from a hand-held configuring tool or input devices on the actuator.
    b. Local interface, integral to actuator:
        1) Selector switches:
            a) Local-Off:
                i. Motor actuator operation is prevented with the switch in OFF.
            b) Auto:
                i. Controls the valve when the local hand switch is in AUTO.
                ii. Spring return to center.
                iii. Configurable between maintained (actuator runs until end of travel, high torque, or a local-stop-remote is switched to STOP) and momentary (actuator stops when lever is released).
    c. Control inputs:
        1) Capable of using 120 VAC.
        2) Controls the valve when local-stop-remote is in AUTO.
        3) Isolated inputs capable of operating from external control voltage source or internal power supply:
            a) Furnish control power supplies within the actuator.
        4) Provide the following inputs:
            a) AUTO.
            b) OFF.
            c) OPEN and CLOSE inputs configurable between maintained (actuator runs until end of travel, high torque, or a OFF input) and momentary (actuator stops when command is removed).
    d. Status outputs:
        1) Monitor relay output: Dry contact, normally closed, opens when actuator is not in REMOTE or in the event of any internal fault or alarm condition.
        2) Dry contact outputs configured for the functions indicated on the Drawings. Provide the following outputs for all actuators:
            a) FULLY CLOSED.
            b) FULLY OPEN.
            c) Local-Off-Remote in REMOTE position.
        3) All output contacts rated for 5 amps, 120 VAC and 24 VDC.
    e. Analog input:
        1) Provide a 4-20 milliampere analog input for analog modulating valves when indicated on the Drawings.
        2) Modulate valve to maintain position based on analog input value.

3) Maximum input impedance 250 ohms.

f. Analog output(s):

1) Provide an isolated 4-20 milliampere analog outputs when indicated on the Drawings:

a) Loop power sourced from the actuator power supply.

b) Capable of driving into a load up to 500 ohms.

c) Output proportional to process value(s) indicated on the Drawings.

d) Gate position.

e) Operating torque.

5. Control interface for Disc Filter Actuators:

a. Configuration:

b. Local interface, integral to actuator:

c. Control inputs:

d. Status output(s):

e. Analog input:

f. Analog output(s):

2.3 FEATURES

A. Time delay on reversal: Incorporate time delay between stopping actuator and starting in opposite direction to limit excessive current, torque, and heating from instantaneous reversal.

2.4 MATERIALS

A. Construct motorized actuators of materials suitable for the environment in which the valve or gate is to be installed.

2.5 COMPONENTS

A. Motors:

1. Specifically designed for valve actuator service with high starting torque, totally enclosed non-ventilated construction.
2. Torque ratings equal to or greater than that required for valve seating and dynamic torques with a minimum of 25 percent factor of safety:

a. Design requirements for rubber-seated AWWA butterfly valves:

1) Design valves and actuators for maximum operating torque, in accordance with and using safety factors required in AWWA C504 and AWWA C542:

a) Valve actuator torque requirement for open-close service: Not less than the required valve-seating and dynamic torques under design operating conditions in accordance with AWWA C504.

b) Valve actuator torque requirement for modulating service: Not less than twice the required valve dynamic torque under design operating conditions in accordance with AWWA C504.

b. Design requirements for slide gates, gate valves, knife gate valves, globe valves, and diaphragm valves:
    1) Design valves and actuators for maximum operating torque, in accordance with and using safety factors required in AWWA C542.
    2) Design for the maximum torque and thrust running load over the full cycle.
    3) Maximum torque or thrust rating: The actuator stall torque or maximum thrust output shall not exceed the torque or thrust capability of the valve or gate, as determined by the valve or gate manufacturer.

3. Capable of being removed and replaced without draining the actuator gear case.
4. Motor bearings shall be amply proportioned of the anti-friction type and permanently lubricated.
5. Rated for operating under the following conditions without exceeding temperature limits with ambient temperature of 40 degrees Celsius:
    a. Continuous operation for 15 minutes or twice the open-to-close operating time (whichever is greater) at normal operating torque or 33 percent of maximum torque (whichever is greater).
    b. 60 starts per hour for open/close service or 1,200 starts per hour for modulating service.
6. Provide the following motor protection features:
    a. Jammed valve (no valve motion detected through a time delay).
    b. High motor temperature (sensed by embedded thermostats).
    c. High torque.
    d. Single phasing protection for 3-phase motors.

B. Enclosures:
1. Actuator housing ratings as indicated in the Valve and Gate Actuator Schedule.
2. Stainless steel external fasteners.
3. Provide seals for each of the following areas:
    a. Between the terminal compartment and the internal electrical elements.
    b. Between the mechanical and electrical portions to protect from the ingress of oil, and to protect the mechanical components of oil from dust and moisture when the electrical terminal is open.
4. Provide the following minimum enclosure ratings:
    a. NEMA Type 4X for general applications.

C. Position sensing:
1. Integral with valve actuator.
2. Gearing: Intermittent type; bronze or stainless steel; grease lubricated; totally enclosed.
3. Contacts: Heavy duty and silver-plated with wiping action or encoder wheel.
    a. Remote indication contacts: As indicated on the Drawings.

4. Switches: Adjustable; allowing for trip points from fully open to closed positions of valve travel; not subject to breakage or slippage due to over travel; permits visible verification of switch position without disassembly.
5. Capable of retaining position and monitoring valve or gate motion when valve is manually actuated and when main power is not present.
6. Valve range and position switch outputs field adjustable.

D. Torque sensing:
1. Capable of interrupting control circuit in both opening and closing when valve torque overload occurs.
2. Silver-plated contacts.
3. Graduated dials for both open and close directions of travel, each independently adjustable or 0-100 LTD display.
4. Positive means to limit adjustability to avoid exceeding actuator output torque capability with solid-state sensor embedded within the torque transducer.
5. Permits visible verification of switch position without disassembly.
6. Torque shutdown setting: 40 percent to 100 percent rated torque:
   a. Adjustable in 1 percent increments.
7. Capable of interrupting control circuit during both opening and closing and when valve torque overload occurs.
8. Independent of variations in frequency, voltage, or temperature.
9. Provide a temporary inhibit of the torque sensing system during unseating or during starting in mid-travel against high inertia loads.

E. Manual actuators:
1. Hand wheel for manual operation:
   a. Maximum 80-pound pull on rim when operating gate or valve under maximum load.
   b. Provide pull chain when motorized actuator is located more than 6 feet above floor surface.
      1) Chain shall be of sufficient length to reach approximately 4 feet above the operating level.
      2) Where the chain obstructs an aisle or walkway, provide holdback or other means to ensure chain does not create a nuisance or hazard to operating personnel.
2. Declutch lever: With padlock, capable of mechanically disengaging motor and related gearing and freeing hand wheel for manual operation.

F. Gearing: Hardened alloy steel spur or helical gears and self-locking, alloy bronze worm gear set:
1. Accurately cut to assure minimum backlash.

G. Bearings:
1. Anti-friction bearing with caged balls or rollers throughout.
2. Sealed-for-life type thrust bearings housed in a separate thrust base.

H. Drive bushing:
   1. Easily detachable for machining to suit the valve stem or gearbox input shaft.
   2. Positioned in a detachable base of the actuator.

I. Lubrication:
   1. Provide totally enclosed actuator gearing with oil filled gear case suitable for operation at any angle.
      a. Suitable for standard SAE80EP gear oil.
   2. Actuators requiring special or exotic lubricants are not acceptable.
   3. Provide seals for all shafts.

2.6 ACCESSORIES

A. Setting tool:
   1. If required for setting or configuring the actuator, provide a hand-held setting tool.
      a. Furnish 1 setting tool for every 10 actuators.
      b. Capable of communicating with PC-based configuration software, and transferring the following in either direction between the computer and programmer and setting tool, and between the setting tool and actuator.
      c. Actuator configurations:
         1) Capable or storing up to ten different configurations.
      d. Diagnostic data.
         1) Capable of storing 4 complete sets of diagnostic data.

2.7 SOURCE QUALITY CONTROL

A. Factory test:
   1. Test each actuator in the factory, and submit an individual test certificate for each actuator.
   2. Perform a high potential test and record the following information:
      a. Test voltage.
   3. Simulate a maximum and typical valve loads and record the following information:
      a. Current and power factor at maximum and set torque values.
      b. Torque as measured by the actuator.
      c. Actuator output speed or operating time.
   4. Performance testing: Conduct performance test for each actuator simulating valve operating torque from full-open to full-close and from full-close to full-open. The following information shall be recorded during each performance test:
      a. Torque at maximum torque setting.
      b. Current at maximum torque setting.
      c. Test voltage and frequency.
      d. Actuator output speed and operating time for full-open to full-close.
      e. Amperage draw on motors at breakaway and under normal operation.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install actuators in accordance with manufacturer's instructions.

3.2 MOTORIZED ACTUATOR SCHEDULE

A. Provide all actuators required by the Drawings. Major process actuators are listed in the Valve and Gate Actuator Schedule.

B. Abbreviations relating to type:
   1. BFV = Butterfly Valve.
   2. BV = Ball Valve.
   3. PV = Plug Valve.
   4. SG = Slide Gate.
   5. KGV = Knife Gate Valve.
   6. TSV = Telescoping Valve.
   7. FCV = Global-Style Flow Control Valve.

C. Abbreviations relating to actuator type:
   1. O/C = Open and Close Service.

D. Abbreviations relating to controls:
   1. MB = Modbus RTU (RS-485).
   2. NET = Manufacturer’s proprietary network.
   3. A = Analog (4-20 mA) control, modulating duty.
   4. D = Discrete control, modulating duty.
   5. D-O/C = Discrete Open/Close.

VALVE AND GATE ACTUATOR SCHEDULE									
Equipment Number	**Location**	**Reference DWG**	**Valve Type**	**Size**	**Actuator Type**	**NEMA Rating**	**Voltage**	**Open Time**	**Controls**
AWRF									
SC-001-ACE	SECONDARY CLARIFIER NO. 1 ACTIVATED SLUDGE EFFLUENT VALVE	M-04.01	PV	12-IN	O/C	4X	480/3/60	TBD	D
SC-003-ACE	SECONDARY CLARIFIER NO. 3 ACTIVATED SLUDGE EFFLUENT VALVE	M-04.01	PV	12-IN	O/C	4X	480/3/60	TBD	D
SC-004-ACE	SECONDARY CLARIFIER NO. 4 ACTIVATED SLUDGE EFFLUENT VALVE	M-04.01	PV	16-IN	O/C	4X	480/3/60	TBD	D
MOV-DS6-BW1	DISC FILTER NO. 6 BACKWASH VALVE 1	M-5.04	BAV	2-IN	O/C	TBD	120/1/60	TBD	TBD
MOV-DS6-BW2	DISC FILTER NO. 6 BACKWASH VALVE 2	M-5.04	BAV	2-IN	O/C	TBD	120/1/60	TBD	TBD
MOV-DS6-BW3	DISC FILTER NO. 6 BACKWASH VALVE 3	M-5.04	BAV	2-IN	O/C	TBD	120/1/60	TBD	TBD
MOV-DS6-BW4	DISC FILTER NO. 6 BACKWASH VALVE 4	M-5.04	BAV	2-IN	O/C	TBD	120/1/60	TBD	TBD

MOV-DS6-BW5	DISC FILTER NO. 6 BACKWASH VALVE 5	M-5.04	BAV	2-IN	O/C	TBD	120/1 /60	TBD	TBD
MOV-DS6-BW6	DISC FILTER NO. 6 BACKWASH VALVE 6	M-5.04	BAV	2-IN	O/C	TBD	120/1 /60	TBD	TBD
MOV-DS6-BW7	DISC FILTER NO. 6 BACKWASH VALVE 7	M-5.04	BAV	2-IN	O/C	TBD	120/1 /60	TBD	TBD
MOV-DS6-SW1	DISC FILTER NO. 6 SOLIDS WASTE VALVE 1	M-5.04	MUV	2-IN	O/C	TBD	120/1 /60	TBD	TBD
MOV-DS6-SW2	DISC FILTER NO. 6 SOLIDS WASTE VALVE 2	M-5.04	MUV	2-IN	O/C	TBD	120/1 /60	TBD	TBD
NAOCL-VLV-001	HEADWORKS NAOCL STAGE 2/3 DOSING VALVE	M-11.03	FCV	½ -IN	Electric	4X	120/1 /60	11 s	A
NAOH-VLV-001	HEADWORKS NAOH STAGE 1 DOSING VALVE	M-11.03	FCV	½ -IN	Electric	4X	120/1 /60	11 s	A
NAOH-VLV-002	HEADWORKS NAOH STAGE 2/3 DOSING VALVE	M-11.03	FCV	½ -IN	Electric	4X	120/1 /60	11 s	A
NAOCL-VLV-002	PRE-STAGE 1 NAOCL STAGE 2/3 DOSING VALVE	M-11.04	FCV	½ -IN	Electric	4X	120/1 /60	11 s	A
NAOH-VLV-003	PRE-STAGE 1 NAOH STAGE 1 DOSING VALVE	M-11.04	FCV	½ -IN	Electric	4X	120/1 /60	11 s	A
NAOH-VLV-004	PRE-STAGE 1 NAOH STAGE 2/3 DOSING VALVE	M-11.04	FCV	½ -IN	Electric	4X	120/1 /60	11 s	A

NAOCL-VLV-003	PRE-STAGE 2 NAOCL STAGE 2/3 DOSING VALVE	M-11.05	FCV	½ -IN	Electric	4X	120/1 /60	11 s	A
NAOH-VLV-005	PRE-STAGE 2 NAOH STAGE 1 DOSING VALVE	M-11.05	FCV	½ -IN	Electric	4X	120/1 /60	11 s	A
NAOH-VLV-006	PRE-STAGE 2 NAOH STAGE 2/3 DOSING VALVE	M-11.05	FCV	½ -IN	Electric	4X	120/1 /60	11 s	A

++ END OF SECTION ++

SECTION 14610

DAVIT CRANE

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish and install one (1) davit crane socket base flush mount supports on each walkway above zone 8 of the OWRF MBR Bioreactor Basins, in accordance with this Section and as shown on the Drawings.

B. CONTRACTOR shall furnish one (1) Thern Ensign Series 5110 Portable Davit Crane with electric winch operation capable of 1,000 lbs. Davit cranes shall be stainless steel and installed such that equipment can be removed easily. Each crane shall be furnished with all appurtenances required for a complete and operational system.

1.2 REFERENCES

A. The following reference standards shall be the latest edition, including addenda, supplements, and revisions. Applicable publications include the following:
   1. American Society for Testing and Materials (ASTM):
      a. ASTM A48 - Standard Specification for Gray Iron Castings.
      b. ASTM A108 - Standard Specification for Steel Bars, Carbon, Cold-Finished, Standard Quality.
      c. ASTM A276 - Standard Specification for Stainless and Heat Resisting Steel Bars and Shapes.
      d. ASTM A573 - Standard Specification for Structural Carbon Steel Plates of Improved Toughness.
      e. ASTM A582 - Standard Specification for Fee-Machining Stainless and Heat Resisting Steel Bars, Hot-Rolled or Cold Finished.
      f. ASTM A743 - Standard Specification for Castings, Iron-Chromium, Iron-Nickel, Corrosion Resistant, for General Application.
      g. ASTM F593 - Specification for Stainless Steel Bolts, Hex Cap Screws and Studs.
      h. ASTM F594 - Specification for Stainless Steel Nuts.

1.3 QUALITY ASSURANCE

A. Manufacturer's Qualifications:
   1. The equipment to be furnished under this Section shall be the product of firms regularly engaged in the design and manufacture of such equipment. All like items shall be furnished by one manufacturer to ensure uniformity and interchange ability of parts. Manufacturer shall guarantee all equipment furnished; however, this shall not be construed as relieving the

CONTRACTOR from his responsibility for the proper installation and functioning of the Work.

B. Manufacturer shall have five installations of same size equipment in same application within the last five years in the State of Arizona. Manufacturer shall submit installation information, including size, location, and a total of three operator contact names and operator phone numbers with the submittals.

C. Complete assemblies including cable and all accessories shall be listed and approved by the Nationally Recognized Testing Laboratories (NRTL).

1.4 SUBMITTALS

A. See Section 01300, Submittals, for submittal procedures.

B. Product Data: Provide complete data on all manufactured components of davit crane assemblies.

C. Shop Drawings: Indicate overall dimensions, interface with supporting structure.

D. Shop Drawings: Submit for approval the following:
   1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance with the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
   2. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**

E. Structural calculations: Submit calculations for davit crane elements, sealed by a structural engineer registered in the state of Arizona.

F. Operation Data: Submit with closeout package.

G. Maintenance Data: Submit with closeout package.

H. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packing and Shipping: Deliver equipment properly packaged and mounted on pallets or skids to facilitate handling of heavy items. Utilize factory fabricated-type containers or wrappings, which protect equipment from damage.

B. Acceptance at Site: Inspect equipment to ensure that no damage has occurred during shipment. Handle equipment carefully to prevent physical damage to equipment and components. Remove packaging, including the opening of crates and containers, avoiding the use of excessive hammering and jarring which would damage the electrical equipment contained therein. Do not install damaged equipment; remove from site and replace damaged equipment with new. Inspect all equipment at time of delivery as to model, quantity, and physical condition. All equipment shall be identified by name and tag number. Site conditions must be clean, dry, heated, and dust-free before equipment is removed from packaging or installed.

C. Storage and Protection: The CONTRACTOR shall store the items furnished under this Section until they can be installed. Such storage shall meet the requirements of the system supplier and be approved by the OWNER. Use all means necessary to protect the material of this Section before, during, and after installation, and to protect the installed Work and materials of all other trades.

1.6 WARRANTY

A. See Section 01700, Contract Closeout, for additional warranty requirements.

B. The manufacturer shall warrant the units being supplied to the OWNER against defects in workmanship and material for a period of two years under normal use, operation, and service. The warranty shall cover all parts and labor and shall be in printed form and apply to all similar units.

C. A warranty statement shall be included by the manufacturer in the Installation, Operation and Maintenance Manual, which defines the terms of a two year warranty.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Thern Inc., Ensign 5110 Model 5110M1 with socket base mounted flush.

B. Or approved equal.

2.2 DAVIT CRANE SYSTEM

A. CONTRACTOR shall provide three crane systems as specified herein to be located at Disc Filter Basins. Crane base locations shown in the drawings.
   1. Hoist System Components:
      a. Provide three portable hoist with winch and associated support base, as specified and as shown on the Drawings.
      b. Loading Rating: Lifting capacity shall be 1,000 lbs. The portable hoist assembly and winch shall not weigh more than 160 lbs.
      c. Dimensional Characteristics: Horizontal reach shall be between a minimum of 36-inches to a maximum of 66-inches. Hook height shall be a minimum of 36-inches and a maximum of 80-inches. Hook height shall be defined as the vertical distance from the top of the base support to the eye of the hook.
      d. Mast and Boom Interface:
         1) Boom shall rotate 360 degrees on mast center.
         2) Boom shall be affixed to mast with assembly pins for easy disassembling.
         3) Adjustable boom shall telescope to four different lengths and adjust in height while under load with ratchet style screw jack.
      e. Wire Rope: Wire rope shall be capable of interfacing with the crane. The wire rope shall be 1/4-inch by 36 feet in length of stainless steel with SS eyehook and swagged ball fitting.

2.3 HOIST BASE SUPPORT

A. Acceptable Manufacturer:
   1. Thern, Inc., suitable for use with crane Model 5110. Crane base models shall be socket base mounted flush stainless steel.

B. The CONTRACTOR shall furnish and install pedestal base supports as shown on the Drawings and as specified herein. The number of base supports is as follows:

Location	No. of Base Support	Type of Base Support
OWRF MBR Bioreactor Basins	2	Socket Base Mounted Flush

2.4 SHOP PAINTING

A. Crane and accessories to include corrosion resistant electrostatic powder coated finish.

B. Stainless steel finish to be provided as specified.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install Davit crane, mounting socket, and accessories according to the manufacturer's printed instructions.

B. Test crane as recommended by manufacturer.

3.2 MANUFACTURER'S FIELD SERVICE

A. Equipment Start-Up: A factory employed representative of the manufacturer shall visit the site and provide installation and start-up services as specified in Section 01650, Starting of Systems.

B. Training: A factory employed representative of the manufacturer shall visit the site and provide operator training services, in addition to equipment start-up services, as specified in Section 01650, Starting of Systems. Training time shall be for a period of one day (eight hours).

3.3 FACTORY CERTIFIED TESTS

A. The Davit crane manufacturer shall perform the following inspections and tests on each crane before shipment from the factory:
   1. Winch, drum, mast, boom, handle, boom extension, and pedestal bases shall be checked for structure integrity and mobility.
   2. Wire rope, winch, and drum shall be tested to provide sufficient strength for the capacity of the crane.

B. A written report confirming the Davit cranes have met all established quality assurance standards shall be submitted to the ENGINEER prior to installation.

3.4 SPARE PARTS

A. Deliver one set of special tools to assemble and disassemble Davit crane system.

3.5 DEMONSTRATION

A. The CONTRACTOR shall demonstrate that the cranes operate as a system and according to manufacturer's specifications.

++ END OF SECTION ++

SECTION 14630

HOISTS, TROLLEYS, MONORAILS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the conductor bar which will replace the festoon system for the existing monorail trolley and hoists at the AWRF Disc Filters.

1.2 RELATED DOCUMENTS

A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 1, General Requirements, Specification Sections, apply to this Section.

1.3 RELATED SECTIONS

A. The following Sections contain requirements that relate to this Section:
   1. Section 05120, Structural Steel, for structural steel to which bridge crane components are fastened.
   2. Division 16, Electrical, Sections for electrical service to monorail hoists and trolleys, including fused disconnect switches and electric motors.

1.4 DEFINITIONS

A. Monorail Hoist: Cranes by which load blocks are hoisted by wire ropes using an electrically driven drive trolley and are defined to include driving machines; trolleys; hoists; brakes; roping; buffers; signals; control systems; electrical wiring within crane system; and devices for operations, safety, security, required performance at rated speed and capacity, and for complete crane installation.

B. Monorail: A single girder and end trucks supported by a building or structure with rails to which the trolley and hoist are fastened.

C. Hook Height: The minimum acceptable distance in feet from the bottom of the hook in full raised position to the nearest floor surface.

D. Lift Height: The distance in feet form the bottom hook in full raised position to the surface of the lowest floor from which items may be hoisted.

E. Ultimate Load-Carrying Capacity: Live Load, weight of all equipment and an allowance for impact.

F. Total Trolley Capacity: The ultimate load-carrying capacity of the trolley based on the ultimate strength of the material (with a 5:1 safety factor) and the bearing life.

1.5 SUBMITTALS

A. General: Submit each item in this Paragraph according to the Conditions of the Contract and Division 1, General Requirements, Specification Sections.

B. Product data for each monorail hoist, including capacities, sizes, performances, operations, safety features, finishes, and similar information.

C. Shop Drawings: Submit for approval the following:
   1. Shop Drawings for each monorail hoist showing plans, elevations, sections, and large-scale details indicating coordination with building structure, and relationships with other construction. Indicate variations from specified requirements, maximum dynamic and static loads imposed on building structure at points of support, and locations of equipment and signals. Include maximum and average power demands.
   2. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
   3. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**

D. Operation & Maintenance Manuals for each different monorail hoist, including operation and maintenance instructions, parts listing with sources indicated, recommended parts inventory listing, emergency instructions, erection or assembly drawings, repair parts bulletins, lubrication instructions, instructions for making repairs, and similar information. Include all diagnostic and repair information available to manufacturer's and installer's maintenance personnel.
   1. Submit manuals for approval before any components of the monorail crane system are shipped to the job site.

E. Inspection and Acceptance Certificates and operating permits (if any) as required by governing authorities for normal, unrestricted bridge crane use.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Engage the monorail crane manufacturer or an experienced installer approved by the monorail hoist manufacturer who has completed monorail hoist installations similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.

B. Regulatory Requirements: In addition to local governing regulations, comply with OSHA Standards and the following:
   1. Motor protection in all phases.
   2. Branch circuit over current protection for all motors.
   3. Running motor protection by use of automatic overload relays.
   4. All hooks shall be provided with safety latches.
   5. Rubber bridge and trolley bumpers shall be provided.

1.7 WARRANTY

A. General Warranty: The monorail hoist warranty specified in this paragraph shall not deprive the OWNER of other rights the OWNER may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the CONTRACTOR under requirements of the Contract Documents.

B. Standard Monorail Hoist Warranty: Submit a written warranty signed by manufacturer agreeing to repair, restore, or replace defective Work within the specified warranty period.
   1. Warranty Period: 12 months from date of substantial completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. For compliance with requirements, provide products by one of the following:
   1. Conductix-Wampfler
   2. Or approved equal.

2.2 HOIST AND TROLLEY DESIGN CRITERIA

A. Provide equipment for each monorail hoist to comply with requirements indicated below:
   1. Class C Service, ANSI Specification No. MH27.1.
   2. Monorail Manufacturers Association.

B. Existing Airport Disc Filters Monorail Hoist: Single girder, under-running, electric trolley and hoist, conforming to the following:
   1. Capacity: 1 ton.
   2. Girder Span: As indicated on the Drawings.
   3. Hoist Hook Height (feet): 3 feet 7-inches measured from the top of AWRF Filter Complex.
   4. Hoist Lifting Height (feet): 23 feet 6-inches measured from the finish floor of the Filter Pump Gallery.
   5. Type of Bumper: Rubber.
   6. Ambient Temperature: 120º F maximum and 40º F minimum.
   7. Humidity: 100%.
   8. Materials Handled: Progressive cavity pumps.
   9. Speeds Required:
      a. Hoist: Two speeds; 20 feet per minute, 3.2 feet per minute.
      b. Trolley: variable speed with electric acceleration control; full speed of65 feet per minute
   10. Crane Control: Single, pendant type, push-button station suspended from a supporting track, capable of controlling the trolley and hoist from anywhere along the monorail.
   11. Power Supply: 460 V, 60 Hz, 3-phase.
   12. Horsepower: 3.4 horsepower maximum.
   13. Crane Motors: T.E.N.V., 30 minute, with Class F insulation, 55º F rise over 60º F ambient, with AC disc brake.

2.3 ELECTRICAL

A. Monorail Electrification: Provide electrical power to the motor-driven hoists and trolleys using one of the following methods as specified below:
   1. Conductor Bar System:
      a. Provide conductor rail power system supported from the monorail. Pendant shall be supported on a separate track and trolley system. Provide all splices and power feed as required for the existing system and shall be UL approved and provided with all brackets, hangers, power feeds, end caps and collectors. Conductor bar must be fully covered and insulted with PVC. Include all components needed for a complete and operable system.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine monorail hoist areas, with installer present, for compliance with requirements, installation tolerances, and other conditions affecting performance of monorail work. Examine structure, channels, openings, walls, pits, and wash-down areas, as constructed; verify critical dimensions; and examine supporting structure and other conditions under which monorail work is to be installed. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer's instructions and recommendations. Do not proceed with installation until the maintenance manual submittal as described in Part 1 of this Specification, has been approved.

B. Welded Construction: Provide welded connections for installing monorail hoist work where bolted connections are not required for subsequent removal or for normal operation, adjustment, inspection, maintenance, and replacement of worn parts. Comply with AWS standards for workmanship and for qualifications of welding operators.

C. Coordination: Coordinate monorail work with work of other trades for proper time and sequence to avoid construction delays. Use established benchmarks, lines, and levels to ensure dimensional coordination of the Work.

D. Lubricate operating parts of systems, including ropes, as recommended by manufacturers.

E. Alignment: Coordinate installation of trolley and hoist with installation of monorail girder for accurate alignment.

3.3 FIELD QUALITY CONTROL

A. Acceptance Testing: Upon nominal completion of monorail installation and before permitting use (either temporary or permanent) of monorails, perform acceptance tests as required and recommended by the "Code" and governing regulations and agencies.

B. Operating Test: Load monorails to 125% rated capacity and operate continuously for 30 minutes over full travel distances, stopping at locations as directed by the OWNER and proceeding immediately to the next. Record temperature rise of monorail machines during 30 minute test period. Record failure of monorails to perform as required.

C. Advise OWNER, ENGINEER, and authorities having jurisdiction in advance of dates and times tests are to be performed on monorails.

3.4 DEMONSTRATION

A. Instruct OWNER'S personnel in proper use, operation, and daily maintenance of monorails. Review emergency provisions, including emergency access and procedures to be followed at time of failure in operation and other building emergencies. Train OWNER'S personnel in procedures to follow in identifying sources of operational failures or malfunctions. Confer with OWNER on requirements for a complete monorail maintenance program.

B. Make a final check of each monorail operation with OWNER'S personnel present and just prior to date of substantial completion. Determine that operation systems and devices are functioning properly.

3.5 PROTECTION

A. Temporary Use: Do not use monorails for construction purposes.

B. Provide protective coverings, barriers, devices, signs, or other procedures to protect monorails. If, despite such protection, monorails become damaged, engage monorail installer to restore damaged work so that no evidence remains of correction work. Return items that cannot be refinished in the field to the shop, make required repairs and refinish entire unit, or provide new units as required.

C. Provide final protection and maintain conditions, in a manner acceptable to monorail manufacturer and installer that ensure monorails are without damage or deterioration at the time of substantial completion.

++ END OF SECTION ++

SECTION 15010

BASIC MECHANICAL REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Basic Mechanical Requirements specifically applicable to Division 15, Mechanical, Sections, in addition to Division 1, General Requirements.

1.2 WORK SEQUENCE

A. Install Work to accommodate OWNER'S occupancy requirements during the construction period. Coordinate mechanical schedule and operations with OWNER and ARCHITECT/ENGINEER.

1.3 SUBMITTALS

A. Submit under provisions of Division 1, General Requirements.

B. Submit Shop Drawings and product data grouped to include complete submittals of related systems, products, and accessories in a single submittal.

C. Mark dimensions and values in units to match those specified.

D. Submit published ratings or capacity; detailed equipment drawings for fabricated items.

E. Submit complete electrical schematic and connection diagrams for each particular motor control or other electrical system. Generic diagrams are not acceptable.

F. Submit manufacturer’s printed instructions for installation.

G. Shop Drawings: Submit for approval the following:
   1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or

services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

2. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**

1.4 REGULATORY REQUIREMENTS

A. Conform to editions in effect on the date of Advertisement for Bids.

B. Plumbing: Conform to Uniform Plumbing Code.

C. Obtain permits and request inspections from authority having jurisdiction.

1.5 PROJECT/SITE CONDITIONS

A. Existing conditions shown on Drawings are based on casual field observation and existing Record Documents.

B. Install Work in locations shown on Drawings, unless prevented by Project conditions.

C. Prepare Drawings showing proposed rearrangement of Work to meet Project conditions, including changes to Work specified in other Sections. Obtain permission of ARCHITECT/ENGINEER before proceeding.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 DRAWINGS

A. Drawings are diagrammatic in character. Exact locations of systems and their elements shall be as determined from the structure and the equipment, not from the Drawings.

3.2 SPACE REQUIREMENTS

A. Verify space requirements of materials and equipment before ordering. Equipment that will not enter openings or that will not fit the assigned space will not be accepted.

3.3 DRAWINGS INTERPRETATION

A. All omissions, discrepancies, or questions of clarity of intent of Drawings and/or Specifications shall be referred to ARCHITECT/ENGINEER for interpretation before bid is submitted.

3.4 RECORD DOCUMENTS

A. Prepare Record Documents under provisions of Division 1, General Requirements.

3.5 MECHANICAL EQUIPMENT

A. Install mechanical equipment to facilitate maintenance, repair, and/or replacement of equipment and components. As much as practical, connect equipment for ease of disconnecting with minimum interference with other installations.

3.6 COORDINATION

A. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.

++ END OF SECTION ++

SECTION 15050

PIPING SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope: This Section specifies systems of process piping and general requirements for piping systems. Detailed Specifications for the components listed on the Piping System Specification Sheets are found in other Sections of Division 15, Mechanical. This Section shall be used in conjunction with those Sections.

B. Related Sections:
   1. Section 02315, Earthwork, Excavation, and Backfill.
   2. Section 09900, Painting.
   3. Section 11295, Hydraulic Valves.
   4. Section 15051, Buried Piping Installation.
   5. Section 15052, Exposed Piping Installation.
   6. Section 15061, Ductile Iron Pipe.
   7. Section 15065, Thermoplastic Pipe and Accessories.

1.2 QUALITY ASSURANCE

A. This Section contains references to the following documents. They are a part of this Section as specified and modified. In case of conflict between the requirements of this Section and those of the listed documents, the requirements of this Section shall prevail.

B. Unless otherwise specified, references to documents shall mean the documents in effect on the effective date of the agreement. If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, whether or not the document has been superseded by a version with a later date, discontinued, or replaced.
   1. AASHTO M36/M36M, Metallic (Zinc or Aluminum) Coated Corrugated Steel Culverts and Underdrains.
   2. ANSI A13.1, Scheme for the Identification of Piping Systems.
   3. ANSI B1.20.1, Pipe Threads, General Purpose (Inch).
   4. ANSI B16.1, Cast Iron Pipe Flanges and Flanged Fittings Class 25, 125, 250, and 800.
   5. ANSI B16.3, Malleable Iron Threaded Fittings Class 150 and 300.
   6. ANSI B16.5, Pipe Flanges and Flanged Fittings.

7. ANSI B16.9, Factory Made Wrought Steel Butt Welding Fittings.
8. ANSI B16.11, Forged Steel Fittings, Socket Welding and Threaded.
9. ANSI B16.12, Cast Iron Threaded Drainage Fittings.
10. ANSI B16.22, Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
11. ANSI B16.26, Cast Copper Alloy Fittings for Flared Copper Tubes.
12. ANSI B31.1, Power Piping.
13. ANSI B31.3, Chemical Plant and Petroleum Refinery Piping.
14. ASME Section IX, Boiler and Pressure Vessel Code; Welding and Brazing Qualifications.
15. ASTM A47, Malleable Iron Castings.
16. ASTM A74, Cast Iron Soil Pipe and Fittings.
17. ASTM A105/A105M, Forgings, Carbon Steel, for Piping Components.
18. ASTM A106, Seamless Carbon Steel Pipe for High Temperature Service.
19. ASTM A126, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
20. ASTM A197, Cupola Malleable Iron.
21. ASTM A234/A234M, Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.
22. ASTM A312/A312M, Seamless and Welded Austenitic Stainless Steel Pipe.
23. ASTM A403/A403M, Wrought Austenitic Stainless Steel Piping Fittings.
24. ASTM A536, Ductile Iron Castings.
25. ASTM A570/A570M, Hot-Rolled Carbon Steel Sheet and Strip, Structural Quality.
26. ASTM B88, Seamless Copper Water Tube.
27. ASTM C76, Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
28. ASTM C443-REV A, Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.
29. ASTM C564, Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
30. ASTM D1248, Polyethylene Plastics Molding and Extrusion Materials.
31. ASTM D1784, Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
32. ASTM D1785, Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
33. ASTM D2241, Poly (Vinyl Chloride) (PVC) Plastic Pipe (SDR-PR).
34. ASTM D2513, Thermoplastic Gas Pressure Pipe, Tubing, and Fittings.
35. ASTM D2665, Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings.
36. ASTM D2996, Filament Wound Reinforced Thermosetting Resin Pipe.
37. ASTM D3034, Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
38. ASTM D3261, Butt Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.
39. ASTM D4174, Cleaning, Flushing, and Purification of Petroleum Fluid Hydraulic Systems.
40. ASTM D4101, Propylene Plastic Injection and Extrusion Materials.

41. ASTM F441, Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80.
42. AWWA C105, Polyethylene Encasement for Ductile Iron Piping for Water and Other Liquids.
43. AWWA C110, Ductile Iron and Gray Iron Fittings, 3" Through 48", for Water and Other Liquids.
44. AWWA C111, Rubber Gasket Joints for Ductile Iron and Gray Iron Pressure Pipe and Fittings.
45. AWWA C115, Flanged Ductile Iron and Gray Iron Pipe with Threaded Flanges.
46. AWWA C151, Ductile Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids.
47. AWWA C200, Steel Water Pipe 6" and Larger.
48. AWWA C205, Cement Mortar Protective Lining and Coating for Steel Water Pipe - 4" and Larger - Shop Applied.
49. AWWA C206, Field Welding of Steel Water Pipe.
50. AWWA C207, Steel Pipe Flanges for Waterworks Services - Sizes 4" Through 144".
51. AWWA C208, Dimensions for Fabricated Steel Water Pipe Fittings.
52. AWWA C209, Cold Applied Tape Coating for Special Sections, Connections, and Fittings for Steel Water Pipelines.
53. AWWA C210, Liquid Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipe.
54. AWWA C214, Tape Coating Systems for the Exterior of Steel Water Pipelines.
55. AWWA 301, Pre-stressed Concrete Pressure Pipe, Steel Cylinder Type, for Water and Other Liquids.
56. AWWA C303, Reinforced Concrete Pressure Pipe, Steel Cylinder Type, Pre-tensioned, for Water and Other Liquids.
57. AWWA C600, Installation of Ductile Iron Water Mains and Their Appurtenances.
58. AWWA C651, Disinfecting Water Mains.
59. AWWA C900, Polyvinyl Chloride (PVC) Pressure Pipe, 4" Through 12", for Water.
60. AWWA M11, Steel Pipe - A Guide for Design and Installation.
61. CISPI 301, Specification Data for Hubless Cast Iron Sanitary System with No-Hub Pipe and Fittings.
62. FEDSPEC L-C-530B(1), Coating, Pipe, Thermoplastic Resin, or Thermosetting Epoxy.
63. MIL-H-13528B, Hydrochloric Acid, Inhibited, Rust Removing.
64. MIL-STD-810C, Environmental Test Methods.
65. SAE J1227, Assessing Cleanliness of Hydraulic Fluid Power Components and Systems.
66. UPC, Uniform Plumbing Code.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Unless otherwise specified, piping materials, including pipe, gaskets, fittings, connection and joint assemblies, linings, and coatings, shall be selected from those listed on the Piping System Specification Sheets.

B. Piping materials shall conform to detailed specifications for each type of pipe and piping appurtenance specified in other Sections of Division 15, Mechanical.

C. All piping shall be compatible with the fluid to which it is exposed.

2.2 PIPING IDENTIFICATION

A. Pipe Coding:
   1. Refer to Section 09900, Painting, for pipe identification in above ground installations.

B. Plastic Tracer Tape:
   1. Tracer tape shall be per MAG Section 616, colored the same as the background colors, as specified in Table A, Paragraph 3.5 of this Section.
   2. Tape shall be capable of stretching to twice its original length and shall be as manufactured by Allen Systems, W. H. Brady Co., Seton Name Plate Corporation, Marking Services, Inc., or equal.
   3. The message shall read "**CAUTION CAUTION CAUTION _____ PIPE BURIED BELOW**", with bold letters approximately 2-inches high. The blank shall be filled with the particular system fluid, such as chlorine, non-potable water line, potable water line, drain line or wastewater line. All lines shall have tracer tape.

C. Locator Tape:
   1. Detectable locator wire shall be per City of Chandler Standard Detail C-408.

2.3 VALVES

A. Valves of the same size and service shall be provided by a single valve manufacturer. Packing shall be non-asbestos material. Actual length of valves shall be within ±1/16-inch of the manufacturer's specified length. Flanges shall meet the requirement of ANSI B16.5 and conform to the requirements of Section 15052, Exposed Piping Installation. Push-on and mechanical joints shall meet the requirements of AWWA C111 and conform to the requirements of Section 15051, Buried Piping Installation. Refer to Section 11295, Hydraulic Valves, for additional requirements.

2.4 FLEXIBLE COUPLINGS

A. Not all required flexible couplings are shown on Drawings. CONTRACTOR is responsible to provide and install flexible couplings as required in addition to those shown on Drawings.

2.5 AIR – RELEASE VALVES (ARV)

A. The alignments of piping systems as shown in the Drawings may necessitate the use of air-release valves. It will be the responsibility of the CONTRACTOR to provide and install required ARVs and other appurtenances including manholes, at all high points encountered in the routing of potable and non-potable water lines as well as other pressurized process piping.

2.6 SUBMITTALS

A. The following shall be included in all piping submittals:
   1. Shop Drawings: Submit for approval the following:
      a. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
      b. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**
   2. Shop Drawings:
      a. Letters of Certification of Compliance on materials, equipment, etc. for each pipe system as required in pipe material specification.

b. Final certified drawings showing outline dimensions, foundation layout or mounting information, and other pertinent dimensions.
c. Field erection instructions, assembly drawings and/or diagrams, detailed reference drawing lists, and lists of erection details.
d. Shop detail drawings showing individual sub-assemblies and fabricated pieces with material specifications and other applicable data.
e. Drawings and/or diagrams depicting proposed pipe and fittings layout, locations and quantities.

3. O&M Manuals:
a. Letters of Certification of Compliance on materials, equipment, etc.
b. Final certified drawings showing outline dimensions, foundation layout or mounting information, and other pertinent dimensions.
c. Field erection instructions, assembly drawings and/or diagrams, detailed reference drawing lists, and lists of erection details.
d. Shop detail drawings showing individual sub- assemblies and fabricated pieces with material specifications and other applicable data.

B. Shop Drawings shall also include the following information for all piping systems:
1. Fabrication and/or Layout Drawings:
a. Exterior Yard Piping Drawings (minimum 1-inch = 10 feet) with information, including:
1) Dimensions of piping lengths.
2) Invert or centerline elevations of piping crossings. CONTRACTOR shall provide a proposed solution if conflicts do exist.
3) Acknowledgement of bury depth requirements.
4) Details of fittings, tapping locations, thrust blocks, restrained joint segments, harnessed joint segments, hydrants, and related appurtenances.
5) Acknowledge designated valve or gate tag numbers, manhole numbers, instrument tag numbers, pipe, and line numbers.
6) Line slopes and vents.
7) Electrical duct bank locations shall be provided in the Drawings. CONTRACTOR shall provide a proposed solution if conflicts do exist.
b. Interior Piping Drawings (minimum scale 1/8-inch = 1 foot), with information, including:
1) Dimensions of piping from column lines or wall surfaces.
2) Centerline dimensions of piping.
3) Centerline elevation and size of intersecting ductwork, conduit/conduit racks, or other potential interferences requiring coordination.
4) Location and type of pipe supports and anchors.
5) Locations of valves and valve actuator type.

6) Details of fittings, tapping locations, equipment connections, flexible expansion joints, connections to equipment, and related appurtenances.
7) Acknowledgement of valve, equipment, and instrument tag numbers.
8) Provisions for expansion and contraction.
9) Line slopes and air release vents.
10) Rough-in data for plumbing fixtures.

c. Product Technical Data, including:
1) Acknowledgement that products submitted meet requirements of standards referenced.
2) Copies of manufacturer's written directions regarding material handling, delivery, storage, and installation.
3) Separate schedule sheet for each piping system scheduled in this Section showing compliance of all system components. Attached technical product data on gaskets, pipe, fittings, and other components.

d. Qualifications:
1) Qualifications of lab performing disinfection analysis on water systems.

e. Test Reports:
1) Copies of pressure test results on all piping systems.
2) Reports defining results of dielectric testing and corrective action taken.
3) Disinfection test report.
4) 24 hour notification of time and date prior to conducting piping pressure tests.

C. All additional Submittal information shall be included with this Submittal information as noted in the Division 15, Mechanical, Pipe Material Specifications.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Location:
1. Piping shall be provided as specified, except for adjustments to avoid architectural and structural features, and shall be coordinated with electrical construction.

B. Piping Sizes:
1. Where the size of piping is not specified, the CONTRACTOR shall provide piping of the sizes required by UPC. Unless specified otherwise, small piping (less than 1-inch in diameter) required for services not described by UPC shall be 1/2-inch.

C. Pipe Support, Anchorage, and Seismic Bracing:
   1. Piping shall be supported by anchor brackets, guides, saddles, or hangers.
   2. Acceptable types of supports, guides, saddles, hangers, and structure attachments for general pipe support, expansion/contraction, and for seismic bracing, as well as anchorage details, are shown on the Drawings.
   3. Minimum spacing shall be as specified for supports and for seismic bracing.
   4. Where a specific type of support or anchorage is indicated on the Drawings, only that type shall be used there.
   5. Piping shall be vertically supported by anchor brackets, guides, saddles, or hangers and shall be seismically braced where indicated to resist lateral load.
   6. Supports shall be provided on each run at each change of direction.
   7. Pipe supports shall be hot-dip or mechanically galvanized or as indicated on the Drawings
   8. Unless otherwise specified, existing pipes and supports shall not be used to support new piping.

D. Anchorage for Buried Piping:
   1. All plugs, caps, tees, and bends in buried pressure piping systems shall be anchored by means of restrained joints.

E. Bedding and Backfill:
   1. Bedding and backfill for all pipes shall conform with Section 02315, Earthwork, Excavation, and Backfill, and Section 15051, Buried Piping Installation.
   2. All piping, at a minimum, shall be backfilled with a 4-inch thick bedding layer below the pipe, extending to a height equal to 1 foot above the top of the pipe.
   3. The bedding and backfill operations shall, at minimum, follow the Maricopa Association of Government (MAG) guidelines.

3.2 PIPING IDENTIFICATION

A. Pipe Coding:
   1. After application of the specified coating and insulation systems, exposed piping, interior and exterior, and piping in ceiling spaces, pipe trenches, pipe chases, and valve boxes shall be identified with plastic markers, as specified in Paragraph 2.2.A of this Section.
   2. Legend markers and directional arrows shall be located at each side of walls, floors, and ceilings, at one side of each piece of equipment, at piping intersections, and at approximately 50 foot centers.

B. Plastic Tracer Tape:
   1. A single line of tape, as specified in Paragraph 2.2.B of this Section, shall be provided 2-1/2 feet above the centerline of buried pipe.

2. For pipelines buried 8 feet or greater below finished grade, CONTRACTOR shall provide a second line of tape 12-inches below finished grade, above and parallel to each buried pipe.
3. Tape shall be spread flat with message side up before backfilling.

C. Locator Tape:
1. Detectable locator wire shall be per City of Chandler Standard Detail C-408.

3.3 TESTING

A. General:
1. Upon completion of piping, but prior to application of insulation on exposed piping, the CONTRACTOR shall test the piping systems in accordance with the appropriate MAG Specifications. Pressures, media, and test durations shall be as specified in the Section 15051, Buried Piping Installation and 15052 Exposed Piping Installation. Equipment which may be damaged by the specified test conditions shall be isolated. Testing shall be performed using calibrated test gauges and calibrated volumetric measuring equipment to determine leakage rates. Each test gauge shall be selected so that the specified test pressure falls within the upper half of the gauge's range. Unless otherwise specified, the CONTRACTOR shall notify the Construction Manager 24 hours prior to each test.
2. Unless otherwise specified, testing, as specified herein, shall include existing piping systems which connect with new pipe systems. Existing pipe shall be tested to the nearest existing valve.
3. All piping shall be tested at the pressure values listed in the Section 15051, Buried Piping Installation, and 15052 and Exposed Piping Installation.
4. Pressure and leakage testing for water systems shall be in accordance with MAG Section 611. Unless otherwise specified, leakage from other buried liquid piping systems shall be less than 0.02 gallons per hour per inch diameter per 100 feet of buried piping.
5. Building Drains:
a. Drain systems, other than pumped drain systems, shall be tested in accordance with UPC.

3.4 CLEANING AND FLUSHING

A. General:
1. Piping systems shall be cleaned following completion of testing and prior to connection to operating, control, regulating, or instrumentation equipment.
2. The CONTRACTOR may, at his option, clean and test sections of buried or exposed piping systems. Use of this procedure, however, will not waive the requirement for a full pressure test of the completed system.
3. CONTRACTOR may propose alternate disinfection methods in writing for review and approval, on a case-by-case basis, prior to installation.

4. Unless specified otherwise, piping 24-inches in diameter and smaller shall first be cleaned by pulling a tightly fitting cleaning ball or swab through the system.
5. Piping larger than 24-inches in diameter may be cleaned manually or with a cleaning ball or swab.

B. Liquid Systems:
1. After completion of cleaning, liquid systems, unless otherwise specified, shall be flushed with clean water.

C. Water Systems:
1. Potable water piping systems shall be flushed and disinfected in accordance with AWWA C651 and MAG Section 611.
2. For non-potable water systems, final flushing and microbiological testing, as specified in MAG Section 611.15, is not required.

3.5 PIPING SPECIFICATION SHEETS (PIPESPEC)

A. Piping and valves for groupings of similar plant processes or types of service lines are specified on individual Piping Specification Sheets (PIPESPECS). Piping services are grouped according to the chemical and physical properties of the fluid conveyed and/or by the temperature or pressure requirements. Piping services specified in the PIPESPECS and on the Drawings are alphabetically arranged by designated service symbols, as shown in Table A. Table A also indicates the system symbol, fluid category, and pipe marker background color of each service.

TABLE A - PIPING SERVICES (AWRF)		
Symbol	**Service**	**Fluid Category**
A	AIR	AIR
BWW	BACKWASH WATER	LIQUID
CAS	SODIUM HYDROXIDE	LIQUID
D	DRAIN	LIQUID
DL	DIESEL	LIQUID
FA	FOUL AIR	AIR
NPW	NON-POTABLE WATER	LIQUID
RAS	RETURN ACTIVATED SLUDGE	LIQUID
S	SLUDGE	LIQUID
SCM	SCUM	LIQUID
SHY	SODIUM HYPOCHLORITE	LIQUID
SS	SANITARY SEWER	LIQUID
SW	SOLIDS WASTE	LIQUID

TABLE B - PIPING SERVICES (OWRF)		
Symbol	**Service**	**Fluid Category**
A	AIR	AIR
D	DRAIN	LIQUID
DL	DIESEL	LIQUID
NPW	NON-POTABLE WATER	LIQUID
SCM	SCUM	LIQUID
S	SLUDGE	LIQUID
WW	WASTEWATER	LIQUID

AWRF

Service	Pipe Material	Gasket	
		Flange	Push-on
A	PVC	N/A	Nitrile or Neoprene
A	SST	Neoprene binder gasket suitable for compressed air application and continuous maximum temperature of 400 degrees Fahrenheit, Garlock Blue-Gard Style 3800 or approved equal	N/A
BWW	CPVC	PTFE bonded EPDM, full face gaskets, ANSI B16.1, Garlock Grylon 3504, or approved equal.	N/A
CAS	CPVC	PTFE bonded EPDM, full face gaskets, ANSI B16.1, Garlock Grylon 3504, or approved equal.	N/A
D	CPVC	PTFE bonded EPDM, full face gaskets, ANSI B16.1, Garlock Grylon 3504, or approved equal.	N/A
D	PVC	N/A	Nitrile or Neoprene
DL	STEEL	N/A	N/A
FA	FRP	N/A	N/A
NPW	COP	N/A	N/A
S	DIP	Red Rubber Gasket Material (SBR) conforming to ASTM D1330	Nitrile or Neoprene
SHY	CPVC	PTFE bonded EPDM, full face gaskets, ANSI B16.1, Garlock Grylon 3504, or approved equal.	N/A
SS	RCP	N/A	Rubber Gasket per ASTM C443
SW	CPVC	PTFE bonded EPDM, full face gaskets, ANSI B16.1, Garlock Grylon 3504, or approved equal.	N/A
SCM	SST	N/A	N/A

OWRF

Service	Pipe Material	Gasket	
		Flange	**Push-on**
A	PVC	N/A	Nitrile or Neoprene
DL	STEEL	N/A	N/A
NPW	COP	N/A	N/A
S	DIP	Red Rubber Gasket Material (SBR) conforming to ASTM D1330	Nitrile or Neoprene
SCM	SST	N/AA	N/A

AWRF Exposed Pipe and Fitting

Service	Diameter	Pipe	Connections	Fittings	Spec
A	4-inches and larger	Polyvinyl Chloride (PVC)	Per Spec. 11375	Per Spec. 11375	15065
BWW	2-inches and larger	CPVC, Schedule 80	Solvent Weld. Flange adapters where called for on drawings.	CPVC, Schedule 80, Solvent weld	15065
CAS	4 inches and smaller	CPVC, Schedule 80	Solvent Weld. Flange adapters where called for on drawings.	CPVC, Schedule 80, Solvent weld	15065
D	2-inches and larger	CPVC Schedule 80	Solvent Weld. Flange adapters where called for on drawings.	Schedule 80, Solvent weld	15065
	2-inches and larger	Polyvinyl Chloride (PVC), Sch. 80	Solvent Weld. Flange adapters where called for on drawings.		15065
DL	3 inches and smaller	Carbon Steel	Welded	N/A	15062
FA	8 inches and larger	Fiberglass Reinforced Plastic	Per Spec. 15067	Per Spec. 15067	15067
NPW	3 inches and smaller	Copper Tube, ASTM B88, Type K, annealed or drawn	Solder type with threaded or flanged adapters for valves	Wrought copper or bronze, ANSI b16.22	15064
S	6 inches and larger	Ductile Iron, AWWA C151, Protecto 401 lining	Flanged	Coating, lining and ends to match pipe	15061
SCM	4 inches and larger	304L Stainless Steel, Schedule 10S	Flanged	See Spec.	15066
SHY	3-inches and smaller	CPVC, Schedule 80	Solvent Weld. Flange adapters where called for on drawings.	CPVC, Schedule 80, Solvent weld	15065
SW	2-inches and larger	CPVC, Schedule 80	Solvent Weld. Flange adapters where called for on drawings.	CPVC, Schedule 80, Solvent weld	15065

OWRF Exposed Pipe and Fitting

Service	Diameter	Pipe	Connections	Fittings	Spec
A	4-inches and larger	PVC	Per Spec. 11375	Per Spec. 11375	15065
DL	3 inches and smaller	Carbon Steel	Welded	N/A	15062
NPW	3-inches and smaller	Copper Tube, ASTM B88, Type K, annealed or drawn	Solder type with threaded or flanged adapters for valves	Wrought copper or bronze, ANSI b16.22	15064
S	12-inches	Ductile Iron, AWWA C151, Protecto 401 lining	Flanged	Coating, lining and ends to match pipe	15061
SCM	4 inches and larger	304L Stainless Steel, Schedule 10S	Flanged	See Spec.	15066
WW	20-inches and larger	Stainless Steel	See Spec.	See Spec.	15066

AWRF Exposed Valves

Service	Diameter	Valves	Type	Spec
BWW	2-inches and larger	Ball	CF8M Stainless Steel, TCI/RCI, Nibco, Equal	11400
	3-inches and smaller	Gate	Class 125 Bronze, Nibco, Equal	11400
CAS	2-inch and smaller	Ball	CPVC Hayward, or approved equal	11295
	2-inch and smaller	Back Pressure	CPVC Griffco, or approved equal	
	2-inch and smaller	Pressure Regulating	CPVC Hayward, or approved equal	
	2-inch and smaller	High Pressure Relief	CPVC Hayward, or approved equal	
	2-inch and smaller	Needle	CPVC Marquest Scientific, or approved equal	
	2-inch and smaller	Flow Control Globe Style Valve	Badger Meter, or approved equal	
D	2 inch	Ball	Hayward TBH Series True Union, or approved equal	11295
	2 inch	Check	Asahi Ball Check Valve, True Union, or approved equal	
SW	2-inches and larger	Ball	CF8M Stainless Steel, TCI/RCI, Nibco, Equal	11400
	3 inches and smaller	Gate	Class 125 Bronze, Nibco, Equal	11400
NPW	2-inches	Globe	Bronze, Type II, Class A, Watts, Equal	11295
		Ball		11295

SHY	2-inch and smaller	Ball	CPVC Hayward, or approved equal	11295
	2-inch and smaller	Back Pressure	CPVC Griffco, or approved equal	
	2-inch and smaller	Pressure Regulating	CPVC Hayward, or approved equal	
	2-inch and smaller	High Pressure Relief	CPVC Hayward, or approved equal	
	2-inch and smaller	Needle	CPVC Marquest Scientific, or approved equal	
	2-inch and smaller	Flow Control Globe Style Valve	Badger Meter, or approved equal	

AWRF Buried Pipe and Fitting

Service	Diameter	Pipe	Connections	Fittings	Spec
D	12 inches and smaller	Polyvinyl Chloride (PVC), SDR 26	Restrained push-on rubber gasket joint.	Coating, lining and ends to match pipe	15065
FA	12-inches	Fiberglass Reinforced Plastic	Per Spec. 15067	Per Spec. 15067	15067
NPW	3-inch and smaller	Copper Tube, ASTM B88, Type K, annealed or drawn	Solder type with threaded or flanged adapters for valves	Wrought copper or bronze, ANSI b16.22	15064
S	4 inches and larger	Ductile Iron, AWWA C151, Protecto 401 lining	Restrained push-on rubber gasket joint. Flanged adapters for valves and ends.	Coating, lining and ends to match pipe	15061
SCM	4 inches and larger	304L Stainless Steel, Schedule 10S	Restrained push-on rubber gasket joint. Flanged adapters for valves and ends.	See Spec.	15066
SS	12-inch and smaller	Polyvinyl Chloride (PVC), SDR 26	Restrained push-on rubber gasket joint.	Coating, lining and ends to match pipe	15065
SS	30-inches	Reinforced Concrete Pipe (RCP), lining per spec.	Restrained push-on rubber gasket joint.	Coating, lining and ends to match pipe	15068
SW	20-inch and larger	CPVC, Schedule 80	Solvent Weld. Flange adapters where called for on drawings.	CPVC, Schedule 80, Solvent weld	15065

OWRF Buried Pipe and Fitting

Service	Diameter	Pipe	Connections	Fittings	Spec
D	8-inches	Ductile Iron, AWWA C151, Protecto 401 lining	Restrained push-on rubber gasket joint. Flanged adapters for valves and ends.	Coating, lining and ends to match pipe	15061
SCM	4 inches and larger	304L Stainless Steel, Schedule 10S	Restrained push-on rubber gasket joint. Flanged adapters for valves and ends.	Coating, lining and ends to match pipe	15061

AWRF Buried Valves

Service	Diameter	Valves	Type	Spec
D	4-inches and smaller	Ball	True Union Valve with 2” square nut as manufactured by Hayward, or approved equal	11295
NPW	2-inches	Ball	Jamesbury Fig. 351,Nibco T-580, or equal	11295
S	12-inches	Plug	See Spec.	11295

OWRF Buried Valves

Service	Diameter	Valves	Type	Spec
S	12-inches	Plug	See Spec.	11295

++ END OF SECTION ++

SECTION 15051

BURIED PIPING INSTALLATION

PART 1 - GENERAL

1.1 SUMMARY

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to install and test all buried piping, fittings, and specials. The Work includes, but is not limited to, the following:
      a. Excavation and backfill.
      b. All temporary means required to prevent discharge of sediment to water courses from dewatering systems or erosion.
      c. All types and sizes of buried piping, except those specified under other Sections.
      d. Piping beneath structures.
      e. Restraints and thrust blocks.
      f. Pipe encasements.
      g. Work on or affecting existing piping.
      h. Testing.
      i. Cleaning and disinfecting.
      j. Installation of all jointing and gasketing materials, specials, flexible couplings, mechanical couplings, harnessed and flanged adapters, sleeves, tie rods, and all other Work required to complete the buried piping installation.
      k. Incorporation of valves, meters and special items shown on the Drawings or specified into the piping systems as required and as specified in the applicable Sections in Division 15, Mechanical.
      l. Unless otherwise specifically shown on the Drawings, specified, or included under other Sections, all buried piping Work required, beginning at the outside face of structures or structure foundations and extending away from structure.
   2. No classification of excavated materials will be made. Excavation includes all materials regardless of type, character, composition, moisture, or condition thereof.

B. Coordination:
   1. Review installation procedures under other Sections and coordinate with the Work that is related to this Section.
   2. Section 15051, Buried Piping Installation, specifies the installation of all buried piping materials specified in Sections of Division 15, Mechanical. Coordinate with these Sections.

1.2 RELATED SECTIONS

A. Section 02315, Earthwork, Excavation and Backfill.

B. Section 11295, Hydraulic Valves.

C. Section 15050, Piping Systems.

D. Section 15061, Ductile Iron Pipe.

E. Section 15064, Copper Pipe.

F. Section 15065, Thermoplastic Pipe and Accessories.

G. Section 15066, Stainless Steel Pipe.

H. Section 1568, Reinforced Concrete Pipe.

I. Section 15120, Piping Specialties and Accessories.

1.3 QUALITY ASSURANCE

A. CONTRACTOR shall conform to all applicable requirements of Parts 600 and 700 of the Uniform Standard Specifications for Public Work Construction by the Maricopa Association of Governments (MAG). If there is a conflict between MAG Standard Specifications and these Specifications, the provisions of these Specifications shall govern.

B. Requirements of Regulatory Agencies:
   1. Comply with requirements of NFPA Standard No. 24 for "Outside Protection" where applicable to water pipe systems used for fire protection.
   2. Comply with requirements of UL, FM, and other jurisdictional authorities, where applicable.
   3. Refer to the General and Supplementary Conditions regarding permit requirements for this Work.
   4. Applicable building codes.

C. Reference Standards: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
   1. ASTM D2321, Practice for Underground Installation of Flexible Thermoplastic Pipe.
   2. ASTM D2774, Practice for Underground Installation of Thermoplastic Pressure Piping.
   3. AWWA C105, Polyethylene Encasement for Ductile Iron Piping for Water and Other Liquids.
   4. AWWA C111, Rubber Gasket Joints for Ductile Iron Pressure Pipe and Fittings.
   5. AWWA C200, Steel Water Pipe.

6. AWWA C205, Cement Mortar Protective Lining and Coating for Steel Water Pipe.
7. AWWA C206, Field Welding of Steel Water Pipe.
8. AWWA C207, Steel Pipe Flanges for Waterworks Service.
9. AWWA C208, Dimensions for Fabricated Steel Water Pipe Fittings.
10. AWWA C600, Installation of Ductile Iron Water Mains and Their Appurtenances.
11. AWWA C606, Grooved and Shouldered Joints.
12. AWWA C651, Disinfecting Water Mains.
13. AWWA M11, Steel Pipe - A Guide for Design and Installation.
14. AWWA M23, PVC - Design and Installation.
15. AWWA M41, Ductile Iron Pipe and Fittings.
16. ASCE MOP No. 37, Design and Construction of Sanitary and Storm Sewers.
17. Concrete Pipe Handbook, American Concrete Pipe Association.

1.4 SUBMITTALS

A. Shall be in accordance with Section 15050, Piping Systems submittal information.

B. Shop Drawings: Submit for approval the following:
1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
2. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to the site to ensure uninterrupted progress of the Work.

B. Handle all pipe, fittings, specials, and accessories carefully with approved handling devices. Do not drop or roll material off trucks. Do not otherwise drop, roll, or skid piping.

C. Store pipes and fittings on heavy wood blocking or platforms so they are not in contact with the ground.

D. Unload pipe, fittings, and specials opposite to or as close to the place where they are to be installed as is practical to avoid unnecessary handling. Keep pipe interiors completely free from dirt and foreign matter.

E. Inspect delivered pipe for cracked, gouged, chipped, dented, or other damaged material and immediately remove defective pipe from site.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Required pipe materials are listed in the Piping Schedule. Refer to applicable Sections for Material Specifications.

B. General:
   1. Marking Piping:
      a. Clearly mark each piece of pipe or fitting with a designation conforming to those shown on the laying schedule and/or Shop Drawings.
      b. Cast or paint material, type, and pressure designation on each piece of pipe or fitting 4-inches in diameter and larger. Each piece of steel pipe shall be clearly marked with the thickness of the steel in the pipe wall.
      c. Pipe and fittings smaller than 4-inches in diameter shall be clearly marked by manufacturer as to material, type, and rating.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:
   1. Installation of all pipe, fittings, valves, specials, and appurtenances shall be subject to the review and/or approval of the ENGINEER.
   2. Install piping as shown, specified, and as recommended by the manufacturer and in conformance with referenced standards and approved Shop Drawings.
   3. Request instructions from ENGINEER before proceeding if there is a conflict between the manufacturer's recommendations and the Contract Documents.
   4. All piping shall be inspected by the ENGINEER prior to installation. ENGINEER'S inspection will not relieve CONTRACTOR or manufacturer from responsibility for damaged products.
   5. All piping shall be carefully examined for cracks, damage, or other defects before installation. Any piping that is defective, including, but not limited to,

cracked, damaged, in poor condition, or with damaged linings or improper markings shall be rejected, unless the product can be repaired in a manner acceptable to the manufacturer and ENGINEER. Any piping found to be broken or defective after it has been installed shall be removed, replaced, or repaired at the CONTRACTOR'S expense.

6. Minimum earth cover over the piping shall be as shown on the Drawings, specified, or directed by the ENGINEER, but in no case shall the earth cover be less than 4 feet for all piping, except drains.
7. Required earthwork shall be as specified in applicable Sections of Division 2, Sitework.
8. Present all conflicts between piping systems and equipment, structures, or facilities to ENGINEER for determination of corrective measures before proceeding.
9. Take field measurements, where required, prior to installation to ensure proper fitting of Work. The CONTRACTOR shall uncover the existing pipelines sufficiently in advance of the proposed Work in order that the type and location of the existing pipes and joints and other information required to fabricate the proposed piping can be determined. It shall be the responsibility of the CONTRACTOR to obtain whatever information is required to complete the connections of the proposed pipelines to the existing pipelines. Refer to Paragraph 3.3 of this Section, as applicable.
10. Interior of all piping and mating surfaces shall be inspected and all dirt, gravel, sand, debris, or other foreign material shall be completely removed from the interior and mating surfaces before installation. Measures shall be taken to maintain the interior of all piping clean until acceptance of the completed Work. Care shall be taken to prevent foreign matter from entering joint space. Bell and spigot mating surfaces shall be wiped clean immediately before piping is laid. For ductile iron pipe, the bell and spigot mating surfaces shall be thoroughly cleaned with a wire brush.
11. Install piping accurately to line and grade shown, specified, or directed, unless otherwise approved by the ENGINEER. Accurate means of determining and checking the alignment and grade shall be used, which shall be subject to the approval of the ENGINEER. Any modifications to the Contract Documents to suit the pipe manufacturer's standard shall be approved by the ENGINEER. Remove and relay piping that is incorrectly installed, at CONTRACTOR'S expense.
12. Do not lay piping in water unless otherwise specified in these Specifications or approved by the ENGINEER. Ensure that the water level in the trench is at least 6-inches below the bottom of piping. Maintain a dry trench until jointing and backfilling are complete unless otherwise specified in these Specifications or approved by the ENGINEER.
13. Where unforeseen conditions will not permit the installation of piping as shown or specified, no piping shall be installed without approval of the ENGINEER. Do not modify structures or facilities without approval of the ENGINEER.
14. Start laying piping at lowest point and proceed toward the higher elevations, unless otherwise approved by the ENGINEER. Slope piping uniformly

between elevations shown on the Drawings or as otherwise directed by the ENGINEER.

15. Place bell and spigot piping so that the bells face the direction of laying, unless otherwise approved by the ENGINEER.
16. Piping shall be installed so that the barrel of the piping, and not the joints, receives the bearing pressure from the trench bottom or other bedding condition.
17. No piping shall be brought into position until the preceding length, valve, fitting, or special has been bedded and secured in place.
18. Whenever pipe laying is not actively in progress, the open ends of the piping shall be closed by a temporary plug or cap to prevent soil, water, and other foreign matter from entering the piping.
19. Field cutting of metallic piping, where required for inserting valves, fitting, specials, and closures, shall be made with a machine specially designed for cutting piping and in accordance with the manufacturer's instructions. Cuts shall be carefully done, without damage to piping, so as to leave a smooth end at right angles to the axis of the piping. Cut end shall be tapered and sharp edges filed off smooth. Flame cutting shall not be permitted. Piping damaged by the CONTRACTOR by improper or careless methods of cutting shall be replaced or repaired at his expense.
20. Blocking under piping shall not be permitted, unless specifically approved by ENGINEER for special conditions.
21. Protective linings and coatings shall be touched up prior to installation, where required.
22. Except where bends, wyes, or similar fittings are used, changes in alignment and grade of the piping shall be made by deflecting joints or with beveled pipe. Permissible joint deflection shall not exceed 75% of the amount allowed by the manufacturer.
23. All joints shall be made in the presence of the ENGINEER, or his duly authorized representative, except as otherwise approved.
24. Special care shall be taken to ensure that each section of piping abuts against the next in such a manner that there will be no shoulder or unevenness of any kind along the piping invert.
25. Piping shall be rotated as required to place outlets in proper position.
26. Blind flanges and cleanouts shall be provided at locations shown on the Drawings, specified, or required. Cleanouts on buried piping shall include all pipe, fittings, and appurtenances required to bring cleanout to finished grade and terminate in a flange and blind flange or suitably capped piping as shown. Cleanout piping shall be same as that specified for the main run.
27. All gravity lines shall pitch uniformly at the grade shown or as specified or approved.
28. Short pipe stubs, maximum 4 feet in length, shall be used at all manholes and other wall faces, except as otherwise specified.
29. Field painting shall be accomplished after joints are made.
30. All piping shall be plugged watertight with a suitable cap or plug securely fastened to the end of the piping at all contact interfaces.

31. CONTRACTOR shall notify ENGINEER in advance of backfilling operations.
32. On steep slopes, take measures acceptable to ENGINEER to prevent movement of the pipe during installation.
33. Thrust Restraint: During the installation of the pipe, thrust blocks, tied joints, or proprietary restrained joint systems shall be provided wherever required for thrust restraint. Thrust restraint shall conform to the applicable requirements of Paragraph 3.2 of this Section.
34. Exercise care to avoid flotation when installing pipe in cast-in-place concrete.

B. Manufacturer's Installation Specialist:
1. The CONTRACTOR is required to provide the services of the pipe manufacturer when pipe installation begins for the following:
   a. Fiberglass reinforced plastic pipe.
2. Provide the services of a competent installation specialist of the pipe manufacturer when pipe laying begins if the CONTRACTOR is not experienced in laying and jointing a particular type of pipe.
3. Retain installation specialist at the site for a minimum of two days or until competency of the pipe laying crew has been satisfactorily demonstrated.

C. Separation of Sewers and Potable Water Pipe Lines:
1. Conform to all applicable separation requirements of the Uniform Standard Specifications for Public Work Construction by the Maricopa Association of Governments (MAG).

D. Plugs:
1. Temporarily plug installed pipe at the end of each day's Work or other interruption to the installation of any pipe line. Plugging shall prevent the entry of animals, liquids, or persons into the pipe or the entrance or insertion of deleterious materials.
2. Install standard plugs into all bells at dead ends, tees, or crosses. Cap all spigot ends.
3. Fully secure and block all plugs and caps installed for pressure testing to withstand the specified test pressure.
4. Where plugging is required for phasing of the Work or for subsequent connection of piping, install watertight, permanent type plugs.

E. Bedding Pipe: Bed pipe as specified below and in accordance with the details shown.
1. Trench excavation and backfill and bedding materials shall conform to the requirements of Section 02315, Earthwork, Excavation and Backfill, as applicable.
2. Excavate trenches below the pipe bottom by an amount specified. Remove all loose and unsuitable material from the trench bottom.
3. Carefully and thoroughly compact all pipe bedding with hand held pneumatic compactors.
4. Do not lay pipe until the ENGINEER approves the bedding condition. If a conflict exists, obtain clarification from ENGINEER before proceeding.

5. No pipe shall be brought into position until the preceding length has been bedded and secured in its final position.

F. Laying Pipe:
   1. Conform to manufacturer's instructions and requirements of the standards listed below, where applicable:
      a. Ductile Iron Pipe: AWWA C600, AWWA C105.
      b. Thermoplastic Pipe: ASTM D2774.
      c. Concrete Pipe: AWWA M9, Concrete Pipe Handbook.
      d. ASCE Manual of Practice No. 37.

G. Polyethylene Encasement:
   1. Provide polyethylene encasement for ductile iron piping to prevent contact between the pipe and surrounding bedding material and backfill.
   2. Polyethylene may be supplied in tubes or in sheet material.
   3. Polyethylene encasement materials and installation shall be in accordance with the requirements of MAG Section 610.5.

H. Jointing Pipe:
   1. Ductile Iron Mechanical Joint Pipe:
      a. Wipe clean the socket, plain end, and adjacent areas immediately before making joint. Make certain that cut ends are tapered and sharp edges are filed off smooth.
      b. Lubricate the plain ends and gasket with soapy water or an approved pipe lubricant, in accordance with AWWA C111, just prior to slipping the gasket onto the plain end of the joint assembly.
      c. Place the gland on the plain end with the lip extension toward the plain end, followed by the gasket with the narrow edge of the gasket toward the plain end.
      d. Insert the pipe into the socket and press the gasket firmly and evenly into the gasket recess. Keep the joint straight during assembly.
      e. Push gland toward socket and center it around pipe with the gland lip against the gasket.
      f. Insert bolts and hand tighten nuts.
      g. Make deflection after joint assembly, if required, but prior to tightening bolts. Alternately tighten bolts 180 degrees apart to seat the gasket evenly. The bolt torque shall be as follows:

Pipe Size (inches)	Bolt Size (inches)	Range of Torque
3	5/8	45-60
4-24	3/4	75-90

      h. All bolts and nuts shall be heavily coated with two 10 mil, minimum, coats of coal-tar epoxy coating as manufactured by Koppers, Tnemec, or equal.
      i. Restrained mechanical joints shall be in accordance with Section 15061, Ductile Iron Pipe.
   2. Ductile Iron Push-On Joint Pipe:

a. Prior to assembling the joints, the last 8-inches of the exterior surface of the spigot and the interior surface of the bell shall be thoroughly cleaned with a wire brush, except where joints are lined or coated with a special protective lining or coating.
b. Rubber gaskets shall be wiped clean and flexed until resilient. Refer to manufacturer's instructions for procedures to ensure gasket resiliency when assembling joints in cold weather.
c. Insert gasket into joint recess and smooth out the entire circumference of the gasket to remove bulges and to prevent interference with the proper entry of the spigot of the entering pipe.
d. Immediately prior to joint assembly, apply a thin film of approved lubricant to the surface of the gasket which will come in contact with the entering spigot end of pipe. CONTRACTOR may, at his option, apply a thin film of lubricant to the outside of the spigot of the entering pipe.
e. For assembly, center spigot in the pipe bell and push pipe forward until it just makes contact with the rubber gasket. After gasket is compressed and before pipe is pushed or pulled all the way home, carefully check the gasket for proper position around the full circumference of the joint. Final assembly shall be made by forcing the spigot end of the entering pipe past the rubber gasket until it makes contact with the base of the bell. When more than a reasonable amount of force is required to assemble the joint, the spigot end of the pipe shall be removed to verify the proper positioning of the rubber gasket. Gaskets which have been scoured or otherwise damaged shall not be used.
f. Maintain an adequate supply of gaskets and joint lubricant at the site at all times when pipe jointing operations are in progress.

3. Proprietary Joints:
   a. Pipe which utilizes proprietary joints such as Fastite, by American Cast Iron Pipe Company, Tyton by U.S. Pipe Incorporated, restrained joints described under Paragraph 3.2 of this Section, or other such joints shall be installed in strict accordance with the manufacturer's instructions.
4. Rubber Gasket Reinforced Concrete Pipe:
   a. Immediately before making the joint, completely clean the bell and spigot surfaces to be jointed.
   b. Apply a lubricant supplied by the pipe manufacturer to the sealing surfaces of the bell and spigot and the gasket. After lubrication, install the gasket in the spigot groove and ensure that the stretch in the gasket is equalized.
   c. After the pipe is lowered into place, align the spigot and bell so that the spigot will squarely enter the bell.
   d. Before the joint is fully assembled, check the position of the gasket in the bell using methods recommended by the pipe manufacturer and approved by the ENGINEER.
   e. If the gasket is found to be in the correct position around the entire circumference of the bell, remove temporary joint stoppers, if used, and shove the pipe completely home. If the gasket is not in the proper location, the joint shall be opened and reinstalled using a new gasket.

f. Where a joint opening is required to make a grade or alignment adjustment, the joint shall be installed completely closed first, then opened as necessary on one side. Joint openings shall not be greater than 75 percent of the maximum opening recommended by the pipe manufacturer.
g. Joints with gap greater than 2" or as recommended by PVC Liner's Manufacturer's representation shall be grouted with non-shrink grout in accordance with Section 03600, Grout.
h. Do not use gaskets which have been scored or otherwise damaged.

5. Thermoplastic Pipe Joints:
   a. Solvent Cement Joints:
      1) Bevel pipe ends and remove all burrs before making joints. Clean both pipe and fittings thoroughly. Do not attempt to make solvent cement joints if temperature is below 40° F or above 90° F when exposed to direct sunlight or in wet conditions.
      2) Use solvent cement supplied or recommended by the pipe manufacturer.
      3) Apply joint primer and solvent cement and assemble joints in strict accordance with the recommendations and instructions of the manufacturer of the joint materials and the pipe manufacturer.
      4) Observe safety precautions with the use of joint primers and solvent cements. Allow air to circulate freely through pipelines to permit solvent vapors to escape. Slowly admit water when flushing or filling pipelines to prevent compression of gases within pipes.
   b. Push-On Joints:
      1) Bevel all field-cut pipe, remove all burrs, and provide a reference mark the correct distance from the pipe end.
      2) Clean the pipe end and the bell thoroughly before making the joint. Insert the O-ring gasket, making certain it is properly oriented. Lubricate the spigot well with an approved lubricant; do not lubricate the bell or O-ring. Insert the spigot end of the pipe carefully into the bell until the reference mark on the spigot is flush with the bell.
6. Copper Tubing Joints:
   a. Assemble copper tubing with soldered joints. Solder shall be 95-5 tin-antimony solder conforming to ASTM B32.
   b. Ream or file pipe to remove burrs.
   c. Clean and polish contact surfaces of joints.
   d. Apply flux to both male and female ends.
   e. Insert end of tube into full depth of fitting socket.
   f. Heat joint evenly.
   g. Form continuous solder bead around entire circumference of joint.
   h. Runs shall contain unions at connection to equipment and at reasonable distances along the lengths of runs to permit convenient disassembly of piping and removal of equipment.
7. Mechanical Coupling Joints:
   a. Prior to the installation and assembly of mechanical couplings, the joint ends shall be cleaned thoroughly with a wire brush to remove foreign

matter. Following this cleaning, lubricant shall be applied to the rubber gasket or inside of the coupling housing and to the joint ends. After lubrication, the gasket shall be installed around the joint end of the previously installed piece and the joint end of the subsequent piece shall be mated to the installed piece. The gasket shall be positioned and the coupling housing placed around the gasket and over the grooved or shouldered joint ends. The bolts shall be inserted and the nuts screwed up tightly by hand. The bolts shall then be tightened uniformly in order to produce an equal pressure on all parts of the housing. When the housing clamps meet metal to metal, the joint is complete and further tightening is not required.

8. Stainless Steel Pipe Joints:
    a. All joints in stainless steel pipe shall be welded, except that flanged connections shall be provided at connections to valves, meters and similar equipment.
    b. Welding shall conform to the requirements of AWWA C206. All field welded joints shall be full circumferential welds designed to take the thrust at the joint location. A minimum 3/16-inch weld is required.
    c. After assembly and welding the interior and exterior of the joint and the surrounding damaged or uncoated area shall be lined and coated with the same material and to the same thickness as the shop applied lining and coating.
    d. Where flanged connections or couplings are provided, the flanges, couplings, bolts and nuts shall be coated with two 8 mil coats of high-build epoxy coating as manufactured by Tnermec, or approved equal.
9. Concrete Pipe Joints:
    a. Refer to Section 15068, Reinforced Concrete Pipe, for concrete pipe joints.

I. Backfilling:
1. Conform to the applicable requirements of Section 02315, Earthwork, Excavation and Backfill.
2. Place backfill as construction progresses. Backfill by hand and use power tampers until pipe is covered by at least 1 foot of fill.

J. Connections to Valves and Hydrants:
1. Install valves and hydrants as shown on Drawings.
2. Provide suitable adapters when valves or hydrants and piping have different joint types.
3. Provide thrust restraint at all hydrants and at valves at pipeline terminations.

K. Transitions from One Type of Pipe to Another:
1. Provide all necessary adapters, specials, and connection pieces required when connecting different types and sizes of pipe or connecting pipe made by different manufacturers.

L. Unions:

1. Install dielectric unions wherever dissimilar metals are connected, except for bronze or brass valves, in ferrous piping.
2. Provide a union downstream of each valve with screwed connections.
3. Provide screwed or flanged unions at each piece of equipment, where shown, and where necessary to install or dismantle piping.

M. Closures:
1. Provide all closure pieces shown or required to complete the Work.

3.2 THRUST RESTRAINT

A. Provide thrust restraint on all piping systems. Pipe joints shall be restrained as specified in Paragraph 3.2.C of this Section.

B. Thrust restraint shall be accomplished by means of restrained pipe joints. Concrete thrust blocks shall be used only when specifically shown on the Drawings or as directed by the ENGINEER. Thrust restraints shall be designed for the axial thrust exerted by the test pressure given in the Buried Piping Schedule.

C. Restrained Pipe Joints:
1. Pipe joints shall be restrained by means suitable to the type of pipe being installed.
   a. Ductile iron push-on joints and mechanical joints shall be restrained utilizing a proprietary restrained joint system such as American Lok-Ring, Lok-Fast, Lok-Set, U.S. Pipe Field Lok Gasket, U.S. Pipe TR Flex System, lugs and tie-rods, or other system approved by ENGINEER.
   b. Steel pipe shall be restrained with welded joints or flanged joints. Steel pipe requiring restraint shall have sufficient longitudinal steel reinforcement provided to handle the thrust forces at a maximum design stress of 15,000 psi. The thrust forces in the longitudinals must be transmitted directly to the steel joint bands using welded connections sufficient to carry the stresses involved. No allowance for the mortar coating to handle any tensile forces is permitted.
   c. Thermoplastic and copper piping shall generally be installed with soldered, solvent weld, threaded, flanged, or similar type joints. Where push-on type or other non-restrained joints are provided, the CONTRACTOR shall provide tie-rods or other suitable joint restraint system for these joints, subject to the approval of ENGINEER.
   d. All pipe lengths shall be restrained.

D. Concrete Thrust Blocks:
1. Thrust blocks shall be constructed of Class "B" concrete, conforming to the requirements of MAG.
2. Blocks shall be placed against undisturbed soil as shown on Drawings or as directed by the ENGINEER. Concrete shall be placed so that pipe joints and fitting joints will be accessible for repair.
3. Size of concrete thrust blocks shall be as shown on the Drawings, or as directed and approved by ENGINEER.

4. Concrete thrust blocks shall not be used for pipe restraint except where specifically shown on the Drawings or as approved by the ENGINEER.

3.3 WORK AFFECTING EXISTING PIPING

A. Location of Existing Piping:
   1. Locations of existing piping shown should be considered approximate.
   2. CONTRACTOR shall determine the true locations of existing piping to which Work is to be performed and locations of other facilities which could be disturbed during earthwork operations or which may be affected by CONTRACTOR'S Work already installed.

B. Taking Existing Pipelines Out of Service:
   1. 1. Do not take pipelines out of services, unless specifically provided for under this Project or approved by ENGINEER. Notify ENGINEER at least 48 hours prior to taking pipeline out of service.

C. Work on Existing Pipelines:
   1. Cut or tap pipes as shown or required with machines specifically designed for this Work.
   2. Install temporary plugs to prevent entry of mud, dirt, water, and debris.
   3. Provide all necessary adapters, fittings, pipe, and appurtenances required to complete the Work.
   4. Existing pipelines which are cut and abandoned shall be adequately capped or filled with grout.

3.4 TESTING OF PIPING

A. General:
   1. Test all piping, except as otherwise authorized by ENGINEER.
   2. Notify ENGINEER and local authorities having jurisdiction at least 48 hours in advance of testing if their presence is required.
   3. Conduct all tests in the presence of the ENGINEER.
   4. Remove or protect any pipeline-mounted devices which may be damaged by the test pressure.
   5. Provide all apparatus and services required for testing, including but not limited to, the following:
      a. Test pumps, bypass pumps, hoses, calibrated gauges, meters, test containers, valves and fittings.
      b. Temporary bulkheads, bracing, blocking and thrust restraints.
   6. Provide air if an air test is required and power if pumping is required.
   7. Unless otherwise specified, OWNER will provide fluid required for testing.
   8. Repair and retest pipelines that fail to hold specified test pressure or which exceed the allowable leakage rate.
   9. Unless otherwise noted, pipelines shall hold specified test pressure for two hours.
   10. Unless otherwise specified, test pressures required are at the lowest elevation of the pipeline section being tested.

B. Schedule of Pipeline Tests:
   1. Refer to Section 15050, Piping Systems, for the type of test required and the required hydrostatic test pressure.
   2. Unless otherwise specified, the required hydrostatic test pressures are at the lowest elevation of the pipeline.
   3. For piping not listed in Section 15050, Piping Systems:
      a. Hydrostatically test pipe that will be operating at a pressure greater than five psig.
      b. Use exfiltration testing or low-pressure air testing for all other piping.
   4. Hydrostatic Test Pressure:
      a. Use test pressures listed in Section 15050, Piping Systems.
      b. If a test pressure is not listed in Section 15050, Piping Systems, or if a hydrostatic test is required for piping not listed in Section 15050, Piping Systems, the test pressure will be determined by the ENGINEER based on the maximum anticipated sustained operating pressure and the methods described in the AWWA Manual or Standard which applies to the piping system.
   5. CONTRACTOR shall provide a test plan 14 days prior to performing the hydrostatic pressure tests on the pipe lines.

C. Hydrostatic Testing:
   1. Preparation for Testing:
      a. For plastic pipe, including fiberglass pipe, follow procedures described in Section 7 of AWWA Standard C605.
      b. For all other piping follow procedures described in AWWA Manual M9 except that the minimum wetting period required immediately prior to testing for cement-lined steel pipe and asbestos cement pipe shall be 24 hours rather than the 48 hours prescribed for concrete pipe. A wetting period is not required for metal pipe that is not cement-lined or for plastic pipe.
      c. Ensure that adequate thrust protection is in place and that all joints are properly installed.
   2. Test Procedure:
      a. Complete backfill and compaction at least to the pipe centerline before testing, unless otherwise required or approved by ENGINEER.
      b. Allow concrete for thrust blocks to reach design strength before testing.
      c. Fill pipeline slowly to minimize air entrapment and surge pressures. Fill rate should not exceed one foot per second in the pipe being tested. Install corporation cocks, if necessary, to remove all air.
      d. Examine exposed joints and valves, and correct visible leakage.
      e. After the wetting period prescribed above, add fluid to pressurize line to the required test pressure. Maintain test pressure for a stabilization period of ten minutes before beginning test.
      f. After the stabilization period, maintain test pressure for the duration specified in Section 15050, Piping Systems. Add fluid to restore test pressure if pressure drops five psi below test pressure at any time during the test period.

g. Pump from a test container to maintain test pressure. Measure the volume of fluid pumped from the container and record on the test report. Record pressure at the test pump at 15 minute intervals for the duration of the test.

3. Allowable Leakage Rates:
   a. Conduct leakage test for all liquid piping after satisfactory completion of pressure test.
   b. Allow concrete pipe to stand full of water at least 12 hours prior to starting leakage test.
   c. Maintain test pressure constantly for the minimum test period and accurately measure the amount of water which must be added to maintain the test pressure.
   d. Allowable Leakage Rates (in gallons per hour per 1,000 feet per inch diameter):
      1) DIP Push On or Mechanical Joints: 0.075.

D. Required Tests for Gravity Sewer and Storm Drains:
   1. Elect to test piping, using either air or water test procedures. Notify ENGINEER, in writing, in advance of all testing, which method he plans to utilize and must follow through with the same method on all pipeline testing.
      a. Gravity sewers shall be tested with either air or water testing; however, storm drains may only be water tested.
      b. Tests shall be performed after backfilling is completed, but shall be performed before final cleanup and acceptance of Work.
      c. Tests shall be performed prior to final acceptance.
         1) Test all piping and manholes for leakage by means of the tests described below.
         2) Test to be performed between adjacent manholes or as approved by the ENGINEER.
      d. Prior to making tests, submit details of his testing procedures, with a description of methods and equipment CONTRACTOR proposes to use, to the ENGINEER for approval. Furnish all necessary labor, equipment, water, watertight bulkheads, rodding machine, generator, pumps and all else necessary to carry out the required tests.
   2. Air Test:
      a. Wet and thoroughly clean the inside of the pipe before test is performed.
      b. Insert test plugs in ends of pipe to be tested.
      c. Securely brace test plugs.
      d. Measure and record groundwater height above the pipe invert. All gage pressures in the test shall be increased by the amount of the back pressure due to groundwater submergence.
      e. Slowly fill the pipe with air to a pressure of four psig. Maintain pressure between 4 and 3.5 psig for at least two minutes for temperature stabilization.
      f. Check all plugs for tightness.
      g. With a pressure of approximately four psig in pipe, disconnect air supply.
      h. Allow pressure to decrease to 3.5 psig.

i. When the pressure reaches 3.5 psig, record the time required to decrease to 2.5 psig using a stopwatch.

j. The line is considered acceptable if the time for the pressure to decrease from 3.5 psig to 2.5 psig is not less than the amount shown on the following table for the respective pipe diameters.

Minimum Acceptance Times	
Pipe Diameter (Inches)	**Time**
6	2 min. 50 sec.
8	3 min. 50 sec.
10	4 min. 45 sec.
12	5 min. 40 sec.
14	6 min. 40 sec.
16	7 min. 5 sec.
18	7 min. 35 sec.
20	9 min. 30 sec.
21	9 min. 55 sec.
24	11 min. 20 sec.

k. If the leakage in the section tested exceeds the specified amount, make the necessary repairs or replacements required to reduce the leakage to within the specified limits and the test shall be repeated until the leakage requirement is met.

l. No one shall be allowed in the manhole during air testing.

3. Water Test:

a. When water test is performed for reinforced concrete pipe, the test section shall be filled with water and allowed to stand for 24 hours. The water shall then be replenished and the test performed.

b. Insert test plugs and securely brace.

c. Fill the pipe and manhole with water to provide a positive differential head on the top of the pipe at the highest point of the pipeline under test of at least the test pressure specified in Section 15050, Piping Systems.

d. The amount of water added to maintain this head shall be the leakage.

e. Test for a period of at least four hours.

f. Total leakage of any section tested shall not exceed the following rates:

1) Gravity Sewer: 0.5 gallons per hour per 100 feet of pipe per inch diameter of pipe.

2) Storm Drains: 2.0 gallons per hour per 100 feet of pipe per inch diameter of pipe.

g. If the leakage in the section tested exceeds the specified amount, make the necessary repairs or replacements required to reduce the leakage to within the specified limits and the test shall be repeated until the leakage requirements is met.

h. On steep grades it may be necessary to place plugs in the pipe between manholes to avoid excessive pressures in the pipe.

4. Visual Inspection:
   a. Prior to final acceptance, a visual inspection by ENGINEER of all appurtenant structures, (e.g., manholes, chambers, etc.), shall be required. Any visual leaks, regardless of their magnitude shall be repaired by CONTRACTOR.
5. Watertight Sewers:
   a. It is imperative that all sewers and appurtenant structures be constructed as watertight as practicable. Adhere rigidly to all requirements of the Contract Documents and follow all directions of the ENGINEER to secure a watertight sewer. If, during the Work or after its completion, any leaks are discovered, they shall be repaired in a satisfactory manner at the expense of CONTRACTOR even though the pipe and appurtenant structures may have already successfully passed the leakage tests.

E. Vertical Deflection Test for Thermoplastic Pipe:
   1. The vertical deflection test shall be conducted after the final backfill has been in place at least 30 days.
   2. Manually pull a pin-type vertical gauge mounted on a sled through the pipe. Gauge shall be set so that if vertical deflection of pipe exceeds five percent, it will stop. Excavate and reinstall all such piping. Gauge shall be as manufactured by Quality Test Products, or equal.

3.5 DISPOSAL OF WATER

A. CONTRACTOR shall provide suitable means for disposal of test and, flushing water so that no damage results to facilities or waterways.

B. Means of disposal of test and flushing water shall be subject to the approval of ENGINEER, local governing authorities, and regulatory agencies.

C. CONTRACTOR shall be responsible for any damage caused by water disposal operations.

3.6 CLEANING

A. Cleaning:
   1. Thoroughly clean all piping and flush prior to placing in service in a manner approved by ENGINEER.
   2. Piping 24-inches in diameter and larger shall be inspected from inside and all debris, dirt, and foreign matter removed.
   3. If piping that requires disinfection has not been kept clean during storage or installation, CONTRACTOR shall swab each section individually before installation with a 5% hypochlorite solution to ensure clean piping.

B. Disinfection:
   1. Disinfect all potable water piping.

2. Disinfection shall conform to the requirements of MAG Section 611.

3.7 PIPING SCHEDULE

A. The following abbreviations are used in the Buried Piping Schedule included at the end of the Section.
   1. Service Abbreviations:
      a. Potable Water: POT
      b. Non-Potable Water: NPW
      c. Drain: D
      d. Air: A
      e. Foul Air: FA
      f. Scum: SCM
      g. Sludge: S
      h. Sanitary Sewer: SS
   2. Material Abbreviations:
      a. Ductile Iron Pipe: DIP
      b. Polyvinyl Chloride: PVC
      c. Copper Pipe: COP
      d. Stainless Steel: SST
      e. Reinforced Concrete Pipe: RCP
      f. Fiberglass Reinforced Plastic: FRP
   3. Lining/Coating Abbreviations:
      a. Bituminous Coated: BC
      b. Cement Mortar Lined: CM
      c. Polyethylene Wrap: PE
      d. Protecto 401 Ceramic Epoxy: CE
      e. Painted per Section 09900, Painting: P
   4. Joint Abbreviations:
      a. Bell and Spigot: BS
      b. Mechanical Joint: MJ
      c. Welded: W
      d. Soldered: S
      e. Butt Wrapped: BW
      f. Solvent Welded: SW

(The rest of this page left intentionally blank)

AWRF BURIED PIPING SCHEDULE

Process Area	Pipe Size (in)	Material	Pipe Number	Class	Lining	Coating	Joints	Service	Test Pressure (psig)
NHLW Disposal Station	2	PVC	D-2-PVC	SCH 80	N/A	N/A	SW	Pressure	150
NHLW Disposal Station	4	PVC	D-4-PVC	SDR 26	N/A	N/A	BS	Gravity	15ft/GR
NHLW Disposal Station	10	FRP	FA-10-FRP	Per 15067	N/A.	P	BW	Foul Air	1.5
Secondary Clarifiers	12	DIP	S-12-DIP	350	CE	BC, PE	MJ	Gravity	30ft/GR
Secondary Clarifiers	16	DIP	S-16-DIP	350	CE	BC, PE	MJ	Gravity	30ft/GR
Secondary Clarifiers	6	DIP	SCM-6-DIP	350	CE	BC, PE	MJ	Gravity	15ft/GR
NHLW Disposal Station	8	PVC	SS-8-PVC	SDR 26	N/A	N/A	BS	Gravity	15ft/GR
Influent Pump Station	30	RCP	SS-30-RCP	Per 15104	Per 15104	Per 15104	Per 15104	Gravity	15ft/GR
RWIF Blower Building	2	PVC	D-2-PVC	SDR 26	N/A	N/A	SW	Gravity	15ft/GR

OWRF BURIED PIPING SCHEDULE

Process Area	Pipe Size (in)	Material	Pipe Number	Class	Lining	Coating	Joints	Service	Test Pressure (psig)
Secondary Clarifiers	8	DIP	TD-8-DIP	350	CE	BC, PE	MJ	Gravity	30ft/GR
Secondary Clarifiers	6	DIP	SCM-6-DIP	350	Glass	BC, PE	MJ	Gravity	15ft/GR

++ END OF SECTION ++

SECTION 15052

EXPOSED PIPING INSTALLATION

PART 1 - GENERAL

1.1 SUMMARY

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to install and test all exposed piping, fittings, and specials. The Work includes, but is not limited to, the following:
      a. All types and sizes of exposed piping except those specified under other Sections.
      b. Piping embedded in concrete within a structure or foundation will be considered as exposed and included herein.
      c. Supports, restraints, and other anchors.
      d. Work on or affecting existing piping.
      e. Testing.
      f. Cleaning and disinfecting.
      g. Installation of all jointing and gasketing materials, specials, flexible couplings, mechanical couplings, harnessed and flanged adapters, sleeves, tie-rods, and all other Work required for completing the exposed piping installation.
      h. Incorporation of valves, meters, and special items shown or specified into the piping systems as required and as specified in the appropriate Division 15, Mechanical, Sections.
      i. Unless otherwise specifically shown, specified, or included under other Sections, all exposed piping Work required, beginning at the outside face of structures or structure foundation, and extending into the structure.

B. Coordination:
   1. Review installation procedures under other Sections and coordinate with the Work that is related to this Section.
   2. This Section 15052, Exposed Piping Installation, specifies the installation of all exposed piping materials specified in Division 15, Mechanical. Coordinate with these Sections.

1.2 RELATED SECTIONS

A. Section 02315, Earthwork, Excavation and Backfill.

B. Section 09900, Painting.

C. Section 11295, Hydraulic Valves.

D. Section 15050, Piping Systems.

E. Section 15061, Ductile Iron Pipe.

F. Section 15064, Copper Pipe.

G. Section 15065, Thermoplastic Pipe and Accessories.

H. Section 15066, Stainless Steel Pipe.

I. Section 15120, Piping Specialties and Accessories.

1.3 QUALITY ASSURANCE

A. Requirements of Regulatory Agencies:
   1. Comply with applicable requirements of NFPA Standard No. 13 for "Installation of Sprinkler Systems" and NFPA Standard No. 14 for "Standpipe and Hose Systems" used for fire protection.
   2. Comply with requirements of UL, FM, and other jurisdictional authorities, where applicable.

B. Reference Standards: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
   1. ANSI B 16.3, Malleable-Iron Threaded Fittings, Classes 150 and 300.
   2. ANSI B 16.4, Cast Iron Threaded Fittings, Classes 125 and 250.
   3. ANSI B 16.5, Pipe Flanges and Flanged Fittings, Steel Nickel Alloy and Other Special Alloys.
   4. ANSI B 16.9, Factory-Made Wrought Steal Butt Welding Fittings.
   5. ANSI B 16.11, Forged Steel Fittings, Socket-Welding and Threaded.
   6. ANSI B 31.1, Power Piping.
   7. ANSI B 31.3, Chemical Plant and Petroleum Refinery Piping.
   8. ANSI B 31.8, Gas Transmission and Distribution Piping Systems.
   9. AWWA C 111, Rubber Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
   10. AWWA C 206, Field Welding of Steel Water Pipe Joints.
   11. AWWA C 600, Installation of Ductile Iron Water Mains and Their Appurtenances.
   12. AWWA C 606, Grooved and Shouldered Type Joints.
   13. AWWA C 651, Disinfecting Water Mains.
   14. AWWA M11, Steel Water Pipe Design and Installation.
   15. AWWA M23, PVC Piping.
   16. AWS D 1.1, Structural Welding Code.
   17. AWS D 10.7, Recommended Practices For Gas Shielded-Arc Welding of Aluminum and Aluminum Alloy Pipe.
   18. AWS D 10.9, Standard for Qualification of Welding Procedures and Welders for Piping and Tubing.
   19. ASME Boiler and Pressure Vessel Code.
   20. NFPA 13, Installation of Sprinkler Systems.
   21. NFPA 14, Standpipe and Hose Systems.

22. NFPA 54, National Fuel Gas Code.
23. NSF/ANSI 61, Drinking Water System Components Health Effects.
24. Arizona Administrative Code R18-4-213, Standards for Additives, Materials, and Equipment.
25. MAG, Maricopa County Association of Government Standard Specifications and Details.

1.4 SUBMITTALS

A. Shall be in accordance with Section 15050, Piping Systems submittal information.

B. Shop Drawings: Submit for approval the following:
   1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
   2. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to the site to insure uninterrupted progress of the Work.

B. Handle all pipe, fittings, and accessories carefully with approved handling devices. Do not drop or roll pipe off trucks. Do not otherwise drop, roll, or skid piping.

C. Store pipes and fittings on heavy wood blocking or platforms so they are not in contact with the ground.

D. Unload pipe, fittings, and specials opposite to or as close to the place where they are to be installed as is practical to avoid unnecessary handling. Keep pipe interiors completely free from dirt and foreign matter.

E. Inspect delivered pipe for cracked, gouged, chipped, dented, or other damaged material and immediately remove from site.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Required pipe materials are listed in the Piping Schedule. Refer to applicable Sections for Material Specifications.

B. General:
   1. Marking Piping:
      a. Clearly mark each piece of pipe or fitting with a designation conforming to that shown on the Shop Drawings.
      b. Cast or paint material, type, and pressure designation on each piece of pipe or fitting 4-inches in diameter and larger.
      c. Pipe and fittings smaller than 4-inches in diameter shall be clearly marked by manufacturer as to material, type, and rating.

C. Pipe Identification Markers and Arrows: Refer to Section 09900, Painting.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:
   1. Install piping as shown, specified, and as recommended by the manufacturer.
   2. If there is a conflict between manufacturer's recommendations and the Contract Documents, request instructions from ENGINEER before proceeding.

B. Manufacturer's Installation Specialist:
   1. Provide the services of a competent installation specialist of the pipe manufacturer when pipe installation begins for the following:
      a. Stainless steel pipe.
      b. Ductile iron pipe.
      c. Copper pipe
      d. Thermoplastic Pipe
   2. Retain installation specialist at the site for a minimum of two days or until competency of the pipe installation crew has been satisfactorily demonstrated.

C. Piping Installation:
   1. Install straight runs true to line and elevation, unless otherwise noted on Plans.

2. Install vertical pipe truly plumb in all directions.
3. Install piping parallel or perpendicular to building walls. Piping at angles and 45 degree runs across corners will not be accepted unless specifically shown or approved.
4. Install small diameter piping generally as shown when specific locations and elevations are not indicated. Locate such piping as required to avoid ducts, equipment, beams, and other obstructions.
5. Install piping so as to leave all corridors, walkways, work areas, and like spaces unobstructed. Unless otherwise approved, provide a minimum headroom clearance under all piping of 7 feet 6-inches.
6. Protect and keep clean water pipe interiors, fittings, and valves.
7. Provide temporary caps or plugs over all pipe openings at the end of each day's Work and when otherwise required or directed by ENGINEER.
8. Cutting: Cut pipe from measurements taken at site, not from Drawings.
9. Install dielectric unions wherever dissimilar metals are connected, except for bronze or brass valves in ferrous piping.
10. Provide a union downstream of each valve with screwed connections.
11. Provide screwed or flanged unions at each piece of equipment where shown and where necessary to install or dismantle piping.
12. Additional Requirements for Thermoplastic Piping:
    a. Support all valves independently of the piping system.
    b. Utilize wide band supports as recommended by manufacturer and approved by ENGINEER to minimize localized stresses.
    c. Provide piping passing through walls with a sleeve of wearing material to prevent abrasion damage to piping.
    d. When anchors are required at locations other than equipment or tanks they shall be placed at elbows, valve locations, and at bends in pipeline.
    e. Spacing of supports shall be in accordance with the manufacturer's published recommendations at the maximum design operating temperature of the pipe.
    f. Use "U" clamps with wide band circumferential contact.
    g. Use guides on long runs of piping to maintain alignment and reduce chance of elastic failure of pipe. Space guides as recommended by manufacturer.
    h. Use bellows with low axial force to take up pipe expansion. Provide anchors to restrain the expansion joint. Use of bellows joints shall be kept to a minimum. Flexible connectors may be used to absorb thermal movement when approved by ENGINEER.
    i. Do not install pipe when ambient temperature is less than 60° F.

D. Joints:
1. General:
    a. Make joints in accordance with the pipe manufacturer's recommendations and the following requirements:
        1) Cut piping accurately and squarely and install without forcing or springing.

2) Ream out all pipes and tubing to full inside diameter after cutting. Remove all sharp edges on end cuts.
3) Remove all cuttings and foreign matter from the inside of pipe and tubing before installation. Thoroughly clean all pipe, fittings, valves, specials, and accessories before installing.

2. Mechanical Joints:
   a. Wipe clean the socket, plain end and adjacent areas immediately before making joint. Make certain that cut ends are tapered and sharp edges are filed off smooth.
   b. Lubricate the plain end and gasket with soapy water or manufacturer's recommended pipe lubricant, in accordance with AWWA C111, just prior to slipping the gasket onto the plain end of the joint assembly.
   c. Place the gland on the plain end with the lip extension toward the plain end, followed by the gasket with the narrow edge of the gasket toward the plain end.
   d. Insert the pipe into the socket and press the gasket firmly and evenly into the gasket recess. Keep the joint straight during assembly.
   e. Push gland toward socket and center it around pipe with the gland lip against the gasket.
   f. Insert bolts and hand tighten nuts.
   g. Make deflection after joint assembly, if required, but prior to tightening bolts. Alternately tighten bolts 180 degrees apart to seat the gasket evenly. The bolt torque shall be as follows:

Pipe Size (inches)	Bolt Size (inches)	Range of Torque (ft-lbs)
3	5/8	45 to 60
4 to 24	3/4	75 to 90
30 to 36	1	100 to 120

3. Flanged Joints:
   a. Assemble flanged joints using 1/8-inch ring-type gaskets for raised face flanges. Use full face gaskets for flat face flanges, unless otherwise approved by ENGINEER. Gaskets shall be suitable for the service intended in accordance with the manufacturer's ratings and instructions. Gaskets shall be properly centered.
   b. Bolts shall be tightened in a sequence which will insure equal distribution of bolt loads.
   c. The length of bolts shall be uniform, and they shall not project beyond the nut more than 1/4-inch or fall short of the nut when fully taken up. The ends of bolts shall be machine cut so as to be neatly rounded. No washers shall be used.
   d. Bolt threads and gasket faces for flanged joints shall be lubricated prior to assembly.
   e. Alternately tighten bolts 180 degrees apart to compress the gasket evenly.
4. Stainless Steel Pipe Joints:

a. For threaded joints, use standard, right hand tapered full depth threads on steel piping and apply an approved joint compound, to the male threads only, before installation. Remove all cuttings and foreign matter from the inside of the pipe. Thoroughly clean all pipe, fittings, valves, specials, and accessories before installing.

5. Thermoplastic Pipe Joints:
   a. Solvent Cement Joints:
      1) Bevel pipe ends and remove all burrs before making joints. Clean both pipe and fittings thoroughly. Do not attempt to make solvent cement joints if temperature is below 40° F or above 90° F when exposed to direct sunlight, nor in wet conditions.
      2) Use solvent cement supplied or recommended by the pipe manufacturer.
      3) Apply joint primer and solvent cement and assemble joints in strict accordance with the recommendations and instructions of the manufacturer of the joint materials and the pipe manufacturer.
      4) Observe safety precautions with the use of joint primers and solvent cements. Allow air to circulate freely through pipelines to permit solvent vapors to escape. Slowly admit water when flushing or filling pipelines to prevent compression of gases within pipes.
   b. Threaded Joints:
      1) Clean both pipe and fittings thoroughly.
      2) Use Teflon tape to ensure a watertight seal with threads.
      3) Observe safety precautions with the use of joint primers and solvent cements. Allow air to circulate freely through pipelines to permit solvent vapors to escape. Slowly admit water when flushing or filling pipelines to prevent compression of gases within pipes.
6. Copper Tubing Joints:
   a. Assemble copper tubing with soldered joints. Solder shall be 95-5 tin-antimony conforming to ASTM B32.
   b. Ream or file pipe to remove burrs.
   c. Clean and polish contact surfaces of joints.
   d. Apply flux to both male and female ends.
   e. Insert end of tube into full depth of fitting socket.
   f. Heat joint evenly.
   g. Form continuous solder bead around entire circumference of joint.
   h. Runs shall contain unions at connections to equipment and at reasonable distances along the lengths of runs to permit convenient disassembly of piping and removal of equipment.

E. Installing Valves and Accessories:
   1. Provide supports for large valves, flow meters, and other heavy items as shown or required.
   2. Position valve operators as shown. When the position is not shown, CONTRACTOR shall notify ENGINEER prior to installation for position approval by ENGINEER. The valve shall be installed so that it can be

conveniently operated and as approved by ENGINEER. Avoid placing operators at angles to the floors or walls. If valve operator is installed without notification to ENGINEER, CONTRACTOR shall move valve, as required, without additional expense.

3. Position flow measuring devices in pipe lines so that they have the amount of straight upstream and downstream runs recommended by the manufacturer, unless specific location dimensions are shown.

F. Unions:
   1. Install dielectric unions wherever dissimilar metals are connected, except for bronze or brass valves, in ferrous piping.
   2. Provide a union downstream of each valve with screwed connections.
   3. Provide screwed or flanged unions at each piece of equipment, where shown, and where necessary to install or dismantle piping.

G. Eccentric Reducers: Use eccentric reducers where shown and where air or water pockets would otherwise occur in mains because of a reduction in pipe size.

H. Transitions From One Type of Pipe to Another:
   1. Do not take pipelines out of service unless specifically named below or approved by ENGINEER.
   2. Provide all necessary adapters, specials, and connection pieces required when connecting different types and sizes of pipe or connecting pipe made by different manufacturers.

I. Work on Existing Pipelines:
   1. Cut or tap pipes as shown or required with machines specifically designed for this Work.
   2. Install temporary plugs to keep out all dirt, water, and debris.
   3. Provide all necessary adapters, fittings, pipe, and appurtenances required.

3.2 THRUST RESTRAINT

A. Provide thrust restraint on all pressure piping systems and where otherwise shown on the Drawings or specified.

B. Thrust restraint shall be accomplished by means of restrained pipe joints. Thrust restraints shall be designed for the axial thrust exerted by the test pressure specified in Section 15050, Piping Systems.

C. Restrained Pipe Joints:
   1. Pipe joints shall be restrained by means suitable for the type of pipe being installed.
   2. Restrain concrete pipe joints utilizing welded joints.
   3. Restrain ductile iron mechanical joint pipe utilizing tie rods and clamps or proprietary restrained joint system conforming to the requirements of Section 15061, Ductile Iron Pipe.

4. Restrain ductile iron pipe connected by flexible couplings or flanged coupling adapters by harnessing across the coupling or adapter using tie rods or extended bolts connecting between flanges.

3.3 PAINTING

A. All pipe field painting shall conform to the requirements of Section 09900, Painting.

3.4 TESTING OF PIPING

A. General:
   1. Test all piping as specified below, unless otherwise authorized by ENGINEER.
   2. Notify ENGINEER 48 hours in advance of testing.
   3. Provide all testing apparatus including pumps, hoses, gauges, and fittings.
   4. Pipelines shall hold the specified test pressure for two hours.
   5. Repair and retest pipelines which fail to hold specified test pressures or which exceed the allowable leakage rate.
   6. Test pressures required are at the lowest elevation of the pipeline section being tested, unless otherwise specified.
   7. Follow special test procedures below for gaseous chemical and liquid chlorine lines.
   8. Conduct all tests in the presence of the ENGINEER. Repeat tests in the presence of local authorities having jurisdiction, if required.

B. Schedule of Pipeline Tests:
   1. Test piping at the test pressure listed in the Exposed Piping Schedule.
   2. For piping not included in the Schedule, the ENGINEER will notify CONTRACTOR in writing of the test pressure to be utilized.

C. Pressure Test Procedure:
   1. Insure that all supports and restraint protection are securely in place.
   2. Fill section to be tested slowly with water and expel all air. Install cocks, if necessary, to ensure removal of air.
   3. Test only one section of pipe at a time.
   4. Apply 150 psi for two hours and observe pressure gauge. Check carefully for leaks while test pressure is being maintained.

D. Leakage Testing:
   1. Conduct leakage test after satisfactory completion of pressure test.
   2. Allow concrete pipe to stand full of water at least 12 hours prior to starting leakage test.
   3. Allowable Leakage Rates (gallons per hour per 1,000 feet per inch diameter:
      a. Concrete Pressure Pipe: 0.0.
      b. Copper, Steel, Ductile Iron, Thermoplastic, and all Other Piping: 0.0.
      c. Ductile Iron Pipe with Mechanical Joints: 0.0.
   4. Leakage Test Procedure:

a. Examine exposed pipe, joints, fittings, and valves. Repair visible leakage or replace the defective pipe, fitting, or valve.
b. Refill the line under test to reach the required test pressure.
c. Provide a test container filled with a known quantity of water at the start of the test. Attach the test pump suction to the test container.
d. Pump water from the test container into the line with the test pump to hold the specified test pressure for the test period. Water remaining in the container shall be measured and the amount used during the test shall be recorded on the test report.
e. Perform all repairs, replacement, and retesting required because of failure to meet testing requirements.
f. Leakage shall be less than rate specified above.

E. Additional Procedures for Gaseous Chemical Piping:
1. Purge piping completely with dry compressed nitrogen or air after pressure and leakage tests have been satisfactorily completed.
2. Fill pipeline with dry air or nitrogen and pressurize to 50 psi.
3. Test all joints with a soapy water solution.
4. Demonstrate that vacuum lines are completely tight under a vacuum of 25-inches of mercury.

F. Test Procedures for Chlorine Piping: Conform to all requirements of the Chlorine Manual and Pamphlet No. 6 of the Chlorine Institute.
1. Dry the piping with steam and dry air, and then purge piping completely with dry compressed nitrogen or air after pressure and leakage tests have been satisfactorily completed.
2. Fill pipeline with dry air or nitrogen and test as described in the Chlorine Manual.
3. Test all joints with a soapy water solution.

3.5 CLEANING AND DISINFECTION

A. Cleaning:
1. Thoroughly clean all piping and flush prior to placing in service in a manner approved by ENGINEER.
2. Piping 24-inches in diameter and larger shall be inspected from inside and all debris, dirt, and foreign matter removed.
3. If piping which requires disinfection has not been kept clean during storage or installation, CONTRACTOR shall swab each section individually with a 5% hypochlorite solution to ensure clean piping.

B. Disinfection:
1. Disinfect all potable water piping. Disinfection shall conform to MAG Section 611.

C. Provide suitable means for disposal of test and flushing water so that no damage results to facilities or waterways.

D. Means of disposal of test and flushing water shall be subject to the approval of ENGINEER, local governing authorities and regulatory agencies.

E. Responsibility for any damage caused by the water disposal operations belongs to CONTRACTOR.

3.6 IDENTIFICATION OF PIPING

A. Pipe Identification Markers and Arrows:
   1. Product and Manufacturer: Provide one of the following:
      a. Brady B-500 vinyl cloth self-sticking arrows and markers except on insulated pipe. Brady B-350 perma-code film self-sticking arrows and markers on pipe insulation.
      b. Equivalent products as made by Seton Name Plate Corporation.
      c. Or equal.
   2. Install markers and arrows at following locations:
      a. At intervals not exceeding 50 feet along continuous runs of pipe.
      b. Wherever pipes pass through walls, floors or panels.
      c. At each valve or equipment connection.
      d. At each branch where it connects to a main line.

3.7 PIPING SCHEDULE

A. The following abbreviations are used in the Exposed Piping Schedule at the end of this Section.
   1. Service Abbreviations:
      a. Air: A
      b. Backwash Water: BWW
      c. Drain: D
      d. Diesel: DL
      e. Foul Air: FA
      f. Non Potable Water: NPW
      g. Return Activated Sludge/Waste Activated Sludge: RAS/WAS
      h. Scum: SCM
      i. Sodium Hydroxide: CAS
      j. Sodium Hypochlorite: SHY
      k. Solids Waste: SW
      l. Sanitary Sewer: SS
      m. Wastewater: WW
   2. Material Abbreviations:
      a. Ductile Iron Pipe: DIP
      b. Reinforced Concrete Pipe: RCP
      c. Chlorinated Polyvinyl Chloride: CPVC
      d. Polyvinyl Chloride: PVC
      e. Copper Pipe: COP
      f. Fiberglass Reinforced Plastic: FRP
      g. Stainless Steel: SST

h. Steel: S

3. Lining Abbreviations:
   a. Protecto 401 Ceramic Epoxy: CE
   b. Glass Lined: GL
   c. Cement Mortar: CM
4. Joint Abbreviations:
   a. Flanged: FLG
   b. Mechanical Joint: MJ
   c. Welded: W
   d. Solvent Welded: SW
   e. Butt Wrapped: BW
   f. Soldered: S
5. Coating Abbreviations:
   a. Bituminous Coating: BC
   b. Painted per Section 09900, Painting: P
   c. Polyethylene Wrap: PE

(The remainder of this page is left intentionally blank)

AWRF EXPOSED PIPING SCHEDULE

Process Area	Pipe Size (in)	Material	Pipe Number	Class	Lining	Coating	Joints	Service	Test Pressure (psig)
Aeration Basins	4	PVC	A-4-PVC	Sch. 40	N/A	N/A	See 11375	Process Air	See 11375
Aeration Basins	6	PVC	A-6-PVC	Sch. 80	N/A	N/A	See 11375	Process Air	See 11375
Aeration Basins	12	PVC	A-12-PVC	Sch. 80	N/A	N/A	See 11375	Process Air	See 11375
Aeration Basins	14	PVC	A-14-PVC	Sch. 80	N/A	N/A	See 11375	Process Air	See 11375
Disc Filter	2	CPVC	BWW-2-CPVC	Sch. 80	N/A	P	SW	Pressure	150
Disc Filter	3	CPVC	BWW-3-CPVC	Sch. 80	N/A	P	SW	Pressure	150
Disc Filter	3	CPVC	D-3-CPVC	Sch. 80	N/A	P	SW	Pressure	150
NHLW Disposal Station	2	PVC	D-2-PVC	Sch. 80	N/A	N/A	SW	Pressure	150
NHLW Disposal Station	4	PVC	D-4-PVC	SDR 26	N/A	N/A	SW	Gravity	15ft/GR
Fuel Storage Tank	3/4	Carbon Steel	DL-3/4-S	Sch. 40	N/A	P	W	Pressure	150
Fuel Storage Tank	2	Carbon Steel	DL-2-S	Sch. 40	N/A	P	W	Pressure	150
Fuel Storage Tank	3	Carbon Steel	DL-3-S	Sch. 40	N/A	P	W	Pressure	150
Headworks	8	FRP	FA-8-FRP	See 15067	N/A.	P	BW	Foul Air	15
Headworks	10	FRP	FA-10-FRP	See 15067	N/A.	P	BW	Foul Air	15
Headworks	18	FRP	FA-18-FRP	See 15067	N/A.	P	BW	Foul Air	15

Process Area	Pipe Size (in)	Material	Pipe Number	Class	Lining	Coating	Joints	Service	Test Pressure (psig)
Headworks	22	FRP	FA-22-FRP	See 15067	N/A.	P	BW	Foul Air	15
Headworks	30	FRP	FA-30-FRP	See 15067	N/A.	P	BW	Foul Air	15
Secondary Clarifiers	2	SST	NPW-2-SST	304L; Sch. 40S	N/A.	N/A	BW	Pressure	150
Secondary Clarifiers	6	SST	SCM-6-SST	304L; Sch 10S	N/A	N/A	FLG	Gravity	50 ft/GR
Secondary Clarifiers	6	PVC	D-6-PVC	Sch. 80	N/A.	P	SW	Pressure	150
Chemical Loop	1/2	CPVC	1/2-CPVC-NaOCl	Sch. 80	N/A	P	SW	Pressure	150
Chemical Loop	1	CPVC	1-CPVC-NaOCl	Sch. 80	N/A	P	SW	Pressure	150
Chemical Loop	2	CPVC	2-CPVC-NaOCl	Sch. 80	N/A	P	SW	Pressure	150
Chemical Loop	1/2	CPVC	1/2-CPVC-NaOH	Sch. 80	N/A	P	SW	Pressure	150
Chemical Loop	1	CPVC	1-CPVC-NaOH	Sch. 80	N/A	P	SW	Pressure	150
Chemical Loop	2	CPVC	2-CPVC-NaOH	Sch. 80	N/A	P	SW	Pressure	150

OWRF EXPOSED PIPING SCHEDULE

Process Area	Pipe Size (in)	Material	Pipe Number	Class	Lining	Coating	Joints	Service	Test Pressure (psig)
MBR Bioreactor Basin	4	PVC	A-4-PVC	Sch. 40	N/A	N/A	See 11375	Pressure	See 11375
MBR Bioreactor Basin	6	PVC	A-6-PVC	Sch. 80	N/A	N/A	See 11375	Pressure	See 11375
MBR Bioreactor Basin	30	SST	MLR-30-SST	316L; Sch. 10S	N/A	P	See 15066	Pressure	150
Fuel Storage Tank	3/4	Carbon Steel	DL-3/4-S	Sch. 40	N/A	P	W	Pressure	150
Fuel Storage Tank	2	Carbon Steel	DL-2-S	Sch. 40	N/A	P	W	Pressure	150
Fuel Storage Tank	3	Carbon Steel	DL-3-S	Sch. 40	N/A	P	W	Pressure	150
Secondary Clarifier	2	SST	NPW-2-SST	304L; Sch. 40S	N/A	N/A	W	Pressure	150
Secondary Clarifier	12	DIP	S-12-DIP	CL53	CE	P	FLG	Pressure	150
Secondary Clarifier	6	DIP	SCM-6-DIP	CL53	Glass	P	FLG	Pressure	150
MLE Anoxic Basin	20	DIP	WW-20-DIP	CL53	CE	See 09900	FLG	Pressure	150

++ END OF SECTION ++

SECTION 15061

DUCTILE IRON PIPE

PART 1 - GENERAL

1.1 SUMMARY

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install ductile iron pipe and fittings.
   2. The extent of ductile iron pipe is shown on the Drawings and in the Schedules included in Section 15051, Buried Piping Installation, and Section 15052, Exposed Piping Installation.
   3. All pipe and fittings shall be restrained.

1.2 RELATED SECTIONS

A. Section 02315, Earthwork, Excavation, and Backfill.

B. Section 09900, Painting.

C. Section 15051, Buried Piping Installation.

D. Section 15052, Exposed Piping Installation.

E. Section 15120, Piping Specialties and Accessories.

1.3 REFERENCES

A. Manufacturers' Qualifications:
   1. Manufacturer shall have a minimum of five years of experience producing ductile iron pipe and fittings and shall show evidence of at least five installations in satisfactory operation.

B. Reference Standards: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
   1. AWWA C104, Cement Mortar Lining for Ductile Iron Pipe and Fittings for Water.
   2. AWWA C105, Polyethylene Encasement for Ductile Iron Pipe Systems.
   3. AWWA C110, Ductile Iron and Gray Iron Fittings, 3-inches through 48-inches, for Water and Other Liquids.
   4. AWWA C111, Rubber Gasket Joints for Ductile Iron Pressure Pipe and Fittings.
   5. AWWA C115, Flanged Ductile Iron Pipe with Threaded Flanges.

6. AWWA C116, Protective Fusion-Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile Iron and Gray Iron Fittings for Water Supply Service.
7. AWWA C150, Thickness Design of Ductile Iron Pipe.
8. AWWA C151, Ductile Iron Pipe, Centrifugally Cast, for Water or Other Liquids.
9. ASME B16.1, Grey Iron Pipe Flanges and Flanged Fittings.
10. ASME B18.2.1, Square, Hex, Heavy Hex, and Askew Bolts and Hex, Heavy Hex, Hex Flange, Lobed Head, and Lay screws (Inch series).
11. ASME B18.2.2, Machine screw nuts, hex, square, hex flange, and coupling nuts.
12. ASTM A307, Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
13. ASTM A354, Specification for Quenched and Tempered Alloy Steel Bolts, Studs and Other Externally Threaded Fasteners.
14. AWWA C600, Installation of Ductile Iron Water Mains and Their Appurtenances.
15. AWWA C153, Ductile Iron Compact Fittings for Water Service.

1.4 SUBMITTALS

A. Shop Drawings: Submit for approval the following:
   1. Letter of Certification of Compliance on materials, equipment, etc.
   2. Final Certified Drawing showing outline dimensions, mounting information, and other pertinent dimensions.
   3. Detailed drawings and data on pipe, fittings, gaskets, and appurtenances. Submit these with Shop Drawings required under Section 15051, Buried Piping Installation, and Section 15052, Exposed Piping Installation.
   4. Installation instructions, operating and/or service manuals, and all other operating data. Preventive maintenance instructions and recommended frequency.
   5. Service data sheets showing design performance, utility requirements, etc., as applicable.
   6. Renewal parts list diagrammatic or cross-section drawings showing part identification. Material analysis or traders designation for each significant part is to be noted on parts lists or on a separate sheet.
   7. Submit test certificates.
   8. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The

ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

9. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**

B. Certificates: Submit Certificates of Compliance with referenced standards.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 15051, Buried Piping Installation, and Section 15052, Exposed Piping Installation.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Joints shall be as specified in piping schedules in Section 15051, Buried Piping Installation, and Section 15052, Exposed Piping Installation. If not specified, provide flanged joints for exposed piping and push-on or mechanical joints for buried piping. Couplings shall be provided on pipe with plain ends, where shown or where approved by ENGINEER.

B. Ductile Iron Pipe and Fittings:
   1. Flanged Pipe: Fabricate in accordance with requirements of AWWA C115.
      a. Thickness: As shown on Piping Schedules. If not shown, use Special Thickness Class 53.
      b. All exposed DIP shall be flanged.
      c. Mechanical groove and shouldered type fittings are not acceptable.
   2. Non-Flanged Pipe: Conform to AWWA C151 for material, pressure, dimensions, tolerances, tests, markings, and other requirements.
      a. Pressure: As shown on Piping Schedules. If not shown, use Pressure Class 350 (Buried Piping).
      b. Special Thickness Class 53 (Exposed Piping).
   3. Joints:

a. Flanged Joints: Conform to AWWA C110 and C115 capable of meeting, working, and test pressure specified in Section 15051, Buried Piping Installation, and Section 15052, Exposed Piping Installation.
    1) Gaskets: High temperature resistant sealing compounds (Loctite PST 592) or equivalent with Dimethacrylate ester base and Teflon can be used.
        a) Gaskets: Unless otherwise specified, gasket stock shall be a synthetic rubber, 1/8-inch thick, full face compound in which the elastomer is nitrile or neoprene. The compound shall contain not less than 50% by volume nitrile or neoprene and shall be free from factice, reclaimed rubber, and other deleterious substances. Gaskets shall comply with AWWA C111 for push-on and mechanical joints.
    2) Bolts and Nuts: Conform to ANSI B18.2.1 and ANSI B18.2.2, respectively. Exposed bolts and nuts shall be ASTM A307, Grade B. Buried or submerged bolts and nuts shall be Type 316 stainless steel.

b. Mechanical Joints: Conform to AWWA C153 or AWWA C110 and AWWA C111.
    1) Glands: Ductile iron.
    2) Gaskets: Plain tip.
    3) Bolts and Nuts: High strength, low alloy steel.

c. Push-On Joints: Conform to AWWA C111.
    1) Gaskets: Molded rubber.
    2) Stripes: Each plain end shall be painted with a circular stripe to provide a guide for visual check that joint is properly assembled.

d. Restrained Push-On Joints: Restrained push-on joints shall be capable of being deflected after full assembly. Joint assembly shall be in strict conformance with AWWA C600 and manufacturer's recommendations. No field cuts of restrained pipe are permitted without prior approval of the ENGINEER.

e. Restrained Mechanical Joints:
    1) Restrained joints for mechanical joint piping shall be one of the following:
        a) Push-On-Restrained Joint, as manufactured by Clow Cast Iron Pipe and Foundry Division of the Clow Corporation.
        b) Megalug, as manufactured by EBBA Iron Sales, Inc.
        c) Or equal.
    2) Restrained joints for push-on joint piping shall be one of the following:
        a) Clow Super-lock Joint Pipe Style F-128, as manufactured by Clow Cast Iron Pipe and Foundry Division of Clow Corporation.
        b) Lok-Ring Joint, as manufactured by American Cast Iron Pipe Company.

c) Push-On Restrained piping shall be provided by a single manufacturer.
d) Or equal.

4. Flanged Fittings: Conform to AWWA C110 or C115.
   a. Pressure Rating: 150 psig.
   b. Material: Ductile iron.
   c. Gaskets: As specified above for joints.
   d. Bolts and Nuts: As specified above for joints.
5. Mechanical Joint Fittings: Conform to AWWA C110 or AWWA C153.
   a. Pressure Rating: 150 psig.
   b. Material: Ductile iron.
   c. Glands: Use ductile iron glands only. Cast iron glands are not allowed.
   d. Gaskets: As specified above for joints.
   e. Bolts and Nuts: As specified above for joints.
6. Coatings:
   a. Bituminous Coatings: Buried pipe and fittings shall be coated on the outside with a bituminous coating, approximately 1 mil thick. Buried pipe shall be provided with polyethylene encasement in accordance with Section 15051, Buried Piping Installation.
   b. Polywrap: All buried ductile iron pipe, valves, and fittings shall be wrapped in a polyethylene sleeve or sheet for protection against corrosive soils. The polyethylene sleeve for protective wrap shall conform to the requirements of ANSI/AWWA C105/A21.5-05 and be as manufactured by the American Cast Iron Pipe Company or equal. Installation of polyethylene wrap shall be per MAG 610.
   c. Painted: Exposed pipe shall be prime coated in accordance with Section 09900, Painting. Field painting shall be performed in accordance with Paragraph 2.3 of this Section.
7. Linings:
   a. Provide linings as specified in the Pipe Schedules. Pipe and fittings shall be lined with the same materials.
   b. Cement mortar lining shall be performed in accordance with AWWA C104.
   c. Bituminous seal coating shall be performed in accordance with AWWA C104.
   d. Epoxy Lining:
      1) Condition of Ductile Iron Prior to Surface Preparation:
         a) No asphalt, cement, or other lining shall be applied to interior of pipe and fittings prior to epoxy lining.
         b) No asphalt, cement, or other coating shall be applied to the first 6-inches of the exterior of the pipe ends.
      2) Epoxy Lining Material: The material shall be an amine cured novalac epoxy containing at least 20% by volume of ceramic quartz pigment. Epoxy lining material manufacturer shall demonstrate a successful history of lining pipe and fittings for sewer service and

submit a test report verifying the following properties and a certification of the test results.

a) A permeability rating of 0.00 when tested according to Method A of ASTM E96-66, Procedure A, with a test duration of 30 days.
b) The following tests shall be run on coupons from factory lined ductile iron pipe:
    i) ASTM B1117 Salt Spray (scribed panel): Results to equal 0.0 undercutting after two years.
    ii) ASTM G95 Cathodic Disbondment 1.5 volts @ 77° F: Results to equal no more than 0.5 mm undercutting after 30 days.
    iii) Immersion Testing rated using ASTM D714-87:
    iv) 20% Sulfuric Acid: No effect after two years.
    v) 25% Sodium Hydroxide: No effect after two years.
    vi) 160° F Distilled Water: No effect after two years.
    vii) 120° F Tap Water (scribed panel): 0.0 undercutting after two years with no effect.
c) An abrasion resistance of no more than 4 mils loss after one million cycles - European Standard EN 598: 1994 Section 7.8 Abrasion Resistance.

3) Interior of the pipe shall receive 40 mils dry film thickness.
4) Applicator: The lining shall be applied by a competent firm with a successful history of applying linings to the interior of ductile iron pipe and fittings.
5) Surface Preparation: Pipe surfaces shall be cleaned and sandblasted prior to lining application in accordance with manufacturer's recommended procedures.
6) Inspection and Certification:
    a) All ductile iron pipe and fitting linings shall be checked for thickness using a magnetic film thickness gauge. The thickness testing shall be done using the method outlined in SSPC-PA-2 Film Thickness Rating.
    b) The interior lining of all pipe barrels and fittings shall be tested for pinholes with a non-destructive 2,500 volt test. Any defects found shall be repaired prior to shipment.
    c) The pipe or fitting manufacturer shall supply a certificate attesting to the fact that the applicator met the requirements of this Specification.
7) Produce and Manufacturer: Provide one of the following
    a) Protecto 401.
    b) No other product or manufacturer will be accepted.
8) Mortar lining with an epoxy top coat is not acceptable.

e. Glass Lining:
    1) General:

a) All glass-lined ductile iron pipe shall adhere to the General Specifications of the ductile iron pipe.
b) The glass lining shall be a specially formulated internal porcelain coating for handling sludge at a wastewater treatment facility, and shall be resistant to adherence to grease and crystalline metal salt deposits within these systems. All metal preparation, application and processing will follow the manufacturer's recommended procedures
c) The lining shall consist of special glasses and inorganic materials applied to internal surfaces in a minimum of two coatings, separately fired, each to a maturing temperature greater than 1,300° F. The resulting bond shall be sufficient to withstand a metal yield of 0.001-inch/inch without damage to the glass.
d) The entire lining system shall have a minimum thickness of 0.010-inch and a maximum thickness of 0.020-inch. It shall have a hardness exceeding on the MOHS Scale and a density of 2.5 to 3.0 grams per cubic centimeter. The lining shall be capable of withstanding an instantaneous thermal shock of 350° F without crazing, blistering, or spalling; shall be resistant to corrosion by most solutions between PH-3 and PH-10 at 125° F shall show a weight loss of not more than 3 milligrams per square inch when tested according to ASTM Designation C283-54. There shall be no visible loss of surface gloss after immersion of a normal production run sample in an 8% sulfuric acid solution at 148° F for a period of 10 minutes.
e) The glass lining shall provide continuous coverage when tested by a low voltage (67.5 volt) wet sponge holiday detection unit such as a Tinker and Rasor Model M-1 low voltage detection device. Isolated detectable pinholes are permitted, providing they are limited to less than 0.01% of the total glass-lined surface (no more than 1-2 pinholes per fitting or an average of 5 or less per 20 feet of pipe). Documented test results shall be furnished with all shipments.
f) Testing procedures and acceptance criteria shall be provided for approval as a part of the glass-lined pipe and fitting submittal information.
g) Glass-lining shall be performed by Vitco Corp., Type SG-14, or approved equal.

2) Installation
a) Glass-lined pipe requires no special handling procedures from that of any other type of lined piping. The materials should not be lifted internally with hooks, forks, straps, or cables are recommended.

b) External impact or vibration during handling will not affect the glass lining provided that the base metal material is not dented or bent beyond the yield point of the metal itself.
c) Field cutting should be limited to one piece per run of pipe from closure purposes only. Cuts should be made using a band saw with a Lenox neo-type blade, 1/4-inch wide by .125-inch thick by 18 teeth per inch, or finer, set at a speed of 100 feet per minute or faster. If the material is not forced against the blade, but set so that the cut is progressive in a natural way, chipping or spalling of the glass lining is held to a minimum. Pipe can also be cut with an abrasive high speed cutting wheel.
d) Acceptable Defects:
i) Scratches: A 1/16-inch wide maximum-providing there is no bare metal showing. No more than two scratches per pipe or fittings.
ii) Chips (caused by physical damage or field cutting): No larger than a ten cent piece, preferably smaller; not more than one per pipe or fitting

3) Maintenance:
a) All field repair is based on judgment by the ENGINEER. An occasional repair will not impair the function of glass-lined pipe, but an excessive amount of repair could eventually encourage build-up within the system.
b) For repair of any minor chipping or spalling which occurs during cutting, Glidden Glid-Guard Epoxy Resin shall be used.
c) Welding on glass-lined material is not permitted.
d) Glass-lined pipe requires no special storage.

C. Couplings:
1. Refer to Section 15120, Piping Specialties and Accessories.

D. Specials:
1. Transition Pieces:
a. Furnish suitable transition pieces (adapters) for connections to process piping.
2. Service Saddles:
a. Provide service saddles where shown or required for small diameter pipe connections.
b. Style: double bale, model 313 as manufactured by Smith-Blair, or approved equal.

E. Pipe and fittings shall be the product of a single manufacturer.

2.2 MARKING FOR IDENTIFICATION

A. All pipeline materials shall be stamped, marked, or identified with the following:

1. Name or trade mark of the manufacturer.
2. Pipe class.
3. Size and length dimensions.
4. Date and place of manufacture.

2.3 SURFACE PREPARATION AND SHOP PAINTING

A. Exposed Pipe and Fittings:
   1. Clean and prime coat ferrous metal surfaces of piping in the shop in accordance with the requirements of Section 09900, Painting.
   2. Field painting shall conform with the requirements of Section 09900, Painting.

B. Buried Pipe and Fittings:
   1. Refer to Paragraph 2.1.B.6.b, above.

PART 3 - EXECUTION

3.1 INSTALLATION

A. For buried piping installation, refer to Section 15051, Buried Piping Installation.

B. For exposed piping installation, refer to Section 15052, Exposed Piping Installation.

3.2 INSPECTION

A. CONTRACTOR shall inspect all piping to assure that piping is free from defects in material and workmanship. The compatibility of all pipe, fittings, and coatings shall be verified by CONTRACTOR.

++ END OF SECTION ++

SECTION 15062

STEEL PIPE

PART 1 - GENERAL

1.1 SUMMARY

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified, and required to furnish and install steel pipe and fittings.
   2. The extent of steel pipe to be provided is shown on the Drawings and in the Schedules included in Sections 15051, Buried Piping Installation, and 15052, Exposed Piping Installation.

1.2 RELATED SECTIONS

A. Section 09900, Painting.

B. Section 15050, Piping Systems.

C. Section 15051, Buried Piping Installation.

D. Section 15052, Exposed Piping Installation.

E. Section 15066, Stainless Steel Pipe.

F. Section 15120, Piping Specialties and Accessories.

G. Section 15140, Supports and Anchors.

1.3 REFERENCES

A. Manufacturer Qualifications:
   1. Manufacturer shall have a minimum of five years of experience in the production of steel pipe and fittings and shall show evidence of satisfactory service in at least five installations.
   2. Steel pipe and fittings shall be the product of one manufacturer.

B. Reference Standards: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
   1. ASTM E96, Test Method for Water Vapor Transmission of Materials.
   2. ASME B16.5, Pipe Flanges and Flanged Fittings.
   3. ANSI B36.10, Welded and Seamless Wrought Steel Pipe.
   4. ASTM A53, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
   5. ASTM B209, Aluminum and Aluminum Alloy Sheet and Plate.

6. ASTM A194, Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature service.
7. ASTM C921, Determining properties of Jacketing materials for Thermal Insulation.
8. ASTM A234, Piping Fittings of Wrought Carbon steel and Alloy steel for moderate and high temperatures.
9. ASTM C547, Mineral Fiber Pipe installation.
10. ASTM A36, Carbon Structural Steel.
11. ASTM C150, Portland cement.
12. ASTM A193, Alloy-Steel and Stainless steel bolting for High Temperature or High Pressure service and other Special purpose applications.
13. ASTM A307, Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
14. AWWA C200, Steel Water Pipe 6-inches and Larger.
15. AWWA C203, Coal-Tar Protective Coatings and Linings for Steel Water Pipelines-Enamel and Tape-Hot Applied.
16. AWWA C205, Cement-Mortar Protective Lining and Coating for Steel Water Pipe - 4-inches and Larger - Shop Applied.
17. AWWA C206, Field Welding of Steel Water Pipe.
18. AWWA C207, Steel Pipe Flanges for Waterworks Service - Sizes 4-inches through 144-inches.
19. AWWA C208, Dimensions for Fabricated Steel Water Pipe Fittings.
20. AWWA C209, Cold-Applied Tape Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines.
21. ASME B1.1, Unified Tech Screw Threads.
22. ASME B16.21, Nonmetallic Flat Gaskets for Pipe Flanges.

C. Verification of Field Conditions: Verify and, if required, correct indicated dimensions and sizes of pipe connections by field measurement prior to preparation of design drawings and fabrications of shop fabricated pipe.

1.4 SUBMITTALS

A. Shop Drawings: Submit for approval the following:
1. Detailed Drawings and data on pipe, fittings, gaskets, and appurtenances. Submit these with Shop Drawings required under Section 15052, Exposed Piping Installation.
2. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of

requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

3. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**

B. Certificates: Submit Certificates of Compliance with referenced standard.

C. Design calculations, including determination of wall thickness satisfactory for external loading, special loading, and internal pressure. The design calculations shall be signed and sealed by a Registered Professional ENGINEER licensed in the State of Arizona.

D. Mill certificates for cement used in fabrication of piping.

E. Test reports for rubber gaskets for the characteristics specified hereinafter.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 15052, Exposed Piping Installation.

PART 2 - PRODUCTS

2.1 DESIGN CONDITIONS FOR LIQUID SERVICE PIPE 24-INCHES AND LARGER

A. Pipe and fittings shall be designed by CONTRACTOR.

B. Design shall be in accordance with the recommended procedures in AWWA Manual M11, as complemented and modified herein. A design pressure of 150 psi for pipes larger than 16-inches and 200 psi for pipes 16-inches and smaller shall be used in equation 4-1 of AWWA Manual M11.

C. Joints shall be welded by the CONTRACTOR per AWWA Manual M11.

D. Thickness of pipe, fittings, and specials shall be the thicker of:
   1. The thickness designed in accordance with the design methods specified in the preceding Paragraph 2.1.B.
   2. The thickness specified in the following:

a. For pipes 26-inches and less in nominal diameter, not less than 3/8-inch.
b. For pipes more than 26-inches and less than 38-inches in nominal diameter, not less than 0.5-inch.
c. For pipes 38-inches to and less than 56-inches in nominal diameter, not less than 5/8-inch.
d. For pipe 56-inches to and including 72-inches in nominal diameter, not less than 13/16-inch.

3. A D/t ratio (diameter over thickness) of 240.

E. The working stress for steel used for fabrication of pipe shall not exceed 50% of the yield stress, or 18,000 psi, minimum.

F. The laying lengths shall not be longer than 40 feet and not shorter than 20 feet, except as follows:
1. Laying length of pipe shall be not longer than 40 feet.
2. Short pieces shall be provided as necessary for curves, closures, and to locate fittings and specials.

G. Longitudinal and girth seams for straight seam pipe shall be no greater in number than would be required for the fabrication of pipe with 96-inch by 120-inch steel plates.
1. Longitudinal seams shall be offset at the girth seams.

H. Where piping is designated to be flanged or welded in order to restrain thrust, the design of the cylinder and flange or welded joint shall take into account the effect of stresses caused by thrust loads.

I. Steel cylinder shall be subjected to no more than 50% of the yield stress.

J. Design steel pipe and welds between pipes for the axial thrust exerted by full working pressure. All joints shall be restrained.

K. Nominal pipe diameter refers to the outside diameter for steel pipe smaller than 45-inches and the inside diameter for steel pipe 45-inches and larger. Nominal pipe diameters are prior to any coating or linings to be applied.

2.2 DETAILED REQUIREMENTS - LIQUID SERVICE

A. Steel pipe shall be ASTM A36. Thickness class shall be as follows, except as shown on the piping schedule:
1. Exposed Pipe:
2. 12-inches and Smaller: Minimum 3/8-inch wall thickness.
3. 24-inches and Larger: Refer to Paragraph 2.1.

B. Material, manufacturing operations, testing and inspection of pipe shall be in conformance with applicable portions of AWWA C200.

C. All special sections and fittings shall be made with component parts having the dimensions, ends, and other details as shown and as herein specified. All fittings shall have the same minimum wall thickness as the pipe.

D. Galvanized steel pipe shall conform to ASTM A53, latest revision, Schedule 40 and shall be hot-dip galvanized. Fittings shall be hot-dip galvanized malleable iron.

E. Mechanical Coupled Joints: Outside ends shall be free from surface defects and shall have welds ground to surface smooth for a sufficient distance from the end. Pipe shall be grooved for a segmental, clamp type, mechanical coupling, whose housing shall enclose a U-shaped rubber gasket. The housing shall lock pipe ends together to prevent end movement.

F. Flanged Joints: Pipe ends shall be fitted with steel pipe flanges in accordance with AWWA C207. Flange shall be AWWA Standard steel ring type Class D. Flanges shall be attached to pipe by means of two fillet welds. Gasket shall have full face, one-piece construction of rubber, 1/16-inch thick for pipe 12-inches in diameter and smaller and 3/32-inch thick for pipe larger than 12-inches. Buried or submerged bolts and nuts shall be Type 316 stainless steel.

G. Welded Joints: Joints shall be lap joints, unless otherwise specified. The field welding of the joints shall meet the applicable requirements of AWWAC206. Lugs shall be welded to the pipe where required for harnessing of flexible couplings. The lugs shall be as required by the manufacturer of the couplings.

H. Threaded Joint: Steel pipe less than 4-inches in diameter shall be furnished, unless otherwise shown or specified, with threaded end and line couplings. Threads shall conform to ANSI B2.1, tapered threads 3/4-inch per foot. Use Teflon tape on threaded joints.

I. Fittings: Fittings shall be fabricated of the same material as the pipeline of which they are a part. Unless otherwise shown or approved, all fittings shall conform to AWWA C208.

J. Couplings:
   1. Sleeve Type, Flexible Couplings:
      a. Pressure and service shall be the same as connected piping.
      b. Materials: Steel.
      c. Gaskets: Suitable for specified service.
      d. Bolts and Nuts: Alloy steel, corrosion-resistant, prime coated. Buried couplings shall have Type 316 stainless steel bolts and nuts.
      e. Harnessing:
         1) Harness all couplings to restrain all pressure piping.
         2) Dimensions, sizes, spacing, and materials for lugs, tie bolts, washers, and nuts shall conform to the standards of the

manufacturer for the pipe size, wall thickness, and working pressure required.

3) No less than two bolts shall be furnished for each coupling.
4) Flexible couplings for flanged steel pipe shall be harnessed with tie bolts and lugs conforming to AWWA Manual M11 "Steel Pipe Design and Installation".
5) Lugs shall be fabricated from steel equal to or better than that specified for the pipe to be harnessed. The lugs shall be shop welded to the pipe.
6) Lugs and tie bolts shall be designed for 150% of the piping system test pressure specified in Section 15051, Buried Piping Installation, and Section 15052, Exposed Piping Installation.
7) Tie bolts, nuts, and washers shall be ASTM A193, Grade B7, steel or better.

f. Product and Manufacturer: Provide couplings as manufactured by one of the following:
1) Dresser Industries, Style 38.
2) Rockwell International Corporation.
3) Or approved equal.

2. Flanged Adapters:
a. Pressure and service shall be the same as connected piping.
b. Materials: Steel.
c. Bolts and Nuts: Alloy steel, corrosion-resistant. Buried adapters shall have Type 316 stainless steel bolts and nuts.
d. Harnessing:
1) Flanged coupling adapters for steel pipe shall be harnessed by using tie bolts and lugs as specified for flexible couplings.
e. Product and Manufacturer: Provide flanged adapters as manufactured by one of the following:
1) Dresser Industries Style 128.
2) Rockwell International Corporation.
3) Or approved equal.

K. Coatings and Linings:
1. The exterior of exposed steel pipe shall receive a commercial blast cleaning according to Steel Structures Painting Council, SSPC-SP-6. Immediately after cleaning, the pipe surface shall be prime coated in the shop. Paint system shall be in accordance with the requirements of Section 09900, Painting.
2. Where specified in Section 15052, Exposed Piping Installation, interior of pipe shall be cement mortar lined. The lining shall be shop applied and meet the applicable requirements of AWWA C205. Lining shall be twice the standard thickness. Influent pump station header shall be lined with ceramic epoxy lining per Specification 15061, Ductile Iron Pipe.
3. Cement shall conform to ASTM C150, Type II Low Alkali.

2.3 STEEL PIPE AND FITTINGS FOR AIR SERVICE

A. This Section of the Specification covers the steel pipe for air service. See Section 15052, Exposed Piping Installation, and Drawings locations.

B. Steel pipe for air service (blower buildings) shall be welded Schedule l0S with standard thickness conforming to API 5LB, ANSI B36.l0, and ASTM A53.
   1. Compound shall be suitable for the service and shall be provided maximum protection against corrosion and leakage. Steel pipe for air services shall not have any internal lining or coating. Steel pipe has been proposed for Centrifugal blower suction and discharge piping.

C. Steel fittings shall conform to ASTM A234, shall be welded type, and shall be Schedule 10.

D. Where flanged joints are required for steel pipe, faced slip-on or weld neck type flanges shall be furnished and shop welded to the pipe, special, or fittings. Flanges shall be 150 lb forged and rolled steel conforming to ASME B16.5. Flanges shall be back faced or spot faced on the back for bolt heads and nuts. Flanged bolts for use with steel flanges shall be of carbon steel conforming to ASTM A307, Grade B. Nuts shall be of the cold-pressed type conforming to ASTM A194, Grade 1. Bolts and nuts shall be threaded in accordance with ASME Bl.l for coarse thread series, Class 2 fit. Gaskets shall be 1/16-inch compressed ring conforming to ASME B16.21.

E. The CONTRACTOR shall ensure coordination of dimensions and drilling patterns of all piping, fittings, specials, valves, and ancillary items. Nuts and bolts shall have hexagonal patterns. Diameters of flange bolts for each size of flange shall conform to ANSI Standard Specifications and the lengths shall be such that the installed projections are not less than 1/8-inch, nor greater than 3/8-inch beyond the outer nut face.

F. Pipe and fittings shall be capable of withstanding a continuous working pressure of 150 psi at 200° F.

G. Pipe Insulation:
   1. Glass fiber insulation shall conform to ASTM C547; rigid molded, non-combustible.
      a. 'K' ('ksi') Value: ASTM C335, 0.23 at 75° F (0.035 at 24° C).
      b. Minimum Service Temperature: -20° F (-28.9° C).
      c. Maximum Service Temperature: 300° F (150° C).
      d. Maximum Moisture Absorption: ASTM C553; 0.2% by volume maximum.
      e. Micro-Lok manufactured by Manville, or approved equal.
   2. All Service Vapor Barrier Jacket:
      a. ASTM C921, white 35 lb Kraft paper reinforced with glass fiber yarn and bonded to aluminized film with flame resistant adhesive.

b. Moisture Vapor Transmission: ASTM E96; 0.02 perm.
c. Secure with self-sealing longitudinal laps and butt strips.

3. Fabrication Adhesive: Non-flammable, quick setting; Spark-Fas 85-20 manufactured by Foster Products Corp.; Drion 85-75 manufactured by Foster Products Corp., or approved equal.
4. Vapor Barrier Mastic Finish:
   a. Piping Service At or Below Ambient Temperature: Single component, elastomeric coating containing Hypalon, white color, maximum 0.02 perm; Monolar 60-95 manufactured by Foster Products Corp.; or approved equal.
   b. Piping Service Above Ambient Temperature: Water based mastic, white color, minimum 3.0 perm; Seal Fas G-P-M 3 5-00 manufactured by Foster Products Corp.; WC-5 manufactured by Vimasco Corp.; or approved equal.
5. All steel pipes to be insulated shall be wrapped with an aluminum jacket conforming to ASTM B209. Jacket shall be corrugated with a thickness of 0.016-inch sheet and fitting shall be 0.020-inch thick die shaped fitting covers with factory attached protective liner. Joining shall be longitudinal slip joints and 2-inch laps. Metal jacket bands shall be 3/8-inch wide, 0.020-inch thick aluminum. Aluminum jacket shall be manufactured by Childers or approved equal.

2.4 MARKING FOR IDENTIFICATION

A. All pipeline materials shall be stamped, marked, or identified with the following:
   1. Name or trade mark of the manufacturer.
   2. Pipe class and specification designation.
   3. Size and length dimensions.
   4. Date and place of manufacture.

PART 3 - EXECUTION

3.1 INSTALLATION

A. For exposed piping installation, refer to Section 15052, Exposed Piping Installation.

B. Buried steel piping will not be accepted.

++ END OF SECTION ++

SECTION 15064

COPPER PIPE

PART 1 - GENERAL

1.1 SUMMARY

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown on the Drawings, specified and required to furnish and install copper pipe and fittings.
   2. All jointing materials, end caps and other appurtenances and accessories shall be provided.
   3. It is the intent of the Contract Documents to provide complete and workable piping systems. Any supplementary fittings and appurtenances required for proper completion of the Work shall be considered as having been included under this Section.

1.2 RELATED SECTIONS

A. Section 02315, Earthwork, Excavation, and Backfill.

B. Section 15050, Piping Systems.

C. Section 15051, Buried Piping Installation.

D. Section 15052, Exposed Piping Installation.

E. Section 15120, Piping Specialties and Accessories.

1.3 QUALITY ASSURANCE

A. Manufacturer's Qualifications:
   1. Manufacturer shall have a minimum of five years experience in the production of copper pipe and fittings, and shall be able to show evidence of satisfactory service in at least five installations.
   2. Each type of pipe and fitting shall be obtained from no more than one manufacturer.

B. Requirements of Regulatory Agencies: Comply with the applicable provisions of the following regulatory agencies, where applicable:
   1. ASME, Boiler and Pressure Vessel Code.
   2. National Fire Protection Association.
   3. Underwriters' Laboratories, Incorporated.
   4. Uniform Plumbing Code.
   5. State and Local Building Codes and Ordinances.

C. Reference Standards: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
   1. ANSI B16.22, Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
   2. ANSI B16.26, Cast Copper Alloy Fittings for Flared Copper Tubes.
   3. ASTM B32, Specification for Solder Metal.
   4. ASTM B42, Specification for Seamless Copper Pipe, Standard Size.
   5. ASTM B68, Specification for Seamless Copper Tube, Bright Annealed.
   6. ASTM B75, Specification for Seamless Copper Tube.
   7. ASTM B88, Specification for Seamless Copper Water Tube.
   8. ASTM B280, Specification for Seamless Copper Tube for Air-Conditioning and Refrigeration Field Service.
   9. ASTM B302, Specification for Threadless Copper Pipe, Standard Sizes.
   10. ASTM B306, Specification for Copper Drainage Tube (DWV).

D. Inspection: The quality of all materials provided and adequacy of installation shall be subject to the review and approval of the ENGINEER.

1.4 SUBMITTALS

A. Shop Drawings: Submit for approval the following:
   1. Detailed drawings and data on pipe fittings and appurtenances. Submit these with Shop Drawings required under Section 15051, Buried Piping Installation, and Section 15052, Exposed Piping Installation.
   2. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
   3. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE**

WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.

B. Certificates: Where specified or otherwise required by the ENGINEER submit test certificates. Submit certificates of compliance with referenced standards.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 15051, Buried Piping Installation, and Section 15052, Exposed Piping Installation.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Potable Piping: Potable piping shall conform to the requirements of ASTM B88. Underground, buried piping, unless otherwise specified, shall be Type K. All fittings shall be soldered, except at valves which may be flared, compression types or threaded type supplied with solder socket by threaded adaptors. Exposed piping shall be Type L, unless otherwise specified.

B. Threadless Copper Pipe: Pipe shall be assembled with brazing-joint pipe fittings. Material shall conform to ASTM B302.

C. Copper Drainage Pipe: Pipe for sanitary drainage or soil, waste and vent pipe, shall conform to ASTM B306.

D. Couplings and fittings for copper tubing:
   1. Unless otherwise specified, couplings for copper tubing 1/2-inch and smaller nominal diameter shall be compression type, bronze or brass, capable of holding the full bursting strength of the tubing and shall meet the requirements of ANSI B16.26.
   2. Product and Manufacturer: Provide fittings and couplings for copper tubing by one of the following:
      a. Swagelok.
      b. Gyrolok.
      c. Or equal.

2.2 JOINTS

A. Potable water piping shall be assembled with soldered type joints. Fittings shall conform to ANSI B 16.22, Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
   1. Soldered joints shall be 95-5 tin- antimony solder, conforming to ASTM B32

B. All joints shall conform to manufacturer's recommendations and shall be made by skilled workmen.

C. Joints shall develop full strength and shall be greater than the pipe joined.

2.3 MARKING

A. All items shall be marked or labeled with the following information:
   1. Metal or alloy designation.
   2. Temper.
   3. Size and schedule.
   4. ASTM specification number.
   5. Name and location of supplier.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Refer to Section 15050, Piping Systems, Section 15051, Buried Piping Installation, for installation, testing and cleaning.

B. Refer to Section 15050, Piping Systems, and Section 15052, Exposed Piping Installation, for installation, testing and cleaning.

C. Dielectric Protection: Copper tubing or fittings shall not be permitted to come in contact with steel piping, reinforcing steel, or other steel at any location. Electrical checks shall be made to ensure no contact is made between copper tubing and steel elements. Wherever electrical contact is demonstrated by such tests, CONTRACTOR shall provide dielectric protection as specified in Section 15120, Piping Specialties and Accessories.

++ END OF SECTION ++

SECTION 15065

THERMOPLASTIC PIPE AND ACCESORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Scope:
   1. Provide all labor, materials, equipment and incidentals as shown on the Drawings, specified and required to furnish and install and place in satisfactory service, polyvinyl chloride (PVC) piping and chlorinated polyvinyl chloride (CPVC) piping, fittings and specials.
   2. The extent of piping is shown on the Drawings and Section 15050, Piping Systems.

B. Coordination:
   1. Review installation procedures under other Sections and coordinate with the Work that is related to this Section.

1.2 RELATED SECTIONS

A. Section 02315, Earthwork, Excavation and Backfill.

B. Section 09900, Painting.

C. Section 11295, Hydraulic Valves.

D. Section 15050, Piping Systems.

E. Section 15051, Buried Piping Installation.

F. Section 15052, Exposed Piping Installation.

1.3 QUALITY ASSURANCE

A. Manufacturer's Qualifications:
   1. Manufacturer shall have a minimum of five years experience in the production of thermoplastic pipe and fittings, and shall be able to show evidence of satisfactory service in at least five installations.
   2. Thermoplastic pipe and fittings shall be the product of one manufacturer.

B. Reference Standards:
   1. Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
   2. ASTM D1598, Test for Time-to-Failure of Plastic Pipe Under Constant Internal Pressure.

3. ASTM D1599, Test for Short-Time Rupture Strength of Plastic Pipe, Tubing, and Fittings.
4. ASTM D2122, Determining Dimensions of Thermoplastic Pipe and Fittings.
5. ASTM D1784, Rigid Poly (Vinyl Chloride) PVC Compounds and Chlorinated Poly (Vinyl Chloride) CPVC Compounds.
6. ASTM D1785, Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 12.0
7. ASTM D2467, Socket-Type Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings.
8. ASTM D2564, Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings.
9. ASTM D2774, Underground Installation of Thermoplastic Pressure Piping.
10. ASTM D2846, Chlorinated Poly (Vinyl Chloride) Plastic Hot Water Distribution Systems.
11. ASTM D3034, Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
12. ASTM F437, Threaded Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.
13. ASTM F439, Socket-Type Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.
14. ASTM F441, Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80.
15. ASTM F477, Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
16. ASTM F493, Solvent Cements for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe and Fittings.
17. Standard No. 14, National Sanitation Foundation.
18. American National Standards Institute.
19. AWWA C900, Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4-inches through 12-inches, for Water Distribution.
20. AWWA C901, Polyethylene (PE) Pressure Pipe and Tubing, 1/2-inch through 3-inches for Water Service.
21. ASTM D2152, Standard Test Method for Adequacy of Fusion of Extruded Poly (Vinyl Chloride) (PVC) Pipe and Molded Fittings by Acetone Immersion.
22. ASTM D2241, Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).
23. ASTM D2837, Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials.
24. ASTM D2855, Standard Practice for Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings.
25. ASTM D3139, Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
26. ASTM D2239, Standard Specification for Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter.
27. ASTM 2737, Standard Specification for Polyethylene (PE) Plastic Tubing.
28. ASTM D3350, Standard Specification for Polyethylene Plastics Pipe and Fittings Materials.
29. ASTM F412, Standard Terminology Relating to Plastic Piping Systems.

C. Shop Tests:
   1. Piping manufacturer shall maintain a continuous quality control program.
   2. All PVC and CPVC plastic molding materials used to manufacture pipe and fittings under this Section shall be tested for conformance to the requirements of ASTM D 1784 and ASTM D1785.

1.4 SUBMITTALS

A. Shop Drawings:
   1. Submit for approval the following:
      a. Detailed procedures to be used in jointing and installing piping system including manufacturer's recommendations.
      b. Interfacing of piping system to equipment and appurtenances.
      c. Detailed requirements for burial, supports, anchors, guides, expansion joints, and all accessories required for a satisfactory piping system.
      d. Bill of materials, indicating material composition of pipe, fittings and solvent, pressure rating, nominal size and its location on the piping installation drawings.
      e. Certification letter from pipe manufacturer confirming that the materials to be used are suitable for the intended service.
      f. Quality assurance information in accordance with Paragraph 1.2 of this Specification.
      g. The formal test protocol for use during performance testing.
      h. Submit these with Shop Drawings required under Section 15051, Buried Piping Installation and Section 15052, Exposed Piping Installation.
      i. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance with the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

j. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**

B. Certificates:
   1. Submit certificates of compliance with referenced standards.

1.5 PRODUCT DELIVERY, HANDLING, AND STORAGE

A. Delivery:
   1. All necessary precautions shall be taken to prevent damage to pipe fittings and other materials during shipment and delivery.
   2. All materials shall be securely fastened to truck or rail car to prevent movement or damage during shipment.
   3. All materials shall be inspected by CONTRACTOR, upon delivery to the site.

B. Handling:
   1. All pipe materials shall be handled to prevent damage.
   2. Pipe and fittings shall not be dropped, rolled, or pushed off from any height on delivery, storage or installation.

C. Storage:
   1. All pipe materials shall be stored off the ground.
   2. Pipe ends shall be secured by caps or plugs.
   3. Do not store pipes or fittings in sunlight.
   4. Pipe shall be stored to prevent sagging or bending.
   5. Store off the ground, under cover, and in a dry location.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General:
   1. Valves shall have manufacturer's name and working pressure cast in raised letters on valve.
   2. Manual valve operators shall turn clockwise to close, unless otherwise specified. Valves shall indicate the direction of operation.
   3. Unless otherwise specified, all flanged valves shall have ends conforming to ANSI B16.1, Class 125.
   4. Buried valves shall have flanged ends with mechanical joint adapters and installed with a flanged adapter or have grooved mechanical couplings. All bolts shall be Type 316 stainless steel.
   5. Buried valves shall be provided with adjustable two piece valve boxes and provided with extension stems, operating nuts and covers unless otherwise

shown or specified. Extension stems shall terminate 12-inches below finished grade.

6. All bolts, nuts and studs on or required to connect buried or submerged valves shall be Type 316 stainless steel.
7. All bolts and studs embedded in concrete and studs required for wall pipe shall be of Type 316 stainless steel.
8. For stainless steel bolting, except where Nitronic-60 nuts are required, use anti-seize compound, graphite free, to prevent galling. Strength of the joint shall not be affected by the use of anti-seize compound.
9. All other bolts, nuts and studs shall, unless otherwise approved, conform to ASTM A 307, Grade B or ASTM A 354.
10. Bolts and nuts shall have hexagon heads and nuts.
11. Gasket material and installation shall conform to manufacturer's recommendations unless otherwise specified by the ENGINEER.
12. Identification: Identify each valve 4-inches and larger with a stainless steel manufacturer's nameplate stamped with the approved designation. Manufacturer's nameplate shall be permanently fastened to valve body at the factory. Stenciled designations are acceptable for buried valves.
13. All materials of construction of the valves shall be suitable for the application, as shown on the Drawings.
14. Responsibility to coordinate compatible materials of construction for all wettable parts of all valves for each process application belongs to CONTRACTOR.

B. PVC Pressure Pipe:
   1. PVC pipe shall be Schedule 80, Class 14554B, conforming to ASTM D1784 and ASTM D1785.
   2. Fittings: Fittings and specials for PVC pipe shall be Schedule 80, solvent weld type and shall conform to ASTM D2467 for socket type.
   3. Provide flanged fittings at all valves and equipment with Teflon gaskets, as specified.
   4. Solvent cement shall conform to requirements of ASTM D2564.
      a. Chemical service: For CPVC or PVC pipe in chemical service, provide the following primer and cement, or approved equal:
         1) Primer: IPS Corp Type P70.
         2) Cement: IPS Corp Type 724 cement or another cement certified by the manufacturer for chemical service.
   5. Where threaded connections are needed, CONTRACTOR shall use Teflon tape to provide a watertight seal.
   6. Liquid Teflon type products are prohibited.
   7. If connections are used with liquid Teflon type products, then the CONTRACTOR shall remove and clean the threads before applying the Teflon tape.
   8. PVC pressure pipe and fittings 4-inches to 12-inches shall conform to AWWA C900.

9. CONTRACTOR shall chamfer and deburr pipes at joints to prevent leakage through cemented sockets.

C. CPVC Pipe:
   1. CPVC pipe shall be Schedule 80, Class 23447-B, conforming to ASTM D1784 and ASTM F441.
   2. Fittings shall be Schedule 80, solvent welded, socket type, conforming to ASTM F439.
   3. For CPVC pipe in chemical service, utilize IPS Corp Type 724 cement or another cement certified by the manufacturer for high strength hypochlorite service.
   4. Provide flanged fittings at all valves and equipment with true union fittings with chemically compatible O-ring seals as specified.
   5. Solvent cement shall conform to requirements of ASTM F493.
   6. Liquid Teflon type products are prohibited.
   7. If connections are used with liquid Teflon type products, then the CONTRACTOR shall remove and clean the threads before applying the Teflon tape.
   8. CONTRACTOR shall chamfer and deburr pipes at joints to prevent leakage through cemented sockets.

D. PVC Gravity Sewer Pipes:
   1. Pipes and fittings shall conform to requirements of ASTM D1784, Class 12454-B and ASTM D3034, SDR 26.
   2. Elastomeric gaskets for joints shall conform to requirements of ASTM F477.

E. PVDF Disconnect Couplings:
   1. Type:
      a. Quick-connect, dry disconnect coupling for chemical feed loop dosing piping ends.
      b. Couplings shall be dry break type on coupler and adapter.
      c. Components shall be compatible with conveyed chemical and CPVC piping system.
   2. Materials:
      a. Body:
         1) PVDF.
      b. Mounting:
         1) Elbow.
      c. Gaskets:
         1) EPDM for NaOH Piping.
         2) FKM for NaOCl Piping.
      d. Ends:
         1) CPVC socket connections shall be compatible with CPVC piping.
   3. Product and Manufacturer:
      a. Provide one of the following:
         1) Colder Products.

2) Or Approved Equal.

F. Couplings:
1. Type:
   a. Quick-connect, male adapter with treaded ends for permanent pipe installation, hose shank coupler for hose connection.
2. Materials:
   a. Body:
      1) Polypropylene.
   b. Cam Arms:
      1) Stainless steel.
   c. Gaskets:
      1) Viton or EPDM.
   d. Ends:
      1) As specified above.
      2) Each adapter provided shall be equipped with adapter cap constructed of same materials.
3. Product and Manufacturer:
   a. Provide one of the following:
      1) Plastic Piping System, Inc.
      2) Or Approved Equal.

G. FEP Whip Tubing:
1. Type:
   a. Tubing for chemical connection to scrubber injection point.
2. Material of Construction:
   a. FEP (fluorinated ethylene propylene).
3. Temperature Rating:
   a. Up to 150° F.
4. Each tube shall be unreinforced, corrosion resistant, and clear in color.
5. Each tube shall be fitted with PVDF disconnect coupling.
6. Product and Manufacturer:
   a. Provide one of the following:
      1) Grainger.
      2) Fluorotherm.
      3) Or Approved Equal.

H. Hose:
1. Material of Construction:
   a. Cross-linked polyethylene tube, non-staining, with neoprene cover.
2. Temperature Rating:
   a. Up to 150° F.
3. Hose shall be high tensile, horizontal textile braid with helix wire reinforcements.
4. Each hose shall be fitted with hose shank coupler.

5. Product and Manufacturer:
    a. Provide one of the following:
        1) Goodyear Rubber Company.
        2) Or Approved Equal.

I. Expansion Joints (Bellows Type):
1. Provide expansion joints as part of the pipe support system, as required.
2. Provide connections to storage tanks and scrubber vessels with expansion joints to compensate for expansion, contraction and misalignment.
    a. Connections requiring bellows type expansion joints are as follows:
        1) Pump suction lines.
        2) Fill pipes.
        3) Vent pipes.
        4) Recirculation pump suction lines.
        5) Recirculation pump discharge lines.
        6) Blowdown lines.
3. Features:
    a. Type: Flanged bellows type with three or five convolutions.
    b. Working Pressures (maximum):
        1) Three convolutions:
            a) 125 psi.
        2) Five convolutions:
            a) 50 psi.
    c. Materials of Construction:
        1) Bellows:
            a) TFE. Bellows material shall be wrapped around flanges for corrosion protection.
        2) Flanges:
            a) Cadmium plated steel.
    d. Reinforcing rings around bellows:
            a) Plated for corrosion protection.
    e. All expansion joints in gallery piping shall have limit rods for over expansion protection.
    f. Rods shall be sized with a safety factor of 1.5 above the maximum force developed.
4. Product and Manufacturers:
    a. Provide one of the following:
        1) Unaflex, Style.
        2) Garlock, Style.
        3) Resistoflex, Model.
        4) Or Approved Equal.
    b. Supply type, grade and strength of pipe required to meet the specified service conditions.
5. Provide expansion compensation in accordance with the requirements of Section 15140, Supports and Anchors. Painting shall conform to requirements of Section 09900, Painting.

2.2 DETAILED REQUIREMENTS

A. Workmanship
   1. The pipe shall be homogeneous throughout and free from visible cracks, holes, foreign inclusions or other defects.
   2. The pipe shall be uniform in color, opacity, density, and other physical properties.

B. Dimensions and Tolerances:
   1. Dimensions and tolerances shall be measured in accordance with ASTM D2122.
   2. The eccentricity of the inside and outside circumferences of the pipe walls shall not exceed 12%.

C. Sustained Pressure:
   1. The pipe shall not fail, balloon, burst, or weep as defined in ASTM D1598.

D. Burst Pressure:
   1. The minimum burst pressure shall be determined in accordance with ASTM D1599.

E. Marking:
   1. Marking on the pipe shall include the following, spaced at intervals of not more than five feet.
      a. Pipe nominal size.
      b. Pipe schedule.
      c. Specification of plastic material.
      d. Type and grade of plastic.
      e. Date and place of manufacture.
   2. Piping and fittings shall be manufactured with a minimum of 2% of titanium oxide for ultraviolet protection.

2.3 ADAPTERS

Where required to join piping of different materials, provide the required adapters, as recommended by the thermoplastic pipe manufacturer.

1. Steel to PVC adapter.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:
   1. Refer to Section 15050, Piping Systems, Section 15051, Buried Piping Installation, and Section 15052, Exposed Piping Installation, for piping installation, testing, cleaning and acceptance.

2. Install all valves and appurtenances in accordance with the manufacturer's instructions.
3. Request instructions from ENGINEER before proceeding if there is a conflict between Contract Documents and manufacturer's recommendations.
4. Pipe, fittings and accessories that are cracked, damaged, not identified or in poor condition will be rejected.

++ END OF SECTION ++

SECTION 15066

STAINLESS STEEL PIPE

PART 1 - GENERAL

1.1 SUMMARY

A. Scope:
   1. Provide all labor, materials, equipment and incidentals as shown on the Drawings, specified and required to furnish and install stainless steel pipe and fittings.
   2. The extent of the piping is shown on the Drawings and Section 15051, Buried Piping Installation and Section 15052, Exposed Piping Installation.

1.2 RELATED SECTIONS

A. Section 02315, Earthwork, Excavation, and Backfill.

B. Section 09900, Painting.

C. Section 15051, Buried Piping Installation.

D. Section 15052, Exposed Piping Installation.

E. Section 15120, Piping Specialties and Accessories.

1.3 QUALITY ASSURANCE

A. Manufacturer's Qualifications:
   1. Manufacturer shall have a minimum of five years experience in the production of stainless steel pipe and fittings and shall be able to show evidence of satisfactory service in at least five installations.
   2. Stainless steel pipe and fittings shall be the product of one manufacturer.

B. Reference Standards: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
   1. ANSI B2.1, Pipe Thread.
   2. ANSI B16.1, Cast Iron Pipe Flanges and Flanged Fittings.
   3. ANSI B16.11, Forged Steel Fittings, Socket Welding and Threaded.
   4. ANSI B36.19, Stainless Steel Pipe.
   5. ASTM A182, Specification for Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service.
   6. ASTM A193, Specification for Alloy Steel and Stainless Steel Bolting Materials for High-Temperature Service.
   7. ASTM A194, Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service.

8. ASTM A240, Specification for Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels.
9. ASTM A276, Specification for Stainless Steel Bars and Shapes.
10. ASTM A312, Specification for Seamless and Welded Austenitic Stainless Steel Pipes.
11. ASTM A320, Specification for Alloy Steel Bolting Materials for Low-Temperature Service.
12. ASTM A403, Specification for Wrought Austenitic Stainless Steel Piping Fittings.
13. ASTM A409, Specification for Welded Large Diameter Austenitic Steel Pipe for Corrosive or High Temperature Service.
14. ASTM A480, Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip.
15. ASTM A774, Specification for As-Welded Wrought Austenitic Stainless Steel Fittings for General Corrosive Service at Low and Moderate Temperatures.
16. ASTM A778, Specification for Welded, Unannealed Austenitic Stainless Steel Tubular Products.
17. AWS D1.1, Structural Welding Code.

1.4 SUBMITTALS

A. Drawings: Submit for approval the following:
   1. Submit detailed Drawings and data for stainless steel pipe and fittings.
   2. Submit laying schedules and detailed plan and profile drawings for all stainless steel piping showing full details of piping, valves, hangers, supports, restraints, couplings, accessories and specials.
   3. Submit design calculations signed and sealed by a Registered Professional Engineer showing that the wall thickness of pipes and fittings, and that the pipe reinforcement at lugs and pipe supports are adequate for all loads imposed by the manufacturer's design and for the specified service conditions.
   4. Coordinate and submit with Shop Drawings required under Section 15051, Buried Piping Installation, and Section 15052, Exposed Piping Installation.
   5. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification

sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

6. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**

B. Certificates: Submit certificates of compliance with referenced standards, including welder's certificates.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Refer to Section 15051, Buried Piping Installation, and Section 15052, Exposed Piping Installation.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Fabricated Stainless Steel Pipe:
   1. Pipe:
      a. Type: Pipe and fittings less than 3-inch diameter shall be seamless. Pipe 3-inch diameter and larger may be electrically welded or seamless. Spiral welded pipe is not acceptable.
      b. Material: ASTM A312, Type 304L stainless steel.
      c. Diameter: Pipe diameters shown on the Drawings shall mean the nominal outside diameter of the pipe, except for pipes specified with schedule numbers for wall thickness which shall conform to ANSI.
      d. Wall Design Criteria:
         1) Provide a piping system designed to meet the fabrication, installation and service conditions shown on the Drawings and specified.
         2) Based on the internal design pressure indicated for test pressure in Section 15050, Piping Systems and 15052, Exposed Piping Installation.
         3) Support weight of pipe fittings and valves using the support system shown on the Drawings or specified.
         4) Minimum Wall Thickness:
            a) Exposed and Submerged Pipe shall be Schedule 10S, unless otherwise specified in Section 15050, Piping Systems.
            b) All stainless steel piping less than 6-inches in diameter shall be Schedule 40S.
            c) All stainless steel piping equal to 6-inches in diameter and above shall be Schedule 10S.
      e. Fabrication:

1) Longitudinal Seams: Maximum of two per section.
2) Girth Seams: Not less than 6 feet apart, except at fittings and specials.
3) Pipe Ends: Perpendicular to longitudinal axis.
4) Roundness: ±1/16-inch.
5) Straightness: ±1/8-inch in 10 feet.
6) Edges: All joint-edges shall be true so as not to leave a shoulder on the inside of the pipe.

f. Welding:
1) Longitudinal Welds: Tungsten Inert Gas or Metal Inert Gas.
2) Circumferential Welds: Heliarc or metallic air process.
3) Grinding: All interior welds shall be ground smooth to provide an internal bead of 1/16-inch or less.

g. Factory Finish:
1) All pipe and fittings shall be pickled after manufacture by immersion in acid bath until all weld discoloration and iron pickup is removed.
2) Passivate all piping welds after fabrication.
3) Thoroughly wash all pipe and fittings with clear water after pickling.

2. Joints:
a. General:
1) Comply with Section 15052, Exposed Piping Installation.
2) Provide flanged joints at valves and equipment.
3) Provide flanged joints for field assembly of exposed and submerged piping.
4) Provide flexible stainless steel expansion joints, where shown on the Drawings.
5) All joints shall be shop welded, unless otherwise shown on the Drawings or specified.
6) Stainless steel pipe fabricated into spool pieces shall have shop-welded circumferential butt welded joints or flanges.

b. Flanged Joints:
1) Two part flange:
a) Slip-on rolled angle face rings of 1/8-inch stainless for pipe less than 16-inches in diameter and 3/16-inch thick for pipe 16-inches and larger. The angle face ring thickness shall be equal to or greater than the wall of the pipe or fitting to which it is welded and it shall be continuously welded on both sides to the pipe or fitting. The angle leg shall not interfere with the flange bolt holes.
b) Backing Flange: Hot dipped galvanized ductile-iron drilled to ANSI B16.1 Class 125 Standards. For submerged joints, backing flanges shall be stainless steel plate flanges. Minimum flange thickness shall be:

Diameter	Flange Thickness
10-inches to 12-inches	11/16-inch
14-inches to 18-inches	3/4-inch

20-inches to 30-inches	1-inch
36-inches to 54-inches	1-3/8-inch

2) Gaskets:
   a) Comply with manufacturer's recommendations for service conditions as shown on the Drawings and specified.
   b) Gaskets provided on process air and channel air service shall be neoprene or EPDM suitable for minimum 25 psi pressure and 250° F air temperature.
3) Bolts and Nuts:
   a) Exposed: Type 316 stainless steel.
   b) Submerged: Type 316 stainless steel.

3. Fittings:
   a. Type: Welded or flanged as shown on the Drawings, all stainless steel.
   b. Construction:
      1) Stainless steel fittings, 2-1/2-inch and smaller, shall be ASTM A403, of the same material and pressure rating as the pipe, threaded, long radius with dimensions conforming to ANSI B16.11.
      2) Unless otherwise specified, stainless steel fittings 3-inch and larger shall be of the same material and in the same thicknesses as the pipe. Long radius elbows up to 24-inches in diameter shall be smooth flow. All short radius, special radius and reducing bends and long radius bends greater than 24-inches in diameter shall be of mitered construction. Reducers shall be tapered, cone type. Tees, crosses, laterals and wyes shall be shop-fabricated pipe.
   c. Wall Thickness: Conform to the wall thickness required for service conditions specified, but in no case less than the pipe wall thickness.
   d. Base Fitting: Provide Type 316L stainless steel.
4. Field Assembly of Piping:
   a. Field welding of pipe is not permitted.
   b. Connect exposed and submerged piping with flanges.
5. Threaded Connections: Threaded pipe, gauge or instrument connections shall be made using stainless steel, 150-pound, threaded half-couplings conforming to ASTM A182 or ASTM A276, shop welded to the pipe at the locations specified or shown on the Drawings.

B. Specials:
   1. Taps:
      a. Provide taps where shown on the Drawings or required for small pipe and instrument connections.
      b. Connections shall be welded, forged threaded Type 316L stainless steel boss.
      c. Product and Manufacturer: Provide one of the following:
         1) Thredolet by Grinnell Company.
         2) Or approved equal.

2. Pipe Adapters: Where necessary to join pipe of different type, provide necessary adapters. Ends shall conform to Specifications for the appropriate type joint.

C. Product and Manufacturers: Pipe and fittings shall be the product of one single manufacturer. Provide one of the following:
   1. Alaskan Copper.
   2. Felker Brothers Corporation.

2.2 STAINLESS STEEL PIPE AND FITTINGS FOR AIR SERVICE

A. This Section of the Specification covers the stainless steel pipe for air service. See Specification 15052, Exposed Piping Installation, and Drawings locations.

B. Stainless steel pipe for air service shall be welded Schedule 10S conforming to ASTM A778, Grade 316L, and ANSI B36.19 unless noted otherwise. Compound shall be suitable for the service and shall be provided maximum protection against corrosion and leakage. Stainless steel pipe manifolds for air service shall be coated as specified in Section 09900, Painting.

C. Stainless steel fittings shall be the butt welding, smooth flow type, and shall be Schedule 10S unless noted otherwise. Stainless steel fittings shall conform to ASTM A774 Grade WP316L, ANSI B16.9, or Class CR, Grade CR316L, MSS SP-43.

D. Stainless steel flanges shall be forged stainless steel, raised-free, weld-neck type, or slip-on weld per AWWA C207, Class D ASTM A240 TP 316 L, ASTM A182, Grade F316. Drilling and OD matching ANSI B16.5 Class 150 steel flange standard, MSS SP-42 150 lb. corrosion resistant valve standard. Weld-neck flanges shall be bored to match pipe inside diameter.

E. The CONTRACTOR shall ensure coordination of dimensions and drilling patterns of all piping, fittings, specials, valves and ancillary items. Nuts and bolts shall have hexagonal patterns. Diameters of flange bolts for each size of flange shall conform to ANSI standard specifications and the lengths shall be such that the installed projections are not less than 1/8-inch nor greater than 3/8-inch beyond the outer nut face.

F. Pipe and fittings shall be capable of withstanding a continuous working pressure of 150 psi at 200° F.

2.3 IDENTIFICATION

A. All pipeline materials shall be stamped, marked or identified with the following:
   1. Name of manufacturer.
   2. Date of manufacture.
   3. Operating design pressure at operating design temperature.
   4. Type of service.

5. Manufacturer's part number.

PART 3 - EXECUTION

3.1 INSPECTION

A. Inspect all piping to ensure that piping is free of defects in material and workmanship.

3.2 INSTALLATION

A. For buried piping installation, refer to Section 15051, Buried Piping Installation.

B. For exposed piping installation, refer to Section 15052, Exposed Piping Installation.

C. Field welded pipe joints are prohibited.

++ END OF SECTION ++

SECTION 15067

FIBERGLASS REINFORCED PLASTIC PIPE AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install fiberglass reinforced plastic pipe and accessories.
   2. The extent of FRP pipe to be supplied per this Specification shall be for the following areas and as shown in the Drawings:
      a. All above and below grade odor control piping to the following facilities:
         1) Headworks Building
         2) Non-Hazardous Liquid Waste Disposal Station

B. Fiberglass reinforced plastic pipe and pipe fittings.

C. Expansion joints.

D. Flexible couplings.

E. Odor control dampers.

1.2 RELATED SECTIONS

A. 15050, Piping Systems.

B. 15051, Buried Piping Installation.

C. 15120, Piping Specialties and Accessories.

1.3 QUALITY ASSURANCE

A. Manufacturer's Qualifications:
   1. Manufacturer shall have a minimum of five years of experience producing fiberglass reinforced plastic pipe and fittings and shall show evidence of at least five installations in satisfactory operation.
   2. Fiberglass reinforced plastic pipe and fittings shall be the product of one manufacturer.

B. Reference Standards: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
   1. ASTM D2412.

2. ASTM D2996.
3. ASTM D2997.
4. ASTM D2310.
5. ASTM D3567.
6. ASTM E84, Standard Test Methods for Surface Burning Characteristics of Building Materials.
7. ASME A307.
8. ASME D2240.
9. AWWA C950.
10. NBS PS15-69, Custom Contact-Molded Reinforced Polyester Chemical Resistant Process Equipment.

1.4 SUBMITTALS

A. Shop Drawings: Submit for approval the following:
1. Detailed Drawings and data on pipe, fittings, gaskets, and appurtenances. Submit these with Shop Drawings required under Section 15051, Buried Piping Installation, and Section 15052, Exposed Piping Installation.
2. Detailed procedures to be used in joining and installing piping system including manufacturer's recommendations.
3. Interfacing of piping system to equipment and structures.
4. Detail requirements for burial, supports, anchors, guides, expansion joints, and all accessories required for a satisfactory piping system.
5. Bill of materials, indicating material composition of pipe and joining material, pressure rating, nominal size, and its location of the piping installation drawings.
6. Certifications letter from pipe manufacturer confirming that the materials to be used are suitable for the intended service.
7. Quality assurance information in accordance with Paragraph 1.2 of this Specification.
8. The formal test protocol for use during performance testing, if required.
9. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for

any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

10. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**

B. Certificates: Submit Certificates of Compliance with referenced standards.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 15051, Buried Piping Installation, and Section 15052, Exposed Piping Installation.

1.6 EXTRA MATERIALS

A. Provide two flange gaskets for each size of damper.
   1. Spare parts shall be suitably packaged in accordance with the General Equipment Stipulations, with label indicating the contents of each package and equipment number designated.

PART 2 - PRODUCTS

2.1 FIBERGLASS REINFORCED PLASTIC PIPE

A. FRP shall be designed for 75 psig pressure at 200° F operating temperature. This FRP shall be filament wound per ASTM D2996, Smith Fibercast Co., Model F-Chem-V, or approved equal, with associated fittings and adhesive suited for 250° F temperature. All joints shall be butt wrapped per manufacturer's recommendations, except where flexible couplings, dampers, structure connections, and fittings specifically located in the Drawings as flange connections are shown. Flanged joints shall be per manufacturer's recommendations.
   1. The pipe shall have a minimum 20 mil thick vinyl ester resin liner as determined per ASTM D3567. The liner shall have a minimum 65% by weight vinyl ester resin content.
   2. The pipe shall have a minimum reinforced wall thickness per Table 1 or AWWA C-950, whichever is greater. Reinforced wall thickness shall be determined per ASTM D3567. The reinforced wall shall have a minimum 45% by weight continuous glass roving content.

Table 1

(inches)									
Nominal Pipe Diameter	11-12	13-17	18	20	24	30	36	42	48
Reinforced Wall "Above Grade"	.226	.268	.310	.310	.310	.352	.394	.436	.478
Reinforced Wall "Below Grade"	.226	.268	.310	.310	.310	.394	.436	.520	.562

B. Below ground FRP pipe and fittings, as shown on the Drawings, shall, at a minimum, be designed and suited for burial service. Design shall be incorporated to withstand a minimum burial depth to the top of the pipe, as shown in the Plans, and be subject to H-20 wheel loading. FRP pipe submittal shall note where design requirements are incorporated.

C. Above ground FRP pipe and fittings, as shown on the Drawings, shall be determined per the following criteria.
   1. Wall thickness for the unsupported span based on three span beam bending equations with 1/2-inch allowable deflection.
   2. Wall thickness for an unsupported span beam bending stress of 1/3 the ultimate.

D. The same manufacturer shall produce the pipe, fittings, and adhesive. The piping system fittings shall have internal pressure ratings of at least 75 psi.

E. Flange Bolts, Nuts, Washers:
   1. Type 316 Stainless Steel: Length such that, after installation, bolt will project 1/8-inch to 3/8-inch beyond the outer face of the nut.

F. Flange Gaskets:
   1. Full face, ASTM D2240, Type A, durometer 50-70, 1/8-inch minimum thickness, EPDM.

G. Butt Joints:
   1. Butt and wrap, resin bonded, shall comply with US NBS Voluntary Product Standard PS-15, with pressure rating equal to the pipe.

H. Inhibitor:
   1. All pipe, fittings, and appurtenances shall contain ultraviolet (UV) inhibitors.
      a. Below Ground:
         1) Underground joints shall be bell and spigot type sealed with thixotropic resin paste provided by the pipe manufacturer or a field butt-and-wrap connection. Joints and gaskets shall be in accordance with the pipe manufacturer's recommendations.

2.2 EXPANSION JOINTS

A. Expansion joints shall be furnished and installed at the locations indicated on the Drawings. Expansion joints shall be resistant to UV light and shall be suitable for the service conditions.

B. Expansion joints shall be flange type. Flange type expansion joints shall be EPDM, fiberglass reinforced, and have ANSI Class 125 diameter drilling. Flange bolts, nuts, and washers shall be per Paragraph 2.1.F.

C. Expansion joints shall be designed to compress 2-inches and to elongate 1-inch with a maximum force to cause movement of 100 lbs or less. The joint shall also allow lateral deflections of up to 2-inches.

D. Manufacturers: Red Valve or approved equal.

2.3 FLEXIBLE COUPLINGS

A. Flexible couplings shall be furnished and installed at the locations indicated on the Drawings. Flexible coupling material shall be EPDM, resistant to UV light degradation, and suitable for contact with heavy concentrations of H2S laden air.

B. Flexible couplings shall be of a slip-on configuration, whereas a section of pipe is removed and the rubber connector is slipped into place.

C. Stainless steel bands shall be provided to secure each end connection.

D. Manufacturers: Red Valve, Model SL-100, or approved equal.

2.4 ODOR CONTROL DAMPERS

A. Dampers furnished and installed under this Section shall be fabricated, assembled, and placed in proper operating condition in full conformity with the Drawings, Specifications, engineering data, instructions, and recommendations of equipment manufacturer, unless exceptions are noted by the ENGINEER.

B. Performance and Design Requirements: Each damper shall be designed for the following condition:
   1. Operating Temperature:
      a. Internal: 275° F.
      b. External: 120° F.
   2. Design Pressure: 12.5-inches w.c.
   3. Design Vacuum: 12.5-inches w.c.

C. Materials:
   1. Frame: Fiberglass reinforced plastic with vinyl ester resin.

2. Blade: Fiberglass reinforced plastic with stiffeners as required. 36-inches and under: 0.25-inch thick.
3. Axle: Continuous fiberglass reinforced plastic rod with stiffeners as required: 6-inch extensions beyond frame.
4. Bearings: Molded synthetic.
5. Blade Stop: Fiberglass reinforced plastic bar or angle.
6. Flanges: Flanges shall comply with NBS PS15-69 Table 5 at a design pressure of 25 psi and shall have ANSI/ASME B16.1, Class 25, diameter and drilling.

D. Operators:
1. All dampers shall be provided with heavy-duty hand operators. Each operator shall have a locking quadrant suitable for positioning the blade at any intermediate position.

E. Construction:
1. Dampers shall be of the single blade type complete with channel type frame, close fitting blade, full-length axle, and bearings. The damper shall be constructed of fiberglass reinforced plastic using a vinyl ester resin and shall have the same inside diameter as the connecting piping. The axles shall be not less than 1-inch in diameter and shall be continuous through the damper.
2. Dampers for balancing service shall be equipped with a blade stop.
3. Dampers shall have a minimum pressure rating of 10-inch water column.

F. Manufacturer: Swartwout or approved equal.

PART 3 - EXECUTION

3.1 FABRICATION

A. Jointing Method: Unless otherwise specified, 14-inch and smaller pipe shall have coupled adhesive bonded joints. 16-inch and larger pipe shall have butt joints. Shop-fabricated assemblies should be provided to the maximum extent possible to minimize the number of field joints.
1. Flanged joints shall be provided at each damper and item of equipment to facilitate disassembly, at each change in material, and where indicated on the Drawings.
2. Field butt joints, when needed, shall be made at locations at least 12-inches from any increasing or decreasing cross-section of pipe where the pipe to be jointed has the same diameter.
3. All bolts, nuts, washers, and gaskets required for all connections of the piping system, including connections to equipment shall be provided.

B. Transitions: Fiberglass-reinforced plastic transition sections shall be furnished for connecting round pipe to rectangular openings on equipment. Transitions shall have a pressure rating and wall stiffness equal to that of the pipe. Internal lining

shall be of the same type of material and thickness as specified for the pipe. Transitions shall have flanged end connections compatible with the connecting pipe and equipment.

3.2 INSTALLATION

A. Route piping in orderly manner, plumb and parallel to building structure, and maintain gradient.

B. Install piping to conserve building space and not interfere with use of space and other work.

C. Pipe shall be cut using measurements taken at the site and not from the Drawings.

D. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

E. Pipe shall be installed as specified and as indicated on the Drawings. All necessary provisions shall be taken in the fabrication and installation of piping to provide for expansion and contraction.

F. The piping shall be supported as indicated on the Drawings and in accordance with the requirements of the pipe supports section.

G. Slope piping and arrange systems to drain at low points. Use eccentric reducers to maintain top of pipe level.

H. The inside of pipe, fittings, and transitions shall be smooth, clean, and free from blisters when installed.

I. Jointing Procedures: Training and Certification: All field butt joints shall be made by the pipe manufacturer or by employees of the CONTRACTOR who have been trained and certified by the pipe manufacturer. The pipe manufacturer shall provide hands-on training for the CONTRACTOR'S employees in the proper assembly of butt joints. The pipe manufacturer shall submit written certification that the CONTRACTOR'S employees have satisfactorily completely all training and instruction and can perform the jointing required for this Project in accordance with the pipe manufacturer's recommendations and as specified herein. The pipe manufacturer's representative shall be on-site for at least one 8-hour day, during which time he shall observe the assembly of at least three butt joints.

J. Adhesive Bonded Joints: All joint preparation, cutting, and jointing operations shall comply with the pipe manufacturer's recommendations. Adhesive shall be mixed and applied in accordance with the manufacturer's recommendations. Newly assembled joints shall be suitably blocked or restrained to prevent movement during the recommended curing period.

K. Flanged Joints: Flange bolts shall be tightened sufficiently to slightly compress the gasket and make a good seal, but not so tight as to distort the flanges. A flat washer shall be installed under each nut and bolt head.

L. Butt Joints: Butt joints shall be made in accordance with the manufacturer's recommendations and as specified herein. 24-inch and larger pipe shall be overlaid both inside (when accessible) and outside. The interior of the joint shall also be sealed by covering with not less than 0.100-inch of liner of the same material as the pipe. 18-inch and smaller pipe shall be overlaid on the outside only. The minimum width of the overlay shall be in accordance with manufacturer's recommendations. The inside overlaps shall be made to seal the joint, but shall not be considered in meeting the strength requirements.
   1. Finished joints shall be built up in successive layers, shall be as strong as the pieces being joined, and shall be crevice-free as is commercially practicable, in accordance with ASTM D2563. The width of the first layer shall be at least 4-inches. Successive layers shall increase uniformly to provide the specified minimum total width of overlay, which shall be centered on the joint. Crevices between jointed pieces shall be filled with resin, leaving a smooth inner surface.
   2. The inner surface shall be free of cracks and crazing, with a smooth finish, and with an average of not more than two pits per square foot, providing the pits are less than 1/8-inch in diameter, not more than 1/32-inch deep, and covered with sufficient resin to avoid exposure of inner surface fabric. Some waviness is permissible as long as the surface is smooth and free of pits. This surface may be reinforced with glass surfacing mat, synthetic fibers as usage requires.

M. Alignment: Piping shall be laid to the lines and grades indicated on the Drawings. Batter boards, laser beam equipment, or surveying instruments shall be used to maintain alignment and grade.
   1. Batter boards, if used, shall be erected at intervals of not more than 25 feet. Batter boards shall be used to determine and check pipe subgrade. At least three batter boards shall be maintained in proper position at all times when trench grading is in progress.
   2. If laser beam equipment is used, periodic elevation measurements shall be made with surveying instruments to verify accuracy of grades. If such measurements indicate thermal deflection of the laser beam due to differences between the ground temperature and the air temperature within the pipe, precautions shall be taken to prevent or minimize further thermal deflection.

N. Laying of Pipe: Pipe shall be protected from lateral displacement by placing the specified pipe embedment material. Pipe shall not be laid in water not under unsuitable weather or trench conditions.

1. Pipe laying shall begin at the lowest elevation with bell ends facing the direction of laying, except when reverse laying is permitted by the ENGINEER.
2. Whenever pipe laying is stopped, the open end of the pipe shall be closed with an end board closely fitting the end of the pipe, to keep sand and earth out of the pipe. The end board shall have several small holes near the center to permit water to enter the pipe and prevent flotation in the event of flooding the trench.

O. Field Tests: All necessary testing equipment and materials, including tools, appliances, and devices shall be furnished. All tests shall be made by and at the expense of the CONTRACTOR and at such time as directed by the ENGINEER. All tests shall be conducted in a manner acceptable to the ENGINEER and shall be repeated as many times as necessary to demonstrate compliance with specified requirements. The ENGINEER shall be present during all testing work. The piping system shall be tested at 5 psig, for pipe sizes 14-inch and larger, with air for at least one hour and shall not leak. The piping system shall be tested at 1.5 psig, for pipe sizes smaller than 14-inch, with air for at least one hour and shall not leak. All joints which are found to leak, by observation or during testing, shall be repaired by the CONTRACTOR, and the test repeated.
   1. Leakage may be determined by loss of pressure or other methods acceptable to the ENGINEER. All equipment or other accessories that would be damaged if subjected to the specified test pressure shall be disconnected, and the ends of branch lines plugged or capped, as required, during the testing procedures.

P. Air Balance: Testing, adjusting, and balancing of odor control systems shall be performed in compliance with the AABC National Standards for Field Measurement and Instrumentation, Total System Balance or NEBB Procedural Standards for Testing, Balancing and Adjusting of Environmental Systems. CONTRACTOR shall submit one copy of the standard procedure manual to the ENGINEER for record purposes only.
   1. Adjust volume dampers, control dampers, splitter dampers, air extractors, etc., to proper design cfm in main ducts, branch ducts, and zones.
   2. Prepare summation of readings of observed cfm for each system, compared with required cfm, and verify that duct losses are within specified allowable range.
   3. If the total measured cfm (sum of all branches) exceeds or is below the total design cfm, each branch shall be adjusted proportionally based on its percentage of each branch design cfm relative to the total design cfm.
   4. If the air systems are not properly balanced, CONTRACTOR shall rebalance and recheck all data in the presence of ENGINEER and as approved by the ENGINEER.

Q. Damper Installation:

1. Equipment Installation: The dampers shall be positioned to fit in the connecting pipe. Unless otherwise necessary for proper operation of the damper, the axles shall be installed in the horizontal position.
2. Cleaning: The inside of the dampers shall be smooth, clean, and free from blisters and dirt when installed.

++ END OF SECTION ++

SECTION 15068

REINFORCED CONCRETE PIPE

PART 1 - GENERAL

1.1 SUMMARY

A. Scope:
   1. Provide all labor, materials, equipment, and incidentals as shown on the Drawings, specified, and required to furnish and install reinforced concrete pipe, fittings, specials and appurtenances.

1.2 RELATED SECTIONS

A. Section 15051, Buried Piping Installation.

1.3 QUALITY ASSURANCE

A. Manufacturer's Qualifications:
   1. Manufacturer shall have a minimum of five years of experience of producing substantially similar equipment and shall be able to show evidence of at least five installations in satisfactory operation for at least five years.
   2. Each type of concrete pipe and fittings shall be the product of one manufacturer.

B. Reference Standards: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
   1. ASTM A36, Specification for Carbon Structural Steel.
   2. ASTM A283, Specification for Low and Intermediate Tensile Strength Carbon Steel Plates.
   3. ASTM A497, Specification for Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement.
   4. ASTM A569, Specification for Steel, Carbon, Hot-Rolled Sheet and Strip Commercial Quality.
   5. ASTM A570, Specification for Steel, Sheet and Strip, Carbon, Hot-Rolled, Structural Quality.
   6. ASTM A615, Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
   7. ASTM A663, Specification for Steel Bars, Carbon, Merchant Quality, Mechanical Properties.
   8. ASTM C14, Specification for Concrete Sewer, Storm Drain, and Culvert Pipe.
   9. ASTM C33, Specification for Concrete Aggregates.
   10. ASTM C76, Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
   11. ASTM C94, Specification for Ready-Mixed Concrete.
   12. ASTM C150, Specification for Portland Cement.

13. ASTM C361, Specification for Reinforced Low-Head Pressure Pipe.
14. ASTM C387, Specification for Packaged, Dry, Combined Materials for Mortar and Concrete.
15. ASTM C443, Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.
16. ASTM C478, Specification for Precast Reinforced Concrete Manhole Sections.
17. AWWA C208, Fabricated Steel Water Pipe Fittings.
18. AWWA C303, Concrete Pressure Pipe, Bar Wrapped, Steel Cylinder Type.
19. AWWA Manual M9, Concrete Pressure Pipe.
20. Maricopa Association of Governments Standard Specifications.

C. Inspection: The quality of all materials, process of manufacture, and the finished pipe shall be subject to the inspection and approval of the ENGINEER.

D. Shop Tests: Manufacturer shall conduct all shop tests in accordance with the requirements of AWWA C303.

1.4 SUBMITTALS

A. Shop Drawings: Submit for approval the following:
1. Detailed drawings and data on pipe, fittings, gaskets, and appurtenances. Submit these with Shop Drawings required under Section 15051, Buried Piping Installation.
2. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
3. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**

B. The manufacturer shall submit design calculations to the ENGINEER. The design calculations shall be signed and sealed by a Registered Professional Engineer licensed in the State of Arizona. The design calculations shall indicate that the pipe wall thickness will be satisfactory for all conditions of external pressure and earth loadings, special physical loadings, and internal pressure.

C. Certificates: Submit Certificates of Compliance with referenced standards.

D. Product Data: Couplings, materials, and pipe lining and coating.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 15051, Buried Piping Installation.

B. Install cross bracing at ends of pipe and fittings to eliminate excessive deflection. Keep braces in place until welding, backfilling, and compaction have been completed.

C. Store pipe and fittings on skids, sand or dirt berms, sand bags or tires, or other suitable means to prevent damage to pipe and fittings.

D. Inspect pipe lining and coating immediately before installation for damage and holidays. Correct deficiencies.

PART 2 - PRODUCTS

2.1 SERVICE CONDITIONS

A. General:
   1. Pipe shall be designed for an external live loading, including impact, equal to AASHTO H-20 truck loading. The external loading shall be calculated in accordance with MAG Section 758.

B. The allowable combined load compressive stress in the concrete shall not exceed 45% of the 28-day strength.

C. Service Conditions:
   1. Liquid Service: Plant Sanitary Sewer (Refer to Section 15050, Piping Systems.)
   2. Pipe Overburden and Trench Bedding Condition: Refer to Drawings.

D. Design Criteria:
   1. Internal Working Pressure: Gravity
   2. Internal Field Test Pressure: Gravity
   3. Unit Weight of Fluid: 62.4 lbs per cubic foot (pcf).
   4. Height of Earth Cover Over Pipe: Refer to Drawings. Height of cover shall be the greater of 8 feet or the maximum cover over the entire pipe run.
   5. Time period of exposure to outdoor environment shall not exceed 180 days.

6. Relative humidity of the outdoor environment is 25%.
7. External Live Load: HS20 per AASHTO, calculated at 4 feet of cover or the cover depth shown on Drawings, whichever creates a larger load.
8. Unit Weight of Earth for Determining Earth Load on Pipe (assume a positive projecting embankment condition): 120 pcf.
9. Settlement Ratio, rsdp: 0.3.
10. Soil Coefficient, Ku and Ku': 0.150.
11. Maximum Allowable Deflection Under Specified External Loads: $D^2/4000$.
12. Bedding Constant, K: 0.1.
13. Modulus of Soil Reaction, E': 700 psi.
14. Minimum Deflection Lag Factor, D^l: 1.0.
15. Earth loads on pipe shall be calculated assuming a positive projecting embankment condition.
16. Maximum Allowable Stress for Determining Throat Thickness of Welds at Restrained Joints (E60 low-hydrogen electrode): 8,800 psi.
17. Maximum Allowable Stress in Steel Cylinder and at Restrained Joints: Lesser of 15,000 psi or 50% yield stress of steel alloy.
18. Inside Clear Diameter: As noted in Piping Schedule.
19. Steel Cylinder Thickness: Shall be the thicker of:
    a. Requirements of AWWA C303.
    b. Thickness calculated using design criteria.
    c. Increase cylinder thickness as necessary at bends, fittings, anchorages, and other locations where stress due to thrust forces may occur.
20. Maximum height of groundwater shall be top of wall of connecting structure or ground surface, whichever is greater.

2.2 CONSTRUCTION AND MATERIALS

A. Reinforced Concrete Pipe:
   1. Pipe and fittings shall conform to the requirements of AWWA C303. Pipe shall have the following features: A welded steel cylinder with sized steel joint rings welded to its ends; a lining of concrete or cement mortar centrifugally applied within the steel cylinder and spigot ring; reinforcement consisting of continuous steel rod wound helically around the outside of the cylinder at predetermined stress and securely fastened by welding to the steel joint ring at each end of the cylinder; a coating of dense mortar covering the cylinder and rods, except for the necessary exposed surfaces of the spigot joint rings; and a self-centering watertight preformed rubber gasket.

B. Pipe Materials:
   1. Cement for concrete work shall be in accordance with ASTM C150, Type II.
   2. Aggregates for concrete work shall be in accordance with ASTM C33.
   3. Steel for cylinders, joint and fittings shall be in accordance with ASTM A570, ASTM A569, or ASTM A283.
   4. Unless otherwise specified, fittings for concrete cylinder pipe shall be fabricated from steel plate or sheets and shall be cement mortar coated. All fittings shall

conform to AWWA C303 and the dimensional requirements of AWWA C208, and shall be equal to the strength of the pipe. Bell adapters shall be fabricated from steel plate and shall be accurately dimensioned for a rubber gasket.

5. Steel for reinforcements shall be in accordance with ASTM A663, Grade 80; ASTM A615, Grade 40; or ASTM A497.
6. Rubber for gaskets shall contain not less than 50% by volume of first grade natural crude or first grade synthetic rubber. The remainder of the compound shall consist of pulverized fillers free from rubber substitutes, reclaimed rubber, and other deleterious substances.

C. Pipe Closures:
   1. Pipe layout submitted by the manufacturer shall reflect CONTRACTOR'S planned schedule for operations and the schedule of construction.
   2. Pipe closures shall be designed by the manufacturer for the pressure required and shall be located in straight runs of pipe.
   3. The number, design, and location of all closure pieces shall be as shown on the Drawings or subject to the approval of the ENGINEER.
   4. CONTRACTOR'S Option: To either cut the closure cylinder to the required length in the field, or if timing permits, to have the pipe manufacturer supply the required length based upon exact field measurements.
   5. No extra payment will be made for closures, including the cost of concrete required for protection of the cylinder and joint rings.

D. Restrained Joints:
   1. All joints shall be restrained.
   2. Restrained joints shall be full circumferential welded joints.
   3. All restrained joints shall be designed for the maximum working pressure.
   4. Design steel cylinders and welds between cylinders and joint rings for the axial thrust exerted by full working pressure.
   5. Increase thickness of cylinder as necessary, taking into account the effect of stresses caused by thrust loads.
   6. Restrained joints shall be capable of withstanding all internal and external forces applied to the pipe during service and testing without additional thrust blocking or anchoring.

E. Wall Fittings:
   1. Connection to structures shall be made by casting a fabricated bell wall fitting into the concrete.
   2. Fabricated bell wall fittings shall consist of a bell ring suitable for connection to the steel spigot, steel pipe section, and waterstop ring, all welded together to form a complete unit, with a laying length equal to the width of the wall in which it is installed, plus any necessary additional length to accommodate the pipe connection.
   3. Fittings shall have a welded fabric or wire mesh reinforced mortar lining furnished to the interior diameter of the connecting pipeline.
   4. Connect sluice gates and flanged piping to special fabricated flange wall fittings.

5. Fabricated flange wall fittings shall consist of a steel flange, steel pipe section, waterstop ring, and a bell ring suitable for connection to the steel spigot to be furnished, all welded together to form a complete unit, with a laying length equal to the width of the wall in which it is installed, plus the necessary additional length to accommodate the pipe connection.
6. Fittings shall have a welded fabric or wire-mesh reinforced mortar lining finished to the interior diameter of the connecting pipe.
7. Flanges shall be stress relieved after welding to the steel pipe section and then machined.
8. Flanges shall be drilled and tapped to receive Type 316 stainless steel stud bolts.
9. Flanges shall conform to AWWA Standard C207 for steel flanges, Class D, with ANSI B16.1, Class 125 drilling.
10. The maximum lay length of the first section of pipe out of the wall fitting shall be 4 feet.

F. PVC Sheet Liner for Reinforce Concrete Pipe:
1. PVC sheet liner shall be Ameron T-lock or approved equal. The manufacturer of the lining shall furnish to the District an affidavit attesting to the successful use of its material as a lining for sewer pipes for a minimum period of 10 years in sewage conditions recognized as corrosive or otherwise detrimental to concrete. All work for and in connection with the installation of the lining in concrete pipe, and the field sealing and welding of joints, shall be done in strict conformity with all applicable specifications, instructions and recommendations of the lining manufacturer. All welding must be done by individuals who have certification by manufacturers of each individual that will be performing the work.

G. Coating thickness:
1. The cement-mortar coating shall provide a minimum cover of 3/4-inch over the bar reinforcement or 1-inch over the cylinder, whichever results in the greater thickness.

H. Flanges:
1. Provide flanges of the type specified, as follows:
   a. For Design Pressures 175 lbs per square inch Gauge, or Less:
      1) For Piping 12-inches and less in Nominal Diameter: Class D or E in accordance with AWWA C207, or Class 150 in accordance with ANSI B16.5.
      2) For Piping Larger than 12-inches in Nominal Diameter: Class 150 in accordance with ANSI B16.5.
   b. For Piping with Design Pressures Exceeding 175 lbs per square inch Gauge: Class 300 in accordance with ANSI B16.5.
2. Provide flat face flanges.
3. Position bolt holes to straddle the vertical axis of the pipe.
4. For flanged valves installations, match the valve flanges in size and pressure rating.

5. Flanged Bolts for Underground Installation: Type 304 or Type 316 stainless steel.
    a. During installation, protect threads with a product designed for that purpose, manufactured by Anti-Seize Compound, Permatex, or equal.

I. Shop Coat of Primer:
1. Provide shop coating of primer on flanges and exposed portions of pipe.

J. Bend Radii of Fittings:
1. Minimum 2.5 times the nominal diameter.

K. Fabricated Steel Piping Fittings and Specials:
1. General:
    a. Specified herein are the design and fabrication requirements for fabricated steel piping fittings and specials, which include elbows, branches, nozzles, manifolds, headers, heads, collars, stiffeners, reinforcements, and other piping fittings and specials.
2. Design:
    a. Design and Detail Fittings and Specials.
        1) Design: In accordance with AWWA Manual M9, as complemented and modified herein.
        2) Nozzles: Reinforced in conformance with in AWWA Manual M11.
        3) Design reinforcing for internal pressure of 250 lbs per square inch, minimum.
        4) Fittings: Conform in dimensions to AWWA C208.
        5) Do not utilize a value for the working stress of more than 50% of the yield stress of the steel.
    b. Thickness of Fittings and Specials: Use the thicker of:
        1) Thickness designed in accordance with the design methods specified in the preceding Subparagraph 1.
        2) Thickness indicated on the Drawings.
        3) Thickness specified in the following:
            a) For fittings and specials smaller than 72-inches in diameter, minimum 1/4-inch.
            b) For fittings and specials 72-inches and larger, minimum 5/16-inch.
        4) Ends of fittings to be welded to pipe shall be beveled for welding.
3. Fabrication:
    a. Shop fabricate in units as long as practicable for safe hauling and installation. Minimize number of field welds.
    b. Fabricate to uniform lengths with proper end clearance for the specified types of joint or attachment.
    c. Fabricate to allow field assembly without cutting or special work.

L. Gaskets:

1. Minimum tensile strength, tested in accordance with ASTM D412, between 2,000 and 2,700 lbs per square inch.
2. Minimum elongation, tested in accordance with ASTM D412, between 350% and 400%.
3. Shore A durometer hardness, tested in accordance with ASTM D2240, between 50 and 65.
4. Specific gravity, tested in accordance with ASTM D297, between 0.90 and 1.50.
5. Maximum compression set, tested in accordance with Method B of ASTM D395, 20%.
6. Maximum tension strength loss, tested in accordance with ASTM D573 at 96 hours, 70° C, in air, 20%.
7. Maximum elongation loss, tested in accordance with ASTM D573 at 96 hours, 70° C, in air, 20%.

M. Flange Bolts, Nuts, and Washers:
1. Buried Locations: ASTM A193 stainless steel, Type 316 or 304.
2. Exposed Locations: In accordance with AWWA C207.

2.3 MARKING FOR IDENTIFICATION

A. All pipeline materials shall be stamped, marked, or identified with the following information:
1. Name or trademark of the manufacturer.
2. Pipe class and specification designation.
3. Size and length dimensions.
4. Date and place of manufacture.
5. Pipe 24-inches and larger shall also be marked on its interior as above.

PART 3 - EXECUTION

3.1 INSTALLATION

A. For buried piping installation, refer to Section 15051, Buried Piping Installation.

B. All exposed metal surfaces that are not lined and coated at the factory shall be treated with one coat of factory-applied lead-free primer.
1. A diaper shall be used and filled with concrete sand slurry for these areas to encase and protect the pipe.
a. This requirement shall apply to flanges, joint rings and bells, field closures, and any other portions of pipe or fittings, which are not otherwise protected from corrosion.

++ END OF SECTION ++

SECTION 15120

PIPING SPECIALTIES AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install all piping specialties and accessories. Included, but not limited to, are flexible couplings, mechanical couplings, flanged and harnessed adapters, and expansion joints.

1.2 RELATED SECTIONS

A. Section 09900, Painting.

B. Section 11295, Hydraulic Valves.

C. Division 15, Mechanical.

1.3 REFERENCES

A. Manufacturer's Qualifications:
   1. Manufacturer shall have a minimum of five years of experience in the production of substantially similar types of piping specialties specified and shall show evidence of satisfactory service in at least five installations.
   2. Each type of piping specialty and accessory shall be the product of one manufacturer.

1.4 SUBMITTALS

A. Shop Drawings: Submit for approval the following:
   1. Detailed drawings and data on each type of coupling, adaptor, expansion joint, and sight glass to be furnished. Submit and coordinate these with Shop Drawings required for piping systems.
   2. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a

detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

3. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 15051, Buried Piping Installation, and Section 15052, Exposed Piping Installation.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Couplings: Unless otherwise specified, piping 2-inches in diameter and larger passing from concrete to earth shall be provided with two pipe couplings or flexible joints as specified within 2 feet or one pipe diameter of the structure, whichever is greater.
   1. Sleeve Type, Flexible Couplings:
      a. Pressure and Service: Same as connected piping.
      b. Material: Carbon steel for carbon steel and exposed ductile iron piping systems, or stainless steel for stainless steel and buried or submerged ductile iron piping systems.
      c. Gasket: Suitable for wastewater service or high temperature air service.
      d. Bolts and Nuts: Alloy steel, corrosion-resistant, prime coated. Buried couplings shall have Type 316 stainless steel bolts and nuts.
      e. Harnessing:
         1) Harness couplings to restrain pressure piping. Test pressures for pressure pipe lines are included in the Piping Schedules in Section 15051, Buried Piping Installation, and Section 15052, Exposed Piping Installation.
         2) Adjacent flanges shall be tied with bolts of corrosion resistant alloy steel. Provide flange mounted stretcher bolt plates as shown and to be designed by manufacturer, unless otherwise approved.

3) Conform to dimensions, size, spacing, and materials for lugs, bolts, washers, and nuts as recommended by manufacturer and approved by ENGINEER for the pipe size, wall thickness, and test pressure required. However, the following minimum bolting shall be provided, unless otherwise approved by the ENGINEER.

Pipe Diameter (inches)	Number of Bolts	Bolt Diameter (inches)	At (degrees)
4	2	5/8	180
6-8	2	3/4	180
10-12	2	7/8	180 or 250
14-20	4	1	190
24-48	4	1	90

f. Remove pipe stop, unless otherwise shown or specified.
g. Product and Manufacturer: Provide one of the following:
   1) Style 38, as manufactured by Dresser Industries.
   2) Type 411, as manufactured by Rockwell International.
   3) Or approved equal.

2. Flanged Adapters:
   a. Description: One end of adapter shall be flanged and the other end shall have a sleeve type flexible coupling.
   b. Pressure and Service: Same as connected piping.
   c. Material: Cast iron or steel.
   d. Gasket: Suitable for wastewater service and can withstand the specified temperature. EPDM gaskets for 250° F air service.
   e. Bolts and Nuts: Type 316 stainless steel.
   f. Harnessing:
      1) Harness adapters to restrain pressure piping. Test pressures for pressure pipe lines are included in the piping schedules in Section 15051, Buried Piping Installation, and Section 15052, Exposed Piping Installation.
      2) For adapters 12-inch diameter and less, provide 1/2-inch minimum stainless steel anchor studs installed in a pressure tight anchor boss. Provide number of studs required to restrain test pressure and service conditions. Harness shall be as designed and recommended by manufacturer; however, the following minimum anchor studs shall be provided, unless otherwise approved by ENGINEER.

a) 6-inch diameter and less: Two.
b) 8-inch diameter and less: Four.
c) 10-inch diameter and less: Six.
d) 12-inch diameter and less: Eight.

3) For adapters larger than 12-inch diameter, provide split-ring harness clamps with a minimum of four Type 316 stainless steel bolts. Harness assembly shall be as designed and recommended by manufacturer. Dimensions, sizes, spacings, and materials shall be suitable for service and conditions encountered and shall be approved by ENGINEER.
4) Harness couplings to restrain pressure piping.
5) Test pressures for pressure pipe lines are included in the piping schedules in Section 15051, Buried Piping Installation, and Section 15052, Exposed Piping Installation.
6) Harnessing shall conform to the details shown on the Drawings.

g. Product and Manufacturer: Provide one of the following (Manufacturers listed in alphabetical order):
1) Type 913, as manufactured by Rockwell International.
2) Style RFCA, as manufactured by Romac Industries, Inc.
3) Or approved equal.

B. Rubber Type Expansion Joints:
1. General:
a. Use rubber type expansion joints at all expansion joint locations, as noted on the Drawings.
2. Construction:
a. Tube and Cover: EPDM w/Kevlar.
1) Fabric Reinforcement: High quality cotton or synthetic fabric impregnated with rubber or other synthetic compounds to permit flexibility.
2) Metal Reinforcement: Wire or solid steel rings embedded in and bonded to the body rubber.
b. Retaining Rings:
1) Stainless Steel (Type 316)
2) Drilled to match flanged drilling.
c. Flanges: Rigid Steel Mating Flange.
d. Temperature:
1) Expansion couplings for ambient service shall be suitable for service temperature up to 350° F at 25 psi pressure.
3. Restraints:
a. General:
1) Provide control units on all expansion joints to permit movement and prevent excessive compression or elongation.
2) Furnish and install control units complete with all tie bolts, drilled plates, spacers, rubber and steel washers, stretcher bolt plates,

retaining rings, stretcher bolts, sleeves, and appurtenances, as required.

3) Design and install all control units to limit expansion and compression to within the manufacturer's standard limits.
4) Design the stretcher bolts and sleeves to withstand the maximum thrusts developed within the piping system.
5) Anchor, guide, and install all expansion joints according to the manufacturer's recommendations.
6) Harness all rubber expansion joints by tying between adjacent flanges.

b. Materials:
1) Stretcher Bolts and Nuts:
a) Material: Type 304 stainless steel.
b) Number:
i) Twice the number of stretcher bolts as recommended by manufacturer.
ii) Minimum four required for each rubber expansion joint.

c. Washers: Rubber or neoprene.

4. Product and Manufacturer: Provide one of the following (Manufacturers listed in alphabetical order):
a. Standard spool type, single arch by Mercer Rubber Company.
b. Standard spool type, single arch by U.S. Rubber.
c. Or approved equal.

C. Stainless Steel Expansion Joints:
1. Stainless steel expansion joints are required on all exterior yard air piping, process aeration piping, as well as interior blower facility air piping, as indicated on the drawings and specified.
2. All expansion joints shall be provided for a minimum axial movement of 2.50-inches for expansion and 1-inch for contraction per 100 feet length between any two fixed supports.
3. Expansion joint elements shall be hydraulically formed of single ply austenitic stainless steel and shall be selected by the manufacturer to withstand the specified pressure and temperature conditions and to absorb thermal expansion of the piping. Joints shall be free flexing type with internal sleeves and shall be of Type 316L stainless steel construction on air piping headers located upstream of 20-inch butterfly valves for the four aeration basins as indicated in mechanical drawings. Design burst strength shall be equal to minimum four times the working pressure of 7.6 psig for process air piping. Test hydrostatic pressures shall be equal to 10.5 psig for expansion joints in process air piping.
4. Expansion joints in yard air piping shall have an internal guide with a thickness equal to the piping system thickness.
5. Harness joints as shown, against thrust for the test pressure in the pipe line. Test pressures for air pipe lines are included in the piping schedules in

Section 15052, Exposed Piping Installation. Harnessing shall be by two or more limit rods connected between flanges set for maximum allowable elongation of the joint. Limit rods and connection accessories shall be of Type 316 stainless steel for Type 316L stainless steel expansion joints. Limit rods shall be provided in accordance with the recommendations of the expansion joint manufacturer.

6. Product and Manufacturer: Provide one of the following (Manufacturers listed in alphabetical order):
   a. Hyspan.
   b. Pathway Bellows, Incorporated.
   c. Victaulic Depend-O-Lok, Inc., Omni-Flex.
   d. Or approved equal.

D. Expansion Joints – Sludge Pipes:
   1. Sludge expansion joints shall have suitable packing good for temperatures greater that 212° F. Where sludge expansion joints are installed in glass lined pipe, the slip pipe shall be glass lined. The interior of the body shall be coated with Protecto 401 ceramic epoxy. Where the pipes are not glass lined, the slip pipe shall be lined with Protecto 401 ceramic epoxy and the interior of the body shall be coated with Protecto 401 ceramic epoxy. Exterior surface are of slip pipe in contact with the packing during movement shall be chrome-plated machined surface.
   2. Product and Manufacturer: Provide one of the following (Manufacturers listed in alphabetical order):
      a. Dresser Industries Inc., Style 63.
      b. Smith-Blair, Model 611, with stainless steel hardware.
      c. Or approved equal.

E. Special Restrainers for PVC Pipe:
   1. All transitions from PVC pipe to DIP shall be provided with a restraining device. The device must not impart point loads or distort PVC pipe. Device shall be a two-piece uni-flange design with machined serrations on the inside diameter of the flange. Device must be rated for all rated pressures of PVC pipe class and range in sizes of 2-inch diameter to 36-inch diameter for PVC pipe. Restrained device shall be Uni-Flange Block Buster 1300, as manufactured by Ford Meter Box.

F. Dielectric Connections:
   1. Where a copper pipe is connected to steel or cast iron pipe, an insulating section of rubber or plastic pipe shall be provided. The insulating section shall have a minimum length of 12 pipe diameters. Dielectric unions may be used instead of the specified insulating sections.
   2. Product and Manufacturer: Provide one of the following (Manufacturers listed in alphabetical order):
      a. Capitol Manufacturing.
      b. EPCO.

c. Or approved equal.

G. DIP to RCP Adapters:
1. Provide large diameter couplings for connection of ductile iron pipe to reinforced concrete pipe. Coupling shall be 3/8-inch thick flexible PVC with stainless steel straps and T-bolt clamps, as manufactured by Fernco. Provide Fernco bushings when outside diameters differ more than 1-inch. Large diameter couplings shall be restrained with Star National Harness Restraints, Models 24-1BS18 and 24-1BCS18, Star Tieanchor III with 3/4-inch SS12 SuperStar Tierods and Tienuts.

H. DIP to PVC Adapters:
1. All transitions from CPVC/PVC pipe to DIP pipe shall be provided with a restraining device. The device must not impart point loads or distort CPVC/PVC pipe. Device shall be two-piece uni-flange design with machine serrations on the inside diameter of the flange. Device must be rated for all rated pressures of CPVC/PVC pipe class and range in sizes of 2-inch diameter to 36-inch diameter for CPVC/PVC pipe. Restrained device shall be Uni-Flange Block Buster 1300 as manufactured by Ford Meter Box.

I. DIP to CCP Adapters:
1. Per manufacturers recommendations.

J. Spray Nozzles
1. Design:
a. Operating pressure 10 pounds per square inch gauge, at which pressure each nozzle discharges not less than 3.5 gallons per minute, nor more than 5.0 gallons per minute.
1) Spray: Flat, heavy sheet, fan with uniform distribution.
2) Fan width at the water surface not less than 5 feet at 10 pounds per square inch gauge.
3) Spray deflection with a replaceable deflector insert free to rotate away from the orifice opening and mechanically locked in place and counterweighted.
b. Spray nozzles structurally suitable for pressure up to 200 pounds per square inch gauge.
c. Nozzles, easy flush type.
2. Materials:
a. Counterweight Lever: Brass Casting.
b. Inlet Body: Brass Casting.
c. Nozzles provided with 1/4 inch national pipe thread, and the orifice diameter not less than 1/4 inch.
d. Spray deflector: Neoprene rubber.

2.2 PAINTING

A. Clean and prime coat ferrous metal surfaces of equipment in the shop in accordance with the requirements of Section 09900, Painting.

B. Coat machined, polished and non-ferrous surfaces and similar unpainted surfaces with corrosion prevention compound which shall be maintained during storage and until equipment begins operation.

C. Field painting shall conform to the requirements of Section 09900, Painting.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install piping specialties and accessories in accordance with manufacturer's instructions.

B. Make adjustments to expansion joints as required to ensure that they will be fully extended when the ambient temperature is at minimum operating temperature and fully compressed at maximum operating temperature for the system in which they are installed.

++ END OF SECTION ++

SECTION 15140

SUPPORTS AND ANCHORS

PART 1 - GENERAL

1.1 SUMMARY

A. All supports and anchors on the site shall adhere to these specifications.

1.2 SECTION INCLUDES

A. Pipe and equipment hangers and supports.

B. Equipment bases and supports.

C. Sleeves and seals.

D. Flashing and sealing equipment and pipe stacks.

1.3 SUBMITTALS

A. Descriptive submittals shall be made in accordance with the Data Reference symbols defined in Section 01300, Submittals.
   1. Shop Drawings: Indicate system layout with location and detail of trapeze hangers.
   2. Product Data: Provide manufacturers' catalog data for pipe hangers, pipe supports, and roof curbs, including load capacity.
   3. Design Data: Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers.
   4. Manufacturer's Installation Instructions: Indicate special procedures and assembly of components.

B. Shop Drawings: Submit for approval the following:
   1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph

not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

2. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**

1.4 QUALITY ASSURANCE

A. Base selection and location of pipe hangers on MSS SP69, Pipe Hangers and Supports - Selection and Application.

1.5 REGULATORY REQUIREMENTS

A. Conform to specified code for support of plumbing piping.

PART 2 - PRODUCTS

2.1 PIPE HANGERS AND SUPPORTS

A. Plumbing Piping - Potable Water/DWV/Non-Potable Water/Storm Drain/Drain:
   1. Conform to 2012 International Plumbing Code.
   2. Hangers for Pipe Sizes 1/2-inch to 3-inches: Malleable iron or carbon steel; Type 6 adjustable swivel, split ring, or Type 10 adjustable swivel band type.
   3. Hangers for Pipe Sizes 4-inches and Over: Type 1 carbon steel, adjustable, clevis.
   4. Multiple or Trapeze Hangers: Steel channels with spacers and hanger rods, double nuts, or Type 41 cast iron roll, double nuts.
   5. Wall Support for Pipe Sizes to 2-inches: Type 12 split extension or cast iron hook.
   6. Wall Support for Pipe Sizes 3-inches and Over: Type 33 welded steel bracket and oversized U-bolt.
   7. Vertical Support: Type 8 steel riser clamp.
   8. Floor Support for Pipe Sizes to 3-inches and all DWV Pipe Sizes: Type 37 cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support, or Type 46 adjustable cast iron roll and stand, steel bolts, and concrete pier or steel support.
   9. Floor Support for Pipe Sizes 4-inches and Over: Type 46 adjustable cast iron roll and stand, steel bolts, and concrete pier or steel support.
   10. Protection Saddles for Piping 2-1/2-inches and Larger: Hard block non-conducting saddles in 90 degree segments, 12-inch minimum length, block thickness same as insulation thickness.

11. Copper Pipe Support: Copper plated or vinyl coated.

2.2 ACCESSORIES

A. Hanger Rods in dry areas: Galvanized threaded both ends, threaded one end, or continuous threaded.

B. Hanger Rods in wet areas: Stainless Steel threaded both ends, threaded one end, or continuous threaded.

2.3 HANGER INSERTS

A. Inserts: Stainless Steel or galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.4 FLASHING

A. Metal Flashing: 0.032-inch thick aluminum; 26 gauge galvanized steel.

B. Metal Counterflashing: 0.05-inch thick aluminum; 22 gauge galvanized steel.

C. Flexible Flashing: 47 mil thick sheet EPDM or butyl; compatible with roofing.

D. Caps: Steel, 22 gauge minimum; 16 gauge at fire resistant elements.

E. Flashing shall be compatible with specified roofing material.

2.5 SLEEVES

A. Sleeves for Pipes Through Non-fire Rated Floors: 18 gauge galvanized steel or 0.08-inch thick aluminum.

B. Sleeves for Pipes Through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gauge galvanized steel or 0.08-inch thick aluminum.

C. Sleeves for Pipes Through Fire Rated and Fire Resistive Floors and Walls, and Fire Proofing: Pre-fabricated fire rated sleeves, including seals UL listed.

D. Sleeves for Round Duct Work: 0.08-inch thick aluminum.

E. Sleeves for Rectangular Duct Work: 0.08-inch thick aluminum.

F. Stuffing Insulation: Glass fiber type, non-combustible.

G. Sealant: Acrylic; refer to Division 7, Thermal and Moisture Protection.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

3.2 INSERTS

A. Provide inserts for placement in concrete formwork.

B. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4-inches.

D. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

E. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut flush with top of slab.

3.3 PIPE HANGERS AND SUPPORTS

A. Support piping in accordance with the code or standard that the piping system is installed under.

B. Install hangers to provide minimum 1/2-inch space between finished covering and adjacent work.

C. Place hangers within 12-inches of each horizontal elbow.

D. Use hangers with 1-1/2-inch minimum vertical adjustment.

E. Support horizontal cast iron pipe adjacent to each hub, with 5 feet maximum spacing between hangers.

F. Support vertical piping at every floor. Support vertical cast iron pipe at each floor at hub.

G. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.

H. Support riser piping independently of connected horizontal piping.

I. Provide copper plated or vinyl coated hangers and supports for copper piping.

J. Design hangers for pipe movement without disengagement of supported pipe.

K. Prime coat exposed steel hangers and supports. Refer to Division 9, Finishes. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

3.4 EQUIPMENT BASES AND SUPPORTS

A. Provide equipment pads of concrete, minimum 4-inches thick and extending 6-inches beyond supported equipment. Refer to Division 3, Concrete.

B. Provide templates, anchor bolts, and accessories for mounting and anchoring equipment.

C. Construct supports of aluminum structural members. Brace and fasten with flanges bolted to structure.

D. Provide rigid anchors for pipes after vibration isolation components are installed.

3.5 FLASHING

A. Provide flexible flashing and metal counterflashing where piping and duct work penetrate weather or waterproofed walls, floors, and roofs.

B. Flash vent and soil pipes projecting 3-inches minimum above finished roof surface with pre-fabricated EPDM sealing system with aluminum base and stainless steel clamps.

C. Seal floor drains watertight to adjacent materials.

3.6 SLEEVES

A. Set sleeves in position in formwork. Provide reinforcing around sleeves.

B. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.

C. Extend sleeves through floors 1-inch above finished floor level. Caulk sleeves.

D. Where piping or duct work penetrates floor, ceiling, or wall, close off space between pipe or duct and adjacent work with stuffing insulation and caulk air tight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.

E. Install chrome plated steel escutcheons at finished surfaces.

F. Provide alkali resistant coating on aluminum sleeves before installing in contact with mortar, concrete, or other masonry.

++ END OF SECTION ++

SECTION 15260

PIPING INSULATION

PART 1 - GENERAL

1.1 WORK INCLUDED

A. All work specified in this section shall comply with the provisions of these specifications.

B. Work required under this section consists of insulation for piping and duct systems and equipment specified in Division 15.

C. Provide all necessary labor, materials, tools, and equipment to perform work required on the drawings and specified herein.

D. Certain equipment and/or systems to be factory insulated by the manufacturer. Factory insulation materials to be as specified in applicable sections of the specifications.

E. All pipe, fittings, and valves to be insulated.

F. Thermal resistance "R" values used herein are expressed in units of hour/degrees F/sq. ft./Btu per inch of thickness on a flat surface at a mean temperature of 75ºF, unless specifically noted.

1.2 DEFINITIONS

A. "Exposed" equipment, ducts and piping are areas which will be visible without removing ceilings or opening access panels. "Concealed" is not "Exposed."

B. Outdoors is considered exposed to the weather.

C. Underground is buried, whereas in a trench below grade is considered concealed.

1.3 APPLICABLE CODES AND STANDARDS

A. ASTM E-84.

B. NFPA 225.

C. UL 723.

D. NFPA 90A.

1.4 SUBMITTALS

A. Submit digital copy of all insulating materials data for review by the Architect.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. CertainTeed, Armstrong, Owens-Corning, Manville.

2.2 CERTIFICATION/QUALITY ASSURANCE

A. Only products of manufacturers meeting this specification will be approved.

B. Products shall meet applicable national, model, state and local building codes and be UL (or other recognized testing lab) listed for intended service.

C. All insulation materials shall be delivered and stored in manufacturer's containers and kept free from dirt, water, chemical, and mechanical damage.

D. All insulation, adhesives, coatings, sealers, tapes, shall have a flame spread rating of 25 or less and smoke development of 50 or less when tested in accordance with ASTM E-84, NFPA 225, UL 723, and further must meet the requirements of NFPA 90-A where applicable and model and local buildings, plumbing, and mechanical codes.

E. Insulation for duct, pipe, and equipment for above grade exposed to weather outside building shall be certified as being self-extinguishing for 2" thickness in less than 53 seconds when tested in accordance with ASTM D1692.

2.3 MATERIAL FOR PIPE

A. Materials for Pipe and Equipment: Provide factory premolded or shop or site metered segment type insulation for pipe, pipe fittings, and valves. Fitting insulation to be of same thickness and material as adjoining pipe insulation.
   1. Flexible Tubular Elastomeric:
      a. Provide fire-retardant closed-cell slip-on flexible type similar to Armstrong Armaflex. Product to have continuous operational temperature limit of not less than 220ºF and a minimum "R" value of 2.57.
      b. Use flexible tubular elastomeric for the following services:
         1) Moisture condensate drains - ½" thick.
         2) Remote drinking fountain cold water piping from cooler to fountain ½" thick.
         3) Exposed waste piping serving handicap lavatories.
      c. Seal all joints with vapor barrier mastic similar to Childers CP-30.
   2. Glass Fiber:

a. Provide factory-formed, fiberglass pipe insulated factory-jacketed system type similar to Manville Micro-Lok ASJ heavy density, one-piece, dual temperature, and premolded insulation with temperature limit of 850ºF.
b. Insulate all valves, fittings and flanges with 3-pound density fiberglass insulation to a thickness equal to the adjacent piping insulation and covered with premolded 25/50 rated PVC fitting, vapor sealed with Childers CP-30 vapor barrier mastic.
c. Jacket to be fiberglass reinforced white kraft paper bonded to aluminum foil.
d. Use glass fiber insulation for the following services:
    1) Domestic hot water piping; 1" thick.
e. The insulation shall be applied over clean, dry pipe with all joints butted firmly together.
f. All piping exposed to exterior shall be insulated with Manville Metal-Lok, CSG, Gustin-Bacon, Brower, Armstrong or approved.
    1) The insulation shall be jacketed with a minimum thickness of 0.016" aluminum. The insulation and aluminum shall be secured in place by a continuous friction type joint to provide a positive weatherproof seal along the entire length of the aluminum jacket.
    2) Then an aluminum preformed strap containing a permanently plastic weatherproof sealant shall be centered over each circumferential joint and secured by tightening of a clip or by use of separate ½" wide stainless steel banding (.015" minimum thickness).
    3) Fittings: All elbows, tubes, turns, sweeps and bends shall be insulated with metered sections of insulation and covered with preformed aluminum fitting cover. Joints shall be sealed with a sealing compound and preformed aluminum bands such as Manville Miter-Seals.
g. Insulated piping exposed in mechanical equipment rooms shall be coated using arabol and canvas or white PVC plastic
    1) jacket installed in accordance with manufacturer's instructions.

PART 3 - EXECUTION

3.1 GENERAL

A. Insulation shall be applied in a workmanlike manner by experienced, qualified workmen.

B. Insulation shall not be applied until all pressure testing has been completed, inspected and released for insulation applications. (This does not apply to ductwork with acoustical liner.)

C. No pipe insulation shall be cut where a hanger is located. If hangers have been installed which violates this strict requirement notify the Architect immediately.

D. All surfaces shall be clean and dry when covering is applied. Covering to be dry when installed and before and during application of any finish, unless such finish requires specifically a wetted surface for application.

E. All adhesives, cements, and mastics shall be compatible with materials applied and shall not attack materials in either wet or dry state.

F. Install insulation using professional insulators who have adequate experience and ability.

G. Exposed-to-view insulation shall have a well-tailored appearance.

3.2 INSTALLATION OF INSULATION

A. Piping Insulation:
   1. Insulation end joints to be tightly butted together and the longitudinal seam stapled closed with outward clinch staples, 3" on center. Before stapling, heavily coat the underside of the jacket overlap with vapor barrier adhesive, Childers CP-30 or equal. Locate all longitudinal seams out of sight.
   2. Cover end joints with factory furnished, 4" wide vapor barrier striping tapes, heavily coating the underside and secure with vapor barrier adhesive. Seal all ends of pipe insulation with vapor barrier mastic at valves, fittings, flanges, direct hanger contacts and every butt joint of straight run.
   3. In addition to ASJ jacket, cover all piping, valves, fittings, etc., in all exposed areas and all catwalk areas and where exposed to view with white PVC plastic jacket installed in accordance with manufacturer's instructions or 8-ounce canvas sized with Foster's 30-36 or equal Arabol lagging adhesive and left suitable for painting. Final installation shall be vaportight.
   4. Valves, Fittings and Flanges: Insulate all valves, fittings and flanges with 3-pound density, flexible fiberglass insulation to a thickness equal to the adjacent piping insulation and covered with premolded 25/50 rated PVC fittings, vapor sealed with Childers CP-30 vapor barrier mastic.
   5. Hangers and Rollers: At hangers and rollers where the pipe is supported by the insulation, the Insulation Contractor shall install an insert section of wood cellular glass or calcium silicate on all piping 3" diameter and larger inside the vapor barrier. The length of insert section shall not be less than 12" for all piping through 8" and 18" on pipe size 10" and over. Coat the insert section with vapor barrier mastic to provide an effective vapor seal.
   6. Provide a protective shield covering of 18 gauge for piping 6" and smaller and 16 gauge for 8" and larger, galvanized steel placed centrally between the insert section of all hangers and rollers. Shield shall cover half of the insulation and have a length of not less than 12" on pipe sizes up to 8" and 18" on pipe sizes 10" and over.

++ END OF SECTION ++

SECTION 15441

SUMP PUMPS

PART 1 - PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall furnish and install one new submersible non-clog sump pump at the NHLW Disposal Station at AWRF.

B. Coordination:
   1. Review installation procedures under other Sections and coordinate with the Work which is related to this Section.

1.2 QUALITY ASSURANCE

A. Manufacturer's Qualifications:
   1. Manufacturer shall have a minimum of five years of experience of producing substantially similar equipment, and shall be able to show evidence of at least five installations in satisfactory operation for at least five years.
   2. Person(s) adjusting, repairing or receiving training on electrically energized equipment shall follow guidelines outlined in NFPA 70E, OSHA 910, Subpart "S" and OSHA 1926 Subpart "K" regarding arc flash safety, and protection.

B. Reference Standards: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified:
   1. Standards of the Hydraulic Institute, (HI).
   2. National Electrical Code, (NEC).
   3. Standards of National Electrical Manufacturers Association, (NEMA).
   4. Institute of Electrical and Electronic Engineers, (IEEE).
   5. American National Standards Institute, (ANSI).
   6. Standards of American Water Works Association, (AWWA).

C. Unit Responsibility: Assign Unit Responsibility as specified in Section 01300, Submittals, to the manufacturer or supplier for the equipment specified in this Section. A Certificate of Unit Responsibility shall be provided.

1.3 SUBMITTALS

A. Shop Drawings: Submit for approval the following:
   1. Manufacturer's literature, illustrations, specifications and engineering data including dimensions, materials, size, weight, performance data and curves showing overall pump efficiencies, flow rate, head, brake horsepower, motor horsepower, speed and shut-off head.

2. Fabrication, assembly, installation and wiring diagrams and instructions.
3. Deviations from Contract Documents.
4. Control Panels shall be furnished in accordance with the requirements as shown on the Drawings, and as specified in Section 16161, Control Panels, and in Division 17, Sections 17111, Float Switches, and 17454, Operations and Control Descriptions.
5. Submit for approval the following:
    a. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
    b. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**

B. Operation and Maintenance Manuals:
1. Submit complete installation, operation and maintenance manuals including test reports, maintenance data and schedules, description of operation and spare parts information.
2. Furnish Operation and Maintenance Manuals in conformance with the requirements of Section 01730, Operation and Maintenance Data.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Store materials in compliance with requirements under Section 01640, Materials and Equipment.

B. Deliver materials to the site to ensure uninterrupted progress of the Work. Deliver anchor bolts and anchorage devices, which are to be embedded in cast in place concrete, in ample time to not delay the Work.

C. All boxes, crates and packages shall be inspected by CONTRACTOR upon delivery to the Site. A document shall be provided by CONTRACTOR, notifying the ENGINEER if any loss or damage exists to equipment or components. Replace loss and repair damage to new condition, in accordance with manufacturer's instructions.

D. Store materials to permit easy access for inspection and identification. Keep all materials in covered storage, off the ground utilizing pallets, platforms or other supports. Protect steel members and packaged materials from corrosion and deterioration.

E. Store all mechanical equipment to prevent condensation and in accordance with the manufacturer's instructions for long term storage. Provide power to the space heater while actuators are in storage to avoid condensation on the control devices.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Design Criteria:
   1. Pumps shall be submersible, sewage, non-clog type. They shall be specially designed, constructed, and installed for the service intended and shall comply with the following minimum design conditions:

Design Conditions	
Location:	AWRF NHLW Disposal Station
Number Required:	1
Type:	Constant Speed Drive
Design Flow: gpm	100
Design TH: ft.	10
Min. Efficiency at Design: %	68
Motor: hp	1
Max. Operating Speed: rpm	3450
Suction Lift: ft.	N/A
Discharge Size: in.	2
Liquid Pumped:	Wastewater
Motor: Volts/Phase/Hertz	120/1/60

* Pump horsepower requirements shall not exceed stated horsepower at any point on operating curve.

** Flow at the 2nd design point TH shall be within ten percent of the value specified.

B. Fabrication:
   1. End Suction Centrifugal Sump Pump, Submersible Type:
      a. Pumps and motors shall be designed for continuous operation under submergence, without leakage.
      b. Pumps shall include an all cast iron housing, cover, base, control chamber and impeller.
      c. The motor chamber shall be hermetically sealed against entry of moisture and shall be oil filled.
      d. The shaft seal shall be of high quality carbon, stainless steel and Buna-N seal and ceramic seat combination.
      e. The shaft shall be of Type 416 stainless steel. Fluids shall not contact the shaft.
      f. The impeller shall be non-clogging vortex.
      g. The bearings shall be sleeve type, permanently lubricated.
      h. The motor shall be suitable for operation as shown on the pump schedule.
      i. The power cord shall be UL approved, 20 foot length, waterproof and oil resistant, complete with grounding type cord cap and stainless steel strain relief cable grip.
      j. The motor shall have built-in thermal overload protection.
      k. Float switches and accessories shall be furnished as follows:
         1) Float Switch: Normally open switch encapsulated in epoxy resin. Float casing shall be PVC/polypropylene.
         2) Switch Cable: Cable within sump shall be Type SO neoprene jacket, four #18 conductor, 41 strand, 600 volt insulation. Cable and conduit shall conform to the requirements of Division 16, Electrical.
         3) Cable Supports: Polypropylene composition clamp with Type 316 SST.
         4) Mercury type devices are not allowed.
         5) Simplex Sequence of Operation:
            a) Float switch energizes pump on liquid level rise.
            b) Float switch actuates high water alarm on liquid level rise, de-energizes alarm on liquid level drop.
            c) Float switch de-energizes pump on liquid level drop.
      l. Control panels shall conform to the requirements of Specification Section 16161, Control Panels.
      m. Alarms:
         1) Sump shall be equipped with a second float switch that triggers a High High Level Alarm and alerts SCADA.
      n. All door mounted components shall be NEMA 4X.
      o. The motors shall have built-in thermal overload protection.

C. Product and Manufacturer: Provide one of the following:
   1. Zoeller,
   2. Drummond,
   3. Or approved equal.

2.2 SURFACE PREPARATION AND SHOP PAINTING

A. Surface preparation and painting of all ferrous surfaces shall be in accordance with requirements of Section 09900, Painting. All these surfaces shall be considered submerged. The surface preparation and painting of these surfaces shall be by the manufacturer.

B. Machined, polished and non-ferrous surfaces shall be coated with corrosion prevention compound.

C. Painting shall conform to the requirements of Section 09900, Painting.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Inspect all equipment immediately upon delivery to site. If damaged, notify ENGINEER and manufacturer immediately.

B. Do not install damaged equipment until repairs are made in accordance with manufacturer's written instructions and approved by the ENGINEER. Only minor repair work shall be permitted in the field. All other damaged items shall be sent to factory for repair or replacement.

3.2 START-UP AND TEST

A. After completion of installation, the system shall be completely tested to ensure compliance with the operating requirements as specified, indicated on the Drawings and in accordance with Sections 01650, Starting of Systems, and 01660, Field Test of Equipment. Should the tests indicate any malfunction, make any necessary repairs and/or adjustments. Such tests and adjustments shall be repeated until, in the opinion of the ENGINEER, the installation is complete and the equipment is functioning properly and accurately, and is ready for permanent operation.

B. A factory trained service representative shall be provided for installation supervision, initial setting and start-up testing services. The representative shall make a minimum of 1 visit to the site to approve the completed installation and to perform start-up testing of the equipment. The representative shall coordinate each visit with the ENGINEER prior to arrival on the site. The representative shall test operate the system in the presence of the ENGINEER and verify that the equipment conforms to requirements. The representative shall revisit the job site as often as necessary until the installation and testing is entirely satisfactory.

++ END OF SECTION ++

SECTION 15700

GENERAL HVAC REQUIREMENTS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Labor, materials, tools, and services for a complete and operable installation of equipment and systems as applies to all sections included in Division 15 and Contract Documents.

B. Definitions.
   1. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
   2. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
   3. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
   4. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and duct shafts.
   5. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

C. Principal features of the work included are:
   1. Heating, ventilating, air conditioning systems, piping, controls, and mechanical systems insulation.
   2. Ground mounted curbs for HVAC system, louvers, intake hoods and fans furnished and set under this Division.
   3. Demolition of existing HVAC equipment as indicated on the drawings.
   4. Furnish anchor bolts, sleeves, supports and similar items to be built into concrete and masonry.
   5. Preparation for testing and balancing of mechanical systems and correcting deficiencies.
   6. Preparation and submittal of shop drawings and product data.
   7. Maintaining a record set of blueline prints and marking them to indicate locations of concealed items, and deviations made to suit conditions and production of mechanical as-built (record) drawings.
   8. Two days, 16 hours, on site (exclusive for travel time) of training for HVAC system controls and equipment operation, troubleshooting and restarting.
   9. Preparation and submittal of the "Operations and Maintenance Manual" in accordance with Division 01 for HVAC Systems.

10. Attendance of a pre-construction conference to take place within 15 days after award of contract. Major Division 23 Sub-Contractors required attendance shall be Mechanical Representative and Superintendent for this project.

1.2 RELATED WORK

A. Maintenance and operations manuals.

B. Concrete (equipment pads, as may be required for items in Division 15 that are not provided by General Contractor).

C. Rough Carpentry (wood blocking in walls required for attaching mechanical items).

D. Flashing and Sheet Metal (flashing for mechanical items penetrating walls).

E. Painting.

F. Fire Protection.

G. Plumbing.

H. Electrical.

1.3 JOB CONDITIONS

A. Submittal of bid implies bidder has read applicable paragraphs of the specifications including the AIA General Conditions Document A201 and will be bound by their conditions.

B. The Mechanical Contractor shall be licensed and hold a current Contractor License that has been valid for a minimum of Two (2) Years in the State of Arizona as a Mechanical Contractor.

C. The Mechanical Contractor shall be able to bond work he is bidding to perform and shall provide a written statement to the Architect from the proposed bonding agency to be used for this project as a separate document in addition to the mechanical bid or proposal submitted by the General Contractor. The bonding agency proposed to be used by the Mechanical Contractor shall have a Best's insurance rating of A or A+.

1.4 LOCAL CONDITIONS

A. Existing conditions and/or Facility/Utility: This Contractor shall coordinate in writing Seven (7) business days prior to start of work for any shut-down and/or removal of any existing condition(s). Coordination letter shall identify start/stop times (shut down time), and total man-hours to perform all facets of necessary work. This coordination letter shall be submitted to the Architect.

1.5 EXAMINATION OF PREMISES

A. Visit the site before submitting a Bid or Proposal, verify all measurements and job conditions, and pay all the necessary costs to perform the work.

1.6 REGULATIONS, PERMITS, FEES, CHARGES, INSPECTIONS

A. Fees and Permits: Pay for all connections, installation, use, development, etc., fees and/or charges. Obtain and pay for all required permits and licenses. Refer to Division 01.

B. Inspections: All work must be inspected and approved by local authorities. Prior to final approval, furnish the Architect with certificates of inspections and approvals by the local authorities in accordance with Division 01.

1.7 VERIFICATION OF DIMENSIONS

A. Scaled and figured dimensions are approximate only. Before proceeding with work, carefully check and verify dimensions at site, and be responsible for properly fitting equipment and materials together and to the structure in spaces provided.

B. Drawings are essentially diagrammatic, and all required offsets, bends, special fittings and exact locations are not indicated.

C. Carefully study drawings and premises to determine best methods, exact locations, routes, building obstructions, and install apparatus and equipment in available locations. Install apparatus and equipment in manner and in locations to avoid obstructions, preserve headroom, and keep openings and passageways clear. Notify Architect if a conflict exists on the drawings or between the drawings and specifications, any special building conditions and special building areas in which the drawings conflict as to the fit of ductwork, piping or equipment. This notification shall occur in written form (such as an 'RFI'), prior to the installation of any work in these special areas.

D. This notice shall occur prior to the purchase and/or shipment of equipment to the job site for these areas. The Architect shall affect an alternate relocation of the ceiling, duct, or piping to avoid installing materials more than one time.

1.8 EXISTING MATERIALS AND EQUIPMENT

A. General: Certain items of mechanical equipment, piping, ductwork, etc., are to be removed as indicated on the drawings. Certain of these items are to be reused where indicated.

B. Disposition: Apart from items which are to be reused or retained by the Owner, all other materials shall be removed and disposed of by the Contractor. Items to be retained by the Owner and are to be located by the Contractor as directed by the Owner.

C. Unused Materials: All unused piping, ductwork, controls and miscellaneous materials shall be removed by the Contractor except were located within walls, below or above existing construction which is not being altered and would require removal and replacement of this existing construction. All visible piping, ductwork, etc., shall be removed and sealed or capped within wall, below floor, or above ceiling.

D. Exterior Services: The Contractor shall be responsible for maintaining service to the existing building during the construction period. Existing services are to be retained until such a time that the new services, if any, are completely installed and ready for use. Scheduling of service interruptions is to be coordinated with the Architect.

E. Demolition in Existing Building: In the areas of the existing building which are having major alterations, the Contractor shall remove existing material which will not be reused, Contractor shall be responsible for capping services in demolition areas to ensure safe conditions.

F. Continuity of Services in Existing Building: Contractor shall permanently reroute existing services or provide temporary connection as required to maintain service in the building which are to remain in service. All temporary outages shall be coordinated with the Architect.

G. Rerouting and Relocation of Existing Mechanical Equipment and Services in Existing Building: Mechanical Contractor shall reroute, relocate all existing mechanical work which is against the building alterations, and which is required to be maintained in use.

H. Existing Piping and Ductwork: Where applicable, as noted on plans and as approved, existing material may be reused in their original location unless otherwise noted or shown.

1.9 INTENT

A. The contract documents (drawings, plans and specifications) describe the mechanical work of this project. Any item mentioned in one part shall be as binding as though mentioned in all parts.

B. The contract documents form a guide for complete and operable mechanical installation. Where an item is reasonably necessary but not specifically mentioned, such as duct hangers or transitions, piping offsets, drains, vents, etc., for a complete system, provide same as if were specified.

C. Mechanical system layouts indicated on drawings are diagrammatical only. Exact locations of ducts, pipes, and equipment shall be coordinated with related trades prior to installation of any work. Also, these locations shall be coordinated with the Engineer/Architect for evaluation regarding future building needs. This relocation/rerouting review (if required) shall occur prior to actual work being done.

D. The Engineer shall not be responsible for the means, methods, procedures, techniques, or sequences of construction, nor for safety on the job site, nor shall the Engineer be responsible for the contractor's failure to carry out the work in accordance with the contract documents.

E. Compliance by the Contractor with the provisions of this Specification does not relieve him of the responsibilities of furnishing equipment and materials of proper design, mechanically suited to meet operating guarantees at the specified service conditions.

1.10 DEVIATIONS

A. Deviations from specifications and drawings shall not be made without full knowledge and written consent of the Architect.

B. Contractor shall report all items discovered during construction that require deviation from the Contract Documents. See Division 01 for procedures.

1.11 REQUEST FOR INFORMATION (RFI)

A. Request for Information:
   1. A document submitted by the Contractor requesting clarification of a portion of the Contract Documents, hereinafter referred to as RFI.
   2. A properly prepared request for information shall include a detailed written statement that indicates the specific drawings or specifications in need of clarification and the nature of the clarification requested.
      a. Drawings shall be identified by drawing number and location on the drawing sheet.
      b. Specifications shall be identified by section number, page, and paragraph.

B. Improper RFI's:
   1. RFI's which are not properly prepared.
   2. Improper RFI's will be processed by the Architect/Engineer at the Architect/Engineer's standard hourly rate, and the Architect/Engineer will charge the Owner, and such costs will be deducted from monies still due the Contractor. The Contractor will be notified by the Architect/Engineer prior to the processing of improper RFI's.

C. Frivolous RFI's:
   1. RFI's that request information that is clearly shown on the Contract Documents.
   2. Frivolous RFI's may be unanswered or may be processed by the Architect/Engineer at the Architect/Engineer's standard hourly rate and Architect/Engineer will charge the Owner, and such costs will be deducted from monies still due the Contractor. The Contractor will be notified by the Architect/Engineer prior to the processing of frivolous RFI's.

1.12 QUALITY ASSURANCE

A. Comply with applicable local, state, and federal codes.

B. Comply with applicable requirements of recognized industry associations which promulgate standards for the various trades. (See individual Section of Division 15.)

C. Employ only qualified journeymen for this work. Employ competent, qualified mechanics to supervise the work.

1.13 CODES AND STANDARDS

A. Perform work specified in Division 15 in accordance with codes and standards listed below, and such standards that may be specified in other sections. When these specifications are more stringent, they take precedence. In case of conflict, obtain a decision from the Architect.
   1. NFPA 90A: Air Conditioning and Ventilation Systems.
   2. NFPA 101: Life Safety Code.
   3. 2024 International Building Code with City Amendments.
   4. 2024 International Mechanical Code with City Amendments.
   5. 2024 International Plumbing Code with City Amendments.
   6. 2024 International Energy Conservation Code.
   7. ANSI Handicapped Code-A117.1.
   8. ANSI: American National Standards Institute.
   9. ARI: American Refrigeration Institute.
   10. ASHRAE: American Society of Heating Refrigeration and Air Conditioning.
   11. ASME: American Society for Mechanical Engineers.
   12. ASTM: American Society for Testing and Materials.
   13. MSS: Manufacturer's Standardization Society of the Valve and Fitting Industry.
   14. NEMA: National Electrical Manufacturers' Association.
   15. NFPA: National Fire Protection Association.
   16. SMACNA: Sheet Metal and Air Conditioning Contractors' National Association.
   17. UL: Underwriters' Laboratories, Inc.
   18. CISPI: Cast Iron Soil Pipe Institute.
   19. ADA: Americans with Disabilities Act.
   20. FM: Factory Mutual.

1.14 COORDINATION

A. Carefully examine specifications and drawings to be thoroughly familiar with items which require HVAC connections and coordination including equipment, Contractor's drawings and Specifications.

B. Coordinate with other Divisions to leave proper chases and openings. Place outlets, anchors, sleeves, and supports prior to pouring concrete or installation of masonry work.

1.15 SUBMITTALS

A. Prior approval substitution The Contractor shall include clearly marked engineering data on both the specified items and the proposed substitute items.

B. Submit items to the Architect. Submittals are only required for specific items of equipment or material listed in individual sections of these specifications.

C. Within 15 days after award of contract for this work, submit a complete list of proposed manufacturers from all individual sections of the Division 15 Specification (of equipment or material to be used) for approval by the Architect/Engineer.

D. Submit this list before submitting shop drawings and product data and obtain approval before submitting items. If Architect/Engineer does not approve a proposed manufacturer, then coordinate with him in selecting another manufacturer who does meet with his approval.

E. Shop Drawings: Within 30 days after award of Contract for this work. Submit PDF of product information as required from all individual sections of the Division 15 specification at one time for all HVAC items indexed and separated by dividers. Partial submittals will not be accepted.

F. Brochures: Submit PDF of manufacturer's brochures including:
   1. Complete descriptions.
   2. Illustrations.
   3. Specifications data of materials, operating rates, fan curves, weights, electrical characteristics, etc.
   4. Where items other than those proposed for use are illustrated and/or described on the same brochure pages, clearly indicate the items proposed for use.

G. Review of a specific item shall not indicate acceptance of an assembly of which the item is a component. The Engineer shall not be required to review and shall not be responsible for any deviations from the contract documents not clearly noted by the Contractor, nor shall the Engineer be required to review partial submissions or those for which submissions for correlated items have not been received. One review and one resubmittal will be permitted. Submittals requiring more than two submittals will be reviewed by the Architect/Engineer at the Architect/Engineer's standard hourly rate and Architect/Engineer will charge the Owner, and such costs will be deducted from monies still due the Contractor. The Contractor will be notified by the Architect/Engineer prior to the processing of Submittal. Resubmittal fee shall be for each submission of more than two (2).

H. Any piece of equipment placed on the job without prior written review shall be subject to removal.

1.16 OPERATING AND MAINTENANCE MANUALS

A. Three sets and an electronic copy of the following data are required:
   1. Operating and maintenance instructions prepared in accordance with these specifications.
   2. Spare parts lists.
   3. Illustrated parts breakdown for each piece of equipment.
   4. Copies of approved submittal data.
   5. Local supply house name and address, local supply house phone number and contact person for each item of equipment for future parts procurement. Also include National and/or Regional Headquarters phone number.
   6. Equipment warranties.
   7. Air and water test and balance report.
   8. Control wiring diagrams, operating sequences, and devices literature.
   9. All programmable logic documentation.
   10. All as-built drawings.
   11. Valve tag identification chart.
   12. A list of all filter sizes used, identified by each piece of equipment per equipment plan numbers.
   13. A list of all belt sizes, type and model, by equipment plan numbers.

B. Arrange each set of data in an orderly way and bind each set in a separate three-ring, hard cover binder.

C. Two weeks prior to substantial completion of the project deliver three complete sets to Architect to be used for the Owners training of equipment operating personnel.

1.17 DELIVERY AND STORAGE

A. Deliver items in manufacturer's original unopened packaging. Cover items with protective materials to keep them from being damaged (physical and weather).

B. Store items in a clean, dry place, and protect them from damage which may be caused by theft, the weather, and/or all building and construction operations.

C. All flange facings shall be protected by securely fastened durable covers to prevent damage during shipment.

D. Exposed finished and machined surfaces, including bolting, shall be given a heavy coating of rust-inhibiting compound. Internal metal surfaces shall be sprayed or coated with a suitable rust preventative which is strippable.

E. Bearings, bearing housings, and oil systems, including reservoirs, coolers, filters, and piping, shall be thoroughly cleaned internally of metal particles, dirt and debris, and coated with a suitable rust preventative prior to shipment.

F. All instruments and valves, including auxiliary systems, must be securely mounted and/or supported to eliminate damage during shipment, storage, operation, and maintenance.

G. Support and rigging connections shall be provided to prevent damage during transit, lifting or unloading.

H. Threaded connections shall be provided with a pipe plug of the same material as the connections (except cast iron connections shall have steel plugs). Plugs shall have a square or hex head. Teflon tape shall be used as a thread sealant.

I. Open ends of tubes and pipes shall be capped (just taping is not adequate) for protection.

1.18 GUARANTEE

A. Guarantee all material, equipment, and workmanship for all sections under Division 15 in writing to be free from defects of material and workmanship for a minimum of two (2) years from date of final acceptance by the Owner or substantial completion. Replace without charge any material or equipment proving defective during this period. The guarantee shall include performance of the equipment under all conditions of load, installing any additional items of control and/or protective devices as required and the replacing of any refrigerant lost.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. Acceptable Manufacturers: In general, see individual sections of these specifications.

B. Within the Contract Documents relating to mechanical work, manufacturers' names, catalog numbers, and other proprietary references to materials and equipment are made. Such references are made to establish the standards of quality and type required, and not to limit competition. Most well-known or acceptable manufacturers of competitive products are listed in applicable sections as "Acceptable Manufacturers". Reasonable requests for substitution or additions to "Acceptable Manufacturers" will be considered, but the Architect will be the sole judge of acceptability of items proposed as substitutes.

C. Materials and equipment used in carrying out these specifications shall bear UL or other codes and standards, listed in Section 1.12 and 1.13, recognized testing laboratory label.

D. Where substitutions are desired, they comply with the requirements of Substitutions and Product Options.

2.2 EQUIPMENT DESIGN AND INSTALLATION

A. Design: Design all equipment in accordance with latest edition of ASME, AGA, UL and other applicable technical standards as follows:
   1. Pressure Vessels: ASME Code constructed and stamped.

2. Electric Appliances: UL labeled.
3. Fans: AMCA rated and stamped.
4. Cooling Equipment: ARI certified.

2.3 ACCESS DOORS

A. Acceptable manufacturers: Inland-Milcor, Bilco, or Miami Carey. Use panels equal to Milcor Style M for masonry and drywall construction, equal to Milcor Style K for plastered masonry walls and ceilings. Stainless steel, or as selected by the Architect, panels shall be used in ceramic tiles or glazed structural tiles.

B. Access Doors, Panels and Frames: Style and type as required for material in which installed.
   1. Size: 16"x16" minimum, as indicated, or as required to allow inspection, service and removal of items served.
   2. Fourteen gauge minimum sheet metal for doors, 16-gauge frames of cadmium-plated or galvanized construction. Doors should have expanded plaster rings in plaster walls or flanged finish were in drywall or block construction.
   3. Panels shall have spring hinges with screwdriver locks in non-public areas. Key lock, keyed alike, for panels in public areas.
   4. Prime painted or rust inhibitive paint finish.
   5. UL labeled when in fire-rated construction, one and one half (1-1/2) hour rating or as specified against 2" W.G. static pressure.
   6. Provide in walls, floors, and ceilings to permit access to all equipment and piping requiring service or adjustment. Examples of such equipment needing access are dampers, mechanical system valves, and equipment needing periodic or replacement maintenance.
   7. Furnish and locate access panels under this Division. Coordinate with other trades who are responsible for building system in which panels are to be installed.

2.4 SUPPORTS, ANCHORAGE AND RESTRAINTS:

A. General
   1. When support, anchorages, and seismic restraints for equipment, and supports and seismic restraints for conduit, piping and ductwork are not shown on the Drawings, the Contractor shall be responsible for their design.
   2. Seismic restraints and anchorages shall resist seismic forces, as specified in latest edition of the International Building Code, for the seismic zone specified above.
   3. Seismic restraints shall not introduce stresses in piping or ductwork caused by thermal expansion or contraction.
   4. Connections to structural framing shall not introduce twisting, torsion, or lateral bending in the framing members. Provide supplementary steel as required.

B. Suspended Piping and Ductwork: Seismic restraints shall be in accordance with the latest edition of the SMACNA “Seismic Restraint Manual - Guidelines for Mechanical Systems” and ASHRAE “Practical Guide to Seismic Restraints” for the Seismic Hazard Level (SHL) as specified above.

C. Submittal Requirements:
   1. Suspended piping and ductwork: Submit shop drawings of piping and ductwork indicating point loads and seismic restraint locations, along with applicable details keyed to layouts. Submittals shall include seal and signature of a registered Engineer.
   2. Support frames, equipment supports, and anchorage: Submit shop drawings indicating point loads and seismic restraint locations, along with Engineer's calculations and details keyed to the layouts pertaining to support frames, anchorages, and seismic restraints. Submittals shall include seal and signature of a registered Engineer.

PART 3 - EXECUTION

3.1 INSTALLATION

A. All equipment installations shall be in accordance with the requirements and recommendations of the equipment manufacturer.

3.2 LOCATIONS

A. Mechanical layouts indicated on drawings are diagrammatical. Exact locations of ducts, pipes, and equipment may vary because of conflicts with work of other trades. Resolve conflicts where relocations will not affect operation or appearance of systems prior to installing any equipment, ductwork, or piping. Also, these locations shall be coordinated with the Engineer/Architect for evaluation regarding future building needs.

B. Locate equipment requires periodic service so that it is "readily accessible". Do not back up service sides to walls, nor place it too close to other equipment making service impractical. Coordinate with manufacturers' recommended equipment placement guidelines to determine maintenance access required.

C. All equipment and appurtenances shall be installed in accordance with the requirements of the manufacturer.

3.3 CUTTING AND PATCHING

A. Cut and patch as necessary to properly install the work. As the work progresses, leave necessary openings, holes, chases, etc., in their correct location. If the required openings, holes and chases are not in their correct locations, make the necessary corrections at no cost to the Owner. Avoid excessive cutting and do not cut structural members without the consent of the Architect.

B. Repair or replace routine damage caused by cutting in performance of contract.

C. Correct unnecessary damage caused due to installation of mechanical work.

D. Perform repairs with materials which match existing and install in accordance with the appropriate section of these specifications.

3.4 CLOSING-IN OF UNFINISHED WORK

A. Cover no work until inspected, tested, and approved. Where work is covered before inspection and test, uncover it, and when inspected, tested, and approved, restore all work to original proper condition.

3.5 COUNTER FLASHING

A. Counter-flash ducts, pipes, etc., at penetrations of outside walls. Coordinate with Architect and/or General Contractor for roof type, and the requirements of same for a weather-tight penetration.

3.6 CONNECTION TO EQUIPMENT

A. Connect or install equipment shown on mechanical drawings that require mechanical hookups.

B. Rough-in piping and connecting equipment.

C. Provide piping, shutoff valves, drain valves and unions as required for a complete and serviceable operable installation.

D. Provide flexible connections to all rotating or vibrating equipment unless otherwise noted or detailed.

3.7 SERVICE OF SYSTEMS

A. If equipment is placed in service prior to acceptance of the project by Owner, operate equipment strictly in accordance with manufacturer's instructions.
   1. Employ competent, qualified personnel in operation of the equipment.
   2. Provide for proper operation and cleanliness. Provide temporary filters with all air-handling equipment.
   3. Open equipment for inspection as directed by the Architect. Provide a clean set of filters installed after final acceptance of the building by the Architect.

B. Lubricate equipment and perform such other maintenance as required to place it in optimum operating condition.

3.8 IDENTIFICATION

A. Equipment: Equipment shall be identified with engraved plates made of 3/32” thick laminated black Bakelite with white core. Engrave to produce 3/8” high white lettering on black background. Engraved plates shall be screwed on. The identification shall correspond to the designation used on construction drawings and shall include, but not be limited to, the following: air handlers, condensing units, fans, chillers, pumps, boilers,

temperature control equipment, heat exchangers, cooling towers, variable frequency drives, etc. All equipment located above lay-in ceiling grids shall be identified on the grid support by the equipment ID tag using a clear plastic film label applied to the steel grid directly below the service access point for the equipment. Thermostats shall be labeled to match equipment IDs on the plans (not room numbers). Hand-written ink or marker labeling is not acceptable and should be removed and replaced by this specification.

B. Instrument and Controls: Identify all control devices; sensors, transducers, damper motors and automatic valves, flow switches and pressure switches, with engraved Bakelite nameplates with 3/8" high lettering, permanently affixed to each item with screws or short chain and S-hooks if drilling for screws could damage item, indicating service and, where applicable, normal setting.

C. Valves:
   1. Carefully prepare chart or diagram for each piping system, indicating by number each valve in the system and each valve's location and function. Numbers used on valves shall correspond with chart.
   2. Mount one of each chart in every mechanical equipment room applicable. Mount each chart in aluminum frame with clear glass front and secure to wall where directed.
   3. Bind a copy of each chart in maintenance manuals.
   4. Provide each valve with a brass or aluminum disc not less than 1-1/4" diameter and bearing 3/8" high, engraved numbers corresponding to those shown on chart. Fasten tag to valve with #14 brass wire.

D. Pipe:
   1. Mark each individual pipe with Brady, Seton, Brimar, or Set Mark identification markers with flow arrows of snap-on type after pipe has been painted or insulated.
   2. Install stencils at all major branch takeoffs, risers and at 10-foot intervals on straight runs and at each entrance or exit from pipe shafts. Markers shall be located for maximum visibility from expected personnel approach.
   3. Identification material sizes shall be as follows:
      a. 2" and Under: 1/2" high letters.
      b. Over 2": 1" high letters.
   4. Provide a typewritten schedule of all markers used, with identification framed under glass and posted in the Mechanical Equipment Room and included in the Operation and Maintenance Manuals.
      a. Identify pipe with following:

Service	Abbreviation
Equipment Drains	D
Condensate Drains	CD

   5. Pipe markers for piping not listed above shall conform to the latest ANSI and OSHA requirements.

3.9 ACCESSIBILITY

A. Install valves, dampers, thermometers, gauges, traps, cleanouts, control devices or other specialties requiring reading, adjustment, inspection, repairs, removal or replacement conveniently and accessibly throughout the finished building. Where any of these devices are shown on the contract drawings to be installed above any inaccessible ceiling or behind any inaccessible wall, the Mechanical Contractor shall furnish access doors or panels as required.

B. All access doors or panels in walls and ceilings required for access to control devices, traps, valves, and similar devices are to be furnished and installed as part of the work under this section. Provide type as specified.

C. Refer to architectural drawings for types of walls and ceiling in each area and for rated construction.

D. Coordinate work of various sections to locate valves, traps and dampers with others to avoid unnecessary duplication of access doors.

E. The Contractor, along with the Owner's representative, shall complete the Mechanical Accessibility/Clearance Checklist at the end of this section for all mechanical equipment. The chart shall be submitted to the Architect/Engineer for approval prior to substantial completion. All conflicts shall be resolved to the Architect's/Owner's satisfaction prior to submission.

3.10 ACCEPTANCE OF SYSTEMS

A. Complete the following before requesting a final inspection:
   1. Work required under this division of specifications except as permitted.
   2. System balancing.
   3. Control system checkout.
   4. Furnish required operating instructions, wiring diagrams, and electric "project record document" control diagrams in accordance with Division 01 within a frame with glass face and mount one copy of each in the equipment rooms and as specified elsewhere.
   5. Architects will accept jobs on basis of tests and inspections. A representative of the firm that performed test and balance work is to be in attendance to assist, and Contractor is to furnish necessary mechanics to operate system, make any necessary adjustments, and assist with final inspection.
   6. The Contractor shall be responsible for proper operation of all systems, minor subsystems, and services provided under this Section. Contractor shall coordinate startup procedures, calibration, and system checkout with all subcontractors involved. Any system operational problems shall be diagnosed; all correctional procedures shall be initiated with the various subcontractors as required to bring the system into compliance with the design, and the problem then shall be rechecked to verify that the system operates properly. Any remaining difficulties shall be brought to the attention of the Architect.

7. Thoroughly clean all parts of the installation at the completion of the work. The Contractor shall clean up and remove from the premises all refuse material, crates and rubbish arising from his Work. Provide clean filters. Belt-drive tensions and alignments shall be checked. All motors and bearings shall be lubricated in accordance with the manufacturer's service manuals prior to equipment startup. Provide a lubrication schedule for every item of equipment furnished under this Section. The schedule shall include the type of lubricant and the application frequency.

3.11 TRAINING:

A. At a time agreed upon by the Architect, and Owner's representative provide training of the HVAC system operating personnel. This training shall be for a minimum period of 16 hours exclusive of travel time to the job site. The training shall be by a factory authorized and trained agent of the controls manufacturer. The training shall include, as a minimum, start-up, normal operation, set point adjusting, start-up after a power failure start-up after a smoke detector alarm and troubleshooting.

B. Establishment of Owner/manufacturer interface (name, telephone number, and times of availability of contact person) for future problem resolution, annual maintenance/system checkout shall be established at this time. Training shall include 4 hours of follow-up sessions to occur 6 months after project is awarded substantial completion.

++ END OF SECTION ++

SECTION 15710

SUMMARY OF WORK FOR HEATING, VENTILATING AND AIR CONDITIONING

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. The work specified in this section applies to all work required under the air conditioning, heating, and ventilating sections of the specifications. Refer to the drawings and other sections of this division for work described herein.

B. Drawings indicate the general arrangement of ductwork, grilles, and piping. Investigate structural and finish conditions affecting work and arrange work accordingly. Provide all necessary offsets to avoid conflicts with structural members.

C. All work specified in the section shall comply with all sections in Division 15.

1.2 REGULATIONS

A. Comply with all applicable codes, latest rules of National Board of Fire Underwriters regulations and State Fire Marshal regulations.

B. Obtain and pay for all required permits.

1.3 GENERAL AND SUPPLEMENTARY CONDITIONS

A. The General and the Supplementary Conditions of this project apply in every aspect to all the sections under this division of these specifications.

1.4 RELATED WORK SPECIFIED IN OTHER SECTIONS

A. Concrete.

B. Openings for Ducts, Grilles, and Registers.

C. Finished Painting.

D. Plumbing.

E. Electrical.

1.5 SCOPE

A. The work under these sections includes furnishing all labor, material, and equipment necessary for the installation and placing into operation the air

conditioning, heating and ventilating systems as specified herein and indicated on the drawings. The work includes, but is not necessarily limited to, the following.

B. Installation of cooling and heating systems.

C. Installation of complete air handling systems, including air handling units, factory fabricated, along with cooling and heating coils, all supply and return air ductwork, grilles, registers, diffusers, plenums, filters, dampers, controls, etc.

D. Installation of complete piping systems, including:
   1. Coil condensate and other incidental drain piping.
   2. All piping systems shall be complete with valves, fittings, hangers, trim, insulation, etc., as indicated or specified.

E. Furnishing and installation of all ducts, plenum, equipment, and piping insulation including thermal and acoustical insulation.

F. Miscellaneous items of work and material required to complete the system and place it in proper operation.

G. Cleaning, testing and balancing of all air and water systems.

1.6 EQUIPMENT CONNECTIONS

A. Mechanical Contractor shall install all condensate drains, drain and overflow piping from all equipment furnished under this section of the specifications to floor sinks or as indicated.

B. Make all final connections to all equipment that is installed under this section of the specifications.

PART 2 - PRODUCTS

2.1 ALTERNATE EQUIPMENT

A. Specifications of all equipment and materials in Division 15 by brand name are intended to establish a standard of quality. Further, this equipment has been checked as to size and weight requirements, and space allocations have been made accordingly.

B. Submitting equipment by other acceptable manufacturers in accordance and complete in every detail including space requirements, weight, complete performance data, and supplemental data requested by the Architect. Contractor shall be responsible for assurance that the equipment meets all the requirements detailed in this and other sections and shown in the drawings.

C. Approved Mechanical Equipment Manufacturers: Refer to individual sections of these specifications for approved manufacturers.

PART 3 - EXECUTION (NOT USED)

++ END OF SECTION ++

SECTION 15720

AIR HANDLING AND AIR DISTRIBUTION SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish and install all air outlets, dampers, etc., as shown on the drawings and herein specified. Each unit must be designed for the service intended, of the size and capacities indicated and complete with all accessories as noted.

B. All work specified in this Section shall comply with all Sections of Division 15.

PART 2 - PRODUCTS

2.1 GRILLES, REGISTERS, DIFFUSERS

A. Approved Manufacturers:
   1. Krueger.
   2. Titus.
   3. Price.
   4. Metalaire.

B. Summary: Furnish and install grilles, registers and diffusers where shown. They shall be of the size, type, and model indicated including appropriate frame for ceiling or wall material and construction.

C. Dampers and Gasketing: Provide all diffusers and all supply, exhaust and return registers with opposed blade dampers painted flat black, complete with neoprene gasketing all around.

D. Extractors: Provide extractors behind all diffusers, grilles, and registers with right angle takeoffs.

E. Finish: All units must be factory finished. Provide finish of color as indicated or as otherwise directed by Architect.

F. All grilles, registers, and diffusers in shower rooms and kitchen areas shall be all aluminum construction.

G. Ceiling Damper Operators: Provide a Young #315 or equal concealed damper operator for all dampers located in inaccessible locations. Provide cover plate at ceiling.

2.2 LOUVERS

A. Approved Manufacturers:
   1. Ruskin.
   2. Greenheck.
   3. Titus.
   4. Krueger.

B. Furnish and install louvers as indicated on the drawing and herein specified.

C. Construction: Louvers shall be .081 thick extruded aluminum construction, 4" deep frame, drainable, equal to Ruskin ELF375DX, 54% free area, 3/4" expanded, flatted aluminum bird screen in removable frame on interior face. Factory Kynar 500 paint. Color selected by Architect. Provide free area guide with submittal.

2.3 BACKDRAFT DAMPERS

A. Furnish and install counter-balanced backdraft dampers as indicated on the drawings and herein specified.

B. Construction: Dampers shall be aluminum with 0.90" thick channel frame and .025" thick blades with extruded vinyl edge seals. Linkage shall be aluminum concealed in the frame and bearings shall be nylon. Leakage shall not exceed 15 CFM per square foot at 1" WG. Damper shall be equal to Ruskin #CBD2.

PART 3 - EXECUTION - NOT USED

++ END OF SECTION ++

SECTION 15730

CLEANING MECHANICAL SYSTEMS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Comply with provisions of Section 15710, Summary of Work for Heating, Ventilating, and Air Conditioning.

B. Cleaning ducts and apparatus casings.

C. Cleaning HVAC systems equipment and piping.

D. Cleaning domestic water systems equipment and piping.

1.2 RELATED WORK

A. Section 15700: General HVAC Requirements

1.3 SUBMITTAL

A. Submit seven (2) copies of Water Analysis and Test copies from Arizona State Certified Laboratory.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 DUCTS AND APPARATUS

A. Thoroughly clean ducts and apparatus casings before fans are operated with first set of filters. New filters are to be set in place for air balancing and Owner's beneficial use.

3.2 HVAC SYSTEMS AND PIPING

A. Verify coils are clean and free of debris on package units, both indoor and outdoor, prior to starting equipment.

B. Clean condensate drain piping including downstream traps.

C. Prior to final acceptance by the Architect and the Owner's use, thoroughly clean all air supply, return and exhaust modules, grilles or registers.

3.3 FACTORY FINISHES

A. Clean items with factory finishes.

B. Touch up bare places, scratches and other minor damage to finishes. Use only factory supplied paint of matching color and formula.

C. If finishes are damaged to any extent, including but not limited to scratches and unfinished spots, refinish the entire item. Architect will be the judge of whether refinishing is required.

3.4 GENERAL CLEANUP

A. Upon completion of contract and progressively as work proceeds, clean up dirt, debris, oil materials, etc., and remove from site, keeping premises in neat and clean condition to satisfaction of the Architect.

B. Stainage, discoloration or other damage to parts of the building, its finish, or furnishings due to Contractor's failure to properly clean piping systems or duct systems shall be repaired without cost to the Owner.

++ END OF SECTION +

SECTION 15732

PACKAGE HEAT PUMP AIR CONDITIONING UNITS

PART 1 - GENERAL

1.1 EVAPORATOR FAN COMPARTMENT INSULATION

A. Interior cabinet surfaces shall be insulated with a minimum 1/2-in. thick, minimum 1 1/2 lb. density, flexible fiberglass insulation bonded with a phenolic binder, neoprene coated on the air side.

B. Insulation and adhesive shall meet NFPA 90A requirements for flame spread and smoke generation.

1.2 GENERAL

A. Shall be complete with self-contained low-voltage control circuit protected by a resettable circuit breaker on the 24-v transformer side. Transformer shall have 75VA capability.

B. Shall utilize color-coded wiring.

C. Shall include a central control terminal board to conveniently and safely provide connection points for vital control functions such as: smoke detectors, phase monitor, economizer, thermostat, DDC control options, and low and high pressure switches.

D. Unit shall include an integrated economizer controller to support an economizer with 4-20 mA actuator input.

E. Unit shall include a minimum of one 8-pin screw terminal connection board for connection of control wiring.

1.3 ELECTRONIC CONTROL SAFETIES

A. Compressor over-temperature, over current.

B. Low-pressure switch:
   1. Low pressure switch shall use different color wire than the high-pressure switch.

C. Electronic Heat High-Pressure Switch:
   1. High pressure switch shall use different color wire than the low-pressure switch.

1.4 AUTOMATIC RESET, MOTOR THERMAL OVERLOAD PROTECTOR.

A. Standard Filter Section:
   1. Shall consist of factory-installed, low velocity, throwaway 2-in. thick fiberglass filters of commercially available sizes.
   2. Unit shall use only one filter size. Multiple sizes are not acceptable.
   3. Filters shall be accessible through an access panel with "no-tool" removal as described in the unit cabinet section of this specification.
   4. Provide Two (2) Sets of MERV 7 Filters for each Unit. The Second set of Filters shall be installed immediately prior to Air Balancing.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Product and Manufacturer: Provide one of the following:
   1. Carrier.
   2. Trane.

2.2 GENERAL

A. Outdoor, rooftop mounted, electrically controlled, heating and cooling unit utilizing a(n) hermetic scroll compressor(s) for cooling duty.

B. Factory assembled, single-piece heating and cooling rooftop unit. Contained within the unit enclosure shall be all factory wiring, piping, controls, and special features required prior to field start-up.

C. Unit shall use environmentally safe, Puron refrigerant.

D. Unit shall be installed in accordance with the manufacturer's instructions.

E. Unit must be selected and installed in compliance with local, state, and federal codes.

2.3 QUALITY ASSURANCE

A. Unit meets ASHRAE 90.1 minimum efficiency requirements.

B. 3 phase units are Energy Star qualified.

C. Unit shall be rated in accordance with AHRI Standards 340/360.

D. Unit shall be designed to conform to ASHRAE 15, 2001.

E. Unit shall be UL-tested and certified in accordance with ANSI Z21.47 Standards and UL-listed and certified under Canadian standards as a total package for safety requirements.

F. Insulation and adhesive shall meet NFPA 90A requirements for flame spread and smoke generation.

G. Unit casing shall be capable of withstanding 500-hour salt spray exposure per ASTM B117 (scribed specimen).

H. Unit casing shall be capable of withstanding Federal Test Method Standard No. 141 (Method 6061) 5000-hour salt spray.

I. Unit shall be designed in accordance with ISO 9001, and shall be manufactured in a facility registered by ISO 9001.

J. Roof curb shall be designed to conform to NRCA Standards.

K. Unit shall be subjected to a completely automated run test on the assembly line. The data for each unit will be stored at the factory, and must be available upon request.

L. Unit shall be designed in accordance with UL Standard 1995, including tested to withstand rain.

M. Unit shall be constructed to prevent intrusion of snow and tested to prevent snow intrusion into the control box up to 40 mph.

N. Unit shake tested to assurance level 1, ASTM D4169 to ensure shipping reliability.

O. High Efficient Motors listed shall meet section 313 of the Energy Independence and Security Act of 2007 (EISA 2007).

2.4 DELIVERY, STORAGE, AND HANDLING

A. Unit shall be stored and handled per manufacturer's recommendations.

B. Lifted by crane requires either shipping top panel or spreader bars.

C. Unit shall only be stored or positioned in the upright position.

2.5 OPERATING CHARACTERISTICS

A. Unit shall be capable of starting and running at 125°F (52°C) ambient outdoor temperature, meeting maximum load criteria of AHRI Standard 210/240 or 340/360 at ± 10% voltage.

B. Compressor with standard controls shall be capable of operation down to 35°F (2°C), ambient outdoor temperatures. Accessory low ambient kits shall be available if operation below 35°F (2°C), is required. See below for head pressure control package or winter start kit.

C. Unit shall discharge supply air vertically or horizontally as shown on contract drawings.

D. Unit shall be factory configured for vertical supply & return configurations.

E. Unit shall be field convertible from vertical to horizontal airflow, no special kit required.

F. Unit shall be capable of mixed operation: vertical supply with horizontal return or horizontal supply with vertical return.

2.6 UNIT CABINET

A. Unit cabinet shall be constructed of galvanized steel, and shall be bonderized and coated with a pre-painted baked enamel finish on all externally exposed surfaces.

B. Unit cabinet exterior paint shall be: film thickness, (dry) 0.003 inches minimum, gloss (per ASTM D523, 60°F): 60, Hardness: H-2H Pencil hardness.

C. Evaporator fan compartment interior cabinet insulation shall conform to AHRI Standards 210/240 minimum exterior sweat criteria. Interior surfaces shall be insulated with a minimum 1/2-in. thick, 1 lb. density, flexible fiberglass insulation, neoprene coated on the air side. Aluminum foil-faced fiberglass insulation shall be used in the heat compartment.

D. Base of unit shall have a minimum of four locations for thru-the-base electrical connections (factory installed or field installed), standard.

E. Base Rail
   1. Unit shall have base rails on a minimum of 3 sides.
   2. Holes shall be provided in the base rails for rigging shackles to facilitate maneuvering and overhead rigging.
   3. Holes shall be provided in the base rail for moving the rooftop by fork truck.
   4. Base rail shall be a minimum of 16 gauge thickness.

F. Condensate pan and connections:
   1. Shall be an internally sloped condensate drain pan made of a non-corrosive material.
   2. Shall comply with ASHRAE Standard 62.
   3. Shall use a 3/4” -14 NPT drain connection, through the end of the drain pan. Connection shall be made per manufacturer’s recommendations.

G. Top panel:
   1. Shall be a single piece top panel.

H. Electrical Connections
   1. All unit power wiring shall enter unit cabinet at a single, factory-prepared, knockout location.
   2. Thru-the-base capability
      a. Standard unit shall have a thru-the-base electrical location(s) using a raised, embossed portion of the unit basepan.
      b. Optional, factory-approved, water-tight connection method must be used for thru-the-base electrical connections.
      c. No base pan penetration, other than those authorized by the manufacturer, is permitted.

I. Component access panels
   1. Cabinet panels shall be easily removable for servicing.
   2. Unit shall have one factory installed, tool-less, removable, filter access panel.
   3. Panels covering control box, indoor fan, indoor fan motor, electrical components (where applicable), and compressors shall have molded composite handles.
   4. Handles shall be UV modified, composite, permanently attached, and recessed into the panel.
   5. Screws on the vertical portion of all removable access panel shall engage into heat resistant, molded composite collars.
   6. Collars shall be removable and easily replaceable using manufacturer recommended parts.

2.7 COILS

A. Standard Aluminum Fin/Copper Tube Coils:
   1. Standard evaporator and condenser coils shall have aluminum lanced plate fins mechanically bonded to seamless internally grooved copper tubes with all joints brazed.
   2. Evaporator coils shall be leak tested to 150 psig, pressure tested to 450 psig, and qualified to UL 1995 burst test at 1775 psig.
   3. Condenser coils shall be leak tested to 150 psig, pressure tested to 650 psig, and qualified to UL 1995 burst test at 1980 psig.

2.8 REFRIGERANT COMPONENTS

A. Refrigerant circuit shall include the following control, safety, and maintenance features:
   1. Thermostatic Expansion Valve (TXV) shall help provide optimum performance across the entire operating range. Shall contain removable power element to allow change out of power element and bulb without removing the valve body.
   2. Refrigerant filter drier.

3. Service gauge connections on suction and discharge lines.
4. Pressure gauge access through a specially designed access port in the top panel of the unit.

B. There shall be gauge line access port in the skin of the rooftop, covered by a black, removable plug.
1. The plug shall be easy to remove and replace.
2. When the plug is removed, the gauge access port shall enable maintenance personnel to route their pressure gauge lines.
3. This gauge access port shall facilitate correct and accurate condenser pressure readings by enabling the reading with the compressor access panel on.
4. The plug shall be made of a leak proof, UV-resistant, composite material.

C. Compressors
1. Unit shall use one fully hermetic, scroll compressor for each independent refrigeration circuit.
2. Models shall be available with single compressor/single stage cooling design.
3. Compressor motors shall be cooled by refrigerant gas passing through motor windings.
4. Compressors shall be internally protected from high discharge temperature conditions.
5. Compressors shall be protected from an over-temperature and over-amperage conditions by an internal, motor overload device.
6. Compressor shall be factory mounted on rubber grommets.
7. Compressor motors shall have internal line break thermal, current overload and high pressure differential protection.
8. Crankcase heaters shall not be required for normal operating range, unless provided by the factory.

2.9 FILTER SECTION

A. Filters access is specified in the unit cabinet section of this specification.

B. Filters shall be held in place by a pivoting filter tray, facilitating easy removal and installation.

C. Shall consist of factory-installed, low velocity, throw-away 2-in. thick, MERV 7, fiberglass filters.

D. Filters shall be standard, commercially available sizes.

E. Only one size filter per unit is allowed.

F. Provide an extra set of Filters and install just prior to air balancing.

2.10 EVAPORATOR FAN AND MOTOR

A. Evaporator fan motor:
   1. Shall have permanently lubricated bearings.
   2. Shall have inherent automatic-reset thermal overload protection or circuit breaker.
   3. Shall have a maximum continuous bhp rating for continuous duty operation; no safety factors above that rating shall be required.

B. Belt-driven Evaporator Fan:
   1. Belt drive shall include an adjustable-pitch motor pulley.
   2. Shall use sealed, permanently lubricated ball-bearing type.
   3. Blower fan shall be double-inlet type with forward-curved blades.
   4. Shall be constructed from steel with a corrosion resistant finish and dynamically balanced.
   5. Standard on all 04-07 size and 04-06 size models with Humidi-MiZer. Optional on all 04-06 3-phase models.

2.11 CONDENSER FANS AND MOTORS

A. Condenser fan motors:
   1. Shall be a totally enclosed motor.
   2. Shall use permanently lubricated bearings.
   3. Shall have inherent thermal overload protection with an automatic reset feature.
   4. Shall use a shaft-down design.

B. Condenser Fans:
   1. Shall be a direct-driven propeller type fan.
   2. Shall have galvalum blades riveted to corrosion-resistant steel spiders and shall be dynamically balanced.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Air Conditioning Units shall be installed so as to provide adequate service clearance for maintenance. Units installed without adequate clearance as determined by the Architect/Engineer shall be removed and reinstalled at the Contractor's expense, including the removal and reinstallation of all interfering utilities.

B. Air Conditioning Units shall be installed per Manufacturer's recommendations.

++ END OF SECTION ++

SECTION 15734

SPLIT SYSTEM AIR CONDITIONING UNITS (DUCTLESS)

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Section Includes: Indoor blower coil section, outdoor section with compressor, crankcase heater, coil and controls, fan and refrigerant piping, and insulation, as specified.

B. All work specified in this section shall comply with all sections in Division 15.

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's specifications, design data, tables and installation instructions.

B. Shop Drawings: Submit drawings showing refrigerant piping, dimensions and accessories, including recommended sizes of pipes, valves, fittings and related items.

C. Certificates: Submit manufacturer certification that product meets specified efficiency requirements.

PART 2 - PRODUCTS

2.1 APPROVED MANUFACTURERS

A. The following manufacturers are approved subject to detailed requirements of Drawings and Specifications.
   1. Air Conditioning Indoor and Outdoor Units: Carrier, Mitsubishi, LG, Daikin, Trane, & Sanyo.

2.2 INDOOR UNIT

A. Indoor unit shall be direct-expansion, ceiling-suspended fan coil. Fan coil shall be complete with cooling coil, fan, fan motor, piping connectors, and ceiling or wall mounting brackets, seven day programmable thermostat.

B. Unit cabinet shall be zinc-coated bonderized steel finished with a baked enamel paint, with inlet and outlet grilles, high-impact polystyrene. Matching mounting brackets shall be provided.

C. Indoor fans shall be 3-speed centrifugal blower type with air intake in the bottom rear of the unit and discharge in the front.

D. Indoor coils shall be copper tube with aluminum fins and galvanized steel tube sheets. Fins shall be bonded to the tubes by mechanical expansion. A drip pan under the coil shall have a drain connection.

E. Motors shall be permanently lubricated ball bearing with inherent overload protection.

F. Refrigerant circuit components shall include brass external vapor supply line service valve(s), vapor return line service valve(s) with service gage connection port, service gage port connections on compressor suction and discharge lines with Schrader-type fittings (located at outdoor unit).

G. Unit shall have filter track with field-supplied cleanable filters.

H. Unit shall operate on single-phase, 60 cycle power at 208/230 volt as specified on the equipment schedule. Unit electrical power shall be a single point connection with 24 volt control power.

I. Unit to be complete with internal condensate pump with drain pan, and lift capability of 20 inches vertical. Float control shall be in the condensate sump to shut the unit down in case of a pump malfunction.

2.3 OUTDOOR SECTION

A. Factory assembled, single piece, air-cooled outdoor unit. Contained within the unit enclosure shall be all factory wiring, piping, controls, compressor, and full charge of R-410 refrigerant.

B. Unit cabinet shall be constructed of galvanized steel, bonderized and coated with a baked-enamel finish. Unit access panels shall be removable with minimal screws and shall provide full access to the compressor, fan, and control components. All compartments shall be isolated and have an acoustic lining to assure quiet operation.

C. Outdoor fans shall be direct-drive propeller type, and shall discharge air horizontally. Fans shall blow air through the outdoor coil. Outdoor fan motors shall be totally enclosed, single-phase motors with class B insulation and permanently lubricated sleeve bearings. Motor shall be protected by internal thermal overload protection. Shaft shall have inherent corrosion resistance. Fan blades shall be corrosion resistant and shall be statically and dynamically balanced. Outdoor fan openings shall be equipped with PVC-coated protection grille over fan and coil.

D. Compressor shall be fully hermetic scroll type. Compressor shall be equipped with oil system, operating oil charge, and motor. Internal overloads shall protect the compressor from over-temperature and over-current. Compressor shall be provided with crankcase heater to minimize liquid refrigerant accumulation during shut down and prevent refrigerant dilution of oil. Scroll compressors shall also have high discharge gas temperature protection if required. Motor shall be NEMA rated class F, suitable for operation in a refrigerant atmosphere. Compressor assembly shall be installed on rubber vibration isolators and shall have internal spring isolation. Compressors shall be single-phase or 3-phase as specified on the contract drawings.

E. Coil shall be constructed of aluminum fins mechanically bonded to internally enhanced, seamless copper tubes, which are cleaned, dehydrated, and sealed.

F. Refrigerant circuit components shall include brass external liquid line service valve with service gage port connections, suction line service valve with service gage connection port, service gage port connections on compressor suction and discharge lines with Schrader type fittings with brass caps, accumulator, pressure relief, and a full charge of refrigerant.

G. Operating controls and safeties shall be factory selected, assembled, and tested. The minimum control functions shall include the following:
   1. Controls:
      a. Time delay restart to prevent compressor reverse rotation on single-phase scroll compressors.
      b. Automatic restart on power failure.
      c. Safety lockout if any outdoor unit safety is open.
      d. A time delay control sequence provided through the fan coil board, thermostat, or controller.
      e. Liquid line low-pressure switches.
      f. Automatic outdoor-fan motor protection.
   2. Safeties:
      a. System diagnostics.
      b. Compressor motor current and temperature overload protection.
      c. High-pressure relief.
      d. Outdoor fan failure protection.

H. Units shall operate on single-phase, 60 cycle power at 208/230 volt. Unit electrical power shall be a single point connection with 24 volt control power.

2.4 CONTROLS AND POWER WIRING

A. Controls shall include a low voltage room thermostat with fan On-Off-Auto switch and a system Heat-Off-Cool switch. Unit shall be completely factory wired for terminal connections of thermostat and power wiring. Heating side of thermostat shall be two stages: First stage, compressor; second stage, electric heater.

B. Provide one power connection point for electrical wiring to heat pump evaporator and one for remote condensing unit.

2.5 EFFICIENCY

A. Minimum SEER rating as scheduled on the drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install unit in accordance with manufacturer's directions.

B. Cut all copper piping smooth and square. Clean fittings and tubing before installation, using nitrogen gas.

C. Thoroughly test for leaks and prove tight before charging. Tests shall include not less than 20-inch vacuum held for 24 hours. Final test shall be a Halide torch test at all joints after charging and before insulation is applied.

D. Install insulation by slitting tubular sections and applying over piping or sliding the tubing, unslit, over the ends of the piping. Fabricate miter-cut covers for fittings from insulation and conformance with manufacturer's recommendations. Seal joints and butt ends with Armstrong 520 fire retardant, waterproof adhesive, or approved equal. Taped joints will not be accepted.

E. Finish all pipe insulation exposed to weather with two coats of Armaflex finish, or approved equal.

++ END OF SECTION ++

SECTION 15736

VARIABLE REFRIGERANT VOLUME SYSTEMS AND CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Indoor Fan Coil Units
   2. Energy Recovery Ventilators
   3. Outdoor Condensing Units (Heat Pump and/or Heat Recovery)
   4. Branch Selector Boxes (Heat Recovery Systems)
   5. Duct Zoning Kits
   6. Controls
   7. Refrigerant Piping
   8. Mounting Hardware

B. Related Documents: The Contract Documents, as defined in Division 01 Summary of Work, apply to the Work of this Section. Additional requirements and information necessary to complete the Work of this Section may be found in other Documents. Comply with applicable Standards/Codes ANSI/ASHRAE 15, ETL, cETL, NEC, and OSHA as adopted by the State.

1.2 SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 15700 – General HVAC Requirements.

B. Submittals shall include the following:
   1. Dimensioned plan and elevation view drawings of all components with required clearances and locations of all field connections defined
   2. Summary of electrical requirements
   3. Complete wiring and schematic diagrams, sequences of operation, control system architecture, and any other details required to demonstrate that the system has been coordinated and will properly function as a system
   4. Computer generated performance at scheduled conditions including IEER and COP values certified to AHRI Std. 1230.
   5. Computer generated piping diagrams with all sizes indicated as well as an estimate of additional refrigerant requirements

C. Submittals shall include a list of all fan coil units by scheduled tag and corresponding group address of each unit to allow for remote configuration of operational settings via a configurator software package. Installing contractor shall be responsible for assigning a group address to each fan coil unit per the submitted list via the local controller.

D. Contractor shall submit documentation verifying they have personnel that have been trained and certified by the manufacturer.

1.3 QUALITY ASSURANCE

A. The units shall be tested by a Nationally Recognized Testing Laboratory (NRTL), in accordance with ANSI/UL 1995 – Heating and Cooling Equipment and bear the Listed Mark.

B. Performance of equipment shall meet or exceed the scheduled values and be rated in accordance with Air Conditioning Refrigeration Institute's (ARI) Standard 210/240 and bear the ARI label.

C. All wiring shall be in accordance with the National Electric Code (NEC).

D. The system shall be produced in an ISO 9001 and ISO 14001 facility, which are standards set by the International Standard Organization (ISO). The system shall be factory tested for safety and function.

1.4 CONTRACTOR QUALIFICATIONS:

A. Installation shall be performed by a Contractor that has been Certified by the Manufacturer. The Manufacturer shall provide Factory Certification Training to the installing and servicing contractor at no additional cost including travel, lodging, meals and training materials. An accredited factory trainer must conduct the training and provide a certificate of completion to said contractor.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site and store and protect products under provisions of Division 01, General Requirements, and Section 15700, General HVAC Requirements.

B. Protect units from physical damage until ready for installation.

1.6 COORDINATION

A. Coordinate sizes and locations of equipment support structures and concrete pads with actual equipment provided.

1.7 WARRANTY

A. All equipment shall include a 10 year limited parts and compressor warranty. Warranty will start on the date of unit commissioning or 90-days after delivery to jobsite, whichever occurs first.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with project requirements, manufacturers offering Products which may be incorporated in the work include the following:
   1. Daikin
   2. Other prior-approved manufacturers as indicated via addendum. Companies requesting approval to bid shall provide a complete submittal package demonstrating compliance with the design intent at least (10) working days prior to the established bid date. This package shall include, but is not limited to, equipment capacities at the design condition, power requirements, indoor units data sheets including CFM/static pressures and fan curves, control system architecture, and installation requirements. Provide a list of local projects, complete with reference contact information, that utilize the proposed equipment and controls.

2.2 GENERAL SYSTEM REQUIREMENTS

A. The published operating range in cooling or cooling dominate simultaneous cooling/heating shall be 23°F to 122°F (DB) or wider with an indoor temperature range of 57°F to 77°F (WB). The operating range in heating or heating dominate simultaneous cooling/heating shall be -13°F to 61°F (WB) or wider with an indoor temperature of 59°F to 80°F (DB).

B. A single system shall be capable of up to (64) temperature control zones on one piping network.

C. Each condensing unit shall be capable of being connected with nominal indoor evaporator capacity of up to 200% of the condensing unit nominal capacity.

D. Each condensing unit shall use all variable speed “inverter” compressor(s) coupled with inverter fan motors. The system capacity shall modulate based on evaporator and condensing pressures to vary the refrigerant volume to meet the needs of the cooling and heating demand depending on load and weather conditions.

E. Each system shall include a refrigerant auto-charging function and a refrigerant charge checking function.

F. Multi-module systems shall maintain continuous heating during defrost operation and oil return operation.

G. Each system shall be furnished with a centrifugal oil separator and active oil recovery cycle.

H. On Heat Recovery Systems, the operating mode switch from heating to cooling or cooling to heating of any fan coil on the system shall not affect other fan coils on that system.

I. The following are piping minimum limitations – (Note: All values provided below are "one way")
   1. Systems shall be capable of up to 540 ft of piping between the condensing unit and the furtherest indoor unit and up to 295 ft. downstream of the first branch.
   2. Systems shall be capable of up to 3,280 ft of piping in the piping network.
   3. Systems shall be capable of a vertical (height) separation of up to 295 ft between the condensing unit and the lowest or highest indoor unit and up to 98 ft of elevation difference between indoor units.

J. Systems shall use 16/18 AWG, 2 wire, stranded, non-shielded and non-polarized daisy chain transmission (control) wiring starting at the condensing unit.

K. Systems shall include a self-diagnostic, auto-check function to detect a malfunction and display the type and location.

L. Each system shall automatically restart operation after a power failure without loss of any settings.

2.3 INDOOR UNITS

A. All Units
   1. Factory assembled and tested including wiring, piping with flare connections, process control board (PCB), electronic expansion valve, fan motor thermal protection, condensate drain pan, auto-restart function with 3-minute fused time delay, and test run switch.
   2. Units shall be charged with dehydrated air prior to shipment from the factory.
   3. PID control of the electronic expansion valve shall be used to control superheat
   4. The indoor unit shall be powered with 208-230V/1-phase/60Hz. (253 volts maximum and 187 volts minimum).
   5. Coils shall be direct expansion type with copper tubes expanded into aluminum fins.
   6. All units shall be equipped with return air, liquid, and gas line thermistors.
   7. All units shall be equipped with a manually-initiated drying mode that dehumidifies while limiting changes in room temperature.
   8. PCB shall interface with remote controllers, building controllers, and Building Management System (BMS)
   9. Sound Power Levels shall not exceed scheduled or specified values when producing maximum airflow (high speed operation). If not specifically scheduled or specified, Sound Power Levels shall not exceed the values published for the scheduled models.
   10. All units shall be available with a remote temperature sensor kit for when remote controller or RA sensor is not used.

B. Hi Static Ducted Type (FXSA)
   1. Unit cabinet shall be constructed of galvanized steel with foam insulation and have a maximum unit height of 12 inches up to 4.5-Tons and 18.5 inches up to 8-Tons
   2. Configuration shall be horizontal discharge / horizontal return.
   3. Fan shall be a direct-drive, statically and dynamically balanced impeller with multiple speeds available. Unit shall be equipped with automatically adjusting external static pressure logic selectable during commissioning to accommodate field conditions.
   4. Units shall include an integral condensate drain pump and condensate safety shutoff/alarm or a remote condensate pump as indicated or required.
   5. Unless utilized with a filter return grille, units shall include a filter rack designed to accept standard size filters and quantities to meet the minimum filter face area scheduled (500 FPM maximum).
   6. Units with a nominal capacity of 2.5-Tons or larger shall be equipped with and integral air-side economizer when indicated or scheduled.

2.4 AIR HANDLING UNIT INTEGRATION KITS

A. Where indicated or scheduled, provide AHU Integration kits consisting of electronic expansion valve box, control box, and associated sensors and accessories to allow VRV condensing units to be utilized with non-VRV air handling equipment. System shall be capable of external control from a field-supplied controller or integral control provided by the VRV System manufacturer as described in the sequence of operations.

B. Both the valve box and the controller box shall be suitable for indoor or outdoor installation in accordance with UL1995. The control box shall include a hinged cover.

C. The control box will require a 208/230V/1-Ph power supply. The valve box shall be powered from the control box. Wiring between the valve box and the control box shall be via a factory-included wiring harness that allows for up to 65 ft. of separation.

D. Control box shall include voltage free contacts for fan start/stop, compressor on/off, error output, and defrost indication.

2.5 OUTDOOR CONDENSING UNITS

A. Heat Pump/Heat Recovery Condensing Units shall be available with 208-230V/1/60, 208-230V/3/60, or 460v/3/60 power supply as scheduled +/- 10%.

B. Condensing Units shall be factory assembled in the USA.

C. Condensing Units shall be weather proof fabricated from galvanized steel with a polyester finish. The condenser coil shall be manufactured from copper tubes

expanded into aluminum fins. The fins shall be coated with an anti-corrosion hydrophilic coating with a salt spray test rating of 1000-hr per ASTM test standards.

D. Units shall pre-wired with all necessary electronic and refrigerant controls. The refrigeration circuit shall consist of inverter scroll compressors, motors, fans, condenser coil with sub-cooling circuit, electronic expansion valves, solenoid valves, 4-way valve, distribution headers, capillaries, filters, shut off valves, oil separators, service ports, liquid receiver and suction accumulator. The outdoor unit shall be modular in design and allow for side-by-side installation with minimum spacing be capable of being piped and wired from left, right, rear, or bottom.

E. The following safety devices shall be included on the condensing unit; high pressure sensor and switch, low pressure switch, control circuit fuses, crankcase heaters, fusible plug, overload relay, inverter overload protector, thermal protectors for compressor and fan motors, over current protection for the inverter and anti-recycling timers.

F. Each condensing unit module shall include (1) internally spring-isolated Neodymium magnet digitally commutating hermetically sealed variable speed "inverter" compressor coupled with inverter condensing fan motor. Inverter compressor capacity shall be modulated automatically to maintain a constant suction pressure while varying the refrigerant volume to meet the cooling and/or heating loads. The capacity control range shall be as low as 3% to 100%.

G. Units with multiple modules shall include a duty cycling function to equalize run hours and starts. In the event of a compressor failure the remaining compressor(s) shall continue to operate and provide heating or cooling as required at a proportionally reduced capacity. The microprocessor and associated controls shall be designed to specifically address this condition

H. The sound pressure dB(A) for individual modules at rated conditions shall be not greater than 65 decibels at 3 feet from the front of the unit. Night setback control of the fan motor for low noise operation shall automatically limit the maximum speed to one of (3) field selectable noise levels:

OPERATION SOUND dB(A)	**NIGHT MODE SOUND PRESSURE LEVEL dB(A) APPROX.**
Level 1	55
Level 2	50
Level 3	45

I. Each module shall include vertical discharge propeller type, direct-drive fans with variable speed operation via a DC inverter. The fan motors shall include permanently lubricated bearings and inherent motor protection. Fans shall be

capable of up to 0.32" of external static pressure by a field adjustable setting. The fan assembly shall include a fan guard to prevent contact with moving parts.

J. The outdoor coil shall have a three-circuit heat exchanger design. The lower part of the coil shall be used for inverter cooling eliminating the need for a drain pan heater in defrost operation.

K. Each condensing unit shall incorporate contacts for electrical demand shedding with 3-stage demand control with 12 customizable demand settings.

L. Each outdoor condensing unit (regardless of quantity of modules) shall include a ventilated NEMA 3R UL508A Single-Point Power Panel (SPPP) with Thru-the-Door Main Input Disconnect for termination by the EC on the line side lugs. Panel shall be rated for 100 kAIC and include Class J, time delay, dual element fuses, voltage/phase monitoring, fused primary/secondary control transformer, and all required branch circuit protection. Power wiring between SPPP and individual modules terminal blocks shall be provided by the equipment manufacturer as part of their startup services.

2.6 BRANCH SELECTOR BOXES FOR HEAT RECOVERY SYSTEMS

A. Provide factory-assembled and run tested Branch Selector Boxes (BSB's) as indicated or scheduled. BSB's shall be available with up to 12 ports in increments of two capable of controlling up to 290 MBH of cooling capacity.

B. BSB's shall be fabricated with a galvanized steel casing insulated with sound absorbing flame and heat resistant foamed polyethylene resulting in a maximum sound pressure level of 40 dB(A) for any branch (circuit).

C. Each BSB branch shall include (3) electronic expansion valves and a subcooling heat exchanger. The use of solenoid valves for changeover and pressure equalization shall not be acceptable.

D. BSB's shall not require condensate removal.

E. The unit electrical power shall be 208-230V/1 phase with an MCA of 0.1 and MOP of 15.

F. Where indicated or scheduled. Multi-port BSB's shall accommodate left, right, or pass-through layouts. Pass-thru configurations shall be capable of up to 12 ports and 230 MBH downstream.

2.7 REFRIGERANT PIPING

A. Systems may be piped using hard drawn copper. Where piping is located indoors and not exposed, soft copper may be utilized.

B. Hard drawn copper tubing shall be ASTM B280, Type ACR. Fittings shall be ASME B16.22 wrought copper. Braze joints with AWS A5.8 BCuP silver/phosphorus/copper alloy with melting range 1190 to 1480°F.

C. Soft copper shall comply with ASTM B75 and be of UNS C12200 grade (99.9% pure copper).

D. Both liquid and suction lines shall be individually and completely insulated between the outdoor and indoor units with a minimum of 1/2" insulation. Outdoor insulation shall be protected with a UV protective cover.

E. Drawings indicate general routing of refrigerant piping and may also show pipe sizes. If indicated, pipe sizes should be considered as representative only. Prior to beginning of work, installing contractor shall indicate in writing the intent is to follow the engineered drawings or submit drawings showing the proposed locations of all equipment and routing of piping. The Equipment manufacturer shall size all refrigerant piping and provide an estimate of the additional refrigerant that will be required for each system based on this information.

2.8 CONDENSING UNIT EQUIPMENT SUPPORTS

A. Support condensing units and outdoor piping/conduit with an engineered system. On roof mounted installations, the design shall not require penetrating roof membrane. The engineered support system shall consist of injection molded glass fiber filled nylon support foot, recycled rubber bound by polyurethane pre-polymer anti-vibration mat, hot dipped galvanized mild steel framework and fittings.

B. System shall be designed specifically for the selected equipment and provide a means for routing the piping and conduit under the equipment.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of Conditions: Verify that field measurements, surfaces, substrates and conditions are as required, and ready to receive work.

B. By beginning Work, Contractor accepts conditions and assumes responsibility for correcting unsuitable conditions encountered at no additional cost to the Owner.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install units level and plumb.

C. Install refrigerant lines from Indoor Units to Condensing Units in accordance with manufacturer's recommendations.

D. Install condensate drain pipes from Indoor Unit drain pan to designated location shown on drawings. Provide minimum 1/8 inch per foot slope on all horizontal pipes.

E. Where piping is installed adjacent to unit, allow space for service and maintenance of unit.

F. Duct Connections: Duct installation requirements are specified in Division 15 Section "Sheet Metal Ductwork". Drawings indicate the general arrangement of ducts. Connect supply ducts to split-system air-conditioning units with flexible duct connectors. Flexible duct connectors are specified in Division 15 Section "Sheet Metal Ductwork"

G. Upon completion of the work, provide complete sets of 'as-built' drawings and other project-specific documentation.

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections.
   1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:
   1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
   2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
   3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Remove and replace malfunctioning units and retest as specified above.

D. Prepare test and inspection reports.

3.4 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.
   1. Complete installation and startup checks according to manufacturer's written instructions.

3.5 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain equipment, systems, and controls.

++ END OF SECTION ++

SECTION 15738

DEDICATED OUTDOOR AIR SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes Dedicated Outdoor Air System (DOAS) units for indoor applications.

1.2 SUBMITTALS

A. Product Data: Submit product data for specified products with the following information.

B. General layout drawing with plan and elevation views including all relevant dimensions.

C. Performance schedule including airflow, heating and cooling capacities, electrical data, unit weight.

D. Full fan curve.

E. Sound power data by octave band for all openings and radiated through the cabinet.

F. Electrical schematics including field wiring connections.

G. Component details including construction method and materials.

H. Control point schematic and complete written sequence of operation.

1.3 QUALITY ASSURANCE

A. Entire unit shall be UL 1995 certified and bear certification label by ETL, UL or CSA.

B. Unit shall meet ASHRAE Standard 90.1 performance requirements.

1.4 DELIVERY, STORAGE AND HANDLING

A. Store equipment away from construction areas where it may be damaged and protected from harmful weather conditions.

B. Keep factory shipping packaging in place until unit is ready to be installed.

C. Follow manufacturer’s instructions for rigging and placement of equipment.

1.5 COORDINATION

A. Coordinate all system connections and building penetrations including electrical and duct connections.

1.6 WARRANTY

A. Standard Warranty for the Unit (Parts only): 24 months (2 years) from shipment date

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with project plans and specifications the following manufacturers are approved to supply products.
   1. Acceptable Manufacturers
      a. Oxygen8

2.2 DOAS Units

A. DOAS units shall be factory assembled and tested. Units shall include insulated steel cabinet, split DX coil, fan and motor assembly, filter rack, and integral controls. Unit shall have a single circuit power connection.

2.3 CABINET

A. Cabinet shall be nominal 1-inch double wall panel with R6.5 thermal insulation. Cabinet exterior shall be 22-gauge pre-painted steel that meets or exceeds 650-hour salt spray test based on ASTM B117. Liners and other steel components shall be galvanized steel. All seams shall be sealed to provide airtight casing.

B. Doors shall be nominal 1-inch double wall panel with the same construction as cabinet. Doors shall be fitted with hinges and door handles. The doors shall have one lockable handle as standard.

C. The unit will be designed for service and maintenance on the bottom side for major components and front for filter and control panel access only to allow for a compact installation.

D. All dampers shall have extruded heavy gauge 6063 aluminum frame that includes jamb seals. Blades shall be airfoil shaped extruded aluminum and include rubber blade seals. Linkage shall be installed in the frame outside of the airstream.

2.4 FILTERS

A. Unit shall include 2-inch filter rack for the outdoor air path upstream of the DX hydronic cooling coil. Filters shall be accessed through hinged filter access door. Supply one set of MERV 13 pleated filters for the outdoor air stream. All filters must be UL approved.

B. Provide factory mounted pressure sensors to measure filter pressure drop across filters. Pressure drop shall be digital feedback to controller for utilization in control and alarm sequencing. Unit controller shall monitor filter pressure level and report when filter changes are required.

2.5 FANS

A. Fans shall be mixed flow plenum type with direct drive motor. Fan and motor assembly shall be factory mounted and balanced. The fans will be capable of operating in ambient temperatures of up to 40°C.

B. Fan motors shall be permanent magnet, synchronous motor type with integral digital motor controller. Fan bearings shall be serviceable type with an L-10 life of 40,000 hours. Fan motors will be UL approved.

C. All fans shall be equipped with integral airflow monitoring system connected to the unit controller.

D. Provide means to easily remove fan-motor assembly for service through standard doors.

E. Fans should be designed such that all service can be performed in the field, including replacement of bearings.

F. Fan motor drives shall be 208/60/1 and be UL approved. Fans will be protected by UL approved motor protection circuit breaker.

2.6 COOLING COIL [Pick coil type(s)]

A. Where indicated, unit shall include AHRI 410 certified fin tube type chilled water coil. Fins shall be aluminum with a minimum thickness of 0.006” and shall be free of oils and oxidation; aluminum properties are to be Alloy 1100 per ASTM B209. Tubes shall be round 5/8” OD and minimum 0.016” wall thickness seamless copper tube, mechanically expanded into fins; copper is to be Alloy 11000 per ASTM B152-06. Coils shall be brazed with a minimum 5% silver content filler material to ensure joint integrity. Coil casings shall be G90 galvanized steel, minimum 16 gauge. Coils shall include external drain and vent connections.

B. Coils shall be tested at 550 psig using dry nitrogen while submerged under water. Coils shall be designed to withstand a maximum operating temperature 250°F and a 300 psig maximum operating pressure.

C. Coil headers shall be constructed of seamless UNS C12200, Type L copper sized to match the specified connection size.
   1. Supply 2 way modulating control valves complete with valve actuators for field installation.

2.7 HEATING COIL

A. Where indicated, unit shall include AHRI 410 certified fin tube type hot water coil. Fins shall be aluminum with a minimum thickness of 0.006" and shall be free of oils and oxidation; aluminum properties are to be Alloy 1100 per ASTM B209. Tubes shall be round 5/8" OD and minimum 0.016" wall thickness seamless copper tube, mechanically expanded into fins; copper is to be Alloy 11000 per ASTM B152-06. Coils shall be brazed with a minimum 5% silver content filler material to ensure joint integrity. Coil casings shall be G90 galvanized steel, minimum 16 gauge. Coils shall include external drain and vent connections.

B. Coils shall be tested at 550 psig using dry nitrogen while submerged under water. Coils shall be designed to withstand a maximum operating temperature 250°F and a 300 psig maximum operating pressure.

C. Coil headers shall be constructed of seamless UNS C12200, Type L copper sized to match the specified connection size.
   1. Supply 2 way modulating control valves complete with valve actuators for field installation.

2.8 ELECTRIC HEATING COIL

A. Provide open coil electric heaters of the size, capacity and performance shown in the equipment schedules.

B. All duct heaters shall be tested and certified to UL and CSA.

C. Frame to be corrosion-resistant and made of galvanized steel.

D. Coils shall be made of high-grade Nickel-Chrome alloy and shall be insulated from the frame by means of non-rotating ceramic bushings.

E. Heater to come with door mounted disconnect switch and air proving switch

F. SCR control is time proportioning type that modulates the heater and supplies the exact amount of power to match the demand. Input signal will be 0-10V.

G. Heaters shall be equipped with a fail-safe automatic reset disc-type thermal cut-out located in the top frame component above the heating element.

H. Duct heaters shall be non-sensitive to air flow direction and interchangeable for horizontal or vertical ducts without impairing safety.

2.9 DX HEAT PUMP COIL (Heating and Cooling)

A. Where indicated, unit shall include AHRI 410 tested fin tube type DX coil for use with R-410A. Fins shall be aluminum with a minimum thickness of 0.0075". Tubes shall be 3/8" OD, 0.016" tube wall seamless copper tube mechanically expanded into fins. Coil shall have interlaced circuits to match remote condensing unit when required. Coil casings shall be galvanized steel. Coils shall include external drain and vent connections. Coil shall be mounted in a rack over a stainless-steel double sloped condensate pan. Coil shall be shipped with nitrogen holding charge and tested to 700 psi.

B. When VRV integration is used, the AHU integration controller (EKEQ) must be factory mounted and wired to EKEXV expansion valve kit.

C. Liquid and Gas thermistors are to be mounted to coil and wired to EKEQ kit in the factory.

D. EKEXV expansion valve kit will be mounted, and connections will be brazed to coil. Liquid and Gas lines to be capped at outside of AHU. Coil and EKEXV kit must be tested to 400 psi, and then nitrogen charged for shipment to site.

2.10 CONTROLS

A. Unit shall include an integrated microprocessor-based unit controller. The controls shall be located in the electrical panel. All unit controls shall operate off a transformer from the main power supply for single point power connection. All internal controls and sensors shall be factory prewired and tested.

B. The control system will regulate temperatures, airflows and other functions as required. Unit controller shall be pre-programmed with factory tested software for all possible functions.

C. The controller shall provide the following, refer to sequence of operation for specific unit control sequences;
   1. Control of fans correcting for both changes in total static pressure and air density in both VAV and constant airflow applications.
   2. Fan performance monitoring.
   3. Ventilation airflow monitoring and control.
   4. Airflow density correction for winter and summer conditions.
   5. Energy recovery optimization including operation of bypass damper.
   6. Supplemental heating and cooling when included.

7. Frost protection.
8. Monitoring alarms, faults and maintenance points including filter changeout.
9. Time and date schedules.
10. Humidity control.
11. Data logging and trending.

D. Include wireless capability that will allow the client to access remotely via internal wi-fi network.

E. If non factory controls are proposed as an option, a factory witness test is required to show integration and functionality.

F. Controller shall be BACnet IP and BTL certified and include Modbus communication. Communication shall include monitoring, control, alarms, faults and maintenance information.

G. Provide factory installed and tested contactors, overloads, fusing, starters motor speed controllers for supply fans. Include all necessary control transformers.

H. Provide unit mounted non-fused disconnect switch with single point power connection.

I. Supply all necessary temperature and pressure sensors complete with plug in wiring harnesses for proper option of unit.

J. When VRV integration is used, the AHU integration controller (EKEQ) must be factory mounted and wired to EKEXV expansion valve kit.

K. Liquid and Gas thermistors are to be mounted to coil and wired to EKEQ kit in the factory.

2.11 PLASTIC COMPONENTS

A. All plastic components that are in the airstream, must be of a UL94 rated material.

B. If gasketing is used to join unit sections together, gasketing must be a UL94 approved compound.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install equipment in accordance with manufacturer instructions, these specifications, best practices, and all applicable building codes.

3.2 START UP SERVICE

A. Engage factory authorized service technician to start up and commission units. Provide start up report to owner.

++ END OF SECITON ++

SECTION 15780

CONDENSATE AND EQUIPMENT DRAIN SYSTEMS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish and install all drain piping from cooling coil drain pans to the floor sink or as indicated on the drawings, complete with all connections to the air handlers, traps and fittings. Included in this section are all other incidental drain piping as designated.

B. All work specified in this Section shall comply with all Sections of Division 15.

PART 2 - PRODUCTS

2.1 PIPING

A. Type L or M copper, or as specified or shown elsewhere.

2.2 FITTINGS

A. Same as piping.

2.3 UNIONS

A. 150 PSI, galvanized forged steel with bronze-to-steel seat at all connections to A/C units.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Furnish and install all piping as close as possible to layout indicated complete with all connections to drain pans and extension to floor sinks or as otherwise indicated. Trap and vent at air conditioning unit and provide all unions and plugged tees as indicated and all hangers as described in Specifications.

B. Pitch in direction of flow at 1/8" per lf slope minimum.

C. Insulate condensate drain piping in accordance with Specifications.

3.2 TESTING

A. Test by filling to the highest point of each system and hold for four hours. Repair all leaks, replace all defective piping, and retest as required. See Specification Section 15710, Summary of Work for Heating, Ventilating and Air Conditioning.

++ END OF SECTION ++

SECTION 15890

SHEET METAL DUCTWORK

PART 1 - GENERAL

1.1 Scope

A. Furnish all labor, materials, equipment and services necessary for the installation of all low-pressure sheet metal duct systems as herein described and as indicated on the drawings. Each system shall be complete with all accessories, etc., as described herein and in other sections of these specifications.

B. Ductwork Handling and Storage:
   1. The Contractor shall receive, store and install ductwork to prevent dust, debris and moisture from entering the ductwork.
   2. Ductwork shall arrive on the project site with polyethylene film or other waterproof covering over the open ends which will prevent the entrance of dust, debris and moisture. Ductwork shall be stored in a clean and dry location. Any ductwork which is observed with interior dust and/or debris shall be cleaned and not re-installed until approval is received from the Architect/Engineer. Any ductwork which is observed to have wet interior insulation shall be removed from the jobsite and new ductwork furnished at the Contractor's expense.
   3. At ends of ducts which are not connected to equipment or air distribution devices at the time of ductwork installation, provide temporary closure of polyethylene film or other covering which will prevent entrance of dust and debris until the time that connections are to be completed.

C. Fabricate ductwork and fittings according to SMACNA's "HVAC Duct Construction Standards" unless noted otherwise.

D. Static Pressure Classification:
   1. Supply Ductwork: 2 in. w.g.
   2. Return Ductwork: 2 in. w.g., negative.

1.2 Galvanized Sheet Metal

A. For all ductwork except as otherwise specified.

PART 2 - PRODUCTS

2.1 Galvanized Ductwork

A. Galvanized, prime-grade, lock-forming, quality steel (LFQ) having a G60 galvanized coating. Cross-break all sides of ducts. Ductmate, TDC or TDF Systems for ductwork over 22".

2.2 Aluminum Ductwork

A. Aluminum sheets with an aluminum alloy base containing not more than 0.40% copper, a minimum tensile strength of 16,000 PSI and a forming quality to satisfactorily make a Pittsburgh lock seam.

2.3 Round Ductwork and Fittings

A. Galvanized spiral lock seam as manufactured by United McGill, Pacific Air Reps., Metal Manufacturing, SEMCO or approved equal. Five-gore, fixed 90º and 3-gore, fixed 45º elbows with a radius 1-1/2 times the diameter. Branch take-off shall be expanded throat type with a 45º lateral takeoff. Start collars shall be flared spin-in type (dovetail is not acceptable). Tees shall be Loloss. Ductwork shall be primed per architectural painting section and ready to paint. Minimum duct gauge shall meet the requirement of the Mechanical Code.

2.4 Longitudinal Seams

A. Pittsburgh lock groove hammered flat. Seal all longitudinal seams with a listed duct sealant. Button punch or snap lock is not acceptable.

2.5 Turning Vanes

A. Sheet Metal Vanes: Factory fabricated, single thickness, galvanized sheet metal with airfoil contour, large radius with 3/4" tail on all elbows. Shop fabricated duct turns must be submitted for approval prior to processing any work on project.

2.6 Flexible Duct

A. Flexible, pre-insulated, vinyl-coated fiberglass with corrosion-resistant, steel spiral reinforcing, designed for low velocity application. All duct, insulation and adhesives shall be fire and smoke resistant in conformance with NFPA 90A and UL 181 for Class 1 duct. Flexible duct shall not exceed 5'-0" in length and shall only be used for drops to diffusers. Duct shall be Thermaflex Type M-KE as manufactured by Flexible Tubing Co. or approved equal.

2.7 Flexible Connections

A. Twenty-four ounce glass fabric that is flameproof, airtight, ozone resistant, and a minimum of 3" wide with 3" of metal on each side of 3" of fabric using a grip lock seam, Duro-Dyne "Durolon" or approved equal.

2.8 Manual Dampers

A. Single Blade Rectangular Ductwork: Minimum of 20 gauge galvanized steel, synthetic bearings, 1/2” diametersteel axle, provide continuous axle on ducts larger than 12”, .2” standoff on insulated ducts with manual locking quadrant with indicator pointer. Greenheck MBD-10 or approved equal. Provide damper handle with orange plastic ribbon.

B. Round Ductwork: Minimum of 20 gauge galvanized steel, synthetic bearings, 1/2” diameter steel axle, provide continuous axle on ducts larger than12”, .2”standoff on insulated ducts with manual locking quadrant with indicator pointer. Greenheck MBDR-50 or approved equal. Provide damper handle with orange plastic ribbon.

2.9 Access Doors

A. Uninsulated Ducts: Construct access doors of galvanized sheet metal two gauges heavier than duct with rolled edges, hinges, and Ventfabrics, Inc. "Ventlock" #260 latch. Make airtight with felt strips or neoprene gasketing and provide 1" x 1" x 1/8" galvanized iron frame for installation in ductwork.

B. Insulated Ducts: Double thickness galvanized sheet metal of same gauge as duct (minimum 20 gauge) with minimum of 1" thick, 2-pound density fiberglass or approved equal insulation in between sheet metal, rolled edges, hinges and Ventfabrics, Inc. "Ventlock" #260 latch. Make airtight with felt strips or neoprene gasketing, and provide 1" x 1" x 1/8" galvanized angle iron frame for installation in ductwork.

2.10 Access Panels and Access Openings In Ductwork

A. Galvanized, sheet steel, two gauges heavier than the duct with rolled edges, felt strips or neoprene gasketing and attached to duct with sheet metal screws a maximum of 6" on center.

2.11 Duct Supports

A. Ducts 47" and Smaller: 22-gauge steel hanger straps 1" wide riveted to seams of ducts, maximum of 6'-0" on center. Alternate support for horizontal ducts must be by two 1/4" bolts or two or more #14 sheet metal screws.

B. Ducts over 48" in Width: Support from trapeze hanger consisting of vertical steel rods and angle iron frames.

2.12 Duct Construction

A. All duct construction must conform to local code or to the SMACNA Duct Construction Standards Manual, whichever is more stringent.

PART 3 - EXECUTION

3.1 Fabrication

A. Fabricate all ductwork and install using skilled mechanics in strict conformance with the SMACNA Manual. Provide supplemental stiffening as required to prevent drumming and provide a structurally sound assembly.

3.2 Construction

A. Construct all fittings, elbows, and transitions to provide a minimum of noise and resistance. Where space permits, use elbows with a minimum radius of 1-1/2 times the width (or depth). Where space conditions necessitate abrupt hanges in direction (or as otherwise indicated), use square elbows with turning vanes. Transitions increasing in the direction of airflow shall not change greater than 1" in 7" and transitions decreasing in the direction of airflow shall not change greater than 1" in 5".
   1. Ductmate, TDF and TDC duct connectors are allowed when fabricated and installed in strict compliance with manufacturer's instructions.

3.3 Taping

A. Tape all cross-joints in concealed or insulated sheet metal ductwork with Arabol and canvas or reinforced Hardcast.

3.4 Weatherproofing

A. All ductwork exposed to weather shall be made weather-tight, seal all joints with a minimum of two coats of weatherproof duct sealer (DP1010 or approved equal).

3.5 Duct Sizes

A. Indicated sizes are to the inside of acoustical linings. Increase the size of all sheet metal ducts as required to accommodate acoustical lining.

3.6 Duct Openings

A. Construct duct openings at grilles or registers so that the plaster will not crack when the registers are attached.

3.7 Painting

A. Paint the inside of all supply, return and exhaust ducts and dampers one coat of dead black paint whenever visible through the openings. Where the duct insulation is visible through the grilles, registers, or diffusers, the insulation must have a black finish.

3.8 Flexible Connections

A. Provide flexible connections at the intake and discharge of all air handling and air conditioning units and elsewhere as indicated.

3.9 Manual Dampers

A. Provide manual dampers in each supply duct to outlet/inlet and elsewhere as indicated. Provide locking quadrants with memory stop.

3.10 Measurements

A. Before fabrication, check all ductwork with the building construction for dimensions, locations, clearances, etc. Make up duct with any necessary variations to conform to the details of the construction of the building, to suit the space available, and to fit the equipment furnished. The entire duct system must be substantially constructed, rigidly erected and free of any duct vibration or noises.

3.11 Flashing

A. Flash all ducts passing through the roof, floor or through exterior walls.

3.12 Testing and Balancing

A. See Specification Sections 15951, Testing, Adjusting and Balancing of Mechanical Systems.

3.13 Air Leakage

A. The ductwork shall be sealed and tested. Maximum allowable leakage shall be 5% of scheduled airflow in duct.

++ END OF SECTION ++

SECTION 15910

MECHANICAL SYSTEMS INSULATION

PART 1 - GENERAL

1.1 WORK INCLUDED

A. All work specified in this Section shall comply with all Sections of Division 15.

B. Work required under this section consists of insulation for piping and duct systems and equipment specified in Division 15.

C. Provide all necessary labor, materials, tools, and equipment to perform work required on the drawings and specified herein.

D. Certain equipment and/or systems to be factory insulated by the manufacturer. Factory insulation materials to be specified in applicable sections of the specifications.

E. All pipe, fittings, and valves to be insulated.

F. Thermal resistance "R" values used herein are expressed in units of hour/degrees F/sq. ft./Btu per inch of thickness on a flat surface at a mean temperature of 75ºF, unless specifically noted.

1.2 DEFINITIONS

A. "Exposed" equipment, ducts and piping are areas which will be visible without removing ceilings or opening access panels. "Concealed" is not "Exposed."

B. Outdoors is considered exposed to the weather.

C. Underground is buried, whereas in a trench below grade is considered concealed.

1.3 APPLICABLE CODES AND STANDARDS

A. ASTM E-84.

B. NFPA 225.

C. UL 723.

D. NFPA 90A.

1.4 SUBMITTALS

A. Submit an electronic copy of all insulating materials data for review by the Architect.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. CertainTeed, Armstrong, Owens-Corning, Manville, Manson.

2.2 CERTIFICATION/QUALITY ASSURANCE

A. Only products of manufacturers meeting this specification will be approved.

B. Products shall meet applicable national, model, state and local building codes and be UL (or other recognized testing lab) listed for intended service.

C. All insulation materials shall be delivered and stored in manufacturer's containers and kept free from dirt, water, chemicals, and mechanical damage.

D. All insulation, adhesives, coatings, sealers, tapes, shall have a flame spread rating of 25 or less and smoke development of 50 or less when tested in accordance with ASTM E-84, NFPA 225, UL 723, and further must meet the requirements of NFPA 90-A and local building codes.

E. Insulation for duct, pipe, and equipment for above grade exposed to weather outside building shall be certified as being self-extinguishing for 2" thickness in less than 53 seconds when tested in accordance with ASTM D1692.

2.3 ACOUSTICAL DUCT INSULATION

A. Scope: Line all rectangular exhaust ducts (not including shower exhaust ducts) with minimum 1/2" thick insulation. Line all rectangular supply and return ducts with a minimum of 1-1/2" thick insulation. Line all sheet metal return air plenums with 1-1/2" thick insulation. Line all exterior ductwork with a minimum of 2"-thick insulation. Dimensions shown are the clear inside dimensions of the duct; sheet metal shall be increased to accommodate the liner. Exposed round ductwork is not required to be lined.

B. Material:
   1. Supply and return ductwork shall have a minimum R-6 rating for 1-1/2” thick duct liner and a R-8 rating for 2” thick insulation. Not less than an NRC of 1.0 for 2" duct liner, .85 for 1-1/2" duct liner and .55 for 1/2" duct liner, coated to a smooth finish. Duct liner shall meet the requirements of NFPA 90A and be so labeled, suitable for velocities of no less than 4,000 fpm.

2. Resistance to Mold Growth: Material surfaces shall be determined to be resistant to mold growth in accordance with a standardized test method, such as Underwriters' Laboratories, Inc. (UL) 181 "Mold Growth and Humidity Test," ASTM C 1338 "Standard Test Method for Determining Fungi Resistance of Insulation Material and Facings," or other comparable test methods.
3. Resistance to Erosion: Air stream surface materials shall be evaluated in accordance with the UL 191 "Erosion Test" and shall not break away, crack, peel, flake off, or show evidence of delamination or continued erosion under test conditions.

C. Application: Apply insulation to the tops, bottoms and sides of all ducts and plenums, except the floors of plenums provided with access doors. Use mechanical clips and adhesive to fasten all insulation. Metal clips shall be Miracle Surface Anchors, Gemco Anchors adhered with three spot welds or spot-welded pins, not over 12" O.C. Adhesive shall be Minnesota Mining and Manufacturing Corp. #38 applied to 100% of the surface. Cut all insulation squarely and evenly to provide a smooth insulation surface to all seams and joints and point up to form a smooth surface with cement. Butt ends of insulation exposed to airflow in supply ducts shall be covered and tapered to duct wall with 4-ounce canvas saturated with Foster's or Arabol lagging adhesive.

2.4 THERMAL DUCT INSULATION – CONCEALED DUCTS & PLENUMS

A. Scope: Insulate (wrap) all round concealed supply and return air ducts, outside air and mixed air ducts as specified hereafter. Wrapped, concealed round ductwork is not required to be lined. Exposed round ductwork is not required to be wrapped.

B. Material: Flexible blanket glass fiber insulation, flame retardant, all-service duct wrap, factory laminated to FRK vapor retarder facing, maximum K of 0.30 at 75°F mean temperature, minimum 1-pound density. Insulation shall be 2" thick, 1.0 lb./FT^3 with a minimum R-6 rating.

C. Application: Insulation shall be applied over surfaces that have been wiped clean and dry. Insulation shall have 2"-tab overlap on both longitudinal and transverse seams. Butt edges of all insulation firmly together. Coat the underside of the exposed circumferential and longitudinal seams with 3M #37 or #38 or undiluted Foster's adhesive and firmly press on surface of vapor barrier again, making sure all seams are tightly butted. Staple all joints with outward clinch staples on 6" centers, 1" back from the edge. Seal all staples with a vapor barrier tape cemented to the insulation.

D. Application for Larger Ducts: In addition to the above procedures, secure the insulation on ducts 30" or more in width to the bottom of the duct with 3M ECO104 adhesive in 4" strips, 12" O.C. and with welded pins on 12" centers. Secure weld pins with washers or clips on each pin applied flush to the face of the

insulation without depressing the surface. Cut off pin as close to the washer as possible and coat the entire exposed pin to the washer assembly with a vapor barrier adhesive.

2.5 PIPING INSULATION

A. Insulate all interior above grade chilled water supply and return piping, including piping to compressed air and oil coolers, where applicable, as specified hereinafter.

1. Material: ASJ, heavy density, two-piece, UL rated, dual temperature. Insulation shall have factory applied, flame retardant, kraft-foil (ASJ) vapor barrier jacket. Insulation thickness shall be as follows:

Pipe Size	Thickness
1/2" – 1-1/2"	1"
2" and larger	1-1/2"

2. Application - Piping: Insulation end joints to be tightly butted together and the longitudinal seam stapled closed with outward clinch staples, 3" on center. Before stapling, heavily coat the underside of the jacket overlap with vapor barrier adhesive. Locate all longitudinal seams out of sight. Cover end joints with factory furnished, 4" wide vapor barrier striping tapes, heavily coating the underside and secure with vapor barrier adhesive. Seal all ends of pipe insulation with vapor barrier mastic at valves, fittings, flanges, direct hanger contacts and every 21 feet of straight run.
3. In addition to ASJ jacket, cover all piping, valves, fittings, etc., in the central plant, all tunnels, and all air handling and fan rooms with 8-ounce canvas sized with Arabol or Foster's lagging adhesive and left suitable for painting.
4. Valves, Fittings and Flanges: Insulate all valves, fittings and flanges with molded, pre-shaped sectional covering or wrapped with 3-pound density flexible fiberglass insulation to a thickness equal to the adjacent piping insulation and covered with Zeston fitting cover or secure with jute or glass twine and cover with 1/4" thick coat of hard finish plastic insulating cement and finish by strapping with open mesh glass or canvas fabric, overlapping adjoining pipe insulation 2", and apply two thick wet coats of vapor barrier mastic.
5. Hangers and Rollers: At hangers and rollers where the pipe is supported by the insulation, the Insulation Contractor shall install an insert section of cellular glass or calcium silicate inside the vapor barrier. The length of insert section shall not be less than 12" for all piping through 8" and 18" on pipe size 10" and over. Coat the insert section with mastic to provide an effective vapor seal. Provide a protective shield covering of 18 gauge for piping 6" and smaller and 16 gauge for 8" and larger, galvanized steel placed centrally between the insert section of all hangers and rollers. Shield shall cover half of the insulation and have a length of not less than 12" on pipe sizes up to 8" and 18" on pipe sizes 10" and over.

B. Refrigerant Piping:
   1. Insulate refrigerant suction piping with 1" thick, pre-glued, flexible-foamed, closed-cell pipe insulation. Insulation shall have a 'K' factor of not more than .25 at 75°F and a water vapor transmission rate of 0.0 perm-inch in accordance with ASTM C-518 and E-96. Insulation shall have a flame spread of not more than 25 and a smoke development of not more than 50. Seal joints, butt ends, and miters with fire retardant, waterproof adhesive equal to Armstrong 520. (Tape joints will not be accepted.) When insulation is exposed to sunlight, wrap with polytape with one-third overlap.
   2. Paint all insulation and/or tape exposed to the exterior with ultraviolet resisting paint.

C. Condensate Drain Piping:
   1. Insulate condensate drain piping with 3/4" thick, pre-glued, flexible foamed, closed cell pipe insulation. Insulation shall have a "K" factor of not more than .25 at 75°F and a water vapor or transmission rate of 0.0 perm-inch in accordance with ASTM C-518 and ASTM E-96. Insulation shall have a flame spread of not more than 25 and a smoke development of not more than 50. Seal joints, butt ends and miters with fire retardant, waterproof adhesive equal to Armstrong 520. (Tape joints will not be accepted.)

2.6 OUTDOOR PIPING – INSULATION & FINISH (ABOVE GRADE)

A. Straight Piping: All chilled water, heating water, steam, and steam condensate piping exposed to exterior shall be insulated with Manville Metal-Lok, CSG, Gustin-Bacon, Brower, Armstrong or approved:

Pipe Size	Thickness
1/2"-1-1/2"	1-1/2"
2" and larger	2"

B. The insulation shall be applied over clean, dry pipe with all joints butted firmly together. The insulation shall be jacketed with a minimum thickness of 0.016" aluminum. The insulation and aluminum shall be secured in place by a continuous friction-type joint to provide a positive weatherproof seal along the entire length of the aluminum jacket. Then an aluminum preformed strap containing a permanently plastic weatherproof sealant shall be centered over each circumferential joint and secured by tightening of a clip or by use of separate 1/2" wide stainless-steel banding (.015" minimum thickness).

C. Fittings: All elbows, tubes, turns, sweeps and bends shall be insulated with mitered sections of insulation and covered with preformed aluminum fitting cover. Joints shall be sealed with a sealing compound and preformed aluminum bands such as Manville Miter-Seals.

2.7 EQUIPMENT INSULATION

A. Scope: Insulate all hot water expansion tanks as specified hereinafter.

B. Material: Calcium silicate block insulation, maximum K of 0.38 at 200°F mean temperature. Minimum density of 10 pounds cubic foot insulation thickness shall be as follows:

Maximum Diameter	Thickness
36" and below	1-1/2"
Above 36"	2"

C. Application: Miter cut all insulation to form a smooth, continuous insulation finish then securely wire or band in place. Cover insulation with one coat 1/8" to 1/4" thermal setting fiberglass or rock wool and Portland cement plastic (50-50), finished smooth, and covered with 12-ounce canvas pasted in place.

PART 3 - EXECUTION

3.1 GENERAL

A. Insulation shall be applied in a workmanlike manner by experienced, qualified workmen.

B. Insulation shall not be applied until all pressure testing has been completed, inspected, and released for insulation applications. (This does not apply to ductwork with acoustic liner.)

C. No pipe insulation shall be cut where the hanger is located. Insulation shall be continuous through hanger. If hangers have been installed, which violates this strict requirement notify the Architect immediately.

D. All surfaces shall be clean and dry when covering is applied. Covering to be dry when installed and before and during application of any finish, unless such finish requires specifically a wetted surface for application.

E. All adhesives, cements, and mastics shall be compatible with materials applied and shall not attack materials in either wet or dry state.

F. Install insulation using professional insulators who have adequate experience and ability.

G. Exposed-to-view insulation shall have a well-tailored appearance.

++ END OF SECTION ++

SECTION 15950

TESTING MECHANICAL SYSTEMS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. All work specified in this section shall comply with all sections of Division 15.

B. Test mechanical systems and equipment to demonstrate proper operation.

1.2 SUBMITTALS

A. Submit PDF electronic file of Test Results to Architect of all Tests described in Part 3 of this Specification.

1.3 COORDINATION

A. Advise the Architect of scheduled systems testing and completed system demonstration/operation schedules so that he may witness, if desired.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 TESTING - GENERAL

A. Test systems and equipment installed to demonstrate proper operation.

B. Submit notices of readiness for testing to the Architect and other appropriate people.

C. Correct and retest work found defective when tested.

D. Make repairs to piping systems with new materials. Peening, doping or caulking of joints or holes will not be acceptable.

3.2 AIR SYSTEMS, AIR DISTRIBUTION AND WATER SYSTEM TEST AND BALANCE

A. Perform air and water systems test and balance in accordance with Section 15951, Testing, Adjusting and Balancing of Mechanical Systems.

B. Test return, relief, exhaust and supply ductwork to 2” static pressure prior to connecting outlet devices, or air moving devices.

C. Verify all manual dampers are installed correctly and in 100% open position.

3.3 TEST PROCEDURES

A. Make tests before the rough work is covered. The system may be tested in parts if approved.

B. When the tests show the work in any way defective, remove defective material or equipment from the premises and retest.

C. Make piping tests on all piping as required by code or provide a 150 PSI hydrostatic pressure test for four hours, unless otherwise noted.

D. Coil Condensate Drain and Evaporative Cooler Drain Piping: Fill to highest point of system for four hours with no drop in water level.

3.4 TESTING OUT

A. Check out and test operate all equipment installed under heating, ventilating and air conditioning sections of these specifications, including a check of all work performed under the Electrical and Mechanical Divisions in conjunction with the equipment installed under all sections of this division.
   1. Check electrical work to see that the power is properly supplied to all electrical motors and that all electric controls are properly hooked up in the control circuits. Furnish a list of the voltage and current readings taken under load of all motors (except fan coil units).
   2. Check all work and see that all controls are in good working order and properly adjusted. After the equipment has been properly adjusted, start up and run all equipment enough to determine that the controls and equipment are all operating properly and that the installation is complete. During the test runs, balance the water quantities and water flow as required in the piping circuits after the cooling and ventilation systems are connected to all equipment. Balancing shall be accomplished as described under Specification Section 15951, Testing, Adjusting and Balancing of Mechanical Systems.
   3. When the test or observations show that the work is in any way defective or at a variance with the specification requirements, immediately make all changes necessary to correct the work and remedy the defects to the satisfaction of the Architect. Remove any defective material or equipment from the premises. In the event the Contractor does not remedy all defects and make all changes demanded by the Architect within a reasonable time, the right is reserved to have the defects remedied or changes made and to charge the cost of the work against the account of the Contractor.
   4. Furnish all appliances, equipment and labor for the tests and meet all expenses of the tests.

3.5 FINAL TESTS

A. Before acceptance and at a time designated, make a complete test to demonstrate that the water and air quantities are balanced for even temperatures throughout, that all controls are adjusted and that, in general, the system is placed into proper operation. Furnish a skilled operating engineer for a period of at least two 8-hour days, at time or times designated by the Owner, to instruct the Owner's representative in the operation and maintenance of the equipment.

++ END OF SECTION ++

SECTION 15951

TESTING, ADJUSTING AND BALANCING OF MECHANICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Test, adjust, and balance piping systems and air systems as specified.
   1. Contractor will pay the cost of employing a testing and balancing firm subject to the approval of the Architect, to perform testing, adjusting and balancing.

B. All work specified in this section shall comply with all sections in Division 15.

1.2 SCOPE OF WORK

A. The Mechanical Contractor will contract with an independent Testing, Adjusting and Balancing Agency (hereinafter referred to as "TAB Agency" or "Agency") to test, adjust, and balance the HVAC systems.
   1. The Contractor shall not in any way prohibit the TAB Agency from communicating freely with the Architect / Engineer.
   2. Reporting: The TAB Agency is required to copy the Architect on all communication to the Contractor relating to the review, inspection, status, or progress of the mechanical installation and related balancing work.

B. The work included in this section consists of furnishing labor, instruments and tools required in testing, adjusting and balancing the HVAC systems, as described in these specifications or shown on accompanying drawings. Services should include checking equipment performance, taking the specified measurements, and recording and reporting the results. As part of the work of this Contract, the Mechanical Contractor shall make any changes in the pulleys, belts and dampers, or the addition of dampers required for corrected balance, as recommended by the TAB Agency, at no additional cost to the Owner. The Contractor shall furnish the necessary labor to assist the TAB Agency to complete its work.

C. The items requiring testing, adjusting and balancing include the following:
   1. Air Systems:
      a. Supply/Return Fan AHU.
      b. Zone Branch and Main Ducts.
      c. Diffusers, Registers and Grilles.
      d. Coils (Air Temperature).

1.3 SUBMITTALS

A. Submit letter naming proposed TAB technician along with copy of certification and detailed listing of previous experience and references.

B. Submit reports on standard forms like those shown in the National Standards for Field Measurements and Instrumentation Manual published by the Associated Air Balance Council.
   1. Forms shall be fully completed.
   2. Forms shall be signed by technician who performed tests.
   3. All sheets shall be neatly typed.
   4. All information listed in the above manual and/or below shall be included in the submittal.

1.4 QUALITY ASSURANCE

A. Qualifications:
   1. Testing and balancing of the HVAC air and water systems shall be performed by an independent Test and Balance firm specializing in and whose business is limited to the testing and balancing of heating, ventilating and air conditioning systems.
   2. Work shall be under the direct supervision of a qualified Test and Balance Engineer employed by the HVAC subcontractor. Tests shall be conducted in the presence of the Contractor.
   3. Agency Qualifications: The TAB Agency shall be a current member of the Associated Air Balance Council (AABC). A National Environmental Balancing Bureau (NEBB) certified contractor may perform this work if he has prior approval from the Architect.

B. Approved Agencies:
   1. Arizona Air Balance.
   2. Precision Air.
   3. Technical Air Balance.
   4. TAB Technologies.
   5. Commercial Systems Analysis (CSA).
   6. Southwest Testing and Balancing.

1.5 WARRANTY

A. Test and Balance firm shall include an extended warranty of one year after completion of test and balance work, during which time, at the discretion of the Architect, a recheck or resetting of any outlet, supply air fan as listed in test report may be requested. The firm shall provide technicians to assist the Architect in making tests which may be required during this period.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 TAB PREPARATION AND COORDINATION

A. Preparation:
   1. Shop drawings, submittal data, up-to-date revisions, change orders, and other data required for planning, preparation, and execution of the TAB work shall be provided to the TAB Agency no later than 30 days prior to the start of TAB work.
   2. System installation and equipment startup shall be complete prior to the TAB Agency being notified to begin.
   3. The building control system should be complete and operational. The Building Control System Contractor shall install all necessary computers and computer programs and make them operational. Assistance shall be provided as required for reprogramming, coordination, and problem resolution.
   4. All test points, balancing devices, identification tags, etc., shall be accessible and clear of insulation and other obstructions that would impede TAB procedures.
   5. Qualified installation or startup personnel shall be readily available for the operation and adjustment of the systems. Assistance shall be provided as required for coordination and problem resolution.

3.2 TESTING, ADJUSTING AND BALANCING AIR SYSTEMS

A. Contractor shall cooperate with the Test and Balancing Engineer and provide sufficient time before final completion of the HVAC work so that testing and balancing can be accomplished. Contractors shall provide labor and tools to make corrections to the system when required to balance the system without undue delay to Test and Balancing firm employee(s).

B. Provide Test and Balancing Engineer one (1) set of shop drawings on all equipment which will require adjustment when balancing the HVAC system.

C. Work shall not begin until all systems which are to be tested have been completed and are in full working order. All filters shall be changed, and coils clean before system is balanced. The Contractor, together with the subcontractor, shall put all systems and equipment into full operation and shall continue the operation of all equipment during each working day of the testing and balancing work.

D. Adjusting tolerances shall be within 10% of design.

3.3 ADDITIONAL TAB AGENCY SERVICES

A. The TAB Agency shall provide the following additional services:

1. Life Safety Controls: The TAB Agency shall test and record life safety control operations on the HVAC equipment. The Agency shall verify the installation of required smoke detectors in air handling equipment (AHE) and shall verify operation of the smoke detector by activating the smoke detector and observing air handler shutdown. With the Controls and Alarm Contractors, the Agency shall verify the operation of interconnected systems such as the AHE smoke detector activation of the fire alarm system and the alarm system activation of the life safety control sequences.

3.4 ACCEPTANCE TEST

A. Final Acceptance Tests: The date for the final acceptance tests shall be sufficiently in advance of the Contract completion date to permit the execution before the expiration of the Contract of any adjustments and/or alterations which the final acceptance tests indicate as necessary for the proper functioning of all equipment. Any such modifications shall be completed within the number of days allotted for completion of the Contract. Retests shall not relieve the Contractor of completion date responsibility.

B. Before starting or operating systems equipment, make thorough check to determine that systems have been flushed and cleaned as required and equipment has been properly installed, lubricated, and serviced. Notify Architect in writing at least three days in advance of starting these tests.

3.5 FINAL REVIEW

A. System Operation: System shall be operating properly with all water and air volume balanced and all temperature controls adjusted. Air balance report shall be submitted to the Architect.

B. Documentation: Certificates and documents required herein shall be in order and presented to the Architect at least two weeks prior to the review.

C. Changes and Corrections: After the review, changes or corrections noted by the Architect as necessary for the work to comply with these Specifications and Drawings shall be accomplished without delay in order to secure final acceptance of the Work.

D. The Owner’s representative reserves the right, during the final acceptance inspection, to witness a verification of not more than 5 percent or less than 5 of the readings. The particular readings to be verified will be determined during the final acceptance inspection.

E. Final inspection will require demonstration of the systems to the Architect by a team consisting of the Mechanical Subcontractor, Temperature Control Subcontractor, and TAB Technician.

F. At the Owner's discretion, all or any part of the testing and balancing may be witnessed by the Architect.

3.6 OPERATING INSTRUCTIONS

A. Supervision: The Contractor shall provide the services of a competent Operating Engineer to supervise the operation of all equipment specified herein and to instruct the Owner's Representative during a one-day operating period. The operating instruction period shall be defined as straight time working hours and shall not include nights and weekends.

B. Notification: The Architect shall be notified in writing at least 5 days before each operating instruction period begins. The Architect must accept the instructional starting time in writing to the Contractor. Upon arrival, the various instructors shall report to the Architect.

++ END OF SECTION ++

SECTION 16000

GENERAL ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Work and materials necessary for erecting a complete electrical and instrumentation system, tested and ready for continuous use.

B. Related Sections:
   1. Division 0, Bid Requirements, Contract Forms, and Contract Conditions.
   2. Division 1, General Requirements.
   3. Division 2, Site Construction.
   4. Division 3, Concrete.
   5. Division 9, Finishes.
   6. Division 11, Equipment.
   7. Division 13, Special Construction.
   8. Division 15, Mechanical.
   9. Division 17, Instrumentation and Controls.

1.2 DEFINITIONS

A. The term "Provide" means "Furnish and Install".

1.3 SYSTEM DESCRIPTION

A. Design Requirements:
   1. If any contradictions, contrasts, or inconsistency appears, the most strict criteria noted and the collective requirements in any and all of the Project documents shall apply.

1.4 SUBMITTALS

A. Intent:
   1. Organize Work so that a complete electrical, instrumentation, and control system for the facility will be provided and will be supported by accurate Shop Drawings, Record Drawings, and O&M Manuals.
   2. Submit detailed Shop Drawings and data prepared and organized by the suppliers. Provide quantity of submittal sets in accordance with the requirements of Division 1, General Requirements.
   3. Submittals shall be neatly grouped and organized by Specification Section number, and sub-section. Related information shall be highlighted and the

specific product shall be marked. All Submittals shall be complete and presented in one package. Incomplete Submittals will be returned without review. If a portion of the Project requires a fast track schedule, that portion only may be submitted earlier under a separate cover letter.

4. Work performed or equipment provided without ENGINEER approved Submittals is done at CONTRACTOR'S risk. Cost to re-work or re-supply will be born solely by the CONTRACTOR.

B. Product Data:
   1. A complete list of the equipment and materials, including the manufacturer's name, product Specification, descriptive data, technical literature, performance charts, catalog cuts, installation instructions, and spare part recommendations for each different item of the equipment specified. The above shall clearly show all the specified requirements as described in the Specifications including but not limited to specific UL and NEMA rating, technical capabilities, test result verifications, and acceptance letters.
   2. Submittals not in compliance with the Specifications must include the following information:
      a. Reason for non-compliance or variance.
      b. Calculations and Drawings for redesign of related components, including detail drawings showing internal and assembly details, with installation instructions.
      c. Proposed layout showing any modifications or exceptions to related Work made necessary by this Work, with calculations and drawings showing such modifications or exceptions.

C. Shop Drawings:
   1. Drawings containing complete wiring and schematic diagrams, control diagrams, and any other details required to demonstrate that the system has been coordinated and will operate as intended. Drawings shall show proposed layout, anchoring, support, and appurtenances of equipment, and equipment relationship to other parts of the Work, including clearances for maintenance and operations.
   2. Submit for approval the following:
      a. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if

an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

b. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**

D. Utility Coordination:

1. Submit copies of service entrance Shop Drawings to the utility, per utility submittal requirements, prior to submittal to the ENGINEER. Obtain written approval from the power utility company that the service entrance equipment is acceptable prior to release the order to the supplier for fabrication. Provide a copy of the approval letter from the utility with the Submittal.

E. Closeout Submittals:

1. Provide "Record Drawings" of the electrical, control, and instrumentation work to include:
   a. Step-by-step procedure manuals for the installation, operation start-up, and maintenance of the equipment.
   b. Installation, operating, troubleshooting, and maintenance and overhaul instructions in complete detail.
   c. Possible breakdowns and repairs, and troubleshooting guides, as well as simplified wiring and control diagrams of the system installed. This shall provide the OWNER with comprehensive information on all systems and components to enable operation, service, maintenance and repair.
   d. Exploded or other detailed views of all equipment, devices, assemblies, and accessory components shall be included, together with complete parts lists and ordering instructions.
   e. Provide an "As Built" set of Plans to OWNER. Maintain at all times a marked up set of Plans showing the following information:
   f. Actual installed circuit numbers, conduit sizes, cable tray routing, number of conductors, conductor sizes (larger than #12 AWG), and all other deviations from the Design Plans.
   g. Underground conduit, duct banks, and concealed items dimensioned on the Plans from permanent, visible, building features.
   h. Actual motor size, starter size, and overload heater size, along with all other protective equipment for all 480 V and 4160 V motor circuits.
   i. Conductor identification and panel schedules.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Electrical work, including connection to electrical equipment integral with mechanical equipment, shall be performed in accordance with the latest adopted regulations, codes, and standards, of the following:
      a. National Electrical Code (NEC).
      b. State and local codes.
      c. Institute of Electrical and Electronic Engineers (IEEE).
      d. American National Standards Institute (ANSI).
      e. American Society for Testing and Materials (ASTM).
      f. Insulated Cable Engineers Association (ICEA).
      g. National Electrical Manufacturers Association (NEMA) Standards.
      h. Federal Occupational Safety and Health Act (OSHA).
      i. National Fire Protection Association (NFPA).
      j. National Electrical Testing Association (NETA).

1.6 DELIVERY, STORAGE, AND HANDLING

A. Electrical panels, switchgear, motor control centers, and other electrical equipment, shall be shipped in sealed dust and moisture proof plastic sheet enclosures, and the seal maintained until units are installed. Said units shall be new and free of any dirt, dust, water, grease, rust, damaged parts, or components.

1.7 PROJECT/SITE CONDITIONS

A. Verify site conditions before bidding or performing Work.

1.8 SCHEDULING

A. Maintain a Work schedule showing Work to be performed, sequence of Work, major milestones, and manpower loading. Coordinate schedule requirements with other trades. Provide adequate staff to perform the Work in the time required by the schedule.

1.9 SYSTEM START-UP

A. After installation and testing of all electrical and instrumentation equipment and systems, energize all equipment and leave ready for continuous operation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers and model numbers shown on Plans or listed in the Specifications are intended to establish a minimum standard of quality and acceptability.

2.2 MATERIALS

A. Materials, equipment, and parts comprising any unit, or part thereof, specified or indicated on the Plans, shall be new and unused, of current manufacture, and of highest grade consistent with the state of the art. Damaged materials, equipment, and parts are not considered to be new and unused and will not be accepted.

2.3 MANUFACTURED UNITS

A. The fabricator of major components and manufactured units, such as distribution panel boards, switchgear, and motor control centers, shall also be the manufacturer of the major devices therein. Exceptions to this requirement are:
   1. Transfer Switches
   2. Variable Frequency Drives
   3. Solid State Drives and Reduced Voltage Soft Starters
   4. Harmonic Filters
   5. Power Quality Meters
   6. Protection Relays
   7. Transformers

B. Electrical equipment provided with mechanical equipment assemblies shall be in compliance with this Specification.

2.4 EQUIPMENT

A. Minimum sizes of equipment and electrical devices are indicated, but it is not intended to show every offset and fitting, nor every structural or mechanical difficulty that will be encountered during the installation of the Work.

B. Electrical equipment shall be capable of operating successfully at full-rated load, without failure, at an ambient air temperature of 60º C, and specifically rated for the altitude indicated on the Plans. Provide air conditioning to meet the manufacturers' operating temperature for electrical equipment not rated for operation at that temperature.

C. When applicable, the material used in the performance of the electrical work shall be listed by the Underwriters' Laboratories, Inc. (UL), for the class of service for which they are intended.

D. Provide nameplates where indicated elsewhere in these Specifications or on the Plans. Nameplates shall be black laminate with white letters and fastened to the various devices with round head stainless steel screws. Provide nameplates for each disconnecting means for service, feeder, branch, or equipment conductors indicating its purpose.

2.5 FABRICATION

A. Shop Assembly:
   1. Equipment assemblies, such as Service Entrance Sections, Switchgear, Switchboards, Control and Distribution Panels, and other custom fabricated electrical enclosures, shall bear a UL label as a complete assembly. The UL label on the individual components making up the assembly will not be considered sufficient to meet the present requirement. Whenever a generic UL label does not apply for the assembly, a serialized UL label shall be affixed to the assembly, and the serial number shall be submitted with the assembly record Shop Drawings.
   2. Custom fabricated electrical control panels, and enclosures, shall bear a UL label affixed by a local UL inspector.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Site Verification of Conditions:
   1. Verify site conditions before bidding or performing Work.

3.2 INSTALLATION

A. Coordinate Work with other trades and with certified vendor shop drawing submittals.

B. Provide equipment in accordance with the manufacturers' requirements.

C. Identify each conductor as required by the Contract Documents.

D. Equipment Access:
   1. Install equipment so it is readily accessible for operation and maintenance.
   2. Equipment shall not be blocked or concealed.
   3. Do not install electrical equipment such that it interferes with normal operation and maintenance requirements of other equipment.

E. Equipment shall be installed plumb, square and true with the building construction, and shall be securely fastened.

F. Outdoor wall-mounted equipment and indoor equipment mounted on earth or water bearing walls, shall be provided with corrosion-resistant spacers to maintain 1/4-inch separation between the equipment and the wall.

G. Arrange for the building in of equipment during structure construction. Where equipment cannot be built-in during construction, arrange for sleeves, box-outs, and

other openings, as required to allow installation of equipment after structure construction is complete.

H. Verify that equipment will fit support layouts indicated.

I. Screen or seal all openings into outdoor equipment to prevent the entrance of rodents and insects.

J. Equipment fabricated from aluminum shall not be imbedded in earth or concrete.

K. Provide all necessary anchoring devices and supports.
   1. Use supports as detailed on the Plans and as specified.
   2. Supports and anchoring devices shall be rated and sized based on dimensions and weights verified from approved equipment Submittals.
   3. Hardware shall be stainless steel.
   4. Do not cut, or weld to, building structural members.
   5. Do not mount safety switches and external equipment to other equipment enclosures, unless enclosure mounting surface is properly braced to accept mounting of external equipment.

L. Verify exact rough-in location and dimensions for connection to electrical items furnished by others.
   1. Obtain Shop Drawings from those furnishing the equipment.
   2. Proceeding without proper information may require the CONTRACTOR to remove and replace Work that does not meet the conditions imposed by the equipment supplied.
   3. Provide sleeves wherever openings are required through new concrete or masonry members. Place sleeves accurately and coordinate locations with the ENGINEER.
   4. Do not endanger the stability of any structural member by cutting, digging, chasing, or drilling and shall not, at any time, cut or alter the Work without the ENGINEER'S written consent.
      a. Provide additional reinforcing if required.
      b. Use proper tools and methods to cut, core drill, or make other penetrations.
      c. Restore walls, ceilings, or floors to their original condition.

M. Provide concrete foundations or pads required for electrical equipment as indicated or specified.
   1. Provide a 4-inch concrete housekeeping pad for floor mounted electrical equipment. Pour on top of the finished floor or slab. Drill existing slab and epoxy rebar to anchor housekeeping pad in place.

N. Do not use equipment that exceeds the indicated dimensions except as approved in writing by the ENGINEER.

O. Do not use equipment or arrangements of equipment that reduce required clearances or exceed the space allocation.

P. Work indicated on the Plans is approximately to scale, but actual dimensions and detailed Plans should be followed as closely as field conditions permit. Field verification of scale dimensions on Plans is governed by field conditions. Installation of systems and equipment is subject to clarification as indicated in reviewed Shop Drawings and field coordination.

Q. Discrepancies indicated on different Plans, between Plans and actual field conditions, or between Plans and Contract Documents shall be promptly brought to the attention of the ENGINEER for clarification, prior to purchasing and installing equipment.

R. Adjust the alignment of equipment and conduit to accommodate architectural changes or to avoid work of other trades.

S. Provide parts and pieces necessary to the installation of equipment, in accordance with the best practice of the trade, and in conformance with the requirements of these Contract Documents.

T. Items not specifically mentioned in these Contract Documents, or noted on the Plans, or indicated on reviewed Shop Drawings, but which are obviously necessary to make a complete working installation, shall be deemed to be included herein.

U. Layout and install electrical work prior to placing floors and walls. Provide sleeves and openings through floors and walls, required for installation of conduits. Sleeves shall be rigidly supported and suitably packed, or sealed, to prevent ingress of wet concrete. Spacers shall be installed in order to prevent conduit movement. Dimensions indicated for electrical equipment and their installation are restrictive dimensions.

V. Provide inserts and hangers required to support conduits and other electrical equipment. Coordinate inserts and hangers with other trades. Replace inserts, hangers, sleeves, or other mounting hardware which are improperly placed.

W. Perform necessary saw cutting, core drilling, excavating, removal, shoring, backfilling, and other work required for the proper installation of conduits, whether inside, or outside of the buildings and structures. Use core drills to make circular holes.

X. Electrical Utility:
   1. Coordinate the electrical utility work with the electrical utility company. Note the additional submittal requirements under Paragraph 1.4.D of this Specification. Provide equipment and material required to bring electrical service to the service location in conformance with the electrical utility requirements. Provide the following for the electrical utility company's

primary (from utility power line to the utility transformer) and secondary (from utility transformer to the service) electrical lines in accordance with the electrical utility company's specifications and requirements:

a. Conduits (verify quantity and sizes).
b. Trenching, backfill, and compacting (verify trench size(s), backfill material, and compaction percentage requirements).
c. Concrete pad(s) (for pad mounted transformer(s)).
d. Cable protection along the vertical drop at the utility company's pole (if pole mounted transformer(s)).
e. Other items required by the power utility company's specifications.

Y. Telephone Service:

1. Coordinate with the telephone company to provide telephone service as shown on the Plans. Provide trenching, conduit, and backfill for the telephone company's communication lines from the telephone company's main distribution panel to the telephone company's connection box at this Project site, as required by the telephone company.

Z. Temporary Power:

1. Provide and maintain temporary power and lighting systems needed for construction. Work shall include:
   a. Weatherproof panel(s) for the CONTRACTOR'S main breakers and distribution system.
   b. Conduit and cable.
2. Use ground fault interrupting equipment.
3. Connections shall be watertight, with wiring done with Type SO portable cable.
4. Route and support cables to avoid mechanical damage.
5. Remove temporary power equipment and devices upon completion of construction.

AA. Corrosion Protection:

1. Wherever dissimilar metals, except conduit and conduit fittings, come in contact, the CONTRACTOR shall isolate these metals, as required, with neoprene washers, 9 mil polyethylene tape, or gaskets. Where fastening conduit, electro plated, or equivalent fasteners and stainless steel bolts shall be used.

3.3 REPAIR/RESTORATION

A. Repair damage caused by construction or demolition work to restore damaged areas to original condition.

B. Factory finishes damaged during shipping, or construction, shall be restored to original new condition. Rust shall be removed, and bare metal surfaces shall be primed and painted to match the original surrounding finish.

3.4 FIELD QUALITY CONTROL

A. Site Tests:
   1. Perform electrical equipment field quality control and testing in accordance with Section 16920, Electrical Acceptance Testing.
   2. The electrical work shall be free from improper grounds and from short circuits. Visually compare the conductor connections with connection diagrams. Perform individual circuit continuity checks using electrical circuit testers. Demonstrate proper operation of the energized electrical and mechanical devices. Correct any wiring deficiencies.

3.5 ADJUSTING

A. Calibrate and set all adjustable electrical equipment, including circuit breakers, motor circuit protectors, overload relays. Align photo cells and lights to achieve desired effects.

3.6 CLEANING

A. Relays, starters, circuit breakers, switches, contacts, insulators, mechanisms, and buses shall be free of dust, dirt, oil, moisture, metal shavings, and other debris before testing and energizing equipment. Vacuum and wipe down inside and outside of electrical enclosures and control panels.

3.7 PROTECTION

A. Once equipment is installed, it shall be protected at all times with plastic sheet covers until the area is free of dirt, dust, paint spray, water, and other trades. Provide heat to eliminate condensation.

++ END OF SECTION ++

SECTION 16001

PACKAGED SYSTEMS AND PACKAGED CONTROL PANELS

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. The CONTRACTOR shall furnish and install, ready to use, the complete Package Control System as indicated on the Drawings and the Contract Documents.

B. If any contradictions or inconsistencies appear, the most strict criteria noted and the collective requirements in any and all of the Contract Documents shall apply.

1.2 DEFINITION

A. Packaged Systems are those equipment(s) which are noted as such in the Contract Documents, the CONTRACTOR is providing those equipment(s) to function as a system, or the nature of the operation indicates so.

B. The Packaged Systems may include, but are not limited to, the following:
   1. Blower systems.
   2. Hydro-pneumatic tank systems.
   3. HVAC Chillers.
   4. Air Handling Units.
   5. Air Compressors/Dryers.
   6. Chemical feed & booster pumps.

1.3 SUBMITTALS

A. Provide submittals for the Packaged Control Panels in accordance with Section 16000, General Electrical Requirements, and the Contract Documents.

B. Shop Drawings: Submit for approval the following:
   1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The

remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

2. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**

1.4 RELATED SECTIONS

A. Related Sections may include, but are not limited to, the following:
   1. Section 16000, General Electrical Requirements.
   2. Section 16111, Conduits.
   3. Section 16123, 600 Volt Class Conductors.
   4. Section 16124, Instrumentation Class Cable.
   5. Section 16143, Terminal Blocks.
   6. Section 16160, Enclosures
   7. Section 16161, Control Panels.
   8. Section 16195, Electrical Identification.
   9. Section 16440, Disconnect Switches.
   10. Section 16461, Transformers - Dry-Type.
   11. Section 16470, Panelboards.
   12. Section 16476, Low Voltage Circuit Breakers.
   13. Section 16477, 600 V Fuses.
   14. Section 16481, Motor Control Centers (MCC).
   15. Section 16485, Variable Frequency Drives - Low Voltage.

PART 2 - PRODUCTS

2.1 CONTROL SYSTEMS

A. Main disconnecting means.

B. Motor circuit protectors and starters for each motor.

C. Automatic motor alternation with manual override and lead selection. (If the system has more than one motor).

D. Capability to interface with other related systems/devices as described in the Contract Documents.

E. Control, delay, timer, and other relays as required.

F. Pushbutton and switches as follows:
   1. Start/ Stop.
   2. Hand-Off-Auto.
   3. Slow/Fast (if applicable).
   4. Forward/Reverse (if applicable).
   5. Emergency Stop.

G. Pilot Lights as follows:
   1. On/Off status.
   2. Manual/Auto Status.
   3. Slow/Fast Status (if applicable).
   4. Forward/Reverse Status (if applicable).
   5. Alarm (General malfunction).
   6. Alarms (Individual malfunctions).
   7. The Packaged Control Panel shall incorporate devices to visually represent all information needed to diagnose the individual malfunction alarm cause. The CONTRACTOR shall review and confirm all requirements with manufacturer(s) in order to bid a complete working package.

H. Indicators as follows:
   1. Speed LCD display (if VFD controlled).
   2. Running time meters for each motor.

I. Enclosures
   1. Refer to Section 16161, Control Panels, for more information.

J. The Packaged Systems shall be supplied for a single source of power (480 V, 3-phase, or 120/240 V, single-phase). All power and control transformers shall be provided as required. Transformers shall be sized and protected by fuses as required by NEC as a minimum.

K. The Packaged Systems shall include transient voltage surge suppressors.

L. The Packaged Systems shall include NEMA Rated auxiliary relays, amplifiers, and connections needed for transmission of specified information to the remote location. Auxiliary relays shall also be provided for control and status communication above and beyond the standard control panel.

PART 3 - EXECUTION

3.1 GENERAL

A. Electrical Power and Control:
   1. The CONTRACTOR shall provide electrical power for all the packaged units, including, but not limited to, all equipment, instruments, devices, controls, alarms, lights, etc., as recommended by the equipment

manufacturer(s) installation instructions and recommendations, and the Contract Documents.

B. The CONTRACTOR shall review, verify, and confirm all requirements with the manufacturer in order to bid a complete working package and system. This includes, but is not limited to, package control panel, power distribution panel, transformer(s), conductors, inter/intra connections, and all other Work needed for a complete working system.

C. In the situation that a system is not specified and/or the CONTRACTOR is proposing an equal system, the CONTRACTOR shall provide all necessary equipment, instruments, devices, controls, alarms, lights, conduits, conductors, inter/intra connections, etc., in order to provide a complete system. The CONTRACTOR shall obtain prior approval to provide the equal system before the submittal phase of the project. These requirements are above and beyond what is shown on the Drawings and/or specified in the Specifications. The CONTRACTOR shall be fully responsible for any and all work resulting from changes requiring more than what is indicated on the Contract Documents.

D. The CONTRACTOR shall refer to Civil, Structural, Architectural, Mechanical, Electrical, P&ID Drawings, control descriptions, and all collective Contract Documents for complete information, requirements, implementations, and coordination in order to determine the system control logic.

++ END OF SECTION ++

SECTION 16010

ELECTRICAL BASIC REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes basic requirements for electrical work.

B. Install and wire all equipment, including pre-purchased equipment, and perform all tests necessary to assure conformance to the Drawings and Specifications and ensure that equipment is ready and safe before energizing.

C. Related Sections include but are not necessarily limited to:
   1. Division 0, Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 1, General Requirements.

D. Drawings Use and Interpretation:
   1. Drawings indicate the location and arrangement of electrical equipment and the approximate location of other equipment requiring electrical work.
      a. For exact locations of building elements, refer to dimensioned architectural/structural drawings.

E. Field measurements take precedence over dimensioned drawings Installation of all systems and equipment is subject to clarification as indicated in reviewed Shop Drawings and field coordination drawings.

1.2 AREA CLASSIFICATIONS

A. Outdoor locations may contain corrosive and hazardous areas:
   1. Corrosive and hazardous areas are identified on the Drawings.
      a. Areas not identified as such shall be considered wet.

B. Indoor locations may contain damp, wet corrosive, and hazardous areas:
   1. Damp, wet, corrosive and hazardous areas are identified on the Drawings.
      a. Areas not identified as such shall be considered unclassified.

1.3 DEFINITIONS

A. Outdoor Areas:
   1. Those locations on the Project site where the equipment is normally exposed to wind, dust, rain, snow, etc.

B. Indoor Areas:

1. Those locations on the Project site where the equipment is normally protected from wind, dust, rain, snow, etc.

C. Shop Fabricated:
   1. Manufactured or assembled equipment for which a UL test procedure has not been established.

1.4 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Iron and Steel Institute (AISI):
      a. Steel Products Manual - Stainless and Heat Resisting Steel.
   2. American National Standards Institute (ANSI):
      a. C2, National Electrical Safety Code.
   3. American Society for Testing and Materials (ASTM):
      a. A36, Specification for Structural Steel.
      b. A153, Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
   4. Factory Mutual System (FM):
      a. A Guide to Equipment, Materials and Services.
   5. Institute of Electrical and Electronics Engineers (IEEE):
      a. 141, Recommended Practice for Electrical Power Distribution for Industrial Plants.
      b. 242, Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems.
   6. National Electrical Manufacturers Association (NEMA):
      a. ICS 6, Enclosures for Industrial Controls and Systems.
   7. National Fire Protection Association (NFPA):
      a. 70, National Electrical Code (NEC).
   8. Underwriters Laboratories, Inc (UL):
      a. 508, Safety Industrial Control Equipment.
      b. 698, Industrial Control Equipment for Use in Hazardous Locations.

B. When a specific code or standard has not been cited, the applicable codes and standards of the following code-making authorities and standards organizations shall apply:
   1. American Association of State Highway and Transportation Officials (AASHTO).
   2. American Iron and Steel Institute (AISI).
   3. American National Standard Institute (ANSI).
   4. American Society for Testing and Materials (ASTM).
   5. ETL Testing Laboratories, Inc (ETL).
   6. Insulated Cable Engineers Association (ICEA).
   7. Institute of Electrical and Electronic Engineers (IEEE).
   8. Illuminating Engineering Society of North America (IES).
   9. Instrument Society of America (ISA).
   10. Lightning Protection Institute (LPI).

11. National Electrical Manufacturers Association (NEMA).
12. National Fire Protection Association (NFPA).
13. Occupational, Health and Safety Administration (OSHA).
14. Underwriters Laboratories Inc (UL).

C. In case of conflict or disagreement between codes, standards, laws, ordinances, rules, regulations, Drawings, and Specifications, or within either document itself, the more stringent condition shall govern.

1.5 SYSTEM DESCRIPTION

A. Provide functional systems in compliance with manufacturer's instructions, performance requirements specified or shown on the Drawings, and modifications resulting from reviewed Shop Drawings and field coordinated drawings.

1.6 SUBMITTALS

A. Shop Drawings:
   1. See Contract Documents for other requirements.
   2. Submit shop drawings prior to purchase or fabrication of equipment. See individual Division 16, Electrical, Sections for specific requirements.
   3. Prior to submittals of Shop Drawings, coordinate electrical equipment, particularly motor control equipment, control panels, and instrumentation, with all applicable equipment and systems interfacing with that equipment.
   4. For each product, clearly identify manufacturer by name.
   5. Provide manufacturer's technical information on products to be used, including:
      a. Product descriptive bulletin.
      b. Electrical data pertinent to the Project and necessary to assure compliance with Specifications and Drawings.
      c. Equipment dimensions, where applicable.
      d. Evidence that the products submitted meet the requirements of the standards referenced.
   6. When general data sheets are provided as part of the submittal, specifically identify the products to be used on this Project.
   7. Ensure that all submittals clearly indicate the equipment is UL or ETL listed or is constructed utilizing UL or ETL listed or UL recognized components. Where an UL standard has not been established, clearly identify that no UL standard exists for that equipment.
   8. For all equipment, provide manufacturer's installation instructions.
   9. Submit for approval the following:

A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the

identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**

B. Operation and Maintenance Manuals:
   1. See Contract Documents for requirements.

1.7 DELIVERY, STORAGE, AND HANDLING

A. See Section 01600.

B. Ensure that equipment is not used as steps, ladders, scaffolds, platforms, or for storage, either inside or on top of enclosures.

C. Protect nameplates on electrical equipment to prevent defacing.

D. Repair, restore, or replace damaged, corroded, and rejected items at no additional cost to the OWNER.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Refer to related Division 16, Electrical, Sections.
   1. All equipment of a similar type shall be by one manufacturer, unless otherwise noted in the Specifications.

2.2 MATERIALS

A. Trade names and catalog numbers may be used in the Drawings or Specifications to establish quality standards and basics of design.
   1. Other listed manufacturers in the applicable Specification Sections with equal equipment may be acceptable.

2. If no other manufacturer is listed, then manufacturers of equal equipment may be acceptable.

B. Listed:
   1. Where UL test procedures have been established for the product type, electrical equipment shall be approved by UL or ETL and shall be provided with the UL or ETL label.

C. Structural Steel Supports:
   1. Galvanized Steel: ASTM A36.
      a. PVC coated in Class I and in corrosive areas.
   2. Stainless Steel: AISI Type 316.

2.3 FABRICATION

A. When equipment is shop fabricated for the Project, the electrical devices and enclosures utilized shall be UL or ETL listed and labeled or shall be UL recognized.

B. Shop or Factory Finishes:
   1. Interiors of other painted equipment shall be either white or light gray.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Equipment shall be installed in accordance with the requirements of the NEC.

B. Enclosures for Use with Electrical Equipment:
   1. NEMA 12: Use in unclassified indoor locations.
   2. NEMA 3R: Use with HVAC equipment.
   3. NEMA 4:
      a. Use in wet indoor locations.
      b. Use in wet outdoor locations except with HVAC equipment.
   4. NEMA 4X: Use in all corrosive locations.
   5. Exceptions:
      a. As modified in other Division 16, Electrical, Sections.
      b. As otherwise indicated on the Drawings.
   6. Standards:
      a. NEMA ICS-6, Enclosures for Industrial Controls and Systems.
      b. UL 508, Safety Industrial Control Equipment.
      c. UL 698, Industrial Control Equipment for Use in Hazardous Locations.

C. Coordinate the installation of electrical equipment with other trades.
   1. Arrange for the building in of equipment during structure construction.

2. Where equipment cannot be built-in during construction, arrange for sleeves, box-outs, openings, etc., as required to allow installation of equipment after structure construction is complete.

D. Verify that equipment will fit support layouts indicated.

E. Equipment Dimensions and Clearances:
   1. Do not use equipment that exceeds the indicated dimensions.
      a. Except as approved in writing by the ENGINEER.
   2. Do not use equipment or arrangements of equipment that reduce required clearances or exceed the space allocation.

F. Install equipment in accordance with the manufacturer's instructions.

G. Equipment Access:
   1. Install equipment so it is readily accessible for operation and maintenance.
   2. Equipment shall not be blocked or concealed.
   3. Do not install electrical equipment such that it interferes with normal maintenance requirements of other equipment.

H. Equipment shall be installed plumbed, square, and true with the building construction and shall be securely fastened.

I. Outdoor wall-mounted equipment and indoor equipment mounted on earth or water bearing walls shall be provided with corrosion-resistant spacers to maintain 1/4-inch separation between the equipment and the wall.

J. Screen or seal all openings into outdoor equipment to prevent the entrance of rodents and insects.

K. Equipment fabricated from aluminum shall not be placed in direct contact with earth or concrete.

L. Provide all necessary anchoring devices and supports.
   1. Use supports as detailed on the Drawings and as specified.
      a. Where not detailed on the Drawings or specified, use supports and anchoring devices rated for the equipment load and as recommended by the manufacturer.
   2. Supports and anchoring devices shall be rated and sized based on dimensions and weights verified from approved equipment submittals.
   3. Hardware shall be malleable type, corrosion resistant, and shall be supported by heavily plated machine screws or brass, bronze or stainless steel bolts.
   4. Do not cut, or weld to, building structural members.
   5. Do not mount safety switches and external equipment to other equipment enclosures, unless enclosure mounting surface is properly braced to accept mounting of external equipment.

M. Provide concrete foundations or pads required for electrical equipment as indicated or specified.
   1. Floor-mounted equipment shall be mounted on a 4-inch high concrete housekeeping pad. Pad shall be poured on top of the finished floor or slab.

N. Material that may cause rusting or streaking on a building surface shall not be used.

O. To avoid interference with structural members and equipment of other trades, it may be necessary to adjust the intended location of electrical equipment. Unless specifically dimensioned or detailed, the CONTRACTOR may, at his discretion, make minor adjustments in equipment location without obtaining the ENGINEER'S approval.

P. Provide tagging of electrical equipment, conduits, and conductors in accordance with the Contract Documents.
   1. Each equipment item shall be provided with a nameplate identifying the equipment by the tag number shown on the Drawings.
   2. Each branch circuit and feeder shall be provided with a nameplate identifying, by name and tag number as shown on the Drawings, the load served.
      a. Do not abbreviate.
   3. Each control device shall be provided with an escutcheon defining the device function and a nameplate identifying the controlled equipment.

Q. Provide electrical danger, caution, warning or safety instruction signs in accordance with applicable safety standards.

R. Conduit and wire between temperature control thermostats and the associated HVAC equipment shall be furnished and installed with the equipment (see Division 15, Mechanical, of the Specifications).
   1. Conduit and wire between alarm or shutdown thermostats and air flow switches and the associated alarm devices or panels shall be furnished and installed as part of Division 16, Electrical.
   2. Thermostats included as part of a heat trace system shall be installed as part of Division 16, Electrical.

3.2 FIELD QUALITY CONTROL

A. Do not remove or damage fireproofing materials.
   1. Install hangers, inserts, supports, and anchors prior to installation of fireproofing.
   2. Repair or replace fireproofing removed or damaged.

B. Make all penetrations through roofs prior to installation of roofing.
   1. For penetrations required after installation of roofing:
      a. In built-up roofing (BUR), provide all curbs, cants and base flashings.
      b. In elastic sheet roofing (ESR), arrange and pay for base flashing work by authorized roofer.

C. Make all penetrations of electrical work through walls and roofs water and weather-tight.

D. Equipment furnished under this Contract for use on future work and all concealed equipment, including conduits, shall be dimensioned, on the Record Drawings, from visible and permanent building features.

E. After installation, test all electrical equipment and systems as recommended by the manufacturer and in accordance with Specification 16920, Electrical Acceptance Testing.

F. Test Equipment Interface:
   1. Verify systems coordination and operation.

3.3 CLEANING

A. Clean dirt and debris from all surfaces.

B. Apply touch-up paint as required to repair scratches, etc.

C. Replace nameplates damaged during installation.

D. Thoroughly vacuum the interior of all enclosures to remove dirt and debris.

3.4 DEMONSTRATION

A. Demonstrate equipment in accordance with the Contract Documents.

++ END OF SECTION ++

SECTION 16050

BASIC MATERIALS AND METHODS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This Section consists of general electrical materials and methods. Electrical materials that are a part of equipment specified under other Sections shall meet the requirements of this Section, unless part of larger factory-assembled equipment.

1.2 SUBMITTALS

A. Submit manufacturer's literature for raceways and fittings, boxes, wires and cables, wiring devices, nameplates, legend plates, labels, panelboards, and safety switches, service entrance equipment, control panels, and any other electrical component utilized in this Project.

B. Shop Drawings: Submit for approval the following:
   1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

C. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**

1.3 QUALITY ASSURANCE

A. Refer to Section 16000, General Electrical Requirements.

1.4 SPARE PARTS

A. Provide spare components as indicated on Drawings and elsewhere herein.

PART 2 - PRODUCTS

2.1 BASIC MATERIALS

A. Electrical safety switches, distribution and control equipment shall be rated for heavy-duty service.

B. Wiring devices shall be Specifications Grade.

2.2 MISCELLANEOUS METAL AND MOUNTING CHANNELS

A. Metal Framing:
   1. Unless otherwise shown, mounting channels shall be cold rolled from mild strip steel, 12 gage, 1-5/8-inches by 1-5/8-inches, with 316 stainless steel by Unistrut, Unistrut P-1000, as manufactured by Unistrut, or pre-approved equal.
   2. Screws, bolts, washers, and nuts shall be 316 stainless steel. Parts and brackets for assembly of channels shall be 316 stainless steel.

B. Miscellaneous Metal: 316 stainless steel, unless otherwise shown.

2.3 NAMEPLATES, LEGEND PLATES, AND LABELS

A. Nameplates: Laminated sheet plastic, approximately 1/16-inch-thick, with engraved white letters on a black background, with adhesive backing and mounting screw holes. Stainless steel or brass screws; minimum height of letters shall be 5/16-inch. Card holders are not acceptable.

B. Legend Plates: Type KN-3 standard legend plates; Square D, or pre-approved equal.

C. Control Wire Markers: Heat-shrink sleeve types, manufactured by W.H. Brady Company or pre-approved equal.

PART 3 - EXECUTION

3.1 BASIC MATERIALS

A. The completed installation shall conform to all applicable Federal, State, and local codes, ordinances, and regulations. CONTRACTOR shall obtain necessary permits and inspections required by the governing authorities. Work shall be done in a neat, workmanlike, finished and safe manner, according to the latest published NECA Standards of installation, under competent supervision. Install grounding as required by the National Electrical Code.

3.2 MISCELLANEOUS METAL AND MOUNTING CHANNELS

A. Install where electrical equipment is to be surface-mounted to walls and where indicated on Drawings. Where two or more devices are to be installed side by side, support on metal framing, bolt together, and brace as required to form a rigid structure.

B. Clean cuts and welds. Coat unpainted surfaces with cold application zinc galvanizing. Coat cuts and welds on painted surfaces with zinc chromate primer and finish to match existing paint.

3.3 NAMEPLATES, LEGEND PLATES, AND LABELS

A. Nameplates: Identify panels, switchgear, regulators, load-break junction boxes, disconnect switches, and component enclosures. Fasten nameplates with stainless steel self-tapping screws or rivets.
   1. Panels: Identify panel number, voltage, and amperage of panel bus.
   2. Switchgear: Identify equipment, voltage, amperage, and phase and number of wires.
   3. Safety Switches and Relays: Identify equipment controlled and circuits from which they are fed.

B. Legend Plates: Install on selector switches, pushbuttons, pilot lights, starters, and other components.

C. Control Wire Markers: Install at both ends of each control wire interconnecting between such items as control panels, sensors, and control devices at each end of control wires within control panels, and other such enclosures. Wiring markers shall correspond to control wire numbers on approved wiring diagrams.

++ END OF SECTION ++

SECTION 16060

ELECTRICAL DEMOLITION

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. Demolition of existing electrical shall be as indicated on the Drawings or as indicated elsewhere herein.

B. Demolition information shown on the Drawings is based on visual field examination and existing Record Drawings. The CONTRACTOR is responsible for verification of all items indicated or not. All items affected that are not indicated on the Drawings shall be brought to the ENGINEER'S attention before demolition for direction.

C. The CONTRACTOR shall confine demolition work to the item specifically identified on the drawings. The CONTRACTOR shall be liable for any other damage he may inflict to the existing installations.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. Care shall be taken in demolition or removal of items as indicated on drawings as being returned to the OWNER. The CONTRACTOR shall notify the OWNER prior to removing existing equipment.

B. Whether indicated on the Drawings or not, the CONTRACTOR shall provide patching material to fill voids where demolition has taken place. Patching materials shall match, as nearly as practical, the existing original structure material for each surface being patched.

PART 3 - EXECUTION

3.1 COORDINATION

A. The CONTRACTOR shall verify existing field conditions, measurement, circuitry etc., as indicated on Drawings prior to performing any demolition.

B. The CONTRACTOR shall verify that abandoned or demolished wiring and electrical equipment serve only abandoned facilities. If demolished or abandoned electrical is necessary for proper operation of facilities to remain in service, the CONTRACTOR shall immediately notify the ENGINEER for direction.

C. Demolition shall not be performed without coordinating with new construction to limit down time and ease of switchover. The CONTRACTOR must coordinate with the ENGINEER and the OWNER prior to any demolition.

D. Prior to performing any demolition work, the CONTRACTOR shall provide temporary wiring and connections to maintain existing systems in service during construction. Temporary wiring shall conform to the National Electrical Code.

3.2 PERFORMANCE

A. General: The means and methods of performing electrical demolition and removal operations are the sole responsibility of the CONTRACTOR. However, equipment used, and methods of demolition and removal will be subject to approval of the ENGINEER.
   1. Remove exposed abandoned conduit systems, including abandoned conduit systems in false ceilings.
   2. Remove wiring in abandoned conduit systems to source of power supply, where indicated.
   3. In exposed through-structure conduit or foundation locations, cut conduits and foundation below the finished structure surfaces in order to perform adequate surface patching.
   4. Maintain electrical continuity of existing electrical installations which remain active. Modify installations as necessary to maintain continuity and provide adequate access as required by the National Electrical Code.
   5. Extend existing installations using materials and methods compatible with existing electrical installations, and as specified elsewhere herein.
   6. Disconnect and leave in place electrical devices and equipment serving utilization equipment that has been removed or demolished.

B. Cutting: Perform cutting work of existing structure materials by such methods as will prevent extensive damage beyond the immediate area of cutting.

C. Unless otherwise indicated existing, electrical equipment, conduit, wire, etc., indicated for demolition shall be removed and disposed of in a lawful manner, off-site.

D. The CONTRACTOR shall move existing electrical equipment required to be returned to the OWNER, to locations as directed by the OWNER. Care shall be taken to ensure existing electrical equipment being returned to the OWNER does not become damaged. The CONTRACTOR shall provide a means for storing and or stacking of the returned equipment prior to moving to final location, if necessary.

E. Items Abandoned in Place:
   1. All items to be abandoned in place shall be de-energized.

2. Connections shown or otherwise indicated as disconnected shall be removed with lugs left in place and with all conduit and cable openings properly plugged and sealed as required by the NEC.
3. Any abandoned in-place equipment damaged by CONTRACTOR shall be repaired and restored to its original condition.

++ END OF SECTION ++

SECTION 16062

LIGHTNING PROTECTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:
   1. Design and installation of a complete lightning protection system.
   2. Materials and components for the lightning protection system.

B. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
   3. The following sections are related to the Work described in this Section. This list of related sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
   4. Division 01, General Requirements.
   5. Division 07, Thermal and Moisture Protection.
   6. Section 16050, Basic Materials and Methods.
   7. Section 16170, Grounding and Bonding.

1.2 REFERENCES

A. As specified in Section 16050.

B. Lightning Protection Institute (LPI):
   1. LPI-175 - Standard of Practice.

C. National Fire Protection Association (NFPA):
   1. ANSI/NFPA 780 - Standard for the Installation of Lightning Protection Systems.

D. Underwriters Laboratories, Inc. (UL):
   1. 96 - Standard for Lightning Protection Components.
   2. 96A - Standard for Installation Requirements for Lightning Protection Systems.

1.3 DEFINITIONS

A. As specified in Section 16050.

B. Specific definitions:
   1. LPI: Lightning Protection Institute.

1.4 SYSTEM DESCRIPTION

A. Retain the services of a lightning protection contractor to design, furnish, and supervise the installation of a complete lightning protection system, connected to the facility grounding system.

B. Lightning protection system: ANSI/NFPA 780; Class I UL 96A; master labeled system(s) protecting the building envelope and any roof-mounted mechanical equipment, consisting of:
   1. Air terminals on roof(s).
   2. Bonding of structure and other metal objects.
   3. Grounding electrodes.
   4. Interconnecting conductors.

C. Connect the lightning protection system to the facility grounding electrode:
   1. Provide common ground connections as necessary to the electric and telephone service conductors.

D. The installing contractor is responsible for all costs associated with UL inspection of the lightning protection system, including any costs associated with re-inspection necessary to obtain the UL 96A Master Label.

1.5 SUBMITTALS

A. Furnish submittals as specified in Sections 01300 and 16050.

B. Product data:
   1. Provide samples and pertinent catalog data for:
      a. Air terminals.
      b. Conductors.
      c. Connectors.
      d. Accessories.
      e. Include dimensions and materials of each component, and include indication of listing in accordance with UL 96.

C. Shop drawings:
   1. Including but not limited to:
      a. Layout of air terminals with the respective configuration of the zone of protection.
      b. Grounding electrodes, and bonding connections to structure and other metal objects.
      c. Type, size and locations for:
         1) Terminal.
         2) Electrode.

3) Conductor.
d. Conductor routing details.
e. Connection details.
f. Termination details.
g. Applicable air terminal and other calculations.

2. Details showing installation of air terminals, conductors, and connectors.
3. Shop Drawings: Submit for approval the following:
   a. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
   b. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**

D. Certificates:
   1. Submit 2 notarized photocopies of the completed Application for UL Master Label for each lightning protection system.
   2. Submit written confirmation of having obtained UL Master Label and LPI certification for each lightning protection system.
   3. Photocopy of UL and LPI Installers' Certificate(s) for installation of lightning protection systems.
   4. Written confirmation regarding the system manufacturer's and the system installer's membership in the Lightning Protection Institute.
   5. Proof of the manufacturer and installer having been UL-listed and LPI-certified for at least 5 years.

E. Record Documents:

1. Provide Record Documents as specified in Sections 16050.
2. Accurately record actual locations of air terminals, grounding electrodes, bonding connections, and routing of system conductors.
3. Manufacturer's installation instructions.

1.6 QUALITY ASSURANCE

A. As specified in Section 16050.

B. Conform to the requirements of the UL and NFPA standards for lightning protection systems:
   1. Components shall be listed in accordance with UL 96.

C. Manufacturer’s qualifications:
   1. Company specializing in lightning protection equipment with minimum 5 years documented experience and a fully certified manufacturer member of the Lightning Protection Institute:
      a. Listed in section "Lightning Conductor, Air Terminals and Fittings" of the UL "Electrical Construction Materials Directory" for at least 5 years previous to this Contract's bid opening date.

D. Installers qualifications: Authorized installer for manufacturer with minimum 5 years documented experience. and member of the Lightning Protection Institute. member of the UL quality control program listed in section "Lightning Protection Installation" of the UL "Electrical Construction Materials Directory" for at least 5 years previous to this Contract's bid opening date and LPI-certified installer for installation of lightning protection systems for at least 5 years previous to this CONTRACTOR's bid opening date.

E. The lightning protection system shall meet the applicable requirements of NFPA 780.

F. Upon completion of installation the lightning protection contractor to have the building lightning system physically inspected by Underwriters Laboratories and furnish a UL Master Label for the building:
   1. Application for the UL Master Label without a physical inspection by UL is unacceptable.

1.7 DELIVERY, STORAGE, AND HANDLING

A. As specified in Section 16050.

1.8 SEQUENCING

A. Pre-installation conference:
   1. Convene a pre-installation conference 1 week before commencing the Work of this Section, as specified in Division 01 and Section 16050.

B. Coordinate Work with other trades to ensure neat, correct, and unobtrusive installation.

C. Coordinate the Work of this Section with roofing and exterior and interior finish installations.

1.9 WARRANTY

A. As specified in Section 16050.

1.10 SYSTEM STARTUP

A. As specified in Section 16050.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. One of the following or pre-approved equal:
   1. Erico.
   2. Thompson Lightning Protection, Inc.
   3. Harger Lightning and Grounding.
   4. VFC, Inc.

2.2 MATERIALS

A. Air terminals:
   1. Material: Copper when used with non-galvanized roofing and appurtenances. Aluminum where used with galvanized roofing. Chemical compatibility shall be assured, such that galvanic potential between lightning protection material and surfaces is minimized.
   2. Size : 3/8-inch by 18-inch minimum extending a minimum of 12 inches above the object to be protected.
   3. On flat or walkable roofs, provide air terminals with:
      a. Mushroom type blunt tip incapable of impalement if fallen upon.
      b. Spring mounted and capable of being pushed flush to the roof.
   4. Air terminal bases:
      a. Cast bronze with bolt pressure cable connections securely mounted with stainless steel screws and bolts.

B. Ground rods:
   1. As specified in Section 16060.

C. Ground plate: Copper.

D. Conductors:
   1. Perimeters:

a. Aluminum, where compatible with roofing and structure.
2. Down conductors:
a. Copper.
3. At least 32 strands of 17 gauge or larger copper wire weighing not less than 215 pounds per 1000 feet.
4. UL listed for the application.
5. Copper Cables connected to appropriate ground rod:
a. Perimeters and down conductors:
1) At least 32 strands of 17 gauge or larger copper wire weighing not less than 215 pounds per 1000 feet.
2) UL listed for the application.
6. Cable fasteners:
a. Electrolytically compatible with conductors and mounting surface:
1) Spaced in accordance with LPI and NFPA requirements.

E. Connectors and splicers: Bronze / Aluminum:
1. Make connections between dissimilar metals with approved bimetallic connectors.

F. Miscellaneous Materials:
1. Copper of type and size recommended by the manufacturer of the lightning protection system.
2. Stainless steel bolts, screws, and other threaded fasteners.

G. System: Aluminum components for aluminum roofing, compatible with aluminum roofing materials; mechanical connectors and transition joints between aluminum and copper, suitable, properly installed by trained personnel.

PART 3 - EXECUTION

3.1 EXAMINATION

A. It is the responsibility of the lightning protection subcontractor to review the electrical system design, and provide any and all additional equipment and materials needed in order to construct a master labeled UL lightning protection system.

B. Verify that surfaces are ready to receive work.

C. Verify that field measurements are as indicated on the Drawings and as specified elsewhere in this Section.

D. Protect elements surrounding Work of this Section from damage or disfiguration.

3.2 INSTALLATION

A. As specified in Section 16050.

B. Install systems in accordance with manufacturer's instructions unless otherwise specified in this Section.

C. Installation must be made under the supervision of an LPI certified master installer.
   1. Physically connect lightning protection equipment to structural roof framing members including metal deck.
   2. Do not attach lightning protection equipment to rigid roof insulation.
   3. Coordinate sealing roofing penetrations with roofing specifications to prevent leakage.

D. Conductor Installations:
   1. Install the lightning protection roof system(s) grounding and bending conductors exposed on flat roof areas and concealed at ridge roof areas.
   2. Install main downleads completely concealed and sleeved.
   3. Other than for the purpose of protecting downlead conductors from damage up to 6 inches above grade level, do not use exposed conduits to conceal the downleads on the exterior of the building(s) outside walls.
   4. Use minimum 1-inch PVC conduits to protect lightning system conductors from damage:
      a. Bond both ends of PVC-coated rigid steel conduit to conductor.

E. Clearances: Assure 6-foot minimum distance required by NEC:
   1. From lightning rod conductors to non-current-carrying metal parts of electrical equipment unless they are bonded to the rods.
   2. From lightning system conductors to open conductors of communication systems.
   3. From lightning protection grounding electrodes to electrodes of other grounding systems.

F. Extend air terminals a minimum of 12 inches above object to be protected.

G. Maintain horizontal or downward coursing of main conductor and ensure that bends have at least an 8-inch radius and that no bend of a conductor forms an included angle of less than 90 degrees.

H. Install ground electrodes not less than 1 foot below grade and not less than 2 feet from foundation walls.

I. Interconnection of Metals:
   1. Bond all metal bodies within 6 feet of the conductor to the system with approved fittings and conductor.

2. Connections between dissimilar metals shall be made with approved bimetallic connections.
3. Bond metal bodies of inductance located within 6 feet of a conductor or object with secondary bonds.

J. Bond all isolated metallic bodies at or below the roof subject to inductance and within 6 feet of lightning protection system conductors.

K. Provide necessary common grounds between the lightning protections system and the electric and telephone service entrance wires.

L. Ensure that air terminals are installed to withstand calculated wind force due to 100 miles per hour winds or as specified in Division 01, whichever is greater with a 1.3 gust factor without structural damage and without damage to integrity of the lightning protection system.

M. Protect down conductors entering corrosive soil against corrosion by a protective coating for not less than 3 feet above grade level and for the entire length below grade level until connection to the ground ring and rods.

3.3 FIELD QUALITY CONTROL

A. As specified in Section 16050:

B. Provide the services of Underwriters Laboratories, Inc. to physically inspect the entire lightning protection system and issue the UL Master Label:

C. Furnish Underwriters' Laboratories, Inc. Master Label as evidence that the installation has met with UL 96A code requirements.

D. Obtain LPI system certification reports and LPI system certification.

3.4 PROTECTION

A. As specified in Section 16050.

++ END OF SECTION ++

SECTION 16111

CONDUITS

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. Furnish and install conduits as required and as shown on the Drawings. Materials employed shall be as shown on the Drawings.

1.2 SUBMITTALS

A. Submit product literature including manufacturer part number, model number, material, size, and specifications. Material shall not be installed until the ENGINEER has reviewed the submittal data.

B. Shop Drawings shall be submitted for review and acceptance showing routing, conduit size, and number and size of wires in each conduit before installation of conduit and any related work.

C. Proposed routing of conduits buried under floor slabs-on-grade.

D. Identify conduit by tag number indicated in the Conduit Block Diagrams on the Drawings, in accordance with Section 16195, Electrical Identification.

E. Proposed routing and details of construction including conduit and rebar embedded in floor slabs, columns, etc. Identify conduit by tag number of equipment served or by circuit schedule number.

F. Proposed location and details of construction for openings in slabs and walls for raceway runs.

G. Refer to Section 16000, General Electrical Requirements, for further submittal requirements.

H. Shop Drawings: Submit for approval the following:
   1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of

requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

2. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**

1.3 REFERENCES

A. American National Standards Institute (ANSI): C80.1, Rigid Steel Conduit - Zinc-Coated.

B. National Electric Manufacturers Association (NEMA), RN-1, Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit.

C. Underwriters Laboratories Inc. (UL):
   1. 1, Flexible Metal Conduit.
   2. 6, Rigid Metal Conduit.
   3. 360, Liquid-Tight Flexible Steel Conduit.
   4. 467, Grounding and Bonding Equipment.
   5. 514, Nonmetallic Outlet Boxes, Flush-Device Boxes and Covers.
   6. 651, Schedule 40 and 80 Rigid PVC Conduit.
   7. 870, Wireways, Auxiliary Gutters, and Associated Fittings.
   8. 884, Underfloor Raceways and Fittings.
   9. 886, Outlet Boxes and Fittings for Use in Hazardous (Classified) Locations.

PART 2 - PRODUCTS

2.1 RACEWAYS

A. Exposed conduit in an unclassified or hazardous area shall be galvanized rigid steel (GRS) unless specifically indicated otherwise on the Drawings. Conduits in wet and corrosive areas shall be PVC coated GRS, unless otherwise indicated. Underground and/or concrete encased conduits shall be PVC, unless otherwise indicated. All wiring, except as otherwise noted, shall be in conduit. Conduit size shall not be less than the National Electrical Code (NEC) size required for the conductors therein and shall not be smaller than 3/4-inch. No underground conduit shall be less than 1-inch.

B. Condulet type fittings shall be Crouse-Hinds, Appleton, or pre-approved equal with wedge nut covers. All condulets located outdoors or in wet locations shall be weathertight.

C. In unclassified areas, flexible conduit shall be grounding type, weatherproof, corrosion resistant, and watertight.

D. Couplings, connectors, and fittings shall be standard types specifically designed and manufactured for the purpose. They shall be installed to provide a firm mechanical assembly and electrical conductivity throughout.

E. Expansion fittings shall be OZ type AX with jumper for exposed locations and Type DX at structural expansion joints, Spring City, or pre-approved equal. Conduits shall have expansion fittings in accordance with NEC.

F. The conduits and fittings shall be supported per NEC requirements as a minimum.

2.2 GALVANIZED RIGID STEEL (GRS)

A. Conduit and couplings shall be hot-dipped galvanized with zinc coated threads and outer coating of zinc bichromate, in accordance with ANSI C80.1 Standards, as manufactured by Jones & Laughlin Steel Corporation, Allied Tube & Conduit Corporation, Triangle PWC, or pre-approved equal.

B. Steel conduit shall not be buried in earth without concrete encasement and additional corrosion protection. A half lapped rapping of 20 mil PVC based corrosion protection tape shall be used.

2.3 PVC COATED GALVANIZED RIGID STEEL (PVC-GRS)

A. PVC coated GRS conduit shall be installed where shown on the Drawings or elsewhere specified and shall conform to NEMA RN-1 and ANSI C80.1 Standards.

B. The zinc surface of the conduit shall remain intact and undisturbed on both the inside and the outside of the conduit throughout the preparation and application processing. A Polyvinyl Chloride (PVC) coating shall be bonded to the galvanized outer surface of the conduit. The bond between the PVC coating and the conduit surface shall be greater than the tensile strength of the plastic. The thickness of the PVC coating shall be a minimum of 0.040-inch (40 mil).

C. A loose coupling shall be furnished with each length of conduit. A PVC coating shall be bonded to the outer surface of the coupling and a PVC sleeve equal to the outside diameter of the uncoated conduit shall extend beyond both ends of the coupling approximately one pipe diameter or 1-1/2-inches, whichever is smaller. The wall thickness of the coating on the coupling and the sleeve shall be a minimum of 0.040-inch (40 mil).

D. A PVC coating shall be bonded to the inner and outer surface of all conduit bodies and fittings and a PVC sleeve shall extend from all hubs. The wall thickness of the coating on conduit bodies and fittings and the sleeve walls shall be identical to those on couplings in length and thickness. The covers on all conduit bodies shall be coated on both sides and shall be designed to be completely interchangeable. The inside of conduit bodies shall remain undisturbed in the processing.

E. Type 304 stainless steel screws shall be furnished and used to attach the cover to the conduit body. All coated material shall be installed and patched according to the manufacturer's recommended installation and patching instructions.

F. Conduit straps shall be PVC coated or stainless steel.

G. PVC coated conduit and fittings shall be as manufactured by Rob-Roy, or pre-approved equal.

H. PVC coated flexible conduits shall be liquid and vaportight and manufactured in accordance with UL 360 Standards.

2.4 RIGID NONMETALLIC – PVC

A. Where specifically indicated on the Drawings, or elsewhere specified, conduit may be high density Schedule 40, 90° C, heavy-duty PVC. The conduit shall be manufactured from virgin polyvinyl chloride compound which meets ASTM D1784, NEMA TC-2, ANSI C33.91, and UL 651 Standards. Smoke emissions shall be limited to less than 6 grams per 100 grams of material tested.

B. Where conduit concrete encasement is indicated on the Drawings, conduit supports shall be installed at 5 foot intervals. PVC conduit shall be manufactured by Carlon, Triangle Conduit & Cable, or pre-approved equal.

2.5 LIQUIDTIGHT FLEXIBLE METAL CONDUIT

A. Liquidtight flexible metal conduit shall be liquid and vaportight, oil and ultraviolet ray resistant, and manufactured in accordance with UL 360 Standards. Liquidtight flexible metal conduit shall be formed of a continuous, spiral wound, galvanized steel core with an extruded PVC jacket. The PVC jacket shall be rated for high ambient heat applications, 90° Celsius.

B. For corrosive locations, liquidtight flexible metal conduit shall be formed of a continuous, spiral wound, aluminum core with an extruded PVC jacket. The PVC jacket shall be impervious to corrosive liquids and vapors.

C. An external bonding conductor shall be required for flexible conduit connections containing circuits rated at 60 amps or greater and for sizes 1-1/2-inches or larger.

Flexible conduit and connectors for 1-1/4-inches and smaller shall be listed for grounding.

D. Connectors for liquidtight flexible conduit shall be galvanized, furnished with a sealing ring and locknut, and suitable for wet locations.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Conduit runs are schematic only, and shall be modified as required to suit field conditions, subject to review and acceptance by the ENGINEER.

B. Conduit shall run continuously between outlets and shall be provided with junction boxes where connections are made. Couplings, connectors, and fittings shall be acceptable types designed and manufactured for the purpose, and shall provide a firm mechanical assembly, and electrical conductivity throughout.

C. Conduit runs shall be straight and true. Elbows, offsets, and bends shall be uniform and symmetrical. Changes in direction shall be made with long radius bends, or with fittings of the condulet type.

D. Conduit runs in buildings and structures shall be exposed except as specifically noted or accepted by the ENGINEER.

E. Conduit runs shall not interfere with the proper and safe operation of equipment, and shall not block or interfere with ingress or egress, including equipment removal hatches.

F. Exposed conduits shall be securely fastened with clamps, or straps, intended for conduit use. All exposed conduit shall be run on the walls and ceiling only and shall be parallel to the planes of the walls or ceiling. No diagonal runs will be permitted. Flexible conduit shall be used only for short lengths required to facilitate connections between rigid conduit to motors from junction boxes, or control equipment.

G. Conduit runs on water-bearing walls shall be supported 1-inch away from the wall on an accepted channel. When channel galvanizing, or other coating, is cut or otherwise damaged, it shall be field coated to original condition. No conduit shall be run in water-bearing walls, unless specifically designated otherwise.

H. Conduit shall be thoroughly reamed to remove burrs. GRS shall be reamed during the threading process, and rigid nonmetallic PVC shall be reamed before applying fittings. A zinc rich cold galvanizing shall be used to restore corrosion protection on field cut threads. Bushings and lock nuts or hubs shall be used at conduit terminations. The total number of bends in any run between pull points

shall not exceed 360 degrees. Junction boxes and pull boxes shall be installed at points acceptable to the ENGINEER. Conduit ends shall be plugged to prevent the entrance of moisture or debris during construction. All spare conduits shall be adequately capped and shall contain a suitable pull string.

I. Joints shall be set up tight. Hangers and fastenings shall be secure, and of a type appropriate in design, and dimensions, for the particular application.

J. Conduit runs shall be cleaned and internally sized (obstruction tested) so that no foreign objects, or obstructions remain in the conduit prior to pulling in conductors.

K. After installation of complete conduit runs 2-inches and larger, conduits shall be snaked with a conduit cleaner equipped with a cylindrical mandrel of a diameter not less than 85% of the nominal diameter of the conduit. Conduits through which the mandrel will not pass shall not be used.

L. Expansion fittings shall be installed across all expansion joints and at other locations where necessary to compensate for thermal expansion and contraction.

M. Provide trenching, backfill, and compaction for conduits installed underground.

N. Unless approved in advance by the ENGINEER, all conduits which transition from underground to aboveground will utilize galvanized rigid steel conduit for the bend from horizontal to vertical and for the extension above the ground. Factory 90 degree GRS bends shall be used. GRS bends and conduits shall be half lapped with 20 mil PVC tape in non-corrosive areas and shall be PVC coated rigid steel in corrosive areas. Tape wrapping shall extend a minimum 6-inches above top of slab or above finished grade.

O. Liquid tight flexible metallic conduit 1-1/2-inch and larger shall be provided with grounding style bushings and shall have an external ground wire sized and installed in accordance with the NEC.

++ END OF SECTION ++

SECTION 16117

CONCRETE MANHOLES, HANDHOLES AND PULL BOXES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawing and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.

1.2 SUMMMARY

A. This Section includes the following:
   1. Concrete manholes and manhole accessories.
   2. Concrete handholes and handhole accessories.
   3. Concrete pullboxes and pullbox accessories.
   4. Related Sections: The following Sections contain requirements that relate to this Section:
      a. Division 02, Site Work: Excavation and Backfilling.
      b. Division 03, Concrete: Reinforcement, and Cast-in-Place.
      c. Division 07, Thermal and Moisture Protection: Bituminous Waterproofing.
      d. Division 15, Mechanical: Plumbing Specialties.
      e. Section 16111, Conduits.
      f. Section 16170, Grounding and Bonding.

1.3 REFERENCES

A. American Association of State and Highway Officials:
   1. AASHTO HL-93, Standard Specifications for Highway Bridges, Fifteenth Edition.
   2. American Standards for Testing and Materials:
   3. ASTM A48-22, Gray Iron Castings.
   4. ASTM A153-16a (2023), Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
   5. ASTM A1011, Steel, Sheet and Strip, Carbon (0.15% max), Hot-Rolled, Commercial Quality.
   6. ASTM C858-2023 Standard Specification for Underground Precast Concrete Utility Structures.
   7. American National Standards Institute (ANSI):
   8. ANSI-C2-l 997, National Electrical Safety Code.
   9. National Fire Protection Association (NFPA):
   10. NFPA-70-2018, National Electrical Code.

1.4 SUBMITTALS

A. General: Submit each item in this Article according to the conditions stated in General and Supplementary Conditions.

B. Products furnished from listed manufacturers are pre-approved but still require submittal.

C. Submit proposed substitutions for approval in accordance with General and Supplementary Conditions.

D. Product Data for equipment specified, including the following:

E. Certified technical data sheets shall include load capacities for manhole, handhole, and pull box covers.

F. Shop Drawings: Show fabrication and installation details for underground utility structures and include the following:
   1. For manholes and handholes:
      a. Duct sizes and locations of duct entries.
      b. Reinforcement details.
      c. Manhole cover design.
      d. Step details.
      e. Cable Hanger details.
   2. Dimensioned locations of cable rack inserts, pulling-in irons, and sumps.
   3. For precast manholes, handholes and pull boxes: Shop Drawings shall be signed and sealed by a qualified professional engineer, and shall show the following:
      a. Construction of individual segments.
      b. Joint details.
      c. Design calculations.
   4. Shop Drawings: Submit for approval the following:
      a. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the

specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

b. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**

G. Coordination Drawings, including plans and sections drawn to scale. Submit with Shop Drawings. Show layout and relationships between components and adjacent structural and mechanical elements. Show support sub-base criteria, type of support, and weight on each support. Indicate and certify field measurements.

H. Product Certificates: For concrete and steel used in manholes, handholes, and pull boxes according to ASTM C858.

1.5 QUALITY ASSURANCE

A. Drawing Compliance: Manholes, handholes, pull boxes, and accessories shall be designed, fabricated, and installed in compliance with the Drawings.

B. AAHSTO Compliance: Provide manhole covers that are listed and labeled by AAHSTO for loadings specified.

C. Coordination: Coordinate layout and installation of manholes, handholes, and pull boxes with other installations.

D. Comply with ANSI C2.

E. Comply with NFPA 7O.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver equipment as factory-fabricated modules with protective crating and covering.

B. Lift and support components with manufacturer’s designated lifting or supporting points.

1.7 SEQUENCING AND SCHEDULING

A. Coordinate size and location of sub-base materials and compaction with other sections of the specification.

1.8 COORDINATION

A. Coordinate layout and installation of manholes, handholes, and pullboxes with final arrangements of other utilities and site grading, as determined in the field.

B. Coordinate elevations of ducts and duct-bank entrances into manholes and handholes with final profiles of conduits as determined by coordination with other utilities and underground obstructions. Revise locations and elevations from those indicated as required to suit field conditions and to ensure duct runs drain to manholes and handholes, and as approved by Construction Manager.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Underground Precast Concrete Utility Structures:
   1. Carder Concrete Products.
   2. Christy Concrete Products, Inc. (Oldcastle Infrastructure)
   3. Elmhurst-Chicago Stone Co.
   4. Riverton Concrete Products.
   5. Old Castle Infrastructure (CRH).
   6. Utility Vault Co.
   7. Wasau Concrete Co.
   8. Hartford Concrete Products, Inc.
   9. Heritage Concrete Pipe Co.
   10. Or pre-approved equal.

B. Frames, Covers, and Accessories:
   1. Campbell Foundry Co.
   2. East Jordan Iron Works, Inc.
   3. McKinley Iron Works, Inc.
   4. Neenah Foundry Co.
   5. Flockhardt Foundry Co.
   6. A.B. Chance Co.
   7. Or pre-approved equal.

2.2 PRECAST CONCRETE MANHOLES

A. Precast Concrete: Air-entrained, 5,000 psi (25 mPa) compressive strength at 28 days.
   1. Reinforcing: AASHTO H20; bridge loading.
   2. Construction: In modular sections with tongue and groove joints.
   3. Manhole Shape: As indicated, and in accordance with ORNL standard ES-1.1-17 Type A standard electrical manhole.
   4. Inside Dimensions: As indicated.
   5. Wall Thickness: 4 1/2 in minimum.

6. Include 36-in. diameter grooved opening in top section.
7. Necking and Shaft Sections: 30-in. diameter clear opening.
8. Include 8-in. minimum drain opening and two 1-inch ground rod openings in base section.
9. Window for Duct Entry: As indicated.
10. Include cable pulling irons opposite each duct entry window.
11. Include inserts for cable racks at 2 ft. on center.

2.3 CAST-IN-PLACE MANHOLES

A. Concrete: 5,000-psi compressive strength at 28 days in conformance with requirements of Division 3, with steel bar reinforcing per ORNL standard ES-1.1-17.

B. Provide reinforcing under the provisions of Division 3, Concrete.

C. Provide two 1-inch ground rod openings in base.

2.4 MANHOLE ACCESSORIES

A. Manhole Frames and Covers: ASTM A48; Class 30B gray cast iron, machine finished with flat bearing surfaces. Cover shall have custom design cast into exposed face similar to SNS logo with either the word “ELECTRIC” for power manholes or “COMMUNICATIONS” for communications manholes.

B. Pulling Irons: 7/8-in. diameter steel bar forming a triangle of 9 in. per side when set. Galvanize to ASTM A153 for irregular shaped articles.

C. Cable Rack Inserts: Galvanized Steel channel insert with minimum load rating of 800 lb., length to match cable rack channel.

D. Cable Rack Channel: 2 1/4-in. X 2 1/4-in. X 1/4-in, galvanized steel channel wall bracket, 27 1/2-in. length, with 14 cable rack arm mounting holes on 1 1/2-in. centers.

E. Cable Racks: ASTM A569; steel channel, 2 1/2 in. X 10 1/2 in. with high-glazed, wet-process porcelain insulators or pre-approved equal.

F. Manhole Steps: Cast iron, suitable for manhole shape and construction.

2.5 PRECAST CONCRETE HANDHOLES

A. Precast Concrete: Air-entrained, 5,000 psi (35 mPa) compressive strength at 28 days.

B. Reinforcing: AASHTO H20; bridge loading.

C. Construction: In modular sections with tongue and groove joints.

D. Dimensions: Minimum inside dimensions of 48 in. width X 66 in length X 54 in. depth.

E. Wall Thickness: 5 in.

F. Include 12-in. sump in base section.

G. Windows for Duct Entry: 4 duct terminators in each end and 2 duct terminators in each side, located as shown on Drawings.

H. Knockouts: 1-10 in. X 26 in. knockout in each end, and 1-6 in. X 24 in. knockout in each side, located as shown on Drawings.

I. Include cable pulling irons opposite each duct entry window.

2.6 HANDHOLE ACCESSORIES

A. Handhole Frames and Covers: steel angle cast-in-place frame, machine finished with flat bearing surfaces. AASHTO H20; bridge loading. Galvanized checker plate steel cover with formed galvanized steel beams, torsion springs and safety bars, cover shall have either the word “ELECTRIC” for power manholes or “COMMUNICATIONS” for communications handholes engraved in steel name plate on frame.

B. Pulling Irons: 7/8-in. diameter steel bar forming a triangle of 9 in. per side when set. Galvanize to ASTM A153 for irregular shaped articles.

2.7 PRECAST CONCRETE PULLBOXES

A. Precast Concrete: Air-entrained, 5,000 psi (25 mPa) compressive strength at 28 days.

B. Reinforcing: AASHTO H20; bridge loading.

C. Dimensions: Minimum inside dimensions of 10 1/2 in. width X 17 1/4 in length X 12 in. depth.

D. Wall Thickness: minimum 7/8-in.

E. Window for Duct Entry: 2 - 3” knockouts on each side and 1 - 3” knockout on each end.

2.8 PULLBOX ACCESSORIES

A. Covers: reinforced concrete, air-entrained, 5,000 psi (25 mPa) compressive strength at 28 days, AASHTO H20; bridge loading.

PART 3 - EXECUTION

3.1 PREPARATION

A. Excavate, install base material, and compact base material under provisions of Division 2, Site Work.

3.2 EXAMINATION

A. Examine sitework, duct bank installation subbase placement, levelness, and compactness before placing the manhole sections, handholes, or pullboxes.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 INSTALLATION - PRECAST CONCRETE MANHOLES

A. Install and seal precast sections according to manufacturer's instructions.

B. Use precast neck and shaft sections to bring manhole entrance to proper elevation.

C. Install manholes plumb.

D. Set top of each manhole to finished elevation indicated.

3.4 INSTALLATION - CAST-IN-PLACE CONCRETE MANHOLES

A. Form cast-in-place manholes, inside and outside surfaces, according to provisions of Division 3.

B. Manhole configuration, inside dimensions, wall thicknesses concrete reinforcing, and duct bank window sizes and locations: According to details.

C. Include 12-in. drain opening and two 1-in. ground rod openings in base section.

D. Cast cable pulling irons in place opposite each duct entry window.

E. Cast inserts for cable racks in place at 2 ft. centers.

F. Cast manhole steps in place on 16-in. centers.

3.5 INSTALLATION - MANHOLE ACCESSORIES

A. Install drains in manholes where shown on the drawings, and connect to daylight at the nearest location. Install ground rod with top protruding 4 in. above manhole floor.

B. Waterproof exterior surfaces, joints, and interruptions of manholes after concrete has cured 28 days minimum, in accordance with provisions of Division 7.

C. Attach cable racks to inserts after manhole installation is complete.

D. Install manhole covers.

E. Ground cable racks to manhole ground rod with #6 bare, solid copper conductor by exothermic weld process.

F. Bring exterior #4/0 bare copper cable into manhole and connect to ground rod in manhole floor.

G. Ground circuit #4/0 copper cable in 5" conduit to exterior cable in duct bank and manhole ground rod.

3.6 INSTALLATION - PRECAST CONCRETE HANDHOLES AND PULLBOXES

A. Install and seal precast sections according to manufacturer's instructions.

B. Install handholes and pullboxes plumb.

C. Set top of each handhole and pullbox to finished elevation indicated.

3.7 FIELD QUALITY CONTROL

A. Verify that installed manholes, handholes, and pullboxes are installed plumb and level and that covers will be flush with final paved surfaces.

B. Check that accessories are installed according to specifications and drawings.

C. Inspect drain lines to verify proper drainage.

3.8 ADJUSTING

A. Adjust final manhole, handhole, and pullbox frame elevations to match that of final paving or grade.

3.9 CLEANING

A. Clean inside of manholes, handholes, and pullboxes from all construction debris and verify proper operation of drains (for both precast and cast-in-place manholes).

3.10 PROTECTION

A. Protect, handhole, and pullbox interiors from entrance of construction debris after final cleaning is complete.

++ END OF SECTION ++

SECTION 16123

600 VOLT CLASS CABLE

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. This Section covers the furnishing and installation of 600 volt class cables and conductors, terminations and splicing, and pulling lubricants.

1.2 SUBMITTALS

A. Products shall be submitted in accordance with Section 16000, General Electrical Requirements, and elsewhere in the Contract Documents, prior to installation.

B. Shop Drawings: Submit for approval the following:
   1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
   2. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**

1.3 REFERENCES

A. Insulated Cable Engineers Association/National Electrical Manufacturers Association (ICEA/NEMA):

1. S-68-516/WC 8, ethylene-propylene rubber-insulated wire and cable for the transmission and distribution of electrical energy.
2. S-61-402/WC 5, thermoplastic-insulated wire and cable for the transmission and distribution of electrical energy.
3. S-66-524/WC 7, cross-linked thermosetting-polyethylene-insulated wire and cable for transmission and distribution of electrical energy.

B. Underwriters Laboratory, Inc.
1. 44, rubber insulated wires and cables.
2. 83, thermoplastic-insulated wires and cables.
3. 486A, wire connectors and soldering lugs for use with copper conductors.
4. 486B, wire connectors for use with aluminum conductors.
5. 510, insulating tape.

C. National Electrical Code.

D. Insulated Cable Engineers Association.

PART 2 - PRODUCTS

2.1 ACCEPTED MANUFACTURERS

A. Conductors and Multi Conductor Cables (MCC), subject to compliance with Contract Documents, the following manufacturers are acceptable:
1. General Cable (Prysmian).
2. Okonite Company.
3. Southwire Company.
4. Or pre-approved equal.

2.2 CONDUCTORS

A. Wire sizes shall be American Wire Gauge (AWG) sizes with Class B stranded construction. No. 2 AWG and smaller shall be factory color coded with a separate color for each phase and neutral, which shall be used consistently throughout the system. Larger cables shall be coded by the use of colored tape. Conductors sized No. 1 and larger shall be Type 2, rated for 90° C. All circuit conductors, #6 or smaller shall be "THWN" stranded copper. All other conductors shall be "XHHW" stranded copper.

B. Individual or multiple conductor cables for power, control, and alarm circuits of 480 volts or less shall be insulated for not less than 600 volts and shall have insulation type as indicated on the Drawings. "THHW" shall conform to ICEA S-61-402/NEMA WC 5 and UL 83 and "XHHW" shall conform to ICEA S-66-524/NEMA WC 7 and UL 44. Where wire size is not indicated, they shall be of the size required by the NEC, except that no wire external to panels and motor

control centers shall be less than No. 12 AWG, unless specifically noted on the Drawings. Panel control wiring shall not be less than No. 14 AWG.

C. All wiring shall be as indicated on the Drawings. Wires shall be new and shall be soft drawn copper with not less than 97% conductivity. The wire and cable shall have size, grade of insulation, voltage, and manufacturer's name permanently marked on the outer covering at not more than 2 foot intervals. All wires shall conform to the latest Standards of the ASTM, and ICEA, and shall be tested for their full length by these Standards. Insulation thickness shall be not less than that specified by the National Electrical Code.

2.3 TERMINATIONS AND SPLICES

A. Cable shall be rated 600 volts. Other parts of cable systems such as splices and terminations shall be rated at not less than 600 volts. Splicing shall join conductors mechanically and electrically to provide a complete circuit prior to installation of insulation.

B. Splices in wires No. 10 AWG and smaller shall be made with an insulated, solderless, pressure type connector, Type I, Class 1, Grade B, Style G, or Type II, Class 1 of FS W-S-610 and conforming to the applicable requirements of UL 486A.

C. Splices in wires No. 8 AWG and larger shall be made with noninsulated, solderless, pressure type connector, Type II, Class 2 of FS W-S-610, conforming to the applicable requirements of UL 486A and UL 486B. They shall then be covered with an insulation and jacket material equivalent to the conductor insulation and jacket.

D. Insulated conductor splices below grade or in wet locations shall be sealed type conforming to ANSI C119.1 or shall be waterproofed by a sealant-filled, thick wall, heat shrinkable, thermosetting tubing or by pouring a thermosetting resin into a mold that surrounds the joined conductors.

E. Bare conductor splices in wet locations or below grade shall be of the exothermic type.

2.4 PULLING LUBRICANT

A. All cables shall be properly coated with pulling compound such as ClearGluide, Aqua Gel, Polywater, or pre-approved equal before being pulled into conduits so as to prevent mechanical damage to the cables during installation. "Yellow 77" is not acceptable.

B. Other lubricants to be substituted must be accompanied by a statement from the cable manufacturer as to its acceptable use with the cable being installed.

2.5 IDENTIFICATION

A. All conductors shall be numbered with "tube sleeve" type tags with heat impressed letters and numbers.

B. Color code all wiring as follows:
   1. Lighting and Power Wiring:

Conductor	120/208 VAC	480VAC	24V DC	120 VAC Control/ Power
Phase 1	Black	Brown	Blue	Red
Phase 2	Red	Orange	(-) Blue w/ white stripe	
Phase 3	Blue	Yellow		
Neutrals	White	White		White

   2. Color code ends of feeder phase conductors only.

PART 3 - EXECUTION

3.1 INSTALLATION

A. The pulling tension and side-wall pressures, as recommended by the cable manufacturer, shall not be exceeded.

B. As far as practical, all circuits shall be continuous from origin to termination without splices in intermediate pull boxes. Sufficient slack shall be left at the termination to make proper connections. In no case shall a splice be pulled into the conduit. Conductor splicing shall not be permitted without the ENGINEER'S approval.

C. Install all cables in conduit.

D. Each feeder and branch circuit shall be installed in its own individual conduit, unless combining feeder and branch circuits is permitted as defined in the following:
   1. As specifically indicated on the Drawings.
   2. For lighting, multiple branch circuits may be installed in a conduit as allowed by the NEC and with the wire ampacity derated in accordance with the requirements of the NEC. Conduit fill shall not exceed the limits established by the NEC.
   3. When field conditions dictate and written permission is obtained from the ENGINEER.

E. Feeder and branch circuits shall be isolated from each other and from all instrumentation and control circuits.

F. Control circuits shall be isolated from all other feeder, branch and instrumentation circuits, except as noted below:
   1. 12 VDC, 24 VDC and 48 VDC control circuits may be combined in common conduit.
   2. 125 VDC control circuits shall be isolated from all other DC and AC control circuits.
   3. 120 VAC, 240 VAC, and 480 VAC power and control circuits shall be isolated from all DC control circuits.

G. Make splices only at pull or junction boxes.
   1. Splices are not allowed, except if approved by the Engineer.
   2. Crimp or indented-type connectors are not allowed, except for control circuits landed on terminal strips.

3.2 TESTING

A. In accordance with Specification 16920 Electrical Acceptance Testing.

++ END OF SECTION ++

SECTION 16124

INSTRUMENTATION CLASS CABLE

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. This Section covers cable use for process signal and controls.

1.2 SUBMITTALS

A. Products shall be submitted in accordance with Section 16000, General Electrical Requirements, and elsewhere in the Contract Documents, prior to installation.

B. Shop Drawings: Submit for approval the following:
   1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
   2. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with Contract Documents, the instrumentation cable shall be as manufactured by Prysmian, Belden, Okonite, or pre-approved equal.

2.2 INSTRUMENTATION CABLE

A. Instrument cable shall be Type TC, and have the number of individually shielded twisted pairs indicated on the Drawings and shall be insulated for not less than 600 volts. Unless otherwise indicated, conductor size shall be No. 16 AWG minimum. Shielded, grounded instrumentation cable shall be used for all analog signals.

B. The jacket shall be flame retardant with 90° C temperature rating. The cable shield shall be a minimum of 2.3 mil aluminum or copper tape overlapped to provide 100% coverage and a tinned copper drain wire.

C. The conductors shall be bare soft annealed copper, Class B, 7 strand minimum concentric lay with 15 mils nominal thickness, nylon jacket, 4 mil nominal thickness, 90° C temperature rating. One conductor within each pair shall be numerically identified.

D. Pairs shall be assembled with a nominal 2-inch lay and shall then be group shielded with a minimum of 1.3 mil aluminum or copper tape overlapped to provide 100% coverage. All group shields shall be completely isolated from each other.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Feeder and branch circuits shall be isolated from each other and from instrumentation and control circuits. Instrumentation cables shall be installed in separate raceways from other cables and wiring. This includes portions running through manholes. Instrumentation cable shall be continuous between instruments or between field devices and instrument enclosures. There shall be no intermediate splices or terminal boards, unless otherwise shown on the Drawings.

B. Maintain electrical continuity of the shield when splicing twisted shielded pair conductors. Drain wires shall be terminated inside enclosures at grounded terminal blocks. Only one end of each instrument loop cable drain wire shall be grounded. Ground the drain wire of shielded conductors at one end only.

C. Terminate instrumentation and control wiring, including spare wires, at control panels and motor control centers on terminal boards mounted inside the equipment.
   1. Contractor shall supply terminal boards as required.
   2. Do not field wire directly to devices.

++ END OF SECTION ++

SECTION 16130

OUTLET, PULL, AND JUNCTION BOXES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes outlet, pull and junction boxes.

B. Related Sections include but are not necessarily limited to:
   1. Division 0, Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 1, General Requirements.
   3. Section 01650, Commissioning and Process Start-up.
   4. Section 16000, General Electrical Requirements.
   5. Section 16111, Conduits.
   6. Section 16141, Wiring Devices.
   7. Section 16170, Grounding and Bonding.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. Refer to Section 16000, General Electrical Requirements.

1.3 SUBMITTALS

A. Shop Drawings:
   1. Refer to the Contract Documents and Section 16000, General Electrical Requirements.

B. Shop Drawings: Submit for approval the following:
   1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance

on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

2. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**

1.4 DELIVERY, STORAGE, AND HANDLING

A. See Section 16000, General Electrical Requirements.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Sheet Metal Boxes for Indoor and Non-classified Areas:
      a. Hoffman Engineering Co.
      b. Rittal.
   2. Boxes for Outdoor and Corrosion Areas:
      a. Hoffman Engineering Co.
      b. Rittal.
   3. Hazardous Location Boxes (Class I, II & III):
      a. Appleton Electric Co.
      b. Crouse-Hinds.
      c. Killark.
      d. O-Z/Gedney.
   4. Raintight and Watertight Boxes:
      a. Appleton Electric Co.
      b. Crouse-Hinds.
      c. Terminal Boxes:
      d. Hoffman Engineering Co.
   5. Boxes in Sidewalk:
      a. Appleton Electric Co.
      b. Crouse-Hinds.
      c. O-Z/Gedney.
   6. Boxes in Earth:
      a. Carlon Electric Products.
   7. Exposed Switch and Receptacle Boxes:
      a. Appleton Electric Co.

b. Crouse-Hinds.
c. Killark.

B. Submit requests for substitution in accordance with the General Conditions.

2.2 MATERIALS

A. Pull and Junction Boxes for Offices and other Dry Architecturally Finished Areas:
1. Material: 14 gauge, galvanized steel.
2. Concentric knockouts on all four sides.
3. Flat cover fastened with screws.
4. NEMA 1 Classification.
5. UL listed.
6. Pull and Junction Boxes for General Use Indoors in Unclassified Areas:
7. Material: 14 gauge galvanized steel with seams continuously welded, ground smooth and no knockouts.
8. Zinc rich coating on all seams.
9. Stainless steel captivated cover screws threaded into sealed wells.
10. Flat door with oil resistant gasket.
11. NEMA 12 Classification.
12. UL listed.

B. Pull and Junction Boxes for Outdoor and Corrosive Areas:
1. Material: 316 Stainless Steel.
2. Stainless Steel boxes:
3. Seams continuously welded, ground smooth, no knockouts.
4. Rolled lip around all sides.
5. Hinged door.
6. Captivated stainless steel door screws.
7. Flat door with oil-resistant gasket.
8. NEMA 4X Classification.
9. UL listed.

C. Pull and Junction Boxes for Hazardous Areas:
1. Material: Cast gray iron alloy or copper-free cast aluminum.
2. Drilled and tapped openings or tapered threaded hub equipped.
3. Flat bolted down or threaded cover with neoprene gasket.
4. Stainless steel hex head screws.
5. Explosion proof, UL listed for Class 1, Groups C and D.

D. Pull and Junction Boxes for Sidewalks:
1. Cast iron box and cover, hot-dip galvanized.
2. Flange for flush mounting.
3. Checkered cover with neoprene gasket, pry bar slots, and stainless steel screws.
4. UL listed.

5. Drilled and tapped holes.
6. Watertight NEMA 4 Classification.

E. Large Pull and Junction Boxes (100 cubic inches and larger):
   1. Located in offices and other dry architecturally finished areas:
      a. NEMA 1 gasketed without knockouts.
      b. Located in general use areas:
      c. NEMA 12 construction:
         1) Welded steel.
         2) Furnished with gray enamel inside and out over phosphatized surfaces.

F. Located in wet and corrosive areas:
   1. NEMA 4X with stainless steel screws.
   2. Type 304 L welded stainless steel:

G. Constructed of 14 gauge steel with seams continuously welded, ground smooth, no knockouts.

H. Rolled lip around all sides.

I. Rigid handles for covers larger than 9 sq. ft. or heavier than 25 lbs.

J. Split covers when heavier than 25lbs.

K. Terminal Boxes:
   1. Galvanized 16 gauge steel box provided with plain blank screw cover, subpanel, and terminal points.
   2. Refer to Drawing for dimensions and number of terminals.
   3. Terminal blocks shall be screw-post barrier-type, white center marker strip.
   4. Rated 20 ampere, minimum 600 V.

L. Fiberglass Cable-Pulling Enclosure:
   1. Use: Access points to facilitate pulling of electrical cables in buried conduit runs.
   2. Size and quantity: As shown on Drawings.
   3. Type: Rectangular fiberglass composite, suitable for direct burial pedestrian traffic on top, -50° F, chemical, sunlight, and weather resistant.
   4. Provide matching top with "ELECTRIC" logo.

M. Outlet Boxes:
   1. Use extension and plaster rings where required.
      a. Provide grounding screw. Use: Installation of wiring devices.
      b. Boxes for Exposed Wiring:
   2. Cadmium plated, cast, ferrous metal, with threaded hubs.
      a. Boxes for Concealed Wiring:

3. Code gage, hot-dip galvanized steel.
4. Include bar hangers for metal stud partitions.
5. Provide barriers between switches in boxes with 277 VAC switches on opposite phases.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Use locknut and bushing for boxes in non-classified areas.

B. Use cast metal boxes with threaded conduit hubs in hazardous areas.

C. Use Type FS and FD boxes in wet areas and where exposed rigid steel conduit is required.

D. Use epoxy resin coated, stainless steel, cast aluminum or fiberglass boxes for corrosive areas.

E. Use PVC coated, boxes for outdoor areas.

F. Fill unused punched-out, tapped, or threaded hub openings with insert plugs.

G. Use outlet boxes sized to accommodate quantity of conductors enclosed.

H. Use boxes sized to accommodate conduit tying into box.

I. Install pull boxes or junction boxes in conduit runs where indicated or required to facilitate pulling of wires or making connections.

J. Make covers of boxes accessible.

K. Install pull boxes or junction boxes rated for the area classification.

L. Install rigid conduit squarely into boxes which do not have hubs or are drilled and tapped.

M. Install with locknut on the outside and bushing on inside.

N. Install conduit into boxes with hubs, or that are tapped, using thread lubricant.

O. Do not use back-to-back boxes on this Project.

P. Seal all points of conduit entry into fiberglass cable-pulling enclosures for a waterproof installation.

Q. Support outlet boxes for incandescent fixtures and other ceiling-mounted devices in lay-in acoustical tile ceilings by bar hangers anchored to ceiling construction members which do not interfere with tile removal.

++ END OF SECTION ++

SECTION 16137

UNDERGROUND DUCT BANKS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope: Provide all labor, materials, equipment and incidentals as shown on the Drawings, specified and required to furnish and install underground duct banks.

B. Coordination: Duct bank routing on the Drawings is diagrammatic. Coordinate installation with piping and other underground systems and structures and locate clear of interferences.

C. Standard conduit chairs shall be used for all conduit raceway supports.

D. Definition: A duct bank is one or more buried electrical conduits.

1.2 QUALITY ASSURANCE

A. Reference Standards: Comply with applicable provisions and recommendations of the National Electrical Code.

1.3 1.3 SUBMITTALS

A. Shop Drawings: Submit for approval the following:
   1. Layouts showing the proposed routing of duct banks and the locations of manholes, handholes and areas of reinforcement.
   2. Profiles of duct banks showing crossings with piping and other underground systems.
   3. Typical cross sections.
   4. Installation procedures.
   5. Submit for approval the following:
      a. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The

remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

b. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**

B. Record Drawings: Include the actual routing of underground duct runs on Record Drawings in accordance with Section 01720, Record Documents.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Duct: Schedule 40 PVC conduit and fittings in accordance with Section 16111 - Conduit.

B. Exposed: PVC Coated Galvanized Rigid Metal Conduit: PVC coated rigid metal conduit and fittings in accordance with Section 16111 - Conduit, if required.

C. Backfill: Select backfill in accordance with Section 02315, Earthwork, Excavation, and Backfill.

D. Reinforcement: In accordance with Section 03200, Concrete Reinforcement.

E. Concrete: In accordance with Section 03300, Cast-In-Place Concrete.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Duct banks shall be installed as follows:
   1. For small direct burial duct banks (3 conduits or less) use of PVC coated rigid metal conduit. Concrete and reinforcement are not required. Warning tape is required.
   2. For larger duct banks, use PVC conduit, to be encasement, reinforcement and warning tape. All bends (vertical and horizontal) of 45º or more require PVC coated rigid metal conduit.

B. Excavation and backfilling required for duct bank installation.

C. All duct bank installations and penetrations through foundation walls shall be watertight and in accordance with Section 16111 - Conduit.

D. Top of duct banks shall be a minimum of 24-inches below grade, unless otherwise approved by the ENGINEER.

E. Assemble duct banks using non-magnetic saddles, spacers and separators. Position the separators to provide 3-inch minimum concrete separation between the outer surfaces of the ducts. Side forms are only required to prevent excessive widening of the duct bank where over excavation has occurred.

F. Provide a 3-inch minimum concrete covering on sides, top and bottom of concrete envelopes around conduits. Concrete covering size shall be as shown on the Drawings. Add red oxide to concrete for easy identification during subsequent excavation. The red oxide is to be added in the concrete truck prior to the concrete being placed. Red oxide concrete shall include the entire duct bank, top and bottom unless under a slab.

G. Firmly fix ducts in place during placing of concrete. Carefully place and vibrate the concrete to ensure filling of all spaces between ducts.

H. Conduits entering floor mounted equipment, such as, switchgear compartments, motor control centers, transformers shall terminate with PVC coated rigid metal conduit factory 90º elbows, RNC risers and bell ends.

I. Ductbank reinforcement:
   1. Unless otherwise shown on the Drawings, reinforce with No. 4 longitudinal steel bars placed at each corner and along each face at a maximum parallel spacing of 18-inches on centers, and No. 3 tie-bars transversely placed at 18-inch maximum longitudinal intervals. Overlap of No. 3 tie-bars shall be a minimum of 4-inches.
   2. Maintain a maximum clearance of 1-inch from bars to the edge of the concrete encasement.
   3. Install dowel reinforcement rebar where duct bank meets other concrete structures.

J. Do not backfill with material containing large rock, paving materials, cinders, large or sharply angular substances, corrosive material or other materials which can damage or contribute to corrosion of ducts or cables or prevent adequate compaction of fill.

K. Slope duct runs for drainage toward manholes and away from buildings with a slope of approximately 3-inches per 100 feet.

L. Install a bare stranded copper duct bank ground cable (#4/0 or as shown on drawings) in each duct bank envelope. Make ground electrically continuous throughout the entire duct bank system. Connect ground cable to building and station ground grid or

to equipment ground buses. In addition, connect ground cable to steel conduit extensions of the underground duct system. Provide ground clamp and bonding of each steel conduit extension, where necessary to maintain continuity of the ground system. Terminate ground cable at last manhole or handhole for outlying structures.

M. After completion of the duct bank or utilizing existing ducts and prior to pulling cable, pull a mandrel, not less than 12-inches long and with a cross section approximately 1/4-inch less than the inside cross section of the duct, through each duct. Then pull a rag swab or sponge through to make certain that no particles of earth, sand or gravel have been left in the duct.

N. Pulling Rope/Tape
   1. Pulling rope or tape shall be constructed of polyester and factory lubricated. Nylon is not allowed.

O. Warning Ribbon:
   1. Over all underground duct banks and direct cables, install warning ribbon approximately 12-inches below finished grade and centered on direct buried cables, electrical ductbanks and conduits without ductbank encasement. Provide 6-inch wide, 4-mil thickness underground metallic-lined marking tape with red polyethylene film on top and with clear polyethylene film on the bottom. The tape shall be permanently imprinted with "CAUTION BURIED ELECTRIC LINE BELOW".
   2. Manufacturers: Provide one of the following:
      a. Brady "Identoline"; Services and Materials "Buried Underground Tape"
      b. Somerset (Thomas & Betts) "Protect-A-Line"

P. Plug and seal empty spare ducts entering buildings and structures. Install pulling tape in all empty spare ducts. Seal watertight all ducts in use entering buildings and structures in accordance with Section 16111 - Conduit.

++ END OF SECTION ++

SECTION 16141

WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Light switches, receptacles, device plates, dimmers, plug-in strips and tele-power poles.

B. Related Sections include but are not necessarily limited to:
   1. Division 0, Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 1, General Requirements.
   3. Section 01650, Commissioning and Process Start-up
   4. Section 16000, General Electrical Requirements.
   5. Section 16130, Outlet, Pull, and Junction Boxes.
   6. Section 16170, Grounding and Bonding.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. Refer to Section 16000, General Electrical Requirements.

1.3 SUBMITTALS

A. Shop Drawings:
   1. Refer to the Contract Documents and Section 16000, General Electrical Requirements.

B. Shop Drawings: Submit for approval the following:
   1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The

remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

a. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Light Switches (except explosion proof):
      a. Hubbell.
      b. Slater.
      c. P&S.
      d. Arrow Hart.
      e. General Electric.
      f. Leviton.
   2. Explosion-Proof Light Switches:
      a. Crouse-Hinds.
      b. Appleton Electric Co.
      c. Killark.
      d. Door Switches:
      e. General Electric.
      f. Slater.
      g. P&S.
      h. Arrow Hart.
      i. Micro-switch.
   3. Receptacles (except explosion proof):
      a. Hubbell.
      b. Slater.
      c. P&S.
      d. Arrow Hart.
      e. General Electric.
      f. Leviton.
   4. Explosion-Proof Receptacles:
      a. Crouse-Hinds.

b. Appleton Electric Co.
c. Killark.

5. Welding Receptacles:
   a. Crouse-Hinds.
   b. Appleton Electric Co.
6. Tele-power Poles:
   a. Wiremold.
   b. Walker.
7. Dimmers:
   a. Lutron.
   b. General Electric.
   c. P&S.
8. Plug-in Strip:
   a. Wiremold.
   b. Walker.

B. Submit requests for substitution in accordance with the General Conditions.

2.2 MATERIALS

A. Light Switches for Unclassified Areas:
1. Toggle type, quiet action, specification grade with grounding terminal.
2. Back and side wired.
3. Solid silver cadmium oxide contacts.
4. One-piece switch arm rated 20 A, 120/277 VAC.
5. UL listed.
6. Color: Ivory.
7. Wall plate: Type 304 stainless steel.
8. Type: As indicated on Drawings.

B. Receptacles for Unclassified Areas:
1. Straight blade, grounding type, specification grade.
2. Back and side wired with wrap-around bridge.
3. Rated 20 A, 125 VAC.
4. UL listed.
5. Color:
   a. For use on normal power: Ivory.
   b. For use on UPS systems: Red.
   c. For use on isolated ground systems: Orange.
6. Wall plate: Type 304 stainless steel.
7. Type: As indicated on Drawings.

C. Light Switches for Wet Areas:
1. Presswitch type, quiet action, specification grade, with grounding terminal.
2. Back and side wired.
3. Solid silver cadmium oxide contacts.

4. One-piece switch arm rated 20 A, 120/277 VAC.
5. UL listed.
6. Color: Ivory.
7. Wall plate: Gray weatherproof presswitch type.
8. Type: As indicated on Drawings.

D. Receptacles for Wet Areas:
1. Straight blade, grounding type, specification grade.
2. Back and side wired with wrap around bridge.
3. Rated 20 A, 125 VAC.
4. UL listed.
5. Color: Ivory.
6. Wall Plate: Weatherproof, cast aluminum, UL listed, WDL open and closed.
7. Type: Weather Resistant, as indicated on Drawings.

E. Ground Fault Circuit Interrupter Receptacles:
1. Straight blade, grounding type, specification grade.
2. Rated 20 A, 125 VAC.
3. UL listed.
4. Test and reset buttons.
5. Wall plate: Indoor or Weather Resistant as required.
6. Feed-through type.

F. Light Switches for Corrosive Areas:
1. Corrosion-resistant NEMA 4X enclosure with switch consisting of:
   a. NEMA 4X Stainless Steel enclosure.
   b. Stainless Steel gasketed wall plate with built-in toggle lever switch with stainless steel shaft.
   c. Grounding bushing.
   d. Rated 20 A, 125 VAC.
   e. UL listed.
   f. Type: As indicated on Drawings.
   g. Color: Yellow.
2. Optional: Corrosion-resistant enclosure and switch consisting of:
   a. Cast copper-free aluminum "FS" or "FD" ridge type hub box.
   b. Toggle type, quiet action, specification grade with grounding terminal.
   c. Rated 20 A, 125 VAC with solid silver cadmium oxide contacts.
   d. UL listed.
   e. Neoprene gasket.
   f. Cast aluminum cover with stainless steel screws and lever to activate switch.
   g. Type: As indicated on Drawings.
   h. Color: Yellow.

G. Receptacles for Corrosive Areas:
1. Corrosion-resistant straight blade, grounding type, specification grade.

2. Back and side wired with wrap-around bridge.
3. Rated 20 A, 125 VAC.
4. UL listed.
5. Color: Yellow.
6. Box: "FS" or "FD" ridge type cast hub box of copper-free aluminum.
7. Gasket: Neoprene.
8. Wall plate: Weatherproof, cast aluminum, UL listed, WDL open or closed.
9. Type: As indicated on Drawings.

H. Explosion-proof Light Switches for Use in Hazardous Areas:
1. Explosion-proof, UL listed for Class I, Division 1 and 2, Groups B, C, and D; and Class II, Division 1 and 2 areas, Groups E, F, and G.
2. EDS factory sealed.
3. Malleable iron body and cover.
4. Aluminum sealing chamber.
5. Front operated handle with stainless steel shaft.
6. Rated 20 A, 125 VAC.
7. With grounding screw.
8. Type: As indicated on Drawings.

I. Explosion proof Receptacles for Use in Hazardous Areas:
1. Explosion-proof, UL listed for Class I, Division 1 and 2, Groups B, C, and D; and Class II, Division 1 and 2, Groups F and G.
2. Factory-sealed malleable iron receptacle with spring-loaded cover.
3. Malleable iron mounting box.
4. Rated 20 A, 125 VAC.
5. "Dead-front" construction requiring plug to be inserted and rotated to activate receptacle.
6. Type: As indicated on Drawings.

J. Welding Receptacles:
1. 60 A, 480 VAC, 3-pole, 4-wire, grounding type.

K. Plug-In Strip: Surface steel raceway plug-in strip with single 15 A, 125 VAC, 3-wire grounding-type receptacles spaced 18-inch on center.
1. Prewired with two #12 TW and one #12 TW green insulated ground.
2. Minimum 1-1/4-inch wide by 3/4-inch deep.
3. Suitable fittings and snap-in cover.
4. Finish:
   a. Stainless steel.
5. Receptacle Color:
   a. For use on normal power: Ivory.
   b. For use on UPS systems: Red.
   c. For use on isolated ground systems: Orange.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Mount devices where indicated on the Drawings and as scheduled in Section 16010, Electrical: Basic Requirements.

B. Surface-mount receptacles and light switches in concrete construction.

C. In masonry and metal stud construction, recess-mount receptacles and light switches unless device precludes recessed mounting or unless otherwise noted on the Drawings.

D. Where more than one receptacle is installed in a room, they shall be symmetrically arranged.

E. Set switches and receptacles plumb and vertical to the floor.

F. Set recess-mounted switches and receptacles flush with face of walls.

G. Do not connect dimmers to loads in excess of 80% of the rating of the dimmer.

H. Provide blank plates for empty outlets.

++ END OF SECTION ++

SECTION 16142

WEATHERPROOF WHILE IN USE OUTLET ENCLOSURES

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. These Specifications encompass outlet enclosures used on outlet devices where outlets are required to be weatherproof and/or physically protected while in use or idle.

B. These safety outlet enclosures shall be used in locations where attachment plugs will be connected permanently, or for an indefinite period of time, in potentially wet or weather exposed environments.

C. They are also to be used where outlets are subject to contamination, corrosion, or damage.

1.2 DESCRIPTION

A. The safety outlet enclosure shall consist of a suitable style outlet/receptacle plate with a hinged safety cover.

B. The safety outlet enclosure shall have cord port(s) capable of allowing an appropriate size electrical cord(s) to pass through when safety cover is closed.

C. The safety outlet enclosure shall have a latching mechanism to allow the enclosure to maintain weatherproof integrity. The latch shall be a tamper resistant (locking/security) style in areas where security is needed.

D. The safety outlet enclosure shall be sufficient depth to allow full closure with attachment plug(s) in use.

1.3 SUBMITTALS

A. Products shall be submitted in accordance with Section 16000, General Electrical Requirements, and the Contract Documents, prior to installation.

B. Shop Drawings: Submit for approval the following:
   1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by

the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

2. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**

1.4 MANUFACTURER

A. Manufacturer shall be Taymac Corporation, or pre-approved equal.

PART 2 - PRODUCTS

2.1 WEATHERPROOF WHILE IN USE OUTLET ENCLOSURES

A. The enclosures shall be used in outdoor locations, where attachment plugs will be connected permanently, or for an indefinite period of time, in potentially wet or weather exposed environments, or as indicated on the Drawings.

B. They are also to be used where outlets are subject to contamination, corrosion, or damage.

C. The enclosure shall consist of a suitable style outlet/receptacle plate with a hinged safety cover, and shall be of sufficient depth to allow full closure with attachment plugs in use.

D. The enclosure shall have cord ports capable of allowing the appropriate size electrical cords to pass through when safety cover is closed.

E. The enclosure shall have a latching mechanism to allow the enclosure to maintain weatherproof integrity. The latch shall be a tamper resistant, and locking style, in areas where security is needed, as shown on the Drawings.

F. The enclosure shall be Underwriters Laboratories (UL) listed per UL Standard 514C for non-metallic boxes, flush device boxes and enclosures, and conform to

National Electric Code (NEC), Article 406.8 Paragraphs a and b, Article 110.3 and Article 110.11, pertaining to damp, wet or possible corrosive installations.

G. Body materials shall be of a flame resistant, self extinguishing, ultraviolet inhibiting, impact resistant, polycarbonate resin such as GE Lexan 943A, or Mobay Makrolon 6457. Material must meet UL Standard 94.

H. Gasket materials shall be of sufficient thickness to form a weatherproof seal under normal mounting conditions. Thicknesses; 3/16-inch for base plate and 1/8-inch for covers. Material is to be closed cell neoprene foam by Monarch Rubber A5032, or equivalent, self extinguishing and flame retardant. Material must meet UL Standard 94 HF1.

I. Mounting hardware shall be stainless steel, and of sufficient length to properly secure the device, and ensure seal to mounting surface.

J. The enclosures shall be installed over a weatherproof box and outlet in conformance with the manufacturer's instruction. Cover shall be mounted to insure that access holes for the portable line cords will be located at the lower end of the cover.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Equipment shall be installed in accordance with the manufacturer's recommendations.

++ END OF SECTION ++

SECTION 16143

TERMINAL BLOCKS

****NTS: THIS SPECIFICATION IS NOT NEEDED FOR TERMINAL BLOCKS IN CONTROL PANELS.

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. This Section covers terminal blocks for control and other wiring.

1.2 SUBMITTALS

A. Products shall be submitted in accordance with Section 16000, General Electrical Requirements, and elsewhere in the Contract Documents, prior to installation.

1.3 MANUFACTURERS

A. Terminal blocks shall be Entrelec, Phoenix Contact, Allen-Bradley, or equal.

B. Surge protection blocks shall be Phoenix Contact, Terminal or equal.

C. Power distribution blocks shall be Gould, Allen-Bradley Corporation, or equal.

PART 2 - PRODUCTS

2.1 TERMINAL BLOCKS

A. Terminal blocks shall mount on standard DIN rail, and be of the size required for conductors therein. A minimum of 25% spares shall be provided in each terminal box. No more than two conductors shall be allowed per termination. Jumper bar assemblies shall be installed for interconnecting terminal blocks, distributing power, and signal commons. Terminal blocks shall be UL rated for 600 volts and 30 amps, minimum.

B. Grounding terminal blocks shall be provided for instrumentation cable shields. The terminal blocks shall have distinctive two-color bodies, and shall be mounted to the DIN rail with metal screw down type clamps, providing a positive ground connection. One grounding terminal block shall be installed for every two instrument cables terminated. Grounding terminal blocks shall be UL rated for 600 volts, and 20 amps, minimum.

C. Terminal blocks shall be available in a variety of colors, including red, green, blue, gray, black, yellow, and orange.

D. DIN mount fuse holders shall have blown fuse indicators for DC and AC circuits. Fuse holders shall be of the compression clamp type. Fuse holders shall be UL listed and rated for 600 volts. Fuse sizes shall not exceed the UL current rating for the fuse holders.

E. DIN rail shall be prepunched, zinc bichromate plated steel. Symmetrical DIN rail shall be 35mm by 7.5mm, minimum.

F. Terminal blocks for 4 to 20 milliamp signals shall have knife disconnect switches, and accessible test points for testing and measurement of current loop signals, without the need for removing wire terminations.

2.2 SURGE PROTECTION BLOCKS (SPB)

A. Analog inputs and outputs shall be terminated at surge protection blocks (SPB). The SPBs shall be designed for a working voltage of 32 volts, and shall be fused

B. with separate terminal blocks.

C. SPBs shall provide full hybrid line to line protection, and shall have a GDT rating of 10,000 A (8/20μs pulse waveform).

D. SPBs shall be UL94 V-2 listed.

2.3 POWER DISTRIBUTION BLOCKS (PDB)

A. PDBs shall be electro-tin plated and manufactured from high strength 6061-T6 aluminum alloy.

B. PDBs shall be UL Recognized rated 90º C and CSA Certified.

C. PDBs shall provide flexibility in using the connector as an in line splice or to reduce conductor size.

D. PDBs shall be rated for 600 volts and dual rated for copper and aluminum conductor.

E. PDBs shall have the sizes and ratings as shown on the Drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Each terminal block and fuse holder shall be identified with the circuit number, or conductor number, corresponding to the identification appearing on the Shop Drawings for the equipment or system.

B. Terminal block and fuse holder markers shall be computer printed plastic-type, with permanent markings.

C. End clamps and end sections shall be installed on each terminal block and fuse holder assembly.

D. Terminal blocks for DC voltages shall be blue and AC voltages shall be gray.

++ END OF SECTION ++

SECTION 16160

ENCLOSURES

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. This Specification includes enclosures to house electrical controls, instruments, terminal blocks, and serve a junction boxes where shown on the Drawings.

1.2 SUBMITTALS

A. Products shall be submitted in accordance with Section 16000, General Electrical Requirements, and elsewhere in the Contract Documents, prior to installation.

B. Shop Drawings: Submit for approval the following:
   1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
   2. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**

1.3 MANUFACTURERS

A. Enclosures shall be manufactured by Hammond, Hoffman, Rittal, or pre-approved equal.

PART 2 - PRODUCTS

2.1 STEEL

A. Enclosures shall be fabricated from 14 gauge steel with seams that are continuously welded. Doors shall have full length piano hinges with the door removable by pulling the hinge pin.

B. A rolled lip shall be provided around three sides of the door and around all sides of the enclosure opening. The gasket shall be attached with oil-resistant adhesive and held in place with steel retaining strips. Exterior hardware, such as clamps, screws, and hinge pins, shall be of stainless steel for outdoor installations. A hasp and staple shall be provided for padlocking. Each enclosure shall have a print pocket. All wires entering or leaving the enclosure shall terminate on terminal strips. All wires and terminals shall be clearly identified as specified elsewhere in these Specifications.

C. Finish shall be white enamel interior, light gray enamel, ANSI 61 exterior, over phosphatized surfaces. Special finishes and colors shall be furnished for wet locations. Drawings should be checked for special conditions.

2.2 NEMA RATING

A. Unless otherwise indicated on the Drawings, enclosures shall be NEMA 12 for indoors and NEMA 4X for corrosive areas and outdoor installations. NEMA 4X enclosures shall be 316 stainless steel, unless noted otherwise. NEMA 4X enclosures shall also be used in wet or wash down areas.

B. Hazardous locations as indicated on plans shall be Nema 7.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Enclosures shall be installed as indicated on the Drawings and according to manufacturer's instructions.

B. Enclosures shall be properly grounded and shall include ground straps connected to hinged doors and accessories.

++ END OF SECTION ++

SECTION 16161

CONTROL PANELS

PART 1 - GENERAL

1.1 SCOPE

A. Contract Documents illustrate and specify functional and general construction requirements of the panel components and do not necessarily show or specify all components, wiring, and accessories required for a completely integrated system.

B. Provide all labor, materials, equipment, documentation including drawings and incidentals as shown on the Drawings, specified and required to design, furnish, install, calibrate, test, start-up, program, configure, commission and place into satisfactory operation all panels, intermediate termination panels and/or enclosures including panel components and instruments.

C. Conform the design and construction of panels to the specifications herein.

1.2 COORDINATION

A. Coordinate the installation of all items specified herein and required to ensure the complete and proper interfacing of all the components and systems.

B. All control loops to function as described in Section 17, Control Descriptions and depicted on the CONTRACT DRAWINGS.

1.3 DEFINITIONS

A. Intermediate Termination Panel (ITP): An Intermediate Termination Panel is any junction box that has terminals to terminate wires and no electrical or electronic powered devices. These panels act as interim termination points for field wiring to be connected to the control systems equipment. Please note that junction boxes and pull boxes are different. ITP's are sometimes referred to as junction boxes. However, pull boxes are not allowed to have any wire splicing devices, including terminal blocks.

B. Local Control Panel (LCP): A Local Control Panel is an industrial piece of equipment that contains electrical or electronic devices, in addition to wire terminals. Typically, it is a local panel connected to a specific piece of equipment to provide control and/or monitoring of that equipment. A local control panel contains voltages of 120VAC or below.

C. Motor Control Panel (MCP): A Motor Control Panel is an industrial piece of equipment that houses components for the power distribution and starting of motors. The components may include motor starters and variable frequency drives.

1.4 QUALITY ASSURANCE

A. Reference Standards: Construction of panels and the installation and interconnection of all equipment and devices mounted within also comply with applicable provisions of the following, except where otherwise shown or specified.
   1. National Fire Protection Association 79
   2. National Electrical Code (NEC) current adoption.
   3. National Electrical Manufacturer's Association Standards (NEMA).
   4. American Society for Testing and Materials (ASTM).
   5. Operational Safety and Health Administration (OSHA) Regulations.
   6. State and local code requirements.
   7. Where any conflict arises between codes or standards, the more stringent requirement applies.
   8. All panel devices shall bear the label of the Underwriters' Laboratory (UL), Inc. or be UL Recognized. Some products certified by UL are components that are intended to be used in the manufacture of a complete listed product. These components cannot bear the UL symbol, but may use a special Recognized Component Mark.
      a. The UL/UR listed number shall be documented on the Bill of Materials on the drawings.
   9. The assembled LCP's and MCP's are to be conformed to meet UL 508A requirements and labeling.

B. Panel to be designed, schematics drawn and assembled by the manufacturer. Utilize one of the following Panel Manufacturers:
   1. OTC Industrial Industries, Inc., 1881 East University Dr., Phoenix AZ 85034 (602) 437-3015.
   2. Prime Controls, 1515 W University Dr #104, Tempe, AZ 85281 – (480)-781-0220.
   3. RDC Electrical, 3411 South 44th St., Phoenix, AZ 85308 – (602) 437-0760.
   4. Vertech Industrial Systems, 4409 East Baseline Rd., Phoenix, AZ 85042, Tel: (480) 756-2300.
   5. Industrial Power Solutions (IPS), 6615 W. State Ave, Glendale, AZ 85301, Tel: (602) 466-9662

1.5 SUBMITTALS

A. General:
   1. Reference Section 01330, Submittals Procedures.
   2. Panels shall be furnished in accordance with the requirements as shown on the Drawings, and as specified in Division 16, Section 16050 and Division 17000, Sections 17456, 17453, 17460 and 1761.
   3. Generate drawing package utilizing AutoCAD versions 2022 through 2026. If utilizing a newer AutoCAD version, submit files saved at version 2022.
   4. Drawing package shall contain complete wiring and schematic diagrams, control diagrams loop drawings, a complete Bill of Material, and any other

details required to demonstrate that the system has been coordinated and will properly function as a unit. Drawings shall show proposed layout, anchorage, support and appurtenances of equipment and equipment relationship to other parts of the work including clearances for maintenance and operations.

5. Submit legible hard copies of the panel drawing package printed on 11" x 17" sheets.
6. Submit manufacturer's technical data sheets and product literature for the panel and all components utilized. Cleary identify exact equipment and material that is being supplied on the manufacturer's data sheets.
7. Submit a sample nameplate with the submittal.
8. Identify general location of all conduit entry points on the Front Elevation drawing of the documentation package.
9. Submit calculations and recommended cooling and heating load requirements.
10. Utilize the NVent Temperature Calculation tool at: https://www.nvent.com/en-us/hoffman/climate-control-selection-tool.
11. Submit location and tube routing details for air conditioner drain line. Coordinate drain location with ENGINEER.

B. Shop Drawings: Submit for approval the following:
   1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
   2. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**

1.6 O&M MANUALS

A. Comply with the requirements of Section 01730, Operation and Maintenance Data.

B. Provide an electronic copy of the panel drawing package on a separate CD. Panel Drawings are to be provided electronically in AutoCAD version 2004 through 2008. If utilizing a newer AutoCAD version, submit files saved at version 2008.

1.7 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Comply with manufacturers requirements for Transportation and Handling of Materials and Equipment.

B. Comply with manufacturers requirements for Storage of Materials and Equipment.

C. Provide a hard copy of the panel drawings, size 11" x 17", inside the panel upon delivery.

PART 2 - PRODUCTS

2.1 PANEL ENCLOSURES

A. General:
   1. Conform panels and enclosures to the NEMA requirements as stated in Specification 16160, Enclosures.
   2. All outdoor panels shall be provided with sunshade structures. Sunshade structures shall be constructed as shown on CONTRACT DRAWINGS.
   3. Sizes shown on contract drawings are estimates. Furnish panels and enclosures sized to house all equipment, instruments, front panel mounted devices, power supplies, power distribution panels, wiring and other components installed within.
   4. Size the panel to provide 20% spare free space capacity.
   5. Use stainless steel fasteners throughout.
   6. Provide interior mounting panels and shelves constructed of minimum 12 gage steel.
   7. Provide 12"x12' print pocket in panels with a 24" or larger door. Mount on inside door where no door mounted devices are located. If there is not enough room for a 12"x12" print pocket, provide a sized pocket to fit available room.
   8. Provide enclosure mounting supports as required for floor, frame, or wall mounting. Indoor wall mount panels utilizing stainless steel unistrut. Outdoor wall mount panels utilizing PVC-coated Unistrut.

B. Construction Features:
   1. General Construction Features - Provide the following convenience accessories inside of each panel.
      a. One or more 120 VAC light fixtures with a minimum 40 watt lamp or LEDs with a snap switch for on/off control.
      b. Provide grounding studs or lugs for metal panels and doors.

c. Provide all electrical components and devices, support hardware, fasteners, and interconnecting wiring required to make the panels and/or enclosures complete and operational.
d. Provide oil resistant gasket completely around each door or opening.
e. For panels located in the field or outdoors that have door mounted devices which do not meet the NEMA rating for the area, provide a window kit that includes a hinged door with a clear plastic window and an oil resistant gasket to encompass all non-NEMA rated panel instruments for this area.
f. Provide full height doors.
g. Provide panels with no extra holes or knockouts unless shown on Contract DRAWINGS.

C. Environment:
1. General:
a. Provide the following panel(s) with an air conditioner, heat exchanger or ventilation fan based on the submitted calculations for cooling and/or heating load requirements.
1) As Required by cooling and/or heating calculations.
b. Provide a heater for all panels located outdoors to maintain a minimum temperature of 68°F.
c. Provide a separate supplementary protector for the cooling or heating equipment.
d. Provide thermostats to automatically control heating and cooling requirements.
e. Provide a high temperature switch, for alarm purposes, in all panels that require air conditioners, heat exchangers or ventilation fans. The contact shall be wired to alarm to the Process Control Information System.
1) Products and Manufacturers:
a) Hoffman ATEMNC.
b) or pre-approved equal.
2. Air Conditioner:
a. Coordinate utilization of air conditioners with the ENGINEER.
b. Provide an automatically controlled closed loop air conditioner with filtered and adjustable air louvers to maintain temperature inside each enclosure below the maximum operating temperature rating of the lowest rated component.
c. Provide a condensation drain line for each air conditioner.
d. Coordinate space requirements for maintenance.
e. Provide NEMA 4X for outdoor locations.
f. Coat heating and cooling elements including external housing that are in contact with Plant's ambient environment with Heresite, or pre-approved equal, for protection from hydrogen sulfide corrosion with hydrogen sulfide levels up to seven ppm.
1) Coordinate application of coating with the ENGINEER.
g. Product and Manufacturer:
1) Hoffman Spectracool or Protec series.

3. Heat Exchanger:
    a. Coordinate utilization of heat exchangers with the ENGINEER.
    b. Provide an automatically controlled heat exchanger to maintain temperature inside each enclosure below the maximum operating temperature rating of the lowest rated component.
    c. Coordinate space requirements for maintenance.
    d. Products and Manufacturers: 1) Hoffman.
4. Ventilation Fan:
    a. Coordinate utilization of ventilation fans with the ENGINEER.
    b. Provide automatically controlled ventilation fans with filter to maintain temperature of indoor enclosures below the maximum operating temperature of the lowest rated component.
    c. Products and Manufacturers: 1) Hoffman. 2) or pre-approved equal.
5. Heater:
    a. Provide adequately sized automatically controlled 120 VAC heaters to maintain temperature inside each enclosure above 40°F to a maximum of 80°F when the outside temperature is 0°F through 40°F.
    b. Maintain a minimum four inch clearance or minimum clearance recommendations from the manufacturers from any device.
    c. Product and Manufacturer: 1) Hoffman. 2) or pre-approved equal.

D. Identification:
1. Provide laminated plastic nameplates with a white background and black lettering for identification of panels and components.
2. Construct nameplates with 1/16” plastic and with beveled edges.
3. Nameplate Mounting:
    a. Indoor panels: Mount nameplates to the panel utilizing glue.
    b. Outdoor panels: Mount nameplates to the panel utilizing glue and with two self-sealing ¼” stainless steel screws by APM Hexseal.
    c. Glue Product and Manufacturer:
        1) Gorilla Glue.
        2) or pre-approved equal.
        3) Provide nameplates according to Table 2.1.C.5 and Section 3.1.B:

Nameplate Specifications			
Type	**Size**	**Font**	**Font Size**
Manufacturer Nameplate	*1½” x 6”	Arial	1/8“
Panel Nameplate	*2” x 7”	Arial	1/2“
Device Nameplate	*1½”x 2½”	Arial	3/16“

Table 2.1.C.5 Nameplate Specifications

* This is a minimum height size requirement. Size nameplates large enough to display the information required to clearly identify the panel.

2.2 PANEL DEVICES

A. General:
   1. Provide DIN rail mounted devices where practical.
   2. All devices mounted on the exterior of the panel shall match the NEMA rating of the panel.

B. Internal Component Labeling:
   1. Provide a device label for devices mounted inside the panel that conforms to the criteria below:
      a. Instruments: Provide label with the instrument loop number as shown on the CONTRACT DRAWINGS. Place label below the instrument on the backplane.
      b. Supplementary Protector: Label each supplementary protector with CB and the number assigned in the supplementary protector schedule. Place label on the backplane.
      c. Fuses: Label each fuse with FU and the number assigned in the fuse schedule. Place a label on the backplane that includes the fuse number and the fuse size.
      d. Control Relays: Label each relay with CR and the number assigned in the panel drawings. Place label below the relay on the backplane.
      e. Terminal Strips: Label each terminal strip with the terminal strip type. (ex. TB1, TB2, ATB). Place label above the terminal block or at first terminal on the backplane.
      f. Door Mounted Devices: Provide a label on the interior of the front panel door for every panel device. The label should contain the same information as shown on the front panel nameplate. Place the label below the device.
      g. Wireway Covers: Label wireways with the voltage that is being routed through it. For example; “24 VDC” for DC voltage or “120VAC” for AC voltage. Place label on wireway cover. Coordinate label size to fit on wireway cover.
      h. Identify internal components with permanent adhesive plastic labels.
         1) Product and Manufacturer:
            a) Brady USA Inc.
            b) or pre-approved equal.
         2) Provide device label size and fonts per Table 2.2.B.1:

Device	Label Size	Font Size	# Points	Brady Part #
(Wireways) 24VDC	1”x 4”	Arial	48 Points	PTL-42-422
(Wireways) 120VAC	1”x 4”	Arial	48 Points	PTL-42-422
Misc. Device Labels	1”x 1”	Arial	16 Points	PTL-19-423
Panel Door Devices	1” x 1.5”	Arial	8 Points	PTL-31-423

Table 2.2.B.1 Panel Interior Device Label

C. DIN Rail:
   1. General: DIN rail is the metal rail used to mount various electrical components in a panel.
   2. Mount all internal components on DIN Rail.
   3. DIN Rail for terminal blocks shall be raised DIN rail to match the height of the wireways.
   4. Product and Manufacturer, Provide one of the following:
      a. Phoenix Contact.
      b. or pre-approved equal.

D. Control Circuit – Supplementary Protectors:
   1. Provide single pole supplementary circuit protectors with the following features, 120 Volt AC, DIN rail mounted and UL 1099 listed with auxiliary contacts.
   2. Provide end caps, marking strips, insulated side jumpers and other accessories.
   3. Product and Manufacturer, Provide one of the following models where “xx” is the appropriate rating.
      a. Phoenix Contact, TMC 1-M1-xxA.
      b. Allen-Bradley, 1492-SP1Bxxx.
      c. Idec, NRC-11-0-L-xxA-AA.

E. Air Conditioner or Heater Supplementary Protectors:
   1. Provide supplementary protectors with the following features, 120 Volt AC, DIN rail mounted and UL 489 listed with auxiliary contacts.
   2. Product and Manufacturer, Provide one of the following:
      a. Allen-Bradley, Bulletin 1489.
      b. or pre-approved equal.

F. Control Relays:
   1. Type: General purpose, plug-in socket base type rated for continuous duty.
   2. Construction Features:
      a. Coil Voltages: 120 VAC.
      b. Contacts:

1) Silver cadmium oxide rated not less than ten amperes resistive at 120 VAC or 28 VDC continuous.
2) For switching low energy circuits (less than 200 ma) fine silver, gold flashed contacts rated not less than three amperes resistive at 120 VAC or 28 VDC continuous shall be provided.
3) Number of contacts:
a) Minimum: Two double pole/double throw contact sets
b) Maximum: Four double pole/double throw contact sets.
c) Socket type to be blade.
d) Relay Enclosure: Dust-proof plastic enclosure.
e) Relays shall have an LED indicating lamp to show energized state.

3. Product and Manufacturer: Provide one of the following:
a. Type R and/or Type K, as manufactured by Square D Company.
b. Type RH and/or Type RY, as manufactured by IDEC.
c. Potter & Brumfield.

G. Time Delay Relay:
1. Type: Dial adjustable, plug-in type time delay relay providing delay-on-make, delay-on-break one shots or interval operation.
2. Construction Features:
a. MOS digital circuit with transformer coupled power.
b. Switch selectable ranges.
c. Minimum Setting: Three percent of range; except 50 ms for one second range.
d. Contacts:
1) Type: DPDT.
2) Rating: Seven amps resistive at 120 VAC, seven amps at 24 VDC.
e. Housing:
1) Plug-in design with dust and moisture resistant molded plastic case.
f. Power Input: 120 VAC.
3. Product and Manufacturer: Provide one of the following:
a. Manufactured by Automatic Timing and Controls Company.
b. Manufactured by IDEC.

H. Selector Switches, Pushbuttons and Indicating Lights:
1. General:
a. Selector switches, pushbuttons and indicating lights shall be supplied by one manufacturer and be of the same series or model type.
b. Type: 30mm, Heavy duty industrial, oil tight, corrosion resistant, with interchangeable pilot lights, plug-in construction, double break silver contacts, chrome plated lock rings, and modular contacts.
c. Mounting: Flush mounted on panel front, unless otherwise noted.
d. NEMA rated to match panel in which mounted.

e. Provide individual legend plates for indication of switch, pushbutton, and light function (e.g., Open, Closed, Hand-Off-Auto). A list shall be submitted for review and approval.

I. Selector Switches:
   a. Type: Provide selector switches with number of positions as required to perform intended functions as shown on the Drawings and as specified.
   b. Contacts:
      1) Provide number and arrangement of contacts as required to perform intended functions specified, but not less than one double pole, double throw contact per switch.
      2) Type: Double break, silver contacts with movable contact blade providing scrubbing action.
      3) Rating: Compatible with AC or DC current with devices simultaneously operated by the switch contacts, but not less than ten amperes resistive at 120 volts AC or DC continuous.
   c. Switch Operator: Standard black knob.

2. Pushbuttons (Standard or Illuminated):
   a. Momentary Type: Provide momentary, booted type pushbuttons as required to perform intended functions specified and shown on the Drawings. Boot color to be red for stop buttons and black for other functions.
      1) Provide extended head pushbuttons for all stop functions. 2) Provide flush head pushbuttons for all other functions.
   b. Maintained Type: Provide maintained, push/pull, "Mushroom" type, red in color, to perform intended functions as specified, and as shown on the drawings.
      1) Emergency Stop button shall be red and the base of the button shall be yellow.
   c. Contacts: Comply with the requirements specified for selector switches.
   d. Lock-out: Provide locking mechanism for all lock-out functions.

3. Indicating Lights:
   a. Type: Compact, integral non-transformer type.
   b. Lamps: 120 VAC, high-intensity LED type (20,000 hours minimum). Indicating lights shall have clear lenses and LED lamps colored as shown on the Drawings.
   c. Common, push-to-test circuitry shall be provided for each panel to simultaneously test all indicating lights on the panel using a single pushbutton when there are 10 or more lights on the panel. Control panels with less than 10 lights shall utilize individual push-to-test lights and control circuitry.
   d. Button and Lamp Colors:
      1) Red for indication of open, on, or running.
      2) Green for indication of closed, off (ready), or stopped.
      3) YELLOW for indication of equipment malfunction, process trouble or alarms.

4) White for indication of electrical control power on.

4. Rotary Cam Switches:
   a. Provide rotary cam switches with number of positions and poles as required performing the signal switching function specified and shown on the Drawings.
   b. Contacts:
      1) Gold-flashed contacts housed in mechanical contact blocks with number and arrangement of contacts as required performing intended function.
      2) Contact Rating: Compatible with AC or DC through-put current of signals and devices simultaneously operated by the switch contacts, but not less than 20 amperes at 600 VAC or 250 VDC continuous.
   c. Switch Operator: Standard black knob.
5. Product and Manufacturer: Provide one of the following:
   a. Square D.
   b. Allen-Bradley Co.
   c. Eaton.

J. Potentiometer:
   1. Type: Industrial potentiometer operator, direct acting, 3/4 to full turn; and standard 3-wire potentiometer.
   2. Required Features:
      a. NEMA rated to match panel in which mounted.
      b. Resistance Range: 0 to 10,000 Ohms.
      c. Resistance Element: Wire wound or conductive plastic.
      d. Power Rating: Two watts.
      e. Mounting: Flush mounted on panel front, unless otherwise noted.
      f. Provide legend plate for indication of position (0 to 100 percent).
   3. Product and Manufacturer: Provide one of the following:
      a. Square D.
      b. Allen-Bradley Co.
      c. Eaton.

K. Power Supply:
   1. General:
      a. Panel power supply source, type, voltage, number of circuits and circuit ratings shall be as shown on the Contract Drawings.
      b. Panels shall be provided with an internal 120 VAC with number of circuits and separate supplementary protectors sized as required to distribute power to the panel components.

L. 24VDC Power Supplies:
   1. General:
      a. Single unit and multiple unit power supplies, located in panels, as required.
      b. Single Unit Required Features:

1) Solid state circuitry.
2) Surface mounting.
3) Input Power: 120 VAC, ± 10 percent, 60 Hz.
4) Output Power: 24 VDC or as required.
5) Line/Load Regulation: 0.05 percent.
6) Ripple: 0.25 mv RMS.
7) Overload Protection: Internal preset or fused.

2. Product and Manufacturer: Provide one of the following:
   a. Acopian Corporation.
   b. Power One.
   c. Lambda.
   d. Sola.
3. If redundant power supplies are required: Provide one of the following:
   a. Lambda DPL-PU/E.
   b. Phoenix Contact Quint-Diode/40.
   c. Puls.
   d. or pre-approved equal.

M. Wire:
1. General:
   a. Provide internal wiring of Type MTW stranded copper wire with thermoplastic insulation with no nylon jacket rated for 600 V at 90°C for single conductors.
   b. No utilization of Type THHN for panel wiring.
   c. For DC panel signal wiring, use #16 AWG shielded minimum.
   d. For AC power wiring, use #14 AWG minimum. For AC signal and control wiring, use #16 AWG minimum. For wiring carrying more than 15 amps, use sizes required by NEC and NFPA 79 Standards.
   e. Identify wires at each end using heat shrink labels with permanent number codes using current Brady printer (M511/M611/BMP71), or approved equal.
   f. Panels conform to the wire color code as shown in Table 2.2.K.1.f Wire Color Code and NFPA 79 Standards.
2. Product and Manufacturer: Provide one of the following:
   a. Carol.
   b. Belden.
   c. Anixter.

(The remainder of this page intentionally left blank)

WIRE COLOR CODE TABLE (Inside Panels)			
TYPE	**FUNCTION**	**INSULATION COLOR**	**WIRE SIZE**
AC POWER - HOT	120VAC	**BLACK	#14
AC POWER - NEUTRAL	120VAC	WHITE	#14
AC GROUND	120VAC	GREEN	#14
AC CONTROL	120VAC	**RED	#16
ISOLATED DC GROUND	GROUND	GREEN W/YELLOW	#16
DC POWER	SOURCE	BLUE	#16
DC POWER	COMMON	WHITE /BLUE	#16
CONTROL	FOREIGN VOLTAGES	YELLOW	#16
LOW VOLTAGE AC	24 VAC SOURCE	BROWN	#16
LOW VOLTAGE AC	24 VAC COMMON	BROWN W/WHITE	#16
*AC POWER	480 VAC PHASE A	BROWN	Size to FLA
*AC POWER	480 VAC PHASE B	ORANGE	Size to FLA
*AC POWER	480 VAC PHASE C	YELLOW	Size to FLA
TEMPORARY	TEMPORARY	PURPLE	Size to FLA

Table 2.2.K.1.f Wire Color Code * - For Motor Control Panels (MCP's) that are permitted to contain 480 VAC

** - Black 120 VAC wires are hot unless powered down via supplementary circuit protector. Red 120 VAC wires are hot based on the control logic state.

N. Single Shielded Pair Cable:

1. Tinned copper, nineteen strand, PVC insulated conductors, No. 16 AWG minimum, twisted with aluminum-polyester shield, stranded tinned 16 AWG copper drain wire and PVC black or gray outer jacket. Wire conductor colors shall be black (-neg) and red (+pos). 600 Volt Tray Cable (TC) rated.
2. Product and Manufacturer: Provide one of the following:
    a. Belden Company (No. 9342).
    b. Okonite Company.
    c. Dekoron Wire and Cable Company.

O. Wire Terminations:
1. Terminate all field and internal component wiring using insulated ferruled connectors attached with manufacturer's recommended tool.
2. Excessive stripping of the wire so as to allow bare wire outside the insulated ferrule is not permitted.
3. Utilize insulated double ferruled connectors wherever two wires terminate on the same terminal block connection.
4. Product and Manufacturer: Provide one of the following:
    a. Phoenix Contact – Clipline.
    b. Thomas & Betts.
    c. Weidmuller.

P. Terminal Blocks:
1. General:
    a. Numerically code terminals utilizing terminal block manufacturer's marking system. Information must be printed directly on the terminal label. Sticky back labels are not permitted.
    b. Terminal blocks must be DIN rail mountable with screw clamp connections. Spring cage connections are not permitted.
    c. Double level terminal blocks are permitted for use with signals on Analog Terminal Block (ATB) only.
    d. Terminals used for analog signals on ATB shall be colored blue.
    e. Terminal block jumpers must be connected via screw clamp. Screw clamped comb jumpers are permitted. Plug in jumpers are not permitted.
2. Product and Manufacturer: For each terminal strip type provide one of the following:
    a. Power Terminal Block (PTB).
        1) Phoenix Contact, Type UK 5 N, Color Gray, Model # 30 04 36 2.
        2) Allen Bradley, Type 1492-J4, Color Gray, Model # 1492-J4.
        3) Weidmuller, Type WDU 4, Color Dark Beige, Model # 1020100000.
    b. Field Wiring Discrete Signal Terminal Blocks (TB1 and TB2).
        1) Phoenix Contact, Type UDK 3, Double Connection, Color Gray, Model # 27 75 37 5.
    c. Weidmuller, Type WDK 2.5V, Double Connection, Double Level, Internal Connection, Color Dark Beige, Model # 1905060000.
    d. Field Wiring Analog or Internal Wiring DC Power (ATB) - Single Level Terminal Blocks:

1) Phoenix Contact, Type UK 3N BU, Color Blue, Model # 30 01 51 4.
2) Allen Bradley, Type 1492-J3-B, Color Blue, Model # 1492-J3-B.
3) Weidmuller, Type WDU 2.5 BL, Color Blue, Model # 1020080000.

e. Field Wiring Analog or Internal Wiring DC Power (ATB) - Double Level Terminal Blocks. Alternating double and single level ATB terminal blocks are permitted.
1) Phoenix Contact, Type MBKKB 2,5 BU, Double Level, Color Blue, Model # 27 71 09 4.
2) Allen Bradley, Type 1492-JD3-B, Double Level, Color Blue, 3) Model # 1492-JD3-B.
3) Weidmuller, Type WDK 2.5 BL, Double Level, Color Blue, 5) Model # 1021580000.

Q. Surge Protection:
1. Provide DC surge protection with integrated varistor for all analog signal loops that are terminated to Programmable Logic Controllers.
2. Provide maintenance free, self-restoring surge protection to protect the electronic instrumentation system from surges propagating along the signal and power supply lines. Device shall be removable without interrupting the circuit.
3. Provide a separate surge protector for the positive and a separate surge protector for the negative polarity of each loop.
4. Mount the surge protectors on the ATB.
5. Ground the surge protectors to the panel DC ground bus.
6. Label the surge protectors in sequential order starting with the ATB signals.
7. Required Features:
a. Amp Rating: Compatible with working voltage and current of device being protected.
b. Voltage Rating: Compatible with the working voltage of protected device.
c. Reaction Time: nanosecond range.
8. Product and Manufacturer: Provide one of the following:
a. Phoenix Contact.
b. Advanced protection Technologies.
c. EDCO.
d. or pre-approved equal.

R. Wireways:
1. General:
a. Mount wireways using stainless steel bolts. Drill and tap the sub-panel to accommodate the bolts.
b. Color to be Gray or White throughout the entire panel. Provide only one color.
c. All wireways to include cover.
d. Wireway covers to be labeled as per section 2.2.B.
2. Product and Manufacturer: Provide one of the following:
a. Panduit.

b. Thomas & Betts.
c. or pre-approved equal.

S. Alarms:
1. Audible alarms shall be UL listed, 120VAC, with solid state circuitry, vibrating horn, non-metallic corrosion resistant housing, with required mounting hardware, suitable for outdoor use capable of producing 100 dB at 10 feet. The audible alarm shall be manufactured by Federal Signal model 350, Edwards Model 878-EX, or pre-approved equal.
2. Rotating beacons for interior and/or exterior locations shall be UL listed, 120VAC, with motor and cooling fan, rotating lights at 60 times per minute minimum, capable of producing 36,000 candlepower with required mounting hardware. Lens color shall be verified at the time of construction. The rotating beacons shall be manufactured by Federal Signal Model 27XST or pre-approved equal.
3. Rotating beacons for corrosive and/or hazardous locations shall be UL listed, 120VAC, with solid state circuitry, rotating lights at 60 times per minute minimum, suitable for outdoor use capable of producing 36,000 candlepower with required mounting hardware. Lens color shall be verified at the time of construction. The rotating beacons shall be manufactured by Edwards Model 52EX, or pre-approved equal.
4. Strobe beacons shall be UL listed, NEMA 4X, 120VAC, flashing at 80 times per minute minimum, producing peak candlepower of 520,000, effective candlepower of 165, with required mounting hardware. Lens color shall be verified at the time of construction. The rotating beacons shall be manufactured by Federal Signal model 224XST, 225XST, or pre-approved equal.

T. Intrinsically Safe Barriers:
1. Intrinsic safety barriers shall permit connection of devices located in a hazardous area to other devices located in a safe area. Intrinsic safety barriers shall be EMC compliant, 10 to 35VDC, 35mA output current, hazardous area terminals identified by blue labels, terminals accommodating conductors up to 12AWG, ambient temperature rating of -20° C to +60° C. The intrinsic safety barriers shall be manufactured by Eaton MTL, Ronan Engineering Co., R. Stahl Inc., A.T.C., or pre-approved equal.

U. Elapsed Time Meters and Time Clocks:
1. Elapsed time meters shall be self powered, non-reset, solid state counter which provides silent, accurate and noise immune operation. Elapsed time meters shall require no external power, five year minimum battery life, 120VAC power, accessories for panel mounting, nameplate below LCD display reading "HOURS", liquid crystal display with 6 digits approximately 2-inches high with 50,000 hour minimum display life and indication of sufficient battery power. The elapsed time meters shall be manufactured by Redington/Trumeter, or pre-approved equal.

2. Time clocks shall be microprocessor based, have 24 hour time control, up to 24 operations per day, programmable from panel face keys, skip-a-day feature allowing schedule to be skipped for one to seven days, SPDT switch contact rated at 15 amps at 120VAC, with battery carryover to maintain time and program during power outage for 275 hours. The time clocks shall be manufactured by Intermatic, or Tork EWZ series, or pre-approved equal.

V. Motor Starters and Overload Relays:
   1. Refer to Specification Section 16480, Motor Controllers.

PART 3 - PEXECUTION:

3.1 EXTERIOR PANEL:

A. Component Layout:
   1. Arrange associated control and indication devices for a particular part of the process in close proximity to each other.
   2. Mount indicating lights above control switches and push buttons.
   3. Standard component spacing is 3 ½" center to center and 3 ½" above and below. It is acceptable to use more space if required, but spatial consistency must be maintained.
   4. Maximum height for panel exterior-mounted devices is 6'-0" from the floor. Minimum height for panel exterior-mounted devices is 3'-0" from the floor.
   5. Locate alarm horn at the top of the panel. The alarm horn may be located above 6'-0" device height limitation.
   6. Unless otherwise noted; route field wiring through the bottom of the enclosure. Provide watertight conduit openings.

B. Exterior Panel Nameplates:
   1. General:
      a. Refer to Section 2.1.D for material and size requirements.
      b. Provide specific panel identification on nameplates derived from the contract specifications and drawings.
      c. Obtain ENGINEER approval for panel identification for panels that are not identified in the contract specifications and drawings.
   2. Panel Manufacturer Identifier and Power Requirements Nameplate (NP-1):
      a. Mount nameplate in the upper left corner of the panel front.
      b. Provide the following information for each circuit feeding the panel:
         1) The first line indicates the name of the manufacturer, location and phone number of who assembled the panel.
         2) The following lines:
            a) Include panel voltage, current, phase, frequency, short circuit current rating for each panel feed.
            b) Provide switchboard name and circuit number for each circuit feeding the panel.
            c) Refer to figure 3.1.B.2.

WILSON & Sons, CHANDLER, AZ 85226 - (480) 555-1234
120 VAC, 0.5 AMPS, 1Ø, 60HZ, SCCR 5KA, FED FROM LP-34, CIRCUIT 6

120 VAC, 7.5 AMPS, 1Ø, 60HZ, SCCR 8KA, FED FROM LP-34, CIRCUIT 8

Figure 3.1.B.2
Panel Manufacturer Identifier and Power Requirements Nameplate (NP-1)

3. Panel Identification Nameplate (NP-2)
   a. Mount panel identification nameplate in the top, center of the panel.
   b. Provide the following information:
      1) The first line of text is an abbreviation of the panel as shown on the CONTRACT drawings.
      2) The second line of text on the nameplate is used to spell out the process abbreviation.
      3) Refer to figure 3.1.B.3.

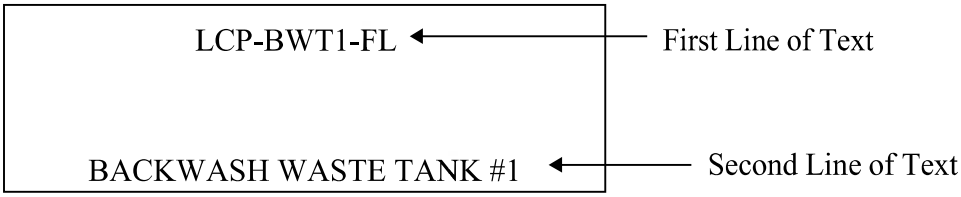


Figure 3.1.B.3

Panel Identification Nameplate (NP-2)

4. Panel Component Nameplates
   a. Mount nameplates above all control and indicating devices.
   b. Provide the following information:
      1) The first line indicates the instrument device loop identifier and number as shown on the DRAWINGS.
      2) The second line identifies the system equipment that the component is associated with.
      3) The third line identifies the control position, condition of the equipment or the alarm state being monitored.
      4) Refer to figure 3.1.B.4.

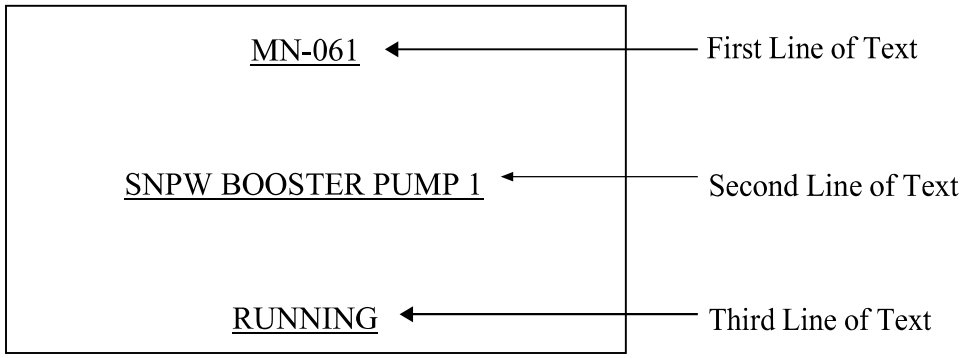


Figure 3.1.B.4
Panel Component Nameplates

3.2 INTERIOR PANEL

A. General:
   1. All Wall Mounted Panels - Where conduit enters the panel, maintain a minimum of 4" clearance from any device or wireway to allow room for routing of field wiring.
   2. Concrete Pad or Floor Mounted LCP's and MCP's – Where conduits enter the panel through the concrete pad, maintain a minimum of 6" clearance from any device or wireway to allow room for routing of field wiring. Where conduit enters the panel sides or top, maintain a minimum of 4" clearance from any device or wireway to allow room for routing of field wiring.
   3. Elevated Floor Mounted LCP's and MCP's - Where conduit enters the panel, maintain a minimum of 4" clearance from any device or wireway to allow room for routing of field wiring.
   4. Concrete Pad, Floor Mounted or Elevated Floor Mounted ITP's - Where conduits enter the panel through the top or bottom, maintain a minimum of 6" clearance from any device or wireway to allow room for routing of field wiring.
   5. Locate and install all devices and components so that connections can be easily made and that there is ample room for servicing each item.
   6. Maintain a minimum 2'0" clearance between components mounted on side panels and components mounted on the opposing side panel.
   7. Components mounted on the back panel are to be unobstructed by any components mounted on side panels.
   8. Adequately support and restrain all devices and components mounted on or within the panel to prevent any movement.

B. Panel Incoming Power:
   1. Panel power fed from lighting panels, or other sources with fused or circuit breaker protection, shall be wired to the Power Terminal Blocks (PTBs). Power sources entering the panel are to be provided with a separate neutral and

ground. The PTBs shall have a separate terminal for the hot and neutral for each circuit. The ground to be terminated to the AC ground bar.

2. Mount the PTBs near the top left corner of the panel.
3. Multiple power sources may be required for each panel. Power requirements are identified on the CONTRACT DRAWINGS. The following additional power sources may be required for the panel.
   a. Control Logic Power and Light Fixture.
   b. Air Conditioning.
4. Arrange the terminal strip in an orderly manner with circuit conductors grouped together. For instance, terminate the hot and neutral conductors on consecutive terminals. Label terminals and internal wiring as H1 and N1 (Control Logic), H2 and N2 (Air Conditioning). Identify each additional source in sequential order beginning with H3 and N3.
5. Terminate all incoming power on one side of the terminal strip.

C. AC Power Distribution:
   1. Identify the wire extending from the PTB to the supplementary protector as H1 and H2, etc. Using H1 as an example; the wire terminated to the line side of the supplementary protector is labeled H1, the wire terminated to the load side of the supplementary protector is labeled as L1-1.
   2. If L1-1 passes through an additional supplementary protector to feed panel components, this supplementary protector can be shown on the drawings in a horizontal or vertical position on a schematic rung and the wire terminated to the line side of the supplementary protector is labeled L1-1. The wire terminated to the load side of the supplementary protector is labeled L1 – (the Supplementary Protector #) and the wire color is black.
   3. If the panel controls multiple pieces of equipment, such as two pumps with separate control circuits, provide a supplementary protector for each control circuit.
   4. Powering 120 VAC field 4-wire instruments from the panel is not permitted.

D. DC Power Distribution:
   1. Mount DC power supplies near the top right of the panel. Mount fuses associated with the power supply in close proximity to the power supplies.
   2. Identify terminals used for DC power distribution as PTB-DC.
   3. Provide a fuse for each analog loop that loop power is provided by a power supply located in the panel.

E. Grounding:
   1. AC Ground:
      a. Provide the AC ground bus bar with cage type or screw terminals installed near the bottom of the back panel with extended mounting bolts.
      b. Provide adequate metal to metal contact between the AC ground bus bar and the back plane.
      c. Connect all AC power sources and devices to ground at this ground bus.
      d. Connect all panel enclosure doors to the AC ground bus.

e. Connect all side panels to the AC ground bus.
f. Provide a connection point on the ground bus for connection to the ground grid system.

2. DC Ground:
   a. Install the isolated DC grounding bus bar with cage type or screw terminals installed near the bottom of the back panel at a minimum distance of 6” from the AC ground bus.
   b. The isolated grounding bus bar consists of two non-conductive mounting blocks with a single copper grounding bar attached between them.
   c. Connect all shields (SH) requiring loop grounding in the panel from the analog signal terminals to the DC grounding bus bar.
   d. To avoid ground loops, connect analog cable signal shields to ground at one location only, preferably in the LCP, MCP or ITP; not in the field. Maintain consistency for the termination point of signal shield for all analog signals.
   e. Provide a connection point on the ground bus for connection to the ground grid system.
   f. Figure 3.2 illustrates a typical ground system within a panel. The illustration depicts the physical terminations of the ground wires in the panel. Ground Conductor AWG size to ground grid system shall be as stated in Specification 16170, Grounding and Bonding.

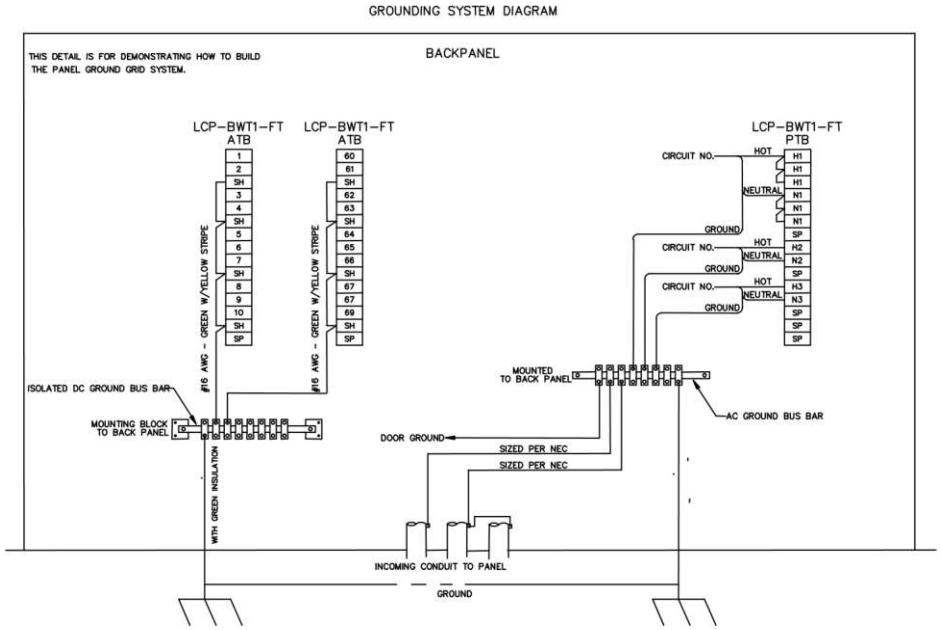


Figure 3.2 Typical Grounding Systems

F. Circuit Protection:
   1. Provide an isolating supplementary protector for each group of control logic. For example: the start, stop and reset control circuit for Pump #1 has a

dedicated supplementary protector supplying power to the control logic. Pump #2 requires a separate isolating supplementary protector for the control logic.

2. Provide an isolating supplementary protector for each component requiring 120 VAC power.
3. A supplementary protector is not required for control circuits powered from a fused control power transformer in an MCP.
4. Size supplementary protector to handle the connected load.
5. Mount supplementary protector next to the PTBs near the top left corner of the panel.
6. Provide an auxiliary contact for each supplementary protector. Wire each auxiliary contact from the supplementary protector in series to one "Power fail' relay. Send one Power Fail status to the Process Control Information System.

G. Internal Panel Wiring:
   1. Route all internal wiring using wireways. Terminate all internal wires on one side of the terminal blocks. The opposite side of the terminal block shall remain available for field wires.
   2. Where wires pass through panel walls, provide suitable bushings to prevent cutting or abrading of insulation.
   3. Adequately support and restrain all wiring runs to prevent sagging or other movement. Wires extended from the control logic to the panel door devices are to be wrapped in plastic protective wire wrap designed for this purpose.
   4. Wire splicing is not allowed at any time.
   5. Utilize two wires (hot and return leg) with field wiring for each field input. It is not acceptable to utilize one common Hot for multiple field inputs.
   6. Terminate wires with a non-insulated ferrule type crimp connector. Excessive stripping of the insulation to allow bare wire strands between the insulation and the ferrule is not permitted.
   7. Orientate wire labels on the individual conductor or cable so that wire labels are legible without having to twist or move the connectors. Securely heat shrink the labels around the conductor. Label wires or cables with the number assigned in the panel documentation. Refer to Section 2.2.K.1.e for wire label materials.
   8. DC wiring for analog and discrete field or Process Control Information System signals that enter or leave the panel are to be terminated on the Analog Terminal Block (ATB).
   9. AC wiring for discrete field signals that enter or leave the panel are to be terminated on the Terminal Block 1 (TB1).
   10. AC wiring for discrete Process Control Information System signals that enter or leave the panel are to be terminated on Terminal Block 2 (TB2).
   11. The terminal blocks (TB1, TB2 or ATB) can be mounted on the left or right side panels.
   12. Provide a minimum of 10% spare terminal DIN rail space per terminal strip.
   13. Signals from the field that enter the panel and only pass through the panel from the field to the Process Control Information System require internal wiring from TB1 to TB2.

14. Arrange all control wiring associated with a particular piece of process equipment together on adjacent terminal blocks.
15. Identify wire number by the schematic rung numbers. Label TB1 and TB2 terminals with the rung number associated with the internal wire number connected to the terminal. Label ATB terminals in sequential order starting with the number 1. Identify analog shield terminations with an "SH" on the terminal block.
16. Multi-conductor cables of two pair or more shall have the outer cable insulation removed before entering the wireway.
17. Route all DC power and analog signals at a minimum of six inches from AC power and controls. When the six inch minimum distance is not available, provide a metallic barrier that extends 3" beyond the tallest wireway between the analog and discrete wireways.

H. Wireways:
1. Mount wireways from the internal panel components and terminal blocks with a minimum 2" spacing.
2. Arrange wireways to maintain a six inch minimum distance between analog and discrete circuit wiring.
3. Provide wireways for all field wiring. Arrange wireways to allow field wiring to enter from the top or bottom of the panel.
4. Align wireways between back and side panels.
5. Install a wireway on both sides of each terminal strip.
6. Size wireways to prevent conductor fill from exceeding 50% of the interior cross-sectional area of the wireway.
7. In addition to the above requirements, for ITP's, wireways are not to be common for two terminal strips. Each terminal strip shall have a dedicated wireway on each side of the strip.

I. Control Logic:
1. The Start commands are to be designed utilizing normally open contacts from pushbuttons and/or the Process Control Information System and shall be of a momentary signal that will require a seal circuit to maintain operation. Constant signals from positions switches are not allowed unless noted on the CONTRACT DRAWINGS.
2. All system failure, safety logic control devices or normal operations that are intended to cause the equipment to stop are to be wired in series with the start seal circuit. The unsealing of the start command on any fault or normal operation that causes the equipment to stop will require another start command to reseal.
3. Provide interlocks for the control functions of Local and Computer Modes in series with the Start and Stop logic. Provide a closed switch or relay contact to the Process Control Information System to identify when the equipment is in Computer Mode.
4. Provide control logic of voltage 120 VAC.

5. Use power relays when control relay contacts are insufficient for the designated load.
6. Terminate the “Hot” conductor on the common of the switch or relay contact.
7. Control alarm logic shall be wired in a fail safe mode from the field device to the panel circuitry to alarm when a field wire has failed.

3.3 PANEL DRAWING DOCUMENTATION

A. General:
   1. Files of the title block, panel symbols for front and internal sub-panel elevations, terminal strips, control schematics, analog loops, etc. are available in hard copy and AutoCAD .dwg format from the OWNER upon request through the ENGINEER via Example Panel Drawing Packages and Drawing Templates.
   2. Provide drawing copies in the following format:
      a. Hard Copy - B Size - 11” X 17”.
      b. Hard Copy - D Size - 22” X 34”.
      c. Soft Copy in .DWG.
   3. The panel drawing documentation package consists of the following drawings types arranged in the following order. a. Cover Sheet.
      a. Symbols and Legends 1 – Exterior and Interior Panel Symbols.
      b. Symbols and Legends 2 – Schematic Symbols.
      c. Front Panel Elevation.
      d. Interior/Sub Panel Layout.
      e. Terminal Strip Drawings.
      f. Control Schematics.
      g. Analog Loop Diagrams.
      h. Point to Point Discrete Wiring Diagrams.
   4. Drawing Scale:
      a. Provide Front Elevation and Interior/Sub Panel Layout Drawings proportionately correct and to scale. Create all drawings on a D Size layout.
   5. Border and Title Block:
      a. Provide each drawing with a border and title block information.
      b. Utilize the border and title block as provided in the Drawing Templates referenced in Section 3.03.A.1.

B. Panel Drawing Types:
   1. General:
      a. Provide a complete documentation package for each panel consisting of the drawings in the order listed in Section 3.03.A.3.
   2. Cover:
      a. Cover sheet for the panel documentation shall include the following information.

1) Located on the left half of the sheet to include the manufacturers name, address, phone number, web address, project reference number and ul508a certification number.
2) On the right half of the sheet include the following, “customer name” “department” and the project title, project number, the panel full title, the panel abbreviation, the facility area in which the panel exists, submittal date, volume number and sheet count.

3. Symbols & Legends:
   a. Utilize the Symbols and Legend sheets as provided by the OWNER upon request from the ENGINEER.
   b. Additional symbols may be added if an existing symbol on the Symbol and Legend sheets does not exist.
4. Front Elevation Drawing:
   a. The Front Elevation drawing illustrates the arrangement of the panel and position of the devices on the front face of the panel.
   b. Provide panel dimensions in inches. Provide dimensions for height, width, and depth. If the panel is small in size, the Front Elevation Drawing and Internal layout Drawing can be combined on one drawing.
   c. Provide the nameplate schedule on the Front Elevation drawing.
   d. Device Callouts:
      1) Device callout hexagons are utilized to reference a device to the bill of materials. Place the bill of material item number inside the hexagon.
      2) Provide a leader from the hexagon that will point to the device.
      3) For a typical of multiple devices of the same type, only one device callout is necessary.

   Provide air conditioning heating and cooling information as provided by the NVent Temperature Calculation tool at: https://www.nvent.com/en-us/hoffman/climate-control-selection-tool.
5. Interior Sub Panel Layout:
   a. General:
      1) The Interior Sub Panel Layout drawing identifies the individual interior components and their physical location.
      2) Draw all components within the panel to scale.
      3) Include all interior sub panels if the panel has sub panels on the side walls.
   b. Provide the following information on the Interior Sub Panel Layout Drawing. Utilize the formats provided on the Drawing Templates. The information can be shown on a second sheet if needed to drawing clutter.
      1) Bill of Materials:
         a) Include the devices on the Front Panel Elevation and the Interior Sub Panel(s) Elevation.
         b) Include items that are not specifically shown on the Front Panel Elevation or the Interior Sub Panel Layout drawing, such as wire size, color and type, on the bill of materials.

c) The utilization or insertion of Microsoft Excel files for the Bill of Materials is not allowed.
2) Fuse Schedule.
3) Supplementary Protector Schedule.

c. Label and identify all devices, including terminal strips, relays, fuses, timers, power supplies and other special components on the drawing.
d. For unique devices not shown on the Symbols and Legend Sheets, use rectangles and squares with the appropriate dimensions of the device.
e. Device Callouts:
1) Device callout hexagons are utilized to reference a device to the bill of materials. Place the bill of material item number inside the hexagon.
2) Provide a leader from the hexagon that will point to the device.
3) For a typical of multiple devices of the same type, only one device callout is necessary.

6. Terminal Strip Drawing:
a. General:
1) Terminal Strip Drawings provides locations for wiring terminations from field devices and other equipment external to the panel.
2) Display the wiring connections exactly as they are physically installed. For example, if field wiring is terminated to the left side of the terminal strip, the terminal strip drawing displays the wiring connections to the left side of the terminal block.
3) There are 5 different types of terminal strips and each has a specific function. The following is a brief description of each: a) For LCP's and MCP's:
a) Power Terminal Block (PTB) – Power supply/supplies to the panel (120 VAC or higher). Identify terminal block number with the wire number assigned in the control logic drawings. Identify power sources with the originating panel, voltage and circuit number.
b) Field Wiring Discrete Signal Terminal Blocks (TB1) – Discrete field inputs and outputs to/from the panel. Identify terminal block number with the rung number assigned in the control logic drawings.
c) Field Wiring Discrete Signal Terminal Blocks (TB2) – Discrete inputs and outputs to/from the Process Control Information System. Identify terminal block number with the rung number assigned in the control logic drawings.
d) Field Wiring Analog (ATB) or Internal Wiring DC Power
e) Terminal Blocks - Field or Process Control Information System Analog inputs and outputs to/from the panel, including 4-20 mA, 1-5 VDC, thermocouple or Resistance Temperature Detectors (RTD's). Identify terminal block number with consecutive numbers starting with number 1.
f) The shield wire terminal block is to be label "SH".

g) For ITP's:
i. TB-A thru Z – Discrete field inputs and outputs to/from the panel.
ii. ATB-A thru Z – Analog inputs and outputs to/from the panel.

4) It is acceptable, if space available, to combine TB1, TB2, ATB and PTB on a single terminal strip drawing.
5) Identify spare terminals with an "SP" inside the rectangle.
6) Display terminals in the order they appear in the panel.
7) Place field wire labels on each line extending toward the terminal. Obtain this information from the cable and conduit schedules. If wire labels are unavailable, place seven "X's" where wire tag normally resides. Provide this information prior to final deliverable of the Operations & Maintenance Manuals.
8) Signal description consists of 3 lines of text. Center the text next to the terminals.
a) The 1st line of text lists the Equipment Name.
b) The 2nd line of text is for the Signal Function.
c) The 3rd line of text is the Signal Loop Number, if applicable.

7. Control Schematic:
a. General:
1) Control Schematics show the controls associated with pieces of process equipment and provide a visual depiction of the majority of control wiring.
b. Control Schematic Components:
1) Power Rail:
a) Represent the power rail with two parallel vertical lines that extend vertically down the schematic.
b) Each drawing includes two sets of power rails separated by 2.5".
c) Identify each power rail with the wire number such as L1 at the top and bottom of each power rail.
d) The left power rail represents the "Hot" side of the power source. The right power rail represents the "Neutral" side of the power source.
2) Power Source:
a) Identify power source(s) with the originating panel, voltage and circuit number between the "Hot" terminal and "Neutral" terminal on the first rung of the portion of the schematic for each source.
b) Indicate the terminals from the PTB providing the source and neutral powering the rail.
c) A supplementary protector or fuse is displayed in the power rail directly below the power source (Hot) terminal. Label the supplementary protector or fuse with the supplementary protector or fuse number and current rating.
d) Power layout for LCP's:

i. In the first portion of the schematic, display power to the general purpose receptacle and panel light.
ii. In the second portion of the schematic, display power to the air conditioner and/or heater.
iii. In the third portion of the schematic, display the power to the control logic.
iv. See Sections 3.2.B Panel Incoming Power and 3.2.C AC Power Distribution.

e) Power layout for MCP's:
i. The first portion is for the typical 480 VAC motor control circuit with starter and disconnect, the next sections are the same as for the LCP's.

f) Rung Number:

3) Rung Number:
a) Rung numbers are used to identify the location and cross referencing of devices within the schematic and provide a practical means of labeling conductors and terminals within the panel.
b) Rung numbers are a sequential series of numbers starting with number 1. Locate the numbers vertically along the left side of the "Hot" power rail.
c) Rungs are to be spaced on 0.5" centers based on a D Sized drawing.

4) Wire Numbering:
a) On the downstream side of the first device on a rung, the wire number takes the rung number appearing to the left of the power rail. If a second device is located in the circuit, the wire number to the right of the second device takes the rung number, but is appended with an "A". The wire number to the right of the third device is appended with a "B", and so on.
b) When the electrical connection originated on the previous rung, the wire numbers continue to use the previous rung number as the base.
c) Connections to the power neutral rail take on the power neutral rail's wire number N#.

5) Electrical Connections:
a) Represent electrical connections as a solid small circle where two or more wires interconnect.
b) Represent electrical connections as a hollow small circle where wires terminate to a device.

6) Electrical Wiring:
a) Electrical wires or circuits are represented by horizontal rungs that connect terminal blocks, relays, contacts and all other components used in the electrical schematic.
b) Space the schematic electrical wiring every other rung at a minimum.
c) Identify each wire with the rung number as the wire number.

d) Label each wire with the conductor insulation color below each electrical wire. Refer to Table 2.2.K.1.f.
e) Indicate electrical wiring that is external to the panel with dashed lines.

7) Device Labeling:
   a) symbols in the schematic for field devices, pilot lights, switches, push buttons etc. requires two lines of text above the device and one line of text below the device to describe the usage of the device.
      i. The first line of text above the device is the name of the equipment the device is associated with.
      ii. The second line of text above the device is the control function of the device.
      iii. The line of text under the device is the loop number.
   b) Relay and timer symbol labels are to be identified with consecutive number starting with the number 1 or the rung number. For relay coils and contacts, identify the relay base terminal connection. Normally open or normally closed contacts refer to the de-energized or "off the shelf" state.
   c) Symbols in the schematic for contacts of relays, timers, etc. require two lines of text above the contact and two lines of text below the contact to describe the usage and coil reference of the contact.
      i. The first line of text above the contact is the name of the equipment the device is associated with.
      ii. The second line of text above the device is the control function of the device.
      iii. The first line of text under the device is the relay or timer number to reference the relay or timer in the schematic.
      iv. The second line of text under the device is the rung number of the relay or timer to reference where the relay or timer is located in the schematic. If using the rung number for the relay or timer coil, the rung number under the contact is not required.
      v. For relays and timer contact references, at the right of the neutral power rail, the schematic rung number location of all associated contacts is shown. If the contact is normally closed, underline the reference number. If a contact is unused, "SP" is shown.
8) Field Contacts:
   a) Show Field Contacts connected to their respective TB1 or TB2 Terminals.
   b) The connection lines from the contact to the terminal are dashed to designate they originate from outside the panel.
9) Selector Switches:
   a) Always show the switch in the far-left position, the switch contacts are shown as either opened or closed in this state. If

they're in the closed state, the contact is shown closed, indicated by a line shown below and touching the two side small circles. If the contact is open in this position, a line is drawn above the two side small circles, but not touching them.

b) Show each position of the switch directly above its respective location on the switch. This indicates whether it is a two, three, four, or more position (pole) switch, and shows what the nameplate on each position will read.

c) To indicate which positions the contact is closed, show a contact legend in parenthesis below and to the right of the contact. If the contact is closed in a position, an "X" is shown in the order of the contact position in which it is closed. If the contact is open in a position, an "O" is shown.

d) When a selector switch is continued onto another sheet or further down on the same sheet, the continuation note is shown below the selector switch. Where the switch is continued, the same note appears, but on the top of the contact.

10) Push Buttons:
    a) Represent the push button contact in its "off the shelf" state.
11) Terminals:
    a) Terminal numbers are dependent upon the specific rung number that they appear in the schematic logic. As a horizontal electrical connection is followed from left to right, the first terminal number takes on the number of the rung. The second terminal number also takes the rung number but is appended by the letter A, the third by the letter B, and so on.
12) Programmable Logic Controller:
    a) Panels that contain a Programmable Logic Controller (PLC) require connection information for the PLC I/O modules.
        i. Utilize the PLC drawings as provided in the Drawing Templates referenced in Section 3.03.A.1.
    b) Module Layout:
        i. Represent the module with a 1 1/2" wide vertical rectangle with a length suitable to encompass a maximum of 16 channels or 8 analog per section based on type of module.
        ii. Two cards can be shown per sheet.
        iii. Display field wiring (inputs) including TB1 and field device connections with a description on the left side of the module symbol.
        iv. Label the module with model number, input voltage, rack number and slot number above the module symbol. iv. Number each screw terminal per manufacturer's data.
        v. Display the associated PLC register address with each signal.

vi. Identify the positive and negative legs of the analog cable.
vii. Include all required jumpers for signal type and all 120VAC and 24VDC power requirements.

13) 480 Volt Equipment:
    a) a) Provide the motor horsepower, full load amps and motor identification.
14) Contact Development:
    a) The last sheet of the control schematic displays contacts for internal panel relay contacts that connect with external field equipment or the Process Control Information System (PCIS).
    b) Organizes into two sections. The first section lists all contacts extending to the PCIS. Title this section "Contacts to PCIS". The second section lists all contacts extending into the field equipment external to the panel. Title this section "Contacts to Field". Group multiple contacts related to a single piece of equipment together.
    c) Each contact includes a signal description and its associated relay number and relay rung number location. Device signals require the appropriate symbol from the Schematic Legend Sheet.

8. Analog Loop Diagrams:
   a. General:
      1) The analog loop diagram only displays the portion of the instrument loop that passes through a particular panel.
      2) The analog loop diagram displays the connections between field instruments, panels and the PCIS.
      3) Analog loop diagrams are reserved for analog signals and control loops, but may be used to show complex connections for a particular instrument or device.
      4) Divide each loop into three different segments.
         a) The left segment is "FIELD" connections. This segment provides information on terminations external to the panel (i.e., connected panels, instrument transmitters). If the first segment is another panel, the panel name replaces the "FIELD" label.
         b) The center segment is the internal panel wiring and controls.
         c) The right segment information represents output or input signals to downstream panels or the PCIS.
      5) Identify shield grounding location.
      6) Identify surge protection devices for each signal. Include surge protection for positive and negative leads. Utilize the surge protection block symbol from the legends and symbols sheet.
      7) Identify the cable number, wire color and polarity for each cable in the loop.

3.4 INSTALLATION

A. Install equipment in conformance with NEC. Mounting panels on handrails is not allowed.

B. Unless otherwise noted, install indoor free standing panels on 4-inch concrete pad. Extend pad 4-inches beyond outside dimensions of base, all sides. Lay grout after panel sills have been securely fastened down.

C. Unless otherwise noted, install outdoor free standing panels on a reinforced concrete pedestal:
   1. Minimum Thickness: 8-inches with No. 4 steel reinforcing bars at 12-inches on centers, each way.
   2. Minimum Size: 4-inches larger than outer dimensions of base, all sides.
   3. Provide excavation and backfill work in conformance with Section 02260, Excavation Support and Protection.
   4. Provide concrete work in conformance with Section 03300, Cast-In-Place Concrete.
   5. Seal the contact surface between the panel base along the outside perimeter of the panel using RTV sealant.
   6. Install anchor bolts and anchor in accordance with Section 05190, Mechanically Anchoring and Fastening to Concrete and Masonry.

D. Elevated Panels with floor stands:
   1. 1. When installing conduits through bottom, utilize bushings to retain the NEMA rating of the panel.

E. Install each item in accordance with manufacturer's recommendations and in accordance with the Contract Documents.

3.5 RECORD DRAWINGS:

A. Maintain a set of red-line panel drawings to reflect changes or deviations that occur during installation, start-up and commissioning and incorporates these deviations into the final Operation & Maintenance Manual.

3.6 SPARE PARTS AND TEST EQUIPMENT

A. Furnish and deliver the spare parts and test equipment as outlined below, identical and interchangeable with similar parts furnished under this Specification.

B. Pack spare parts in containers suitable for long term storage, bearing labels clearly designating the contents and the pieces of equipment for which they are intended.

C. The following constitutes the minimum spare parts:
   1. Five of each type of control relay for each 40 or less furnished for this Contract.

2. One replacement power supply for each type and size furnished for this Contract.
3. One per ten (two, if fewer than twenty) of each type of panel mounted instrument including lights and pushbuttons.
4. One dozen of each type and size of fuse used in panels and instruments.

D. The following constitutes the minimum test and calibration equipment:
1. All tooling required to insert, extract and connect any internal or external connector, including edge connectors.
2. All special calibration equipment required for system calibration.

3.7 TESTING AND ADJUSTMENTS:

A. Perform system testing and make any adjustments necessary in accordance with this Section and Section 17000, Instrumentation.

B. Perform power supply, voltage adjustments to tolerances required by the appurtenant equipment.

C. A Factory Acceptance Test shall be conducted before the panel is shipped to the site.
1. The Factory Acceptance test shall be witnessed by the ENGINEER and OWNER.
2. The Factory Acceptance Test Report shall be utilized to document the test.
3. All Control Panels require the Factory Acceptance Test to be witnessed by ENGINEER and OWNER:
4. Provide all labor, materials, equipment and incidentals as shown on the Drawings, specified and required to perform factory testing, before shipment, at the manufacturer's facility to verify that system components are functioning properly and that they meet the functional and performance requirements of the Contract Documents.
5. Submit information on factory testing procedures to verify that testing shall fulfill the requirements as specified herein. Submittal shall be made at least two months in advance of any scheduled testing and shall include dates of scheduled tests.
6. Notify ENGINEER, in writing, at least four weeks before expected initiation of tests. OWNER and ENGINEER may elect to be present at CONTRACTOR'S facilities during operational test of system equipment, either for individual units or as an integrated system. Presence of OWNER and ENGINEER during testing does not relieve CONTRACTOR from conforming to the requirements of the Contract Documents and shall in no way imply acceptance of the equipment.

D. System Hardware Operational Testing:
1. All input/output devices and components shall be tested to verify operability and basic calibration.

2. All system hardware components equipment shall be tested to verify proper operation of the equipment as stand alone units. Test shall include, but not be limited to, the following:
    a. AC/DC power checks.
    b. Power fail/restart tests.
    c. Diagnostics checks.
    d. Test demonstrating that all specified equipment functional capabilities are working properly.
    e. All system components shall be tested to verify that communication between units is working properly.

3.8 MANUFACTURER'S SERVICE

A. Provide the services of qualified factory-trained service representative to check and approve the installation of the panel(s).

B. The factory trained service representative shall be provided for installation supervision, start-up and testing services. The representative shall make a minimum of 2 visits to the site to approve the completed installation and to perform start-up testing of the equipment. The representative shall coordinate each visit with the ENGINEER prior to arrival on the site. The representative shall test operate the system in the presence of the ENGINEER and verify that the equipment conforms to requirements. The representative shall revisit the job site as often as necessary until the installation and testing is entirely satisfactory.

C. The factory trained service representative shall be provided for operation and maintenance personnel training services. The representative shall make a minimum of 1 visits to the site to perform the services as described under Section 01782, Operations and Maintenance Data. The representative shall coordinate each visit with the ENGINEER prior to arrival on the site.

D. For the factory trained service representative, all costs, including travel, lodging, meals and incidentals, shall be considered as included in the bid price.

E. Warranty: Standard Manufacturers and General Contractor Warranties.

++ END OF SECTION ++

SECTION 16170

GROUNDING AND BONDING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 1, General Requirements, Specification Sections apply to this Section.

1.2 SUMMARY

A. This Section includes grounding of electrical systems and equipment. Grounding requirements specified in this Section may be supplemented by special requirements of systems described in other Sections.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Product Data: For the following:
   1. Ground rods.
   2. Grounding conductors and cables.
   3. Connector products. Submit Shop Drawings identifying each ground rod location, distance between Ground Rods and ground rod assemblies and other grounding electrodes. Identify each by letter in alphabetical order, add a key legend including GPS coordinates.

C. Qualification Data: For firms and persons specified in Paragaph 1.4 of this Specification.

D. Field Test Reports: Submit written test reports to include the following:
   1. Test procedures used.
   2. Test results that comply with requirements.
   3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

E. Shop Drawings: Submit for approval the following:
   1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by

the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

2. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
   1. Comply with UL 467.

B. Comply with NFPA 70; for overhead-line construction and medium-voltage underground construction, comply with IEEE C2.

C. Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Grounding Conductors, Cables, Connectors, and Rods:
   2. Apache Grounding/Erico, Inc.
   3. Chance/Hubbell.
   4. Copperweld Corp.
   5. Dossert Corp.
   6. Erico, Inc.; Electrical Products Group.
   7. Framatome Connectors/Burndy Electrical.
   8. Galvan Industries, Inc.
   9. Kearney/Cooper Power Systems.

10. Korns: C. C. Korns Co.; Division of Robroy Industries.
11. O-Z/Gedney Co.; a business of the EGS Electrical Group.
12. Raco, Inc.; Division of Hubbell.
13. Superior Grounding Systems, Inc.
14. Thomas & Betts, Electrical.

2.2 GROUNDING CONDUCTORS

A. For insulated conductors, comply with Sections 16123 and 16124, Conductors and Cables.

B. Material: Copper.

C. Equipment Grounding Conductors: Insulated with green-colored insulation.

D. Isolated Ground Conductors: Insulated with green-colored insulation with yellow stripe. On feeders with isolated ground, use colored tape, alternating bands of green and yellow tape to provide a minimum of three bands of green and two bands of yellow.

E. Grounding Electrode Conductors: Stranded cable.

F. Underground Conductors: Bare, tinned copper, stranded, unless otherwise indicated.

G. Bare Copper Conductors: Comply with the following:
   1. Solid Conductors: ASTM B3.
   2. Assembly of Stranded Conductors: ASTM B8.
   3. Tinned Conductors: ASTM B33.

H. Copper Bonding Conductors: As follows:
   1. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG copper conductor, 1/4-inch in diameter.
   2. Bonding Conductor: No. 4 or No. 6 AWG, stranded copper conductor.
   3. Bonding Jumper: Bare copper tape, braided bare copper conductors, terminated with copper ferrules; 1-5/8-inches wide and 1/16-inch thick.
   4. Tinned Bonding Jumper: Tinned-copper tape, braided copper conductors, terminated with copper ferrules; 1-5/8-inches wide and 1/16-inch thick.

I. Grounding Bus: Bare, annealed copper bars of rectangular cross-section, with insulators.

2.3 CONNECTOR PRODUCTS

A. Comply with IEEE 837 and UL 467; listed for use for specific types, sizes, and combinations of conductors and connected items.

B. Bolted Connectors: Bolted pressure-type connectors.

C. Welded Connectors: Exothermic welded type, in kit form, and selected per manufacturer's written instructions.

2.4 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel.
   1. Size: 3/4-inch in diameter by 120-inches long.

B. Ground Rods: Sectional type; copper-clad steel.
   1. Size: 3/4-inch in diameter by 120-inches long.

PART 3 - EXECUTION

3.1 APPLICATION

A. Use only copper conductors for both insulated and bare grounding conductors in direct contact with earth, concrete, masonry, crushed stone, and similar materials.

B. In raceways, use insulated equipment grounding conductors.

C. Exothermic Welded Connections: Use for connections to structural steel and for underground connections, except those at test wells.

D. Equipment Grounding Conductor Terminations: Use bolted pressure clamps.

E. Ground Rod Clamps at Test Wells: Use bolted pressure clamps with at least two bolts.

F. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
   1. Use insulated spacer, space 1-inch from wall and support from wall 6-inches above finished floor, unless otherwise indicated.
   2. At doors, route the bus up to the top of the door frame, across the top of the doorway, and down to the specified height above the floor.

G. Underground Grounding Conductors: Use copper conductor, No. 4/0 AWG minimum. Bury at least 24-inches below grade or bury 12-inches above duct bank when installed as part of the duct bank.

3.2 EQUIPMENT GROUNDING CONDUCTORS

A. Comply with NFPA 70, Article 250, for types, sizes, and quantities of equipment grounding conductors, unless specific types, larger sizes, or more conductors than required by NFPA 70 are indicated.

B. Install equipment grounding conductors in all feeders and circuits.
   1. Install insulated equipment grounding conductor with circuit conductors for the following items, in addition to those required by NEC:
   2. Feeders and branch circuits.
   3. Lighting and Receptacle circuits.
   4. Control Circuits.
   5. Single-phase motor and appliance branch circuits.
   6. 3-phase motor and appliance branch circuits.
   7. Flexible raceway runs.
   8. Armored and metal-clad cable runs.

C. Busway Supply Circuits: Install insulated equipment grounding conductor from the grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.

D. Computer Outlet Circuits: Install insulated equipment grounding conductor in branch-circuit runs from computer-area power panels or power distribution units.

E. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate grounding conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.

F. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply raceway with a non-metallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate equipment grounding conductor. Isolate equipment grounding conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.

G. Non-metallic Raceways: Install an equipment grounding conductor in non-metallic raceways unless they are designated for telephone or data cables.

H. Signal and Communication Systems: For telephone, alarm, voice and data, and other communication systems, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.
   1. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-inch by 2-inch by 12-inch grounding bus.
   2. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.

I. Metal Poles Supporting Outdoor Lighting Fixtures: Provide a grounding electrode in addition to installing a separate equipment grounding conductor with supply branch circuit conductors.

3.3 COUNTERPOISE

A. Ground the steel framework of the building with a driven ground rod at the base of every corner column and at intermediate exterior columns at distances not more than 60 feet apart. Provide a grounding conductor (counterpoise), electrically connected to each ground rod and to each steel column, extending around the perimeter of the building. Use tinned-copper conductor not less than No. 4/0 AWG for counterpoise and for tap to building steel. Bury counterpoise not less than 18-inches below grade and 24-inches from building foundation.

3.4 INSTALLATION

A. Ground Rods: Install at least three rods spaced at least one rod length from each other, and located at least the same distance from other grounding electrodes.
   1. Drive ground rods until tops are 2-inches below finished floor or final grade, unless otherwise indicated.
   2. Interconnect ground rods with grounding electrode conductors. Use exothermic welds, except at test wells and as otherwise indicated. Make connections without exposing steel or damaging copper coating.

B. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

C. Bonding Straps and Jumpers: Install so vibration by equipment mounted on vibration isolation hangers and supports is not transmitted to rigidly mounted equipment. Use exothermic welded connectors for outdoor locations, unless a disconnect-type connection is required; then, use a bolted clamp. Bond straps directly to the basic structure taking care not to penetrate any adjacent parts. Install straps only in locations accessible for maintenance.

D. Metal Water Service Pipe: Provide insulated copper grounding conductors, in conduit, from building's main service equipment or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes by grounding clamp connectors. Where a dielectric main water fitting is installed, connect grounding conductor to street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.

E. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with grounding clamp connectors.

F. Bond interior metal piping systems and metal air ducts to equipment grounding conductors of associated pumps, fans, blowers, electric heaters, and air cleaners. Use braided-type bonding straps.

G. Bond each aboveground portion of gas piping system upstream from equipment shut-off valve.

H. Install test wells as indicated on the Contract Documents.

3.5 CONNECTIONS

A. General: Make connections so galvanic action or electrolysis possibility is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.
   1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer to order of galvanic series.
   2. Make connections with clean bare metal at points of contact.
   3. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

B. Exothermic Welded Connections: Comply with manufacturer's written instructions. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.

C. Equipment Grounding Conductor Terminations: For No. 8 AWG and larger, use pressure-type grounding lugs. No. 10 AWG and smaller grounding conductors may be terminated with winged pressure-type connectors.

D. Noncontact Metal Raceway Terminations: If metallic raceways terminate at metal housings without mechanical and electrical connection to housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to grounding bus or terminal in housing. Bond electrically non-continuous conduits at entrances and exits with grounding bushings and bare grounding conductors, unless otherwise indicated.

E. Connections at Test Wells: Use compression-type connectors on conductors and make bolted- and clamped-type connections between conductors and ground rods.

F. Tighten screws and bolts for grounding and bonding connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A.

G. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by connector manufacturer. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on grounding conductor.

H. Moisture Protection: If insulated grounding conductors are connected to ground rods or grounding buses, insulate entire area of connection and seal against moisture penetration of insulation and cable.

3.6 UNDERGROUND DISTRIBUTION SYSTEM GROUNDING

A. Duct Banks: Install a grounding conductor with at least 50% ampacity of the largest phase conductor in the ductbank.

B. Manholes and Handholes: Install a driven ground rod close to wall and set rod depth to 4-inches above handhole or manhole floor. If necessary, install ground rod before manhole is placed and provide a No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive tape or heat-shrunk insulating sleeve from 2-inches above to 6-inches below concrete. Seal floor opening with waterproof, non-shrink grout.

C. Connections to Manhole Components: Connect exposed-metal parts, such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields as recommended by manufacturer of splicing and termination kits.

D. Pad-Mounted Transformers and Switches: Install two ground rods and counterpoise circling pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Use tinned-copper conductor not less than No. 4/0 AWG for counterpoise and for taps to equipment ground pad. Bury counterpoise not less than 18-inches below grade and 6-inches from the foundation.

3.7 FIELD QUALITY CONTROL

A. See Specification 16920, 3.01, Qualifications, for Independent Third Party Testing organization requirements.

B. Testing: Perform the following field quality control testing:
   1. After installing grounding system but before permanent electrical circuitry has been energized, test for compliance with requirements.
   2. Test completed grounding system at each location where a maximum ground resistance level is specified, at service disconnect enclosure grounding terminal, and at ground test wells. Measure ground resistance not less than two full days after the last trace of precipitation, and without the soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance. Perform tests by the fall-of-potential method according to IEEE 81.
   3. Provide Drawings locating each ground rod and ground rod assembly and other grounding electrodes, identify each by letter in alphabetical order, and

key to the record of tests and observations. Include the number of rods driven and their depth at each location and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

a. Equipment Rated 500 kVA and Less: 10 ohms.
b. Equipment Rated 500 to 1,000 kVA: 5 ohms.
c. Equipment Rated More Than 1,000 kVA: 3 ohms.
d. Substations and Pad-Mounted Switching Equipment: 5 ohms.
e. Manhole Grounds: 10 ohms.

4. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Engineer promptly and include recommendations to reduce ground resistance.

++ END OF SECTION ++

SECTION 16190

SUPPORTING DEVICES

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. Supports, anchors, sleeves, and seals are indicated on the Drawings, schedules, and specified in other Sections of these Specifications.

B. Types of supports, anchors, sleeves and seals specified in this Section include the following:
   1. One-hole conduit straps.
   2. One-hole conduit straps with clamp backs.
   3. Two-hole conduit straps.
   4. Conduit hangers.
   5. I-beam clamps.
   6. Channel clamps.
   7. Round steel rods.
   8. Drop-in anchors.
   9. Wedge type anchor bolts.
   10. Lead expansion anchors.
   11. Toggle bolts.
   12. Wall and floor seals.
   13. Cable supports.
   14. U-Channel strut system.
   15. Sleeves.

1.2 SUBMITTALS

A. Products shall be submitted in accordance with Section 16000, General Electrical Requirements, and elsewhere in the Contract Documents, prior to installation.

B. Shop Drawings: Submit for approval the following:
   1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of

requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

2. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work include, but are not limited to, the following: Abbeon Cal Inc., Ackerman Johnson Fastening Systems Inc., Elcen Metal Products Co., Ideal Industries, Inc., Josyln Mfg and Supply Co., McGraw Edison Co., Rawlplug Co. Inc., Star Expansion Co., U.S. Expansion Bolt Co., Allied Tube and Conduit Corp., B-Line Systems, Inc., Greenfield Mfg Co., Inc., Midland-Ross Corp., O-Z/Gedney Div; General Signal Corp., Power-Strut Div.; Van Huffel Tube Corp., and Unistrut Div; GTE Products Corp., and Robroy Industries.

2.2 GENERAL

A. Provide supporting devices that comply with manufacturer's standard materials, design, and construction, in accordance with published product information, and as required for complete installations, and as specified herein.

2.3 SUPPORTS

A. Provide supporting devices of types, sizes, and materials indicated, and having the following construction features:

B. One-Hole Conduit Straps: For supporting electrical metallic tubing, and liquidtight flexible conduit; zinc plated steel, stainless steel or galvanized steel; snap-on, heavy duty.

1. One-Hole Conduit Straps with Clamp Backs: For supporting rigid metal conduit, and intermediate metal conduit; cast galvanized steel.

2. Two-Hole Conduit Straps: For supporting electrical metallic tubing, rigid metal conduit, and intermediate metal conduit; zinc plated steel, stainless steel or galvanized steel.
3. Conduit Hangers: For supporting electrical metallic tubing, rigid metal conduit, and intermediate metal conduit; zinc plated steel, stainless steel or galvanized steel.
4. I-Beam Clamps: Electroplated zinc or hot-dipped galvanized malleable iron.
5. Channel Clamps: Electroplated zinc or hot-dipped galvanized steel.
6. Round Steel Rod: National coarse thread, electroplated.

2.4 ANCHORS

A. Provide anchors of types, sizes, and materials indicated, with the following construction features:
   1. Lead Expansion Anchors: For CMU walls, 1/4-inch-20 threads, set tool required.
   2. Toggle Bolts: Electroplated steel, size as required.
   3. Drop-in Anchors: Stainless steel, size as required.
   4. Anchor Bolts: Stainless steel, size as required.
   5. Half-round head, non-removable anchor bolts shall not be used.

2.5 SEALS

A. Provide seals of types, sizes, and materials indicated, with the following construction features:
   1. Wall and Floor Seals: Provide factory-assembled watertight wall and floor seals, of types and sized indicated; suitable for sealing around conduit, pipe, or tubing passing through concrete floors and walls. Construct seals with steel sleeves, malleable iron body, neoprene sealing grommets and rings, metal pressure rings, pressure clamps, and cap screws.
   2. Conduit sealing bushings shall be manufactured by O-Z/Gedney, Model CSMI, or equal.
   3. The conductor sealing bushings shall be manufactured by O-Z/Gedney, Model CSBG, or equal.

2.6 CONDUIT CABLE SUPPORTS

A. Provide cable supports with insulating wedging plug for non-armored type electrical cables in risers; construct 2-inch rigid metal conduit; 3-wires, type wire as indicated; construct body of malleable-iron casting with hot-dip galvanized finish.

2.7 U-CHANNEL STRUT SYSTEM

A. Provide U-channel strut system for supporting electrical equipment, 12 gauge hot-dip galvanized steel, of types and sizes indicated; construct with 9/16-inch

diameter holes, 8-inch o.c. on top surface, with the following fittings that mate and match with U-channel:

1. Fixture hangers.
2. Channel hangers.
3. End caps.
4. Beam clamps.
5. Wiring stud.
6. Thinwall conduit clamps.
7. Rigid conduit clamps.
8. Post bases.
9. U-bolts.

2.8 PIPE SLEEVES

A. Provide pipe sleeves from the following:
   1. Steel Pipe: Fabricate from Schedule 40 galvanized steel pipe; remove burrs.

2.9 PVC COATED U-CHANNEL STRUT SYSTEM

A. Provide PVC Coated U-channel strut system for supporting electrical equipment, 20 mil PVC coated steel, of types and sizes indicated; construct with 9/16-inch diameter holes, 8-inch o.c. on top surface, with all stainless steel hardware, and the following fittings that mate and match with PVC coated U-channel:
   1. PVC coated strut nut.
   2. PVC coated pipe straps.
   3. Touch up compound (gray).

2.10 STAINLESS STEEL U-CHANNEL STRUT SYSTEM

A. Provide stainless steel U-channel strut system for supporting electrical equipment, of types and sizes indicated; construct with 9/16-inch diameter holes, 8-inch o.c. on top surface, with all stainless steel hardware, and the following stainless steel fittings that mate and match with stainless steel U-Channel:
   1. Fixture hangers.
   2. Channel hangers.
   3. End caps.
   4. Beam clamps.
   5. Wiring stud.
   6. Post bases.
   7. Rigid conduit clamps.
   8. U-bolts.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install hangers, anchors, sleeves, and seals as indicated, in accordance with manufacturer's written instructions and with recognized industry practices to insure supporting devices comply with requirements. Comply with requirements of NECA and NEC for installation of supporting devices.

B. Coordinate with other electrical work, including raceway and wiring work, as necessary to interface installation of supporting devices with other work.

C. Install hangers, supports, clamps and attachments to support piping properly from building structure. Arrange for grouping of two or more parallel runs of conduits to be supported together on channel type hangers where possible. Install supports with spacing indicated and in compliance with NEC requirements.

D. Torque sleeve seal nuts, complying with manufacturer's recommended values. Ensure that sealing grommets expand to form watertight seal.

E. Comply with manufacturer’s recommendations for touch up of field cut ends or damaged PVC coated U-channel and fittings.

F. Remove burrs and apply a cold zinc galvanizing paint to field cut galvanized U-channel strut.

++ END OF SECTION ++

SECTION 16195

ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. Electrical identification work specified in this Section covers the following:
   1. Buried cable warnings.
   2. Electrical power, control and communication conductors.
   3. Operational instructions and warnings.
   4. Danger signs.
   5. Equipment/system identification signs.

1.2 SUBMITTALS

A. Submittals to the ENGINEER shall include the following:
   1. Manufacturer's data on electrical identification materials and products.
   2. Samples of each color, lettering style, and other graphic representation required for each identification material or system.

B. Shop Drawings: Submit for approval the following:
   1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
   2. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE**

WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.

1.3 MANUFACTURERS

A. Subject to compliance with requirements, manufacturers offering electrical identification products maybe incorporated in the Work include, but not limited to, the following:
   1. Brady, W.H. Co.
   2. Ideal Industries, Inc.
   3. Panduit Corp.
   4. Or pre-approved equal.

1.4 QUALITY COMPLIANCE

A. Comply with applicable requirements of UL Std. 969, "Marking and Labeling Systems", pertaining to electrical identification systems.

B. Comply with applicable requirements of NEMA Std. No's WC-1 and WC-2 pertaining to identification of power and control conductors.

PART 2 - PRODUCTS

2.1 GENERAL

A. Except as otherwise indicated, provide manufacturer's standard products of categories and types required for each application. Where more than single type is specified for an application, selection is installer's option, but provide single selection for each application.

2.2 COLOR-CODED CONDUIT MARKERS

A. Provide manufacturer's standard pre-printed, flexible or semi-rigid, permanent, plastic-sheet conduit markers, extending 360 degrees around conduits; designed for attachment to conduit by adhesive, adhesive lap joint of marker, matching adhesive plastic tape at each end of marker, or pretensioned snap-on. Except as otherwise indicated, provide lettering that indicates voltage of conductor(s) in conduit. Provide 8-inches minimum length for 2-inch and smaller conduit, 12-inches length for larger conduit.

B. Unless otherwise indicated or required by governing regulations, provide white markers with black letters.

2.3 CABLE AND CONDUCTOR WIRE MARKERS

A. Cable and conductor wire markers shall be self laminating vinyl on white background, printed using a Seton printer, a Brady TLS2200 printer or pre-approved equal. Handwritten wire markers are not acceptable.

2.4 SELF-ADHESIVE PLASTIC SIGNS

A. Provide manufacturer's standard, self-adhesive or pressure-sensitive, pre-printed, flexible vinyl signs for operational instructions or warnings; of sizes suitable for application areas and adequate for visibility, with proper wording for each application, e.g., 208 V, EXHAUST FAN, RECTIFIER.

B. Unless otherwise indicated or required by governing regulations, provide white signs with black lettering.

2.5 LETTERING AND GRAPHICS

A. Coordinate names, abbreviations and other designations used in electrical identification work, with corresponding designations shown, specified or scheduled. Provide numbers, lettering and wording as indicated or, if not otherwise indicated, as recommended by manufacturers or as required for proper identification and operation/maintenance of electrical systems and equipment. Comply with ANSI A13.1 pertaining to minimum sizes for letters and numbers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install electrical identification products as indicated, in accordance with manufacturer's written instructions and requirements of NEC.

B. Where identification is to be applied to surfaces that require finish, install identification after completion of painting.

C. Comply with governing regulations and requests of governing authorities for identification of electrical work.

3.2 CONDUIT IDENTIFICATION

A. Where electrical conduit is exposed in spaces with exposed mechanical piping that is identified by a color-coded method, apply color-coded identification on electrical conduit in manner similar to piping identification. Except as otherwise indicated, use white as coded color for conduit.

3.3 CABLE/CONDUCTOR IDENTIFICATION

A. Apply cable/conductor identification, including voltage, phase and feeder number, on each cable/conductor in each box/enclosure/cabinet where wires of more than one circuit or communication/signal system are present, except where another form of identification (such as color-coded conductors) is provided. Match identification with marking system used in panelboards, shop drawings, contract documents, and similar previously established identification for Project's electrical work.

3.4 EQUIPMENT/SYSTEM IDENTIFICATION

A. Install engraved plastic-laminate sign on each major unit of electrical equipment in building; including central or master unit of each electrical system including communication-control-signal systems, unless unit is specified with its own self-explanatory identification or signal system. Except as otherwise indicated, provide single line of text, 1/2-inch high lettering on 1-1/2-inch high sign (2-inch high where two lines are required), white lettering in black field. Provide text matching terminology and numbering of the contract documents and shop drawings. Provide signs for each unit of the following categories of electrical work:
   1. Panelboards, electrical cabinets and enclosures.
   2. Access panel/doors to electrical facilities.
   3. Major electrical switchgear.

B. Install signs at locations indicated or, where not otherwise indicated, at location for best convenience of viewing without interference with operation and maintenance of equipment. Secure to substrate with brass or stainless steel screws, except use adhesive where screws should not or cannot penetrate the substrate.

3.5 CIRCUIT IDENTIFICATION

A. The 3-phase wires shall be identified at the switchgear, panelboards and motor control centers as Phases A, B, and C. At 277/480 VAC, Phase A shall be brown, Phase B shall be orange, and Phase C shall be yellow. The neutral shall be gray.

B. In addition to color coding all conductors, each conductor shall be identified in each pull box, manhole, panelboard, cable tray, or termination with circuit identification markers. This identification is applicable to all power, control, alarm, and instrumentation conductors and these markings shall be recorded on the Record Documents. Markers shall be slip-on PVC sleeve type as manufactured by Brady, Seton, or pre-approved equal.

C. Markers for other cabling shall be B-292 vinyl as manufactured by Brady, Seton, or pre-approved equal.

D. Exposed medium voltage conduits shall be labeled at 50 foot intervals with 1-inch letters stating the voltage - example – "12,470 volts". Labels shall be vinyl plastic as manufactured by Brady, Seton, or pre-approved equal.

3.6 AUTOMATIC EQUIPMENT WARNING SIGNS

A. Permanent warning signs shall be mounted at all mechanical equipment that may be started automatically or from remote locations. Signs shall be in accordance with OSHA Regulations and shall be suitable for exterior use. The warning signs shall be fastened with round head brass screws or bolts, located and mounted in a manner acceptable to the ENGINEER.

B. Warning signs shall be 7-inches high by 10-inches wide, colored yellow and black, on not less than 18 gauge vitreous enameling stock. Sign shall read:

CAUTION
THIS EQUIPMENT STARTS
AUTOMATICALLY
BY REMOTE CONTROL

3.7 HIGH VOLTAGE WARNING SIGNS

A. Permanent and conspicuous warning signs shall be mounted on all equipment, doorways to equipment rooms, pull boxes, manholes, where the voltage exceeds 600 volts.

B. Signs shall be in accordance with OSHA regulation, and shall be suitable for exterior use. The warning signs shall be fastened with round head brass screws or bolts, located and mounted in a manner acceptable to the ENGINEER.

C. Signs shall be 7-inches high by 10-inches wide, colored red and white, on not less than 18 gauge vitreous enameling stock. Sign shall read:

WARNING
HIGH VOLTAGE
KEEP OUT

3.8 CONDUCTOR FASTENERS

A. Glue-on type conductor fasteners shall not be used in any panels, panelboards, switchboards, switchgear, motor control centers, or other enclosures containing electrical devices and/or conductors.

++ END OF SECTION ++

SECTION 16225

ELECTRIC MOTORS 250 HORSEPOWER OR LESS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
   1. This Section includes alternating current induction motors, 250 horsepower or less, to be provided with the driven equipment. Unless specified otherwise, electric motors shall be provided by the manufacturer of the driven equipment under an assumption of unit responsibility. This Section refers to motors by enclosure type as defined in NEMA MG 1, except as noted.

B. Horsepower Rating:
   1. Motor horsepower ratings noted in individual equipment Specifications are estimates only and it is the responsibility of CONTRACTOR to furnish motors, electric circuits, and other equipment of ample horsepower capacity to operate the equipment furnished without exceeding the manufacturer's nameplate full-load current at rated manufacturer's nameplate voltage. Full-load current information shall be furnished with the individual submittals.

1.2 QUALITY ASSURANCE

A. General: Motors shall be built in accordance with UL 674, UL 1004, NEMA Standard MG 1, and to the requirements specified.

B. Reference Standards: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified. In case of conflict between the requirements of this Section and those of the listed documents, the requirements of this Section shall prevail.
   1. AFBMA 9: Load Rating and Fatigue Life for Ball Bearings.
   2. AFBMA 11: Load Ratings and Fatigue Life for Roller Bearings.
   3. IEEE 112: Standard Test Procedures for Polyphase Induction Motors and Generators.
   4. IEEE 841, Standard for Petroleum and Chemical Industry - Totally Enclosed Fan Cooled (TEFC) Squirrel Cage Induction Motors - Up to and Including 500 HP.
   5. NEMA ICS 2: Industrial Control Devices, Controllers and Assemblies.
   6. NEMA ICS 6: Enclosures for Industrial Controls and Systems.
   7. NEMA 250, Enclosures for Electrical Equipment (1000 volts maximum).
   8. NEMA MG 1: Motors and Generators.

9. NEMA MG1-31: Application Considerations for Constant Speed Motors Used on a Sinusoidal Bus with Harmonic Content and General Purpose Motors Used with Adjustable-Voltage or Adjustable- Frequency Controls or Both.
10. UL.674: Electric Motors and Generators for Use in Class I Division I Hazardous Locations
11. UL 1004: Electric Motors.

C. Factory Tests:
1. The manufacturer's factory motor Prototype Tests per IEEE Standard 112 Appendix-A on motors through 250 horsepower shall be submitted as Product Data for the motor, and actual factory tests for motors are not required:
a. Winding resistance in ohms and converted to 25 degree C.
b. Resistive Unbalance and Quarter Voltage Impedance, as applicable.
c. Locked-Rotor current (Single phase).
d. High Potential.
e. No-Load Excitation (volts, amperes, RPM).
f. Bearing vibration check.
g. Efficiency, Power Factor, Current at 115%, 100%, 75%, 50%, and no load.

D. Warranty:
1. Motors ½ horsepower and greater shall be warranted against defects in materials and workmanship for a period of 5 years under the specified uses and with normal operation and service. This warranty shall be delivered, in writing, to the Owner and shall include, as a minimum, 100 percent full payment coverage for parts and labor during the first 60 months of operation.

1.3 SUBMITTALS

A. Submittals shall include the following:
1. Shop Drawings: Submit for approval the following:
a. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation

is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

b. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**

2. Manufacture completed IEEE Standard 841 Date Sheet for AC Squirrel Cage Induction Motors with required factory data of motors supplied.
3. Speed-Torque curve per 1.2 C Factory Tests.
4. Factory Test Data: Including Guaranteed Minimum Efficiency for 115% load, 100% load, 75% load, 50% load, and no load.
5. Guaranteed vibration level when measured per MG 1, Figure 7-6:
   a. Displacement: 0.0025 inch peak-to-peak
   b. Velocity: 0.10 inches per second peak
   c. Acceleration: 1g (gravity) peak.
6. Motor heating curve for motors per 1.2 C Factory Tests.
7. Motor outline, dimensions, and weight.
8. Manufacturer's descriptive information relative to motor features.
9. Response curve where a winding over-temperature device is required.
10. For all inverter duty motors: Manufacturer's certification that the motor is compatible with the adjustable frequency drive operating it.
11. Disassembly and repair documentation.
    a. Submit complete Operation and Maintenance Manuals in conformance with the Operation and Maintenance Manuals section of Section 01300, Submittals.

1.4 POWER SUPPLY VARIATIONS

A. Motors shall operate successfully under running conditions at rated load with +/- 10-percent of rated voltage with rated frequency or +/- 5-percent of rated frequency with rated voltage.

1.5 AMBIENT CONDITIONS

A. Unless specified otherwise, motors shall be suitable for continuous operation at an elevation of approximately 1,200 feet above mean sea level. Motors to be installed outdoors, exposed to the weather, shall be suitable for continuous operation in a 50° C ambient temperature; motors to be installed indoors shall be suitable for continuous operation in 50° C ambient temperature, unless otherwise noted.

1.6 NEMA WINDING TEMPERATURES

A. NEMA MG 1 Table 12-7 motors insulation system maximum winding temperatures in degrees-Centigrade (C), with the degrees-Fahrenheit (F) insulation system class specified herein.
   1. Forty degree-C ambient (104 degree-F) is the basis for temperature rise.
   2. For 50 degree C ambient (122F) and above, refer to the driven equipment specifications for additional requirements.

Insulation System Class	Degrees C / F	Temperature Rise by Resistance
A	140 / 284	NA
B	165 / 329	B-rise: 40 + 80 = 120 Degrees C / 248 F
F	190 / 374	F-rise: 40 + 105 = 145 Degrees C / 293 F
H	215 / 419	H-rise: 40 + 125 = 165 Degrees C / 329 F

1.7 NEMA MOTOR TEMPERATURE PROTECTION TYPES

A. The NEMA design shall limit the temperatures of the windings without using a thermal device:
   1. Type-1: Winding Running and Locked Rotor Over-temperature Protection.
   2. Type-2: Winding Running Over-temperature Protection.

PART 2 - PRODUCTS

2.1 MANUFACTURER'S NAMEPLATES

A. Factory installed manufacturer's nameplates shall be stainless steel with embossed or pre-printed lettering and fastened to the motor frame with Type 316 stainless steel pins. Manufacturer's nameplates shall have stamped on them the motor manufacturer's name, design voltage; number of hertz and phase; horsepower rating; amperage and temperature rise at rated load, full load speed, NEMA code letter, service factor, minimum guaranteed efficiency, model number, AFBMA bearing number, serial number and maintenance manual number in accordance with NEMA MGI-10.40.1.

B. A separate factory installed manufacturer's nameplate shall provide lubrication instructions and a separate manufacturer's nameplate connection diagram for dual voltage motors.

C. Additionally, factory to provide the following information on manufacturer's nameplates or additional manufacturer's nameplates for:

1. Motors 1/2 horsepower and larger: Indicate the ABMA L-10 rated life for the motor bearings.
2. Motors 2 to 50 horsepower: Indicate the NEMA nominal efficiency.
3. Motors 50 horsepower and larger: Indicate NEMA guaranteed minimum efficiency.
4. Explosion-Proof motors: Indicate UL frame temperature limit code.
5. Space heater information.
6. NEMA MG 1 Over Temperature Protection Type Number.

2.2 CONSTRUCTION

A. Unless specified otherwise, all motors provided under this Section shall have the following features of construction and operation:
   1. Motor voltage, speed and enclosures are specified in the detailed equipment Specifications. Motors furnished with equipment shall comply with this Section.
   2. All motors shall be of the motor manufacturer's premium energy-efficient design, different from manufacturer's standard product through the use of premium materials, design and improved manufacturing process that reduces motor losses approximately 40 percent from standard efficient designs.
   3. Motor efficiency shall be determined in accordance with NEMA Standard MG1-12.54.1 and guaranteed minimum full load efficiency labeled on manufacturer's motor nameplate in accordance with NEMA Standard MG1-12.54.2 or MG1-10.40.1 below.
   4. Minimum efficiencies shall not be less than those listed in Paragraph 2.4.E., below.
   5. All motors shall successfully operate under power supply variations in accordance with NEMA MG1-14.30.
   6. All motors shall be NEMA Design B with torque and starting currents in accordance with NEMA MG1-12.35 and 12.37, except in special applications requiring higher starting torques where NEMA Design C is permitted.
   7. All motors shall have a 1.15 service factor. Polyphase integral horsepower motors shall be sized so that, under maximum load conditions imposed by the driven equipment, for the conditions specified, the manufacturer's motor nameplate rated horsepower and Class B temperature rise will not be exceeded. Motors with a service factor of 1.15 shall be selected for operation within their full load rating without applying the service factor.
   8. Each motor shall be of the speed and horsepower specified or required to properly operate the driven equipment, torque characteristics as required by the drive load and suitable for direct coupling or V-belt drive, as shown on the Drawings and specified herein. Motors shall be designed for full voltage starting, unless otherwise specified.
   9. Frames shall be of corrosion-resistant cast iron with integrally cast feet or bases. End bells, conduit box and cover and bases shall be cast iron, with precision machined bearing fits, ASTM Type A-48, Class 25 or better. UL approved automatic stainless steel breather drains shall be provided in the

lowest part of front and back brackets to allow drainage of condensation on TEFC and explosion proof motors.

10. Each stator core assembly shall consist of stacked lamination made from specially selected electrical sheet silicon steel.
11. Insulation materials shall be non-hygroscopic and meet or exceed Class H definition, utilizing materials and insulation systems evaluated in accordance with IEEE 117 classification tests. Motor temperature rating shall not exceed Class F temperature limits as measured by resistance method when the motor is operated at full load at 1.0 service factor continuously in a maximum ambient temperature of 50° C. Windings shall be copper.
12. Rotor cages for motors 50 HP or less shall be die cast aluminum or fabricated copper. Shafts shall be made from carbon steel. Rotor cages for motors larger than 50 HP shall be copper only.
13. Rotors on frames 213T and above shall be keyed shrunk or welded to shaft and rotating assembly dynamically balanced to NEMA limits in accordance with MG1-12.06. Balance weights, if required, shall be secured to the rotor resistance ring or fan blades by rivets. Machine screws and nuts are prohibited. The entire rotating assembly between bearing inner caps shall be coated with a corrosion-resistant epoxy.
14. Bearings shall be ball, open, single row, deep groove, Conrad type, and shall have a Class 3 internal fit conforming to AFBMA Std. 20. For belted duty applications, drive end bearing may be cylindrical roller type. Bearings shall be selected to provide L-10 rating life of 100,000 hours minimum. Calculations shall be based on external loads using NEMA applications limits in accordance with MG1-14.41 and typical sheave weights and internal loads defined by the manufacturer, including magnetic pull and rotating assembly weight.
15. Bearing temperature rise at rated load shall not exceed 60° C. Temperature rise shall be measured by RTD or thermocouple at bearing outer race. Bearing AFBMA identification number shall be stamped on manufacturer's motor nameplate.
16. Motor lubrication system shall consist of a sealed bearing or a grease inlet on motor bracket with capped grease fitting on inlet, grease relief plug 180 degrees from inlet, grease reservoir in bracket and grease reservoir in cast inner cap. Motor shall be greased by manufacturer with a premium moisture resistant polyuria thickened grease containing rust inhibitors and suitable for operation over temperatures from -25° C to 120° C.
17. All bolt and cap screws shall be of high strength, SAE Grade 5 zinc-plated and chromatic steel. Screwdriver slot fasteners are unacceptable.
18. All motor parts including frame, brackets, fan cover and terminal box shall receive a minimum of two coats of high grade USDA accepted epoxy paint. Motor assembly shall successfully withstand salt spray tests for corrosion in accordance with ASTM B-117 for 96 hours.
19. All motors shall be painted the same color as the driven equipment.
20. Two-speed motors shall be two-winding motors. Two-speed, one-winding consequential-pole motors that require special motor starters are prohibited.

2.3 MOTORS LESS THAN 1/2 HORSEPOWER

A. General:
   1. Unless otherwise specified, motors less than 1/2 horsepower shall be squirrel cage, single phase, capacitor start, induction run type. Construction features listed in Paragraph 2.2, above, shall be as normally supplied by the equipment manufacturer. Single phase motors shall have Class B insulation, minimum. Small fan motors may be split-phase or shaded pole type. Windings shall be copper.

B. Rating:
   1. Unless otherwise specified, motors shall be rated for operation at 115 volts, single phase, 60 Hz, and shall be continuous-time rated in conformance with NEMA Standard MG 1, Paragraph 10.35. Dual voltage (115/230) rated motors are acceptable if all leads are brought out to the conduit box. Motors shall be non-overloading at all points of the equipment operation.

C. Enclosures:
   1. Unless otherwise specified, motors shall have totally enclosed fan cooled or totally enclosed non-ventilated enclosures.

2.4 MOTORS 1/2 HORSEPOWER THROUGH 250 HORSEPOWER

A. General:
   1. Unless otherwise specified, motors 1/2 horsepower through 250 horsepower shall be three phase, squirrel cage, full voltage start induction type. Unless otherwise specified, motors shall have a NEMA MG 1-1.16 design letter B or C torque characteristic as required by the driven equipment's starting torque requirements.

B. Rating:
   1. Unless otherwise specified, motors shall be rated for operation at 460 volts, 3 phase, 60 Hz, and shall be continuous time rated in accordance with NEMA Standard MG 1, Paragraph 10.35.
   2. Motors for variable frequency systems shall not be required to deliver more than 80 percent of the motor's service factor rating by any load imposed by the driven machine at any specified operating condition or any condition imposed by the driven machine's performance curve at maximum operating speed.

C. Enclosure and Insulation:
   1. General: Motors shall be classified as Type 1 (Process) and Type 2 (Explosion proof). Enclosures and insulation systems shall be as specified in the following paragraphs. Temperature rise for all motor types shall not exceed that permitted by Note II, Paragraph 12.42, NEMA MG 1. The insulation shall be non-hygroscopic.

a. Type 1 Motors (Process): Type 1 motors shall be premium energy efficient motors, totally enclosed, fan cooled. All motors shall have Class H insulation with Class B temperature rise. Motors shall conform to IEEE 841. All internal surfaces shall be coated with an epoxy paint. Motors shall be rated for corrosive atmosphere duty.
b. Type 2 Motors (Explosion proof): Explosion proof motors shall be UL listed in accordance with UL 674 for Class I, Group D hazardous atmospheres. The motor shall have Class H insulation and shall conform to IEEE 841. Steel frame motors will not be permitted. A UL-approved Type 316 stainless steel breather/drain device shall be provided in the motor drain hole. The motor shall be provided with a frame temperature thermostat which meets the UL frame temperature limit code T2A (280°C). The thermostat shall contain an automatically reset, normally closed contact rated two amperes at 115 volts AC.

D. Motors for Variable Frequency Drives:
1. Motors intended for use with variable frequency drives shall be compatible with the characteristics of the intended variable frequency inverters. Motors shall be Type 1 or Type 2 as specified in the detailed Specification. Insulation for all motors operating with variable frequency drives shall be Class H with Class F temperature rise. Variable frequency drive motors shall be premium energy-efficient motors. Motors shall be capable of withstanding a pulse voltage of at least 1750 volts with a rate of rise up to 750V/micro second. The motors shall be certified by the manufacturer as suitable for inverter duty.
2. All motors connected to variable frequency drives shall be equiped with shaft grounding rings. Shaft grounding devices must be factory installed or installed by a reputable motor shop with the expertise in the proper installation of the devices. If the shaft grounding devices are not factory installed, a third party shall be engaged to test the installation to ensure no damaging shaft currents are present.

E. Minimum Manufacturer's Nameplate Efficiency: Motor minimum manufacturer's nameplate efficiency, determined in accordance with IEEE 112B testing procedures, when operating on a sinusoidal power source shall conform to the following:

HORSEPOWER RANGE	SPEED, RPM		
	1200	1800	3600
1-2	82.5	84.5	82.5
3-5	89.5	88.5	86.5
7-25	90.2	90.2	89.5
30-60	92.4	92.4	89.8
75-250	94.1	93.7	91.7

F. Vertical Motors:
   1. Unless otherwise specified, vertical motors shall be full voltage with a Type P base specifically designed for vertical installation. Universal position motors are not acceptable. Vertical motors shall have solid shafts, unless otherwise specified. Vertical motors shall conform to either Type 1 or Type 2 motor requirements as specified under Paragraph 2.4.C., above. Thrust bearing rating shall be compatible with the loads imposed by the driven equipment.

G. Conduit Boxes:
   1. CAUTION: External conduit boxes on motors shall be sized to accommodate oversized feeder conductors and as shown on the Drawings shall, in any case, not be less than one size larger than NEMA standards. The conduit boxes shall be diagonally split and rotatable in 90 degree steps. A gasket shall be furnished between the conduit box and frame. Motor leads shall be stranded copper wire, Class H or better insulated, non-wicking, with permanent identifications spaced 1-1/2-inches maximum. Clamp type grounding terminals shall be provided in the conduit boxes.

H. Lifting Eyes:
   1. Motors weighing more than 50 pounds shall be fitted with at least one lifting eye.

I. Current Imbalance:
   1. Current imbalance shall not exceed the values tabulated below when the motor is operating at any load within its service factor rating and is supplied by a balanced voltage system.
      a. Under five horsepower: Ten percent
      b. Five horsepower and above: Ten percent
   2. Imbalance criteria shall be based upon the lowest value measured.

2.5 MOTOR TYPES

A. The following Standard motor types shall conform to the following requirements:
   1. Horizontal Dripproof: Provide horizontal motors with an enclosure that meets NEMA Standard MG 1 for open, dripproof construction. Provide screen over all air openings.
   2. Horizontal Totally Enclosed Fan-Cooled: Provide totally enclosed fan-cooled (TEFC) motors with frame sizes 182 and larger with cast iron frames and end shields. Smaller frame sizes may be constructed of rolled steel with cast metal end shields. Provide motors with condensate drain holes. For frame size 286 and larger, provide automatic breather/drain device in drain hole.
   3. Vertical Weather Protected Type I: Provide vertical motors with an enclosure that meets NEMA Standard MG 1 for weather protected Type I (WP-I) enclosure. Provide screens over all air openings.

4. Vertical Totally Enclosed Fan-Cooled: Provide vertical motor with an enclosure identical to the requirements for the horizontal TEFC motors.
5. Explosion proof: Provide all horizontal and vertical motors with TEFC explosion proof enclosures, UL listed for Class 1, Division 1, Group D hazardous atmosphere.
6. Submersible: Submersible motors UL listed for explosion proof atmospheres in accordance with subsequent sections of this specification. In addition, provide submersible motors with two mechanical seals; the lower one outside the motor and protecting the upper one, which is in an oil filled chamber. Provide moisture detector probes in the oil filled seal chamber to indicate the presence of moisture in the seal chamber. Provide a temperature detector and switch rated 3 amperes, 120 volts minimum, set to operate when the internal motor temperature exceeds a preset limit. Provide any relays or solid state controls for separate mounting.
7. Horizontal, Totally Enclosed, Fan-Cooled, Severe Duty: Provide horizontal (TEFC), severe duty motors suitable for contaminated environments, including gasketed conduit box, stainless steel drains, double-shielded bearings, and corrosion resistant paint. Provide motors manufactured by Reliance Electric SXT-XT-XE, Century Type SCE E-Plus, or pre-approved equal.
8. Vertical, Totally Enclosed, Fan-Cooled, Severe Duty: Provide vertical (TEFC), severe duty motors with the requirements identical to horizontal (TEFC), severe duty motors, above.

2.6 PRODUCT DATA

A. The following information shall be provided for each motor in accordance with the individual equipment specification.
   1. Motor outline, dimensions and weight.
   2. Manufacturer’s general descriptive information relative to motor features.
   3. Where a winding over temperature device is required, provide a response curve for the temperature device.
   4. Applicable operation and maintenance information specified in Section 01730, Operation and Maintenance Data. Provided overhaul instructions for each motor five HP and over.

2.7 ACCEPTABLE PRODUCTS

A. The following manufacturer's motors generally meet the class and performance requirements of this specification when furnished with appropriate modifications and additional features as specified:
   1. General Electric Inc.
   2. Emerson US Motors.
   3. Siemens.
   4. WEG

PART 3 - EXECUTION

3.1 GROUNDING AND BONDING

A. Verify the circuit ground cable (green) is identified and connected to the grounding lug terminal in the conduit box.

B. Provide supplementary grounding by installing a bond from the motor frame to the grounding electrode system as indicated on the drawings.

3.2 FIELD TESTING

A. Verify breather/drain fittings have been installed as specified herein.

B. Provide winding insulation resistance testing for motors to be witnessed by owner or engineer before connection is complete. Winding insulation resistance shall be not less than 10-megohm measured with a 1000-VAC megohmmeter at 1-minute at or corrected to 40-degree C.

C. Provide motor phases current imbalance testing to be witnessed by owner or engineer.

D. Test motors in accordance with Specification 16920, Electrical Acceptance Testing.

++ END OF SECTION ++

SECTION 16282

SURGE PROTECTIVE DEVICES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
   1. Provide all labor, materials, equipment and incidentals as shown on the Drawings, specified and required to furnish and install surge protective devices (SPD) as a minimum for all 480 VAC and above panelboards, switchboards and motor control centers above 1,000 amp rating and where shown on the Drawings.
   2. These Specifications describe the electrical and mechanical requirements for a system of electrical surge protective device filter components integrating both surge suppression and electrical high frequency noise filtering.

1.2 QUALITY ASSURANCE

A. Manufacturer's Qualifications:
   1. Manufacturer shall have a minimum of five years experience of producing substantially similar equipment, and shall be able to show evidence of at least five installations in satisfactory operation for at least five years.

B. Referenced Standards. Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
   1. ANSI/IEEE (C62.41-1991 and C62.45-2002).
   2. National Electrical Code (NEC) 2011 version.
   3. NFPA (70 [NEC], 75 and 78).
   4. UL Standard No. 248-1, 1283 and 1449 Third Edition.
      a. Each system component shall be UL Standard No. 1283, Listed as an Electromagnetic Interference Filter.
      b. Each system component shall be UL Standard No. 1449, Third Edition, listed as a Surge Protective Device.

1.3 SUBMITTALS

A. Shop Drawings: Submit for approval the following:
   1. Electrical and mechanical drawings for each type of unit that shows electrical ratings, dimensions, weights, mounting provisions, connection details and layout diagrams.
   2. Provide complete copy of Warranty; refer to requirement of paragraph 2.2.G of this Specification.
   3. Provide verification that the SPD complies with the required UL Standard No. 1449 VPRs.

4. Provide actual let through voltage test data in the form of oscillograph results for the ANSI/IEEE C62.41 6kV/3kAcombination wave tested in accordance with ANSI/IEEE C62.45.
5. Provide spectrum analysis of each unit based on MIL-STD-220A test procedures between 50 kHz and 200 kHz verifying the device's noise attenuation exceeds 50 dB at 100 kHz.
6. Submit for approval the following:
    a. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
    b. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**

B. Operation and Maintenance Manuals:
1. Submit complete installation, operation and maintenance manuals including test reports, maintenance data and schedules, description of operation and spare parts information. Provide complete copy of Warranty. Refer to requirements of paragraph 2.2.G of this Specification.
2. Submit complete Operation and Maintenance Manuals in conformance with the Operation and Maintenance Manuals section of Section 01300, Submittals.

PART 2 - PRODUCTS

2.1 GENERAL

A. Unit Operating Voltage: The operating voltage shall be as shown on the Drawings.

B. Maximum Continuous Operating Voltage (MCOV): The MCOV shall be greater than 115 percent of the nominal system operating voltage.

C. Protection Modes: For a wye configured system, the device must have directly connected suppression elements between line-neutral (L-N), line-ground (L-G), and neutral-ground (N-G). For a delta configured system, the device must have suppression elements between line to line (L-L) and line to ground (L-G).

D. The maximum UL Standard No. 1449 VPR for the device must not exceed the following:
   1. Line to Neutral: 1200 volts.
   2. Line to Ground: 1200 volts.
   3. Neutral to Ground: 1200 volts.
   4. Line to Line: 2000 volts.

E. Surge Current Capacity: For branch applications, total surge current per phase (based on an 8x20 microsecond waveform) that the device is capable of surviving shall not be less than 250 kA per phase, or 125 kA per mode on L-G, L-N and N-G modes (Wye system); L-L and N-G (Delta system).

F. Let through voltage at the Motor Control Center Stabs: Upon request, the manufacturer must provide suppression test results measured at the motor control center bucket stabs.

2.2 DESIGN

A. Each circuit shall include arrays of fused Metal Oxide Varistors (MOV) to suppress voltage surges.

B. Balanced Suppression Platform: The surge current shall be equally distributed to all MOV components to ensure equal stressing and maximum performance. The surge suppression platform must provide equal impedance paths to each matched MOV. Designs incorporating SPD modules which do not provide a balanced impedance path to each MOV shall not be acceptable.

C. Electrical Noise Filter: Each unit shall include a high performance EMI/RFI noise rejection filter. Noise attenuation for electric line noise shall be 55 dB at 100 kHz using the MIL-STD-220A insertion loss test method. The unit shall be complimentary listed to UL Standard No. 1283. Products not able to demonstrate noise attenuation of 55 dB @ 100 kHz shall be rejected.

D. Internal Connections: No plug-in component modules or printed circuit boards shall be used as surge current conductors. All internal components shall be hardwired with connections utilizing low impedance conductors and compression fittings.

E. Safety and Diagnostic Monitoring. Each unit shall be equipped with 200 kAIC internal fuses. Each unit shall provide the following three levels of monitoring:

1. Continuous monitoring of fusing system.
2. Internal infrared sensor system for monitoring individual MOVs (including neutral to ground). The system must be capable of identifying open circuit failures not monitored by conventional fusing systems.
3. Thermal detection circuit shall monitor for overheating in all modes due to thermal runaway.

F. A green/red solid state indicator light shall be provided on each phase. The absence of a green light and the presence of a red light; shall indicate which phase(s) have been damaged. Fault detection will activate a flashing trouble light. Units will not be accepted if they cannot detect open circuit damage, thermal conditions, and over current.

G. Warranty: The manufacturer shall provide a full five year warranty from the Date of Shipment against any SPD part failure when installed in compliance with manufacturer's written instructions and National Electrical Code.

H. Product and Manufacturer: Provide one of the following:
1. Joslyn Electronic Systems Company.
2. Square "D" Company.
3. Liebert.
4. Current Technology.

2.3 ACCESSORIES

A. The unit must be equipped with surge event counter and audible alarm.

B. Remote Status Monitor. The SPD device must include Form C dry contacts (one N.O. and one N. C.) for remote annunciation of unit status to Computer Control System. The remote alarm shall change state if any of the three monitoring systems described detect a fault condition.

C. Push-To-Test Feature. Each suppression unit shall incorporate an integral test feature which verifies the operational integrity of the unit’s monitoring system.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Suppressors shall be installed inside the motor control center at the manufacturer’s factory.

B. To facilitate removal and inspection, the suppressor shall be mounted within a standard motor control center bucket.

C. The suppressor shall be mounted in a standard 12-inch NEMA 1 compartment. Conductor length between the suppressor and the stab shall be less than 5-inches. All units shall be internally fused with 200 kAIC. All status indicators and monitors shall be mounted on the front of the motor control center compartment for easy visibility.

++ END OF SECTION ++

SECTION 16307

15KV CLASS CABLE

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. This Specification covers single conductor 15,000 volt shielded copper power cable insulated with an ozone and discharge resistance flexible, rubber-like thermosetting dielectric for medium voltage applications which shall be suitable for use in wet and dry locations in conduit, cable tray, underground ducts, direct burial and aerial installations.

1.2 SUBMITTALS

A. Products shall be submitted to the ENGINEER for review in accordance with Section 16000, General Electrical Requirements, of the Specifications and other Contract Documents.

B. Product technical data including:
   1. Acknowledgment that products submitted meet requirements of standards referenced.
   2. Manufacturer's installation instructions.
   3. Complete catalog data showing compliance with complete Specifications.

C. Test Reports:
   1. The switchgear terminations manufacturer shall, upon request, furnish test reports which verify device stability with time, temperature, and stress variations.
   2. Motor Connection Kits:
      a. Meet or exceed the AC withstand and impulse requirements of IEEE 404 stand for power cable splices. Manufacturer shall provide test reports demonstrating compliance with this standard.
   3. When assembled on cables, the splice shall be capable of passing the electrical test requirements of IEEE 48, IEEE 404, and water immersion tests of IEEE 386. Splice manufacturer shall provide a test report demonstrating compliance with the above test requirements.

D. Licenses And Training:
   1. High Voltage Construction License (A-17).
   2. Certificates of training for their installers.

E. Drawings showing exact cable routing.

F. Provide, minimum 2 weeks prior to conduit installation, cable pulling calculations for review, showing the maximum cable tension. Sidewall pressure shall not exceed the manufacturer recommended value.

G. Submit AC withstand partial discharge (Corona) test X-Y plots after manufacture and prior to shipment.

H. Submit field test reports.

1.3 QUALITY ASSURANCE

A. Association of Edison Illuminating Engineers (AEIC).

B. Insulated Cable Engineers Association (ICEA) and National Electrical Manufacturers Association (NEMA):
   1. S-95-658/NEMA WC70 Ethylene-Propylene Rubber, Insulated Wire and Cable for Transmission and Distribution of Electrical Energy.

C. Institute of Electrical and Electronics Engineers:
   1. IEEE - 48, Standard test procedures and requirements for high-voltage alternating-current table.
   2. IEEE - 400, Guide for making high-direct-voltage tests on power cable systems in the field.
   3. IEEE - 386, Standard for separable insulated connector systems for power distribution systems above 600 V.
   4. IEEE - 404, Standard for cable joints for use with extruded dielectric cable rated 5,000 V through 46,000 V and cable joints for use with laminated dielectric cable rated 2,500 V through 500,000 V.
   5. IEEE - 1202, Vertical Tray Flame Test.

D. National Electrical Code (NEC).

E. Underwriters' Laboratories (UL):
   1. UL 1072, Standard for Safety Medium-Voltage Power Cables.

PART 2 - PRODUCT

2.1 15KV CLASS CABLE

A. The cables shall be single-conductors for 105º C continuous normal operation, 140º C emergency and 250º C for overload. They shall be constructed as follows: Conductor shall be stranded, Class B, annealed copper, covered with an extruded semi-conducting thermosetting strand screen, 220 mil ethylene propylene insulation, extruded thermosetting semi-conducting insulating screen, 5 mil annealed bare copper shielding tape with 25% minimum overlap, overall flame retardant PVC jacket. They shall be rated 15 kV, type MV-105, with 133%

insulation level. Conductor screen, insulation and insulation screen shall be applied using a triple extrusion process.

B. Cables shall be manufactured as per the applicable ICEA S-93-639, AEIC CS-8, UL 1072, and NEMA WC8 Standards. When in conflict, the more stringent test shall apply. The completed cables shall be tested for corona discharge per AEIC requirements. A copy of the original X-Y plot showing discharge levels shall be submitted with the certified test reports.

C. The pulling tension and side-wall pressures, as recommended by the cable manufacturer, shall not be exceeded. Pull boxes located as indicated on the Drawings are based on nominal pulling tension and side-wall pressures. Additional pull boxes shall be installed, as required, to meet the cable manufacturer's recommendations.

D. The cable manufacturer shall have a minimum of 15 years proven and successful experience with the manufacturing of EPR insulated cables at the facility from which the cable will be made.

E. Each reel of cable furnished shall be newly manufactured, (no more than 12 months old), and shall bear a tag containing name of manufacturer, NEC designation, and year of manufacture. Provide cable reels with both ends available for high potential testing before installation.

F. Other parts of the cable system such as joints and terminations shall have ratings not less than the rating of the cables on which they are installed. Separable insulated connectors shall have nominal voltage ratings coordinated to associated apparatus ratings rather than cable ratings when used to connect cable to apparatus.

G. Shields shall be applied as required to continue the shielding system through each entire cable joint. Shields may be integrally molded parts of performed joints. Shields shall be grounded at each joint. Separable insulated connectors of suitable construction or standard splice kits shall be used. Splice kits may be of the heat-shrinkable type for the rated voltage. Cable joints shall provide insulation and jacket equivalent to that of the associated cable.

H. 15 kV cable shall be manufactured by The Okonite Company, Rome Cable, General Cable, or equal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install cables in concrete encased underground chases or ducts as indicated on the Drawings.

1. Pull cables directly from reels.
2. Cable may not be laid on ground or otherwise handles for cutting or sorting.
3. Do not pull cables through more than one intermediate manhole on one pull.
4. Seal all cable ends against moisture after pulling.
5. Use non-metallic pull ropes to prevent cutting of duct material.
6. Pull cables from conductor. Do not use pulling sock that attaches to the insulation.
7. Install cables in manholes and hand-holes not utilizing the shortest route but routes along those walls providing the longest route and the maximum spare cable lengths.
8. Run all cables parallel to the walls, not interfering with the duct entrances.
9. Use proper stripping and terminating tools to ensure integrity of insulation.
10. Ground shield at all terminations and splices.
11. Maintain manufacturer's or NEC's minimum bending radius, whichever is larger.
12. Do not bend, kink or nick cable jacket or insulation.
13. Properly coat wires and cables with pulling compound recommended by cable manufacturer before pulling into conduits and prevent mechanical damage to conductors during installation:
    a. Other lubricants substituted must be accompanied by a statement from cable manufacturer as to its acceptable use with cables being installed.
14. Do not exceed pulling tension and sidewall pressures recommended by cable manufacturer. Install additional pull boxes as required to meet cable manufacturer's recommendations.
15. Electrical identification – As specified in Section 16195.
16. Use only tools that are recommended by the termination or splice manufacturer.
17. Use a dynamometer during cable pulling operations to monitor pulling tensions. Record all cable pulling tensions and provide report to engineer.
18. Fireproof all exposed portions of cables.
    a. Half lapped layer of fire and electric arc proofing tape; secured with double wrapped band of glass cloth electrical tape at each end.
19. Fire and electric arc proofing tape – 3M-Scotch #77.
20. Fireproof all exposed portions of cables.
    a. Half lapped layer of fire and electric arc proofing tape; secured with double wrapped band of glass cloth electrical tape at each end.
21. Fire and electric arc proofing tape – 3M-Scotch #77.
22. Fireproof all exposed portions of cables.
    a. Half lapped layer of fire and electric arc proofing tape; secured with double wrapped band of glass cloth electrical tape at each end.
    b. Fire and electric arc proofing tape – 3M-Scotch #77.
    c. Glass cloth – 3M-Scotch #69
    d. Self-fusing silicone rubber tape – 3M-Scotch #70

B. Coordinate work with other trades in order to avoid complications and interference.

C. Installation shall be such to readily provide for future expansions.

D. The cables shall be installed as per manufacturer's recommendation with appropriate equipments. Cables shall not be pulled with a truck, automobile, or similar equipment which may exceed the manufacturers' recommended cable specifications. The CONTRACTOR shall replace the cables at no cost to OWNER if such happens.

E. The installing contractor must be licensed for High Voltage Construction (A-17).

3.2 15 KV CABLE TESTS

A. Test cables in accordance with Specification 16920, Electrical Acceptance Testing.

B. All cables shall be tested after cables are in place and terminators have been installed on the cable ends.

C. Final field cable tests shall be witnessed by the ENGINEER.

D. Test procedures shall conform to the following standards applicable to the cable insulation under test:
   1. ICEA, -95-658 (Interim Standard No. 1), cable rated 0-35,000 volts and having ozone-resistant ethylene-propylene rubber insulation.
   2. IEEE, TD 400 Guide for making high-direct-voltage tests on power cable systems in the field.

E. Replace and retest any faulty cable or termination.

3.3 SWITCHGEAR TERMINATIONS (15 KV CLASS CABLE)

A. Terminations shall be stress cones type. Termination kits supplied shall be capable of properly terminating single conductor polymeric-insulated cable. Kits shall meet Class I requirements and be design proof tested per IEEE 48-1975 and be capable of passing a test sequence per draft and revisions of IEEE 404-1986. Kits as specified shall accommodate any common form of cable shielding/construction without the need for special adapters and accessories, and shall accommodate a wide range of cable sizes and, also, be capable of being properly installed on out-of-round or out-of-tolerance cable as per relevant ICEA Standards. Kits shall accommodate commercially available connectors.

B. Terminations for single conductor cables shall consist of heat shrinkable stress control and outer non-tracking insulation tubings along with a high relative permittivity stress relief mastic for insulation shield cutback treatment with a heat

activated sealant for environmental sealing. Three conductor kits shall contain necessary materials to seal the cable jacket, phase conductors, and any ground wires, as well as re-jacket phase and ground conductors.

C. The manufacture shall, upon request, be able to demonstrate 15 years of actual field experience and suitable accelerated and real-time testing of weather resistance. Test reports shall also be available, upon request, which verify device stability with time, temperature, and stress variations.

D. Termination kits shall be manufactured by Raychem Corporation or equal.

3.4 MOTOR TERMINATIONS (15 KV CLASS CABLE)

A. All feeder cable connections to unshielded motor leads shall be insulated and sealed with factory engineered kits. Motor connection kits shall consist of heat-shrinkable, corona resistant, polymeric insulating materials and a high dielectric strength mastic to seal the ends against ingress of moisture and contamination. Bolt connection area shall be kept fee of mastics and fillers to facilitate rapid stripping and re-entry.

B. Motor connection kits shall accommodate a range of cable sizes for both inline and stub type configurations. All connection kits shall be independent of cable manufacturer's tolerances.

C. Motor connection kits shall meet or exceed the AC withstand and impulse requirements of IEEE 404-1986 standard for power cable splices. Manufacturer shall provide test reports demonstrating compliance with this standard.

D. Motor connection kits shall be manufactured by Raychem Corporation or equal.

3.5 SPLICES (15 KV CLASS CABLE)

A. In general, cables shall be run without splices between termination and equipment. Splices shall be made only when authorized by the ENGINEER and only where cables have to be cut to meet manufacturer's pulling tension requirements or to meet manufacturer's maximum shield voltage requirement. Where cable splices are installed, the metallic shield shall be brought out of the overall jacket and grounded.

B. Power cable splices for shielded solid dielectric plastic cables shall be factory engineered kits containing all necessary components to reinstate primary cable insulation, metallic shielding, grounding system and overall jacket to the equivalent of the cable itself.

C. Splices shall be of a uniform cross section heat-shrinking polymeric construction utilizing a high dielectric strength insulating layer. The insulating layer shall be bonded to a conducting layer for shielding. The splice shall be rejacketed with a

heavy-wall, heat-shrinkable lined sleeve to provide a waterproof hot melt adhesive seal.

D. The splice shall accommodate a range of cable sizes and be completely independent of cable manufacturer's tolerances.

E. When assembled on cables, the splice shall be capable of passing the electrical test requirements of IEEE 48-1975, IEEE 404-1986, and water immersion tests of ANSI C119.2-1974.

F. Splice manufacturer shall provide a test report demonstrating compliance with the above test requirements.

G. Splices shall be manufactured by Raychem Corporation or equal.

3.6 WARRANTY

A. Fully warranty all Work under this Section, for a period of 20 years from the date of Final Acceptance by the OWNER, against imperfect workmanship or failure or malfunction of materials due to faulty or imperfect workmanship. Give this guarantee in writing to the Owner at the time of issuing Final Certificate. Work found to be defective within this period shall be replaced without cost to the OWNER.

3.7 ACCEPTANCE

A. As a condition precedent to final acceptance of the Work, the CONTRACTOR shall certify the material and installation included under this Section to be free of defects, and suitable for trouble-free operation under the conditions set forth in the manufacturer's warranty.

++ END OF SECTION ++

SECTION 16321

OIL FILLED SUBSTATION TRANSFORMERS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section covers liquid filled substation transformer(s) and its installation.

B. Scope:
   1. Provide the labor, materials, equipment, incidentals required to furnish and install power transformers 150 KVA and larger with copper windings, complete and operational, as specified and shown on the Drawings.

C. Coordination:
   1. Transformer, medium voltage switch, and medium voltage busway shall be manufactured by the same manufacturer to ensure compatibility of installation.

1.2 QUALITY ASSURANCE

A. Manufacturer's Qualifications:
   1. Manufacturer shall have a minimum of five years of experience of producing substantially similar equipment, and shall be able to show evidence of at least five installations in satisfactory operation for at least five years.

B. Reference Standards: Comply with applicable provisions and recommendations of the following, except where otherwise shown or specified.
   1. ANSI C57.12.00 – Standard General Requirements for Liquid-Immersed Distribution Power, and Regulating Transformers
   2. ANSI/IEEE C57.12.27 - Liquid Filled Transformers
   3. ANSI C57.12.90 – Test Code for Liquid-Immersed Distribution, Power and Regulating Transformers and Guide for Short-Circuit Testing of Distribution and Power Transformers.
   4. ANSI C57.13 – IEEE Standard Requirements for Instrument Transformers.
   5. ANSI C57.19.00 – IEEE Standard General Requirements and Test Procedure for Outdoor Power Apparatus Bushings.
   6. ANSI C57.19.01 – Performance Characteristics and Dimensions for Outdoor Apparatus Bushings.
   7. ANSI C57.91 – IEEE Guide for Loading Mineral-Oil-Immersed Transformers.
   8. ASTM D877 - Liquid Filled Transformers Testing
   9. ASTM D 3487 – Specifications for Mineral Insulating Oil Used in Electrical Apparatus.

10. National Electrical Code, as amended by the City of Chandler.

1.3 SUBMITTALS

A. Products shall be submitted to the Engineer in accordance with Section 16000 and other Contract Documents.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver materials to the site to ensure uninterrupted progress of the Work. Deliver anchor bolts and anchorage devices which are to be embedded in cast-in-place concrete in ample time to prevent delay of the Work.

B. Shipping:
   1. Impact recorders shall accompany the transformers during transit, if rail transit is required. Responsibility for inspecting the transformers and impact recorders in the presence of the ENGINEER upon arrival at destination to determine if any damage has occurred belongs to CONTRACTOR.
   2. ENGINEER shall be notified by CONTRACTOR at least 72 hours prior to shipment and by the manufacturer 24 hours prior to arrival of each transformer at the site.

C. All boxes, crates and packages shall be inspected by CONTRACTOR upon delivery to the site. Notify ENGINEER of any loss or damage exists to equipment or components. Replace loss and repair damage to new condition in accordance with manufacturer's instructions.

D. Store materials to permit easy access for inspection and identification. Keep all materials off the ground, using pallets, platforms or other supports. Protect steel members and packaged materials from corrosion and deterioration.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. The medium voltage switches in Specification 16341 shall be manufactured by the same manufacturer as the substation transformer.

B. The substation transformer(s) shall be manufactured by one of the following:
   1. Square D Company.
   2. Eaton.
   3. ABB.

2.2 SUBSTATION TRANSFORMER

A. Minimum transformer ratings shall be as follows:

*kVA Rating	300	500	750	1,000	1,500
Impedance	5%	5%	5.75%	5.75%	5.75%
*Primary Voltage	12470	12470	12470	12470	12470
*Secondary Voltage	480	480	480	480	480
HV BIL	95kV	95kV	95kV	95kV	95kV
HV Taps	± 2%	± 2%	± 2%	± 2%	± 2%
LV BIL	30kV	30kV	30kV	30kV	30kV
**Noise	58db	62db	65db	65db	65db
* Refer to Single Line diagrams for more information. ** Noise level is at 10 feet.					

B. The transformer shall carry its continuous rating with average winding temperature rise by resistance that shall not exceed 65 degrees C temperature rise, based on average ambient of 30 degrees C over 24 hours with a maximum ambient of 40 degrees C. The insulation system shall allow an additional 12% kVA output at 65 degrees C average winding temperature rise by resistance, on a continuous basis, without any decrease in normal transformer life.

C. Transformer shall include all devices, wiring, fans, control power transformer, and auxiliary equipment necessary for automatic temperature controlled forced air cooling to obtain an additional 15% capacity on units 750 through 2000 kVA and an additional 25% capacity on units 2500 kVA and over. Fan motors shall be single phase, capacitor start, 230 volts, single phase. Fans shall be built in accordance with IEEE, NEMA, and ANSI standards.

D. Transformer shall include a NEMA 4X, stainless steel control cabinet for power, control, alarm and current transformer connections. Enclosure shall be padlockable.

E. The transformer(s) shall be the substation type with side-wall mounted primary and secondary terminations. Coolant and insulating fluid shall be inhibited mineral oil. Terminations shall be side-wall mounted for close-coupling to high and low voltage switch-gear sections. Bushing location and phase rotation shall be coordinated with primary and secondary switchgear to provide correct alignment when switchgear and transformer are connected in the field.

F. The transformer shall be designed to carry short time emergency overloads in accordance with ANSI C57.92 and NEMA TR 98 as applicable. Duration and magnitude of designed withstand capability shall be as outlined in ANSI C57.12 and the latest draft of the IEEE Short Circuit Test Code.

G. Transformer features and accessories shall include:
   1. De-energized tap changer with cover mounted, two 2.5% taps above and below rated voltage, externally operated, padlockable handle.

2. Drain and filter press valve, globe type, 2-inch NPT female with 0.375-inch sampler.
3. Top filter press valve, globe type, 1-inch NPT female on top of tank.
4. Lightning arrestors on the primary.
5. Manual gas pressure test connection.
6. Vacuum filling connection, 2-inch NPT male, on top of main transformer tank.
7. Liquid temperature indicator with two Form “C” contacts. Dial calibration of this indicator shall be in degrees Celsius with one pointer to indicate present liquid temperature and a second, red pointer to indicate previous maximum temperature. Provide external reset for red pointer and mount gage no higher than five feet above ground.
8. Winding temperature indicator with two, Form “A” contacts and one Form “C” contact. Dial calibration of this indicator shall be in degrees Celsius with one pointer to indicate present liquid temperature and a second, red pointer to indicate previous maximum temperature. Provide external reset for red pointer and mount gage no higher than five feet above ground.
9. Pressure vacuum gage.
10. Magnetic liquid level indicator with low alarm.
11. Lifting facilities for cover, core and entire transformer.
12. Jacking facilities.
13. Base designed for skidding or rolling in two directions
14. Two tank copper grounding pads for 4/0 bare copper ground cable.
15. Instruction nameplate.
16. Diagrammatic, stainless steel nameplate.
17. Welded-on main tank cover with handhole in cover.
18. Self-resetting, pressure relief device.
19. Fault pressure relay designed to operate on the sudden, abnormal change of pressure in the transformer due to a fault. Relay shall have one Form "C" contact.
20. Provide the required volume of oil to place transformer into service.

H. All windings shall be copper.

I. The main transformer tank and attached components shall be designed to withstand pressures 25% greater than the required operating design value without permanent deformation. Construction shall consist of carbon steel plate reinforced with external sidewall braces. All seams and joints shall be continuously welded.

J. Each radiator assembly shall be individually welded and receive a quality control pressurized check for leaks. The entire tank assembly shall receive a similar leak test before tanking. A final six hour leak test shall be performed after the transformer is tanked, welded and completed to ensure that there are no leaks before shipment from the factory. Each radiator assembly shall include

removable type shutoff valves at top and bottom of radiators to permit removing radiators without draining transformer oil.

K. Each transformer shall be painted utilizing an initial phosphatizing cleaning treatment, followed by a baked-on epoxy primer, an intermediate paint coat, and a finish coat of light gray (ANSI 70) paint. Total dry film thickness shall be three mils, minimum. Transformers are outdoor type.

L. As a minimum, perform the following tests. All tests shall be in accordance with the latest revision of ANSI Test Code C57.12.90 and/or NEMA TR1 and in accordance with the requirements of Specification 16920 – ELECTRICAL ACCEPTANCE TESTING:
   1. Resistance measurements of all windings on the rated voltage connection of each unit and at the tap extremes of one unit only of a given rating on this project.
   2. Ratio tests on the rated voltage connection and on all tap connections.
   3. Polarity and phase-relation tests on the rated voltage connections.
   4. No-load loss at rated voltage on the rated voltage connection.
   5. Exciting current at rated voltage on the rated voltage connection.
   6. Impedance and load loss at rated current on the rated voltage connection of each unit.
   7. Temperature Test or tests shall be made on one transformer unit. When a transformer is supplied with auxiliary cooling equipment to provide more than one kVA rating, temperature tests as listed above shall be made on the lowest kVA OA or AA rating and the highest kVA FA rating.
   8. Applied potential test.
   9. Induced potential tests.
   10. Standard ANSI impulse tests on all windings of one unit if test data is not available on an essentially duplicate unit performed within the last two years.
   11. See specification 01756 – Commissioning and Start up.

M. Results of the above tests including no load loss data shall be submitted with final drawings in the form of certified test reports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Inspect to confirm that all items and accessories are in accordance with specifications and Drawings.

B. Verify field measurements are as shown on Shop Drawings.

3.2 INSTALLATION

A. Install equipment in accordance with the requirements of the National Electrical Code and project specifications.

B. Installation of equipment shall be such that sufficient access and working space is provided for ready and safe operation and maintenance.

C. Install equipment on concrete pad, as indicated on Drawings. Coordinate exact pad dimensions with equipment furnished. Comply with the requirements of Section 05190, Mechanical Anchoring and Fastening to Concrete and Masonry.

D. Switchgear(s) shall be mounted on concrete pads. Units shall be carefully installed so as not to scratch finishes. After installation, finished surfaces shall be inspected and scratches touched up with a finish furnished by the manufacturer especially for this purpose.

E. Concrete pads shall be constructed as indicated. Tops of concrete pads shall be level and shall project 4 inches above finished grade and sloped to drain. Conduits for primary, secondary, and grounding conductors shall be set in place prior to pouring of concrete pads.

3.3 FIELD INSPECTION AND TESTS

A. Set taps for proper voltage at service distribution equipment.

B. Provide the services of an authorized representative of the equipment manufacturer to make site visits to supervise the field testing and installation to be performed by the Contractor. The manufacturer's representative shall state in writing that the equipment has been correctly installed and tested.

C. Test in accordance with Specification 16920, Electrical Acceptance Testing.

D. The manufacturer's representative shall supply results of all factory and field tests in writing for submittal to the ENGINEER.

++ END OF SECTION ++

SECTION 16341

MEDIUM-VOLTAGE SWITCHES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
   1. Provide all labor, materials, equipment and incidentals, including concrete pad, as shown on the Drawings, specified and required to furnish and install free-standing metal enclosed, medium-voltage switches complete and operational. The switch shall be configured in a single switchgear assembly consisting of one load interrupter switch to feed one, fused circuit.
   2. Provide key interlocks to prevent opening of the front door of each vertical section containing a switch, unless the switch is locked open. Each switch assembly shall consist of a deadfront, completely metal enclosed vertical section with a 15 KV, 600 amp, interrupter switch.
   3. Where located outdoors, each switchgear assembly shall be bus connected to an outdoor, liquid-filled, unit substation type transformer. See Specification 16321, Oil Filled Substation Transformers. Where located indoors, each switchgear assembly shall be bus connected to a cast coil, dry-type, unit substation transformer.
   4. Medium-voltage switches shall be manufactured by the same manufacturer as the oil-filled substation transformers in Specification 16321.

1.2 QUALITY ASSURANCE

A. Manufacturer's Qualifications:
   1. Manufacturer shall have a minimum of five years of experience of producing substantially similar equipment, and shall be able to show evidence of at least five installations in satisfactory operation for at least five years.

B. Reference Standards: Comply with applicable provisions and recommendations of the following, except where otherwise shown and specified.
   1. ANSI C37.20.3.
   2. ANSI C37.20.4.
   3. ANSI C37-57, Switchgear-Metal-Enclosed Interrupter Switchgear Assemblies-Conformance Testing.
   4. ANSI C37.58, Conformance Test Procedures for Indoor AC Medium Voltage Switches for Use in Metal-Enclosed Switchgear.
   5. NEMA SG-5, Power Switchgear Assemblies.
   6. National Electrical Code, Article 490, over 600 V, nominal including Article 490-21(e).

1.3 SUBMITTALS

A. Shop Drawings: Submit for approval the following:
   1. Manufacturer's technical information for equipment proposed for use. Submittals shall include the following:
      a. Dimensional information.
      b. Three-line diagrams.
      c. Technical specifications.
      d. Catalog cuts.
      e. Construction details of enclosure.

B. Certification of Ratings: Submit for approval copies of certifications as follows:
   1. The integrated switchgear assembly shall have a BIL rating established by test on switchgear of the type to be furnished under this Specification. Certified test abstracts establishing such ratings shall be furnished.

C. Operation and Maintenance Manuals:
   1. Submit complete installation, operation and maintenance manuals including test reports, maintenance data and schedules, description of operation and spare parts information.
   2. Furnish operation and maintenance manuals in conformance with the requirements of Section 01782, Operation and Maintenance Data.

PART 2 - PRODUCTS

2.1 RATINGS

A. The distribution system will be grounded wye.

B. The ratings for each integrated switch assembly shall be as designated below:
   1. Nominal System Voltage: 12,470 V, three-phase, four-wire.
   2. System Grounding: Solid.
   3. Maximum Design Voltage: 15 KV.
   4. Basic Impulse Level: 95 KV.
   5. Bus Continuous Current: 600 amps.
   6. Momentary: 40,000 amps.
   7. Fault Close: 40,000 amps.
   8. Two seconds rated short time current (two seconds): 25,000 amps.

2.2 MATERIALS

A. General:
   1. Each metal-enclosed switchgear assembly shall consist of one, outdoor or indoor as required, self-supporting bay with interrupter switch and all necessary hardware and adaptor throat for copper bus connection to a unit substation type transformer.

B. Interrupter Switch:
   1. The switch shall be load-interrupting type and shall be quick-make, quick-break with stored energy operation. The switch shall have insulating barriers between phases and between outer phases and the enclosure.
   2. The switch shall be three-pole, gang operated utilizing a heavy duty coil spring to provide opening and closing action of the switch. The spring charging mechanism shall consist of a rigid metal-to-metal linkage.

C. Fuses:
   1. Fault protection shall be furnished by current-limiting fuses rated as shown on the Drawings. The fuses shall have a minimum symmetrical interrupting rating of 120,000 amps at 15 KV and shall be Mersen/Ferraz Shawmut LLC Type EJO-1 power fuse, or equal. Furnish three spare fuse refills for each fused switch.

D. Main Bus:
   1. Power bus shall be tin-plated copper. Ground bus shall be full length, copper. The main bus shall have epoxy flame-retardant, track-resistant insulation. Bus supports between units shall be shall be flame-retardant, track-resistant, porcelain. The bus shall be braced to withstand fault currents equal to the close and latch rating of the circuit breakers contained therein.
   2. Furnish cable terminators for all incoming and outgoing cables.

E. Weatherproof Enclosure:
   1. Where located outdoors, the switches shall be completely enclosed in a heavy gauge steel weatherproof enclosure. The enclosure shall include the following:
      a. Space heater with adjustable, differential type thermostat.
      b. Gasketed doors and covers.
      c. Three-point latches on each door.
      d. Provisions for padlock on each door.
      e. Hinged rear doors (padlock able).
      f. Steel floor channels.
      g. Viewing window.
      h. Sloped roof.
      i. Finish shall be ANSI-61, light gray.

F. Additional Controls:
   1. Furnish a control power transformer for serving space heaters and other auxiliary loads.
   2. Furnish all necessary wiring and auxiliary devices including current and potential transformers.

G. Conductors:
   1. Small wiring, fuse blocks, and terminal blocks within each vertical section shall be furnished as shown on the Drawings and as required. Each control wire shall be labeled with wire markers. Control wiring shall be Type SIS, No. 14 AWG

minimum. Terminal blocks shall be provided for customer connections to other apparatus.

2. Furnish all internal wiring for 120/240 volt, auxiliary power.

H. Additional Equipment:

1. 13.2 KV intermediate class surge arresters shall be provided and connected at the incoming terminations on each phase and securely grounded to the metal structure.

I. Manufacturer's Nameplates:

1. Factory installed engraved manufacturer's nameplates, mounted on the face of the assembly, and shall be furnished for all main, tie and feeder breakers. These nameplates shall be in accordance with Specification 16195, Electrical Identification, or match existing, secured with stainless steel screws. These nameplates shall also contain item designation, equipment served, switch size and fuse rating.
2. All control components within the assembly shall be identified in correspondence to appropriate designations on the manufacturer's wiring diagrams.

J. Product and Manufacturer: Provide one of the following:

1. Square "D" Company, Model HVL.
2. Eaton, Model HVS.
3. Or equal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install equipment so that sufficient access and working space is provided for ready and safe operation and maintenance.

B. Install equipment on concrete pad, as shown on the Drawings. Coordinate the pad dimensions to fit equipment furnished.

C. Install in accordance with the National Electrical Code.

3.2 FIELD INSPECTION AND TESTS

A. Provide the services of an authorized service representative of the equipment manufacturer to make site visits to supervise the field-testing to be performed by CONTRACTOR. The manufacturer's representative shall inform the OWNER if the equipment has been correctly installed and shall submit the factory and field test results to the OWNER. The manufacturer's representative shall certify, in writing, that the equipment has been installed, adjusted and tested in accordance with the manufacturer's recommendations.

B. Perform the following minimum tests and checks before energizing equipment:
   1. Perform insulation resistance tests on each bus section, phase-to-phase and each phase-to-ground for a period of one minute at 2500 volts DC.
   2. After successful completion of insulation resistance test, perform an overpotential test on each bus section, each phase-to-ground for a period of one minute at manufacturer's recommended voltage.
   3. Inspect all mechanical and electrical interlocks for proper operation.
   4. Perform insulation resistance test on all control wiring at 1000 volts DC after disconnecting devices.

C. The manufacturer shall supply test results to confirm that the switchgear assembly design has been tested to substantiate conformance with the applicable ANSI and NEMA Standards. The tests shall verify not only the performance of the switch or integrated switch and fuse, but also the suitability of the enclosure venting, rigidity and bus bracing. In addition, the switchgear assembly shall be factory tested in accordance with all applicable ANSI Standards and the Contract Documents.

D. Perform any other tests recommended by the equipment manufacturer.

3.3 MANUFACTURER'S SERVICES

A. A factory trained representative shall be provided for installation supervision, start-up and test services and operation and maintenance personnel training services. The representative shall make a minimum of 3 visits, minimum 8 hours on-site for each visit, to the site. The first visit shall be for assistance in the installation of equipment. The second visit shall be for checking the completed installation and start-up of the system. The third visit shall be as described under Division 1 Requiremetns. Manufacturer's representative shall test operate the system in the presence of the ENGINEER and verify that the medium-voltage switches conform to requirements. Representative shall revisit the job site as often as necessary until all trouble is corrected and the installation is entirely satisfactory.

B. All costs, including travel, lodging, meals and incidentals, shall be considered as included in CONTRACTOR’S bid price.

++ END OF SECTION ++

SECTION 16343

MEDIUM VOLTAGE METAL-CLAD SWITCHGEAR

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
   1. Provide all labor, materials, equipment and incidentals as shown on the Drawings, specified and required to furnish and install an indoor EUSERC rated, free-standing metal enclosed, 15 KV switchgear lineup complete and operational. The metal enclosed switchgear assembly shall consist of deadfront, completely metal enclosed 15KV vertical sections. Provide 120 volt VAC system for switchgear control power. The switchgear control power shall be derived from a supplied control power transformer. Both switchgear vertical assemblies will have a section dedicated for future controls of automatic switch transfer and future generator breaker. The assembly shall also include all other sections as indicated on the Drawings. A neutral lug will be provided in the SRP metering section. Each section shall meet the requirements of Salt River Project (SRP). Electrical Service Specification. Provide all high voltage metering and service equipment requirements and coordination as specified in the Salt River Project (SRP) Electrical Service Specifications 2013, section 9-62 through 9-71.
   2. The latest version of this document can be found at http://www.srpnet.com/electric/business/specs/.

B. The manufacturer of the 15 KV switchgear shall also be the manufacturer of all major components therein. Manufacture shall be Square D or Eaton Cutler Hammer.

C. The switchgear and associated circuit breakers should be UL listed and approved by SRP for EUSERC Service.

1.2 QUALITY ASSURANCE

A. Manufacturer's Qualifications:
   1. Manufacturer shall have a minimum of five years of experience of producing substantially similar equipment, and shall be able to show evidence of at least five installations in satisfactory operation for at least five years.

B. Reference Standards: Comply with applicable provisions and recommendations of the following, except where otherwise shown and specified.
   1. ANSI C37.010 Application Guide for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis.
   2. ANSI C37.04 (SG-2), Rating Structure for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis. High Voltage Fuses.

3. ANSI C37.06, Switchgear-AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis. Preferred rating of Power Circuit Breakers
4. ANSI C37.09 (SG-4), Test Procedure for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis.
5. ANSI C37.11 (SG-5), Power Circuit Breaker Control Requirements.
6. ANSI C37.20.2, Metal-clad and Station-Cubicle Switchgear.
7. ANSI C37.90, Standard for Relays and Relay Systems Associated with Electric Power Apparatus.
8. ANSI C37.100, Definitions for Power Switchgear.
9. ANSI C57.13, Instrument Transformers, Standards for.
10. NEMA SG-2, High Voltage Fuses.
11. NEMA SG-4, Alternating Current High Voltage Power Circuit Breakers.
12. NEMA SG-5, Power Switchgear Assemblies.
13. National Electrical Code, Article 490, Equipment, Over 600 Volts, Nominal.
14. UL Standard No. 1670.
15. C37.010 Application Guide for Power Circuit Breakers.

C. For the equipment specified herein, the manufacturer shall be ISO 9000, 9001 or 9002 certified.

1.3 SUBMITTALS

A. Shop Drawings: Submit for review and approval the following:
   1. Submit for approval, to both the ENGINEER and Owner 4 copies of manufacturer's technical information for equipment proposed for use. Submittals shall include the following:
      a. Dimensional information.
         1) Front view elevation
         2) Floor Plan with conduit entries indicated.
         3) Top view.
         4) Construction details of enclosure.
      b. One-line diagrams.
         1) Supply major medium – voltage cable lengths sizes and construction.
         2) Supply system available short-circuit capability in symmetrical MVA (plus X/R ration or per unit R+jX on a given basis).
         3) Verify that all circuit conductors are applied within the conductor short circuit heating limit.
      c. Technical specifications.
   2. Assembly rating including:
      a. Short-circuit rating.
      b. Voltage.
      c. Continuous current.
      d. Basic impulse level (BIL) for equipment over 600 volts.
      e. Catalog cut sheets. Cable terminal sizes.
      f. Schematic control diagrams for breaker control and all other controls.
      g. Component list/Bill of material.

h. Master drawing index.
i. Nameplate Schedule.
j. Product data sheets.

3. Additional information shall be submitted to the ENGINEER where applicable.
   a. Bus way connection.
   b. Connection details between close-couple assemblies.
   c. Composite floor plan of close-coupled assemblies.
   d. Descriptive bulletins.
   e. Anchoring details of the gear to the floor. See 1.01 Qualifications.
   f. Provide a control diagram and connection diagram showing all the switches, fusing, indicator lights of the power on, breaker open, and breaker closed as well as the on - off switch status, the open breaker button and the close breaker button on the front of the breaker door located in the switchgear. The manufacturer shall provide the rating of the 120VAC Control Power Transformer required to accommodate the requirements of all 15 kV breakers protective relays and switchgear device requirements.
   g. Provide a letter from the electric utility stating that the utility metering compartment meets all utility requirements.

1.4 QUALIFICATIONS

A. Provide Seismic qualified equipment as follows:
   1. The equipment and major components shall be suitable for and certified by actual seismic testing to meet all applicable seismic requirements of the latest International Building Code (IBC). The equipment will be installed in Chandler Arizona, USA.
   2. The Project Structural Engineer will provide site specific ground motion criteria for use by the manufacturer to establish SDS values required.
   3. The IP rating of the equipment shall be 1.5.
   4. The Structural Engineer for the Site will evaluate the SDS values published on the Manufacturer's website to ascertain that they are "equal to" or "greater than" those required for the Project Site.
   5. The following minimum mounting and installation guidelines shall be met, unless specifically modified by the above referenced standards.
      a. The Contractor shall provide equipment anchorage details, coordinated with the equipment mounting provision, prepared and stamped by a licensed civil engineer in the state. Mounting recommendations shall be provided by the manufacturer based upon the above criteria to verify the seismic design of the equipment.
      b. The equipment manufacturer shall certify that the equipment can withstand, that is, function following the seismic event, including both vertical and lateral required response spectra as specified in above codes.
      c. The equipment manufacturer shall document the requirements necessary for proper seismic mounting of the equipment. Seismic qualification shall be considered achieved when the capability of the equipment, meets or exceeds the specified response spectra.

B. Certification of Ratings: Submit for approval copies of certifications as follows:
   1. The integrated switchgear assembly shall have a BIL rating established by test on switchgear of the type to be furnished under this Section. Certified test abstracts establishing such ratings shall be furnished.

C. Operation and Maintenance Data:
   1. Submit complete installation, operation and maintenance manuals including test reports, maintenance data and schedules, description of operation and spare parts information.
   2. Furnish Operation and Maintenance Manuals in conformance with requirements of Section 01782, Operation and Maintenance Data.

D. Submittals - For Construction:
   1. The following information shall be submitted for record purposes to both the Engineer and OWNER - 4 copies of the Manufacturing Technical Information.
      a. Final as-built drawings and information for items listed in Submittals 1.3, and shall incorporate all changes made during the manufacturing process.
      b. Wiring diagrams /Schematic control diagrams for breaker controls and other control systems.
      c. Installation information including equipment anchorage provisions.
      d. Seismic certification as specified in Qualifications above.
      e. Certified production test reports.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver materials to the site to ensure uninterrupted progress of the Work. Deliver anchor bolts and anchorage devices which are to be embedded in cast-in-place concrete in ample time to prevent delay of the Work.

B. All boxes, crates and packages shall be inspected by CONTRACTOR / Owner upon delivery to the site. Notify ENGINEER of any loss or damage exists to equipment or components. Replace loss and repair damage to new condition in accordance with manufacturer's instructions.

C. Equipment shall be handled and stored in accordance with manufacturer's instructions. One copy of these instructions shall be included with the equipment at time of shipment.

D. Shipping groups shall be designed to be shipped by truck, rail, or ship. Indoor groups shall be bolted to skids. Breakers and accessories shall be packaged and shipped separately.

E. Switchgear shall be equipped to be handled by crane. Where cranes are not available switchgear shall be suitable for skidding in place on rollers using jacks to raise and lower the groups.

F. Switchgear being stored prior to installation shall be stored so as to maintain the equipment in a clean and dry condition. Switchgear shall have provisions for heaters. If stored outdoors, indoor gear shall be covered and heated and outdoor gear shall be heated.

PART 2 - PRODUCTS

2.1 RATINGS

A. The distribution system will be solidly grounded wye.

B. The ratings for the integrated switchgear assembly shall be as designated below:
   1. Nominal System Voltage: 12.47 KV, three phase, four wire.
   2. System Grounding: Solid.
   3. Maximum Design Voltage: 15 kV.
   4. Basic Impulse Level: 95 kV. (BIL:105kV for SRP SES requirement see Section 1.1 A. 1. Electrical Service Specification).
   5. Bus Continuous Current: 1200 Amperes.

C. Each circuit breaker shall have the following ratings.
   1. Maximum voltage peak- BIL - Basic Impulse Level: 95kV.
   2. Continuous current at 15 kV: 1200A.
   3. Short Circuit Current at rated Maximum Voltage: 40 kA RMS sym.
   4. Rated Voltage Range Factor K: K = 1.
   5. Closing and Latching Capability: 104 kA peak.
   6. Maximum Symmetrical Interruption and 2 second rating: 63kA RMS Sym.
   7. Rated Interrupting /time; 3 cycle-standard for 15 kV K=1 Breaker.

2.2 MATERIALS

A. General:
   1. The metal-enclosed switchgear assembly shall consist of multiple, self-supporting bays. The sections shall contain drawout vacuum circuit breakers and controls as shown on the Drawings. Breakers shall be dual stacked in an enclosure. Two rear covers shall be furnished for each vertical section for circuit isolation and ease of handling.

B. Construction:
   1. The switchgear shall consist of a stationary structure constructed from individual vertical sections as shown on the Drawings. The vertical sections shall be bolted together to form a rigid metal-clad switchgear assembly. Metal sheets shall provide grounded metal barriers between adjacent sections.
   2. Each breaker compartment shall be equipped to house a removable breaker element. The breaker levering mechanism shall be cell mounted. A metal shutter shall be positively driven by the breaker racking mechanism to cover the stationary primary disconnecting contacts when the breaker is in the

disconnected position or out of the cell. Rails shall allow the withdrawal of each circuit breaker for inspection and maintenance without the use of a separate lifting device. Breaker can be moved to disconnected position within the enclosure. Lift truck shall be required to move the breaker out of the cubicle for maintenance.

3. Blocking devices shall interlock breaker frame sizes to prevent installation of a lower ampere rating or interrupting capacity element into a compartment designed for one of a higher rating.
4. The racking mechanism to move the breaker between positions shall be operable with the front door closed and position indication shall be visible with door closed.

C. Bus:
   1. Power bus shall be tin-plated copper and insulated.
   2. Ground bus shall be full bare copper and extend the entire length of the switchgear.
   3. The main bus shall have epoxy flame-retardant, track-resistant insulation. Bus supports between units shall be shall be flame-retardant, track-resistant, glass polyester. The bus shall be braced to withstand fault currents equal to the close and latch rating of the circuit breakers contained therein.
   4. All power terminations shall be single conductor potheads for single conductor, copper conductors.
   5. All bus joints shall be plated, bolted and insulated with easily installed boots. The temperature rise of the bus and connections shall be in accordance with ANSI standards and documented by design tests. All hardware used to assemble switchgear will be specified and supply by manufacturer.
   6. All sections indicated as "SPACE" on the Drawings shall be provided with all necessary provisions for a future, 1200 amp circuit breaker.

D. Circuit Breakers:
   1. Each circuit breaker shall be horizontal, draw-out type, capable of being withdrawn on rails. The breakers shall be operated by a motor-charged spring stored energy mechanism. The spring may be charged manually in an emergency or during maintenance procedures.
   2. Each circuit breaker shall have three vacuum interrupter assemblies that are separately mounted on glass polyester insulators. Each vacuum interrupter pole unit shall be mounted on glass polyester supports Each vacuum interrupter assembly shall have a contact wear indicator which does not require any tools to indicate the contact wear. The current transfer from the vacuum interrupter moving stem to the breaker main conductor shall be a non-sliding design. The circuit breaker shall not utilize air or oil dash pots for minimizing vacuum interrupter contact "bounce," upon opening.
   3. Each circuit breaker shall meet the requirements of ANSI Standards, C37.010, C37.04, C37.06, C37.07, C37.09, C37.11, C37.100, and shall have the ratings indicated in section 2.1 C.

4. Each breaker shall have the number of status (52a and 52b) contacts as required by the Drawings and four mechanism cell switches (switches close when circuit breaker is in the "TEST" or "WITHDRAWN" position).
5. The breaker front panel shall be removable when the breaker is withdrawn for ease of inspection and maintenance.
6. The secondary contacts shall be silver-plated and shall automatically engage in the breaker operating position, which can be manually engaged in the breaker test position.
7. Interlocks shall be provided to prevent closing of a breaker between operating and test positions, to trip breakers upon insertion or removal from stationary structure and to discharge stored energy mechanisms upon insertion or removal from the stationary structure. The breaker shall be secured positively in the stationary structure between and including the operation and test positions.
8. The breaker shall be electrically operated by the 120VAC control voltage. For AC control a capacitor trip device is used with each circuit breaker shunt trip to ensure that the energy will be available for tripping during fault conditions. A control power transformer is required on the source side of each incoming line breaker. The control power transformer may also supply other AC auxiliary power requirements of the switchgear.
9. Product and Manufacturer: Provide one of the following:
    a. Square D: VR Series Breaker.
    b. Eaton: 150 VCP-WS 40.

E. Protective Distribution Relay (Main breakers):
1. Each 15 KV circuit breaker shall be provided with a multifunctional, microprocessor based front panel mounted over current trip device relay, providing current, voltage, and frequency protection , which shall operate from 120 VAC control power with the following ANSI device functions: 51/50, 51N/50N, 50BF, 25, 27, 32, 46, 47, 55, 59, 59N, 67, 79, 81O, 81U, 86, and including metering functions as follows:
2. The device shall sense true RMS current in each phase and ground. The ground element shall be capable of either residual ground fault, (neutral return-unbalanced phases) or zero sequence ground fault detection or deactivation.
3. The unit shall provide the following protective functions:
    a. Phase/ground/neutral time overcurrent: 50/51, 50/51N
    b. Negative sequence time overcurrent. (Unbalanced currents).
    c. Over frequency.
    d. Under frequency.
4. The unit shall have the following additional features:
    a. Display of individual phase currents, ground current, magnitude and phase of trip current, peak current for each phase and ground since last reset, and CT ratio.
    b. Total harmonic distortion.
    c. Adjustable CT ratio.
    d. Separate time-overcurrent (ANSI 51) and instantaneous (ANSI 50) trip contacts.

e. Unit failure alarm contact.
f. Trip alarm contact.
g. Programmable lockout or self-reset after trip. Integral manual testing.

5. Communications Capability:
   a. Eight relay outputs.
   b. Seven analog outputs.
   c. Four analog inputs.
   d. Three relay inputs.
6. Product and Manufacturer: Provide one of the following:
   a. Square D: SEPAM S82.
   b. Eaton: EDR-5000 Distribution Protective Relay.

F. Protective Relaying (Transformer Feeder):
1. Each 15 KV circuit breaker feeding the transformers shall be provided with a front-panel mounted microprocessor based relay, overcurrent trip device which shall operate from 120 VAC control power. The device shall sense true RMS current in each phase and ground. The ground element shall be capable of either residual or zero sequence ground fault detection or deactivation. ANSI device function 87T, 87GD, and 50/51G for neutral and 51/50 &51N/50N for Primary and secondary windings, and metering functions as follows:
2. The unit shall provide the following protective functions:
   a. Phase/ground/neutral time and instantaneous overcurrent.
   b. Breaker failure.
   c. Manual close control.
3. The unit shall have the following additional features:
   a. Display of individual phase currents, ground current, magnitude and phase of trip current, peak current for each phase and ground since last reset, and CT ratio.
   b. Adjustable CT ratio.
   c. Separate time-overcurrent (ANSI 51) and instantaneous (ANSI 50) trip contacts.
   d. Unit failure alarm contact.
   e. Trip alarm contact.
   f. Programmable lockout or self reset after trip.
   g. Integral manual testing capability.
   h. Zone-selective interlocking capability for short time and ground fault protection.
4. Communications Capability:
   a. Eight relay outputs.
   b. Seven analog outputs.
   c. Four analog inputs.
   d. Three relay inputs.
5. Product and Manufacturer: Provide one of the following:
   a. Square D: Sepam T42.
   b. Eaton: ETR-4000 Distribution Protective Relay.

G. Additional Controls and Equipment:
   1. Provide provisions in each 15KV metal clad switchgear units that will accommodate space for a future Automatic Transfer Control for each of the future generators.
   2. Furnish all necessary wiring and auxiliary devices including current and potential transformers, control power transformers and control relays. Control relay contacts shall be adequately rated for the currents to be switched.
   3. 15 KV intermediate class surge arresters shall be provided and connected at the incoming terminations for each line and securely grounded to the metal structure.
   4. Mimic bus, plastic.
   5. All breakers shall include a manually resettable, lockout (Device No. 86) relay. Relay shall have the quantity and type of contacts as required by the Drawings and shall be Manufacturer standards.
   6. One SRP metering section shall be provided for each incoming line and shall have a complete metering section built in accordance with all applicable SRP standards and requirements. Doors shall have provisions for padlocking.

H. Conductors:
   1. Small wiring, fuse blocks, and terminal blocks within each vertical section shall be furnished as shown on the Drawings and as required. Each control wire shall be labeled with wire markers. Control wiring shall be Type SIS, No. 14 AWG, and minimum wire gauge size. Terminal blocks shall be provided for customer connections to other apparatus.
   2. Furnish all internal wiring for controls, and AC power circuits.

I. Instrument Transformers:
   1. Ring type current transformers shall be furnished as specified, as shown on the Drawings and verified by the Power System Study. The thermal and mechanical ratings of the current transformers shall be coordinated with the circuit breakers. Their accuracy rating shall be equal or higher than ANSI standard requirements. Shorting terminal blocks shall be furnished on the secondary of all the current transformers.
   2. Voltage and control power transformers of the quantity and ratings as shown on the Drawings shall be supplied. Voltage transformers and control power transformers shall mounted in drawout drawers. Rails shall be provided for each drawer to permit easy inspection, testing, and fuse replacement. Shutters shall isolate primary bus stabs when drawers are withdrawn. Furnish a main secondary circuit breaker for each control power transformer. A mechanical interlock shall be provided which shall require the secondary breaker to be open before the CPT drawer or CPT primary fuse drawer can be opened.
   3. Instrument transformers shall have metering accuracies compatible with the relays and microprocessor based metering equipment.

J. Metering:

1. Provide a metering device for each incoming main circuit breaker with current and potential transformers as shown on the Drawings.
2. Metering device shall monitor and display the following information:
    a. Phase amperes (each phase): 0.3 percent accuracy.
    b. Voltage, phase-to-phase: 0.3 percent accuracy.
    c. Watts: 0.6 percent accuracy.
    d. Vars: 0.6 percent accuracy.
    e. Power factor: 1.0 percent accuracy.
    f. Frequency: 0.1 hertz.
    g. Kilowatt hours: 6 percent accuracy.
    h. Kilovar hours: 0.6 percent.
    i. Percent current total harmonic distortion in each phase.
    j. Percent voltage total harmonic distortion between each phase.
3. The unit shall have the following additional features:
    a. Trend analysis which shall display minimum and maximum values for each metered parameter with date and time of each occurrence.
    b. The input range of the device shall accommodate external current transformers with ranges from 100/5 to 5000/5 and potential transformers from a ratio of 120:120 to 500,000:120.
    c. Alarm contacts rated five amps at 120 VAC.
    d. Three analog outputs programmable to reflect any of the metered parameters (except kilowatt hours and kilovarhours).
    e. Communications capability via a communications gateway module. Provide schematic of system communications for a power metering network and breaker or device communications.
4. Control power shall be drawn from the monitored incoming AC line. The device shall have non-volatile memory and not require battery backup. In the event of a power failure, the device shall retain preset parameters.
5. Product and Manufacturer: Provide one of the following:
    a. Square D - Embedded in Power Meter or an EGX series gateway.
    b. Eaton EDR-5000 Distribution Protective Relay. Power Expert Gateway.

K. Manufacturer’s Nameplates:
1. Factory installed engraved manufacturer’s nameplates, mounted on the face of the assembly, and shall be furnished for all main, tie and feeder breakers. These nameplates shall be laminated plastic with ½ inch minimum, Arial black characters on a white background or match existing, secured with stainless steel screws. These nameplates shall also contain item designation, equipment served breaker frame size and breaker trip rating.
2. All control components within the assembly shall be identified in correspondence to appropriate designations on the manufacturer's wiring diagrams.

L. Accessories:
1. Maintenance tool for manually charging the breaker closing spring and manually opening the shutter.

2. Lift truck to remove breaker from breaker cell.
3. Manual ground and test device. Furnish for each breaker current rating 1200 amp. Provide grounding balls on the equipment for operator safety when getting into equipment.
4. Levering crank for moving the breaker between "TEST" and "CONNECTED" positions.
5. Test jumper for electrically operating the breaker while out of its compartment.
6. Breaker lifting yoke used for attachment to breaker for lifting breaker on or off compartment rails.
7. One set of rail extensions and rail clamps.
8. Any additional devices as required and as shown on the Drawings.
9. Transfer truck (turning dolly) for removing and transporting circuit breakers.
10. Circuit breaker remote control station for opening and closing the circuit breaker with 50 ft. minimum cord and plug.
11. Remove circuit breaker racking mechanism. Cord and Plug should be 50 ft. minimum. Connection of the mechanism shall be made with the circuit breaker compartment door closed.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install equipment so that sufficient access and working space is provided for ready and safe operation and maintenance.

B. Install equipment on concrete pad as shown on the Drawings. Coordinate pad dimensions to fit equipment furnished.

C. Install in accordance with National Electrical Code

D. Insure all requirements of the service utility (SRP) are meet.

E. All hardware and methods to install and assemble switchgear meet manufacturer’s recommendations.

F. All equipment grounding and secondary ground grid bonding installed in accordance with NEC.

G. Provide all labeling of equipment and conductors per NEC requirements.

3.2 FACTORY TESTS

A. The manufacturer shall perform standard factory tests on each circuit breaker. The factory tests shall be witnessed by the ENGINEER. Include the cost of the witness testing in the price. The cost shall include all transportation, lodging and meals.

3.3 FIELD INSPECTION AND TESTS

A. Provide the services of an authorized service representative of the equipment manufacturer to make site visits to supervise the field testing to be performed by CONTRACTOR. The manufacturer's representative shall inform the OWNER if the equipment has been correctly installed and shall submit the factory and field test results to the OWNER and ENGINEER. The manufacturer's representative shall certify, in writing, that the equipment has been installed, adjusted and tested in accordance with the manufacturer's recommendations. See testing requirements in specification 16920.

B. Perform the following minimum tests and checks before energizing equipment.
   1. Perform insulation resistance tests on each bus section, phase-to-phase and each phase-to-ground for a period of one minute at 2500 volts DC. Minimum insulation resistance shall be 5000 megohms.
   2. After successful completion of insulation resistance test, perform an overpotential test on each bus section, each phase-to-ground for a period of one minute at manufacturer's recommended voltage.
   3. Inspect all mechanical and electrical interlocks for proper operation.
   4. Perform insulation resistance test on all control wiring at 1000 volts DC after disconnecting devices. Minimum, measured insulation resistance shall be one megohm.

C. The manufacturer shall submit the test results to the ENGINEER to confirm that the switchgear assembly design has been tested to substantiate conformance with the applicable ANSI and NEMA Standards. The tests shall verify not only the performance of the switch or integrated switch and fuse, but also the suitability of the enclosure venting, rigidity and bus bracing. In addition, the switchgear assembly shall be factory tested in accordance with ANSI Standard C37.20.3. and these Specifications.

D. Perform any other tests recommended by the equipment manufacturer.

3.4 MANUFACTURER'S SERVICES

A. A factory trained representative shall be provided for installation supervision, start-up and test services and operation and maintenance personnel training services. The representative shall make a minimum of 4 visits, minimum 4 hours on-site for each visit, to the site. The first visit shall be for assistance in the installation of equipment. The second visit shall be for checking the completed installation and start-up of the system. The third visit shall be as described under Division 1 Requirements. Manufacturer's representative shall test operate the system in the presence of the ENGINEER and verify that the 15 KV switchgear conform to requirements. Representative shall revisit the job site as often as necessary until all trouble is corrected and the installation is entirely satisfactory.

B. All costs, including travel, lodging, meals and incidentals, shall be considered as included in CONTRACTOR'S bid price.

3.5 FIELD ADJUSTMENTS

A. Relay settings on the microprocessor protective device shall be performed by CONTRACTOR in the field in accordance with the recommended settings designated in the coordination study in Section 16951, Short circuit, coordination, and arc-flash hazard report

++ END OF SECTION ++

SECTION 16430

CUSTOMER POWER METERING SYSTEM

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. This Specification covers the customer power monitoring system installed on the service entrance section(s), motor control center(s), and other distribution panel(s) as indicated on Plans.

1.2 SUBMITTALS

A. Products shall be submitted in accordance with Section 16000, General Electrical Requirements, and elsewhere in the Contract Documents, prior to installation.

B. Submit manufacturer's catalog cut sheet indicating all options to be supplied as specified herein.

C. Submit Shop Drawing indicating wiring connection diagram and elevation drawing indicating location of component(s) on the service entrance section.

D. Submit complete Operation and Maintenance Manuals in conformance with the Operation and Maintenance Manuals section of Section 01300, Submittals.

1.3 MANUFACTURER

A. Acceptable Manufacturer:
   1. Square D, Eaton Cutler-Hammer, ABB or Engineer approved equal.

PART 2 - PRODUCTS

2.1 GENERAL

A. The system shall consist of electronic circuit monitors as required to obtain signals as specified herein. Components shall include CTs, PTs, CPT, etc, and other devices as required.
   1. The electronic Circuit Monitors shall report metering values such as frequency, temperature, current, voltage, power factor, power, demand current, and real power, and accumulated energy.
   2. Each Circuit Monitor shall retain historical circuit data, time and date, set-up and configuration values, and diagnostics data in the event of a control power failure without the need for an internal battery.

3. Each Circuit Monitor shall be capable of capturing current and voltage waveforms which may be exported to a personal computer where waveform or other power quality analysis may be performed.
4. The Circuit Monitor shall include an LED readout which will allow local display of the following electrical parameters:
    a. Current, per phase RMS.
    b. Voltage, phase-to-phase and phase-to-neutral.
    c. Real power, 3-phase total.
    d. Reactive power, 3-phase total.
    e. Apparent power, 3-phase total.
    f. Power factor, 3-phase total and per phase.
    g. Frequency.
    h. Peak demand current, per phase.
    i. Peak demand, real power.
    j. Accumulated energy (MWH and MVARH).
5. Reset the following electrical parameters shall also be allowed from the front of the Circuit Monitor:
    a. Peak demand current.
    b. Peak demand power.
    c. Energy (MWH).
    d. Reactive energy (MVARH).
6. Circuit Monitor setup for system requirements shall be allowed from the front of the Circuit Monitor. Set-up provisions shall include:
    a. CT rating (xxxx:5) – See Drawings
    b. PT rating (xxxxx:120) – See Drawings
    c. System type (3-wire and 4-wire).
    d. Demand interval (5-60 min.).
7. All reset and functions shall be key switch protected to prevent unauthorized/accidental changes.
8. Unit shall be configured to communicate over Modbus RTU protocol using RS-485 cable network connections with a remote PLC.

B. The system shall have System Display units which display data from the Circuit Monitors. The display unit shall contain the following:
    1. Each System Display shall provide real-time access to all metering data available for each circuit (present as well as historical data).
    2. Each System Display unit shall access and display the data available from selected electronic Circuit Monitors connected on the individual data transfer network.
    3. The System Display unit shall utilize a 4 line by 20 character, high contrast LCD technology display with backlighting to provide high reliability and superior readability in all light conditions.
    4. The level of backlighting as well as the contrast shall be adjustable.
    5. The System Display unit shall allow for easy operation by providing a keypad with large keys for operator selections.

6. The keys shall have a raised perimeter and tactile feedback to ensure a positive response even with gloved hand operation.
7. The keys shall be clearly marked to indicate the function and separated into meaningful groups with display prompting to assist the user in operation.
8. Each System Display unit shall be configured by the manufacturer with all necessary data such as CT ratios, PT ratios, main and feeder device nameplates, demand alarm set points, etc.
9. It shall be possible to change the configuration for each System Display unit using the keypad provided on each display.
10. This capability shall be password protected to prevent unauthorized modification of the configuration.
11. All data with the exception of the captured waveform shall be accessible by the System Display unit.
12. Data shall be displayed in a logically organized manner complete with the proper scaling and units.
13. It shall be possible to sequentially view all available data from a selected Circuit Monitor by single keystroke advancing through the various display pages.
14. It shall be possible to view the same pages of data from other Circuit Monitors by single keystroke advancing back and forth from Circuit Monitor to Circuit Monitor.

PART 3 - EXECUTION

3.1 INSTALLATION

A. System Display units shall be installed by the manufacturer in the switchgear as indicated on the Plans.

B. The System Display units shall be flush mounted on switchgear door panels.

C. Electronic Circuit Monitors shall be installed by the switchgear manufacturer for all circuits as indicated by the project drawings.

D. All control power, CT, PT, and communications wire shall be factory wired and harnessed within the switchgear lineup.

E. Where external circuit connections are required, terminal blocks shall be provided and the manufacturer's drawings must clearly identify the interconnection requirements including wire type to be used.

F. The metering components included within the service entrance sections shall be factory installed, wired, and tested prior to shipment to the job site.

G. All wiring required to externally connect the personal computer shall be installed by the CONTRACTOR per manufacturer's requirements and per other portions of these Specifications.

H. CONTRACTOR interconnection wiring requirements shall be clearly identified on the metering system drawings to be submitted for approval.

3.2 TESTING

A. Test in accordance with Specification 16920, Electrical Acceptance Testing.

3.3 TRAINING

A. On-site start-up and training of the metering system shall be included in the Project bid.

B. Start-up shall include a complete working demonstration of the system with simulation of possible operating conditions which may be encountered.

C. Training shall include any documentation and hands-on exercises necessary to enable operations personnel to assume full operating responsibility for the system after completion of the training period.

D. The Project bid shall include two days start-up assistance and one day training.

++ END OF SECTION ++

SECTION 16431

LOW-VOLTAGE DRAWOUT SWITCHGEAR

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
   1. Provide all labor, materials, equipment and incidentals, including concrete pad, as shown on the Drawings, specified and required to furnish and install indoor, free-standing metal enclosed, low voltage switchgear lineups complete and operational as shown on the Drawings and as specified herein. Each metal enclosed switchgear assembly shall consist of completely metal enclosed vertical sections and include the quantity of low voltage, drawout circuit breakers as required by the Contract Documents.

1.2 QUALITY ASSURANCE

A. Manufacturer's Qualifications:
   1. Manufacturer shall have a minimum of five years experience of producing substantially similar equipment, and shall be able to show evidence of at least five installations in satisfactory operation for at least five years.

B. Reference Standards: Comply with applicable provisions and recommendations of the following, except where otherwise shown and specified.
   1. ANSI C37.13, IEEE Standard for Low-Voltage AC Power Circuit Breakers Used in Enclosures.
   2. ANSI C37.20, Switchgear Assemblies.
   3. NEMA SG-3.
   4. NEMA SG-5, Power Switchgear Assemblies.
   5. NEMA SG-6, Power Switching Equipment.
   6. UL Standard No. 1558, Metal-Enclosed Low-Voltage Power Circuit Breaker Switchgear.
   7. National Fire Protection Association 79, Electrical Standards for Industrial Machinery.

C. For the equipment specified herein, the manufacturer shall be ISO 9000, 9001 or 9002 certified.

1.3 SUBMITTALS

A. Shop Drawings: Submit for approval the following:
   1. Manufacturer's technical information for equipment proposed for use. Submittals shall include the following:
      a. Dimensional information.

b. Three-line diagrams.
c. Technical specifications.
d. Catalog cuts.
e. Construction details of enclosure.
f. Schematic control diagrams for breaker control and all other controls.

B. Certification of Ratings: Submit for approval copies of certifications as follows:
1. The integrated switchgear assembly shall have a BIL rating established by test on switchgear of the type to be furnished under this Specification. Certified test abstracts establishing such ratings shall be furnished.

C. Operation and Maintenance Manuals:
1. Submit complete installation, operation and maintenance manuals, including, test reports, maintenance data and schedules, description of operation and spare parts information.
2. Furnish Operation and Maintenance Manuals in conformance with the requirements of Section 01782, Operation and Maintenance Data.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver materials to the site to ensure uninterrupted progress of the Work. Deliver anchor bolts and anchorage devices which are to be embedded in cast-in-place concrete in ample time to prevent delay of the Work.

B. Equipment shall be handled and stored in accordance with manufacturer's instructions. One copy of these instructions shall be included with the equipment at the time of shipment.

C. All boxes, crates and packages shall be inspected by CONTRACTOR upon delivery to the site. Notify ENGINEER of any loss or damage exists to equipment or components. Replace loss and repair damage to new condition in accordance with manufacturer's instructions.

D. Store materials to permit easy access for inspection and identification. Keep all materials off the ground, using pallets, platforms or other supports. Protect steel members and packaged materials from corrosion and deterioration.

E. Switchgear being stored prior to installation shall be stored so as to maintain the equipment in a clean and dry condition.

PART 2 - PRODUCTS

2.1 RATINGS

A. The switchgear shall be rated for 600 volts service with a 3-phase, 4-wire bus rating as shown on the Drawings. Bus shall be braced for a symmetrical short circuit current of at least 65,000 amps.

2.2 MATERIALS

A. General: The metal-enclosed switchgear assembly shall consist of multiple self-supporting bays. The sections shall contain drawout power air circuit breakers.

B. Construction:
   1. The switchgear shall consist of a stationary structure constructed from individual vertical sections as shown on the Drawings. The vertical sections shall be bolted together to form a rigid metal-clad switchgear assembly. Metal sheets shall provide grounded metal barriers between adjacent sections. Each vertical section shall contain one or more individual breaker or instrument compartments and a rear compartment for the bare busses and outgoing cable connections. Barriers shall be provided to isolate the cable compartment from the horizontal and vertical bus compartments. Where low voltage busway entry, is required into top of main breaker sections, provide necessary cutout and switchgear bus risers and auxiliary hardware. Connection to low voltage busway shall be tin-plated, copper bus. Cable connection is not acceptable.
   2. Each breaker compartment shall be equipped with primary and secondary contacts, drawout extension rails, stationary levering mechanism parts and required instrument transformers. A formed steel door equipped with an emergency trip button and supported on concealed hinges with removable pins shall be provided for each circuit breaker compartment.
   3. All busses and connections shall consist of tin-plated copper bar mounted on heavy duty supports and shall have bolted joints utilizing Belleville type spring washers. Ground bus shall be full length, copper.
   4. Each circuit shall include the necessary three phase bus and connections between the bus and one set circuit breaker studs. Provide NEMA two-hole cable lugs attached to tin-plated copper extensions for the outgoing cables on the other set of circuit breaker studs.
   5. Terminal blocks with integral type barriers shall be provided for secondary circuits. The terminal blocks shall be front accessible through a removable tray above each circuit breaker. All control wiring shall be securely fastened to the switchgear assembly without the use of adhesive wire anchors. A dedicated wiring path shall be provided for customer's control wiring.
   6. The stationary part of the primary disconnecting devices for each circuit breaker shall consist of a set of contacts extending through a glass polyester insulating base. Busses and outgoing cable terminal shall be directly connected to them. The corresponding moving contacts shall consist of a set of contact fingers

suitably spaced on the circuit breaker studs. In the "CONNECTED" position, these contacts shall form a current-carrying bridge. High uniform pressure on each finger shall be maintained by springs. Contact engagement shall be maintained only in the "CONNECTED" position.

7. The secondary disconnecting devices shall consist of floating fingers mounted on the removable unit and engaging contacts located at the rear of the compartment. The secondary disconnecting devices shall be silver-plated to ensure permanence of contact. Contact engagement shall be maintained in the "CONNECTED" and "TEST" positions.
8. Each removable breaker element shall consist of an air circuit breaker equipped with the necessary disconnecting contacts, wheels and interlocks for drawout application. The removable element shall have four-position features and shall permit closing the compartment door with the breaker in the "CONNECTED", "TEST", "DISCONNECTED" and "REMOVE" positions. Door shall be closed and stationary when breaker is racked between "CONNECTED", "TEST" and "DISCONNECTED" positions for added personnel safety
9. All circuit breakers shall be drawout type, power air circuit breakers, manually operated and have a minimum of 65,000 amps symmetrical interrupting capacity at 480 volts. Breaker frame and trip ratings shall be as shown on the Drawings. All breakers shall be UL listed for application in their intended enclosures at 100 percent of continuous ampere rating. The circuit breakers shall include, where necessary, current-limiting fuses, integrally mounted, coordinated with the breaker trip device to avoid unnecessary blowing of the fuses. Breakers equipped with current-limiting fuses shall have an anti-single phase device that will trip the breaker in the event of a blown fuse, indicate on the front of the breaker which limiter is blown, and prevent the breaker from being reclosed on a single phase condition due to missing or blown limiters. Breakers shall have stored energy operating mechanisms. Only one stroke of the operating handle shall be required to charge the stored energy spring when operating the breaker. The release of the energy to close the breaker shall be by means of a mechanical pushbutton to ensure positive control of the closing operation. Both main breakers and the tie breaker shall have key interlocking to prevent no more than two breakers from being closed simultaneously at any time.
    a. Each breaker shall be equipped with a microprocessor based tripping device. Current sensors shall provide operation and signal function. The trip unit shall use microprocessor-based technology to provide the basic adjustable time-current protection functions. True RMS sensing circuit protection shall be achieved by analyzing the secondary current signals received from the circuit breaker current sensors and initiating trip signals to the circuit breaker trip actuators when predetermined trip levels and time delay settings are reached. Interchangeable rating plugs shall establish the continuous trip ratings of each circuit breaker.
10. All control wire shall be No. 14 AWG minimum, Type SIS, bundled and secured with nylon ties. Insulated locking spade terminals shall be provided for all control connections, except where saddle type terminals shall be provided integral to a device. All groups of control wires leaving the switchgear shall be

provided with terminal blocks with suitable numbering strips. Provide wire markers at each end of all control wiring. The color coding of the wires shall be in accordance with NFPA 79.

11. All current transformer secondary leads shall first be connected to conveniently accessible short circuit terminal blocks before connecting to any other device.
12. Each compartment labeled as "SPACE" on the Drawings, shall be equipped provisions for a future, manually operated breaker of frame rating as shown on the Drawings. All breaker locations designated as "FUTURE SPACE" on the Drawings, shall be furnished with all necessary provisions for a future, manually operated circuit breaker.

C. Manufacturer's Nameplates:
   1. Factory installed engraved manufacturer's nameplates, mounted on the face of the assembly, and shall be furnished for all main, tie and feeder breakers. These nameplates shall be laminated plastic with 6-inch minimum, ¼-inch black characters on a white background or match existing, secured with stainless steel screws. These nameplates shall also contain item designation, equipment served breaker frame size and breaker trip rating.
   2. All control components within the assembly shall be identified in correspondence to appropriate designations on the manufacturer's wiring diagrams.

D. Accessories:
   1. Portable, breaker lifting device for each lineup.
   2. Portable test kit for testing and verification of trip units. Test kit shall operate on 120 VAC power from any outlet.
   3. Any additional devices as required and as shown on the Drawings.

E. Product and Manufacturer: Provide one of the following:
   1. Eaton.
   2. Square D Company.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install equipment so that sufficient access and working space is provided for ready and safe operation and maintenance. Seal bottom of equipment with RTV silicone.

B. Install equipment on concrete pad, as shown on Drawings. Coordinate pad dimensions to fit equipment furnished.

C. Responsibility for all overcurrent protection settings as determined by Section 16215, Power System Study, belongs to CONTRACTOR. The trip settings shown on the Drawings represent the desired long time pickup setting.

D. Install in accordance with National Electrical Code.

3.2 FACTORY TESTS

A. The manufacturer shall perform standard factory tests on each circuit breaker. The factory tests shall be witnessed by the ENGINEER. Include the cost of the witness testing in the price. The cost shall include all transportation, lodging and meals.

3.3 FIELD INSPECTION AND TESTS

A. Provide the services of an authorized service representative of the equipment manufacturer to make site visits to supervise the field testing to be performed by CONTRACTOR. The service representative shall be an employee of the manufacturer of the low voltage drawout switchgear. The manufacturer's representative shall provide certification to the OWNER that the equipment has been correctly installed and shall submit the factory and field test results to the OWNER. The manufacturer's representative shall certify, in writing, that the equipment has been installed, adjusted and tested in accordance with the manufacturer's recommendations.

B. Perform the following minimum tests and checks before energizing equipment.
   1. Perform insulation resistance tests on each bus section, phase-to-phase and each phase-to-ground for a period of one minute at 2200 volts DC.
   2. After successful completion of insulation resistance test, perform an over-potential test on each bus section, each phase-to-ground for a period of one minute at manufacturer's recommended voltage.
   3. Inspect all mechanical and electrical interlocks for proper operation.
   4. Perform insulation resistance test on all control wiring at 1500 volts DC after disconnecting devices.

C. The manufacturer shall supply, upon request, test results to confirm that the switchgear assembly design has been tested to substantiate conformance with the applicable ANSI and NEMA Standards. The tests shall verify not only the performance of the switch or integrated switch and fuse, but also the suitability of the enclosure venting, rigidity and bus bracing. In addition, the switchgear assembly shall be factory tested in accordance with ANSI Standard C37.20.3. and the Contract Documents.

D. Perform any other tests recommended by the equipment manufacturer.

E. The testing specified in paragraph above shall be performed by a certified lab under the direction of the manufacturer’s representative. See specification 16920.

3.4 MANUFACTURER’S SERVICES

A. A factory trained representative shall be provided for installation supervision, start-up and test services and operation and maintenance personnel training services. The

representative shall make a minimum of 3 visits, minimum 8 hours on-site for each visit, to the site. The first visit shall be for assistance in the installation of equipment. The second visit shall be for checking the completed installation and start-up of the system. The third visit shall be as described under Section 01821, Instruction of Operations and Maintenance Personnel. Manufacturer's representative shall test operate the system in the presence of the ENGINEER and verify that the low voltage drawout switchgear conforms to requirements. Representative shall revisit the job site as often as necessary until all trouble is corrected and the installation is entirely satisfactory.

B. All costs, including travel, lodging, meals and incidentals, shall be considered as included in CONTRACTOR'S bid price.

3.5 FIELD ADJUSTMENTS

A. Relay settings on the microprocessor protective device shall be performed by CONTRACTOR in the field in accordance with the recommended settings designated in the coordination study in Section 16951 Short Circuit, Coordination, and Arc-Flash Hazard Report

++ END OF SECTION ++

SECTION 16440

DISCONNECT SWITCHES

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. This Section covers electrical disconnecting safety switches.

1.2 SUBMITTALS

A. Products shall be submitted in accordance with Section 16000, General Electrical Requirements, and elsewhere in the Contract Documents, prior to installation.

B. Shop Drawings: Submit for approval the following:
   1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
   2. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**
   3. Submit complete Operation and Maintenance Manuals in conformance with the Operation and Maintenance Manuals section of Section 01300, Submittals.

PART 2 - PRODUCTS

2.1 DISCONNECT SWITCHES

A. Disconnect switches shall be heavy-duty safety switches with a quick-make, quick-break operating mechanism, with full cover interlock, and indicator handle. The disconnect switches shall be furnished with fuses of the size indicated on the DRAWINGS. One set of spare fuses shall be furnished for each fused disconnect switch. Disconnect switches shall be NEMA Type HD heavy duty construction, UL 98 listed.

B. Provide one normally-open and one normally-closed auxiliary contact that indicate the disconnect switch position. Contact shall change state just prior to disconnect switch opening to provide advance indication to VFD.

C. Enclosures shall be rated NEMA 12 for indoor use and NEMA 4X 316 SS for outdoor use, unless otherwise indicated on the Drawings.

D. Disconnect switch handle shall be padlockable.

E. Disconnect switches in the corrosive areas, shall be NEMA 4X, 316 stainless steel unless otherwise indicated on the Drawings.

F. Disconnect switches shall be as manufactured by Square D, Eaton, or equal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Disconnect switches shall be installed as indicated on the DRAWINGS.

B. Provide grounding per NEC and Section 16170, Grounding and Bonding.

3.2 TESTING

A. Test in accordance with Specification 16920, Electrical Acceptance Testing.

++ END OF SECTION ++

SECTION 16461

TRANSFORMERS - DRY TYPE

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. This Section covers dry type transformers used for low voltage, single- and 3-phase, power distribution and lighting.

1.2 SUBMITTALS

A. Products shall be submitted in accordance with Section 16000,General Electrical Requirements, and elsewhere in the Contract Documents, prior to installation.

B. Shop Drawings: Submit for approval the following:
   1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
   2. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**
   3. Submit complete Operation and Maintenance Manuals in conformance with the Operation and Maintenance Manuals section of Section 01300, Submittals.

1.3 QUALITY ASSURANCE

A. ANSI C57.12.01, Dry Type Transformers.

B. ANSI C89.2, Dry Type Transformers.

C. NEMA ST-20, Dry Type Transformers.

D. UL 506, Specialty Transformers.

PART 2 - PRODUCTS

2.1 DISTRIBUTION - LOW VOLTAGE LIGHTING AND POWER

A. Transformers shall be premium high efficiency quiet type, and shall be installed where indicated on the Drawings. The primary winding of the transformers shall have two 2-1/2% taps above and below normal.

B. The transformers shall have a BIL of 10 KV with a temperature class of 185° C for transformers up to 25 KVA, and a temperature class of 220 C for larger transformers.

C. The sound level shall not exceed 44 dBa measured at 5 feet from the transformer after installation. Core and coil assemblies 30 KVA and larger shall be mounted on rubber vibration isolators, designed to reduce harmonics generated noise.

D. Transformers shall be types manufactured by Cutler-Hammer, Square D, Hevi-Duty, or equal.

2.2 FERRO RESONANT ISOLATION TRANSFORMERS

A. Ferro resonant isolation transformers shall be provided where indicated on the Drawings. Regulation shall be +3% for an input range of +10%. Common mode noise rejection shall be better than 120 dB with transverse mode noise rejection better than 60 dB. Voltage spike attenuation shall be better than 250:1.

B. Isolation transformers shall be as manufactured by Shape Magnetronics, Control Concepts, Inc., or equal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Transformers shall be installed as indicated on the Drawings, and in accordance with the manufacturer's instructions and recommendations. CONTRACTOR shall provide painted metal wall brackets, when required.

B. Grounding shall be provided per NEC and Section 16170, Grounding and Bonding.

3.2 TESTING

A. Test in accordance with Specification 16920, Electrical Acceptance Testing.

++ END OF SECTION ++

SECTION 16470

PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 1, General Requirements, Specification Sections apply to this Section.

1.2 SUMMARY

A. This Section includes load centers and panelboards, overcurrent protective devices, and associated auxiliary equipment rated 1000 volt and less for the following types:
   1. Lighting and appliance branch-circuit panelboards.
   2. Distribution panelboards.

1.3 DEFINITIONS

A. EMI: Electromagnetic interference.

B. GFCI: Ground-fault circuit interrupter.

C. RFI: Radio frequency interference.

D. RMS: Root mean square.

E. SPDT: Single-pole, double throw.

F. SPD: Surge protective device.

1.4 SUBMITTALS

A. Product Data: For each type of panelboard, overcurrent protective device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each panelboard and related equipment.
   1. Dimensioned Plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings. Include the following:
      a. Enclosure types and details for types other than NEMA 10250, Type 1.
      b. Bus configuration, current, and voltage ratings.

c. Short-circuit current rating of panelboards and overcurrent protective devices.
d. UL listing for series rating of installed devices.
e. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

2. Submit for approval the following:
   a. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
   b. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**
3. Wiring Diagrams: Diagram power, signal, and control wiring and differentiate between manufacturer-installed and field-installed wiring.

C. Manufacturer Seismic Qualification Certification: Submit certification that panelboards, overcurrent protective devices, accessories, and components will withstand seismic forces defined for the Project. Include the following:
1. Basis of Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. The term "withstand" means "the unit will remain in place without separation of internal and external parts during a seismic event and the unit will be fully operational after the event".
3. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
4. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Qualification Data: Submit data for testing agencies indicating that they comply with qualifications specified in Paragraph 1.5 of this Specification.

E. Field Test Reports: Submit written test reports and include the following:
   1. Test procedures used.
   2. Test results that comply with requirements.
   3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

F. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.

G. Submit complete Operation and Maintenance Manuals in conformance with the Operation and Maintenance Manuals section of Section 01300, Submittals. Also include the following:
   1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
   2. Time-current curves, including selectable ranges for each type of overcurrent protective device.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NEMA PB 1.

C. Comply with NFPA 70.

1.6 COORDINATION

A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, and encumbrances to workspace clearance requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Panelboards, overcurrent protective devices, controllers, contactors, and accessories:
      a. Square D Company.

b. Eaton.
c. Or pre-approved equal.

2.2 FABRICATION AND FEATURES

A. Enclosures: Flush and surface mounted cabinets. NEMA PB 1, Type 1, to meet environmental conditions at installed location.
   1. Outdoor Locations: NEMA 10250, Type 3R, with intrusion switch.
   2. Other Wet or Damp Indoor Locations: NEMA 10250, Type 4**X**.
   3. Hazardous Areas Indicated on Drawings: NEMA 10250, Type 7C.

B. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.

C. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.

D. Finish: Manufacturer's standard enamel finish over corrosion-resistant treatment or primer coat.

E. Directory Card: With transparent protective cover, mounted inside metal frame, inside panelboard door.

F. Bus: Hard-drawn copper, 98% conductivity.

G. Main and Neutral Lugs: Mechanical-type suitable for use with conductor material.

H. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment ground conductors; bonded to box.

I. Service Equipment Label: UL labeled for use as service equipment for panelboards with main service disconnect switches.

J. Future Devices: Mounting brackets, bus connections, and necessary appurtenances required for future installation of devices.

K. Isolated Equipment Ground Bus: Adequate for branch-circuit equipment ground conductors; insulated from box.

L. Split Bus: Vertical buses divided into individual vertical sections.

M. Gutter Barrier: Arrange to isolate individual panel sections.

N. Feed-through Lugs: Mechanical type suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.

2.3 PANELBOARD SHORT CIRCUIT RATING

A. Fully rated to interrupt symmetrical short circuit current available at terminals.
   1. Distribution Panelboards shall be rated for 65KAIC.
   2. Lighting and Appliance Branch Circuit Panelboards shall be rated for 22KAIC.

2.4 LOAD CENTERS

A. Overcurrent Protective Devices: Bolt-on, full-module circuit breaker.

B. Conductor Connectors: Mechanical type for main, neutral, and ground lugs and buses.

2.5 LIGHTING AND APPLIANCE BRANCH CIRCUIT PANELBOARDS

A. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

B. Doors: Front-mounted with concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.6 DISTRIBUTION PANELBOARDS

A. Doors: Front-mounted, except omit in fused-switch panelboards; secured with vault-type latch with tumbler lock; keyed alike.

B. Main Overcurrent Protective Devices: Circuit breaker as shown on DRAWINGS.

C. Branch Overcurrent Protective Devices shall be one of the following:
   1. For Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.
   2. For Circuit Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.

2.7 OVERCURRENT PROTECTIVE DEVICES

A. Molded-Case Circuit Breaker: UL 489, with interrupting capacity to meet available fault currents.
   1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit breaker frame sizes 250 A and larger.
   2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
   3. Electronic Trip Unit Circuit Breakers: RMS sensing; field-replaceable rating plug; with the following field-adjustable settings:

4. Instantaneous trip.
5. Long- and short-time pickup levels.
6. Long- and short-time time adjustments.
7. Ground-fault pickup level, time delay, and I^2t response.
8. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let through ratings less than UL 248, Class RK-5.

B. Molded Case Circuit Breaker Features and Accessories. Standard frame sizes, trip ratings, and number of poles.
1. Lugs: Mechanical style, suitable for number, size, trip ratings, and material of conductors.
2. Application Listing: Appropriate for application; Type SWD for switching duty on lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
3. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.

2.8 ACCESSORY COMPONENTS AND FEATURES

A. Accessory Set: Tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

B. Portable Test Set: To test functions of solid-state trip devices without removal from panelboard.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install panelboards and accessories according to NEMA PB 1.1.

B. Mounting Heights: Top of trim 74-inches above finished floor, unless otherwise indicated.

C. Mounting: Plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish.

D. Panel Schedule: Create a panel schedule to indicate installed circuit loads after balancing panelboard loads. Obtain approval before installing. Use Microsoft Excel or similar approved software to create this document; handwritten directories are not acceptable.

E. Install filler plates in unused spaces.

F. Wiring in Panelboard Gutters: Arrange conductors into groups and bundle and wrap with wire ties after completing load balancing.

3.2 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Section 16195, Electrical Identification.

B. Panelboard Nameplates: Label each panelboard with engraved metal or laminated-plastic nameplate mounted with corrosion-resistant screws.

3.3 CONNECTIONS

A. Install equipment grounding connections for panelboards with ground continuity to main electrical ground bus.

B. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

3.4 FIELD QUALITY CONTROL

A. Prepare for Acceptance Tests as follows:
   1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
   2. Test continuity of each circuit.

B. Testing: After installing panelboards and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.
   1. Procedures: Perform each visual and mechanical inspection and electrical test indicated in NETA ATS, Section 7.5 for switches and Section 7.6 for molded case circuit breakers. Certify compliance with test parameters.
   2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

C. Balancing Loads: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes as follows:
   1. Measure as directed during period of normal system loading.
   2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24 hour services such as fax machines and on-line data-processing, computing, transmitting, and receiving equipment.
   3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
   4. Tolerance: Difference exceeding 20% between phase loads within a panelboard is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

D. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each panelboard. Remove panel fronts so joints and connections are accessible to portable scanner.
   1. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each panelboard 11 months after date of Substantial Completion.
   2. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
   3. Record of Infrared Scanning: Prepare a certified report that identifies panelboards checked and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

A. Set field-adjustable switches and circuit breaker trip ranges.

3.6 CLEANING

A. On completion of installation, inspect interior and exterior of panelboards. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

++ END OF SECTION ++

SECTION 16474

MOTOR CONTROL EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes separately mounted combination motor starters (including those supplied with equipment), manual motor starters, separately mounted circuit breakers, and control equipment.

B. Related Sections include, but are not necessarily limited to:
   1. Division 0 ,Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 1, General Requirements.
   3. Section 16000, Electrical: Basic Requirements.
   4. Section 16170, Grounding and Bonding.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American National Standards Institute (ANSI):
      a. C62.41, Guide for Surge Voltages in Low Voltage AC Power Circuits.
   2. Canadian Standards Association (CSA).
   3. Institute of Electrical and Electronics Engineers (IEEE).
   4. National Electrical Manufacturers Association (NEMA):
      a. ICS 2, Industrial Control Devices, Controllers, and Assemblies.
      b. 250, Enclosures for Electrical Equipment (1000 Volt Maximum).
   5. National Fire Protection Association (NFPA):
      a. 70, National Electrical Code (NEC).
   6. Underwriters Laboratories, Inc. (UL):
      a. 845, Electric Motor Control Centers.

B. Miscellaneous:
   1. Verify motor horsepower loads, other equipment loads, and controls from approved shop drawings and notify ENGINEER of any discrepancies.
   2. Verify the required instrumentation and control wiring for a complete system and notify ENGINEER of any discrepancies.

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Section 01300, Submittals, and Section 16000, ABB/General Electrical Requirements.
   2. Submit for approval the following:

a. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

b. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**

3. Typical wiring diagrams for all control equipment.

B. Operation and Maintenance Manuals:
   1. See Section 01300, Submittals.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Combination Motor Starters:
      a. ABB/ABB/General Electric.
      b. Square D.
      c. Eaton Cutler Hammer/Westinghouse.
      d. Siemens.
   2. Control Relays:
      a. ABB/ABB/General Electric.
      b. Square D.
      c. Eaton Cutler Hammer/Westinghouse.

d. Siemens.

3. Electronic Timers:
   a. Allen-Bradley 700-HR Dial Multifunction Timer.
4. Timing Relays:
   a. Agastat.
   b. ABB/General Electric.
   c. Square D.
   d. Cutler Hammer/Westinghouse.
   e. Siemens.
5. Enclosures:
   a. Hoffman.
   b. Hammond.
   c. Rittal.
6. Manual Motor Starters:
   a. ABB/General Electric.
   b. Square D.
   c. Cutler Hammer/Westinghouse.
   d. Siemens.
7. Separately Mounted Circuit Breakers:
   a. ABB/General Electric.
   b. Siemens.
   c. Square D.
   d. Cutler Hammer/Westinghouse.
8. Terminal Blocks:
   a. Entrelec.
   b. Phoenix Contact.
   c. Weidmuller.
   d. Or equal.
9. Surge Protection Blocks (SPB):
   a. TELEMATIC, Series SD.
   b. Or equal.

B. Submit requests for substitution in accordance with the General Conditions.

2.2 COMPONENTS

A. Main and Feeder Circuit Breakers - Separately Mounted: Unless specified otherwise in DRAWINGS, provide as below –
   1. Molded case thermal magnetic or solid state trip type, with minimum interrupting rating equal to the main bus fault current rating:
   2. Circuit breaker frame sizes 150 A and less:
      a. Non-interchangeable, non-adjustable thermal magnetic trip units.
   3. Circuit breaker frame sizes 225 A and higher:
      a. Interchangeable and adjustable thermal magnetic trip units.
   4. Circuit breaker frame sizes 600 A and greater:

a. Solid state trip units, unless otherwise noted on the Drawings.
b. Current sensor or rating plug.
c. Adjustable current setting: Minimum range 70% to 100% of current sensor or rating plug.
d. Adjustable instantaneous pickup: Minimum range 3 to 8 times.
e. On circuit breakers 1,000 A and larger provide integral ground fault protection.
    1) Adjustable pick-up.
    2) Adjustable delay.

5. All circuit breakers to be provided with padlocking provision in the OFF position for up to three padlocks.
6. Thermal capability:
    a. Frame size 800 amp continuous and below:
    b. Shall be provided for use at 80% of their continuous rating unless otherwise indicated on the Drawings.
    c. Frame size 1,000 amp continuous and above:
        1) Shall be UL listed for application in their intended enclosure for 100% of their continuous rating.
        2) Wiring associated with these circuit breakers shall have a dry location maximum operating temperature of 90° C.
7. The breakers shall be operated by a handle and shall have a switching mechanism that is mechanically trip free from the handle, so that the contacts cannot be held closed against short circuits, and abnormal currents. Tripping due to overload, or short circuit shall be clearly indicated by the handle automatically assuming a position between the manual ON and OFF positions. Latch surfaces shall be ground and polished. Poles shall be constructed so that they open, close, and trip simultaneously.
8. Breakers must be completely enclosed in a molded case. Non-interchangeable trip breakers shall have their covers sealed; interchangeable trip breakers shall have the trip unit sealed to prevent tampering. Ampere ratings shall be clearly visible. Contacts shall be non-welding silver alloy. Arc extinction must be accomplished by means of arc chutes. The minimum interrupting ratings of the circuit breakers shall be at least equal to the available short circuit current at the line terminals.
9. Circuit breakers shall conform to the applicable requirements of NEMA Standards Publication No. AB1.
10. Molded case circuit breakers shall be ambient temperature compensating that provides inverse time delay overload and instantaneous short circuit protection by means of a thermalmagnetic element. Compensation shall be accomplished by a secondary bi-metal that will allow the breaker to carry rated current between 25° C and 50° C with tripping characteristics that are approximately the same throughout this temperature range.
11. On breakers with interchangeable, thermal, adjustable magnetic trip, the accessibility and position of the adjustment knob shall not be changed from those on the standard breaker.

12. Unless mounted in a switchboard, or panelboard, circuit breakers shall be housed in a NEMA rated enclosure as described elsewhere in these specifications.

B. Combination Motor Starters:
   1. Circuit breaker shall be motor circuit protector (MCP) type.
   2. Contactor shall be NEMA rated.
      a. One-half size and IEC sized starters not permitted.
   3. Operating handle shall clearly indicate whether circuit breaker is ON, OFF, or TRIPPED.
      a. Provide means to lock each circuit breaker handle in OFF position with cover closed by means of up to three padlocks.
      b. Interlock so that circuit breaker must be in OFF position before door can be opened. Provide defeater mechanism for use by authorized personnel.
   4. Provide starter unit with ambient compensated, external manually resettable, three bimetallic type overload relays. Coordinate size with actual motor full load current.
      a. For motors with power factor correction capacitors size heater elements to compensate for the capacitors effect on load current.
   5. Provide heavy-duty oil tight selector switches, pushbuttons, push-to-test pilot lights, or other devices, as indicated on the Drawings. These devices will be accessible with the door closed.
   6. Provide each starter with two extra field reversible NO auxiliary contacts for future use and as shown on the Drawings.
   7. Provide each starter with 480/120 V control power transformer fused on primary and secondary side, and rated for 140% of required load.
   8. Provide six-digit readout elapsed time meter where indicated on Drawings.
   9. Starter units will have the same fault current withstand rating as the MCC main bus fault current withstand rating from which they are fed.
   10. Provide each starter with the following status signals, wired to terminal boards.
      a. Motor run contact (N.O.).
      b. Motor stop contact (N.C.).
      c. Auxiliary overload relay contact (N.O.).

C. Selector Switches, Indicating Lights, and Pushbuttons:
   1. Heavy-duty oiltight/watertight for unclassified or wet areas.
   2. NEMA 4 for outdoor applications or panels specified WP.
   3. NEMA 4X for corrosive areas.
   4. NEMA 7 and 9 for Class I, Division I, Groups C and D, and Class II, Division I, Groups E, F, and G, hazardous locations.
   5. Selector switches shall have standard gloved operator.
   6. Pushbuttons shall have standard flush operator.
   7. Provide switch positions and contacts:

a. As specified on Contract Drawings or as necessary for proper control.

8. Switch contacts shall be NEMA A600 rated.
9. Full voltage indicating lights, unless specified otherwise.
10. Provide 100% replacement lamps for indicating lights.
11. Provide one replacement lens for each color indicating light.

D. Control Relays:
   1. Provide industrial control relays as specified on the Drawings and as required for proper operation and control of supplied equipment.
   2. All control relays shall have 120 V coils capable of operating on line voltage fluctuations of ±10%, unless specified otherwise.
   3. Provide contacts for all required control, plus two spares.

E. Time Delay Relays:
   1. Provide time delay relays with delayed pickup or release as specified on Drawings. All time delay relays shall operate at 115 VAC ±10%.
   2. Heavy duty, solid state construction.
   3. Contact Rating: 5A/250V.
   4. Provide external adjust dial with 0-30 second range unless specified otherwise.
   5. Operating temperature ranges: -18° C to +50° C.
   6. Repeat accuracy: ±3% plus ±10ms over specified voltage range.
   7. Provide all required contacts plus two N.O.spares.
   8. Provide auxiliary relays as required to perform functions specified on Drawings.

F. Terminal Blocks:
   1. Terminal blocks shall mount on standard DIN rail, and be of the size required for conductors therein. A minimum of 25% spares shall be provided in each terminal box. No more than two conductors shall be allowed per termination. Jumper bar assemblies shall be installed for interconnecting terminal blocks, distributing power, and signal commons. Terminal blocks shall be UL rated for 600 volts, and 20 Amps, minimum.
   2. Grounding terminal blocks shall be provided for instrumentation cable shields. The terminal blocks shall have distinctive two-color bodies, and shall be mounted to the DIN rail with metal screw down type clamps, providing a positive ground connection. One grounding terminal block shall be installed for every two instrument cables terminated. Grounding terminal blocks shall be UL rated for 600 volts, and 20 amps, minimum.
   3. Terminal blocks shall be available in a variety of colors, including red, green, blue, gray, black, yellow, and orange.
   4. DIN mount fuse holders shall have blown fuse indicators for DC and AC circuits. Fuse holders shall be of the compression clamp type. Fuse holders shall be UL listed, and rated for 600 volts. Fuse sizes shall not exceed the UL current rating for the fuse holders.

5. DIN rail shall be pre-punched, zinc bichromate plated steel. Symmetrical DIN rail shall be 35 mm x 7.5 mm, minimum.
6. Terminal blocks for 4-20 milliamp signals shall have knife disconnect switches, and accessible test points for testing and measurement of current loop signals, without the need for removing wire terminations.

G. Surge Protection Blocks (SPB):
1. Analog inputs and outputs shall be terminated at surge protection blocks (SPB). The SPBs shall be designed for a working voltage of 32 volts and shall be fused.
2. SPBs shall provide full hybrid line to line protection, and shall have a GDT rating of 10,000 A (8/20μs pulse waveform).
3. SPBs shall be UL 94 V-2 listed.

H. Enclosures and Control Panels:
1. NEMA 12 for unclassified areas.
2. NEMA 4 for outdoor or wet areas.
3. NEMA 4X for corrosive areas.
4. NEMA 7 for Class I hazardous locations.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install as indicated and in accordance with manufacturer's recommendations and instructions.

B. Mount other equipment as shown on the Drawings and per NEC.

C. Ground all equipment per NEC.

3.2 TESTING

A. Test in accordance with Specification 16920, Electrical Acceptance Testing.

++ END OF SECTION ++

SECTION 16475

MINI POWER CENTERS

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. This section covers electrical Mini Power Centers, 15kVA or larger.

B. Submit complete Operation and Maintenance Manuals in conformance with the Operation and Maintenance Manuals section of Section 01300, Submittals.

PART 2 - PRODUCTS

2.1 MINI POWER CENTERS

A. The contractor shall furnish and install Mini Power Centers, as indicated on the Electrical Drawings.

B. Single phase transformers shall be 480 volt primary and 240/120 volt secondary. Three phase transformers shall be 480 volt primary and 208 Y/120 volt secondary.

C. All transformers shall have a minimum of 2-5% full capacity primary taps below normal and shall be rated 115 degree temperature rise above 40 degree maximum ambient. All insulating materials are to be in accordance with current ANSI C89.2 and NEMA ST20 standards for a 185 degree UL component recognized insulation system. Transformers are to be encapsulated using a sand-epoxy resin mixture to provide maximum protection against moisture, dust and corrosive environments.

D. Enclosures shall be cleaned, phosphatized and electrostatically powder coated and shall be UL Listed for indoor and outdoor use.

E. Mini Power Center Units shall include integrally mounted and wired primary and secondary main circuit breakers in accordance with National Electrical Code requirement. These breakers and all branch circuit breakers shall be bolt-on type and as specified elsewhere within these specifications. Minimum A/C rating shall be as indicated on Drawings.

F. A hinged access door shall be provided which maintains itself in the open position when desired, and which has padlock provisions to prevent unauthorized entry. All live parts are to be fully enclosed for personnel protection when installation is

completed. The transformer and panelboards shall be constructed with separate enclosures capable of being assembled or disassembled as independent units.

G. The Mini Power Centers shall be UL Listed for use as service equipment.

H. The Mini Power Centers shall be as manufactured by Square D Company or equal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Mini Power Centers shall be installed as indicated on the drawings and per manufacturer's instruction.

3.2 TESTING

A. Test in accordance with Specification 16920, Electrical Acceptance Testing.

++ END OF SECTION ++

SECTION 16476

LOW VOLTAGE CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. The CONTRACTOR shall furnish and install low voltage circuit breakers, as indicated on the Drawings and specified herein.

1.2 SUBMITTALS

A. Products shall be submitted in accordance with Section 16000, General Electrical Requirements, and elsewhere in the Contract Documents, prior to installation.

B. Shop Drawings: Submit for approval the following:
   1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
   2. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**

1.3 QUALITY ASSURANCE

A. The breaker manufacturer's facilities shall be ISO 9001 certified.

PART 2 - PRODUCTS

2.1 GENERAL

A. Circuit breakers shall be as manufactured by Square D, Cutler-Hammer, Allen-Bradley, General Electric, or equal.

B. Circuit breaker frame, trip, short circuit, and interruption ratings shall be as indicated on the Drawings, except that they shall be coordinated with the ratings of the equipment actually furnished, and shall be modified where necessary to suit the equipment. Circuit breakers to be used in motor control centers shall be as indicated on the Drawings. Where no indication of type is given on the Drawings, circuit breakers protecting motors shall be motor circuit protectors and other circuit breakers shall be molded case type.

C. Circuit breaker for mounting in motor control centers or for separate mounting shall be of the air-break type, quick-make and quick-break, 600 volt, with number of poles as indicated on the Drawings.

D. Each pole of the circuit breaker shall provide inverse time delay and instantaneous circuit protection.

E. The breakers shall be operated by a handle and shall have a switching mechanism that is mechanically trip free from the handle, so that the contacts cannot be held closed against short circuits, and abnormal currents. Tripping due to overload, or short circuit shall be clearly indicated by the handle automatically assuming a position between the manual ON and OFF positions. Latch surfaces shall be ground and polished. Poles shall be constructed so that they open, close, and trip simultaneously.

F. Breakers must be completely enclosed in a molded case. Non-interchangeable trip breakers shall have their covers sealed; interchangeable trip breakers shall have the trip unit sealed to prevent tampering. Ampere ratings shall be clearly visible. Contacts shall be non-welding silver alloy. Arc extinction must be accomplished by means of arc chutes. The minimum interrupting ratings of the circuit breakers shall be at least equal to the available short circuit current at the line terminals.

G. Circuit breakers shall conform to the applicable requirements of NEMA Standards Publication No. AB1.

H. Molded case circuit breakers shall be ambient temperature compensating that provides inverse time delay overload and instantaneous short circuit protection by means of a thermalmagnetic element. Compensation shall be accomplished by a secondary bi-metal that will allow the breaker to carry rated current between 25°

C and 50° C with tripping characteristics that are approximately the same throughout this temperature range.

I. On breakers with interchangeable, thermal, adjustable magnetic trip, the accessibility and position of the adjustment knob shall not be changed from those on the standard breaker.

J. Unless mounted in a switchboard, or panelboard, circuit breakers shall be housed in a NEMA rated enclosure as described elsewhere in these specifications.

K. Provide circuit breakers with shunt trip mechanisms where shown on the Drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Circuit breakers shall be installed as indicated on the Drawings and per manufacturer's instructions.

++ END OF SECTION ++

SECTION 16477

600 V FUSES

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. This Section covers the requirements for protective fusing on this Project. The CONTRACTOR shall furnish and install fuses and fuse holders per the Drawings and equipment manufacturer's recommendations.

B. This Specification includes the general requirements for various types of fuses whether they are shown on the Drawings or not. If fusing is required by codes or manufacturers recommendations, but not shown on the Drawings, this Specification shall apply to the type of fusing provided by the CONTRACTOR.

C. Types of fuses specified in this Section include the following:
   1. Class L time-delay.
   2. Class L fast-acting.
   3. Class RK1 time-delay.
   4. Class RK1 and Class J current-limiting.
   5. Class RK5 time-delay.
   6. Class K5 time-delay, noncurrent-limiting.
   7. Class T current-limiting.

1.2 QUALITY ASSURANCE

A. The fuse manufacturer's facilities shall be ISO 9001 certified.

1.3 CODES AND STANDARDS

A. UL Compliance and Labeling: Comply with applicable provisions of UL 198D, "High-Interrupting-Capacity Class K Fuses". Provide over-current protective devices which are UL listed and labeled.

B. NEC Compliance: Comply with NEC as applicable to construction and installation of fusible devices.

C. ANSI Compliance: Comply with applicable requirements of ANSI C97.1, "Low-Voltage Cartridge Fuses 600 Volts or Less".

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data on fuses, including specifications, electrical characteristics, installation instructions, furnished

specialties, and accessories in accordance with Section 16000, General Electrical Requirements, and the Contract Documents. In addition, include voltages and current ratings, interrupting ratings, current limitation ratings, time-current trip characteristic curves, and mounting requirements.

B. Shop Drawings: Submit for approval the following:
   1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
   2. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**

1.5 MANUFACTURERS

A. Subject to compliance with requirements, manufacturers offering fusible devices which may be incorporated in the work include, but are not limited to, the following:
   1. Bussmann.
   2. Mersen.
   3. Or equal.

PART 2 - PRODUCTS

2.1 GENERAL

A. Except as otherwise indicated, provide fuses of types, sizes, ratings, and average time-current and peak let-through current characteristics indicated, which comply

with manufacturer's standard design, materials, and constructed in accordance with published product information, and with industry standards and configurations.

2.2 CLASS L TIME-DELAY FUSES

A. Provide UL Class L time-delay fuses rated 600 volts, 60 Hz, with 200,000 RMS symmetrical interrupting current rating for protecting transformers, motors, and circuit-breakers.

2.3 CLASS L FAST-ACTING FUSES

A. Provide UL Class L fast-acting fuses rated 600 volts, 60 Hz, with 200,000 RMS symmetrical interrupting current rating for protecting service entrances and main feeder circuit-breakers.

2.4 CLASS RK1 TIME-DELAY FUSES

A. Provide UL Class RK1 time-delay fuses rated 600 volts, 60 Hz, with 200,000 RMS symmetrical interrupting current rating for protecting motors and circuit-breakers.

2.5 CLASS RK1 CURRENT-LIMITING FUSES

A. Provide UL Class RK1 current-limiting fuses rated 250 volts, 60 Hz, with 200,000 RMS symmetrical interrupting current rating for protecting circuit breakers.

2.6 CLASS J CURRENT-LIMITING FUSES

A. Provide UL Class J current-limiting fuses rated 600 volts, 60 Hz, with 200,000 RMS symmetrical interrupting current rating.

2.7 CLASS RK5 TIME-DELAY FUSES

A. Provide UL Class RK5 time-delay fuses rated 600 volts, 60 Hz, with 200,000 RMS symmetrical interrupting current rating for protecting motors.

2.8 CLASS K5 ONE-TIME FUSES

A. Provide UL Class K5 one time fuses rated 250 volts, 60 Hz, with 100,000 RMS symmetrical interrupting current rating for protecting non-inductive loads.

2.9 CLASS T FUSES

A. Provide UL Class T fuses rated 600 volts, 60 Hz, with 200,000 RMS symmetrical interrupting current rating for protection of physically small devices.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Fuse types and sizes shall be as indicated on the Drawings. Fuses shall be installed in accordance with the National Electrical Code (NEC) requirements and the manufacturer's written instructions.

B. Install fuses in proper fuse holders.

C. Where fuses are installed in the motor starters, fuses shall be sized to match the actual motor full load current.

D. Where fuses are installed in disconnect switches at HVAC units, the fuse sizes shall be sized to meet the HVAC manufacturer's requirements.

E. Fuses for control transformers shall be sized in accordance with the National Electrical Code.

F. Fuses shall be installed with the labels clearly visible.

3.2 FIELD QUALITY CONTROL

A. Prior to energizing fusible devices, test devices for circuit continuity and for short circuits.

3.3 SPARE PARTS

A. Furnish three spare fuses of each size and type.

++ END OF SECTION ++

SECTION 16480

MOTOR CONTROLLERS

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. A motor controller is any device or group of devices normally used to start and stop a motor by making and breaking the motor circuit current. The motor controller and devices that make up the motor controller shall be governed by items indicated on the Drawings or elsewhere within these Specifications.

B. Types of Motor Controllers specified in this Section include the following:
   1. Combination.
   2. Fractional horsepower manual.
   3. Solid-state reduced voltage.
   4. Autotransformer reduced voltage.

C. This Section applies to motor controllers rated 480 V and below.

1.2 CODE AND STANDARDS

A. Electrical Code Compliance: Comply with applicable local electrical code requirements of the authority having jurisdiction and NEC Articles 220, 250, and 430, as applicable to installation and construction of motor controllers.

B. NFPA Compliance: Comply with applicable requirements of NFPA 70E, "Standard for Electrical Safety requirements for Employee Workplaces".

C. UL Compliance: Comply with applicable requirements of UL 486A and B, and UL 508, pertaining to installation of motor controllers. Provide controllers and components which are UL listed and labeled.

D. IEEE Compliance: Comply with recommended practices contained in IEEE Standard 241, "Recommended Practice for Electrical Power Systems in Commercial Buildings", pertaining to motor controllers.

E. NEMA Compliance: Comply with applicable requirements of NEMA Standard ICS 2, "Industrial Control Devices, Controllers and Assemblies", and Pub. No. 250, "Enclosures for Electrical Equipment (1,000 Volts Maximum)", pertaining to motor controllers and enclosures.

1.3 MAINTENANCE DATA

A. Submit maintenance data and parts list for each motor controller and component; including troubleshooting maintenance guide. Also, provide product data and shop drawings in a maintenance manual, in accordance with requirements of the Contract Documents.

1.4 SUBMITTALS

A. Product Data:
   1. Submit manufacturer's data and installation instructions on motor controllers.

B. Shop Drawings:
   1. Submit Shop Drawings of motor controllers showing accurately scaled equipment locations and spatial relationships to associated motors and equipment.

C. Wiring Diagrams:
   1. Submit power and control wiring diagrams for motor controllers showing connections to electrical power panels, feeders, and equipment.

D. Submittal documents shall be provided in accordance with Section 16000, General Electrical Requirements, and other requirements of the Contract Documents.

PART 2 - PRODUCTS

2.1 GENERAL

A. Except as otherwise indicated, provide motor controllers and ancillary components that comply with manufacturer's standard materials, design and construction in accordance with published product information and as required for a complete installation.

B. Combination controllers:
   1. Provide full-voltage alternating-current combination controllers, consisting of controller and circuit breaker disconnect switch mounted in a common enclosure, of types, sizes, rating, and NEMA sizes indicated on the Drawings. Equip controllers with electronic overload relays, control relays, and auxiliary contacts as required on the drawings. Provide lockable operating handle for disconnect switch mechanism, mechanically interlocked with enclosure door. Provide NEMA rated enclosure type as shown on the Drawings.

C. Circuit breaker disconnect shall be molded case, motor circuit protector type (MCP), sized per NEC.

D. Provide control power transformer sized properly to accommodate device loads. The control power transformer shall have two primary and one secondary fuse sized according to NEC.

E. Furnish controller with control and indicating devices as indicated on the Drawings. Auxiliary contacts and field connections shall be connected to terminal strips for field connection.

2.2 ELECTRONIC OVERLOAD RELAYS

A. Electronic overload relays shall be provided with the motor starters. The overload relay shall be a 3-pole solid state device that monitors all three phases of the motor current. The unit shall detect overcurrent, phase current imbalance, phase loss, and trip after an adjustable time from three seconds to 30 seconds.

B. The overload relay shall be Class 10, 600 volt rated, ambient temperature compensated, and shall have an LED trip indicator. The unit shall have a manual and automatic reset feature, and a normally closed contact for control.

C. Each module shall provide individual trip indication and reset for each trip condition, visible without opening the motor control center compartment door. Provide a normally open auxiliary contact for remote trip indication.

D. Solid state circuits shall be completely protected from damage arising from line transients and voltage spikes.

2.3 MAGNETIC MOTOR STARTERS

A. Starters, Size 2 and larger, shall have arc quenchers on all load breaking contacts. Starters shall be suitable for the horsepower ratings specified. The CONTRACTOR shall verify the motor ratings, and coordinate the starter and overload trip ratings with the actual horsepower ratings of the motors installed. Extended overload reset buttons shall be mounted so as to be accessible for operation without opening the door of the enclosure.

B. Magnetic contactors shall be factory adjusted and shall be chatter free. Overload relays shall be electronic, as specified herein.

C. Starters shall be furnished complete with a 120 volt control power transformer. Control circuit fuses shall be furnished both on the primary and secondary of the control circuit transformer. If there is no transformer, all live control power supply wires shall be fused.

D. Starters shall be designed to operate in ambient temperatures up to 60º C.

E. The minimum size starter shall be NEMA Size 1.

2.4 MANUAL STARTERS

A. Manual starters shall be rated for the motor load and shall be equipped with built-in overloads.

B. Manual starters shall be provided with enclosures as indicated on the Drawings, lockable handles that clearly indicate ON, OFF, and TRIPPED positions, pilot light, and positive, quick-make, quick-break mechanisms.

C. Manual starters shall be manufactured by Cutler Hammer or approved equal.

2.5 MOTOR PHASE FAILURE RELAY

A. The relay shall detect voltage values below an adjustable value, loss of phase, and phase reversal. The unit shall automatically de-energize the control circuits of the motors to be protected, when one or all three phase voltages drop below the set point. The unit shall have a nominal trip delay time of two seconds and a reset time of two seconds. The relay shall automatically reset upon restoration of the line voltage. Relays shall be MotorSaver, Time Mark Corporation, or equal.

2.6 MOTOR PROTECTION RELAY

A. The motor protection relay shall be capable of the following, as a minimum:
   1. Phase loss.
   2. Low voltage (adjustable).
   3. Phase reversal.
   4. Phase unbalance.

B. The motor protection relay shall be equipped with the following as a minimum:
   1. Adjustable trip delay (2 to 20 seconds).
   2. Automatic reset.
   3. Transient protection (2,500 volts for 10 ms).

C. Motor protection relays shall be set during the Project start-up according to the individual motor characteristics and application parameters. The motor protection relays for the motors with variable frequency drives shall be set as to prevent low voltage tripping.

D. The motor protection relays shall be MotorSaver Model 350, Time Mark Model 264, or equal.

2.7 SOLID STATE REDUCED VOLTAGE STARTER

A. Furnish and install a solid-state reduced voltage starter (SSS) to provide motor soft start and soft stop, where indicated on the Drawings. The starter shall be capable of operating with any standard NEMA design motor of the specified horsepower. The unit shall be self contained, house the logic board, power

switches, heat sinks, motor overload protection, control power transformer, and any applicable disconnect means in one enclosure.

B. Voltage rating to be 460 V, 60 Hz, 3-phase, ±20%.

C. Operating temperature shall be 0 degrees to 50° C, 5% to 95% relative humidity, non-condensing. De-rate 33% for each 10° C over 50° C to a maximum of 70° C.

D. Built in overload protection shall shut down and disable the starter until reset.

E. There shall be three pairs of inverse parallel SCRs. Each SCR shall be rated to block 2.5 times the nominal line to line voltage. The SCRs shall be sized to handle locked rotor current six times full load current for 10 seconds on a cold start at 50° C.

F. The starter shall be installed as indicted on the Drawings and shall be supplied with properly sized input and bypass contactors and controls, as shown on the Drawings.

G. Adjustments and indicators shall be accessible from a digital keypad with LCD panel. Indications shall include control power on, motor on, motor starting, overload, motor on bypass, and current.

H. Power poles and logic assemblies to be removable as one piece assemblies. One logic assembly shall work in any size unit of a given line voltage. The logic assembly shall be conformal coated. The gate drive circuit shall be optically coupled for noise immunity and long life. The logic assembly and SCRs shall be noise immune per NEMA showering arc test for solid-state contactors.

I. The soft start unit shall be capable of voltage or current control. The voltage limit shall be adjustable from 30% to 80% of line voltage and the current control shall be adjustable from 200% to 600% of FLA. In the voltage control mode, the ramp time shall be adjustable from 1 to 30 seconds, and the unit shall have a soft stop feature.

J. The soft start shall have dry contact, Form C, outputs available for internal faults, bypass contactor control, and run status.

PART 3 - EXECUTION

3.1 GENERAL

A. Install motor controllers in accordance with equipment manufacturer's written instructions, and with recognized industry practices. Comply with applicable requirements of NEC, UL, and NEMA Standards, to insure that products fulfill requirements.

B. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque values for equipment connectors. Where manufacturer's torque requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Standards 486A and B and the National Electrical Code.

C. Install fuses, of sizes indicated, in each fusible disconnect switch, if any.

D. Test in accordance with Specification 16920, Electrical Acceptance Testing.

E. Upon completion of installation of motor controller equipment and electrical circuitry, energize controller circuitry and demonstrate functioning of equipment in accordance with requirements. Where possible, correct malfunctioning units at site, then retest to demonstrate compliance; otherwise, remove and replace with new units and retest to demonstrate compliance.

++ END OF SECTION ++

SECTION 16481

MOTOR CONTROL CENTERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 1, General Requirements, Specification Sections apply to this Section.

1.2 SUMMARY

A. This Section includes new motor control centers for use on AC circuits rated 600 VAC.

B. This section also includes modifications to existing motor control centers rated 600VAC.

1.3 SUBMITTALS

A. Product Data: For each type of controller and each type of motor control center. Include dimensions and manufacturer's technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each motor control center.
   1. Dimensioned Plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings. Include the following:
      a. Each installed unit's type and details.
      b. Nameplate legends.
      c. Short circuit current ratings of buses and installed units.
      d. Vertical and horizontal bus capacities.
      e. UL listing for series rating of overcurrent protective devices in combination controllers.
      f. Features, characteristics, ratings, and factory settings of each motor control center unit.
   2. Wiring Diagrams: Power, signal, and control wiring for class and type of motor control center. Differentiate between manufacturer-installed and field-installed wiring. Provide schematic wiring diagram for each type of controller.
   3. Submit for approval the following:
      a. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification

compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

b. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**

C. Manufacturer Seismic Qualification Certification: Submit certification that motor control centers, accessories, and components will withstand seismic forces defined for the site.
   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
      a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event".
   2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
   3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Qualification Data: For firms and persons specified in Paragraph 1.4 of this Specification.

E. Field Test Reports: Written reports specified in Part 3 of this Specification.

F. Manufacturer's field service report.

G. Maintenance Data: Submit complete Operation and Maintenance Manuals in conformance with the Operation and Maintenance Manuals section of Section 01300, Submittals. Also include the following:
   1. Routine maintenance requirements for motor control centers and all installed components.
   2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.

H. Load-Current and Overload-Relay List: Compile after motors have been installed and arrange to demonstrate that selection of heaters suits actual motor nameplate full-load currents.

I. Arc Flash Hazard Survey and appropriate labeling shall be done on all circuits 300 volts and above.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Maintain, within 100 miles of Project site, a service center capable of providing training, parts, and emergency maintenance and repairs.

B. Source Limitations: Obtain controllers of a single type through one source from a single manufacturer.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. Comply with NFPA 70.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver motor control centers in shipping splits of lengths that can be moved past obstructions in delivery path as indicated.

B. Handle motor control centers according to NEMA ICS 2.3, "Instructions for the Handling, Installation, Operation, and Maintenance of Motor Control Centers", use factory-installed lifting provisions.

C. Store motor control centers indoors in clean, dry space with uniform temperature to prevent condensation. Protect motor control centers from exposure to dirt, fumes, water, corrosive substances, and physical damage.

D. If stored in areas subjected to weather, cover motor control centers to protect from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside controllers; install electric heating of sufficient wattage to prevent condensation.

1.6 PROJECT CONDITIONS

A. Existing Utilities: Do not interrupt utilities serving facilities occupied by OWNER or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
   1. Notify construction manager at least two days in advance of proposed utility interruptions. Identify extent and duration of utility interruptions.
   2. Indicate method of providing temporary utilities.
   3. Do not proceed with utility interruptions without Construction Manager's written permission.

1.7 COORDINATION

A. Coordinate layout and installation of motor control centers with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Section 03300, Cast-In-Place Concrete.

C. Coordinate features of motor control centers, installed units, and accessory devices with pilot devices and control circuits to which they connect.

D. Coordinate features, accessories, and functions of each motor control center, each controller, and each installed unit with ratings and characteristics of supply circuit, motor, required control sequence, and duty cycle of motor and load.

1.8 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Spare Fuses: Furnish one spare for every two installed, but not less than one set of three of each type and rating.
   2. Indicating Lights: Two of each type installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products from the following:
   1. Eaton.

2. ABB.
3. Allen-Bradley.
4. Square D.

2.2 MOTOR CONTROL CENTERS

A. Wiring: NEMA ICS 3, Class I, Type B.

B. Enclosures: Flush- or surface-mounted cabinets as indicated.
   1. Outdoor Locations: NEMA 250, Type 3R, provide intrusion switches on all sectional doors.
   2. Indoor Locations: NEMA Type 1A enclosure.
   3. Compartments: Modular; individual doors with concealed hinges and quick-captive screw fasteners. Interlocks on combination controller units requiring disconnecting means in OFF position before door can be opened or closed, except by operating a permissive release device.
   4. Interchangeability: Compartments constructed to allow for removal of units without opening adjacent doors, disconnecting adjacent compartments, or disturbing operation of other units in motor control center. Interchangeability of units requiring the same size compartment and constructed to permit ready rearrangement of units, such as replacing three single units with a unit requiring three spaces, without cutting or welding.
   5. Wiring Spaces: Wiring channel in each vertical section for vertical and horizontal wiring to each unit compartment; supports to hold wiring in place.

C. Short Circuit Current Rating for Each Section: Greater than indicated available fault current in symmetrical amperes at motor control center location or that required by power utility, whichever is greater.

2.3 BUSES

A. Material: Tin-plated copper, 98% conductivity.

B. Ampacity Ratings: As indicated on the Drawings for horizontal busses, 300 amperes minimum for vertical buses.

C. Neutral Buses: Full size.

D. Equipment Ground Bus: Non-insulated, horizontal copper bus, 2-inches by 1/4-inch, minimum.

E. Horizontal Bus Arrangement: Main phase, neutral and ground buses extended with same capacity the entire length of motor control center, with provision for future extension at both ends by bolt holes and captive bus splice sections or equivalent.

2.4 FUNCTIONAL FEATURES

A. Description: Modular arrangement of controllers, control devices, overcurrent protective devices, transformers, panelboards, instruments, indicating panels, blank panels, and other items mounted in compartments of motor control center.

B. Controller Units:
   1. Provide Motor Controller units supplied by the same manufacturer as the motor control center.
   2. Provide units with short circuit current ratings equal to or greater than short circuit current rating of motor control center section.
   3. Equip units in Type B and Type C motor control centers with pull-apart terminal strips or drawout terminal boards for external control connections.

C. Overcurrent Protective Devices: Individual feeder-tap units through 225 A rating shall have drawout mountings with connectors that automatically line up and connect with vertical-section buses while being racked into their normal, energized positions.

D. Surge Protection Devices: Connect to motor control center bus. Provide surge protective devices in accordance with Section 16282, Surge Protective Devices.

E. Transformer housing section for a transformer and a distribution panel with connections, as shown on the Drawings.

F. Spaces and Blank Units: Compartments fully bused and equipped with guide rails or equivalent, ready for insertion of drawout units.

G. Spare Units: Type, sizes, and ratings indicated; installed in compartments indicated "spare".

H. Provide power quality metering.

2.5 MOTOR CONTROLLERS

A. Description: NEMA ICS 2, Class A, full voltage, non-reversing, across-the-line, unless otherwise indicated.

B. Control Circuit: 120 volt; obtained from integral control power transformer with a control power transformer of sufficient capacity to operate connected pilot, indicating and control devices, +100% spare capacity.

C. Combination Controller: Factory-assembled combination controller and disconnect switch.
   1. Circuit Breaker Disconnecting Means: NEMA AB 1, motor-circuit protector with field-adjustable, short circuit trip coordinated with motor locked-rotor amperes.

D. Adjustable Overload Relay: Dip switch selectable for motor running overload protection with NEMA ICS 2, Class 10 tripping characteristic, and selected to protect motor against voltage and current unbalance and single phasing. Provide relay with Class II ground-fault protection, with start and run delays to prevent nuisance trip on starting.

E. Bypass Controller: NEMA ICS 2, full-voltage, non-reversing controller with across-the-line starting capability in manual bypass mode. Provide motor overload protection under both modes of operation with control logic that allows common start-stop capability in either mode.

F. Solid-State, Reduced-Voltage Controller: Provide Solid State Motor Controllers internal to MCC bucket in accordance with Section 16482, Solid State Motor Controllers.

G. Variable Frequency Drive: Provide Variable Frequency Drive motor controllers internal to MCC bucket in accordance with Section 16485, Variable Frequency Drives.

2.6 FEEDER OVERCURRENT PROTECTION

A. Thermal-Magnetic Circuit Breakers: Provide as shown on DRAWINGS. Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
   1. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
   2. Electronic Trip Unit Circuit Breakers: RMS sensing; field-replaceable rating plug; with the following field-adjustable settings:
      a. Instantaneous trip.
      b. Long- and short-time pickup levels.
      c. Long- and short-time time adjustments.
      d. Ground-fault pickup level, time delay, and I2t response.
   3. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
   4. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker; trip activation on fuse opening or on opening of fuse compartment door.
   5. GFCI Circuit Breakers: Single- and 2-pole configurations with 5 mA trip sensitivity.
   6. Molded-Case Switch: Molded-case circuit breaker without trip units.

B. Molded-Case, Circuit-Breaker Features and Accessories: Provide as shown on DRAWINGS. Standard frame sizes, trip ratings, and number of poles.
   1. Lugs: Mechanical style, suitable for number, size, trip ratings, and material of conductors.

2. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
3. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
4. Communication Capability: Circuit breaker-mounted communication module with functions and features compatible with power monitoring and control system.
5. Shunt Trip: 120 volt trip coil energized from separate circuit, set to trip at 75% of rated voltage.
6. Undervoltage Trip: Set to operate at 35% to 75% of rated voltage with field-adjustable 0.1 to 0.6 second time delay.

2.7 MOTOR CONTROL CENTER ACCESSORIES

A. Devices shall be factory installed in controller enclosure and shall be of the same manufacturer as the motor control center, unless otherwise indicated.

B. Pushbutton Stations, Pilot Lights, and Selector Switches: Provide pushbuttons, pilot lights, and selector switches in accordance with Section 16161, Control Panels.

C. Stop and Lockout Pushbutton Station: Momentary-break, pushbutton station with a factory-applied hasp arranged so padlock can be used to lock pushbutton in depressed position with control circuit open.

D. Control Relays: Provide auxiliary and adjustable time-delay relays in accordance with Section 16161, Control Panels.

E. Elapsed Time Meters: Provide elapsed time meters in accordance with Section 16161, Control Panels.

F. Meters: Panel-type, 2-1/2-inch minimum size with 90 degree or 120 degree scale, and ±2% accuracy. Where indicated, provide transfer device with an OFF position. Meters shall indicate the following:
   1. Ammeter: Output current, with current sensors rated to suit application.
   2. Voltmeter: Output voltage.
   3. Frequency Meter: Output frequency.

G. Multifunction Digital-Metering Monitor: UL listed or recognized, microprocessor-based unit suitable for three- or four-wire systems and with the following features:

H. Provide metering in accordance with Section 16430, Customer Power Metering System.

I. Phase Failure and Undervoltage Relays: Solid-state sensing circuit with isolated output contacts for hardwired connection. Provide adjustable undervoltage setting.

J. Current Sensing, Phase Failure Relays: Solid-state sensing circuit with isolated output contacts for hardwired connection; arranged to operate on phase failure, phase reversal, current unbalance of from 30% to 40%, or loss of supply voltage; with adjustable response delay.

K. Spare Fuse Cabinet: Identified cabinet with hinged, lockable door.

2.8 FACTORY FINISHES

A. Manufacturer's standard prime-coat finish ready for field painting.

B. Finish: Manufacturer's standard paint applied to factory-assembled and -tested controllers before shipping.

2.9 ENVIROMENTAL CONTROL

A. Environmental Controls:
   1. Furnish circulation fans near hot spots where required to prevent temperature from exceeding instrument and equipment ratings.
   2. Over-temperature switches shall be utilized to provide special cooling if required to maintain operating temperatures within the manufacturer's specified temperature range.
   3. Air conditioning cooling applications shall also include means of preventing moisture condensation inside the enclosure.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and surfaces to receive motor control centers for compliance with requirements, installation tolerances, and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Select features of each controller to coordinate with ratings and characteristics of supply circuit and motor; required control sequence; duty cycle of motor, drive, and load; and configuration of pilot device and control circuit affecting controller functions.

B. Select horsepower rating of controllers to suit motor controlled.

3.3 INSTALLATION

A. See Section 16050, Basic Materials and Methods, for general installation instructions.

B. Anchor each motor control center assembly to steel-channel sills arranged and sized according to manufacturer's written instructions. Attach by bolting. Level and grout sills flush with motor control center mounting surface.

C. Install motor control centers on concrete bases complying with Section 03300, Cast-In-Place Concrete.

3.4 IDENTIFICATION

A. Identify motor control center, motor control center components, and control wiring according to Section 16195, Electrical Identification.

B. Operating Instructions: Frame printed operating instructions for motor control centers, including control sequences and emergency procedures. Fabricate frame of finished metal and cover instructions with clear acrylic plastic. Mount on front of motor control centers.

3.5 CONTROL WIRING INSTALLATION

A. Install wiring between motor control devices.

B. Bundle, train, and support wiring in enclosures.

C. Connect hand-off-automatic switch and other automatic control devices where available.
   1. Connect selector switches to bypass only manual and automatic control devices that have no safety functions when switch is in "hand" position.
   2. Connect selector switches with motor control circuit in both "hand" and "automatic" positions for safety-type control devices such as low and high pressure cutouts, high temperature cutouts, and motor overload protectors.

3.6 CONNECTIONS

A. Conduit installation requirements are specified in other Division 16, Electrical, Sections. Drawings indicate general arrangement of conduit, fittings, and specialties.

B. Ground equipment.

C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.7 FIELD QUALITY CONTROL

A. Prepare for Acceptance Tests as follows:
   1. Test insulation resistance for each motor control center element, bus, component, connecting supply, feeder, and control circuit.
   2. Test continuity of each circuit.

B. Testing: Perform the following field quality control testing:
   1. Perform each electrical test and visual and mechanical inspection indicated in NETA ATS, Sections 7.5, 7.6, and 7.16.
   2. Certify compliance with test parameters.
   3. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

C. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including pre-testing and adjusting solid-state controllers.

D. Test Reports: Prepare a written report to record the following:
   1. Test procedures used.
   2. Test results that comply with requirements.
   3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

3.8 ADJUSTING

A. Set field-adjustable switches and circuit breaker trip ranges.

3.9 CLEANING

A. Clean controllers internally, on completion of installation, according to manufacturer's written instructions. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

3.10 START-UP SERVICE

A. Engage a factory-authorized service representative to perform start-up service.

B. Verify that motor control centers and components are installed and connected according to the Contract Documents.

C. Verify that electrical wiring installation complies with manufacturer's submittal and installation requirements in Division 16, Electrical, Sections.

D. Complete installation and start-up checks according to manufacturer's written instructions.

3.11 DEMONSTRATION

A. Engage a factory-authorized service representative to train OWNER'S maintenance personnel to adjust, operate, and maintain motor control centers.
   1. Train OWNER'S maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining equipment and schedules.
   2. Review data in maintenance manuals. Refer to Section 01700, Contract Closeout.
   3. Schedule training with OWNER, through Construction Manager, with at least seven days advance notice.

++ END OF SECTION ++

SECTION 16482

SOLID STATE MOTOR CONTROLLERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Solid state motor controllers (SSMC)* for use with NEMA Design "B" 460 VAC motors to reduce the current inrush as well as mechanical shocks that can result from starting or stopping a motor across the line.
   2. This section pertains to stand-alone solid state motor controllers in addition to those provided as part of a Motor Control Center. When providing a SSS inside a MCC, match the manufacturer of the MCC.
   3. Provide SSMC fully assembled as part of a Motor Control Center or as a standalone controller, ready for field installation, testing, and startup.

   *The terms SSMC and SSS (Solid State Starters) can be used interchangeably.

1.2 SUBMITTALS

A. Submit the following in accordance with Specification 16000, General Electrical Requirements:
   1. Complete electrical data on the SSMC and all accessories.
   2. Dimensional and weight information on the enclosure (if applicable).
   3. Fully developed ladder style elementary diagrams complete with terminal and wire designations. Label or tag all control devices.
   4. Comprehensive bill of material for all components used to assemble the finished product.
   5. Anticipated heat load for sizing of building HVAC system.
   6. Verification that unit is listed by an independent testing laboratory in accordance with Electric Industrial Control Equipment Specification UL 508.
   7. List of recommended spare parts for one year operation.

B. Shop Drawings: Submit for approval the following:
   1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The

remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

2. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**
3. Submit complete Operation and Maintenance Manuals in conformance with the Operation and Maintenance Manuals section of Section 01300, Submittals.

1.3 QUALITY ASSURANCE

A. Final assembly to be provided with a UL 508 label installed at the point of manufacturer.

B. The manufacturer shall be a certified ISO 9002 facility.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Package unit to protect against shipping damage.

B. Store unit in a clean, dry, controlled environment until scheduled installation.

C. Handle units in accordance with manufacturer's recommendations and in such a manner as to prevent damage.

D. Replace any unit damaged as a result of improper shipping, storage, or handling.

1.5 PROJECT/SITE CONDITIONS

A. Unit shall be designed specifically for the environment into which it will be installed.

B. Provide weather protection, space heating to prevent condensation, and cooling or ventilation as recommended by SSMC manufacturer.

C. Provide sufficient clearance and housekeeping pads to allow air circulation and to prevent damage from standing water.

1.6 WARRANTY

A. Provide a one year warranty on materials and workmanship from date of start up or 18 months from date of shipment.

B. An optional extended warranty shall be available for up to an additional two years.

PART 2 - PRODUCT

2.1 MANUFACTURER

A. ABB.

B. Allen-Bradley

C. Eaton.

D. Square Company

2.2 GENERAL DESCRIPTION

A. Provided in a configuration suitable for panel mounting.

B. Uses a thyristor bridge consisting of at least two SCRs per phase to control the starting and stopping of industry standard motors. A soft start/current limit will be obtained by a timed voltage ramp of the thyristors. The thyristors will be controlled in such a manner that a smooth and stable acceleration ramp is ensured, independent of motor load.

C. Controlled by a microprocessor that continuously monitors the current and thyristor phasing of the starter.

D. All soft start power ratings shall use the same control module.

2.3 RATINGS

A. Designed to operate in an ambient temperature of 0° C to 40° C.

B. Storage temperature range shall be -25° C to 70° C.

C. Maximum relative humidity shall be 93% at 40° C, non-condensing.

D. Designed to operate in attitudes up to 3,300 feet. For higher altitudes, de-rate by 1.2% for each additional 330 feet.

E. Capable of operation within -15% to +10% of nominal voltage rating and automatically adapt for 50 Hz or 60 Hz.

F. Capable of supplying 300% of rated full load current for 60 seconds at maximum ambient temperature.

G. The SCRs shall have a minimum P.I.V. rating of 1,400 V. Lower rated SCRs with "protection" by MOVs will not be acceptable.

2.4 ADJUSTMENTS AND CONFIGURATIONS

A. All dialog functions, display units, remote functions, terminal blocks, configuration switches and adjustment potentiometers shall be accessible on the front of the control module. Exposure to control circuit boards or electrical power devices during routine adjustments shall be prohibited.

B. Dialog indication shall provide, as a minimum, the following conditions:
   1. Soft start ready for start.
   2. Soft start starting/stopping motor.
   3. Soft start running at full voltage.
   4. Thermal pre-alarm condition.
   5. Thermal fault.
   6. Soft start internal fault.
   7. Power supply fault.

C. Dip switches shall be used for configuring the soft start and will select:
   1. Manual or automatic reset.
   2. Freewheel or controlled stopping.
   3. Stop by deceleration ramp or DC injection braking.
   4. Full voltage boost on start (on or off).

D. Potentiometers or keypads shall be used for adjusting the operating parameters and will provide:
   1. Motor full load amps adjustable from 50% to 100% of the controller's current rating.
   2. Current limitation on starting adjustable from 2 to 5 times rated motor current.
   3. Voltage ramp adjustable from 1 to 30 seconds.
   4. Deceleration ramp or DC injection time adjustable from 2 to 60 seconds.

E. Output relays shall provide the following status indications:
   1. Fault Trip or Soft Start: One Form A and one Form B, minimum.
   2. Thermal Pre-alarm: One Form A and one Form B or one Form C, minimum.
   3. End of Start (voltage ramp complete and current below 130% motor FLA): One Form A.
   4. Brake (for control of braking contactor if this function is specified): One Form A.

F. Relay functions listed above must be isolated with respect to common.

2.5 PROTECTION

A. A microprocessor controlled thermal protection system shall be included, which continuously calculates the temperature-rise of the motor and soft start and provides:
   1. An overload pre-alarm which indicates by relay contact that the motor has exceeded its rated temperature rise by 100%. This function shall be annunciated only without resulting in fault trip of the motor.
   2. A thermal fault condition which stops the motor if the temperature-rise exceeds 120% of the motor thermal capability.
   3. An analog electronic circuit with a time constant adjustable to the motor's thermal cooling time constant ensuring the memorization of the thermal state even after power supply disconnection or shorting out of the power semiconductors.

B. The soft start shall have phase loss, phase unbalance, and under voltage protection.

2.6 CONTROL OPTIONS

A. Provide lockable disconnecting means to isolate the SSMC from incoming power. Disconnect may be either fused or circuit breaker style as shown on the Contract Drawings.

B. Provide lights, pushbuttons, selector switches, indicators, run time meters, and other accessories as shown on the Contract Documents in accordance with Section 16161, Control Panels.

C. Provide control relays in accordance with Section 16161, Control Panels.

D. Provide a control power transformer, 480:120 V, sized to accommodate all the control circuit requirements in addition to 25% spare capacity.

E. The soft start shall accept control logic either by operator devices (pushbuttons, selector switches, etc.) wired directly into the unit or from external relay logic.

F. Provide warning label in accordance with the NEC if power is available from more than one source.

G. Provide nameplates identifying all panel mounted equipment and operator controls.

2.7 SHORTING CONTACTOR

A. A microprocessor shall control the operation of the shorting contactor via an output relay.

B. The shorting contactor shall close, shorting the thyristors after the motor current is below 130% of motor FLA and voltage is below nominal voltage (indicating the acceleration ramp is complete), and open on a stop command to allow a deceleration ramp or DC injection stop.

C. Overload protection shall continue to protect the motor when shorting is used.

2.8 BRAKING CONTACTOR

A. If required by Contract Drawings, a microprocessor shall control the operation of the braking contactor via an output relay.

B. If an overload condition occurs during the injection brake period, braking shall continue as set. When braking is complete, restart shall be prohibited until the motor has cooled.

2.9 ISOLATION AND BYPASS CONTACTORS

A. If required by contract drawings, provide NEMA rated 3-pole isolation contactor to completely isolate the SSMC from the incoming power in the event of a shorted SCR or another defined fault condition.

B. If required by contract drawings, provide NEMA rated 3-pole reversing style contactor to both isolate the output of the SSMC, as well as allow across-the-line starting of the motor.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Mount the SSMC in accordance with manufacturer's recommendations.

B. Provide sufficient clearance for air circulation and operation of any vent fans or cooling equipment.

C. Install conduit, pull and terminate all power and control conductors.

3.2 TESTING

A. Test in accordance with Specification 16920, Electrical Acceptance Testing.

++ END OF SECTION ++

SECTION 16485

VARIABLE FREQUENCY DRIVES - LOW VOLTAGE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Variable Frequency Drive (VFD) systems rated 480 VAC or lower.

1.2 VFD FEATURES

A. The VFDs shall be provided with the following features:
   1. Fused control circuit transformer.
   2. Provision for 4 to 20 mA input speed reference signal.
   3. Electrically isolated auxiliary contacts for ready, running, and trouble status.
   4. Adjustable minimum/maximum frequency limits.
   5. Independent timed linear acceleration and deceleration.
   6. Adjustable motor slip compensation based on motor current.
   7. Terminal blocks for control and signal wires entering and leaving the controller.
   8. Output transistors shall be insulated gate bipolar transistors (IGBT) type, or Darlington pair.
   9. Current limit.
   10. Programmable automatic restart.
   11. 4 to 20 mA output signal proportional to VFD output frequency.
   12. Digital keypad for configuration, programming, local control, and monitoring.
   13. Microprocessor-based control for system logic sequencing functions.
   14. VFD shall have a minimum 18-pulse input circuit (for VFD's rated 40 HP and above) designed to reduce harmonic distortion.
   15. VFD's below 40 HP rating shall have a 6 pulse input circuit designed to reduce harmonic distortion.
   16. Ethernet port for TCP/IP communications.

1.3 FUNCTIONAL REQUIREMENTS

A. Supply Power: The VFD shall operate continuously with supply power of 480 volts ±10%, 60 Hz ±3%. The VFD shall remain on line and operate without damage to either the VFD or its connected load during a supply power variation of plus 50% lasting for a period of up to 0.01 seconds and minus 100% lasting for a period of up to 0.5 seconds.

B. Ambient Conditions: The VFDs shall operate continuously as specified in an ambient temperature of 0° C to +40° C and an ambient humidity of 0% to 90%,

non-condensing. Provide air conditioning as required to maintain the VFD manufacturers' maximum ambient temperature rating.

C. Load: The VFD system shall be capable of 110% continuous current overload. Variable torque inverters shall be capable of delivering 120% of the specified load for up to 60 seconds, and constant torque inverters shall deliver 150% overload current for 120 seconds.

D. Power Factor: Displacement power factor shall be not less than 0.95 at rated full speed and load. Overall power factor, including harmonic distortion, shall be 0.85, or greater. CONTRACTOR shall provide power factor correction components as necessary to meet this requirement.

E. Efficiency: Efficiency of VFD systems shall be at least 96% at 60 Hz output driving the specified maximum load.

F. Frequency and Voltage Regulation: VFD output frequency shall be regulated to within 0.6 Hz of the frequency set point. VFD output voltage shall be regulated to within ± 1.0% of that value which will produce minimum motor heating at any operating frequency within the specified range.

G. Frequency Range: VFD shall be capable of continuous operation with the specified load at any frequency between 0.1 Hz and 60 Hz.

H. Space: VFD system size shall not exceed the size allotments specified on the Drawings, nor shall any portion of the VFD system exceed a height of 90-inches. VFD system shall be front accessible and shall not require rear access. The VFD equipment shall be suitable for mounting directly against the wall without any clearance for ventilation or other purposes. VFD units shall be arranged as required for entry of incoming line cables and as required for entry of load cables.

I. Ambient Noise: Free field noise generated by the VFD shall not exceed 85 dBA at 3 feet out from any point on the VFD cabinet under any normal operating condition.

1.4 PROTECTION AND ANNUNCIATION

A. Overcurrent Protection: The VFD system shall provide electronic current limit at 150% of motor nameplate current. Current limit shall be accurate to within 1.0% and shall smoothly limit motor speed at whatever value is necessary to limit motor current to that value.

B. The VFD shall also provide motor running overcurrent protection in compliance with NFPA 70.

C. Short Circuit Protection: The VFD shall be fully protected against load faults. Bolted faults, phase-to-phase, or phase-to-ground shall not damage the unit. Any

impedance or other current limiting necessary to meet this requirement shall be provided as part of the VFD system, and any losses caused by current limiting devices shall be included in efficiency calculation for the VFD system.

D. Line Voltage: The VFD shall be protected against high and low line voltage on one or more phases.

E. Internal Faults: The VFD shall incorporate an internal fault monitoring system to detect malfunctions. This system shall be designed to protect the VFD from transient and sustained faults, and to limit damage that may be caused by these faults.

F. Overtemperature: Overtemperature circuitry shall shut down the VFD upon overheating and display an overtemperature alarm, or message.

G. Diagnostics: The VFD shall be provided with a fault diagnostics system that indicates the cause of any shutdown. The system shall store faults in memory and discard the oldest faults as new ones fill the memory. Faults shall be accessible via a digital keypad, also used for local control and programming.

1.5 EXTERNAL CONTROL AND MONITORING

A. Speed Reference: The VFD shall accept a 4 to 20 milliampere direct current speed reference signal. Speed reference input shall be galvanically isolated and input resistance shall not exceed 250 ohms.

B. Ready Signal: The VFD shall provide a contact closure that indicates that the controller line power supply is within acceptable tolerances, the control circuits are normal, and there are no internal or external fault conditions that have not been reset. Presence of this signal indicates that the controller should start normally.

C. Running Signal: The VFD shall provide a contact closure which indicates that the controller is running.

D. System Trouble: Isolated normally open contacts for remote fault annunciation shall be provided and wired to terminal blocks, which shall be labeled and identified. Contact shall close under fault conditions. Fault conditions that drive the outputs shall be selectable from the digital keypad.

E. The VFD control circuitry shall shutdown the VFD if the motor overheats. Motor winding temperature switches, or RTDs shall be connected if provided by the motor manufacturer.

1.6 QUALITY ASSURANCE

A. This Section contains references to the following documents. They are a part of this Section as specified and modified. In case of conflict between the requirements of this Section and those of the listed documents, the requirements of this Section shall prevail.
   1. IEEE 519-1992, Guide for Harmonic Control in Electric Power Systems.
   2. NEMA 250-85, Enclosures for Industrial Control and Systems.
   3. NEMA ICS 2-83, Industrial Control Devices, Controllers and Assemblies.
   4. NEMA ICS 3-83, Industrial Systems.
   5. NFPA 70-87, National Electrical Code (NEC).
   6. Underwriters Laboratories, UL 508.

B. The VFD shall comply with the applicable requirements of NEMA ICS 3 and additional standards referenced by ICS 3.

C. The VFDs specified in this Section shall be the product of a single vendor. The CONTRACTOR shall assign unit responsibility for the adjustable frequency drives in this section. The CONTRACTOR shall submit letters of certification with the Shop Drawings from the VFD manufacturer, the motor manufacturer, and the driven equipment manufacturer stating that they have reviewed each application and that the combination will satisfy the application duties required, for the actual motor sizes required, regardless of deviations from the scheduled "nominal horsepower".

D. VFD manufacturing facility shall be ISO 9001 certified.

1.7 SUBMITTALS

A. The following information shall be provided in accordance with the Contract Documents:
   1. Catalog and technical data.
   2. Outline dimensions, shipping section dimensions, weight, and foundation requirements for all assemblies.
   3. External connection wiring diagram showing function and identification of all terminals requiring field connections.
   4. Line harmonic distortion calculations and filter design if applicable.
   5. Component fabrication drawings consisting of detailed circuit schematics, printed circuit board drawings, and chassis layouts for all electrical and electronic components.
   6. Manufacturer's certification that VFD can withstand fault conditions specified in Paragraph 1.4.
   7. Manufacturer's certification that VFD can withstand environmental conditions specified in Paragraph 1.4.

B. Shop Drawings: Submit for approval the following:

1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
2. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**
3. Submit complete Operation and Maintenance Manuals in conformance with the Operation and Maintenance Manuals section of Section 01300, Submittals.

1.8 COOLING REQUIREMENTS

A. VFDs shall be supplied with air conditioning, where shown on the Drawings. The air conditioner shall be mounted and ducted to provide efficient cooling of the VFD. Where air conditioners are mounted on a NEMA 12, 3R, or 4 enclosure, the installation shall maintain the NEMA rating of the enclosure. Enclosure cooling shall be closed-loop, with no outside air entering the enclosure. The unit shall be mounted either on the door, or the side, of the enclosure. Size units to maintain a maximum 40° C operating temperature for the VFDs, based on a 50° C outdoor temperature.

B. Air conditioners installed outdoors shall be supplied with outdoor packages and low operating temperature kits. Air conditioners shall be equipped with integral, or wall mounted thermostats.

C. Air circulation shall be furnished by dual centrifugal blowers; one for the enclosure closed-loop circuit and one for the ambient air circuit.

D. A hot-gas bypass valve shall regulate the air conditioner cooling and prevent freezing of the coils when operating in low ambient temperatures and low heat loads.

E. Air filters shall be standard disposable-type furnace filters with a large surface area. Only half the filter surface area shall be used at one time, so that the filter can be inverted, exposing the unused half to the air flow.

F. Air conditioner cabinets shall be constructed of cold rolled steel, with a phosphatized and baked enamel finish.

G. The air conditioners shall be available in single phase voltages of 120 and 240 volts. Manufacturers shall be McLean Midwest, BARD, or equal.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. The VFDs shall be manufactured by one of the following:
   1. Allen Bradley
   2. Eaton
   3. Square D
   4. Toshiba

B. AC reactors shall be manufactured by one of the following:
   1. MIRUS
   2. Powersmiths
   3. TCI
   4. Or equal.

2.2 ENCLOSURES

A. Enclosures shall be as shown on the Drawings, with force ventilated gasketed enclosures. UL approved Class 1 filters shall be provided on ventilation openings. Cabinets shall be fabricated from 14 gauge minimum thickness sheet steel. Cabinet shall be provided with an interior frame or otherwise formed so as to provide a rigid structure. Doors shall be hung on removable-pin hinges and equipped with vault-type latch capable of accepting a 3/8-inch shackle padlock. Three-point latch hardware shall be provided. Door width shall not exceed 30-inches.

2.3 INVERTER

A. A door-interlocked, flange-mounted, through-the-door power disconnecting means shall be provided to protect the inverter against internal faults and as a backup for external load faults. Provide a thermal-magnetic circuit breaker as the

main disconnecting means for each VFD enclosure as specified in Section 16481.2.06, Motor Control Centers—Feeder Overcurrent Protection. Load faults shall normally be cleared by the inverter assembly.

B. Harmonic filtering shall be provided on each VFD below 40 HP to reduce total harmonic distortion (THD) of the voltage and current power source. Total voltage and current harmonic distortion, including contribution of notching, and with all VFDs in operation shall not exceed the limits set forth for a general system in IEEE 519-1992, Tables 10.2 and 10.3. The voltage THD shall not exceed 5% and the current THD shall not exceed 10% as measured at the point of common coupling. The point of common coupling (PCC) is defined herein as the circuit breakers feeding each VFD, or where each VFD connects to the bus.

C. AC reactor coils in output circuitry of the VFD shall be provided to limit inductive switching surges such that the measured RMS voltage at the motor terminations does not exceed 480 VAC line to line.

D. Provide EMI/RFI filtering to eliminate radio interference between 10 KHZ and 30 MHZ.

E. Provide VFD manufacture's recommended inverter output dv/dt filters within VFD enclosure where conductor length from VFD to motor equals or exceeds 100 feet. Provide in submittal, the manufacture's recommended data for filters.

2.4 CONTROL DEVICES

A. See Control Devices Schematic for requirements.

B. Control devices and indicating lamps shall be provided in accordance with Section 16161, Control Panels.

PART 3 - EXECUTION

3.1 FIELD INSTALLATION

A. Each VFD shall be installed and tested by the CONTRACTOR with the assistance of factory-trained engineers in accordance with the manufacturer's specifications and the Contract Documents. The installation shall be certified on forms provided in the Contract Documents.

3.2 TESTING

A. Test in accordance with Specification 16920, Electrical Acceptance Testing.

3.3 TRAINING

A. Provide four hours of VFD training for the OWNER'S operations and maintenance staff. Training shall be certified on forms provided in the Contract Documents. Training shall cover VFD theory of operation, features and functions available, normal operation, troubleshooting, and routine maintenance. The CONTRACTOR shall submit a syllabus for the training session for approval a minimum of three weeks prior to conducting the class. Provide each attendee with a class syllabus detailing each topic to be discussed.

B. Provide VFD training in accordance with Section 01410, Testing.

3.4 SPARE PARTS

A. The following spare parts shall be supplied with each type or frame size of VFD:
   1. Three sets of all replaceable fuses.
   2. One of each type of replaceable printed circuit board.
   3. Two of each type of output power transistor.

B. Provide three spare air conditioner filters for each type and size of air conditioner installed.

++ END OF SECTION ++

SECTION 16500

LIGHTING

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. The CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install Luminaires.

1.2 QUALITY ASSURANCE

A. Reference Standards:
   1. National Electrical Code (NEC).
   2. UL Standard #844, Luminaires for Use in Hazardous (Classified) Locations.
   3. UL Standard #1598, Luminaires.
   4. Illuminating Engineering Society (IES).
   5. All applicable local lighting ordinances.

B. Miscellaneous:
   1. Lamps are identified for each luminaire in the Luminaire Schedule on the Drawings.
   2. Luminaires and electrical components:
      a. UL labeled, complete with lamps.
      b. Rated for area classification as indicated.
   3. Location of Luminaires on Drawings are intended to be used as a guide.
      a. Field conditions may affect actual locations.
      b. Coordinate with other trades to avoid conflicts in mounting of fixtures and other equipment.
   4. The quality standard is established by the fixture listed in the Luminaire Schedule.
      a. This quality standard includes, but is not necessarily limited to construction features, materials of construction, finish, and photometrics.

1.3 SUBMITTALS

A. The following shall be submitted to the ENGINEER for review:
   1. Acknowledgment that products submitted meet requirements of standards referenced.
   2. Manufacturer's technical information on products to be used including photometric performance curves for the fixture and ballast data.
   3. Acknowledgment that products submitted are UL or ETL listed.

4. When general data sheets constitute part of the submittal, identify the products to be used on this Project.
5. Manufacturer's installation instructions.
6. Identification of fixtures by Luminaire Schedule.
7. UL nameplate data (voltage, wattage, etc.).
8. Finishes, colors, and mounting type.
9. Pole, fixture, and accessories.
10. Pole wind loading.

B. Shop Drawings: Submit for approval the following:
   1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
   2. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**

C. CONTRACTOR shall submit shop drawings, manufacturer's data sheets, and a complete wiring diagram detailing all connections to the electrical system in accordance with Section 16000, General Electrical Requirements, and other requirements of the Contract Documents.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. LED lamps shall be provided by one of the following:
   1. Cree Lighting.

2. Nichia.
3. Signify (Philips).

B. LED power supplies or drivers shall be provided by one of the following:
1. Signify (Philips).
2. Thomas Research.
3. EldoLED.

C. Non LED Lamps and ballasts shall be provided by the same manufacturer. Lamps and ballasts shall be manufactured by one of the following:
1. Ledvance (Sylvania).
2. Signify (Advance/Bodine).

D. All Luminaires for this project shall be provided from the same manufacturer. Luminaires shall be manufactured by one of the following:
1. Holophane.
2. Lithonia Lighting.
3. Day Brite.
4. Columbia.
5. Axis.
6. Rig-A-Lite.

E. Model, catalog number, features, and options for Luminaires shall be provided as indicated on the Luminaire Schedule on the Drawings.

F. Light poles shall be as indicated on the Drawings. Include base template, anchor bolts, stainless steel or zinc-plated hardware and pole grounding lug, handhole, anchor base, and bolt covers. Pole foundations shall be as indicated on the Drawings.

G. General:
1. Lamps:
   a. See Luminaire Schedule on Drawings for manufacture, wattage, voltage, and number required.
2. All Fixtures:
   a. There shall be no live parts normally exposed to contact.
   b. When intended for use in wet area:
      1) Mark fixtures "suitable for wet locations".
   c. When intended for use in damp areas:
      1) Mark fixtures "suitable for damp locations" or "suitable for wet locations".
   d. In wet or damp area, install fixtures so that water cannot enter or accumulate in the wiring compartment, lampholder, or other electrical parts.
   e. Gasket Seals: Urethane foam.
   f. Diffusers: UV stabilized acrylic plastic.

3. Underground Wiring:
    a. Provide all wiring runs with separate green grounding conductor.
    b. Ground all pole bases.
4. Pole Wiring grom Base to Ballast:
    a. No. 12 Type XHHW.
    b. Each phase shall be protected by a 30 A, 600 V, Type Tron waterproof fuseholder, Bussman "Limitron" type fuse, size rating 3-times load current.

H. LED lamps;
1. 4000K for exterior use luminaires.
2. 3500K for interior use luminaires.

I. Furnish a minimum of two lamps, or 10% spare lamps, of each type and wattage, whichever is greater. Furnish a minimum of 10% spare ballast and LED drivers.

2.2 MISCELLANEOUS ELECTRIC DEVICES

A. Photoelectric control units shall meet the following requirements:
1. Cadmium sulfide or silicon photocell.
2. Aluminum weatherproof enclosure.
3. 30 amp rated contacts.
4. 120 volt AC power.
5. The photoelectric control unit shall be NSi Tork Model 2100, or equal.

B. Motion sensors shall meet the following requirements:
1. 110 degrees field of view, 60 foot range.
2. Adjustable time setting from 15 seconds to 15 minutes.
3. Operating temperature of -20° F to +130° F.
4. Complete outdoor, weather proof sensor with complete mounting hardware.
5. UL listed.
6. The motion sensor(s) shall be manufactured by Leviton OSP00/ODW or equal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install lamps in all luminaires.

B. Replace all failed fluorescent, incandescent, metal halide, mercury vapor, and high pressure sodium lamps with LED retrofit lamps prior to final acceptance by OWNER.

C. Surface and flush mounted fixtures shall be solidly connected to a junction box. Suspended fixtures shall be hung utilizing pendant mounting or stainless steel chains and hooks. Each suspended fixtures, shall be electrically connected by a length of Type SO flexible cord. Three conductor No. 14 AWG, minimum, with a twist-lock receptacle mounted in an individual junction box. Plugs and receptacles shall be as manufactured by Hubbell, Eaton, Legrand, or equal.

D. Provide mounting brackets and/or structural mounting support for fixtures.
   1. Do not support fixture from conduit system.
   2. Do not support fixture from outlet boxes.

E. Install with approved mounting hardware following manufacturer's recommendations.

F. Pole mounted fixtures shall be mounted on steel or aluminum poles as indicated on the Drawings. All metal poles shall be bonded to the facility ground system. Poles shall have adequate handholes and weatherproof receptacles where indicated.

G. All anchor bolts and nuts shall be stainless steel. CONTRACTOR shall paint all steel poles with aluminum paint or other color in accordance with these Contract Documents.

H. Fixture mounting heights and locations indicated on the Drawings are approximate and are subject to revision in the field where necessary to avoid conflicts and obstructions.

3.2 ADJUSTING AND CLEANING

A. Wipe all Luminaire reflectors, lenses, lamps, and trims clean after installation and prior to acceptance of Project by OWNER.

++ END OF SECTION ++

SECTION 16611

STATIC UNINTERRUPTIBLE POWER SUPPLY

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. This Section covers the requirements for uninterruptible power supplies (UPSs) to be provided as shown on the Drawings and where specified below.

1.2 SUBMITTALS

A. Products shall be submitted in accordance with Section 16000, General Electrical Requirements, and the Contract Documents, prior to installation.

B. Shop Drawings: Submit for approval the following:
   1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
   2. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**
   3. Submit complete Operation and Maintenance Manuals in conformance with the Operation and Maintenance Manuals section of Section 01300, Submittals.

1.3 REFERENCES

A. National Electrical Code (NEC) Article 250.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. The UPS equipment shall be manufactured by one of the following:
   1. Model Smart-UPS (1500VA minimum), as manufactured by APC.
   2. Toshiba.

B. The UPS shall be sized for a minimum of 30 minutes of backup power at full load for its connected load.

C. The UPS shall be a line-interactive type, consisting of a Ferro resonant or linear transformer, battery charger, batteries, inverter, and microprocessor control. The batteries shall be maintenance free, premium type.

D. The UPS shall pass lightning and surge protection ANSI/IEEE C62.41 standards, Category A and B. The UPS shall be UL 1449 listed.

E. The output waveform shall be a pure sine-wave with less than 5% total harmonic distortion on the inverter.

F. The UPS shall have a digital display for load-dependent runtime, volts in, volts out, battery voltage, percent loading, and alarm codes.

G. The UPS shall operate between 0° C and 40° C, at a minimum of 95% efficiency on-line.

H. Provide one external maintenance bypass switch for each UPS, rated for a minimum of UPS's full input and output load, capable of transferring the UPS's full load with a maximum interruption of 4-millliseconds. Maintenance bypass switch shall be SBP2200 series, as manufactured by APC, or equal.

I. Provide one UPS and UPS Maintenance Bypass Switch in each control panel that has a PLC in it.

J. Provide one UPS and UPS Maintenance Bypass Switch in network racks as shown on the Drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install the UPS equipment in accordance with the manufacturers' recommendations.

B. The UPS and UPS maintenance bypass switch shall be provided with a two year parts and factory service warranty.

++ END OF SECTION ++

SECTION 16720

FIRE SURVEILLANCE AND ALARM SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
Design, furnish and installation of a complete fire surveillance and alarm system for the proposed AWRF Maintenance Building and OWRF Sludge Holding Tank Blower Building No. 2. Fire surveillance and alarm systems shall be subsections B to F below.

B. Initiating devices.

C. Notification appliances.

D. Controls.

E. Supervisory devices.

F. Software.
1. Provide communication Interface with the existing fire annunciator system panel at the AWRF Thickening Building and the OWRF South Admin Building (Simplex). The new system should communicate all existing zones located in the South plant. Provide all devices required to accomplish this interface.

G. Related Sections include but are not necessarily limited to:
1. Division 0 Bidding Requirements, Contract Forms, and Conditions of the Contract.
2. Division 1 General Requirements.
3. Section 10523 – Fire Protection Specialties.
4. Section 13930 – Wet Pipe Fire Extinguishing Systems.
5. Section 15781 – Air Conditioning Unit.
6. Section 15831 – Centrifugal Fans.
7. Section 15890 – Ductwork.
8. Section 16000 – General Electrical Requirements.
9. Section 16111 – Conduit.
10. Section 16123 – 600 Volt Class Cable.
11. Section 16124 – Instrumentation Class Cable.

1.2 SYSTEM DESCRIPTION

A. Automatic and manual, micro processor based, device addressable, supervised, closed circuit, positive non-interfering low voltage fire detection and alarm system, with components as indicated, including but not limited to:
   1. Fire alarm control panel.
   2. Addressable manual stations.
   3. Fire alarm horn/strobes for all areas.
   4. Addressable smoke detectors.
   5. Addressable ductwork smoke detectors with auxiliary relays.
   6. Conduit and wiring system.
   7. Sprinkler system supervision wiring circuits.
   8. Communications connections.

B. Provide all devices, components, conduit and wiring required for a complete functional system as specified whether indicated or not.

1.3 QUALITY ASSURANCE

A. Referenced Standards:
   1. National Fire Protection Association (NFPA):
      a. 70, National Electrical Code.
      b. 72A, Local Protective Signaling Systems for Guards Tour, Fire Alarm and Supervisory Service.
      c. 72E, Automatic Fire Detectors.
      d. 90A, Standard for Installation of Air Conditioning and Ventilating Systems.
      e. 101, Life Safety Code.
   2. Underwriters Laboratories, Inc. (UL):
      a. 268, Smoke Detectors for Fire Protective Signaling Systems.
      b. 268A, Smoke Detectors for Duct Applications.
      c. 346, Water-flow Indicators for Fire Protective Signaling Systems.
      d. 521, Heat Detectors for Fire Protective Signaling Systems.
      e. 753, Alarm Accessories for Automatic Water Supply Control Valves for Fire Protection Service.
      f. 864, Control Units for Fire Protective Signaling Systems.
   3. Factory Mutual Insurance Co. (FM):
      a. All applicable standards.
      b. All components FM approved.

B. Design Criteria:
   1. Comply with all system standards.
   2. Meet all requirements of fire authorities having jurisdiction.
   3. Complete fire detection and alarm project specific layouts, wiring diagrams, interface wiring diagrams, and operational details by system manufacturer or authorized technical representative. Typical layouts are not permitted.

C. Service Organization Qualifications:
   1. Offer an annual maintenance contract including complete service and equipment costs for maintenance of complete system.
   2. Provide for 24 HR emergency service.

1.4 SUBMITTALS

A. See Contract Documents for submittals procedures. Reference Section 01300 Submittals.

B. Shop Drawings:
   1. Entire system shall comply with governing regulations. Provide:
      a. Wiring diagrams, riser diagrams and layouts.
      b. Technical data showing exact types and quantity of all fire alarm devices.
   2. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
   3. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**

C. Name of local service organization and written evidence of City fire prevention bureau's approval for servicing fire alarm systems which have automatic connection to city fire headquarters.

D. Operation and Maintenance Manuals:
   1. Submit complete Operation and Maintenance Manuals in conformance with the Operation and Maintenance Manuals section of Section 01300, Submittals.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Manufacturer must have local service organization.
   2. Fire alarm system:
      a. Simplex Grinnell.
      b. Honeywell.
      c. Notifier.

2.2 EQUIPMENT

A. Control Panel:
   1. Program stored in nonvolatile memory. Program shall remain intact upon simultaneous failure of primary and backup power.
   2. Supervised for failure or removal of any module.
   3. Operator display/interface to include:
      a. Liquid crystal display 80 character alphanumeric.
      b. Alarm acknowledge pushbutton.
      c. Signal silence pushbutton.
      d. System reset pushbutton.
      e. System test pushbutton.
      f. Lamp test pushbutton.
      g. Trouble silence pushbutton.
      h. LED indicators for AC power on, system trouble, system alarm, signals silenced.
   4. Provide filtered, regulated 24 V DC power supply capacity adequate for complete system operation plus 25 percent future capacity.
   5. Provide separate 24 V DC unregulated power supply for horn strobe circuit operation.
   6. Control panel shall supervise signaling line circuits and indicating appliance circuits for opens, shorts and grounds.
   7. Provide supervised standby batteries, maintenance free, sealed non-outgassing type with capacity to maintain system supervision for 24 HRS followed by 5 minutes of operation of system and indicating appliances in alarm condition.
   8. Housed in surface mounted NEMA 1 enclosure with hinged lockable door. Provide transparent viewing window over operator display/interface.
   9. Incorporate transformer, rectifier, fuses, batteries and other power supply components in fire alarm control panel, or separate panel, if approved for application.
   10. Fiber optic communications with fiber optic media modules on the fire alarm network nodes or TCP/IP Physical Bridge Modules. Fiber cable specifications are for 50 or 62.5 micron core with 125 micron cladding, multimode graded index fiber at a 850nm wavelength. Fiber connector to be Type ST.

B. Annunciator Panel:
   1. Alarm indicator lamp for each zone.
   2. Audible trouble signal and a trouble indicator lamp.
   3. Lamp test switch.
   4. Audible to visual trouble signal transfer switch.
   5. Alarm silence switch.
   6. Key reset switch.
   7. Housed in NEMA 1 enclosure with hinged lockable door.
   8. Zone identification shall consist of word description of the zone.

C. Smoke Detectors, Area:
   1. Photo electronic or ionization type as indicated. Plug in type.
   2. System shall automatically recognize sensor type to permit interchanging sensors without replacing or re wiring the base.
   3. Direct entry of device address.
   4. Factory preset sensitivity at nominal values:
   5. Photoelectric: 2.3 percent.
   6. Ionization: 1.5 percent.
   7. Provide RFI filtering for communications noise immunity.
   8. Sealed enclosure with insect screen.
   9. Dual alarm indicator LEDs at 180 degrees for 360 degrees viewing capability.
   10. Designed for satisfactory performance in high airflow velocities.
   11. Sensitivity remotely monitored from control panel.
   12. LED indicator shall flash to indicate normal supervision, solid to indicate system in alarm.
   13. UL listed to 268.

D. Smoke Detectors, Air Duct:
   1. Air sampling type complete with photoelectric smoke detector, sampling tubes, housing, power supply, and auxiliary relay.
   2. Addressable.
   3. Auxiliary relay contacts rated 5A, 125 V AC for fan control.
   4. Listed to UL 268A.

E. Manual Pull Stations:
   1. Double action, non-restoring type requiring key reset after operation.
   2. Semi flush mounting on standard outlet box. In unfinished rooms, surface mount on cast aluminum back box.
   3. Direct rotary decimal switch setting of station address or dip switch addressable.
   4. Red enameled with white lettering.
   5. UL listed.

F. Monitor Module:
   1. Addressable signal interface between signaling line circuits (SLC) and initiating device circuits (IDC).

2. Shall supervise IDC for opens shorts and grounds in style B configuration.
3. Direct rotary decimal switch selection of address or dip switch addressable.
4. Provide supervision/alarm-indicating LED.

G. Isolating Modules:
1. Shall detect line to line short on signaling line circuits and operate to isolate faulted portion of the circuit.
2. Terminal screws for in and out wiring.
3. Supervision/alarm indicating LED.

H. Horn Strobe Units for General Areas:
1. 24 V DC operated.
2. Sound power level 87 dBA at 10 FT per UL reverberant room test method.
3. Strobe intensity: 8000 candela.
4. Vibrating type with re-entrant horn.

I. Fire Alarm Network Annunciator Supervising Station:
1. Touchscreen computer/monitor desk mountable.
2. Application software including licensing, security dongle for the Fire Proprietary Supervising Station inclusive of graphical screen development.
3. Workstation will include latest version of Windows 7 Pro with a Ethernet connection, 19" (min.) touchscreen with compact keyboard and mouse.
   a. Processor: Intel i5 2.4 GHZ (minimum) PC with cooling fan.
   b. (4) GB RAM (minimum).
   c. (2) PCI Slots.
   d. (2) 160 GB Hard Drives (minimum) for Raid 1 support.
   e. (1) DVD/RW Drive.
   f. (2) Integral Amplified 2 Watt Speakers.
   g. (1) VGA Video Output (required for optional 2nd monitor).
4. Graphical displays will show as a minimum, each building and floor using standard fire service annunciation icons to provide firefighters with critical fire response information.
5. System shall also monitor alarms, with historical logging along with password protection to control operator levels.

J. Wiring:
1. Conduit: 3/4" minimum. Refer to Section 16111.
2. Conductors:
   a. Refer to Section 16123.
   b. 120 V AC power: 12 GA minimum.
   c. Alarm indicating circuits: 12 GA minimum.
   d. Initiating circuits: 14 GA solid.
   e. Signaling line circuits: Shielded twisted pair type SC to suit manufacturer's recommendations.

K. Power Supply to Control Panel:

1. 120 V AC single phase, emergency circuit.

2.3 SYSTEM OPERATION: LOCAL

A. Activation of any signal initiating device shall cause all fire alarm horn/strobes to sound and initiate device indication and alarm LED on control panel and shutdown required HVAC equipment. Device address shall report to remote central station CRT and printer. City box shall be activated.

B. Alarm LED and trouble signal operate until alarm condition is corrected and control panel manually reset.

C. A ground, short or open on a detector loop or alarm circuit activates buzzer and common trouble LED at control panel and reports to indicate zone of ground or open at control panel. Grounds or opens shall not cause false alarms.

D. Loss of normal 120 V AC operating power to control panel activates trouble light and buzzer in control panel.

E. Provide silencing switch on control panel for silencing audible trouble buzzer.
   1. Trouble LED remains lighted until trouble condition is corrected.
   2. Restoration of system to normal causes trouble buzzer to sound until silencing switch is returned to normal.

F. All fire alarm signals are automatically locked in at control panel and central station until manually reset at control panel and originating device is returned to normal. Manual reset switch: Self restoring type, which cannot be left in abnormal position.

G. Provide alarm acknowledge switches on control panel for silencing fire alarm horn/strobes during alarm condition. Switch shall not impair ability of system to continue to perform as specified. Successive zone alarms shall cause horn/strobes to resound.

H. Operate control modules to de energize power to certain equipment, upon operation of specific alarm initiating device. Equipment shall not restart until control panel is manually reset.

I. Provide Fan Shutdown Relays: Silver contacts, rated 10A/120 V AC, 3 PDT.
   1. Surface mounted metal cabinet with locking door; key to match control panel door.
   2. Provide engraved phenolic nameplate mounted below unit identifying fan or air handling unit.
   3. Coil voltage as required.

J. Wire sprinkler water valve tamper switches, and water flow switches to initiate trouble signals.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install all components as indicated and in accordance with manufacturer's instructions and recommendations.
   1. Provide identification of panels, boxes, and equipment.

B. Install all wiring in accord with local and national codes and NFPA 72A. Provide separate conduit system for fire alarm and detection system wiring.
   1. Provide separate conduits for signaling line circuits and indicating appliance circuits.

C. Make all fire alarm wiring continuous from terminal to terminal or from terminal to device pigtail lead.
   1. Circuit splices not permitted.
   2. Wiring joints, only when required at devices shall utilize Scotchlok insulated conical spring connector.

D. Provide all interconnection wiring between equipment control panels, motor starters and system modules required for specified performance.

E. In accordance with NFPA 90A, provide automatic smoke detectors for HVAC air systems above 2000-cfm capacity. Mount on 10 x 12 inch. hinged, gasketed door for testing and servicing.

3.2 TESTING

A. Provide a representative of manufacturer to supervise installation and final testing of system.

B. Entire system shall test free from opens, grounds, and short circuits.

C. Test system to satisfaction of ENGINEER and governing regulating authorities.

D. Submit affidavit (certification) to ENGINEER stating that system has been tested and operates properly.

++ END OF SECTION ++

SECTION 16912

ETHERNET NETWORK EQUIPMENT

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. This Section covers the requirements for equipment required to be provided and installed as shown on the plans for the communications system architecture and Ethernet network and specified herein.

B. Products specified herein shall be furnished and installed without substitution. The Work shall be coordinated and scheduled with the ENGINEER and the OWNER.

C. Plant control system shall remain operational wherever possible. No control system shall be shut-down without the approval of the ENGINEER and the OWNER.

1.2 SUBMITTALS

A. Products shall be submitted to ENGINEER for review in accordance with Section 01300, Submittals, and the Contract Documents, prior to installation.

PART 2 - PRODUCTS

2.1 ETHERNET SWITCH DIN-RAIL MOUNT REQUIREMENTS

A. Ethernet Switch with Copper and Fiber Optic ports
   1. The Fast Ethernet switch shall have a minimum of (8) 10/100/1000base-T(X) ports. The Fast Ethernet switch shall have LEDs for power, ready, communication error, and active status. The Fast Ethernet switch shall be powered from dual 24 VDC source with redundancy module.
   2. The Fast Ethernet switch shall contain a minimum of (2) 100base or 1000Base SFP fiber optic multimode connection ports.
   3. Ethernet switch shall be manufactured by Cisco. Cisco Model: #IE-3300-8T2S-E
   4. Provide ethernet switch expansion module. The Ethernet switch shall have minimum of (6) 10/100/1000base-T(X) ports. The Ethernet switch shall contain a minimum of (2) 100base or 1000base SFP fiber optic multimode connection ports. Cisco Model: #IEM-3300-6T2S
   5. Provide power supply: Cisco Model: IE50W-AC-L
   6. Provide additional SFP module: Cisco Model: GLC-LX-SM-RGD-PRO
   7. Environment:

a. Operating Temperature: -40 to 75^{O} degrees C
b. Humidity: 10 to 95 percent, non-condensing

8. Managed Layer 2 switch. Additional features available through software setup includes but not limited to:
   a. Port Monitoring.
   b. Remote switch management.
   c. Port security.
   d. Switch Meshing.
   e. Rapid spanning tree protocol.
   f. Filtering: 802.1Q VLAN.
9. Industrial Protocols: Ethernet/IP, Modbus TCP.
10. Agency Approval: UL508.
11. Warranty: 5 years.

2.2 CATEGORY 6 ETHERNET CABLE

A. Ethernet cables shall be as required per drawings. Ethernet cables shall be 4 twisted pair 24 gauge solid copper known as Category 6 Ethernet Cable.

B. Individual cable lengths between equipment shall be no longer than 100 meters.

C. Cables listed as UTP are Unshielded Twisted Pair cable.

D. Cables listed as STP are Shielded Twisted Pair cable for RF noisy environments.

E. Straight-Through cables are paired for normal connections.

F. Cross-Over cables are paired for T568A and the other as T568B.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install all the above equipment, as indicated on the Plans and in accordance with the manufacturer's recommendations.

3.2 START UP AND TESTING

A. Upon completion of the installation, the CONTRACTOR shall provide two days of start up and testing assistance to the OWNER'S programmer to remedy networking cable and equipment issues.

++ END OF SECTION ++

SECTION 16913

FIBER OPTIC CABLING – SINGLE MODE

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. This Section covers the requirements for the Single Mode Fiber Optic Cable to be furnished and installed, as shown on Plans and specified herein. Also included are fiber testing procedures, equipment accessory and splicing requirements.

B. The entire Single Mode Fiber Optic system is considered to be one component and provided by a single source, hereafter referred to as the Supplier.

C. The Contractor shall furnish and install all hardware, trenching, conduit and fiber optic cable as shown on Plans. Every Fiber Optic Conduit shall include Detectable Pull Tape. The Detectable Pull Tape traveling through a conduit, which terminates in the Pull Box shall have its ends connected together to allow for a continuous locating signal to be used for the entire conduit run. In addition the Contractor shall provide to the Owner one optical light source, one optical power meter, and the latest Windows based PC software specified herein.

D. See Drawings for coordination.

1.2 SUBMITTALS

A. Products shall be submitted to the Engineer for review in accordance with Section 01300 and other Contract Documents, prior to installation.

B. Include the following information in the submittal for this Section:

C. Cut sheets and catalog literature for proposed Single Mode Fiber Optic Cable, and fiber optic cable accessories (pigtails, connectors and Fan out Kits).

D. Manufacturer specifications and data that clearly shows that the Single Mode Fiber Optic Cable meets all requirements specified herein.

E. Samples of the proposed cable.

F. Physical dimension drawings of all fiber optic accessories.

G. Proposed fiber identification sequence and labeling.

H. Provide a Recommended Spare Parts List (RSPL).

I. Provide a list of recommended special tools for fiber installation testing or maintenance.

J. One (1) hand-held optical light source with ATT-complaint ST adapters, manufactured by Siecor, or equal.

K. One (1) hand-held optical power meter with ATT-complaint ST adapters, manufactured by Siecor, or equal.

L. One Latest copy of LinkLoss® Windows based PC software by Siecor, or equal.

M. Operation and Maintenance Manuals.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Corning
   2. Owner approved equal

2.2 DESIGN AND FABRICATION

A. Design Specifications:
   1. Fiber Type: OS2 Single Mode.
   2. Core Diameter: 8.3 microns.
   3. Core Eccentricity : ≤ 1.0 micron (0.3 Typical).
   4. Cladding Diameter: 125 microns.
   5. Mode field diameter: 9.3 ± 0.5 microns.
   6. Maximum Attenuation: 1 dB/km @ 1310 nm.
   7. Zero dispersion wavelength: 1300 to 1320nm.
   8. Buffer Type: Loose Tube, gel filled OR water-blocking.
   9. Number of Fibers: 48 (4x 12 pair) for Branch and Building Trunklines.
   10. Cable Central Strength Member: Dielectric.
   11. Cable Fill: Water blocking gel.
   12. Outer Jacket: Polyethylene, Black, Outdoor Rated.
   13. Coating Thickness: 50 ± 15 microns.
   14. Maximum Pulling Load: 600 lbf (2700 N).
   15. Operating Temperature Range: -34°C to -74°C.
   16. Bending Radius: 20 x Diameter Minimum.
   17. Zero dispersion slope: ≤0.092 picosec/nm^2 –km.
   18. Cutoff Wavelength: 1260nm.
   19. Point discontinuities at 1310nm: ≤0.1 db.
   20. Quantity: As shown on the Plans.
   21. Packaging: Spools/reels, protected during and after shipment.

B. Fabrication:

1. Fibers within the cable shall be color-coded so that each fiber may individually identified. The Single Mode trunk cable "Buffer Tube" outer jackets and fiber jackets shall be colored in accordance with EIA-598 and designated as shown below:

Fiber Buffer Tube Color	System Corridor Application
Blue	As directed by Owner
Orange	As directed by Owner
Green	As directed by Owner
Brown	As directed by Owner

2. The trunk cables shall mate up to existing Fiber Optic Cables regarding the number of Fibers per Buffer Tube. Otherwise, 12 fibers per buffer tube shall be provided in the trunk cables.
3. The outer jackets of the cable shall be continuous, free from holes, splits, blisters or inclusions. The same requirement holds for any inner jackets within a given cable structure as well as for fiber coatings.
4. Materials used for fiber optic cable shall present no environmental or toxicological hazards as defined by current industry standards and shall comply with OSHA and EPA standards or applicable federal or state laws or regulations.
5. The color of the polyethylene outer jacket material shall be black in accordance with ASTM D 1248, and contain a suitable antioxidant substance. The carbon black used shall be furnace-type conforming to designation N 110 in ASTM D 1765. The carbon black content in the jacket material when measured in accordance with ASTM D 1603 shall be 2.6% ± 0.25% by weight. The light absorption coefficient of jacket material shall be at least 400 when measured at wavelength of 375 nm per ASTM D 3349.
6. Outer polyethylene jacket materials shall meet tensile strength and elongation minimum requirements for unaged and aged samples as follows:
7. Tensile Strength at: 2800 psi (Unaged), 2100 psi (Aged).
8. Elongation at Rupture: 400% (Unaged), 375% (Aged).
9. The cable jacket shrinkage test measures the shrinkage or expansion of a cable jacket exposed to temperature aging for specified period of time. Maximum shrinkage shall be less than 5% for each specimen tested. The Test procedure is described in EIA-RS455, FOTP-86.

2.3 CABLE PACKAGING:

A. The cable shall be permanently marked to identify the manufacturer, date of manufacture, length markings, a product identification code, and UL messages where appropriate. The markings shall be printed at regular intervals of not more than two feet apart.

B. The cable shall be packaged on a reel with inner hub diameter greater than the recommended minimum bending diameter of cable. The anchor holes on the reels shall admit a 2-1/2 IN diameter spindle with binding. The package shall be sturdy enough to endure reasonable handling in the process of shipping and storage. The package shall bear the name of the manufacturer, the product identification code and the total amount of product on the reel.

C. The following information shall be securely attached to the reel as a tag or clearly and permanently stenciled or labeled on each reel:
   1. Customer Order Number.
   2. Customer Job Number.
   3. Customer Reel Number.
   4. Termination.
   5. Ship Date.
   6. Manufacturer's Name.
   7. Factory Reel Number.
   8. Manufacturer's Cable Code (Type and Fiber count).
   9. Length of Cable.
   10. Weight of Cable and Reel.
   11. Defect Tag.
   12. The ends of all cable shall be sealed to prevent the escape of filling compound and to prevent the entry of moisture during shipping, handling, storage and installation.

D. Additional Fiber:
   1. The fiber count of the cable shall be at least 95% of cable rated strands. Each fiber will be tested prior to and upon completion of cable installation to verify that all fibers meet these specifications. If testing reveals that any fiber does not meet the requirements, the Contractor shall replace the cable with a new cable and perform all tests for the new cable at no additional cost to the owner.

E. Manufacturer Test Documentation:
   1. Test documentation from the fiber optic cable manufacturer shall be delivered to the Engineer upon delivery of the cable to the job site, as a prerequisite for cable installation.
   2. The documentation shall include Optical Time Domain Reflectometer (OTDR) traces for each fiber of each reel at 1310 nm. Optical attenuation test data shall be furnished for each fiber of each reel, as measured at 1310 nm.

F. Installation Testing:
   1. The Contractor shall test the fiber optic cable prior to its installation. This testing shall be witnessed by the Engineer.
   2. Testing shall consist of making an OTDR trace of each fiber of each reel, at 1310 nm. The test shall incorporate a 1 km long backscatter suppression

cable inserted between the OTDR and the fiber end. Each trace shall include the optical length and average attenuation.

3. The results of the testing shall be submitted to the Engineer prior to installation. Any cable which shows out-of-spec performance shall be replaced at no increase in Contract price or schedule.

G. Cable Termination Enclosure and Hardware:
   1. Cable termination enclosures shall be furnished as required.
   2. The enclosures shall be used to terminate every fiber of the cable.
   3. Minimum of 12 strands.

H. Network Rack/ LIU's:
   1. Administration & Thickening Buildings:
      1. Provide Hoffman AccessPlus Double-Hinge, Type1 EWMW482430 Data Networking Cabinet and required accessories or equal.
   2. Maintenance Building:
      1. Provide Hoffman ProLine V/D and Server Cabinet, Type 1 PDCP2078BFP and required accessories or equal.
   3. Filter Deck (ECOM-FILT):
      1. Provide a NEMA 4X enclosure in accordance with Section 16161.
      2. Provide within the enclosure a wall-mountable WCH connector patch panel housing with required SMFO-OS2 SC connectors and related accessories.
   4. https://ecatalog.corning.com/optical-communications/US/en/Fiber-Optic-Hardware/Housings/Closet-Connector-Housing-%28CCH%29/p/closet-connector-housing-cch?clear=true.
   5. https://ecatalog.corning.com/optical-communications/US/en/Fiber-Optic-Hardware/Wall-Mountable-Hardware/WCH-Hardware/WCH-Housings/Wall-Mountable-Connector-Housing-%28WCH%29/p/wall-mountable-connector-housing-wch.
   6. https://ecatalog.corning.com/optical-communications/US/en/Fiber-Optic-Hardware/Wall-Mountable-Hardware/SPH-Hardware/SPH-Housings/Single-Panel-Housing-%28SPH%29/p/single-panel-housing.
   7. Blue adaptor housing color for SMFO.
   8. SC CCH panels for the LIU's for Singlemode Fiber Optics (SMFO).
      a. https://ecatalog.corning.com/optical-communications/US/en/Adapter-Type/Closet-Connector-Housing-%28CCH%29-Panel%2C-SC-Adapters/p/closet-connector-housing-cch-panel-sc-adapters.
   9. Field terminated SC connectors for SMFO 95-201-41-SP:
      a. https://ecatalog.corning.com/optical-communications/US/en/Fiber-Optic-Connectivity/Field-Installable-Connectors/Anaerobic-Connector/Anaerobic-Connector/Anaerobic-Connector%2C-SC/p/anaerobic-connector-sc.
   10. Buffer tube Fan-Out kits (For OSP fiber).
      a. https://ecatalog.corning.com/optical-communications/US/en/Fiber-Optic-Connectivity/Fan-Out-Kits/Buffer-Tube-Fan-Out-Kits%2C-

indoor/Buffer-Tube-Fan-Out-Kits%2C-indoor/p/buffer-tube-fan-out-kit-indoor.

11. Provide Chatsworth horizontal, vertical cable management trays and blank 19 inch filler panels as required.
12. Provide Panduit-NKFP24Y 19" RJ-45patch panel as required.

I. Pigtail Cables and Connectors:
   1. Each of the fibers shall be terminated with SC type connectors and connected to the termination enclosures.
   2. Pigtails shall be Single Mode for operation at 1300 nm, loose buffered and manufactured from fiber meeting the Specifications described for the main cable.

J. Splicing:
   1. Splices shall be made only at Pull Boxes and by a fusion process and shall have a splice loss no greater than 0.20 dB. Loss measurement shall be performed at the time of splicing and documentation shall be furnished for each splice. Splice testing shall be witnessed by the Engineer.
   2. Prior to stripping the cable, the Contractor shall record the cable length from the cable jacket. This length shall be documented and included in the test documentation, specified below.
   3. Each fiber optic cable shall be installed in innerduct.

K. Fiber Optic Splice Closures
   1. Contractor shall furnish and install Splice Closures, including Splice Trays, in pull boxes and cabinets as shown in the Plans or directed by the Engineer. The Contractor shall furnish and install cable splice closures including fiber optic splices in accordance with the Termination Tables. The Contractor shall place the cable splice closures in the pull boxes and cabinets by a method describes herein and by the Engineer.

2.4 CONSTRUCTION REQUIREMENTS

A. Splice Closures shall be required to meet GR771 CORE, GR769 CORE and be compatible with the fiber to be installed.

B. Splice Tray shall be required to meet ANSI/EIA/TIA-568-a and 606, and be compatible with fiber to be installed.

C. Cable Splice Closure shall seal, Bond Anchor and provide efficient routing, storage, organization, and protection of the fiber optic cable and splices, connectors and Trays. The splice closure shall be a stand-alone closure that does not require an outer closure. It shall consist of a reinforced thermoplastic envelope and an end plate assembly with corrosion resistant hardware. The splice closure shall provide for a minimum of 4 cable entries. The splice closure shall permit the installation of fusion spliced cables. The splice closure shall be designed for use underground, branch and through cable applications. It shall

have a reliable dual seal design with both cable jackets and core tubes sealed. All cables and endplate seals shall be composed of resilient and reusable materials.

D. The Contractor shall furnish, install, and secure splice closures, capable of storing a minimum of 144 fusion splices in splice trays, in pull boxes as designated in the plans. The Contractor shall only splice the needed fiber in the branch cable as indicated in the plans, or directed by the Engineer. The splice closure maximum dimensions shall not exceed 15" Long x 6" Deep where installed in a No. 7 pull box.

E. The following manufacturers are acceptable:
   1. Tyco Electronics, Model FOSC 450

F. Pull Boxes:
   1. Contractor shall furnish and install No. 7 and No. 9 Pull Boxes as shown in the Plans. No. 7 Pull boxes shall include extensions as indicated in the Plans or directly by the Engineer. The Contractor shall furnish and install Racks and Hooks in all No. 9 Pull Boxes. No. 7 with extensions as required and No. 9 pull boxes shall meet the requirements if the ADOT Standard Specifications and the 2004 ADOT Traffic Signals & Lighting Standard Drawings.
   2. Construction Requirements.
      a. The pull boxes shall be constructed per the requirements shown in the plans and per ADOT Standard Specifications. The boxes shall be field located within the intent of the plans. The boxes shall have locking mechanism that has been approved by the Engineer and Owner.
      b. Contractor shall furnish and install racking system in the new No. 9 pull boxes containing splice enclosures. The racking system shall consist of two right angles placed in the lip of the No. 9 pull box along the lateral sides. Each end of the right angles must be modified so that the horizontal face of the right angle rests on the lip of the pull box and the vertical face hangs below the lip. A slotted strap shall be cut to fit and attached to the right angles as a cross member to form an H-shape. Once the Fiber Optic Cables are neatly looped on the sides of the pull box one adjustable "J" hanger shall be attached to each right angle as a hanger for the looped cable. The Splice Closure shall then be secured to the racking system using two nylon tie straps attached to two slotted straps extending down and fastened to the same right angle. The materials used for the racking system shall be submitted to the Engineer for approval.

PART 3 - EXECUTION

3.1 CABLE INSTALLATION

A. All fiber optic cable shall be installed, terminated, and tested by the fiber supplier as specified herein and as shown on the Plans.

B. In pulling the cable, strain-release, or other tension limiting devices shall be used to limit the pull tension to less than 600 lbs.

C. Minimum bend radius restrictions shall be observed both during and after cable installation.

D. Each pull box shall have a minimum of 50 feet of slack cable loosely looped, or as required by the Engineer.

E. All conduit and cabinet entrances shall be sealed with RTV or other re-enterable sealant material to prevent ingress of water, dust or other foreign materials.

F. Splices in the fiber optic cable shall only be made where shown on the Plans. Non-terminating field splices shall not be made unless authorized by the Engineer. If a field splice is required, it shall be fusion spliced and placed in a buried pullbox. Closures shall be Lucent UCB2 with outer case, Siecor SCN, or equal. Encapsulant shall be placed between inner and outer closures. Such splices shall meet the loss parameters/testing requirements specified elsewhere.

3.2 CABLE DAMAGE DURING INSTALLATION

A. If the cable becomes damaged during installation, the Contractor shall stop work and notify the Engineer immediately. The Owner and Engineer will decide whether to replace the entire reel of cable or to install a splice at the damaged section.

B. If the Owner decides to replace the entire reel of cable, the Contractor shall begin the installation at the last designated splice point. The damaged cable between these points shall be removed, coiled, tagged, and given to the Owner. Installation of new cable to replace damaged cable shall not be a basis of extra payment or contract completion time.

C. If the Owner decides to install a splice at the damaged point, and the cable is damaged a second time, the entire reel of damaged cable (and all subsequent damaged reels) shall be replaced with new reels at the Contractor's expense.

3.3 CABLE ACCEPTANCE TESTING

A. Acceptance testing of the fiber and electronic equipment shall be conducted as a part of integrated system field testing, as specified. Prior to such test, however, the fiber optic cable shall be tested as specified herein.

B. The supplier shall conduct fiber optic cable testing as specified below. All testing shall be witnessed by the Engineer. A test plan shall be submitted at least one week prior to the proposed test date(s). The test plan and procedures shall be mutually agreed upon prior to conducting the tests.

C. Each optical fiber in every span shall be tested after installation and termination. For each fiber, an OTDR trace hard copy is required. This end-to-end trace shall be performed from BOTH ends of the fiber. The traces shall be made at 1300 nm. Also for each fiber, an end-to-end power attenuation (insertion less) test shall be performed from BOTH ends of the fiber. The attenuation test shall use a stabilized optical source and an optical power meter calibrated to the appropriate operating wavelength (1300 nm).

D. For each installed fiber, the power attenuation shall not exceed 1.0 dB/km @ 1300 nm, tested from connector to connector at the respective termination enclosures. Connectors shall have an attenuation loss no greater than 0.2 dB per connector.

E. Any fiber optic cables containing one or more fibers not meeting this performance will not be accepted, and shall be replaced at no additional cost to Owner.

F. All fiber optic testing shall be documented on pre-approved test forms. Three (3) copies of all documents (including OTDR traces) shall be submitted to the Engineer upon successful completion of the testing.

G. Work at the termination cabinets shall be performed such that the fiber optic cables, and the fibers, are not subjected to undesirable bending both during the work and when permanently fixed in place. The cables, fibers, pigtails, etc. shall be organized in a neat and orderly fashion within the enclosure. Inspection of the work will be performed by the Engineer. Unsatisfactory work shall be reworked at no additional cost to Owner.

++ END OF SECTION ++

SECTION 16920

ELECTRICAL ACCEPTANCE TESTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Requirements for electrical acceptance testing of electrical equipment and materials.
   2. It is the intent of the tests described herein to assure that all electrical equipment is operational and within industry and manufacturer's tolerances and is installed in accordance with design specifications.
   3. Acceptance testing performed by equipment vendors at the point of manufacturer must conform to all requirements of this specification. Testing performed at the point of manufacture which conforms to generally accepted industry practices is also acceptable so long as adequate test result documentation is provided.

B. Scope:
   1. All of the Acceptance Tests are required to be performed whether they are described in this Section or other applicable Sections. At a minimum, the following electrical systems are to be tested:
      a. Service entrance section.
      b. Main distribution panel.
      c. Motor control centers.
      d. Switchgear, low and medium voltage.
      e. Panelboards, power and lighting/receptacle.
      f. Transformers, dry type.
      g. Feeders.
      h. Cables rated 600 volts and higher.
      i. Transfer switches, manual and automatic.
      j. Transient voltage surge suppression systems.
      k. Grounding and bonding system.
      l. Lighting fixtures and associated controls.
      m. Other systems as listed under Part 3 of this Specification.

C. Related Documents:
   1. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and other Division 1, General Requirements, Specification Sections, apply to the Work of this section.
   2. All work performed under this Section of the Work is subject to all requirements contained under Section 16000, General Electrical Requirements.

3. All Division 16, Electrical, Specifications for electrical equipment provided for this Project that requires electrical acceptance testing.

1.2 REFERENCES

A. NETA ATS, Acceptance Testing Specifications, 2013 edition.

B. NFPA 70, National Electrical Code, 2011 edition.

C. Incorporated by reference all Codes, Standards, and Specifications referred to in the "Applicable References" section of NETA ATS-2013.

1.3 DEFINITIONS

A. NETA, InterNational Electrical Testing Association Inc.

B. NEC, National Electrical Code.

1.4 SYSTEM DESCRIPTION

A. Conditions:
   1. Provide all items, articles, materials, operations, or methods listed, mentioned, or scheduled on Drawings and/or herein including all labor, materials, equipment, and incidentals necessary and required for Electrical Acceptance Testing.
   2. Following established procedures, equipment shall be energized after certification by the testing organization that the installation is satisfactory.
   3. Correct or replace any current-carrying circuit, electrical equipment, or system which is defective or grounded and correct all other troubles encountered by these tests. All defects, whether through faulty workmanship or materials furnished, shall be corrected under this Section at the CONTRACTOR'S expense.

1.5 SUBMITTALS

A. Test Report Forms:
   1. All test reports shall be submitted using NETA or approved similar format and, where appropriate, test forms. Reports shall be legible using permanent ink. Pencil is not acceptable.
   2. Provide for ENGINEER'S review and approval a copy of each test form to be used on the Project. No testing shall be started prior to approval of all test forms.
   3. All test reports shall include the following information:
      a. Summary/description of the Project.
      b. Description of equipment tested.
      c. Description of the tests.

d. Test data and analysis of the data indicating whether the equipment passed or failed the test.

4. All test data records shall include the following minimum requirements:
   a. Equipment identification, including tag numbers.
   b. Humidity, temperature, and other conditions that may affect the results of the tests and/or calibrations.
   c. Date of inspections, tests, maintenance, and/or calibrations.
   d. Identification of the testing technician and their employer.
   e. Indication of inspections, tests, maintenance, and/or calibrations to be performed and recorded.
   f. Indication of expected results when calibrations are to be performed.
   g. Indication of "as-found" and "as-left" results, as applicable.
   h. Sufficient spaces to allow all results and comments to be indicated.

B. Shop Drawings: Submit for approval the following:
   1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
   2. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**

C. Closeout Submittals:
   1. Provide one copy each to ENGINEER and OWNER of all testing reports organized as follows:
      a. Bind report in 3-ring binder(s).
      b. Identify Project name, description, testing organizations name, and submittal date on front face and back cover of binder.
      c. Provide all test reports, organized by equipment tag number.

d. Separate different equipment numbers with colored or numbered tabs.
e. Provide an index/table of contents.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Any materials provided as part of the testing shall be new, unused, and in manufacturer's original packing.

2.2 TEST INSTRUMENT CALIBRATION

A. Contractor performing the testing shall have a calibration program which assures that all applicable test instruments are maintained within rated accuracy for each test instrument calibrated.

B. Contractor performing the testing shall maintain up-to-date instrument calibration instructions and procedures for each test instrument calibrated.

C. It is preferred that instrument calibration accuracy be directly traceable to the national Institute of Standards and Technology (NIST).

D. Instruments shall be calibrated in accordance with the following frequency schedule:
   1. Field Instruments: Analog, six months maximum. Digital, 12 months maximum.
   2. Laboratory Instruments: 12 months maximum.
   3. Leased Specialty Equipment: 12 months maximum.

E. Dated calibration labels shall be visible on all test equipment.

F. Records, which show date and results of instruments calibrated or tested, must be kept up to date.

G. Calibrating standard shall be better accuracy than that of the instrument tested.

PART 3 - EXECUTION

3.1 QUALIFICATIONS

A. The testing organization shall be an independent, third party entity which can function as an unbiased testing authority, professionally independent of the manufacturers, suppliers, and installers of equipment or systems being evaluated. When such testing organization is used, it must meet the following requirements:
   1. The testing organization shall be regularly engaged in the testing of electrical equipment, devices, installations, and systems.

2. The testing organization shall use technicians who are regularly employed for testing purposes.
3. The testing organization shall be a member of NETA or be able to prove qualifications equal to or better than required for membership in NETA.
4. Submit appropriate documentation demonstrating that the testing organization meets the requirements listed above.
5. Technicians performing these electrical tests and inspections shall be trained and experienced concerning the apparatus and systems being evaluated. These individuals shall be capable of conducting the tests in a safe manner and with complete knowledge of the hazards involved. They must evaluate the test data and make a judgment on the serviceability of the specific equipment.
6. Technicians shall be certified in accordance with ANSI/NETA ETT-2000, "Standard for Certification of Electrical Testing Personnel". Each on-site crew leader shall hold a current certification, Level III or higher, in electrical testing.

B. CONTRACTOR may perform the electrical acceptance testing under the following conditions:
1. CONTRACTOR'S personnel performing the testing and their testing equipment meets all other requirements of this Specification.
2. Written approval is received from ENGINEER after review of testing personnel qualifications. At a minimum, CONTRACTOR'S testing personnel must have specific instruction on the testing instruments, accessories, and tests being performed and must be able to evaluate the test results.

3.2 NOTIFICATION

A. Notify ENGINEER and Construction Manager at least two days prior to testing so that they may be present during testing.

3.3 SAFETY AND PRECAUTIONS

A. Safety practices shall include, but are not limited to, the following requirements:
1. Occupational Safety and Health Act OSHA.
2. Accident Prevention Manual for Industrial Operations, National Safety Council, Chapter 4.
3. Applicable State and local safety operating procedures.
4. NETA Safety/Accident Prevention Program.
5. National Fire Protection Association - NFPA 70E.
6. ANSI Z244.1 American National Standards for Personnel Protection.

B. All tests shall be performed with apparatus de-energized, except where otherwise specifically specified.

C. The testing firm shall have a designated safety representative on the Project to supervise operations with respect to safety.

3.4 EQUIPMENT TESTING REQUIREMENTS

A. The intent of this Specification is not to duplicate testing performed at the point of manufacture or to impose additional burden on the CONTRACTOR which does not benefit the Project. The intent is to verify that electrical equipment has been securely fastened down, supported, and installed in accordance with the manufacturer's requirements. The intent is also to verify that all electrical connections are correctly torqued, properly aligned, properly insulated, and properly supported and that equipment is clean and ready for operation.

B. Except as noted below or as approved by engineer, test the following equipment and assemblies in full accordance with NETA-ATS 2003.

C. Switchgear and switchboard assemblies.

D. Transformers, dry type, air-cooled, low-voltage, small.

E. Transformers, dry type, air-cooled, large.

F. Transformers, liquid-filled.

G. Cables, low-voltage, 600 volt maximum.
   1. Perform tests only on cables Size #4 AWG and larger.

H. Cables, medium-voltage and high-voltage.

I. Metal-enclosed busways.

J. Switches, air, low-voltage:
   1. Perform tests only on switches rated 100 amps or higher.

K. Switches, air, medium-voltage, metal-enclosed.

L. Switches, oil, medium-voltage.

M. Switches, vacuum, medium-voltage.

N. Switches, Cutouts:
   1. Perform tests only on equipment rated 100 amps or higher.

O. Circuit Breakers, Air, Insulated-Case, Molded-Case:
   1. Perform visual and mechanical inspections in accordance with NETA for all circuit breakers.
   2. Perform electrical tests only on circuit breakers rated 100 amps or higher provided in power distribution and lighting/receptacle panelboards.
   3. No testing is required for circuit breakers provided as part of any of the following:
      a. A UL listed control panel.

b. UL listed factory supplied motor control centers.
c. Stand-alone combination motor starters.

P. Circuit breakers, air, medium voltage.

Q. Circuit breakers, oil, medium voltage and high voltage.

R. Circuit breakers, vacuum, medium voltage.

S. Circuit switchers.

T. Network protectors, 600 volt class.

U. Protective relays.

V. Metering devices.

W. Regulating apparatus, voltage, step and induction voltage regulators.

X. Regulating apparatus, load tap-changers.

Y. Grounding systems.

Z. Ground-fault protection systems, low-voltage.

AA. Rotating Machinery, AC Motors, and Generators:
1. Motors provided as part of valve actuators do not require testing.
2. Perform visual and mechanical inspections on all motors.
3. Perform rotation tests on all motors.
4. Perform electrical tests only on motors 50 horsepower and larger.

BB. Motor control, motor starters, low-voltage.

CC. Motor control, motor starters, medium-voltage.

DD. Variable speed drive systems.

EE. Direct-current systems, batteries, flooded and valve-regulated lead-acid.

FF. Direct-current systems, chargers.

GG. Surge arresters, low-voltage surge protection devices.

HH. Surge arresters, medium and high-voltage surge protection devices.

II. Capacitors and reactors - all types.

JJ. Outdoor bus structure.

KK. Emergency and standby power systems, engine generator.

LL. Emergency and standby power systems, UPS.

MM. Emergency and standby power systems, automatic transfer switches.

NN. Fiber-optic cable Systems.

3.5 CONSTRUCTION

A. Interface with Other Work:
   1. Coordinate all testing activities with other disciplines. Retest any equipment disturbed or damaged in any manner after initial testing.

3.6 CLOSEOUT REPORT

A. Provide comprehensive bound test report in accordance with Part 1 of this Specification.

++ END OF SECTION ++

SECTION 16951

SHORT CIRCUIT, COORDINATION, AND ARC-FLASH HAZARD REPORT

PART 1 - GENERAL

1.1 DESCRIPTION

A. General:
   1. Prepare a short circuit analysis, protective device coordination study, and an arc flash hazard analysis for the project electrical power source and distribution system for the new facility and any modified existing electrical equipment.
   2. The short circuit, coordination study, and arc flash hazard report shall provide an evaluation of the electrical power system with the model numbers and settings of the protective devices.

B. Scope:
   1. Perform and provide a complete short circuit analysis with equipment interrupting or withstand rating evaluation and a protective device coordination study for the electrical power distribution system serving the facility.
   2. Include all portions of the electrical power distribution system from the utility primary service drop through 12.47 kV, 480 V (including motor loads) and 120/208 V lighting panels.
   3. Electrical equipment bus impedance shall be assumed to be zero. Short circuit momentary duties and interrupting duties shall be calculated on the basis of maximum available fault current at each project power source or power distribution equipment including switchgear, switchboard, motor control center, and branch circuit panelboards.
   4. A protective device coordination study shall be performed to determine proper selection of power fuse ratings, protective relay characteristics and settings, ratios and characteristics of associated voltage and current transformers, and circuit breaker trip characteristics and settings.
   5. The coordination study shall include all voltage classes of equipment from the utility's closest upstream protective device to existing and new equipment including switchgear, switchboards, motor control centers, and 120 volt panelboards main circuit protection.
   6. 120 /208 V panelboard branch circuit devices need not be considered. The phase overcurrent and ground-fault protection shall be included, settings for the adjustable protective devices, and electrical metering and monitoring devices.
   7. Provide an arc flash hazard analysis to warn personnel of the dangers of live exposed electrical equipment. Provide appropriate labeling for electrical equipment per NFPA 70E that indicates the flash hazard boundaries, incident

energy available, and the required PPE (Personal Protective Equipment) level.

8. An equipment evaluation study shall be performed to determine the adequacy of existing or proposed electrical equipment by tabulating and comparing the short circuit ratings with the available fault currents.
9. Problem areas or inadequacies in the proposed equipment shall be identified in the report.

1.2 REFERENCES

A. This Section contains references to the following documents and they are part of this section as specified and modified. In case of conflict between the requirements of this Section and those of the listed documents, the requirements of this section shall prevail.
   1. IEEE 141, Recommended Practice for Electrical Power Distribution for Industrial Plants.
   2. IEEE 242, Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems.
   3. IEEE 1584, IEEE Guide for Performing Arc Flash Hazard Calculations.
   4. NFPA 70E, Standard for Electrical Safety Requirements for Employee Workplaces.

1.3 SUBMITTAL SCHEDULE

A. The report shall be submitted with the major electrical distribution equipment and switchgear detailed product submittal.

B. The ENGINEER reviewed report shall be corrected, revised, and resubmitted as required. The report will be reviewed along with the electrical distribution and switchgear product submittal.

C. The CONTRACTOR shall distribute the ENGINEER accepted report to the major electrical distribution equipment and switchgear manufacturers before the electrical distribution equipment and switchgear is manufactured.

D. Provide an electronic copies of the protective device coordination study results and model files, as generated by the study software.

E. The report specified herein shall be provided in accordance with Contract Documents.

F. Provide arc flash hazard warning labels for all electrical distribution equipment as indicated in section 1.1.B.

G. Shop Drawings: Submit for approval the following:
   1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with

each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

2. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**

PART 2 - PRODUCTS

2.1 REPORT

A. The report shall be sealed and signed by the responsible electrical engineer, summarize the short circuit analysis, protective device coordination study, arc flash hazard analysis, potential problem issues, conclusions, and recommendations that may affect the integrity of the project power distribution system. As a minimum, the report shall include the following.
   1. The equipment manufacturer's information used to prepare the study.
   2. Assumptions made during the study.
   3. Short circuit calculations listing short circuit levels at each bus.
   4. Simplified single line diagrams generated by the study software.
   5. Coordination study time-current curves including the instrument transformer ratios, model numbers of the protective relays, relay settings, and trip unit settings associated with each breaker.
   6. Arc flash hazard analysis calculations.
   7. Comparison of short circuit duties of each bus to the withstand and interrupting capacity of the equipment protecting that bus.
   8. Data used as input to the report including cable impedance, source impedance, equipment ratings, equipment time-current curves etc.

PART 3 - EXECUTION

3.1 GENERAL

A. Provide the short circuit analysis, coordination study, and arc flash hazard analysis for the electrical power distribution system using SKM System Analysis, Inc. Power Tools, or equal.

B. The studies shall be performed in accordance with IEEE Standards 141, 242, 1584, and NFPA 70E and shall utilize the ANSI; method of short circuit analysis in accordance with ANSI C37.010.

C. The studies shall be performed using actual equipment data for the new equipment. The analysis and study shall use the equipment and protective device data provided by the electrical distribution equipment manufacturer for the Project.

3.2 SHORT CIRCUIT ANALYSIS

A. The Short Circuit Analysis and Report shall include the following.
   1. One-Line Diagram:
      a. Location and function of each protective device in the system, such as relays, direct-acting trips, fuses, etc.
      b. Type designation, current rating, range or adjustment, manufacturer's style and catalog number for all protective devices.
      c. Power, voltage ratings, impedance, primary and secondary connections of all transformers.
      d. Type, manufacturer, and ratio of all instrument transformers energizing each relay.
      e. Sources of short circuit currents such as utility ties, generators, synchronous motors, and induction motors.
   2. Impedance Diagram:
      a. Available MVA or impedance from the power utility company.
      b. Local generated capacity impedance.
      c. Bus impedance.
      d. Transformer and/or reactor impedance.
      e. Cable impedance.
      f. Equipment impedance.
      g. System voltages.
      h. Grounding scheme (resistance grounding, solid grounding, or no grounding).
   3. Calculations:
      a. Determine the paths and situations where short circuit currents are the greatest.
      b. Assume bolted faults and calculate the 3-phase and line-to-ground short circuits of each case.
      c. Calculate the maximum and minimum fault currents.

3.3 PROTECTIVE DEVICE COORDINATION STUDY

A. The time-current characteristics of the specified and indicated protective devices shall be plotted on 5-cycle, log-log graph paper with a maximum of eight protective devices per plot. The coordination study time-current plots shall, at a minimum, include the following:
   1. Time-current for each protective relay or fuse showing graphically that the settings will provide protection and selectivity within industry standards. Each curve shall be identified, and the tap and time settings shall be specified.
   2. Time-current curves for each device shall be positioned to provide for maximum selectivity to minimize system disturbances during fault clearing. Reasonable coordination intervals and separation of characteristic curves shall be maintained.
   3. Where selectivity cannot be achieved, the report shall indicate the cause and recommend alternative solutions. Time-current curves and points for cable and equipment damage and symmetrical and asymmetrical fault currents.
   4. Circuit interrupting device operating and interrupting times.
   5. Indicate maximum fault values on the graph.
   6. Sketch of bus and breaker arrangement.

3.4 ARC FLASH HAZARD ANALYSIS

A. Calculated arc flash boundaries, incident energies, and PPE requirements shall be published in the study report as well as displayed on the report one-line diagrams. Study Engineer needs to evaluate settings, make recommendations and evaluate impact to process operations. Coordinate with Owner.

B. Provide a direct printout of warning signs and labels using the study software.

3.5 STUDY FIRM

A. The report for the short circuit analysis and protective device coordination study indicating results shall be performed, stamped, and signed by an Electrical Engineer registered in the State of Arizona.

B. The CONTRACTOR shall provide the ENGINEER with submittal information for the electrical products used for the Project.

C. The ENGINEER performing the study must visit the Project site after equipment is installed and modify the study as required, and resubmit the study.

++ END OF SECTION ++

SECTION 17000

INSTRUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Provide complete instrumentation and control systems as indicated on the Drawings, in the Specifications, and as required by other Contract Documents. These documents include descriptions of functional operation and performance, as well as standards, but do not necessarily enumerate detailed specifications for all components and devices which are necessary. However, all components and devices shall be furnished and installed as required to provide complete and operable systems for accomplishing the functions and meeting the performance requirements.
   2. Scope of Work includes:
      a. Provide all instruments.
      b. Provide all control panels, programmable logic controllers (PLC) panels, SCADA consoles.
      c. Provide all communication equipment required to make the control system fully operational including, but not limited to, radios, antennas, switches, routers, hubs, protocol converters, communication cables, and communication racks and power supplies.
      d. Provide all conduit, conductors, enclosures, materials, and labor to fully interconnect and make operational all control system components.
      e. Provide power at proper voltage and amperage to all system components.
      f. Provide programming for the PLC and SCADA components.
      g. Provide start-up and commissioning assistance.
      h. Train OWNER'S personnel on proper use and maintenance of the control systems.
      i. Other equipment, materials, and work as necessary to achieve a fully tested and operational control system.

B. Products Supplied But Not Installed Under This Section:
   1. None.

C. Products Installed But Not Supplied Under This Section:
   1. Instruments and controls provided loose for field installation by packaged equipment or skid-mounted equipment vendors.

D. Related Sections:
   1. All Division 16 Specifications provided for this Project.
   2. All Division 17 Specifications provided for this Project.

3. Other division Specifications provided for this project as they relate to Submittals, concrete, structural, piping/plumbing, mechanical, and HVAC systems.

E. Allowances:
   1. Not applicable this Section.

F. Unit Prices:
   1. Not applicable this Section.

G. Measurement Procedures:
   1. Not applicable this Section.

H. Special Payment Procedures:
   1. Not applicable this Section.

I. Alternates/Alternatives:
   1. All alternates, alternatives, or proposed substitutions of materials or equipment must be approved by ENGINEER.

1.2 REFERENCES

1.3 DEFINITIONS

A. The word "provide" means "furnish and install".

B. PLC means Programmable Logic Controller.

C. SCADA means Supervisory Control and Data Acquisition System.

1.4 SYSTEM DESCRIPTION

A. Design Requirements:
   1. Using sound engineering principals and current best design practices, provide engineering Drawings, and design documents specifying system components and detailing their interconnection and installation.

B. Performance Requirements:
   1. The instrumentation and control systems shall be furnished and installed complete and ready to operate, including all necessary interconnections and connections to sources of electrical power, air, water, drains and vents, with all required valves, switches and accessories as specified or as recommended for best operation by the manufacturer of the equipment furnished.

1.5 SUBMITTALS

A. General:

1. Submittals for the equipment shall be provided in accordance with Section 16000, General Electrical Requirements, and as required elsewhere in the Contract Documents.

B. Product Data:
   1. Detailed catalog information for all system components in sufficient detail so that ENGINEER has sufficient information to determine if the equipment is acceptable for the intended purpose. Minimum information shall be:
      a. Instrument or equipment tag number.
      b. Manufacturer.
      c. Model number.
      d. Materials of construction.
      e. Materials in contact with process fluids.
      f. Dimensional information.
      g. Weight.
      h. Power consumption with required voltage and ampacity.
      i. Heat dissipation if greater than 200 watts.
      j. Process connection information detailing connection size, and type (threaded, flanged, socket weld, etc.).
      k. Recommended mounting details.
      l. Recommended spare parts for one year of operation.
   2. Instrument Data Sheets in ISA S20 format for all instruments.

C. Shop Drawings:
   1. For complex control systems consisting of mechanical, electrical, and control components, provide the following:
      a. A piping and instrument diagram in ISA format.
      b. Electrical load calculations with conduit and conductor sizing.
   2. For integrated control panels or control assemblies, provide the following:
      a. Dimensioned layout of the control enclosure and mounted equipment and instruments.
      b. Full bill of material for all components with detailed catalog information on all components.
      c. 11-inch by 17-inch fully developed schematic diagram(s) showing power and control wiring, terminal block assignments, and identifying field and enclosure wiring. Provide a drawing index and symbols and legend sheet with all schematics. Show all Input/Output (I/O) card details including rack, slot, channel numbers, field termination points, and control power wiring. Label all conductors and identify conductor size and color. Identify all field devices by tag number and by description. Provide over current protection in accordance with NEC requirements.
      d. 11-inch by 17-inch instrument loop drawings in ISA format for all analog control loops. Alternatively, multiple loops may be combined on a single analog input or analog output I/O card schematic diagram.
      e. Nameplate legend.

f. Paint color and type for painted assemblies.

3. Any special installation details.
4. Submit for approval the following:
   a. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
   b. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**

D. Samples:
   1. Not applicable for this Section.

E. Quality Assurance/Control Submittals:
   1. Design Data, Test Reports:
      a. Submit calibration sheets for all field instruments containing the following information:
         1) Instrument tag number.
         2) Instrument manufacturer and model number.
         3) Person who performed the calibration.
         4) Manufacturer, model, and serial number of the calibrating device.
         5) Date that calibrating device was last calibrated.
         6) For analog instruments, process range and associated analog signal in at least five increments (For example: 4 mA DC/0 psig, 8 mA DC/25 psig, 12 mA DC/50 psig, 16 mA DC/75 psig, 20 mA DC/100 psig).

7) For switches, process values at which the switch changes state and at which the switch resets.
8) For instruments calibrated by manufacturer, manufacturer's calibration report is acceptable as proof of calibration.

b. Factory acceptance test reports on all fabricated control panels or assemblies containing the following information:
1) Date of test.
2) Test participants.
3) Visual inspection of components.
4) Successful application of power.
5) Validation of all internal wiring.
6) Validation of correct control operation.
7) Validation of screen graphics or alarm operation (if applicable)
8) Validation of program installation into PLC's and that I/O is functioning properly (if applicable).

2. Certificates, Manufacturer's:
a. UL 508 certification for all assembled control panels and assemblies.
3. Instructions, Manufacturer's Field:
a. Furnish a complete Operations and Maintenance Manual for all assembled control panels and assemblies.
4. Reports:
a. Not applicable to this Section.

F. Closeout Submittals:
1. Furnish Operations and Maintenance Manuals in 3-ring binders complete with the following:
a. On front and spine of binders provide the project name, OWNER'S name and Project number.
b. Within the binder, identify the CONTRACTOR and provide contact information.
c. Inside binders, provide a volume index and table of contents for each binder. Each instrument or control component tag number must be cross-referenced to a specific binder tab.
d. Furnish manufacturers complete operations and maintenance manuals for all discrete instruments and controls.
e. Furnish custom operations and maintenance Section for each custom control system, control panel, or fabricated assembly.
f. Furnish "As-Built" loop and wiring diagrams.
g. Furnish the written warranty.
2. Turn over all spare parts to OWNER with documentation showing which instrument or control system the spare parts are for.

G. Schedule:
1. Submit a detailed Work schedule showing start/finish dates, task duration, task sequencing, critical path, and available float. Identify task predecessors and identify coordination activities with other trades.

H. Start-up and Commissioning Plan:
   1. Submit a detailed start-up and commissioning plan for review by OWNER and ENGINEER. Plan should include the following information:
      a. The order in which the various plant systems will be started up
      b. What work must be performed prior to the start-up
      c. What documentation will be maintained by the CONTRACTOR and provided to the OWNER validating that the start-up was performed in a safe and efficient manner. Submit examples of proposed start-up and commissioning documentation.

1.6 QUALITY ASSURANCE

A. Qualifications:
   1. CONTRACTOR performing the Work shall have a minimum five years experience performing similar work in similar industries. All CONTRACTOR'S personnel shall be trained and experienced in best current construction practices.

B. Regulatory Requirements:
   1. Perform all Work in accordance with all applicable national and local codes.

C. Certifications:
   1. Not applicable this Section.

D. Field Samples:
   1. Not applicable this Section.

E. Mock-Ups:
   1. Not applicable this Section:

F. Pre-Installation Meetings:
   1. Not applicable this Section.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Packing, Shipping, Handling, and Unloading:
   1. Perform these activities in a manner which assures instruments and equipment will arrive undamaged and in proper working order. Replace any instrument or equipment damaged upon arrival at no additional cost to OWNER.

B. Acceptance at Site:
   1. Maintain a comprehensive log by instrument or equipment tag number of all received instruments or equipment.

C. Storage and Protection:

1. Store all instruments and equipment as recommended by manufacturer. Protect from physical damage, moisture, dirt/dust, or extremes of temperature.

1.8 PROJECT/SITE COORDINATIONS

A. Environmental Requirements:
   1. Follow any and all environmental requirements pertaining to the site.
   2. Maintain a safe and clean job site.
   3. Dispose of all trash and construction debris in an approved manner.

B. Existing Conditions:
   1. CONTRACTOR is to examine the site and be thoroughly familiar with any site requirements which may affect the Work or storage of instruments or equipment.

1.9 SEQUENCING

A. Coordinate all Work with other trades.

1.10 SCHEDULING

A. Provide and maintain a detailed schedule for performance of the Work identifying start/finish dates, durations, required preceding activities, and coordination with other trades. Organize procurement, deliveries, and staff labor to meet the overall construction schedule and to assure that other trades are not delayed.

1.11 WARRANTY

A. Instrumentation:
   1. One year from system acceptance by OWNER for all discrete instrumentation, control devices, or equipment. During this period, replace any defective or malfunctioning device with 15 working days after notification by OWNER.
   2. One year from system acceptance by OWNER for the performance of the overall control system. Correct the defect within 15 working days after notification by OWNER. Warranty repair work includes but is not limited to the following:
      a. Improper sequencing or interlocking of equipment control systems.
      b. Wiring errors or omissions.
      c. Improper calibration of field instruments.
      d. Improper operation of programmable logic controllers or operator interface terminals.
      e. Improper operation of communications systems installed as part of the overall control system.
      f. Unsafe operations or maintenance conditions.

g. Other system malfunctions which prevent or impair the plant from operating at design capacity, requires excessive operator intervention, or results in unsafe operating conditions.

1.12 SYSTEM START-UP/COMMISSIONING

A. General:
   1. Provide labor, tools, and equipment to start up the facility in a safe and efficient manner.
   2. Plant shall be started up by system. A system is defined as a collection of mechanical, electrical, and controls equipment configured to perform a specific function or purpose. Examples may be a UV disinfection system, a dissolved oxygen blower system, a grit removal system, etc. The order in which the systems will be started shall be submitted by CONTRACTOR in the start-up Plan and approved by OWNER and ENGINEER. Any variance in this schedule must be approved by OWNER and ENGINEER.
   3. Unless approved otherwise by OWNER and ENGINEER, CONTRACTOR is to follow the start-up sequence detailed below. The following Work must be complete prior to beginning the start-up:
      a. All mechanical equipment installed and tested in accordance with manufacturer's recommendations.
      b. All motors must have been rotation checked.
      c. Electrical power is available and wired to all mechanical equipment.
      d. All instruments must have been calibrated and installed in accordance with the manufacturer's recommendations.
      e. Control system communication systems are installed and fully operational. This includes Modbus Plus networks, Ethernet networks, radio telemetry systems, telephone systems, etc.
      f. All power and control wiring must be installed, rung out, and validated to be in accordance with approved Construction Drawings.
      g. Programmable logic controllers, SCADA computers, and Operator Interface Terminals all are installed, have their programs installed, and these devices are fully operational and functioning in their design configuration.

B. System Start-up Sequence:
   1. By manipulation of the instrument or direct signal injection at the instrument, verify that the control signal (discrete or analog) is received at the programmable logic controller or by the hard wired control circuit.
   2. For motorized equipment, disconnect the power leads at the starter, VFD, or solid state motor controller.
   3. Completely exercise the control circuit in Manual, Remote, and Automatic modes and verify that all interlocks and permissives are functioning correctly.

4. Verify that the programmable logic controller can start and stop the motor in Auto. Motors may be "bumped" by forcing PLC outputs but these program forces must be removed immediately afterward.
5. Verify that run status, signal levels, and alarms display properly on the OIT and the SCADA screens.
6. Reconnect the motor power leads.
7. Verify PID loop operating correctly (either direct or reverse) and adjust gain constants to achieve critically damped operation.
8. Configure the mechanical system for normal operation and leave system ready for normal operation.
9. Utilize colored tagging scheme to identify start-up condition. Red is not ready for start-up, yellow is mechanically and electrically ready but not yet tested or started up, and green is fully tested and ready for normal operation. Place these tags on all mechanical, electrical, instrumentation, and control components of each system.
10. As plant systems are started up, coordinate and remedy any coordination or interface issues between systems.

C. Remedies for Damages:
1. CONTRACTOR is liable for any and all damage done to mechanical or electrical equipment due to improper start-up procedures and shall repair or replace any damaged equipment at OWNER'S discretion without additional cost to OWNER.
2. CONTRACTOR is forbidden to jumper around any process or safety interlock either with wiring or within a PLC program without the express written permission of both the OWNER and ENGINEER. All jumpers, hardwired and programmed, must be maintained in a log book. Entries shall include:
   a. Name of person placing the jumper.
   b. Date of installation.
   c. Reason for installation.
   d. Approval of OWNER and ENGINEER.
   e. Date of removal.
   f. Name of person removing the jumper.

1.13 OWNER'S INSTRUCTIONS

A. Not applicable this Section.

1.14 MAINTENANCE

A. Extra Materials:
1. Not required this Section.

B. Maintenance Service:
1. Not required this Section.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Approved manufacturers are listed in the other electrical and instrument Specification Sections.

2.2 EXISTING PRODUCTS

A. Not applicable this Section.

2.3 MATERIALS

A. All materials are to be new and the manufacturer's most current model.

2.4 MANUFACTURED UNITS

A. Manufactured units are to be fully assembled and tested at the point of manufacture and delivered to the job site ready for installation and start-up.

B. Regulated DC power supplies for instrument loops shall be designed and arranged so that loss of one supply does not affect more than one instrument loop or system. Power supplies shall be suitable for an input voltage variation of ±10%, and the supply output shall be fused or short circuit protected. Output voltage regulation shall be as required by the instrumentation equipment being supplied. Multi-loop, or multi-system power supplies, will be acceptable if backup power supply units are provided which will automatically supply the load upon failure of the primary supply. The backup supply systems shall be designed so that either the primary or backup supply can be removed, repaired, and returned to service without disrupting the instrument system operation.

C. The power distribution from multi-loop supplies shall be selectively fused such that a fault in one instrument loop will be isolated from the other loops being fed from the same supply. Fuses shall be clearly labeled and located for easy access. Multi-loop supply systems shall be oversized for an additional 20% future load. Failure of a multi-loop supply shall be indicated on the respective instrument panel or enclosure.

2.5 EQUIPMENT

A. All equipment is to be new and the manufacturers most current model. All instruments and control devices and assemblies shall be standard devices constructed of corrosion-resistant materials enclosed in a water and dust proof case and mounted as specified in the individual application. Enclosures shall be manufacturer's standard color unless specified otherwise.

2.6 COMPONENTS

A. Not applicable this Section.

2.7 ACCESSORIES

A. Not applicable this Section.

2.8 MIXES

A. Not applicable this Section.

2.9 FABRICATION

A. Shop Assembly:
   1. Fabricate assemblies in accordance with approved Drawings. Notify ENGINEER and OWNER at least five working days prior to start of testing so that they may witness the testing if they choose to do so.

2.10 FINISHES

A. General:
   1. Finishes for all components, equipment, and fabricated assemblies must take into account the environment in which they will be installed. NEMA ratings must be appropriate for the environment. Ratings for corrosive areas must be NEMA 4X 316SS, for outdoor or wet areas NEMA 4X 316SS, indoor areas may be NEMA 12.

B. Shop Finishing:
   1. Where called for in other sections, sandblast, prime, and paint assemblies.

2.11 SOURCE QUALITY CONTROL

A. Fabrication/Tolerances:
   1. In accordance with generally accepted manufacturing standards.

B. Tests, Inspections:
   1. In accordance with generally accepted manufacturing standards.

C. Verification of Performance:
   1. Not applicable this Section.

PART 3 - EXECUTION

3.1 ACCEPTABLE INSTALLERS

A. CONTRACTORS having a minimum five years experience in the design, procurement, and construction of industrial water/wastewater instrumentation and control systems.

3.2 EXAMINATION

A. Site Verification of Conditions:
   1. Visit job site and ascertain any environmental or physical conditions which may affect the performance of the Work or the equipment requirements.

3.3 PREPARATION

A. Protection:
   1. Not applicable this Section.

B. Surface Preparation:
   1. Not applicable this Section.

3.4 ERECTION

A. Provide 4-inch tall reinforced concrete housekeeping pads for all control panels and floor-mounted fabricated control assemblies and consoles. Dowel into concrete base and extend a minimum of 2-inches past edges of equipment.

B. Provide Unistrut or fabricated structural supports, to match the environment, for heavy equipment or assemblies. Prime and paint supports so that they are unaffected by the environment in which they are installed.

C. Securely fasten all panels and assemblies to their housekeeping pads or structural supports.

D. All interconnecting wiring shall be run in conduit in accordance with the Division 16, Electrical, Sections requirements.

3.5 INSTALLATION

A. Install all instruments and controls in accordance with manufacturer's recommendations and all applicable electrical codes and standards. Connect all required utilities including electrical power, air, hydraulics, etc.

B. Provide stainless steel tags for each instrument engraved with instrument tag number. Attach to instrument with stainless steel wire.

C. Provide engraved nameplates for all panel-mounted instruments. Attach to panel with stainless steel screws.

3.6 APPLICATION

A. Not applicable this Section.

3.7 CONSTRUCTION

A. Special Techniques:

B. In accordance with manufacturers recommended installation procedure.

C. Interface with Other Work:

D. Coordinate with all other trades.

E. Sequences of Operation:

F. Not applicable this Section.

G. Site Tolerances:
   1. Not applicable this Section.

3.8 REPAIR/RESTORATION

A. Repair any damages caused by the installation or erection to original condition.

3.9 INSTALLATION

A. Not applicable this Section.

3.10 FIELD QUALITY CONTROL

A. Site Tests:
   1. Test and calibrate instrumentation in accordance with other parts of this Section.

B. Inspection:
   1. Not required this Section.

C. Manufacturer's Field Services:
   1. If recommended by manufacturer, have equipment/control systems inspected, tested, and started up by manufacturer's representative.

3.11 ADJUSTING

A. Not required this Section.

3.12 CLEANING

A. Remove and dispose of construction debris daily. Wipe down and vacuum out all enclosures.

3.13 DEMONSTRATION/TRAINING

A. In accordance with the Start-up part of this Section.

B. Provide training of personnel in the operation and maintenance of the furnished control systems.

C. Training shall be provided as required elsewhere in the Contract Documents, but shall consist of at least eight hours, in a single, or multiple sessions, to accommodate the personnel schedules.

D. Coordinate with the ENGINEER, and the OWNER, to schedule the training sessions at least five workings days in advance.

3.14 PROTECTION

A. Protect instrumentation and control equipment from environmental damage and from damage by other trades.

3.15 SCHEDULES

A. Not applicable this Section.

++ END OF SECTION ++

SECTION 17111

FLOAT SWITCHES

PART 1 - GENERAL

1.1 SCOPE

A. This Section includes furnishing all float switches as indicated on the Drawings and specified herein.

B. Related work specified elsewhere includes, but is not limited to, Section 16000, General Electrical Requirements. Also refer to requirements of Contract Documents for testing, adjusting, and balancing of systems.

1.2 QUALITY ASSURANCE

A. Equipment to be furnished under this Section shall be the product of firms regularly engaged in the design and manufacture of this type of equipment. Manufacturer shall assume responsibility for, and guarantee performance of equipment furnished. However, this shall not be construed as relieving the CONTRACTOR from responsibility for the proper installation and functioning of the Work.

1.3 SUBMITTALS

A. The following material shall be submitted to the ENGINEER prior to installation, in accordance with Section 16000, General Electrical Requirements, and as required elsewhere in the Contract Documents:
   1. Where applicable, provide complete manufacturer's part number, identifying scaling, operating range, housing and wetted parts materials, NEMA rating, product options, consumable materials, and other pertinent information.
   2. Prior to Final Acceptance of the Work, the CONTRACTOR shall provide Operations and Maintenance Manuals, in accordance with the Contract Documents.

B. Shop Drawings: Submit for approval the following:
   1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The

ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

2. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**
3. Submit complete Operation and Maintenance Manuals in conformance with the Operation and Maintenance Manuals section of Section 01300, Submittals.

PART 2 - PRODUCTS

2.1 BALL TYPE FLOAT WITH INTEGRAL SNAP SWITCH AND ATTACHED CABLE

A. Float switch shall be direct acting and consist of a 316 type stainless steel housing, mounting clamp, a flexible three-conductor cable with a synthetic rubber jacket and a magnetic reed switch. The float housing shall be a sphere of at least 4-1/2-inches in diameter.

B. The magnetic reed switch shall be embedded in a metal housing inside the float. The cable shall be 3/C #14, SO Type with 105 strands per conductor, made specifically for underwater use and heavy flexing service.

C. The magnetic reed switch shall be connected to two of the three conductors of the cable. The third conductor shall be an internal ground and shall be colored green. The switch shall have a 20 ampere rating at 115 volts AC.

D. An additional synthetic rubber jacket shall act as a hinge between the float and where the cable is held by the stationary clamp. This clamp shall be stainless steel with an adapting fitting and two yokes for mounting on a vertical 1-inch pipe.

E. A liquid rise of 1-inch from the reset position shall operate the float switch, and reset shall occur when the liquid level drops to 1-inch. Operating temperature shall be 0° F to +180° F.

F. Weight and buoyancy shall be such that contaminants like a cake of grease will not result in the float switch changing operating level more than 1-inch.

G. A Stainless Steel, NEMA 4X 316SS junction box shall be supplied for termination of the float cable(s), to allow conventional wiring and conduit to be run from the junction box to a control panel. It shall have terminal blocks for the required number of circuits and shall accept sealed fittings furnished with the float switch.

H. Float switches shall be as manufactured by US Filter Model 9G, Flygt Model ENM-10, or equal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Equipment and materials specified in this Section shall be installed and connected as specified and as shown on the Drawings. CONTRACTOR shall coordinate with Mechanical Engineer and Structural Engineer for optimum location of float switches.

3.2 ACCEPTANCE

A. Prior to Final Acceptance of the Work, the CONTRACTOR shall certify the equipment and installation included under this Section to be free of defects, and suitable for trouble-free operation under the conditions set forth in these Specifications.

++ END OF SECTION ++

SECTION 17120

PRESSURE TRANSMITTERS

PART 1 - GENERAL

1.1 SCOPE

A. This Section includes furnishing pressure transmitters as shown on the Drawings and specified herein.

B. Related Work specified elsewhere includes, but is not limited to Section 16000, General Electrical Requirements. Also refer to requirements of Contract Documents for testing, adjusting, and balancing of systems.

1.2 QUALITY ASSURANCE

A. Equipment to be furnished under this Section shall be the product of firms regularly engaged in the design and manufacture of this type of equipment. Manufacturer shall assume responsibility for, and guarantee performance of equipment furnished. However, this shall not be construed as relieving the CONTRACTOR from responsibility for the proper installation and functioning of the Work.

1.3 SUBMITTALS

A. The following material shall be submitted to the ENGINEER prior to installation, in accordance with Section 16000, General Electrical Requirements, and as required elsewhere in the Contract Documents:
   1. Where applicable, provide complete manufacturer's part number, identifying scaling, operating range, housing and wetted parts materials, NEMA rating, product options, consumable materials, and other pertinent information.
   2. Prior to Final Acceptance of the Work, the CONTRACTOR shall provide Operations and Maintenance Manuals, in accordance with the Contract Documents.

B. Shop Drawings: Submit for approval the following:
   1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The

ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

2. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**
3. Submit complete Operation and Maintenance Manuals in conformance with the Operation and Maintenance Manuals section of Section 01300, Submittals

1.4 MANUFACTURERS

A. Rosemount model 3051.

B. Or Engineer approved equal.

PART 2 - PRODUCTS

2.1 PRESSURE TRANSMITTER

A. Provide pressure transmitters with 1/2-inch NPT process connection, block and bleed valve, and local LCD indicator scaled in engineering units.

B. Transmitters shall be of a two-wire (loop-powered) type producing a 4 mA to 20 mA output proportional to the calibrated pressure range of the instrument. Transmitters shall be capable of driving a 500 ohm loop load.

C. Instrument accuracy shall be within plus or minus 0.5% of span, and 0.2% repeatability. Dead band shall be within 0.1 percent of span.

D. Transmitters shall have external zero and span adjustment for field calibration. Instrument enclosure shall be NEMA 4, with 316 stainless steel wetted parts.

E. Diaphragm seals shall be manufactured by Ashcroft, or equal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Equipment and materials specified in this Section shall be installed, connected, and tested in accordance with the manufacturers' recommendations, and as shown on the Drawings. CONTRACTOR shall coordinate with other trades to insure proper connection to piping and other mechanical equipment.

3.2 ACCEPTANCE

A. Prior to Final Acceptance of the Work, the CONTRACTOR shall certify the equipment and installation included under this Section to be free of defects, and suitable for trouble-free operation.

++ END OF SECTION ++

SECTION 17121

PRESSURE SWITCHES AND GAUGES

PART 1 - GENERAL

1.1 SCOPE

A. This section covers pressure switches and differential pressure switches as shown on the Drawings.

B. Related Work specified elsewhere includes, but is not limited to Section 16000, General Electrical Requirements. Also refer to requirements of General Conditions for testing, adjusting, and balancing of systems.

1.2 QUALITY ASSURANCE

A. Equipment to be furnished under this Section shall be the product of firms regularly engaged in the design and manufacture of this type of equipment. Manufacturer shall assume responsibility for and guarantee performance of the equipment furnished. However, this shall not be construed as relieving the CONTRACTOR from responsibility for the proper installation and functioning of the equipment.

B. Reference standards shall be the latest edition, including addenda, supplements, and revision. Applicable reference publications include the following:
   1. NEC.
   2. NEMA.

1.3 SUBMITTALS

A. Submit product information cut sheets containing manufacturer's specifications, operations and maintenance data, instrument enclosure type, installation location, and process pressure range to be supplied. Indicate product part number in full.

B. Provide Submittals in accordance with Section 16000, General Electrical Requirements, and elsewhere in the Contract Documents.

C. Shop Drawings: Submit for approval the following:
   1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a

number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

2. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**
3. Submit complete Operation and Maintenance Manuals in conformance with the Operation and Maintenance Manuals section of Section 01300, Submittals.

PART 2 - PRODUCTS

2.1 PRESSURE SWITCHES

A. Pressure switches shall be capable of dual control with independent setpoints and adjustable deadbands. Differential pressure switches shall be capable of single control with adjustable setpoints and adjustable deadband. Switches shall be snap action, single-pole, double-throw switching elements with an electrical rating of at least 10 amperes at 120 VAC. Pressure switches shall be enclosed in a NEMA 4 or weatherproof housing.

B. Operating pressures and setpoints shall be determined in the field, unless otherwise indicated on the Drawings.

C. Setpoints shall be fully adjustable and shall be in the middle of the working range. Setpoint adjustments shall be made with adjustment screws or thumbwheels. Accuracy shall be ±1% of adjustable range.

D. For pressures up to 150 psig pressure sensing element shall be of the diaphragm or bourdon tube type, and shall have a proof pressure of at least twice the maximum working pressure. For pressures above 150 psig, sensing element shall be bourdon tube type. Diaphragms or bourdon tubes shall be stainless steel.

E. Pressure switches shall be installed with individual ball valves for isolation. Valve material shall be compatible with the process piping and process fluid. In

addition, process piping up to the sensor shall be insulated to protect against freezing.

F. Pressure switches shall be as manufactured by:
   1. Mercoid, DA/DS Series.
   2. Ashcroft.
   3. Barton.

G. Differential pressure switches shall be as manufactured by Mercoid Controls, Series DPAW.

H. Diaphragm seals shall be manufactured by Mercoid.

2.2 PRESSURE GAUGE

A. Manufacturer: One of the following or equal:
   1. Ashcroft.
   2. Wika.

B. Gauge Properties:
   1. Pressure gauges shall be a direct reading mechanical type indicator with a nominal 6-inch diameter dial engraved over a 270 degree arc.
   2. Gauge scale range shall be 0 to 200 with scale units in (psi) and shall be engraved on the scale face. Scale will have 2 psi graduations.
   3. The gauge indicator housing shall be oil-filled.
   4. The indicator shall have a weatherproof housing with a Type 316 stainless steel body.
   5. Accuracy of the indicator shall be 1.0 percent of full scale.
   6. Process connection: 1/2-inch NPT.

C. Diaphragm seals shall be manufactured by gauge manufacturer as indicated in the drawing set.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Equipment and materials specified in this Section shall be installed and connected as specified and shown on the drawings. CONTRACTOR shall coordinate with Mechanical Engineer and Piping Engineer to insure proper connection to piping and/or other mechanical equipment.

3.2 ACCEPTANCE

A. As a condition precedent to Final Acceptance of the Work, the CONTRACTOR shall certify the equipment and installation included under this section to be free

of defects, and suitable for trouble-free operation under the conditions set forth in these Specifications. This requirement is in addition to the manufacturer's guarantee.

++ END OF SECTION ++

SECTION 17124

SUBMERSIBLE LEVEL TRANSMITTER

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. This section covers the Submersible Level Transmitters to be provided where indicated on the Drawings.

B. Related work specified elsewhere includes, but is not limited to Section 16000, General Electrical Requirements. Also, refer to requirements of General Conditions for testing, adjusting and balancing of systems.

1.2 QUALITY

A. Equipment to be furnished under this section shall be the products of companies regularly engaged in the design and manufacture of this type of equipment. Manufacturers shall assume responsibility for, and guarantee performance of, equipment furnished. However, this shall not be construed as relieving the Contractor from their responsibility for the proper installation and functioning of the equipment.

B. Reference standards. Standards shall be the latest edition, including addenda, supplements, and revision. Applicable reference publications include the following:
   1. NEC.
   2. NEMA.

1.3 SUBMITTALS

A. Submit product information cut sheets containing manufacturer's specifications, Operations and Maintenance data, instrument enclosure type, installation location, and process pressure range to be supplied. Indicate product part number in full.

B. Provide submittals in accordance with Section 16000, and elsewhere in the Contract Documents.

C. Shop Drawings: Submit for approval the following:
   1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by

the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

2. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**
3. Submit complete Operation and Maintenance Manuals in conformance with the Operation and Maintenance Manuals section of Section 01300, Submittals.

PART 2 - PRODUCTS

2.1 SUBMERSIBLE LEVEL TRANSMITTER

A. The submersible level transmitter system shall be designed for total submersion, and shall have the following features:
   1. Accuracy of +/-0.1% of full scale.
   2. Titanium construction.
   3. Two-wire, 4 mA output at zero pressure, 20 mA output at full range pressure.
   4. Operating pressure ranges from 1 psi to 900 psi, as required by the application.
   5. Overpressure rating shall be 4 times the operating pressure range from 1 to 5 psi, and 2 times the range for 10 psi and above.
   6. Pressure transducer shall be of the integrated silicon strain gauge bridge type.
   7. Transmitter supply voltage shall be 9-30 VDC.
   8. Operating temperature shall be -20 to +60 degrees C.
   9. Transmitter shall be provided with sufficient cable length to reach terminations point shown on the Drawings.

B. Submersible level transmitter shall be Druck Inc., model PTX 1830, or equal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Equipment and materials specified in this section shall be installed and connected as specified, and as shown on the Drawings. The Contractor shall coordinate the installation with the other trades, to insure proper installation of the transmitter, and associated conduit and cables.

B. The instrument shall be factory calibrated to the proper ranges, as required by the Owner and the Engineer. Where analog signals are connected to local, or remote monitoring equipment, the Contractor shall verify that the calibrated ranges and scaling of the local and remote indicators are correct.

3.2 ACCEPTANCE

A. Prior to final acceptance of the work, the Contractor shall certify the equipment and installation included under this section to be free of defects, and suitable for trouble-free operation under the conditions set forth in these specifications. This requirement is in addition to the manufacturer's guarantee.

++ END OF SECTION ++

SECTION 17134

FLOW SWITCHES

PART 1 - GENERAL

1.1 SCOPE

A. This Section covers flow switches to be furnished as indicated on the Drawings.

1.2 QUALITY ASSURANCE

A. Equipment to be furnished under this Section shall be the product of firms regularly engaged in the design and manufacture of this type of equipment. Manufacturer shall assume responsibility for, and guarantee performance, of equipment furnished. However, this shall not be construed as relieving the CONTRACTOR from their responsibility for the proper installation and functioning of the Work.

1.3 SUBMITTALS

A. The following material shall be submitted to the ENGINEER in accordance with the Contract Documents, and Section 16000, General Electrical Requirements.

B. Shop Drawings: Submit for approval the following:
   1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
   2. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE**

WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.

PART 2 - PRODUCTS

2.1 FLOW SWITCHES

A. Flow switches for pump discharge monitoring shall be thermal dispersion type, made of stainless steel, and shall give a no-flow signal when the flow drops below the set actuating flow rate. The flow switch enclosure shall meet NEMA 4 Standards. The switch contact output shall be SPDT rated at 4 amps. Flow switches shall be by Magnetrol or equal.

B. Eyewash and shower flow switches shall be stainless steel, installed in the potable waterline, and shall indicate eyewash or shower operation.

C. Flow switches for pump seal water lines shall activate at 0.04 gpm to provide an indication of seal water flow to the pump. The housing of the switch body shall be stainless steel, and shall be leakproof. The switch shall allow for a mechanism to set the trip point of the switch. Pipe connections shall be 1/4-inch NPT. Flow switch shall be Fluid Components International FS10A, or equal.

D. Flow switches for foul air shall be marked with a flow arrow indicating the necessary orientation in the duct, and switch DPDT contacts when the foul air flow rate is below 1500 feet per minute (requiring the full length vane). The flow switch wetted components must be stainless steel. The body will have a 1½" MNPT thread to install into a female coupling. The female coupling will be:
   1. Inserted in the duct in such a way that the full flow switch vane is visible within the ID of the duct, and
   2. The coupling will be located where the flow is horizontal, and
   3. The flow switch will be vertical within 5°.
   4. The flow switch shall be UL listed for Class I Group D, explosion proof. The flow switch shall be Dwyer/Anderson Flotect® model V4-SS-2-U-D, or equal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Equipment and materials specified in this Section shall be installed as shown on Drawings.

3.2 GUARANTEE

A. CONTRACTOR shall fully guarantee all Work under this Section for a period of one year from date of Final Acceptance by the OWNER against faulty workmanship and failure or malfunction of materials and/or equipment due to faulty or imperfect workmanship. This guarantee shall be given in writing to the OWNER at the time of issuing final certificate. Work, materials, or equipment found to be defective within this period shall be replaced without cost to the OWNER.

3.3 ACCEPTANCE

A. As a condition precedent to Final Acceptance of the Work, the CONTRACTOR shall certify the equipment and installation included under this Section to be free of defects, and suitable for trouble-free operation under the conditions set forth in these Specifications. This requirement is in addition to the manufacturer's guarantee.

++ END OF SECTION ++

SECTION 17137

MAGNETIC FLOW METERS

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. This Section covers the magnetic flow meters to be provided where indicated on the Drawings. The flow meters shall consist of two parts with manufacturer supplied interconnecting wiring, the field installed flow element and the flow indicating transmitter.

B. Related Work specified elsewhere includes, but is not limited to Section 16000, General Electrical Requirements. Also, refer to requirements of Contract Documents for testing, adjusting, and balancing of systems.

1.2 QUALITY ASSURANCE

A. Equipment to be furnished under this Section shall be the product of firms regularly engaged in the design and manufacture of this type of equipment. Manufacturer shall assume responsibility for, and guarantee performance of equipment furnished. However, this shall not be construed as relieving the CONTRACTOR from responsibility for the proper installation and functioning of the Work.

1.3 SUBMITTALS

A. The following material shall be submitted to the ENGINEER prior to installation, in accordance with Section 16000, General Electrical Requirements, and as required elsewhere in the Contract Documents:
   1. Where applicable, provide complete manufacturer's part number, identifying scaling, operating range, housing and wetted parts materials, NEMA rating, product options, consumable materials, and other pertinent information.
   2. Prior to Final Acceptance of the Work, the CONTRACTOR shall provide Operations and Maintenance Manuals, in accordance with the Contract Documents.

B. Shop Drawings: Submit for approval the following:
   1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a

number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

2. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**
3. Submit complete Operation and Maintenance Manuals in conformance with the Operation and Maintenance Manuals section of Section 01300, Submittals.

PART 2 - PRODUCTS

2.1 MAGNETIC FLOW METERS

A. Acceptable Manufacturers (Manufacturers listed in alphabetical order):
   1. Endress+Hauser model Pro-Mag W 400
   2. Toshiba LF654
   3. Krohne

B. Materials:
   1. All mounting hardware shall be 316 stainless steel, the instrument enclosure shall be rated NEMA 4X, the flow sensor liner shall be polyurethane lined, and the electrode material shall be 316 stainless steel.

C. Design and Fabrication:
   1. Utilize characterized field principle of electromagnetic induction to produce signal directly proportional to flow rate.
   2. Provide flanged end connections, per ANSI B16, rated for piping system operating and test conditions.
   3. Operating Pressure: 100 psi.
   4. Operating Temperature: 122° F.
   5. Grounding Requirements:
      a. Non-metallic or Lined Pipe:
         1) Inlet and outlet grounding rings of same material as electrode.
      b. Conductive Piping:
         1) Conductive path between the meter and the piping flanges.

6. Provide cable between magnetic flow meter and transmitter.
7. Pulsed DC magnetic field excitation.
8. Automatic zero.
9. Adjustable low flow cutoff.
10. 16-character alphanumeric display shall indicate user-defined flow units and total flow. All menu advice and commands shall be viewed on this display.
11. Minimum signal lock (empty tube zero) to prevent false measurement when tube is empty.
12. Accuracy:
    a. ±0.5%of rate above 1 fps.
    b. ±0.01 fps below 1.0 fps.
    c. 4mA to 20 mA DC isolated output into maximum 800 ohms.
    d. Scaled frequency output, 24 VDC.
    e. Power supply: 117 V ±10%, 60 HZ.
    f. Meter operable as specified in liquids with 5.0 micro-ohm/cm or more conductivity.
13. Electrodes shall be self-cleaning.

2.2 MAGNETIC FLOW METERS FOR CHEMICAL SERVICE

A. Acceptable Manufacturers:
   1. Endress+Hauser model Pro-Mag 53H.

B. Design and Fabrication:
   1. The metering tube sensors shall be of the proper sizes to measure the design flow rate of the piping and shall be noted in the instrument schedule.
   2. Materials:
      a. Seals, Orings and Flange gaskets: Viton.
      b. Tube: Stainless steel with PFA liner.
      c. Electrodes: The two measuring electrodes and empty pipe electrode shall be constructed of a material compatible with the measured fluid.
      d. 50% Citric Acid: Tantalum.
      e. 12.5% Sodium Hypochlorite: Platinum.
      f. Grounding rings: Inlet and outlet, same as electrodes.
      g. Housing: Aluminum housing shall enclose the coil assemblies and internal wiring.
      h. Process connections: PVDF flanges, rated NEMA 4X.
      i. Transmitter housing: Powder coated cast aluminum with NEMA 4X rating.

C. Electrodes:
   1. Meters 5/16 inches diameter and larger shall have a third electrode of the same material to serve as an empty pipe detector.
   2. The electrode circuit shall have a minimum impedance of 1012 ohms to overcome moderate coating buildup.

D. Transmitter:
   1. The transmitter shall be a microprocessor controller mounted remotely.
   2. The flowmeter shall have a backlit LCD display used for programming as well as for simultaneous display of flow rate and total flow in user selectable engineering units, and readout of diagnostic error messages.
   3. All programming parameters shall be access-code protected
   4. The electronics shall include infinitely adjustable low flow cutoff.
   5. The power supply to the transmitter shall be 117 V ±10%, 60 Hz.
   6. Upon any power failure, the unit shall retain all setup parameters and accumulated measurements internally in non-volatile memory. All units shall be protected against voltage spikes from the power source with internal transient protection.
   7. The transmitter shall output a scaled 4 to 20 mA DC directly proportional to flow rate plus a scaled 24 VDC pulse or open collector frequency output. The analog output shall include an adjustable low flow cutoff.
   8. The transmitter shall have an algorithm which recognizes pulsating flows from chemical metering pumps and allows for precise measurement of these irregular flow rates.

E. Accessories:
   1. Grounding:
      a. Tantalum electrodes: Provide inlet and outlet grounding rings.
      b. Platinum electrodes: Provide grounding pins.
   2. Provide a stainless steel tag labeled with the instrument tag number.
   3. Provide a standard hand-held HART communicator with the current device drivers for every ten flow meters provided, with a minimum of two.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Equipment and materials specified in this Section shall be installed and connected as specified, and as shown on the Drawings. The CONTRACTOR shall coordinate the installation with the other trades, to insure proper installation of the flow element, transmitter, and associated conduit and cables.

B. The CONTRACTOR shall calibrate the instruments to the proper ranges, as required by the OWNER and the ENGINEER. Where analog signals are connected to local, or remote monitoring equipment, the CONTRACTOR shall verify that the calibrated ranges and scaling of the local and remote indicators are correct.

3.2 ACCEPTANCE

A. Prior to Final Acceptance of the Work, the CONTRACTOR shall certify the equipment and installation included under this Section to be free of defects, and

suitable for trouble-free operation under the conditions set forth in these Specifications. This requirement is in addition to the manufacturer's guarantee.

3.3 SPARE PARTS

A. Provide the OWNER with a list of the manufacturers' recommended spare parts.

++ END OF SECTION ++

SECTION 17150

LIMIT AND POSITION SWITCHES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Position and proximity switches used to monitor equipment status and to detect security intrusion.

B. Related Sections:
   1. Other Division 16 Sections.
   2. General Conditions for testing, adjusting, and balancing of systems.

1.2 SYSTEM DESCRIPTION

1.3 SUBMITTALS

A. In accordance with Section 16000, General Electrical Requirements, and elsewhere in the Contract Documents.

B. Product Data:
   1. Product information brochures, catalog cut sheets, other product literature containing manufacturer's Specifications, sizes, ratings, enclosure type and details, conditions-of-use, and fully developed part numbers.

C. Reference standards shall be the latest edition, including addenda, supplements, and revision. Applicable reference publications include the following:
   1. NEC.
   2. NEMA.

D. Quality Assurance/Control:
   1. Manufacturers' instructions for use.

E. Shop Drawings: Submit for approval the following:
   1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The

ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

2. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**

1.4 QUALITY ASSURANCE

A. Manufacturer must be regularly engaged in the design and manufacture of this type of equipment and shall assume responsibility for and guarantee performance of the equipment furnished. However, this shall not be construed as relieving the CONTRACTOR from responsibility for the proper installation and functioning of the equipment.

PART 2 - PRODUCTS

2.1 MANUFACTURER'S (LIMIT SWITCHES)

A. Cutler-Hammer / Eaton.

B. Square D.

C. General Electric.

D. Honeywell – Microswitch.

E. Allen-Bradley.

2.2 MANUFACTURER'S (INTRUSION SWITCHES)

A. General Electric Sentrol Series 181 Guardswitch.

B. General Electric High Security 2700 series.

2.3 GENERAL

A. Heavy duty, industrial grade units with NEMA rated housings compatible with installation location and environmental conditions. Enclosures to be NEMA 4X unless noted otherwise or provided as part of a packaged system.

B. Electrical contact sets configured as shown on drawings and rated for 5 amps at 250 volts minimum. Electrical connections maximum No. 12 AWG copper wire, and 1/2-inch conduit.

C. Sensing elements must have provisions for field mechanical adjustment.

2.4 LIMIT SWITCHES, GENERAL

A. Combination switch housing and position sensing lever coordinated with mechanical equipment whose position is to be sensed. Lever sensing arm to be rated for 10,000 mechanical operations.

2.5 LIMIT SWITCHES, PROXIMITY

A. Integrated capacitive or inductive proximity sensing unit and switch housing. Coordinate sensing distance with mechanical equipment whose position is being sensed. Provide with adjustable mounting bracket compatible with the switch housing and environmental conditions.

2.6 LIMIT SWITCHES, PHOTO-ELECTRIC

A. Combination switch housing with photo-electric sensor and separate photo-electric emitter or photo-electric reflective unit. Coordinate sensor style, beam intensity, and wavelength with mechanical equipment whose position is being sensed. Unit must operate reliably under all ambient light conditions. Power supply and contact ratings as shown on Drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install and connect as specified and shown on the Drawings.

B. Adjust position sensing elements for reliable and repeatable operation.

C. Coordinate with Mechanical Engineer and other trades to insure proper connection to mechanical or other equipment.

3.2 ACCEPTANCE

A. Certify the equipment and installation included under this Section to be free of defects, and suitable for trouble-free operation under the conditions set forth in these Specifications. This requirement is in addition to the manufacturer's guarantee.

++ END OF SECTION ++

SECTION 17221

ELECTRONIC 4-20MA INDICATORS

PART 1 - GENERAL

1.1 SCOPE

A. This Section covers digital panel meters, and other types of 4mA to 20mA DC analog indicators indicated on the Drawings.

B. Related Work specified elsewhere includes, but is not limited to Section 16000, General Electrical Requirements. Also refer to requirements of General Conditions for testing, adjusting, and balancing of systems.

1.2 QUALITY ASSURANCE

A. Equipment to be furnished under this Section shall be the product of firms regularly engaged in the design and manufacture of this type of equipment. Manufacturer shall assume responsibility for, and guarantee performance of equipment furnished. However, this shall not be construed as relieving the CONTRACTOR from responsibility for the proper installation and functioning of the equipment.

B. Reference Standards: Standards shall be the latest edition, including addenda, supplements, and revision. Applicable reference publications include the following:
   1. NEC.
   2. NEMA.

1.3 SUBMITTALS

A. Submit product information cut sheets containing manufacturer's specifications, operations and maintenance data, instrument enclosure type, installation location, and process pressure range to be supplied. Indicate product part number in full.

B. Provide Submittals in accordance with Section 16000, General Electrical Requirements, and elsewhere in the Contract Documents.

C. Shop Drawings: Submit for approval the following:
   1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by

the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

2. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**
3. Submit complete Operation and Maintenance Manuals in conformance with the Operation and Maintenance Manuals section of Section 01300, Submittals.

PART 2 - PRODUCTS

2.1 ELECTRONIC 4-20mA INDICATORS

A. Digital indicators shall be designed for semi-flush mounting in a panel. The display shall be a 3-1/2 digit LCD type with digit height of not less than 0.35 inches. The display shall be easily read from a distance of 10 feet, in varying lighting environments. Operating temperature range shall be 0° C to 50° C.

B. The indicator shall have a differential type ungrounded input screw terminal connector. Accuracy shall be ±0.5%. The indicators shall include user selectable scale and offset factors, which allow operators to scale and offset displayed measurement for conversion to desired units of measurement. The display shall be scaled in engineering units with the units shown on the display face, or engraved on the associated nameplate. The display shall have a movable decimal point, and shall provide over-range indication.

C. Indicator shall be calibrated from the front panel, using zero and span potentiometers. Decimal place position shall be set from DIP switches. Indicators shall be Action Instruments, Red Lion, Newport, or equal, and shall be powered by 120VAC, or 24VDC, as shown on the Drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Equipment and materials specified in this Section shall be installed, connected, and tested in accordance with the manufacturers Specifications, and as indicated on the Drawings.

3.2 ACCEPTANCE

A. Prior to Final Acceptance, the CONTRACTOR shall certify the equipment and installation included under this Section to be free of defects, and suitable for trouble-free operation.

++ END OF SECTION ++

SECTION 17222

SIGNAL CONDITIONERS

PART 1 - GENERAL

1.1 SCOPE

A. This Section contains Specifications for analog (4mA to 20mA DC) signal conditions, used for loop isolation, protection, and switching. Refer to the Drawings and provide the devices as indicated.

B. Related Work specified elsewhere includes, but is not limited to Section 16000, General Electrical Requirements. Also refer to requirements of General Conditions for testing, adjusting, and balancing of systems.

1.2 QUALITY ASSURANCE

A. Equipment to be furnished under this Section shall be the product of firms regularly engaged in the design and manufacture of this type of equipment. Manufacturer shall assume responsibility for, and guarantee performance of equipment furnished. However, this shall not be construed as relieving the CONTRACTOR from responsibility for the proper installation and functioning of the Work.

1.3 SUBMITTALS

A. The following material shall be submitted to the ENGINEER prior to installation, in accordance with Section 16000, General Electrical Requirements, and as required elsewhere in the Contract Documents:
   1. Where applicable, provide complete manufacturer's part number, identifying scaling, operating range, housing and wetted parts materials, NEMA rating, product options, consumable materials, and other pertinent information.
   2. Prior to Final Acceptance of the Work, the CONTRACTOR shall provide Operations and Maintenance Manuals, in accordance with the Contract Documents.

B. Shop Drawings: Submit for approval the following:
   1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of

requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

2. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**
3. Submit complete Operation and Maintenance Manuals in conformance with the Operation and Maintenance Manuals section of Section 01300, Submittals.

1.4 MANUFACTURERS

A. Moore Industries.

B. Phoenix Contact.

C. Measurement Technologies Ltd.

D. Action Instruments, Inc.

E. Approved equal.

PART 2 - PRODUCTS

2.1 CURRENT-TO-CURRENT CONVERTER

A. Current-to-current converters shall provide electrical isolation between the input and output. Current-to-current converters shall be supplied where indicated on the Drawings, and wherever the circuit impedance exceeds the capability of a transmitter.

B. The converter shall receive a 4mA to 20mA DC analog current input signal and produce an identical 4mA to 20mA DC output signal into a 0 to 1,000 ohm load. Accuracy shall be ±0.1% of span. The converter shall be provided with an enclosure suitable for back of panel mounting.

C. Power requirements shall be 120VAC, or 24VDC, as indicated on the Drawings.

2.2 DUAL CHANNEL CURRENT ISOLATOR

A. Dual channel current isolators shall provide electrical isolation between the input and output. The instruments shall receive a 4mA to 20mA DC analog current input signal and produce two identical 4mA to 20mA DC output signals.

B. Each channel shall be fully isolated, and capable of driving a 0 to 650 ohm load. Accuracy shall be ±0.1% of span. The isolators shall be provided with an enclosure suitable for back of panel mounting.

C. Power requirements shall be 120VAC, or 24VDC, as indicated on the Drawings.

2.3 SET POINT RELAY

A. The set point relays shall be solid state devices, and shall provide dual output relay contact closures from a 4mA to 20mA DC input. Each relay shall be controlled by an adjustable set point from a 10-turn potentiometer.

B. The dual deadbands shall be adjustable from 0 to 100 percent. The output relay shall be DPDT with contacts rated 10 amps at 120 VAC. Accuracy and repeatability shall be within 0.1% of span.

C. The instruments shall be immune to humidity and line voltage regulation problems. Power requirements shall be 120VAC, or 24VDC. The unit shall be housed in a general purpose type housing suitable for subpanel mounting in a control panel enclosure.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Equipment and materials specified in this Section shall be installed and connected as specified, and as shown on the Drawings.

3.2 ACCEPTANCE

A. Prior to Final Acceptance of the Work, the CONTRACTOR shall certify the equipment and installation included under this Section to be free of defects, and suitable for trouble-free operation under the conditions set forth in these Specifications.

3.3 WARRANTY

A. The equipment listed in this Section shall have a seven year warranty from the manufacturer.

++ END OF SECTION ++

SECTION 17321

GAS DETECTION SYSTEM

PART 1 - GENERAL

1.1 SCOPE

A. This Section covers the gas monitoring equipment for personnel safety and combustible gas monitoring.

B. Refer to P&ID's for required installations and configurations of gas detection systems.

C. Related work specified elsewhere includes, but is not limited to Section 16000, General Electrical Requirements. Also refer to requirements of Contract Documents for testing, adjusting and balancing of systems.

1.2 QUALITY ASSURANCE

A. Equipment to be furnished under this Section shall be the product of firms regularly engaged in the design and manufacture of this type of equipment. Manufacturer shall assume responsibility for, and guarantee performance of equipment furnished. However, this shall not be construed as relieving the CONTRACTOR from responsibility for the proper installation and functioning of the Work.

1.3 SUBMITTALS

A. The following material shall be submitted to the ENGINEER prior to installation, in accordance with Section 16000, General Electrical Requirements, and as required elsewhere in the Contract Documents:
   1. Where applicable, provide complete manufacturer's part number, identifying scaling, operating range, housing and wetted parts materials, NEMA rating, product options, consumable materials, and other pertinent information.
   2. Provide a wiring diagram to show connections to power, relays and 4-20mA loops.
   3. Prior to Final Acceptance of the Work, the CONTRACTOR shall provide Operations and Maintenance Manuals, in accordance with the Contract Documents.

1.4 MANUFACTURERS

A. Gas Detection System shall be manufactured by MSA Ultima X5000 series, or equal.

PART 2 - PRODUCTS

2.1 GAS DETECTION SYSTEM

A. Provide a UL listed, intrinsically safe transmitter to be used for setting alarm levels, calibration, and for display of the minimum, maximum, and average gas values.

B. Transmitters, sampling modules, and all other manufacturer-provided electrical housings shall be constructed of stainless steel.

C. Furnish and install a sampling module where required to draw air sample into the analyzer sensor.

D. Transmitters shall be 24 VDC powered.

E. Transmitters and sensors shall be listed for Class 1, Division I, Group D atmospheres.

F. Transmitters shall be furnished with a relay module with three levels of alarm relay outputs along with a normally energized trouble relay.

G. Provide a NEMA 4X enclosure that includes 24VDC power supply for each transmitters, as well as control and alarm features as shown on the P&ID's.

H. The gas detector for monitoring combustible gas (methane/CH_4) shall utilize a Catalytic Bead measuring principle with a default range of 0-100%. A warning status shall be present at 4% and an alarm status at 4.4% (LEL).

I. The gas sensor for monitoring hydrogen sulfide (H_2S) shall utilize an Electrochemical measuring principle with a default range of 0-50ppm. A warning status shall be present at 10ppm and an alarm status at 15ppm.

J. The gas detector for monitoring oxygen (O_2) shall utilize an Electrochemical measuring principle with a default range of 0-25%. An alarm status shall be present at $\leq$19.5%.

K. Provide one calibration kit for each type of unique calibration. Provide a calibration gas cylinder for each gas, as well as a calibration reference gas cylinder.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Equipment and materials specified in this Section shall be installed, connected, and tested in accordance with the manufacturers' recommendations, and as shown on the Plans. CONTRACTOR shall coordinate with other trades to insure proper connection to piping and other mechanical equipment.

B. The CONTRACTOR shall calibrate the instruments to the proper ranges, as required by the OWNER and the ENGINEER. Where analog signals are connected to local, or remote monitoring equipment, the CONTRACTOR shall verify that the calibrated ranges and scaling of the local and remote indicators are correct.

3.2 ACCEPTANCE

A. Prior to Final Acceptance of the Work, the CONTRACTOR shall certify the equipment and installation included under this Section to be free of defects, and suitable for trouble-free operation.

++END OF SECTION++

SECTION 17325

TURBIDITY AND TSS ANALYZER

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Turbidity and suspended solids sensor for monitoring water and sludge concentrations and turbidity values.

1.2 MEASUREMENT PROCEDURES

A. The method of measuring turbidity and suspended solids will be with a dual-beam infrared/scattered light photometer. LED light source transmits light at 45 degrees to the sensor face.
   1. Nephelometric photoreceptors will detect scattered light at 90 degrees to the transmitted beam for turbidity.
   2. Back-scatter photoreceptors will detect scattered light at 140 degrees to the transmitted beam for suspended solids.

1.3 ALTERNATES

A. Other methods of turbidity and suspended solids measurement, such as four-beam or surface scatter methods, are not acceptable.

1.4 SYSTEM DESCRIPTION

A. Performance Requirements:
   1. Measurement range:
      a. Turbidity: 0.001 to 4000 NTU.
      b. Suspended solids: 0.001 mg/l to 50 g/L (ts-line or inline), or 0.001 mg/l to 500 g/L (hs line or highline).
   2. Accuracy:
      a. Turbidity: Less than 1% of reading or ±0.001 NTU, whichever is greater.
      b. Suspended solids: Less than 5% of reading (depends on homogeneity of municipal activated sludge).
   3. Repeatability:
      a. Turbidity: Less than 1% of reading.
      b. Suspended solids: Less than 3% of reading (depends on homogeneity of municipal activated sludge).
   4. Detection limit:
      a. Turbidity: 0.001 NTU.
      b. Suspended solids: 0.001 mg/L.
   5. Response time: Initial response 1 second.
   6. Signal Averaging Time: User selectable ranging from 1 to 300 seconds.
   7. Units of measure:

a. Turbidity: User Selectable NTU, FNU, EBC, FTU and TE/F.
b. Suspended Solids: User Selectable g/L, mg/L, ppm, or % solids.

1.5 CERTIFICATIONS

A. Safety: Listed by ETL to UL 61010A-1: Certified by ETL to CSA C22.2 No. 1010.1.

B. EMC Emissions & Immunity: CE certified to EN 61326-1/A1, /A2 & EN 61010-1/A1, /A2.

1.6 ENVIRONMENTAL REQUIREMENTS

A. Operational Criteria:
1. Sample flow velocity: 3 m/s (9.8 ft./s) maximum.
2. Sample pressure: 6 bar (87 psi) maximum.
3. Sample temperature: 0 to 40 degrees C.
4. Operating temperature: 0 to 40 degrees C.

1.7 WARRANTY

A. The product includes a one-year warranty from the date of shipment.

1.8 MAINTENANCE SERVICE

A. Scheduled maintenance:
1. Clean measurement windows: as experience dictates.
2. Change wiper blades: from 3 to 6 months (depending on the application).
3. Replace probe seals: every two years.

B. Unscheduled maintenance: Clean instrument enclosure.

C. Submit complete Operation and Maintenance Manuals in conformance with the Operation and Maintenance Manuals section of Section 01300, Submittals.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Hach Company, Loveland, CO.
1. Model SOLITAX ts-line SC Turbidity Sensor for immersion in open tanks.

2.2 MANUFACTURED UNIT

A. The SOLITAX Turbidity and Suspended Solids Sensor consists of a sensor contained in stainless steel or PVC, depending on model, with a silicon wiper blade and integral cable.

2.3 EQUIPMENT

A. The SOLITAX sensor is a digital sensor designed to connect to a universal controller (the sc100 or sc1000 controller, 120VAC rated).

B. The sensor provides sample color-independent measurement.

C. The sensor is equipped with a self-cleaning device to prevent erroneous values and maintenance problems caused by biological activity, scum build-up, and gas bubbles.

D. The signal average time for the sensor is user-selected from 1 to 300 seconds.

E. The sensor measures turbidity or turbidity and suspended solids (depending on the sensor).

F. The sensor must be serviceable.

G. The sensor is factory calibrated and needs no calibration prior to use. The sensor shall be capable of immersion in tank or insertion in pipe.

2.4 COMPONENTS

A. Standard equipment:
   1. Sensor with 33 ft. (10m) cable.
   2. Manual.

B. Dimensions:
   1. Models t-line sc, ts-line sc, and hs-line sc for immersion:
      a. Length: 7.87 inches (200 mm).
      b. Diameter: 2.36 inches high (60 mm).
   2. Models inline sc and highline sc for insertion:
      a. Length: 12.40 inches (315 mm).
      b. Diameter: 2.36 inches high (60 mm) C. Weight.
   3. Models inline sc and highline sc for insertion: 5.3 lb. (2.4 kg).
   4. Models t-line sc, ts-line sc, and hs-line sc for immersion:
      a. Stainless steel: 3.0 lb. (1.38 kg).
      b. PVC: 1.2 lb. (0.52 kg).

2.5 ACCESSORIES

A. Calibration kit.

B. Wiper blades.

C. Sun shield for controller.

D. Installation:

1. Fixed point installation kit for immersion.
2. Insertion mounting kit.
3. Sensor adapters.
4. Handrail mounting kit.

E. Extension cables.

PART 3 - EXECUTION

3.1 PREPARATION

A. Immersion sensors: Install the sensor with the optical window facing downstream in the direction of the flow to protect the sensor against the oncoming flow of large objects.

B. Insertion sensors:
   1. Pipe diameter: minimum 4 inches (100 mm) diameter in carbon or stainless steel.
   2. Install minimum 5 ft. (1.5 m) or three times the pipe diameter (whichever is greater) downstream of pumps, valves, or pipe elbows.

C. Locate the sensor 33 ft. (10 m) from the controller with the standard sensor cable. (Maximum distance between sensor and controller of 328 ft. (100 m) with optional extension cables.)

3.2 INSTALLATION

A. Contractor will install the analyzer in strict accordance with the manufacturer's instructions and recommendation.

B. Manufacturer's representative will include a half-day of start-up service by a factory-trained technician, if requested.
   1. Contractor will schedule a date and time for start-up.
   2. Contractor will require the following people to be present during the start-up procedure.
      a. General contractor.
      b. Electrical contractor.
      c. Hach Company factory trained representative.
      d. Owner's personnel.
      e. Engineer.

3.3 MANUFACTURER'S SERVICE AND START-UP

A. Contractor will include the manufacturer's services to perform start-up on instrument to include basic operational training and certification of performance of the instrument.

B. Contractor will include a manufacturer's Service Agreement that covers all the manufacturer's recommended preventative maintenance, regularly scheduled calibration and any necessary repairs beginning from the time of equipment startup through to end user acceptance / plant turnover and the first 12 months of end-user operation post turnover.

C. Items A and B are to be performed by manufacturer's factory-trained service personnel. Field service and factory repair by personnel not employed by the manufacturer is not allowed.

D. Use of manufacturer's service parts and reagents is required. Third-party parts and reagents are not approved for use.

++ END OF SECTION ++

SECTION 17452

PROGRAMMABLE LOGIC CONTROLLER SYSTEM

SOFTWARE AND ACCESSORIES

PART 1 - GENERAL

1.1 SCOPE

A. This Section includes furnishing all programmable logic controllers (PLCs) as indicated in related specifications and on the Drawings and specified herein.

B. Related Work specified elsewhere includes, but not limited to, Section 16000, General Electrical Requirements. Also, refer to requirements of Contract Documents for testing, adjusting, and balancing of systems.

1.2 QUALITY ASSURANCE

A. Equipment to be furnished under this Section shall be the product of firms regularly engaged in the design and manufacture of this type equipment. Manufacturer shall assume responsibility for, and guarantee performance of equipment furnished. However, this shall not be construed as relieving the CONTRACTOR from responsibility for the proper installation and functioning of the Work.

1.3 SUBMITTALS

A. Shop Drawings and Product Data: Include description of components, methods of connecting components, and the following:
   1. Hard copy of the programmable logic controller application program with full I/O documentation and explanation of conventions.
   2. Three copies of the programmable logic controller application program on CD-ROMS.
   3. System interconnection diagram drawing for PLCs, radios, antennas, Modbus Plus data highway, Ethernet data highway, and field instrumentation.
   4. Panel and enclosure plans, sections, and details.
   5. Access opening locations and required clearances for each panel and enclosure.
   6. Mounting plates and details for input and output chassis.
   7. Enclosure internal wiring and terminal blocks.
   8. Tabular Input and Output (I/O) Listing, Including the Following Data:
      a. Each I/O point, chassis number, module number, module I/O point number, name of I/O device.
      b. Instrumentation tag number of the I/O device in the Contract Documents.
      c. Electrical characteristics of the I/O signal.
      d. PLC internal address of each I/O.

9. Hard copies and machine-readable copies of PLC programs and personal computer graphics, reports, and database configuration.

B. Operating and Maintenance Manuals: Submit complete Operation and Maintenance Manuals in conformance with the Operation and Maintenance Manuals section of Section 01300, Submittals. Include the following:
   1. Programming procedures.
   2. Operations manuals.
   3. Maintenance and troubleshooting manuals.
   4. Spare parts manuals.
   5. Configuration manuals.
   6. List of service personnel contacts, including 24 hour service hot lines.

C. Shop Drawings: Submit for approval the following:
   1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
   2. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**

1.4 PLC DIAGNOSTICS

A. Configure the PLC programs and OI to monitor the diagnostic registers in the PLC. Create special diagnostic screens at the OI to display the status of these registers and provide alarms of a PLC diagnostic failure. The following diagnostic status words shall be monitored:
   1. Module status and module failures.
   2. Internal battery condition.
   3. Power supply status.

1.5 PLC APPLICATION PROGRAMMING SOFTWARE

A. Refer to the Contract Documents and P&IDs for the process control descriptions and functional requirements to be implemented using the following application software packages.
   1. Furnish and install complete packages of the latest version of Unity Pro programming software, using primarily Function Block Diagram (FBD) and provide HMI Graphic screens.
   2. PLC Programming:
      a. Submit two copies of the PLC programs for review, prior to installation. The programs shall be fully documented with unique symbol names for each program element (coils, contacts, inputs, outputs, etc.), and comments for every three rungs of logic. The rung comments shall clearly describe the function of the logic so that another programmer can understand the logic and be able to debug and modify the programs at a later date.
      b. Once the programs have been reviewed, comments and changes shall be incorporated into the programs and submitted for a final review. Upon final review of the programs, install the programs in the PLCs to test the control logic using simulated I/O.
      c. Provide instruction, maintenance manuals, and diagrams for supplied programs, device drivers, and custom designed subprograms and device drivers developed for this Project. Provide all materials in one or more three-ring binders. Separate sections by laminated numbered or descriptive tabs, with a table of contents to aid the user in finding specific information. Three-ring binders shall have labels on the spine identifying the contents of each volume.
      d. Submit a training schedule in accordance with these Specifications.
      e. Submittals shall be complete, neat, and orderly.
      f. Submit two CD-ROM copies of the PLC and OI software programming in their final configuration. Also submit all original software registered in the OWNER'S name, and all original documentation that accompanies the original software diskettes.
      g. All programming shall be coordinated with the OWNER, who will provide programming standards to be used.
      h. OWNER will provide graphic symbol library for use during graphic screen development.
      i. OWNER and programmer will hold programming kick-off meeting to coordinate scope and requirements.

1.6 ON-SITE TRAINING

A. Arrange for instruction of the OWNER'S designated personnel. The instruction shall commence within 30 days of OWNER request. Training shall include a minimum of eight hours of OWNER training.

B. The OWNER reserves the right to split training periods to accommodate personnel schedules.

C. The training sessions shall be structured to provide the OWNER'S personnel with a maximum of hands-on experience.

D. Control System Overview Training Shall Consist of the Following Topics:
   1. Definition of control modes, such as AUTO, MANUAL, LOCAL, and REMOTE.
   2. Entering and changing setpoints.

E. Provide the OWNER with the ability to program the PLCs, add new network components and PLCs as needed for future expansion of the system, and update or modify any OI screen to accommodate future expansion.

1.7 START-UP SUPPORT

A. The CONTRACTOR shall have field service and programming personnel on-site to provide start-up and commissioning services for a period of at least five days. The start-up service shall be coordinated with the ENGINEER. The start-up service shall be required prior to starting the final acceptance test.

1.8 PROGRAMMING SUPPORT

A. The CONTRACTOR shall be available to provide programming services for a period of at least 15 days. The start of this service shall commence after successful completion of the final acceptance test. This service shall consist of:
   1. Furnishing additional programming that may be required.
   2. Assisting OWNER'S personnel with additional technical support and training.

1.9 FACTORY WITNESS TESTING

A. Hardware and software components of the PLC system shall be thoroughly tested and "burned in" at the factory by the CONTRACTOR. Inform the ENGINEER 10 working days prior to the testing of the equipment. The ENGINEER and OWNER shall witness these tests before shipment to the site. Provide copies of all test reports to the ENGINEER.

B. The CONTRACTOR shall be responsible for all transportation, meals, and accommodation expenses for the OWNER'S and ENGINEER'S representative witnessing the factory test.

1.10 ON-SITE TESTING

A. On-site testing of the PLC system shall be performed prior to the final acceptance test. Submit a testing schedule detailing the timing and extent of the proposed testing and the test procedures to be followed.

B. Prior to the final acceptance test, the ENGINEER will review the status of the PLC system and determine if the final acceptance test can be performed. All primary elements shall be calibrated and all I/O signals shall be fully functional prior to the start of the final acceptance test.

C. Perform the PLC system final acceptance test and confirm the operation of all control loops, primary elements, control functions and sequences, and monitoring functions required of the complete PLC system. The PLC and OI shall be operated continuously throughout the test without software or hardware failure. In the event of a failure, the acceptance test shall be terminated, the hardware or software failure shall be corrected, and the acceptance test shall be restarted. The ENGINEER and the OWNER shall determine if it is necessary to restart the test at the first day of the test. The final acceptance test shall run uninterrupted for seven calendar days.

1.11 GENERAL PROGRAMMING REQUIREMENTS

A. The software development and programming of the control functions described herein shall be completed by the date defined in the Contract Documents. PLC programs and OI configuration software shall meet the performance requirements described herein, and the control needs of the OWNER.

B. The control descriptions provided herein do not provide every programming detail such as timers, function blocks, coils, contacts, or other relay ladder logic elements that are required to write and implement complete PLC programs. The control descriptions are intended to describe the overall functional capability of the particular process being described. Communication with the OWNER and the ENGINEER shall be necessary to convey the additional information needed to produce the working PLC programs.

C. Any discrepancies in these documents shall be brought to the attention of the ENGINEER, in writing. The ENGINEER will then issue further explanation. The decision of the ENGINEER will be final.

D. Control logic shall be programmed, furnished, and installed as specified. The CONTRACTOR shall be required to test and demonstrate to the satisfaction of the ENGINEER that the control logic functions as specified.

E. The PLC programs shall meet industry norms, and function in such a way as to maintain safe and reliable operation of the equipment they are designed to control. If the ENGINEER determines that the control logic and PLC programming fails to perform the functions described herein in a safe and reliable manner, the CONTRACTOR shall modify and correct the programs.

F. Setpoints for analog control loops shall be displayed in digital form on the screen, similar to a single loop controller display. Additionally:
   1. Automatic and manual loop control shall be available.

2. The display will show the current setpoint, current output value, and the current process variable input values for each respective control loop.
3. The operator shall be able to take the loop out of the automatic mode and drive the output signal manually from the OI. The transfer from automatic to manual shall be "bumpless".
4. PLC analog loops with PID (proportional, integral, and derivative) control shall be tunable from the OI. Tuning of the PID loops shall be completed before Substantial Completion. The PID loops shall meet the following performance requirements:
    a. No more than two major process variable overshoots shall be permitted after a process upset or a setpoint change. The peak overshoot shall not exceed the process variable setpoint value by more than 7% of its value.
    b. A major process variable overshoot is defined as a process variable time-domain measurement that exceeds the process variable setpoint by more the ±2% of the setpoint value.
    c. The process variable shall settle to within ±2% of the setpoints value within a period of time (or oscillation) that is acceptable for the process control application, and as defined by the ENGINEER. The period of oscillation shall be adjustable by tuning the integral rate (or reset rate) of the PID loop.

G. Integer or floating point values, from analog or totalized tags, shall be formatted to display at least three significant digits. For example, a tank level value shall be displayed as "16.2 FEET", or a pump flow rate shall be displayed as "1,324 GPM".

H. The PLC shall not be able to control any equipment item that is not in the Auto or Remote mode.

I. The PLCs shall be programmed to monitor each of their respective analog signal inputs for instrument failures. If the input signal falls below 4 milliamps due to a short circuit, or an open current loop, the PLC shall produce an alarm signal to the OI.

J. All motorized equipment (i.e., wells and pumps) will have Accumulation Runtime Counters associated with them.

PART 2 - PRODUCTS

2.1 APPLICATION SOFTWARE, PROGRAMMING HARDWARE, AND TRAINING

A. Provide fully annotated software with Logic Flow Diagram, rung-by-rung description, register, and variable cross-referencing. Reference program to control descriptions by Logic Flow Diagram.

B. Programming software will be the latest revision of Unity Pro as manufactured by Modicon.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install the programmable logic controller system in accordance with the programmable logic controller manufacturer's instructions and recommendations, including grounding specifications.

3.2 DEMONSTRATION

A. Establish a mutually agreed upon time for demonstrations with the ENGINEER.

B. Deliver written notification of demonstrations to ENGINEER at least seven days before demonstrations. Include an agenda for the demonstration and testing procedures with notification.

C. Demonstrate functional operation of programmable logic controller system hardware and logic program at system assembly location prior to shipment.

D. Demonstrate full functional operation of programmable logic controller system hardware and logic program at the Project job site when fully integrated to the field I/Os.

++ END OF SECTION ++

SECTION 17454

OPERATIONS AND CONTROL DESCRIPTIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Operation and control descriptions.

B. New PCIS programming and graphic screens shall follow the conventions of the existing PCIS application.

C. CONTRACTOR shall coordinate with the ENGINEER during PCIS programming of the process control descriptions. Any deviation from the following Specification shall be approved by the ENGINEER before programming. Any programming that is required and not specified herein shall be the responsibility of the CONTRACTOR. All additional PCIS programming logic shall be approved by the ENGINEER before programming.

D. See additional PLC & OIT software and programming requirements under specification 17461, Programmable Logic Controller System (M340).

1.2 RELATED SECTIONS

A. Section 11218, Magnetic Drive Sealless End Suction Pumps and Appurtenances.

B. Section 11310, Vertical Turbine Pumps.

C. Section 11400, Disc Filtration System.

D. Section 13400 Aboveground Fuel Storage Tank.

E. Section 17000, Instrumentation.

1.3 COMMON CONTROL FUNCTIONS

A. Alarms:
   1. Discrepancy Alarms: Each device capable of being controlled by PCIS in REMOTE mode shall have a discrepancy alarm, which shall be displayed at the PCIS workstations. The discrepancy alarms shall be derived as follows:
      1. Device is commanded to start, and the starter auxiliary contact or VFD does not echo the command after an operator-adjustable time delay.
      2. Device is commanded to stop, and the starter auxiliary contact or VFD does not echo the command after an operator-adjustable time delay.

3. Device is commanded to open, and the open limit switch does not echo the opened condition after an operator-adjustable time delay. An initial setting of two times the normal full travel time shall be used.
4. Device is commanded to close, and the closed limit switch does not echo the closed condition after an operator-adjustable time delay. An initial setting of two times the normal full travel time shall be used.
5. For modulating valves or gates, the alarm shall activate if the valve position is not within 2 percent of scale of the set point position after an operator-adjustable time delay.
6. The discrepancy alarms shall only be active if the LOCAL/REMOTE selector switch at the device is in REMOTE mode.
7. Once a discrepancy alarm occurs, the PCIS shall terminate the command to the device. The command to the device cannot be reinitiated until the discrepancy alarm is acknowledged by the operator from the PCIS workstation.

2. Alarms Based on Analog Measurements shall be derived by the PCIS workstation as follows:
    1. The PCIS workstation shall derive alarms by comparing the process measurement to an operator-adjustable set point.
3. Within PCIS program logic, configure each alarm to eliminate nuisance alarms that would otherwise activate when equipment is not in operation. For example, a low flow alarm on a pump discharge shall not be activated if the pump is off.
4. All alarms derived in the PCIS, whether from analog measurements, discrete inputs, or discrepancy alarms, shall have a proving timer to limit nuisance alarms. The PCIS shall start the timer when it first detects an alarm condition, and shall only activate the alarm after the timer has expired. If the alarm condition clears while the timer is running, the timer shall be reset, and the alarm shall not be activated.
5. Flow Totalizers: Each liquid flow rate transmitted to the PCIS shall have a flow total calculated by the PCIS as follows:
6. The current day's total flow shall be calculated by the PCIS and displayed at the PCIS workstation.
7. These flow totals shall be calculated and displayed even if they are not shown on the P&IDs (Process and Instrumentation Drawings).
8. PID Control Algorithms:
9. Each PID control algorithm shall have a faceplate that shall be displayed at the PCIS workstation. The face plate shall have the following functions:
10. Display process variable.
11. Display set point.
12. Display output.
13. Allow for operator selection of automatic or manual control of output.
14. Under manual control of output allow the operator to enter the desired output value.
15. Allow for input of the three PID tuning parameters.

16. The PID algorithm shall include set point and output tracking to provide bumpless control when switching between control modes.
17. Data Validation:
    1. The PCIS workstation graphic screens shall accept manually entered set point data only if it is within valid process range.
    2. The PCIS workstation shall require low-low set point to be lower than a low set point, high-high set point higher than a high set point, etc.

1.4 SUBMITTALS.

A. Submit software and program in accordance with Section 17000, Instrumentation.

PART 2 - PRODUCTS

2.1 DISC FILTERS (AWRF)

A. Summary:
    1. The Airport WRF will be installed with a sixth Disc Filter Basin upstream of the Chlorine Contact Basins (CCBs). Refer to Specification Section 11400, Disc Filter System.
        1. Effluent from the secondary clarifiers flows via gravity through a 42" pipe to the Rapid Mix Basins, Flocculation Basins, and then to the common Filter Influent Channel. Flow is then distributed between the Disc Filter Basins. The filter influent enters the Filter Basins by flowing over an influent weir, submerging the disks. Under normal operation, the disks are stationary.
        2. The cloth media filters are designed to continuously remove particulates from the flow steam. As the influent passes through the cloth on each side of the disc, solids are built up on the cloth surface, creating a mat. Other, heavier solids settle to the bottom of the filter basin. The filtrate is conveyed via the center tube to the effluent chamber and over an effluent weir, into the common Filter Effluent Channel. The filter effluent is then conveyed to the Chlorine Contact Basins.
        3. As the amount of particulates on and within the pile cloth media increases, the static pressure required to pass water through the pile cloth media increases. This results in an increased water level within the filter basin and increased differential pressure (headloss) on the pile cloth media. When a high-level or differential pressure setpoint is reached, backwash mode is triggered. Backwash mode cleans the pile cloth media by drawing from the filtered side of the pile cloth media. This reverse flow dislodges particulates embedded in the pile cloth media and restores it to a clean condition.
        4. Upon reaching a specific number of backwash cycles performed, or an elapsed time, the solids waste mode will be automatically initiated. Solids on the floor of the filter basin are collected via a perforated manifold that is attached to the Backwash/Solids Waste Pump.

5. Backwash and solids wastewater are transported back to the Influent Pump Station (IPS).
6. The filter manufacturer shall be responsible for implementing all the detailed control strategies for the filter in its vendor supplied LCP/PLC (VCP-DS6). Control strategies for Disc Filter No. 6 shall be incorporated with the existing control logic of Disc Filters No.1 through No. 5.

B. P&ID: I-05.01 thru I-05.04

C. Components:
   1. Equipment:

Associated Disc Filter Unit(s)	Item Description	Item Tag
DS6	Control Panel	*TBD*
DS6	Power Panel	*TBD*
DS6	Drive Unit	*TBD*
DS6	Drive Unit Disconnect Switch	*TBD*
DS6	Motorized Influent Gate	*TBD*
DS6	Solids Waste Valve 1	*TBD*
DS6	Backwash Valve 1	*TBD*
DS6	Backwash Valve 2	*TBD*
DS6	Backwash Valve 3	*TBD*
DS6	Backwash Valve 4	*TBD*
DS6	Backwash Valve 5	*TBD*
DS6	Backwash Valve 6	*TBD*
DS6	Backwash Valve 7	*TBD*
DS6	Solids Waste Valve 2	*TBD*
DS6	Backwash Pump A	*TBD*
DS6	Backwash Pump A Disconnect Switch	*TBD*
DS6	Backwash Pump B	*TBD*
DS6	Backwash Pump B Disconnect Switch	*TBD*

2. Instruments:

Associated Disc Filter Unit(s)	Item Description	Item Tag	Units	Action	Setpoint	Range
DS6	Level Transducer	*TBD*	feet	Initiate Backwash	El. 1220.37 (12.69)	N/A
DS6	High Level Float Switch	*TBD*	feet	Initiate Backwash	El. 1220.37 (12.69)	N/A
DS6	Effluent Chamber Turbidity Probe	*TBD*	NTU	Alarm at CMS	5	0.001 – 4,000
DS6	Vacuum Transmitter No. 1	*TBD*	psi	N/A	N/A	-14.5 – 0
DS6	Vacuum Transmitter No. 2	*TBD*	psi	N/A	N/A	-14.5 – 0
DS6	Vacuum Indicator No. 1	*TBD*	psi	N/A	N/A	-14.5 – 0
DS6	Pressure Indicator No. 1	*TBD*	psi	N/A	N/A	0-15
DS6	Vacuum Indicator No. 2	*TBD*	psi	N/A	N/A	-14.5 – 0
DS6	Pressure Indicator No. 2	*TBD*	psi	N/A	N/A	0-15
DS6	Effluent Chamber Turbidity Analyzer	*TBD*	NTU	N/A	N/A	0.001 – 4,000

D. Safety Interlocks:
   1. The Backwash/Solids Waste Pump will automatically stop on low-level alarm.

E. Control Modes:
   1. Remote Auto (CMS):
      a. In this mode the Disc Filter Basin will be operated solely by the CMS. The operator is required to only select the Filter Enable or Disable command on the operator station.
      b. Disc Filter Influent Gate:
         a. Place Disc Filter Influent Gates LOCAL-OFF-REMOTE switch in the REMOTE position at the gate actuator.
         b. The Disc Filter inlet Gate will be opened by CMS when the operator selects Filter System Enable command on the workstation.
         c. The Disc Filter Influent Gate will be closed by CMS when the operator selects the Filter System Disable command on the workstation.
   3. Backwash/Solids Waste Cycle

a. Place H-O-A switch at VCP-DS6 in the AUTO position. Place the LEVEL or TIMED vendor supplied options in the proper position, dependent on operations, on the HMI at VCP-DS6.
b. Place all Backwash Valves/Solids Waste Valve(s) in the REMOTE position on the HMI.
c. Place all Backwash/Solids Waste Pump(s) in the AUTO position.
d. Place the filter drive unit in the AUTO position.
e. The Disc Filter system will start operation in normal filtration mode when set to ENABLE.
f. The Backwash/Solids Waste Pump(s) will start automatically when a backwash is initiated by either LEVEL or TIME, dependent on operations.
g. The Backwash/Solids Waste Valve(s) will operate automatically during backwash/solids wasting.
h. Backwash interval is set on the Individual Filter Control screen from CMS.
i. Backwash high water level for automatic backwash is set on the Individual Filter Control screen from CMS, backwash high water level cannot be set above 1221.23'.
j. Backwash count to initiate sludge wasting is set on the Individual Filter Control screen from CMS.
k. Solids wasting interval (time) is set on the Individual Filter Control screen from CMS.
l. The Disc Filter System will stop operation when set to DISABLE.

2. Remote Hand:
    1. In this mode the Filter basin will be operated remotely at the control room workstation. Operator will be able to control all equipment set to Remote/Auto modes from their workstation.
    2. Disc Filter Influent Gate:
        a. Place Disc Filter Influent Gate in the REMOTE position at the gate actuator.
        b. The Disc Filter Inlet Gate will open by pressing the OPEN button from the filter control screen at CMS.
        c. The Disc Filter Influent Gate will close by pressing the CLOSE button from the filter control screen at CMS.
    3. Backwash/Solids Waste Cycle:
        a. Place H-O-A switch at VCP-DS6 in the AUTO position.
        b. Place all Backwash/Solids Waste Pump(s) in the AUTO position.
        c. The Backwash/Solids Waste Pump(s) will start by pressing the START BACKWASH button from individual filter control screen at PCIS.
        d. The Backwash/Solids Waste Pump(s) will stop when the backwash/solids waste cycle is complete.
        e. Place all Backwash Valves/Solids Waste Valve(s) in the REMOTE position at the HMI.

f. The Backwash/Solids Waste Valves(s) will open automatically during a backwash/solids waste cycle.
g. The Backwash/Solids Waste Valve(s) will close automatically during a backwash/solids waste cycle.
h. Place the filter drive unit in the AUTO position.
i. The Filter Drive Motor will start by pressing the START BACKWASH button from the filter control screen at PCIS.
j. The Filter Drive Motor will stop when the backwash/solids waste cycle is complete.
k. Backwash interval is set on the Individual Filter Control screen from PCIS.
l. Backwash high water level for automatic backwash is set on the Individual Filter Control screen from PCIS.
m. Backwash count to initiate sludge wasting is set on the Individual Filter Control screen from PCIS.
n. Solids wasting interval (time) is set on the Individual Filter Control screen from PCIS.

3. Local Auto:
   a. In this mode the control panel will operate the respective Filter Basin equipment via its PLC. The influent gate will be operated locally by an operator via pushbuttons on the actuator body.
   2. Disc Filter Influent Gate:
      a. Set the Influent Gate actuator to Local mode.
   3. Backwash/Solids Waste Cycle:
      a. Place all H-O-A switches VCP-DS6 in the AUTO position. Place the LEVEL or TIMED vendor supplied option, in the proper position, dependent on operations at VCP-DS6.
      b. Place all backwash valves/solids waste valve(s) in the LOCAL position.
      c. Place Backwash/Solids Waste Pump(s) in the LOCAL position.
      d. Place the Filter Drive Unit in the LOCAL position.
      e. The Disc Filter System will start operation in normal filtration mode when the Disc Filter Influent Gate is open.
      f. The Backwash/Solids Waste Pump(s) will start automatically when a backwash is initiated by either LEVEL or TIME, dependent on operations.
      g. The Backwash/Solids Waste Valve(s) will operate automatically during backwash/solids wasting.
      h. Backwash interval is set locally at the HMI at VCP-DS6.
      i. Backwash high water level for automatic backwash is set locally at VCP-DS6.
      j. Backwash count to initiate sludge wasting is set locally at VCP-DS6.
      k. Solids wasting interval (time) is set locally at VCP-DS6.
      l. The Disc Filter System will stop operation when the Disc Filter Influent Gate is closed.
4. Local Hand:

a. In this mode operation of all Filter Basins equipment shall be done/conducted locally by an operator. All safety interlocks are disabled in this mode.
b. Disc Filter Influent Gate:
    a. Place Disc Filter Influent Gate in the LOCAL position at the gate actuator.
    b. The Disc Filter Influent Gate will open by pressing the OPEN pushbutton.
    c. The Disc Filter Influent Gate will close by pressing the CLOSE pushbutton.
c. Backwash/Solids Waste Pump(s):
    a. The Backwash/Solids Waste Pump(s) is controlled locally at VCP-DS6 via pushbuttons.
    b. The Backwash/Solids Waste Pump(s) START/STOP button is located at VCP-DS6.
    c. The Backwash/Solids Waste Pump(s) will start by placing the panel H-O-A switch at VCP-DS6 in the HAND position and pressing the START pushbutton.
    d. The Backwash/Solids Waste Pump(s) will stop by placing the panel H-O-A switch at VCP-DS6 in the HAND position and pressing the STOP pushbutton.
d. Backwash/Solids Waste Valve(s):
    a. The backwash/solids waste valve(s) is controlled locally at VCP-DS6 via the HMI.
    b. The Backwash/Solids Waste Valve(s) OPEN/CLOSE button is located at the HMI at VCP-DS6.
    c. The Backwash/Solids Waste Valve(s) actuator will open and close the valve using the OPEN/STOP/CLOSE controls at the HMI when the LOCAL-OFF-REMOTE switch is set to LOCAL.

5. Filter Drive Unit:
    a. The Filter Drive Motor is controlled locally at VCP-DS6 via pushbuttons.
    b. The Filter Drive Motor is started by pressing the START pushbutton.
    c. The Filter Drive Motor is stopped by pressing the STOP pushbutton.
6. NaOCl Recirculation for Cleaning of the Cloth
    a. Close Filter Influent Slide Gate.
    b. Open 3” Manual Ball Valve on Recirculation Pipe.
    c. Close 3” Manual Ball Valve on Filter Backwash/Solids Waste Discharge Manifold.
    d. Open 1” Manual Ball Valve on Sodium Hypochlorite Supply Pipe to add proper dose of NaOCl (See SOP).
    e. The Filter Drive Motor is started by placing the panel H-O-A switch in the HAND position and pressing the START pushbutton.
    f. The Backwash/Solids Waste Pump(s) will start by placing the panel H-O-A switch in the HAND position and pressing the START pushbutton.

g. The Backwash/Solids Waste valve(s) actuator will open and close the valve using the OPEN/STOP/CLOSE controls at the HMI when the LOCAL-OFF-REMOTE switch is set to LOCAL.
h. Close 3" Manual Ball Valve on Recirculation Pipe.
i. Place all H-O-A switches at VCP-DS6, in the AUTO position.
j. Start Backwash/Solids Waste Cycle by pressing the START BACKWASH button from VCP-DS6 until Filter Basin is drained.
k. Open Filter Influent Gate using pushbuttons/switches on the actuator.

7. Manual Backwash with one Backwash/Solids Waste Pump.
   a. LOTO Faulty Backwash/Solids Waste Pump using Pump Disconnect Switch
   b. Open Manual 3" Ball Valve on Common Suction Manifold between Pumps.
   c. Start the Filter Drive Motor by placing the panel H-O-A switch in the HAND position and pressing the START pushbutton.

F. Monitor: The following data will be monitored by CMS for Disc Filter No. 6:
1. Disc Filter High Level Status
2. Disc Filter Filter Drive Unit (FDU) in AUTO/HAND status
3. Disc Filter Filter Drive Unit (FDU) in OFF status
4. Disc Filter Filter Drive Unit (FDU) RUN status
5. Disc Filter Backwash Duration (time) status
6. Disc Filter Solids Wasting Duration (time) status
7. Disc Filter Backwash/Solids Waste Pump A in AUTO/HAND status.
8. Disc Filter Backwash/Solids Waste Pump A in OFF status
9. Disc Filter Backwash/Solids Waste Pump A RUN status
10. Disc Filter Backwash/Solids Waste Pump B in AUTO/HAND status.
11. Disc Filter Backwash/Solids Waste Pump B in OFF status
12. Disc Filter Backwash/Solids Waste Pump B RUN status
13. Disc Filter Backwash Valve 1 Opened / Closed Status
14. Disc Filter Backwash Valve 2 Opened / Closed Status
15. Disc Filter Backwash Valve 3 Opened / Closed Status
16. Disc Filter Backwash Valve 4 Opened / Closed Status
17. Disc Filter Backwash Valve 5 Opened / Closed Status
18. Disc Filter Backwash Valve 6 Opened / Closed Status
19. Disc Filter Backwash Valve 7 Opened / Closed Status
20. Disc Filter Solids Waste Valve 1 Opened / Closed Status
21. Disc Filter Solids Waste Valve 1 Local/Remote Status
22. Disc Filter Solids Waste Valve 2 Opened / Closed Status
23. Disc Filter Solids Waste Valve 2 Local/Remote Status
24. Disc Filter Backwash Valve 1 Local/Remote Status
25. Disc Filter Backwash Valve 2 Local/Remote Status
26. Disc Filter Backwash Valve 3 Local/Remote Status
27. Disc Filter Backwash Valve 4 Local/Remote Status
28. Disc Filter Backwash Valve 5 Local/Remote Status
29. Disc Filter Backwash Valve 6 Local/Remote Status

30. Disc Filter Backwash Valve 7 Local/Remote Status

G. Alarms: The following alarms and indications are available in all control modes for each individual Disc Filter:
   1. Disc Filter Filter Drive Unit (FDU) FAIL
   2. Disc Filter Backwash/Solids Waste Pump A FAIL
   3. Disc Filter Backwash/Solids Waste Pump B FAIL
   4. Disc Filter Backwash/Solids Waste Pump A Emergency Stop Alarm
   5. Disc Filter Backwash/Solids Waste Pump B Emergency Stop Alarm
   6. Disc Filter Backwash Valve 1 FAIL
   7. Disc Filter Backwash Valve 2 FAIL
   8. Disc Filter Backwash Valve 3 FAIL
   9. Disc Filter Backwash Valve 4 FAIL
   10. Disc Filter Backwash Valve 5 FAIL
   11. Disc Filter Backwash Valve 6 FAIL
   12. Disc Filter Backwash Valve 7 FAIL
   13. Disc Filter Solids Waste Valve 1 FAIL
   14. Disc Filter Solids Waste Valve 2 FAIL
   15. Disc Filter High Level Alarm
   16. Disc Filter Emergency Stop Activated Alarm
   17. Disc Filter High Turbidity Alarm
   18. Disc Filter High-High Turbidity Alarm
   19. Disc Filter VCP Temp High Alarm
   20. Disc Filter VCP UPS Batt Low Alarm
   21. Disc Filter High Vacuum A Alarm
   22. Disc Filter High Vacuum B Alarm

2.2 SECONDARY CLARIFIERS (AWRF):

A. Summary:
   1. The secondary clarifiers are designed to separate solids contained in the system mixed liquor from the treated wastewater by gravity settling. The solids settle and are continuously removed from the bottom of the clarifier to the RAS/WAS pump station for reuse and disposal while clarified effluent passes on to the filtration process. There are eight existing secondary clarifiers. The mechanisms in Clarifiers No. 1-4 will be replaced as part of the WRF Improvements Phase 3.

B. References:
   1. P&ID: I-04.01 thru I-04.02
   2. Section 11335 Secondary Clarifier Mechanism.

C. Process Description:
   1. The secondary clarifier is controlled from the Motor Control Panel (MCP). Torque monitoring is available at both the MCP and PCIS. The system once started runs continuously.

D. Components:
1. Instruments:

Item Description	Item Tag	Units	Action	Setpoint	Range
Clarifier 1 Torque Transmitter	*TBD*	mA	Relay to PCIS	NA	4-20
Clarifier 2 Torque Transmitter	*TBD*	mA	Relay to PCIS	NA	4-20
Clarifier 3 Torque Transmitter	*TBD*	mA	Relay to PCIS	NA	4-20
Clarifier 4 Torque Transmitter	*TBD*	mA	Relay to PCIS	NA	4-20
Clarifier 1 High Torque Switch	*TBD*	%	High Torque ALARM	100% of continuous operating torque	0-200
Clarifier 2 High Torque Switch	*TBD*	%	High Torque ALARM	100% of continuous operating torque	0-200
Clarifier 3 High Torque Switch	*TBD*	%	High Torque ALARM	100% of continuous operating torque	0-200
Clarifier 4 High Torque Switch	*TBD*	%	High Torque ALARM	100% of continuous operating torque	0-200
Clarifier 1 High High Torque Switch	*TBD*	%	High High Torque ALARM and Motor SHUTDOWN	125% of continuous operating torque	0-200
Clarifier 2 High High Torque Switch	*TBD*	%	High High Torque ALARM and Motor SHUTDOWN	125% of continuous operating torque	0-100
Clarifier 3 High High Torque Switch	*TBD*	%	High High Torque ALARM and Motor SHUTDOWN	125% of continuous operating torque	0-200
Clarifier 4 High High Torque Switch	*TBD*	%	High High Torque ALARM and Motor SHUTDOWN	125% of continuous operating torque	0-200

2. Equipment:

Item Description	Item Tag
Clarifier 1 Rake Mechanism	*TBD*
Clarifier 2 Rake Mechanism	*TBD*
Clarifier 3 Rake Mechanism	*TBD*
Clarifier 4 Rake Mechanism	*TBD*
Clarifier 1 12-Inch Plug Valve	*TBD*
Clarifier 3 12-Inch Plug Valve	*TBD*
Clarifier 4 16-Inch Plug Valve	*TBD*
Clarifier 1 Rake Drive Motor Control Panel	*TBD*
Clarifier 2 Rake Drive Motor Control Panel	*TBD*
Clarifier 3 Rake Drive Motor Control Panel	*TBD*
Clarifier 4 Rake Drive Motor Control Panel	*TBD*

E. Safety Interlocks:
   1. The clarifier will stop automatically on motor overload alarm and will not start again until the alarm is manually reset at the MCP.
   2. The clarifier will automatically stop on high-high torque alarm and will not start again until the alarm is manually reset at the MCP.

F. Operating Controls
   1. Clarifier:
      a. The operator can Start/Stop the clarifier only by switching the On/Off Selector Switch at the MCP.
      b. PCIS will monitor torque data from each clarifier continuously, display it at the HMI and store it.

G. Control Modes:
   1. General:
      a. Only monitoring at PLC and PCIS
      b. The following features will be available at the motor control panel (MCP), the programmable logic controller (PLC) and PCIS:
         a. At MCP for the clarifier:
            a) ON/OFF Switch
            b) RESET Push Button
            c) High Torque Alarm Indicator Light
            d) High-High Torque Alarm Indicator Light
            e) Running Light
            f) Motor Starter Fail Alarm Light
            g) Shutdown Indicator Light
            h) Torque Indicator Display
         b. At PLC and PCIS:

a) Running Indication
b) High-High Torque Shutdown Indication
c) High Torque Warning Indication
d) Motor Starter Fault Alarm Indication
e) Torque Indication
f) Activated Sludge Valve Position Indication
g) Activated Sludge Valve Position Control

2.3 CHEMICAL FEED LOOP SYSTEM (AWRF):

A. Summary:
1. The chemical storage area consists of a NaOH storage tank and a NaOCl storage tank. This system feeds and controls the concentration of sodium hydroxide (25%) and sodium hypochlorite (12.5%) to the Headworks Odor Control System, Pre-Stage No. 1 Odor Control System, and Pre-Stage No. 2 Odor Control System.
2. The feed pumps, 1 duty + 2 standby for each chemical, shall be capable of 24 hour per day operation. The pumps are kept in the chemical storage area underneath a canopy and are controlled by their respective Local Control Panel.
3. Each feed will have a pressure transmitter that can be monitored from the LCP

B. P&ID: I-11.01 thru I-11-09

C. Components:
1. Equipment:

Item Description	Item Tag	Units	Action	Setpoint	Range
Sodium Hypochlorite Feed Pump No. 1	*NaOCL-PMP-001*	gpm	High Motor Temperature ALARM	N/A	0-45
Sodium Hypochlorite Feed Pump No. 2	*NaOCL-PMP-002*	gpm	High Motor Temperature ALARM	N/A	0-45
Sodium Hypochlorite Feed Pump No. 3	*NaOCL-PMP-003*	gpm	High Motor Temperature ALARM	N/A	0-45
Sodium Hydroxide Feed Pump No. 1	*NaOH-PMP-001*	gpm	High Motor Temperature ALARM	N/A	0-45
Sodium Hydroxide Feed Pump No. 2	*NaOH-PMP-002*	gpm	High Motor Temperature ALARM	N/A	0-45
Sodium Hydroxide Feed Pump No. 3	*NaOH-PMP-003*	gpm	High Motor Temperature ALARM	N/A	0-45

Sodium Hypochlorite Feed Pump No. 1 High Pressure Safety Relief Valve	*NaOCL-PRV-001*	psi	High Pressure ALARM	16	5-25
Sodium Hypochlorite Feed Pump No. 2 High Pressure Safety Relief Valve	*NaOCL-PRV-002*	psi	High Pressure ALARM	16	5-25
Sodium Hypochlorite Feed Pump No. 3 High Pressure Safety Relief Valve	*NaOCL-PRV-003*	psi	High Pressure ALARM	16	5-25
Sodium Hydroxide Feed Pump No. 1 High Pressure Safety Relief Valve	*NaOH-PRV-001*	psi	High Pressure ALARM	16	5-25
Sodium Hydroxide Feed Pump No. 2 High Pressure Safety Relief Valve	*NaOH-PRV-002*	psi	High Pressure ALARM	16	5-25
Sodium Hydroxide Feed Pump No. 3 High Pressure Safety Relief Valve	*NaOH-PRV-003*	psi	High Pressure ALARM	16	5-25
Sodium Hypochlorite Backpressure Valve	*NaOCL-BPV-001*	psi	N/A	15	5-25
Sodium Hydroxide Backpressure Valve	*NaOH-BPV-001*	psi	N/A	15	5-25

2. Instruments:

Item Description	Item Tag	Units	Action	Setpoint	Range
Sodium Hypochlorite Pressure Indicator/Transmitter	*NaOCL-PIT-001*	psi	N/A	N/A	N/A
Sodium Hydroxide Pressure Indicator/Transmitter	*NaOH-PIT-001*	psi	N/A	N/A	N/A
Sodium Hypochlorite Pressure Indicator and Low Pressure Switch	*NaOCL-PSL-001*	psi	Low Pressure ALARM	7	0-25
Sodium Hydroxide Pressure Indicator and Low Pressure Switch	*NaOH-PSL -001*	psi	Low Pressure ALARM	7	0-25
Sodium Hypochlorite Feed Pump No. 1 High Pressure Switch	*NaOCL-PSH-001*	psi	High Pressure ALARM	16	5-25
Sodium Hypochlorite Feed Pump No. 2 High Pressure Switch	*NaOCL-PSH-002*	psi	High Pressure ALARM	16	5-25
Sodium Hypochlorite Feed Pump No. 3 High Pressure Switch	*NaOCL-PSH-003*	psi	High Pressure ALARM	16	5-25

Sodium Hydroxide Feed Pump No. 1 High Pressure Switch	*NaOH-PSH-001*	psi	High Pressure ALARM	16	5-25
Sodium Hydroxide Feed Pump No. 2 High Pressure Switch	*NaOH-PSH-002*	psi	High Pressure ALARM	16	5-25
Sodium Hydroxide Feed Pump No. 3 High Pressure Switch	*NaOH-PSH-003*	psi	High Pressure ALARM	16	5-25
Chemical Trench Sump Float Switch No.1	*CSF-LSH-775*	Inches	Sump Level High ALARM	8	0-36
Chemical Trench Sump Float Switch No.2	*CSF-LSH-776*	Inches	Sump Level High ALARM	8	0-36

D. Hard-Wired Safety Interlocks:
   1. Automatic Mode Only:
      a. On the NaOCl storage tank low-low-level alarm, the NaOCl feed pumps will stop.
      b. On the NaOH storage tank low-low-level alarm, the NaOH feed pumps will stop.
      c. The duty NaOCl pump and duty NaOH pump will continue to operate unless all three Scrubbers shut down.
      d. Each feed pump will stop at its respective High Pressure ALARM.
      e. Each feed pump will stop at its respective High Motor Temperature ALARM.
      f. Each feed pump will stop on a Sump Float Switch ALARM.
      g. The duty NaOCl pump and duty NaOH pump can only be operated one at a time, and no second pump in either feed loop shall run simultaneously.

E. Control modes:
   1. Feed Pumps:
      a. Local Hand:
         1) The NaOH pumps are controlled by an LCP at the Chemical Storage Facility.
         2) The NaOCl pumps are controlled by an LCP at the Chemical Storage Facility.
         3) The panel for each set of chemical feed pumps has an H-O-A switch. The START/STOP switch for each respective pump will control whether a pump is operational or offline.
         4) When the pumps are switched to HAND mode, the pumps can be engaged using their respective START/STOP modes.
      b. Auto:
         1) Switch pump LCP mode to AUTO mode. All 3 pumps will become operational as long as the START/STOP switch for each respective

pump is switched to START. If a pump is switched to STOP while in AUTO, it will not operate in any circumstance.

2) When all pumps are operational, they will operate in a 1 duty and 2 standby modes, dictated by a motor runtime differential. When a pump reaches a specified runtime differential, it turns itself into standby mode while a standby pump initializes and fully engages to duty mode.

2. PCIS Control:
   a. The following are controlled at the PCIS:
      1) Sodium Hypochlorite Pump No. 1 Remote Run Command.
      2) Sodium Hypochlorite Pump No. 2 Remote Run Command.
      3) Sodium Hypochlorite Pump No. 3 Remote Run Command.
      4) Sodium Hydroxide Pump No. 1 Remote Run Command.
      5) Sodium Hydroxide Pump No. 2 Remote Run Command.
      6) Sodium Hydroxide Pump No. 3 Remote Run Command.
   b. The following are displayed at the PCIS for each Chemical Feed Systems:
      1) Sodium Hypochlorite Pump No. 1 Run Status.
      2) Sodium Hypochlorite Pump No. 2 Run Status.
      3) Sodium Hypochlorite Pump No. 3 Run Status.
      4) Sodium Hydroxide Pump No. 1 Run Status.
      5) Sodium Hydroxide Pump No. 2 Run Status.
      6) Sodium Hydroxide Pump No. 3 Run Status.
      7) Sodium Hypochlorite Pressure Transmitter Reading.
      8) Sodium Hydroxide Pressure Transmitter Reading.
3. Alarms: The following alarms and indications are available in all control modes for the chemical feed loop.
      a. Sodium Hypochlorite Pump No. 1 High Motor Temperature ALARM.
      b. Sodium Hypochlorite Pump No. 2 High Motor Temperature ALARM.
      c. Sodium Hypochlorite Pump No. 3 High Motor Temperature ALARM.
      d. Sodium Hydroxide Pump No. 1 High Motor Temperature ALARM.
      e. Sodium Hydroxide Pump No. 2 High Motor Temperature ALARM.
      f. Sodium Hydroxide Pump No. 3 High Motor Temperature ALARM.
      g. Sodium Hypochlorite Pump No. 1 High Pressure ALARM.
      h. Sodium Hypochlorite Pump No. 2 High Pressure ALARM.
      i. Sodium Hypochlorite Pump No. 3 High Pressure ALARM.
      j. Sodium Hydroxide Pump No. 1 High Pressure ALARM.
      k. Sodium Hydroxide Pump No. 2 High Pressure ALARM.
      l. Sodium Hydroxide Pump No. 3 High Pressure ALARM.
      m. Chemical Sump Float Switch No. 1 Sump High Level ALARM.
      n. Chemical Sump Float Switch No. 2 Sump High Level ALARM.

2.4 CHEMICAL FEED VALVES (AWRF)

A. Summary:
   1. The chemical storage area consists of a NaOH storage tank and a NaOCl storage tank. This system feeds and controls the concentration of sodium hydroxide (25%) and sodium hypochlorite (12.5%) to the Headworks Odor Control System, Pre-Stage No. 1 Odor Control System, and Pre-Stage No. 2 Odor Control System.
   2. The dosing valves, 1 motor actuated + 1 manual bypass, for each injection point shall be capable of 24 hour per day operation. The dosing valves are located on the chemical feed pipelines located near each injection point and are controlled by the motor actuator or manually by hand.

B. P&ID: I-11.01 thru I-11-09

C. Components:
   1. Equipment:
      a.

Item Description	Item Tag	Units	Action	Setpoint	Range
Sodium Hypochlorite Actuated Dosing Valve No. 1	*NaOCL-VLV-001*	%	N/A	N/A	1-100
Sodium Hypochlorite Actuated Dosing Valve No. 2	*NaOCL-VLV-002*	%	N/A	N/A	1-100
Sodium Hypochlorite Actuated Dosing Valve No. 3	*NaOCL-VLV-003*	%	N/A	N/A	1-100
Sodium Hydroxide Actuated Dosing Valve No. 1	*NaOH-VLV-001*	%	N/A	N/A	1-100
Sodium Hydroxide Actuated Dosing Valve No. 2	*NaOH-VLV-002*	%	N/A	N/A	1-100
Sodium Hydroxide Actuated Dosing Valve No. 3	*NaOH-VLV-003*	%	N/A	N/A	1-100
Sodium Hydroxide Actuated Dosing Valve No. 4	*NaOH-VLV-004*	%	N/A	N/A	1-100
Sodium Hydroxide Actuated Dosing Valve No. 5	*NaOH-VLV-005*	%	N/A	N/A	1-100
Sodium Hydroxide Actuated Dosing Valve No. 6	*NaOH-VLV-006*	%	N/A	N/A	1-100
Sodium Hypochlorite Manual Bypass Dosing Valve No. 1	*NaOCL-MVLV-001*	%	N/A	N/A	1-100
Sodium Hypochlorite Manual Bypass Dosing Valve No. 2	*NaOCL-MVLV-002*	%	N/A	N/A	1-100
Sodium Hypochlorite Manual Bypass Dosing Valve No. 3	*NaOCL-MVLV-003*	%	N/A	N/A	1-100
Sodium Hydroxide Manual Bypass Dosing Valve No. 1	*NaOH-MVLV-001*	%	N/A	N/A	1-100

Sodium Hydroxide Manual Bypass Dosing Valve No. 2	*NaOH-MVLV-002*	%	N/A	N/A	1-100
Sodium Hydroxide Manual Bypass Dosing Valve No. 3	*NaOH-MVLV-003*	%	N/A	N/A	1-100
Sodium Hydroxide Manual Bypass Dosing Valve No. 4	*NaOH-MVLV-004*	%	N/A	N/A	1-100
Sodium Hydroxide Manual Bypass Dosing Valve No. 5	*NaOH-MVLV-005*	%	N/A	N/A	1-100
Sodium Hydroxide Manual Bypass Dosing Valve No. 6	*NaOH-MVLV-006*	%	N/A	N/A	1-100

2. Instruments:

Item Description	Item Tag	Units	Action	Setpoint	Range
Sodium Hypochlorite Actuator on Dosing Valve No. 1	*NaOCL-ACT-001*	%	N/A	N/A	1-100
Sodium Hypochlorite Actuator on Dosing Valve No. 2	*NaOCL-ACT-002*	%	N/A	N/A	1-100
Sodium Hypochlorite Actuator on Dosing Valve No. 3	*NaOCL-ACT-003*	%	N/A	N/A	1-100
Sodium Hydroxide Actuator on Dosing Valve No. 1	*NaOH-ACT-001*	%	N/A	N/A	1-100
Sodium Hydroxide Actuator on Dosing Valve No. 2	*NaOH-ACT-002*	%	N/A	N/A	1-100
Sodium Hydroxide Actuator on Dosing Valve No. 3	*NaOH-ACT-003*	%	N/A	N/A	1-100
Sodium Hydroxide Actuator on Dosing Valve No. 4	*NaOH-ACT-004*	%	N/A	N/A	1-100
Sodium Hydroxide Actuator on Dosing Valve No. 5	*NaOH-ACT-005*	%	N/A	N/A	1-100
Sodium Hydroxide Actuator on Dosing Valve No. 6	*NaOH-ACT-006*	%	N/A	N/A	1-100

D. Hard-Wired Safety Interlocks:
   1. Automatic Mode Only:
      a. On the NaOCl storage tank low-low-level alarm, the NaOCl actuated dosing valves will fully close.
      b. On the NaOH storage tank low-low-level alarm, the NaOH actuated dosing valves will fully close.
      c. Each actuated dosing valve will close when a Low Pressure Switch alarm and Sump Float Switch alarm occur at the same time.

E. Control modes:
   1. Actuated Dosing Valves:
      a. Local Hand:

1) Ensure connection from the injection point to the actuated dosing valve pipeline.
2) Flip the O-A switch on the actuator to OFF for the desired injection point to manually adjust the flow control valve.
3) The flow control valves can be adjusted between 0% to 100% by using a wrench. See Equipment Set Points / Ranges table.
4) All dosing valves shall fully open and close once a day to maintain serviceability.

b. Computer Manual:
1) Ensure connection from the injection point to the actuated dosing valve pipeline.
2) Flip the H-O-A switch on the actuator to AUTO for the desired injection point to manually adjust the flow control valve.
3) NaOH and NaOCl dosing may be determined by the plant operators and entered in the PCIS in percent open of the flow control valve from the desired flow train between 0% and 100%.
4) All dosing valves shall fully open and close once a day to maintain serviceability.

c. Computer Automatic:
1) Ensure connection from the injection point to the actuated dosing valve pipeline.
2) Flip the H-O-A switch on the actuator to AUTO for the desired injection point to manually adjust the flow control valve.
3) From the PCIS, the pH sensor reading will open the flow control valve between 0% and 100% based on pH reading.
4) All dosing valves shall fully open and close once a day to maintain serviceability.

2. Manual Bypass Dosing Valves:
a. Local Hand:
1) Ensure connection from the injection point to the manual bypass doing valve pipeline.
2) Each Scrubber is controlled locally at the existing vendor local control panel at each respective Scrubber, LCP-OCH, LCP-OCB, LCP-OCB2
3) Each dosing valve at a given Scrubber is started by placing the equipment O-A switch in the OFF position. It is stopped by placing the O-A switches in the OFF position.
4) The dosing valves position is controlled at each valve utilizing a manual knob to open and close the valve via hand.

2. Dosing Valve Notes:
a. Stage 1 pH, Stage 2/ 3 pH, and ORP controllers control their respective dosing valves to maintain the system pH and ORP at set optimum settings.
2) The scrubber will run until the level inside one of the chemical storage tanks reaches a low-low level or stage 1 or stage 2/ 3 sumps reach a low level.

3) The odor control system is shut down by switching the odor control system ON/OFF switch to the OFF position.

3. PCIS Control:
   a. The following are controlled at the PCIS for Chemical feeds NaOH and NaOCl:
      1) NaOCl Dosing valve 1 Position Percentage Controller
      2) NaOCl Dosing valve 2 Position Percentage Controller
      3) NaOCl Dosing valve 3 Position Percentage Controller
      4) NaOH Dosing valve 1 Position Percentage Controller
      5) NaOH Dosing valve 2 Position Percentage Controller
      6) NaOH Dosing valve 3 Position Percentage Controller
      7) NaOH Dosing valve 4 Position Percentage Controller
      8) NaOH Dosing valve 5 Position Percentage Controller
      9) NaOH Dosing valve 6 Position Percentage Controller
   b. The following are displayed at the PCIS for each Chemical Feed Systems:
      1) NaOCl Dosing valve 1 Position Percentage Indicator
      2) NaOCl Dosing valve 2 Position Percentage Indicator
      3) NaOCl Dosing valve 3 Position Percentage Indicator
      4) NaOH Dosing valve 1 Position Percentage Indicator
      5) NaOH Dosing valve 2 Position Percentage Indicator
      6) NaOH Dosing valve 3 Position Percentage Indicator
      7) NaOH Dosing valve 4 Position Percentage Indicator
      8) NaOH Dosing valve 5 Position Percentage Indicator
      9) NaOH Dosing valve 6 Position Percentage Indicator

2.5 NHLW DISPOSAL STATION

A. Summary:
   1. Non-Hazardous Liquid Waste is unloaded into the roll-off dumpster in the disposal station through the hatch doors by a Hydrovac truck. Solids are filtered and remain in the roll-off dumpster, and wastewater drains into the sump pit. The sump pit is connected to the plant's sanitary sewer line where the wastewater is carried to the influent pump station.

B. P&ID: none

C. Components:
   1. Instruments:
      a. NHLW Disposal Station H2S Concentration Sensor

D. Setpoints:
   1. High Level Concentration Setpoint: 10 ppm
   2. Very High Concentration Alarm Setpoint: 20 ppm

E. Control Modes:
   1. Alarms: The following alarms are available:

a. NHLW Disposal Station High H2S Concentration Alarm
b. NHLW Disposal Station Very High H2S Concentration Alarm

2.6 FUEL STORAGE TANK (AWRF)

A. Summary:
1. Diesel Fuel is pumped into the Fuel Storage Tank by the fuel delivery truck through the Inlet pipe. Fuel level and temperature are monitored. A driver can pump fuel out of the storage tank and into a vehicle using the compact fuel dispenser or the fuel outlet station. Once the driver activates the fuel nozzle or presses the button to activate the fuel outlet station, fuel is pumped out of the tank with a submersible turbine pump. Total volume dispensed is monitored using a flow meter and a flow totalizer. Fuel is constantly being recycled and filtered through the Fuel Polishing Unit.

B. P&ID: I-13.01

C. Components:
1. Equipment:
a. 12,000 gallon fuel storage tank
b. Mechanical overfill prevention valve
c. 2 Submersible turbine pumps
d. Compact fuel dispenser
e. Fuel Outlet Station
f. Fuel Polishing Unit
g. Local control panel
2. Instruments
a. Low level switch
b. High level switch
c. Level gauge
d. Level transmitter
e. Flow meter
f. Flow totalizer
g. Flow transmitter

D. Setpoints:
1. Low level switch: 5% of tank height
2. High level switch: 95% of tank height

E. Hard-wired Safety Interlocks:
1. When tank fluid level reaches low level and user is still pressing nozzle, pump will deactivate and fuel will stop being dispensed.
2. When tank fluid level is too low and user presses nozzle, pump will not activate.
3. When tank fluid reaches maximum fluid level, mechanical overfill prevention valve will close and no more fuel will be admitted in the tank.

F. Control Modes:
   1. Local Manual:
      a. The fuel dispensing submersible turbine pump is controlled manually at the local control panel or at the compact fuel dispenser. When the user presses the handle of the fuel nozzle, the fuel pump activates.
   2. Local Auto:
      a. None
   3. Remote Manual:
      a. None
   4. Remote Auto:
      1. None

2.7 MBR BIOREACTORS (OWRF)

A. Summary:
   1. Flow is conveyed from the Headworks Facility to the bioreactors. Flow is distributed to two existing bioreactors. There are seven existing mixers in each bioreactor. Four existing mixers are in the anoxic zone, two existing and one new mixer in the oxic zone. Internal Mixed Liquor Return (IMLR) pumps are being added to convey flow from the aerobic zone back the anoxic zone in the basins.

B. P&ID: I-3.20 thru 3.25.

C. Components:
   1. Equipment:
      a. Bioreactor No. 1 IMLR (IMLR-PMP-101).
      b. Bioreactor No. 2 IMLR (IMLR-PMP-201).
      c. Bioreactor No. 1 Submerged Mixer (MIX-410-181).
      d. Bioreactor No. 2 Submerged Mixer (MIX-410-281).

D. IMLR Pumps Set Points
   1. Constant Flow Set Point: 8.2 MGD to 16.4 MGD
   2. Percentage of Flow Set Point: 200-400 % of Plant Flow (MBR Plant)

E. Hard-Wired Safety Interlocks:
   1. The IMLR pumps and mixers will automatically stop on high stator temperature, and will not start again until the alarm is manually reset at the control panel.
   2. The IMLR pumps and mixers will automatically stop on stator leakage, and will not start again until the alarm is manually reset at the control panel.

F. Control Modes:
   1. Local Manual:
      a. Each IMLR pump is equipped with a LOCAL/OFF/REMOTE selector switch at the local control panel. The operators can select LOCAL and

then start/stop the IMLRs using the START/STOP push buttons at the local control panel.
1) Panel for Bioreactor 1 IMLR Pump.
2) Panel for Bioreactor 2 IMLR Pump.
3) Panel for Bioreactor 1 Mixer.
4) Panel for Bioreactor 2 Mixer.

b. Local manual control and indication for the IMLRs include:
1) Local/Off/REMOTE Selector Switch.
2) Start/Stop push buttons.
3) Speed Control via potentiometer
4) Run Status Indication.
5) Speed Indication.
6) VFD Fail Alarm.
7) Stator Leak Alarm.
8) High Temperature Alarm.

c. Local manual control and indication for the MIXERS include:
1) Local/Off/REMOTE Selector Switch.
2) Start/Stop push buttons.
3) Run Status Indication.
4) Fault Alarm

2. Local Automatic:
a. None.

3. Remote Manual:
a. If the LOCAL/OFF/REMOTE selector switch at the local control panel is in the REMOTE position, the operator can select start/stop the MIXERS, using the START/STOP push button at the PLC Workstation.
b. If the LOCAL/OFF/REMOTE selector switch at the local control panel is in the REMOTE position, the operator can select start/stop and adjust speed for the IMLRs PUMPS using the START/STOP PUSH BUTTON at the PLC Workstation. In Remote Auto Mode, the operator selects one of two modes:
1) IMLR FLOW AS PERCENTAGE OF PLANT INFLUENT FLOW: Provide an operator-adjustable setpoint for the desired percentage of influent flow to the MBR Bioreactor Basins that ranges from 200% to 400%, with a default of 400%. The IMLR Flow Rate Setpoint shall be defined as follows: (Process influent flow as measured by the Flow Transmitter) x (% of process influent flow setpoint).
2) CONSTANT FLOW SETPOINT: Provide an operator adjustable flow setpoint based on pump speed. The Constant Flow Set Point shall be between 8.2 MGD and 16.4 MGD.

4. PLC Status:
a. The following are displayed at the PLC for the IMLRs:
1) REMOTE Mode.
2) Run Status.
3) Speed Indication.
4) VFD Fail Alarm.

5) Stator Leak Alarm.
6) High Temperature Alarm.
7) Disconnect Switch Open Alarm

b. The following are displayed at the PLC for the Mixers:
1) Run Status
2) E-stop pushed Alarm
3) Leak Alarm
4) High Temperature Alarm
5) Overload Alarm

2.8 MLE IMLR VERTICAL TURBINE PUMP (OWRF)

A. Summary:
1. The internal mixed liquor recycle (IMLR) pumps return mixed liquor from the end of the biological basins to the first anoxic stage of the biological process. The IMLR Pumping system includes six existing vertical turbine axial flow pumps (PMP-419-001, PMP-419-002, PMP-419-003, PMP-419-004, PMP-419-005, OWRF-ANX04-PMP06) and one proposed vertical turbine axial flow pump, IMLR Pump No.7, located at the southwest end of the MLE Anoxic Basins. IMLR Pumps No. 1 and 2 feature variable speed drives, and Pumps No. 3, 4, 5, and 6 are constant speed. Proposed Pump No. 7 shall feature a variable speed drive.
2. The programming for the six existing pumps will be modified to function along with proposed Pump No. 7.
3. Flow switches will remain located on the discharge piping of each of the 6 existing pumps and one is to be located on the discharge piping of proposed Pump No. 7.

B. P&ID: I-25.01.

C. Components:
1. Equipment:

Item Description	Item Tag
IMLR Pump 7	*TBD*
IMLR Pump 7 Local Control Panel	*TBD*
IMLR Pump 7 Disconnect Switch	*TBD*
IMLR Pump 7 Seal Water Assembly	*TBD*
IMLR Pump 7 Seal Water Assembly Solenoid Valve	*TBD*
IMLR Pump 7 Seal Water Flow Switch #1	*TBD*
IMLR Pump 7 Flush Water Flow Switch #2	*TBD*
IMLR Pump 7 Low Flow Switch	*TBD*
IMLR Pump 7 Motor High Temperature Switch	*TBD*
IMLR Pump 7 Variable Flow Drive	*TBD*

2. Instruments:

Item Description	Item Tag	Units	Action	Setpoint	Range
Existing 36-Inch IMLR Magnetic Flow Meter	*OWRF-ANX04-FLM01*	gpm			Same As Existing

D. Safety Interlocks:
   1. Pump will automatically stop on VFD failure alarm and will not start again until the alarm is manually reset at the MCC.
   2. Pump will automatically stop if low seal water flow is detected for an adjustable time delay while the pump is running and will not start again until the alarm is manually reset at the MCC.

E. Control Modes:
   1. The pumps are operated in HAND mode by placing the HAND-OFF-AUTO selector switch in the HAND position at the VFD/MCC. The operator can Start/Stop the pump using the Start/Stop pushbuttons.
      a. Pumps 1,2 & 7 speed can be controlled using the potentiometer at the VFD.
   2. The pumps are operated in Remote mode by placing the HAND-OFF-AUTO selector switch in the AUTO position at the MCC/VFD. The operator selects the duty pump and the standby pump from the PCIS interface. The operator then selects Auto or Manual.
      a. In Remote Auto Mode, the operator selects one of two modes:
         1) IMLR FLOW AS PERCENTAGE OF PLANT INFLUENT FLOW: Provide an operator-adjustable setpoint for the desired percentage of plant influent flow that ranges from 100% to 350%, with a default of 300%. The IMLR Flow Rate Setpoint shall be defined as follows: (Process influent flow as measured by the Existing Total Plant Flow Transmitter FIT-419-114) x (% of process influent flow setpoint). The PLC shall control the number of duty pumps and their speed to achieve the adjusted IMLR Flow Rate Setpoint by using a PID controller.
         2) CONSTANT FLOW SETPOINT: Provide an operator adjustable flow setpoint based on pump speed. The PLC shall control the number of duty pumps and their speed to achieve the IMLR Flow Rate Setpoint by using a PID controller.
      b. Minimum Speed: The VFD controlled pumps' minimum speed shall not be less than the pump manufacturer's minimum recommended speed. Not to replace minimum speed setting in VFD.
      c. Seal water:
         1) When a pump is in REMOTE mode and called to start, open the seal water solenoid valve. After the seal water solenoid is opened, the PLC program shall delay the pump start by 10 seconds.

2) When a pump is in HAND mode and called to start, open the seal water solenoid valve. No delay for pump start in HAND mode.
3) When the pump is called to stop, close the seal water solenoid valve without delays in both REMOTE and HAND modes.
4) If low seal water flow is detected for an adjustable time delay (0 to 60 seconds, default 15 seconds) while the pump is operating, shut down the pump.

d. The PLC shall incorporate a PID control algorithm for each pump. The PID algorithm will be based on the flow as measured at IMLR flow meter OWRF-ANX04-FLM01. The operator shall input the following:
   1) Desired flow rate from the anoxic basin, which shall be maintained until a new flow rate is input.
      a) Lead VFD, 5,500 gpm pump.
      b) Order of the 8,500 gpm pumps.
      c) PID Control Deadband: The PID control algorithm shall not change its control output until the flow rate setpoint is outside the range of the PID set point plus or minus the PID control deadband.

e. The pumps shall be matched to the flow rate entered corresponding to the combinations listed in the table below. If additional flow range coverage is required, both VFD driven pumps can be run simultaneously. It is recommended that if both VFD driven pumps are running that there speed be matched.

Pump Combinations	
Description	**IMLR Pumps**
Design Maximum, gpm	45,000
Minimum, gpm	2,700
Maximum Pumps, Variable Speed	2 @ 5,500 gpm (Pumps 1 and 2), 1 @ 8,500 gpm (Pump 7)
Maximum Pumps, Constant Speed	3 @ 8,500 gpm, includes 1 @ Standby (Pumps 3, 4, 5, 6)
2,700 to 5,499 gpm	Pump 1, 2, or 7@ Reduced Speed
5,500 gpm	Pumps 1 or 2, or Pump 7 @ Reduced Speed
5,501 to 8,499 gpm	Pump 1, or 2 & Pump 1, 2, or 7 @ Reduced Speed, or Pump 7 at Reduced Speed
8,500 gpm	Pump 3, 4, 5, 6, or 7
8,501 to 13,999 gpm	Assuming Pump 7 @ Full Speed: Pump 3, 4, 5, 6, or 7 & Pump 1 or 2 @ Reduced Speed Assuming Pump 7 @ Reduced Speed: Pump 3, 4, 5, or 6 & Pump 1, 2, or 7 @ Reduced Speed
14,000 gpm	Assuming Pump 7 @ Full Speed: Pump 3, 4, 5, 6, or 7 & Pump 1 or 2
14,001 to 16,999 gpm	Assuming Pump 7 @ Full Speed: Pump 3, 4, 5, 6, or 7 & Pump 1 or 2 & Pump 1 or 2 @ Reduced Speed Assuming Pump 7 @ Reduced Speed: Pump 3, 4, 5, or 6 & Pump 1, or 2 & Pump 1, 2 or 7 @Reduced Speed
17,000 gpm	Assuming Pump 7 @ Full Speed: Pump 3&4, 3&5, 3&6, 4&5, 4&6, 5&6, 3&7, 4&7, 5&7, or 6&7
17,001 to 22,499 gpm	Assuming Pump 7 @ Full Speed: Pump 3&4, 3&5, 3&6, 4&5, 4&6, 5&6, 3&7, 4&7, 5&7, or 6&7 & Pump 1 or 2 @ Reduced Speed Assuming Pump 7 @ Reduced Speed: Pump 3&4, 3&5, 3&6, 4&5, 4&6, or 5&6 & Pump 1, 2, or 7 @ Reduced Speed
22,500 gpm	Assuming Pump 7 @ Full Speed: Pump 3&4, 3&5, 3&6, 4&5, 4&6, 5&6, 3&7, 4&7, 5&7, or 6&7 & Pump 1 or 2
22,501 to 25,499 gpm	Assuming Pump 7 @ Full Speed: Pump 3&4, 3&5, 3&6, 4&5, 4&6, 5&6, 3&7, 4&7, 5&7, or 6&7 & Pump 1 & 2 @ Reduced Speed Assuming Pump 7 @ Reduced Speed: Pump 3&4, 3&5, 3&6, 4&5, 4&6, or 5&6 & Pumps 1&2, 1&7, 2&7, or Pump 7 @ Reduced Speed
25,500 gpm	Assuming Pump 7 @ Full Speed: Pump 3,4&5, 4,5&6, 3,5&6, 3,4&6, 3,4&7, 3,5&7, 3,6&7, 4,5&7, 4,6&7, or 5,6&7
25,501 to 30,999 gpm	Assuming Pump 7 @ Full Speed: Pump 3,4&5, 4,5&6, 3,5&6, 3,4&6, 3,4&7, 3,5&7, 3,6&7, 4,5&7, 4,6&7, or 5,6&7 & Pump 1 or 2 @ Reduced Speed

	Assuming Pump 7 @ Reduced Speed: Pump 3,4&5, or 4,5&6, or 3,5&6 or 3,4&6 & Pump 1, 2, or 7 @ Reduced Speed
31,000 gpm	Assuming Pump 7 @ Full Speed: Pump 3,4&5, 4,5&6, 3,5&6, 3,4&6, 3,4&7, 3,5&7, 3,6&7, 4,5&7, 4,6&7, or 5,6&7 & Pump 1 or 2
31,001 to 36,499 gpm	Assuming Pump 7 @ Full Speed: Pump 3,4&5, 4,5&6, 3,5&6, 3,4&6, 3,4&7, 3,5&7, 3,6&7, 4,5&7, 4,6&7, or 5,6&7 & Pump 1 & 2 @ Reduced Speed Assuming Pump 7 @ Reduced Speed: Pump 3,4&5, or 4,5&6, or 3,5&6 or 3,4&6 & Pump 1&2, 1&7, or 2&7 @ Reduced Speed
36,500 gpm	Assuming Pump 7 @ Full Speed: Pump 3,4&5, 4,5&6, 3,5&6, 3,4&6, 3,4&7, 3,5&7, 3,6&7, 4,5&7, 4,6&7, or 5,6&7 & Pump 1 & 2
36,501 to 45,000 gpm	Pump 3,4&5, 4,5&6, 3,5&6, 3,4&6, & Pump 1& 2 & Pump 7 or Pump 7 @ Reduced Speed

f. Once the pump combination is selected, the speed of the Lead VFD, 5,500-gpm pump shall be varied to maintain the input mixed liquor flow rate. The speed will range from approximately 75 percent to full speed.
g. A check of the pump flow rate will be determined by looking at the pump discharge flow meter (OWRF-ANX04-FLM01). When the IMLR flow rate is compared with this sum, if the difference is greater than 10 percent (is a password protected number that can be changed), all operating pumps should be stopped.
h. In Remote Manual Mode, the operator inputs the desired pump speed and Starts/Stops the respective pump.

3. Placing the HAND-OFF-AUTO selector switch in the Off position will prevent the pump from running in any mode.
4. The following features will be available at the motor control center (MCC, in electrical enclosure), local control panel (LCP, at equipment) and PCIS.
   a. At the MCC for each IMLR pump:
      1) Start/Stop Push Buttons.
      2) HAND-OFF-AUTO Selector Switch.
      3) VFD Failure Alarm Indicator Light.
      4) Pump Running Indicator Light.
      5) Speed Indication.
      6) Speed Command.
      7) Alarm Reset Push Button.
   b. At the Local Control Panel:
      1) E-Stop Push Button.
      2) Pump Running Indicator Light.
   c. At PCIS:
      1) Pump In Remote Status.
      2) Pump Start/Stop Command.

3) Pump Running Status.
4) Pump VFD Failure Alarm.
5) Pump Speed Indication.
6) Pump Speed Command.
7) Manual/Automatic Mode Select.
8) Percentage of Flow/Constant Mode Select.
9) NH4 Level.
10) NO3 Level.
11) DO Level.
12) Recycle Flow.

F. Set Points:
1. Constant Flow Set-Point = 4 MGD to 40 MGD.
2. Percentage of Flow Set Point = 100-400% of Plant Flow.

2.9 SECONDARY CLARIFIERS (OWRF):

A. Summary:
1. The secondary clarifiers are designed to separate solids contained in the system mixed liquor from the treated wastewater by gravity settling. The solids settle and are continuously removed from the bottom of the clarifier to the RAS/WAS pump station for reuse and disposal while clarified effluent passes on to the filtration process. There are four existing secondary clarifiers. The mechanism in Clarifiers No. 3 will be replaced as part of the WRF Improvements Phase 3.

B. References:
1. P&ID: I-27.01
2. Section 11335 Secondary Clarifier Mechanism.

C. Process Description:
1. The secondary clarifier is controlled from the Motor Control Panel (MCP). Torque monitoring is available at both the MCP and PCIS. The system once started runs continuously. The operator can vary RPM of the clarifier by adjusting the VFD settings at the MCP.

D. Components:
1. Instruments:

Item Description	Item Tag	Units	Action	Setpoint	Range
Clarifier 3 Torque Transmitter	*TBD*	mA	Relay to PCIS	NA	4-20
Clarifier 3 High Torque Switch	*TBD*	%	High Torque ALARM	100% of continuous operating torque	0-200

Clarifier 3 High High Torque Switch	*TBD*	%	High High Torque ALARM and Motor SHUTDOWN	125% of continuous operating torque	0-200

2. Equipment:

Item Description	Item Tag
Clarifier 3 Rake Mechanism	*TBD*
Clarifier 3 Rake Drive Motor Control Panel	*TBD*

E. Safety Interlocks:
   1. The clarifier will stop automatically on motor overload alarm and will not start again until the alarm is manually reset at the MCP.
   2. The clarifier will automatically stop on high-high torque alarm and will not start again until the alarm is manually reset at the MCP.

F. Operating Controls
   1. Clarifier:
      a. The operator can Start/Stop the clarifier only by switching the On/Off Selector Switch at the MCP.
      b. PCIS will monitor torque data from each clarifier continuously, display it at the HMI and store it.

G. Control Modes:
   1. General:
      a. Only monitoring at PLC and PCIS
      b. The following features will be available at the motor control panel (MCP), the programmable logic controller (PLC) and PCIS:
         1) At MCP for the clarifier:
            a) ON/OFF Switch
            b) RESET Push Button
            c) VFD Speed Control
            d) High Torque Alarm Indicator Light
            e) High-High Torque Alarm Indicator Light
            f) Running Light
            g) VFD Fail Alarm Light
            h) Shutdown Indicator Light
            i) Torque Indicator Display
            j) Speed Indication
         2) At PLC and PCIS:
            a) Running Indication
            b) High-High Torque Shutdown Indication
            c) High Torque Warning Indication
            d) VFD Fault Alarm Indication
            e) Torque Indication

2.10 FUEL STORAGE TANK (OWRF):

A. Summary:
   1. Diesel Fuel is pumped into the Fuel Storage Tank by the fuel delivery truck through the Inlet pipe. Fuel level and temperature are monitored. A driver can pump fuel out of the storage tank and into a vehicle using the compact fuel dispenser or the fuel outlet station. Once the driver activates the fuel nozzle or presses the button to activate the fuel outlet station, fuel is pumped out of the tank with a submersible turbine pump. Total volume dispensed is monitored using a flow meter and a flow totalizer. Fuel is constantly being recycled and filtered through the Fuel Polishing Unit.

B. P&ID: I-33.01

C. Components:
   1. Equipment:
      a. 10,000 gallon fuel storage tank
      b. Mechanical overfill prevention valve
      c. 2 Submersible turbine pumps
      d. Compact fuel dispenser
      e. Fuel Outlet Station
      f. Fuel Polishing Unit
      g. Local control panel
   2. Instruments
      a. Low level switch
      b. High level switch
      c. Level gauge
      d. Level transmitter
      e. Flow meter
      f. Flow totalizer
      g. Flow transmitter

D. Setpoints:
   1. Low level switch: 5% of tank height
   2. High level switch: 95% of tank height

E. Hard-wired Safety Interlocks:
   1. When tank fluid level reaches low level and user is still pressing nozzle, pump will deactivate and fuel will stop being dispensed.
   2. When tank fluid level is too low and user presses nozzle, pump will not activate.
   3. When tank fluid reaches maximum fluid level, mechanical overfill prevention valve will close and no more fuel will be admitted in the tank.

F. Control Modes:
   1. Local Manual:

a. The fuel dispensing submersible turbine pump is controlled manually at the local control panel or at the compact fuel dispenser. When the user presses the handle of the fuel nozzle, the fuel pump activates.

2. Local Auto:
   a. None
3. Remote Manual:
   a. None
4. Remote Auto:
   a. None.

PART 3 - EXECUTION (NOT USED)

++ END OF SECTION ++

SECTION 17456

PROGRAMMING GENERAL

PART 1 - GENERAL

1.1 PROGRAMMING REQUIREMENTS

A. The software development and programming of the control functions shall be completed by the date defined in the Contract Documents. PLC programs and HMI/OIT configuration software shall meet the performance requirements described herein, and the control needs of the Owner.

B. The control descriptions provided in the Contract Documents do not provide every programming detail such as timers, function blocks, coils, contacts, or other logic elements that are required to write and implement complete PLC programs. The control descriptions are intended to describe the overall functional capability of the particular process being described. Communication with the Owner and the Engineer shall be necessary to convey the additional information needed to produce the working PLC programs.

C. Any discrepancies in these documents shall be brought to the attention of the Engineer, in writing. The Engineer will then issue further explanation. The decision of the Engineer will be final.

D. Control logic shall be programmed, furnished, and installed as specified. The Contractor shall be required to test and demonstrate to the satisfaction of the Engineer that the control logic functions as specified.

E. The PLC programs shall meet industry norms, and function in such a way as to maintain safe and reliable operation of the equipment they are designed to control. If the Engineer determines that the control logic and PLC programming fails to perform the functions described herein in a safe and reliable manner, the Contractor shall modify and correct the programs.

F. Set points for analog control loops shall be displayed in digital form on the screen, similar to a single loop controller display. Additionally:
   1. Automatic and manual loop control shall be available.
   2. The display will show the current set point, current output value, and the current process variable input values for each respective control loop.
   3. The operator shall be able to take the loop out of the automatic mode, and drive the output signal manually from the HMI/OIT. The transfer from automatic to manual shall be “bumpless”.
   4. PLC Analog loops with PID (proportional, integral, and derivative) control shall be tunable from the HMI/OIT. Tuning of the PID loops shall be

completed before Substantial Completion. The PID loops shall meet the following performance requirements:

a. No more than two major process variable overshoots shall be permitted after a process upset, or a set point change. The peak overshoot shall not exceed the process variable set point value by more than 7 percent of its value.
b. A major process variable overshoot is defined as a process variable time-domain measurement that exceeds the process variable set point by more the ±2 percent of the set point's value.
c. The process variable shall settle to within ±2 percent of the set point value within a period of time (or oscillation) that is acceptable for the process control application, and as defined by the Engineer. The period of oscillation shall be adjustable by tuning the integral rate (or reset rate) of the PID loop.

5. Set points for timers, counters, levels, speed, and other variables shall be adjustable from the HMI/OIT screens by the Operator. Set point screens shall be password protected.

G. Integer or floating point values, from analog or totalized tags, shall be formatted to display at least three (3) significant digits. For example, a wet well level value shall be displayed as "14.7 FEET", or a pump flow rate shall be displayed as "1,591 GPM".

H. The PLC shall not be able to control any equipment item that is not in the Auto or Remote mode.

I. The PLC shall be programmed to monitor each of the analog signal inputs for instrument failures. If the input signal falls below 4 milliamps due to a short circuit, or an open current loop, the PLC shall produce an alarm signal to the HMI/OIT.

J. All motorized equipment will have Accumulation Runtime Counters associated with them, except for motor operated valves.

K. The Contractor shall be responsible for acquiring the services of a PLC programmer.

1.2 APPLICATION PROGRAMMING SOFTWARE

A. Refer to the Contract Documents and P&IDs for the process control descriptions and functional requirements to be implemented.

1. Furnish and install complete packages of the latest versions of Programming Software using PLC specification section 17461
2. PLC Programming
   a. Submit 2 copies of the PLC programs for review, prior to installation. The PLC programs shall be fully documented with unique symbol names for each program element (coils, contacts, inputs, outputs, etc.),

and comments for logic elements. The comments shall clearly describe the function of the logic, so that another Programmer can understand the logic and be able to debug and modify the programs at a later date.

b. Once the programs have been reviewed, comments and changes shall be incorporated into the programs and submitted for a final review. Upon final review of the programs, install the programs in the PLC to test the control logic using simulated I/O.

3. Provide instruction, maintenance manuals and diagrams for supplied programs, device drivers, and custom designed subprograms and device drivers developed for this project. Provide all materials in one or more three-ring binders. Separate sections by laminated numbered or descriptive tabs, with a table of contents to aid the user in finding specific information. Three-ring binders shall have labels on the spine identifying the contents of each volume.
4. Submit a training schedule in accordance with these Specifications.
5. Submittals shall be complete, neat and orderly.
6. Submit two CD-ROM/DVD copies of the PLC and HMI/OIT software programming in their final configuration. Also, submit all original software registered in the Owner's name, and all original documentation that accompanies the original software disks.

1.3 ON-SITE TRAINING

A. Arrange for instruction of the Owner's designated personnel. The instruction shall commence within 30 days of Owner request. Training shall include a minimum of 4 hours of owner training.

B. The Owner reserves the right to split training periods to accommodate personnel schedules.

C. The training sessions shall be structured to provide the Owner's personnel with a maximum of hands-on experience.

D. Control System Overview training shall consist of the following topics:
1. Definition of control modes such as AUTO, MANUAL, LOCAL, and REMOTE.
2. Entering and changing set points.

E. Provide the Owner with the ability to program the PLC, add new network components and PLCs as needed for future expansion of the system, and update or modify any HMI/OIT Screen to accommodate future expansion.

1.4 START-UP SUPPORT

A. The Contractor shall have field service and programming personnel on-site to provide start-up and commissioning services for a period of at least 90 days. The

start-up service shall be coordinated with the Engineer. The start-up service shall be required prior to starting the final acceptance test.

1.5 PROGRAMMING SUPPORT

A. The Contractor shall be available to provide programming services for a period of at least 90 days. The start of this service shall commence after successful completion of the final acceptance test. This service shall consist of:
   1. Furnishing additional programming that may be required.
   2. Assisting Owner's personnel with additional technical support and training.

1.6 FACTORY WITNESS TESTING

A. Hardware and software components of the PLC System shall be thoroughly tested and "burned in" at the factory by the Contractor. Inform the Engineer 10 working days prior to the testing of the equipment. The Engineer and Owner shall witness these tests before shipment to the site. Provide copies of all test reports to the Engineer.

B. The Contractor shall be responsible for all transportation, meals, and accommodation expenses for the Owner's and Engineer's representative witnessing the factory test.

1.7 ON-SITE TESTING

A. On-site testing of the PLC system shall be performed prior to the final acceptance test. Submit a testing schedule detailing the timing and extent of the proposed testing and the test procedures to be followed.

B. Prior to the final acceptance test, the Engineer will review the status of the PLC system and determine if the final acceptance test can be performed. All primary elements shall be calibrated and all I/O signals shall be fully functional prior to the start of the final acceptance test.

C. Perform the PLC system final acceptance test and confirm the operation of all control loops, primary elements, control functions and sequences, and monitoring functions required of the complete PLC system. The PLC and HMI/OIT shall be operated continuously throughout the test without software or hardware failure. In the event of a failure, the acceptance test shall be terminated, the hardware or software failure shall be corrected, and the acceptance test shall be restarted. The Engineer and the Owner shall determine if it is necessary to restart the test at the first day of the test.

1.8 ACCEPTABLE PROGRAMMERS

A. Vertech

B. Prime Controls

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

++ END OF SECTION ++

SECTION 17461

PROGRAMMABLE LOGIC CONTROLLER SYSTEM (M340)

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes solid state programmable controller.

B. PLC Assembly: Provide a PLC assembly, as shown on the Drawings. A PLC assembly consists of PLC processor, discrete and analog I/O bases, communication ports, and power supplies.

C. PLC assembly shall be mounted in a PLC NEMA 12 enclosure, as shown on the Plans.

1.2 SUBMITTALS

A. Design Data:
   1. Modbus TCP/IP addressing scheme.
   2. Modicon M340 PLC I/O and communication configuration.

B. Operating and Maintenance Manuals: Submit complete Operation and Maintenance Manuals in conformance with the Operation and Maintenance Manuals section of Section 01300, Submittals. Include the following:
   1. Programming procedures.
   2. System specifications.
   3. Electrical power requirements.
   4. Submit per Section 01300, Submittals.

C. Shop Drawings: Submit for approval the following:
   1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification

sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

2. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**

1.3 PLC HARDWARE AND OPERATING SOFTWARE

A. Provide programmable logic controller system components by a single manufacturer.

B. Provide programmable logic controller system manufacturer approved hardware, such as cable, mounting hardware, connectors, enclosures, racks, communication cable, splitters, terminators, and taps.

C. Programmable Logic Controller System Manufacturer: Modicon M340 CPU BMX P34 2010 minimum, or as shown on the Drawings.

D. Extend existing City software license as required by manufacturer's copyright for use with equipment provided under this Contract.

1.4 ENVIRONMENTAL REQUIREMENTS

A. Environmental Rating for Components of the Programmable Logic Controller System, except the Programming Equipment:
   1. Humidity: Maximum 95%, non-condensing.
   2. Ambient Temperature:
      a. Operational: 0° C to 60° C.
      b. Storage: -40° C to 80° C.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Programmable Logic Controller System: Modicon M340 PLC minimum, or as shown on the Drawings; no substitutions permitted.

PART 3 - PROGRAMMABLE LOGIC CONTROLLER SYSTEM DESCRIPTION

A. Programmable Logic Controller System: Underwriter Laboratories listed and CSA approved; Modular, capable of field expansion with additional hardware and software to allow tailoring of the system to process control applications.

B. When Programmable Logic Controller Loses DC Power:

1. Outputs shall immediately turn off (De-energize).
2. Internal battery shall provide power to retain user logic, controller configuration information, and data register contents for at least nine months.

C. Diagnostic LEDs: Capable of indicating major status conditions of the programmable logic controller.
1. Upon power-up or power recovery, the programmable logic controller shall self-test operation of the microprocessor, check memory for integrity, verify communication between boards, and reset and resume the logic solving scan only when satisfactory.
2. During each processing cycle, the programmable logic controller shall execute diagnostic routines or critical components within the system. Run time diagnostics shall determine causes of errors, flag causes, and locate failed I/O modules.
3. Diagnostic information shall be available to maintenance personnel through the use of a computer based interface or other memory access devices.

D. Memory Capacity: Maximum 75% design utilization.

3.2 PROCESSOR

A. PLC processors shall be Modicon Compact Model BMX P34 2010 minimum unless designated otherwise on the Drawings. Provide an exterior mounted communication port suitable for programming the CPU with the programming computer defined in these Specifications. The PLCs shall be capable of performing logic control functions described in these Specifications based upon the program stored in memory and the status of I/Os.

B. Upon processor shutdown, outputs shall de-energize and go into a safe shutdown mode.

C. Processor: Capable of being programmed by one or more of the following:
1. IBM compatible PC with RS-232 Serial, or Ethernet or USB serial comms.

D. Minimum Processor Standard Control Functions:
1. Relay ladder logic.
2. Latch/unlatch relays.
3. Timers (0.01 sec., 0.1 sec., and 0.1 min.).
4. Counters (up/down).
5. Data comparisons/transfers.
6. Synchronous shift registers (forward/reverse).
7. Transitional output.
8. Master control relay.
9. Bit read and control.
10. I/O forcing.
11. BCD to binary and binary to BCD conversion.
12. Immediate I/O update.

13. Run mode programming.

E. Additional Processor Features:
   1. Computer/Network Communication Interface.
   2. ASCII output (data handling and report generation).
   3. Protected logic.
   4. Proportional Integral Derivative Process Control.
   5. Multiple Function Integer and Floating Point Math.

F. Processor: Capable of addressing I/O modules and PLCs using Modbus TCP/IP communications network.

G. All control functions at the respective well site shall be resident at the respective processor.

3.3 PROGRAM STORAGE

A. Solid state RAM (volatile) type.

B. RAM Battery Backup: Capable of retaining stored program information through a continuous power outage of at least nine months.

C. Memory Word: Comprised of 16 data and 2 parity bits.

D. Logic Words: Checked for parity upon being read from memory. Detection of a parity error shall cause immediate system shutdown and be indicated by a visual display.

E. The system shall have the capability to program software timers and counters into memory.

F. Timer Time Bases: Selectable from 0.01 second, 0.1 second, and 0.1 minute, minimum.

3.4 INPUT AND OUTPUT - GENERAL

A. Input or Output: Modules configured to process discrete inputs, discrete outputs, and analog inputs and analog outputs shown on Instrumentation Drawings. Input and output modules shall be Modicon and specifically recommended for Modicon M340 PLC platform.

B. During normal operation, a malfunction in a remote I/O channel shall affect the operation of only the malfunctioning channel and not the operation of the CPU or other channels.

C. Upon remote channel shutdown the processor shall see inputs as de-energized on the malfunctioning channel and outputs shall de-energize on the malfunctioning channel.

D. User Wiring to I/O Modules: Through a heavy-duty terminal strip.

E. Power Input: 24VDC protected against short circuits with integral overcurrent and overvoltage protection.

F. Cables, Terminators, Connectors, Miscellaneous Hardware: Provide complete PLC assembly ready for use and mounting within a CONTRACTOR supplied panel.

3.5 MODICON M340 HARDWARE COMPONENTS

A. Modicon Part Numbers:

Part No.	Description
RACK	BMX XBP 0400 – 1200 Rack
PS24	BMX CPS 2010 24VDC Power Supply
PS120	BMX CPS 2000 120VAC Power Supply
DI	BMX DDI 1602 16 Point 24 VDC Sinking Discrete Input Module
DO	BMX DDO 1602 16 Point 24 VDC Sourcing Discrete Output Module
AI	BMX AMI 0410 4 Channel 4-20 mA Analog Input Module
AO	BMX AMM 0410 4 Channel 4-20 mA Analog Output Module
OIT	Modicon Magelis - Color Touchscreen (10-inch minimum display size preferred)

3.6 ETHERNET MODULE CNOE-211

A. Analog inputs shall have a minimum of 12 bits resolution and shall be configurable for 4 to 20 mA DC. The analog input shall be Modicon AMI 0410 and shall be configured for current input by inserting the appropriate jumper settings on the module for the channels that will be in use. Ground the shield of each signal cable at the AMI 0410 only. Provide external or user power as needed.

B. The analog outputs shall have four independently configurable channels and can provide true 12 bit resolution with high an accuracy of (+0.2% of full scale @ 25° C).
   1. The module will have the capability of detecting open current loop (broken wire) detection and warnings via LEDs and registers. The analog output shall be a Modicon AMM 0410 and shall be configured for current output by setting the appropriate jumper settings on the module for the channels that will be in use.

C. The discrete input shall be Modicon DDI 1602 Input and shall have 16 Optocoupled Isolated Inputs. Module response time shall be 4 ms typical. Equipment installation following approved EMC practices; i.e., protective earthing and functional earthing, connections with good conductivity, and grounding cables of sufficient cross section. Use manufacture-approved cabling. Cable routing; i.e., separation of the data and

signal lines from cables, which emit disturbances (e.g., power cables with switching transients). Provide external or user power as needed.

D. 16-point Output Module: Source voltage for any output load shall be 24 VDC. Manufacture recommendations and practices will be followed. Equipment installation following approved EMC practices; i.e., protective earthing and functional earthing, connections with good conductivity, and grounding cables of sufficient cross section. Use manufacture approved cabling. Cable routing; i.e., separation of the data and signal lines from cables, which emit disturbances (e.g., power cables with switching transients).

E. Indicator lights shall also be provided on each I/O point to indicate status of each signal. Each individual input or output point shall be optically isolated to protect the controller I/O circuitry from high voltage transients. External wiring shall terminate on removable terminal strips, or swing arms to allow quick installation, or extraction of I/O modules without disconnecting field wiring. Labels shall be provided on modules, or wiring arms that indicate the I/O address of each termination.

3.7 PROGRAMMING SOFTWARE

A. See Specification 17452, Modicon Unity PLC Systems Software and Accessories.

3.8 OIT (Operator Interface Terminal)

A. Manufacturer/Model: Modicon Magelis Model HMIGTO5310.
   1. Display: Color, touchscreen (10-inch minimum display size preferred).
   2. Include the necessary software and software interfaces communications with OIT operator interface terminal

PART 4 - EXECUTION

4.1 SPARES

A. Furnish a minimum of 3 spare I/O module of each type provided.

B. Furnish a minimum of 1 Network/Communications card in the system.

C. Furnish a minimum of 1 spare PLC Chassis in the system.

D. Furnish 12 fuses of each type and size used on I/O modules power and inputs.

E. Furnish one spare processor of each type.

4.2 INSTALLED SPARE REQUIREMENTS:

A. I/O Points:

1. Provide total of 25 percent spare I/O capacity for each type of I/O at every PLC and remote inputs and outputs (RIO).

B. Wire all spare I/O points to field terminal blocks in the same enclosure the PLC resides in.

4.3 PLC BACKPLANE CAPACITY

A. Provide 25-percent or 3 spare backplane slots, whichever is greater in all racks containing I/O.

4.4 PLC MEMORY

A. Provide 50-percent spare program volatile memory.

++ END OF SECTION ++

EXHIBIT D

ACCEPTED GMP/PRICE PROPOSAL

City of Chandler

WRF Improvements Phase 3

Lump Sum Proposal: Long-Lead Equipment Procurement and Wilson Balance of Plant

Owner:
City Project Manager: Adam Kleiser
City Project No. WW2401.251
Submitted August 27,2026

Prepared by:
McCarthy Building Companies
6225 N 24th Street, Suite 125
Phoenix, Arizona 85016

Engineers:
Wilson Engineers
1620 W Fountainhead Pkwy., Suite 501
Tempe, AZ 85282



Table of Contents

1. Project Description
2. Cost Summary
3. Tax Credit Evaluation
4. Work Category Schedule of Values
5. Work Category Breakout (as applicable)
    a. Solicitation Invite Summary
    b. Scope Sheet
    c. Work Category Clarifications
6. Project Schedule
7. Plans and Specifications
8. Qualifications and Assumptions Summary
9. Question and Answer Log
10. Rate Sheets



City of Chandler

WRF Improvements Phase 3

Project Description

Chandler WRF Improvements Phase 3
Project Description

The Chandler WRF Improvements Phase 3 project provides process, electrical, and control system upgrades at the Airport Water Reclamation Facility (AWRF) and Ocotillo Water Reclamation Facility (OWRF) to improve the use of the City of Chandler's reclaimed water resources and replace aging infrastructure. Phase 3 work supports the ongoing modernization of critical treatment systems while maintaining reliable plant operations and coordinating improvements across multiple active process areas.

Long-Lead Equipment Procurement

This scope provides procurement necessary to maintain project schedule and minimize operational disruption at AWRF and OWRF. This proposal includes:

- **Long-lead equipment and materials procurement** for critical process and electrical upgrades at both facilities, including (as applicable):
    - Clarifier Drain Plug Valves and Actuators
    - Vertical turbine pump
    - Diffusers and aeration equipment
    - Disc filter #6
    - Clarifier mechanisms
    - MCCs and major electrical gear identified in the Wilson scope of work
- Early submittals, coordination, and services tied to these long-lead items to align future construction sequencing with plant operational requirements.

Wilson Scope: Balance of Plant

Proposal focuses on the balance-of-plant construction scope required to advance the Phase 3 improvements at AWRF and OWRF.

This proposal includes:

- **Airport WRF** improvements include the following scope items:
    - Influent Pump Station
        - Hatch and T-Lock Repair
    - Headworks
        - Remove and replace grating with FRP covered grating
        - Reroute foul air suction to under covers
    - Aeration Basins
        - Replace fine bubble diffusers and piping for Basins 5 & 6
    - Disc Filters
        - Install sixth filter and ancillary equipment
        - Replace disc filter monorail festoon with conductor bar
    - Clarifiers No. 1-4
        - Replace mechanisms in four clarifiers
        - Replace underground RAS valves for two clarifiers
    - Chemical Storage and Feed System
        - Install chemical feed loop system for NaOH and NaOCl dosage to Headworks, Pre-Stage Basins 1 & 2 odor control scrubbers
    - Fuel Storage System

        - Install 12,000 gal system
    - Site Piping
        - Ancillary work to facilitate other improvements on site
    - Electrical and Instrumentation
        - Ancillary work to facilitate other improvements on site
    - Miscellaneous Site Work
        - Add stairs to Pre-Stage Basin no. 2
- **Ocotillo WRF** improvements include the following scope items:
    - Electrical Improvements
        - MLE power distribution in new MLE Electrical room to refeed MLE Site
        - Tie in MLE power feed into the MBR Switchgear with Generator backup
        - Install two new transformers outside the new MLE Electrical room to feed the new MLE Switchgear
        - Re-feed existing Aeration Bower MCC No. 1 and 2
        - Re-feed existing Dewatering MCC No. 1 and 2
        - Replace the MLE effluent pump station MCC No. 1 and 2
        - Replace the MLE Aeration Basin MCC No. 1 and 2
        - Replace MCC T1 and T2 with new PDP
        - Replace MCC H1 and H2 with new PDP
        - Replace MCC P wit new PDP
        - Replace MCC POC with a new lighting panel
        - Ancillary EI&C as required to facilitate work throughout site
    - Clarifier No. 3
        - Convert to spiral scraper type mechanism
    - Fuel Storage System
        - Furnish 10,000 gal station
    - MLE IMLR Pump Station
        - Install a 7^{th} pump
    - Bio Reactor Improvements
        - Install new IMLR Pump to MBR Basins 1 & 2
        - Aeration Upgrades
        - Concrete Bridge Modifications
    - Effluent Pump Station Rehab
        - Rehab the structural beam underneath the electrical room at the effluent pump station
    - Sitework
        - Ancillary yard piping and site work to facilitate other scope items



City of Chandler

WRF Improvements Phase 3

Project Cost Summary

LUMP SUM COST SUMMARY

Project Name:	**Chandler Water WRF Phase 3 Improvements**		
Project Location:	**Chandler, AZ**	*Date:*	**September 18, 2026**
City of Chandler Project No:	**WW2401.251**	*Rev:*	**0**

			Amount
A. Cost of Work			
A1	Long Lead Equipment		$9,027,940
A2	Wilson Balance of Plant		$28,545,971
	TOTAL COST OF WORK:		**$37,573,911**
B. General Conditions			
B1	Staff Cost		$5,120,866
B2	General Conditions Support Costs		$700,686
	Total General Conditions		***$5,821,552***
	SUBTOTAL 1 (Cost of the Work) (A + B):		**$43,395,463**
C. CM@Risk's Fee		7.5%	**$3,254,660**
	SUBTOTAL 2 (A + B + C):		**$46,650,123**
D. Bonds and Insurance (on Lump Sum Proposal)			
D1	Bonds (Payment and Performance)		$318,222
D2	Insurance (PL/PD, Builders Risk)		$1,001,578
	TOTAL BONDS & INSURANCE:		***$1,319,800***
	SUBTOTAL 3 (SUBTOTAL 2 + BONDS & INS):		**$47,969,922**
E. Sales Tax (on Lump Sum Proposal)			
E1	Sales Tax Gross Receipts (65% of 7.8%)		$2,432,075
E2	Tax Credits From Evaluation Sheet		($501,998)
	TOTAL SALES TAX:		***$1,930,078***
F. Approved Allowances			
F1	Owner Allowance		$900,000
F2	Other Allowance		$0
F3	Design Phase Allowance		$0
F4	Escalation Allowance		$0
	TOTAL ALLOWANCES:		**$900,000**
G. Contingencies			
G1	Contractor's Contingency		$0
	TOTAL CONTINGENCIES:		**$0**
	TOTAL LUMP SUM PROPOSAL:		**$50,800,000**



City of Chandler

WRF Improvements Phase 3

Work Category

Schedule of Values

City of Chandler
Phase 3 WRF Improvements Project
Work Category Schedule of Values
Long Lead Procurement

August 27, 2026

WC #	WC DESCRIPTIONS	Long Lead Procurement	Recommended
01A.1	General Requirements	$ 308,351	McCarthy CMAR
11D	Hydraulic Valves	$ 148,867	Fortiline - Pratt
11E	Vertical Turbine Pumps	$ 263,124	JCH - Cascade
11H	Secondary Clarifier Mechanism Replacements	$ 3,319,296	Westech
11I	Aeration Systems	$ 574,857	Aquarius
11J	Disc Filters	$ 730,170	IES Southwest - Aqua Aerobics
16A.1	Electrical Long Lead Equipment	$ 3,683,275	Eaton
		$ 9,027,940	

City of Chandler
Phase 3 WRF Improvements Project
Work Category Schedule of Values
Wilson Scope - Balance of Plant

August 27, 2026

WC #	WC DESCRIPTIONS	BOP	Recommended
01A	General Requirements	$ 1,366,558	McCarthy SP
01B	MOPOs Tie Ins	$ 720,296	McCarthy SP
01C	Quality Control Testing	$ 178,118	Certerra
01D	Surveying	$ 143,939	Alta
01F	Start-up, & Commissioning	$ 216,947	McCarthy SP
02A	Demolition	$ 54,427	DQD
02B	Earthwork & Yard Piping	$ 2,592,465	McCarthy
02C	AC Paving	$ 166,249	L&L
02D	Site Concrete	$ 176,169	Buesing
02E	Landscaping	$ 105,751	OCM
03A	Concrete	$ 2,148,774	McCarthy SP
03B	Concrete Reinforcement	$ 126,436	Nucor
05A	Misc Metals	$ 372,427	Resolute
05C	Extruded Flat Panel Covers	$ 290,506	CST
06B	FRP	$ 193,972	Grating Pacific
09C	Painting/Coating Industrial	$ 258,615	PPS
11A	Chemical Feed Pumps	$ 149,253	Finish Thompson
11G	Low Flow Propeller (IMLR) Pumps	$ 401,101	Flygt
13A	Metal Canopies	$ 176,368	GMC
13C	Fuel Storage Tank System	$ 549,866	AZ Fuel Systems
13D	Pre-Engineered Structures	$ 363,432	AZ Corp. Builders
14A	Monorail Festoon Replacement	$ 17,112	MMI
15A	Process Piping and Equipment Installation	$ 7,874,238	McCarthy SP
15C	HVAC	$ 300,079	PPS
16A	Electrical, Instrumentation, and Controls	$ 9,602,875	Loenbro
		$ 28,545,971	



City of Chandler
WRF Improvements Phase 3
Tax Credit Evaluation

City of Chandler
Phase 3 WRF Improvements Project
Tax Credit Evaluation
Long Lead Procurement

Rev Date August 27, 2026

WC #	WC DESCRIPTIONS	Tax Exemption $
11D	Hydraulic Valves	$ 148,867
11E	Vertical Turbine Pumps	$ 263,124
11H	Secondary Clarifier Mechanism	$ 3,319,296
11I	Aeration System	$ 574,857
11J	Disc Filter System	$ 730,170
16A.1	Electrical Gear Long Lead Procurement	$ 2,209,965
	Work Category Totals	$ 7,246,279
	Tax exemption 65% of 7.8% Credit	$ (367,386)

City of Chandler
Phase 3 WRF Improvements Project
Tax Credit Evaluation
Wilson Scope - Balance of Plant

Rev Date August 27, 2026

WC #	WC DESCRIPTIONS	Tax Exemption $
01A	General Requirements	$ -
01B	MOPOs Tie Ins	$ -
01C	Quality Control Testing	$ -
01D	Surveying	$ -
01F	Start-up, & Commissioning	$ -
02A	Demolition	$ -
02B	Earthwork & Yard Piping	$ -
02C	AC Paving	$ -
02D	Site Concrete	$ -
02E	Landscaping	$ -
03A	Concrete	$ -
03B	Concrete Reinforcement	$ -
05A	Misc Metals	$ -
05C	Extruded Flat Panel Covers	$ 290,506
06B	FRP	$ -
09C	Painting/Coating Industrial	$ -
11A	Chemical Metering Pumps	$ 149,253
11L	IMLR Pumps	$ 401,101
13A	Metal Canopies	$ -
13C	Fuel Storage Tank System	$ -
13D	Pre-Engineered Structures	$ -
14A	Monorail Festoon Replacement	$ -
15A	Process Piping and Equipment Installation	$ -
15C	HVAC	$ -
16A	Electrical, Instrumentation, and Controls	$ 1,814,204

Work Category Totals	$	2,655,063

Tax exemption 65% of 7.8% Credit	$	(134,612)



City of Chandler

WRF Improvements Phase 3

Long Lead Work Categories



City of Chandler
WRF Improvements Phase 3
WC 01A.1 – General Requirements

Solicitation Summary
City of Chandler WRF Improvements Phase 3
Long Lead Procurement and Wilson Balance of Plant Proposal
Work Category: **01A - General Requirements**

Subcontractor/Supplier Name	***Status***
McCarthy	*Recommended*

Chandler Phase 3

Work Category: 01A.1 - General Requirements

WC Lead: Dominic McCarver

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		$308,351
Description		
1	Offload / Flag & Tag Delivered Equipment	Yes
2	Protect Long Lead Equipment	Yes
3	Dunnage and Covering Materials for Clarifier Mechanisms	Yes
4	Storage Conex - AWRF (Aeration Basins) (Purchase)	Yes
5	Storage Conex - OWRF (Aeration Basins) (Purchase)	Yes
6	Storage Conex - AWRF (Clarifier Parts) (Purchase)	Yes
7	Storage Conex - OWRF (Clarifier Parts) (Purchase)	Yes
8	Storage Conex - AWRF (Disc Filters) (Purchase)	Yes
9	Storage Conex - OWRF (Vertical Turbine Pump) (Purchase)	Yes
10	Storage Conex - OWRF (Electrical Gear) (Purchase)	Yes
11	Storage Conex - OWRF (Electrical Gear) (Purchase)	Yes
12	Conex Mobilizations (Mob in Only)	Yes
13	CPM Schedule Preparation	Yes
14	CPM Schedule Progress Updates	Yes

Chandler Phase 3

Work Category: 01A.1 - General Requirements

WC Lead: Dominic McCarver

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE	$308,351

ASSUMPTIONS & CLARIFICATIONS:	
1	The following are City of Chandler project costs and have not been included in the proposal:
a.	Temporary/construction/startup use and permanent utility hookup and usage costs including power, sewer, reuse water, trash disposal, and chemicals.
b.	Building and Environmental Permits, Dust Control Permit, MCDES, FAA, and ADEQ permitting fees, plan review fees and impact costs.
2	No costs have been carried for background checks for CMAR or trade partners as outlined in article 9 of the agreement. Based on previous projects no costs had been assessed for background checks.
3	Submittals and preliminary O&Ms have been included to be submitted in electronic format only. No hard copies of shop drawings will be submitted. Two hard copies of Final Approved O&Ms will be supplied for each piece of equipment.



City of Chandler

WRF Improvements Phase 3

WC 11D - Hydraulic Valves

Solicitation Summary
Chandler Improvements Phase 3
Long Lead Procurement and Wilson Balance of Plant Proposal
Work Category: **11D - Hydraulic Valves**

Subcontractor/Supplier Name	***Status***
Fortiline	*Recommended*
Winwater	*Proposed*
Core and Main	*Declined*

Chandler Improvements Phase 3

Work Category: 11D - Hydraulic Valves

WC Lead: Peyton Tucker

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		**$148,867**
MCCARTHY SUBCONTRACT & FRONT END TERMS		
1	Compliant with McCarthy Front Ends	Yes
2	Bid Submitted on McCarthy Bid Form	No
3	Bid Bond Included with Bid	No
4	Surety Company	NA
5	Surety AM Best Rating (Must be A- or Better)	NA
6	Bond/CDI Cost	Yes
7	Insurance Requirements Per Matrix	NA
8	GL Insurance Company Name	NA
9	GL Insurance Carrier AM Best Rating (Must be A- or Better)	NA
10	E&O Insurance (If Required by Front Ends)	NA
11	Pollution Insurance (If Required by Front Ends)	NA
12	Tier 1 Approved	Draft
13	Tier 2 Approved	Draft
14	OSHA Recordable Incident Rate (Current)	NA
15	Includes Hoisting for Sub's Own Work Scope	NA
16	Acknowledges Soils Report	NA
17	Acknowledges Addenda	NA
18	Hold Bid for 150 Days	Yes
Scope of Work:		
20	**Per Plans & Specifications:**	Yes
21	Provide all labor, materials, tools, equipment and appurtenances as required to perform the Work Category - 11D Hydraulic Valves, in accordance with and reasonably inferable from the Contract Documents, complete and without exception unless otherwise noted below, including, but not limited to the following:	Yes
22	Per Plans & Specifications:	Yes
23	Division 1 General Requirements	Yes
24	11295 - Hydraulic Valves	Yes
25	13447 - Electric Motor Actuators	Yes
26	Shipping shall be FOB jobsite	Yes
27	Lead time (wks):	18-22 wks
28	**Scope per Specs Drawings Including:**	Yes
29	Furnish 16" RAS Direct Buried Motor Operated Hydraulic Actuator	Yes
30	Furnish 12" RAS Direct Buried Motor Operated Hydraulic Actuator	Yes
31	Furnish 08" DL Direct Buried Plug Valve	Yes

Chandler Improvements Phase 3

Work Category: 11D - Hydraulic Valves

WC Lead: Peyton Tucker

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		**$148,867**
32	**Field Services (section 3.4)**	Yes
33	Startup Services: 1 Trip	Yes
34	In person operator training services	Yes
37	Bond/CDI Cost	Yes

Chandler Improvements Phase 3

Work Category: 11D - Hydraulic Valves

WC Lead: Peyton Tucker

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE	$148,867

	ASSUMPTIONS & CLARIFICATIONS:
1	Release of equipment to manufacturer must be provided to vendor before bid expires. PO execution does not lock in pricing for the equipment. Subject to escalation up to release for production.
2	Standard warranty for one year from start-up currently held. No cost adder included for warranty in base bid.
3	Valve purchases have been included per Detail 104 on page C-40.01.
4	All plug valves quoted as Henry Pratt FIG 600 Full Round Port Plug Valve, 175 PSI, Mechanical Joints ends, Cast Iron Body, Cast Iron Cap, Nickel seat, Ductile Iron Plug coated in Buna.



City of Chandler

WRF Improvements Phase 3

WC11E – Vertical Turbine Pumps

Solicitation Summary

Chandler Improvements Phase 3

Long Lead Procurement and Wilson Balance of Plant Proposal

Work Category: **11E - Vertical Turbine Pumps**

Subcontractor/Supplier Name	***Status***
JCH (Cascade)	*Recommended*
Arrowhead (Sulzer)	*Proposed*
Hennesy Mechanical (Fairbanks)	*Declined*
Hennesy Mechanical (Peerless)	*Declined*
Phoenix Pumps (Floway)	*Declined*

Chandler Improvements Phase 3

Work Category: 11E - Vertical Turbine Pumps

WC Lead: Jennifer Lee

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		**$263,124**
MCCARTHY SUBCONTRACT & FRONT END TERMS		
1	Compliant with McCarthy Front Ends	Yes
2	Bid Submitted on McCarthy Bid Form	Yes
3	Bid Bond Included with Bid	N/A
4	Surety Company	N/A
5	Surety AM Best Rating (Must be A- or Better)	N/A
6	Bond/CDI Cost	Yes
7	Insurance Requirements Per Matrix	Yes
8	GL Insurance Company Name	Travelers
9	GL Insurance Carrier AM Best Rating (Must be A- or Better)	A++
10	E&O Insurance (If Required by Front Ends)	NA
11	Pollution Insurance (If Required by Front Ends)	NA
12	Tier 1 Approved	No
13	Tier 2 Approved	No
14	OSHA Recordable Incident Rate (Current)	N/A
15	Includes Hoisting for Sub's Own Work Scope	N/A
16	Acknowledges Soils Report	N/A
17	Acknowledges Addenda	N/A
18	Hold Bid for 150 Days	Yes
Scope of Work:		
19	**Per Plans & Specifications:**	Yes
20	Provide all labor, materials, tools, equipment and appurtenances as required to perform the **Work Category - 11E Vertical Turbine Pumps**, in accordance with and reasonably inferable from the Contract Documents, complete and without exception unless otherwise noted below, including, but not limited to the following:	Yes
21	Per Plans & Specifications:	Yes
22	Division 1 General Requirements	Yes
23	01300 – Submittals	Yes
24	01640 – Materials and Equipment	Yes
25	01650 – Starting of Systems	Yes
26	01660 – Field Tests of Equipment	Yes
27	03252 - Anchorage in Concrete	Yes
28	09900 – Painting	Yes
29	11310 - Vertical Turbine Pumps	Yes
30	16225 – Electric Motors 250 Horsepower or Less	Yes
31	Check to Spec completed and submitted to McCarthy	Yes
32	Includes all requirements from McCarthy Exhibits (as applicable)	Yes
33	Warranty Adder - 1 year from Project Final Completion	Yes

Chandler Improvements Phase 3

Work Category: 11E - Vertical Turbine Pumps

WC Lead: Jennifer Lee

Bid Date: August 21, 2026

	TOTAL WORK CATEGORY PACKAGE VALUE	**$263,124**
34	Shipping shall be FOB jobsite	Yes
35	Lead time (wks):	
36	Submittals	4-6 weeks
37	Fabrication	22-24 weeks
38	Anchors and epoxy required for installation	Yes
39	**Scope per Specs Drawings Including:**	Yes
40	Furnish (1) vertical turbine pump with axial impeller, motor drivers, and anti-vortex device	Yes
41	**Submittals per section 1.6**	Yes
42	Calculations: Anchorage	Yes
43	**Quality Assurance per section 1.7**	Yes
44	Pump and equipment for pump from single pump manufacturer	Yes
45	Shop Testing: Hydrostatic, Performance, Motor	Yes
46	Shop testing witnesses by Registered Professional Engineer	Yes
47	**Manufacturers (section 2.1)**	
48	Cascade, Fairbanks Morse, or Approved Equal	Yes
49	Minimum 5 years of experience producing similar equipment	Yes
50	5 reference installations for a period of at least 3 years	Yes
51	**Service Conditions per section 2.2**	Yes
52	Vertical line-shaft type suitable for MLSS up to 3300 mg/L at water temperature 50° F to 85° F	Yes
53	**Materials (section 2.3)**	Yes
54	Cast Iron: ASTM A 48, Class 30 minimum	Yes
55	Nickle Cast Iron: ASTM A 48, Class 30 minimum, 3% nickle	Yes
56	Gray Iron Casting: ASTM A 278, Class 30	Yes
57	Iron-Chromium Alloy: ASTM A 743, Grade CA40, Brinell Hardness 350 to 380	Yes
58	Leaded Tin Bronze: ASTM B 584, Alloy C90300, Leaded red brass	Yes
59	416 SS: ASTM A 582, Type 416 SS	Yes
60	Neoprene: Polychloroprene rubber	Yes
61	Steel: ASTM A 283, Grade D or ASTM A36	Yes
62	Steel Pipe: ASTM 53, Grade B	Yes
63	Aluminum Bronze: ASTM B 148	Yes
64	**Pump Construction per section 2.4-A**	Yes
65	Industrial, heavy duty, vertical turbine type pumps	Yes
66	Discharge Flange: ASME B16.1 or B16.5 drilled, rated for 1.2 times pump shutoff head	Yes
67	Discharge Nozzle: 1/2 in NPT taps for pressure gauges	Yes
68	Bearings: Support line shaft assembly and rated ABMA L10 life of 40,000 hours	Yes
69	Fasteners: Type 316 SS	Yes
70	**Pump Suction Assembly per section 2.4-B**	Yes
71	Include Anti-vortex device	Yes
72	**Pump Impeller Bowl Assembly per section 2.4-C**	Yes
73	**Line Shafts per section 2.4-D**	Yes
74	Include Adjustable Spacer Coupling	Yes
75	**Pump Column Pipe per section 2.4-E**	Yes
76	**Pump Discharge Head Assembly per section 2.4-F**	Yes

Chandler Improvements Phase 3

Work Category: 11E - Vertical Turbine Pumps

WC Lead: Jennifer Lee

Bid Date: August 21, 2026

	TOTAL WORK CATEGORY PACKAGE VALUE	**$263,124**
77	**Equipment Guards per section 2.4-G**	Yes
78	**Driver per section 2.4-H**	Yes
79	**Motor per section 2.4-I and specification 16225**	See Clarifications
80	Acceptable Products (16225 2.7): General Electric, Emerson US Motors, Siemens, WEG)	Yes
81	Temperature Sensor	Yes
82	**Supports per section 2.4-J**	Yes
83	**Design Criteria (section 2.5)**	Yes
84	General Characteristics:	Yes
85	Maximum Noise @ 3 ft: 85 dBA	Yes
86	Pumped Fluid Temperature Range: 50° F to 85° F	Yes
87	Pump Characteristics:	Yes
88	Impeller Type: Axial Flow	Yes
89	Pass Minimum Sphere Size: 3.5"	Yes
90	Pump Impeller Bowl Bearing and Suction Bowl Bearing Lubrication: Water Flush	Yes
91	Suction Cone: Required	Yes
92	Line Shaft Type: Enclosed	Yes
93	Maximum Line Shaft Bearing Spacing: 10 ft	Yes
94	Line Shaft Lubrication: Water Flush	Yes
95	Discharge Shaft Seal Type: Single Mechanical	Yes
96	Column Connection Type: Flanged	Yes
97	Column Diameter: 20"	Yes
98	Max Column Section Length: 10 ft	Yes
99	Discharge Arrangement: Above Base	Yes
100	Coupling Type: Spacer	Yes
101	Speed Control: VFD	Yes
102	Maximum Pump RPM: 1200	Yes
103	Rated Design Point (@ Max Revolutions per Minute):	Yes
104	Flow: 8,500 gpm	Yes
105	Head: 18 ft	Yes
106	Pump Discharge Centerline Elevation: 1199.4	Yes
107	Minimum Pump Efficiency: 79%	Yes
108	Pump Materials:	Yes
109	Suction Bell: Cast Iron	Yes
110	Suction Bell Bearing: High Lead Tin Bronze	Yes
111	Impeller Cases: Cast Iron	Yes
112	Impeller: Aluminum Bronze	Yes
113	Impeller Bearing: Bronze	Yes
114	Impeller Shaft Key: 416 SS	Yes
115	Line Shaft and Coupling: 416 SS	Yes
116	Line Shaft Bearings: Bronze	Yes
117	Shaft Enclosing Tube: Steel Pipe 3/8"/0.01x Pipe ID/Schedule 80	Yes
118	Column Material and Thickness: Steel Pipe 3/8"	Yes
119	Discharge Head/Driver Stand: Fabricated Steel	Yes
120	Discharge Head Bearing: Bismuth Bronze	Yes
121	Discharge Stuffing Box: Cast Iron	Yes

Chandler Improvements Phase 3

Work Category: 11E - Vertical Turbine Pumps

WC Lead: Jennifer Lee

Bid Date: August 21, 2026

	TOTAL WORK CATEGORY PACKAGE VALUE	**$263,124**
122	Driver Characteristics:	Yes
123	Driver Type: Motor	Yes
124	Driver Arrangement: Vertical, coupled	Yes
125	Non-reverse Ratchets: Required	Yes
126	Max Drive Horsepower: 60 HP	Yes
127	Max Driver RPM: 1,200	Yes
128	Inverter Duty Rated: Yes	Yes
129	Motor Voltage/Phase/Hertz: 460/3/60	Yes
130	Enclosure Type: TEFC	Yes
131	**Source Quality Control Testing (section 2.6)**	Yes
132	Pump Performance Testing	Yes
133	Noise Test	Yes
134	**Surface Prep and Coating per section 2.8**	Yes
135	**Spare Equipment (section 2.9)**	Yes
136	(1) set line shaft bronze bearings for each type of pump	Yes
137	(1) of each type of complete mechanical seal	Yes
138	(1) motor/gear thrust bearing set for each type of pump	Yes
139	(1) motor radial bearing set (if applicable)	Yes
140	**Factory Performance Test per section 3.2**	Yes
141	**Field Services (section 3.4)**	Yes
142	Installation/Startup Services: 2 trips, total time of four (eight hour) days	Yes
143	In person operator training services: 4 hours	Yes
144	Textura Included (Total Under $2.2M add 0.22%, if total is Equal or More than $2.2M add $5,000)	Yes
145	Bond/CDI Cost	Yes

	ASSUMPTIONS & CLARIFICATIONS:
1	PO Execution will lock-in pricing for the equipment.
2	Standard warranty of 12 months from start-up covered under cost. Additional costs will be incurred for warranty extended beyond this time frame.
3	11310 – 2.4.C.1.3. [Clarification]: Impeller will be secured by Thrust Collar Halves and Key.
4	16225 – 1.3.A.4. [Clarification]: Guaranteed efficiency is at full load only. Motor manufacturer will supply typical values at ¾ & ½ load.
5	16225 – 2.2.A.12. [Exception]: Copper rotor is not available on the requested rating. Rotor material is cast aluminum.
6	16225 – 2.4.D.2. [Clarification]: Motor is offered with insulated bearing on upper end. Shaft Grounding Ring is not offered on motors rated for Hazardous Areas (as specified in 1.2.B.10 of this specification). Note: this is the same insulation design provided on previously supplied motor for Cascade SO# 19500 (existing pumps).



City of Chandler

WRF Improvements Phase 3

WC11H – Secondary Clarifier Replacements

Solicitation Summary

Chandler Improvements Phase 3

Long Lead Procurement and Wilson Balance of Plant Proposal

Work Category: **11H - Secondary Clarifier Replacement**

Subcontractor/Supplier Name	***Status***
Goble Sampson (Westech)	*Recommended*
Coombs Hopkins (Ovivo)	*Proposed*
IES Southwest (Walker)	*Proposed*
JBI (Clearstream)	*Declined*

Chandler Improvements Phase 3

Work Category: 11H - Secondary Clarifiers

WC Lead: Jennifer Lee

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		**$3,319,296**
MCCARTHY SUBCONTRACT & FRONT END TERMS		
1	Compliant with McCarthy Front Ends	Yes
2	Bid Submitted on McCarthy Bid Form	Yes
3	Bid Bond Included with Bid	Yes
4	Surety Company	Fidelity and Deposit Company of Maryland
5	Surety AM Best Rating (Must be A- or Better)	A+
6	Bond/CDI Cost	Yes
7	Insurance Requirements Per Matrix	Yes
8	GL Insurance Company Name	Zurich American Ins Co
9	GL Insurance Carrier AM Best Rating (Must be A- or Better)	A+
10	E&O Insurance (If Required by Front Ends)	NA
11	Pollution Insurance (If Required by Front Ends)	NA
12	Tier 1 Approved	No
13	Tier 2 Approved	No
14	OSHA Recordable Incident Rate (Current)	N/A
15	Includes Hoisting for Sub's Own Work Scope	N/A
16	Acknowledges Soils Report	N/A
17	Acknowledges Addenda	N/A
18	Hold Bid for 120 Days	Yes
Scope of Work:		
19	Provide all labor, materials, tools, equipment and appurtenances as required to perform the **Work Category - 11H Secondary Clarifiers**, in accordance with and reasonably inferable from the Contract Documents, complete and without exception unless otherwise noted below, including, but not limited to the following:	Yes
20	Per Plans & Specifications:	Yes
21	Division 1 General Requirements	Yes
22	01300 – Submittals	Yes
23	01640 – Materials and Equipment	Yes
24	01650 – Starting of Systems	Yes
25	01660 – Field Tests of Equipment	Yes
26	03252 - Anchorage in Concrete	Yes
27	05522 – Aluminum Handrails and Railings	Yes
28	09900 – Painting	Yes
29	15064 – Copper Pipe	Yes
30	11335 – Secondary Clarifier Mechanism	Yes
31	16161 – Control Panels	Yes
32	16225 – Electric Motors 250 Horsepower or Less	Yes
33	17000 – Instrumentation	Yes

Chandler Improvements Phase 3

Work Category: 11H - Secondary Clarifiers

WC Lead: Jennifer Lee

Bid Date: August 21, 2026

	TOTAL WORK CATEGORY PACKAGE VALUE	**$3,319,296**
34	17454 – Operations and Control Descriptions	Yes
35	Check to Spec completed and submitted to McCarthy	Yes
36	Includes all requirements from McCarthy Exhibits (as applicable)	Yes
37	Shipping shall be FOB jobsite	Yes
38	Lead time (wks):	
39	Submittals	10-12 weeks
40	Fabrication	26-28 weeks
41	Anchors and epoxy required for installation	Yes
42	**Scope per Specs and Drawings Including:**	Yes
43	Furnish 5 secondary clarifiers w/appurtenances: -(1) 100 ft and (3) 75 ft at AWRF -(1) 100 ft at OWRF	Yes
44	Center-drive type, supported on stationary effluent column, with flow entering from bottom of influent column into inner EDI. Scraper blades designed to move sludge uniformly to center of tank (section 2.4)	Yes
45	**Submittals per section 1.5**	Yes
46	Engineering Calculations: Structural, Output Torque and Overload Torque, Bearing, Gear	Yes
47	**AWRF Design Requirements (section 1.6)**	Yes
48	Secondary Clarifiers 1-3:	Yes
49	Clarifier Effluent, Average: 3.5 MGD	Yes
50	Clarifier Effluent, Peak: 6.11 MGD	Yes
51	RAS Flow, Average: 1.05 MGD	Yes
52	RAS Flow, Peak: 1.8 MGD	Yes
53	MLSS Concentration: 3,400 mg/L	Yes
54	Continuous Operating Torque: 35,000 ft-lb AGMA	Yes
55	Momentary Peak Torque: 70,000 ft-lb	Yes
56	Sludge Collector Rotation Speed: 4-10 fpm	Yes
57	Internal Tank Diameter: 75 ft	Yes
58	Nominal Side Water Depth: 13 ft	Yes
59	Bottom Floor Slope: 1:4	Yes
60	Double Bridge	Yes
61	Secondary Clarifier 4:	Yes
62	Clarifier Effluent, Average: 6.21 MGD	Yes
63	Clarifier Effluent, Peak: 10.74 MGD	Yes
64	RAS Flow, Average: 1.85 MGD	Yes
65	RAS Flow, Peak: 3.2 MGD	Yes
66	MLSS Concentration: 3,400 mg/L	Yes
67	Continuous Operating Torque: 66,000 ft-lb AGMA	Yes
68	Momentary Peak Torque: 132,000 ft-lb	Yes
69	Sludge Collector Rotation Speed: 4-10 fpm	Yes
70	Internal Tank Diameter: 100 ft	Yes
71	Nominal Side Water Depth: 14 ft	Yes
72	Bottom Floor Slope: 1:4	Yes
73	**OWRF Design Requirements (section 1.7)**	Yes
74	Secondary Clarifier 3:	Yes
75	Clarifier Effluent, Average: 5 MGD	Yes
76	Clarifier Effluent, Peak: 10 MGD	Yes

Chandler Improvements Phase 3

Work Category: 11H - Secondary Clarifiers

WC Lead: Jennifer Lee

Bid Date: August 21, 2026

	TOTAL WORK CATEGORY PACKAGE VALUE	$3,319,296
77	RAS Flow, Average: 1.9 MGD	Yes
78	RAS Flow, Peak: 3.3 MGD	Yes
79	MLSS Concentration: 3,300 mg/L	Yes
80	Continuous Operating Torque: 66,000 ft-lb AGMA	Yes
81	Momentary Peak Torque: 132,000 ft-lb	Yes
82	Sludge Collector Rotation Speed: 4-10 fpm	Yes
83	Internal Tank Diameter: 100 ft	Yes
84	Nominal Side Water Depth: 14 ft	Yes
85	Bottom Floor Slope: 1:12	Yes
86	**Quality Assurance per section 1.8**	Yes
87	Reference installation of similar design operating at least 5 years	Yes
88	**Manufacturers (section 2.1)**	Yes
89	Clarifiers: Ovivo, Walker Process Equipment, Westech, or Approved Equal	Yes
90	Density Current(Stamford) Baffle: Nefco, or Approved Equal	Yes
91	Launder Brushes: Ford Hall Company, or Approved Equal	Yes
92	Energy Dissipating Inlet (EDI): CPE Type II LA-EDI (No Approved Equal)	Yes
93	**Materials per section 2.3**	Yes
94	Structural Steel: 304 SS	Yes
95	Center Feedwell Minimum Thickness: 3/16 inch	Yes
96	Stainless Steel Minimum Thickness: 1/4 inch	Yes
97	Welding: AWS D1.1	Yes
98	Hardware: 316 SS	Yes
99	Minimum Bolt Diameter: 5/8 inch	Yes
100	Spur and Pinion Gears: AGMA 908-B89, AGMA 240.01, AGMA 2001-C95	Yes
101	Worm Gears: AGMA 6034-A87	Yes
102	Iron Castings: ASTM A48	Yes
103	Anti-friction Bearing Minimum B-10 Life Rating: 200,000 hours	Yes
104	**Center Assembly per section 2.5**	Yes
105	**Control Panels per section 2.6**	Yes
106	VFD: (1) for Ocotillo 100 ft Clarifier	Yes
107	**Overload Protection per section 2.7**	See Clarifications
108	**Walkway and Drive Platform per section 2.8**	Yes
109	Double Walkway	Yes
110	**Center Cage per section 2.9**	Yes
111	**Center Column per section 2.10**	Yes
112	**RAS Adapter per section 2.11**	See Clarifications
113	**Influent Feedwell per section 2.12**	Yes
114	**Energy Dissipating Inlet (EDI) per section 2.13**	Yes
115	**Scum Baffle Supports Brackets per section 2.14**	Yes
116	**Rotating Rake Arms and Scrapers per section 2.15**	Yes
117	**Skimmers and Scum Boxes per section 2.16**	Yes
118	**Lauder Brushes per section 2.17**	Yes
119	**Peripheral Density Current (Stamford) Baffle per section 2.18**	Yes
120	**Surface Preparation per section 2.19**	Yes
121	**Spare Parts (section 2.20)**	Yes
122	Sight glasses and oil gauges	Yes

Chandler Improvements Phase 3

Work Category: 11H - Secondary Clarifiers

WC Lead: Jennifer Lee

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		**$3,319,296**
123	(1) set seals per clarifier	Yes
124	(1) set overload control device switches	Yes
125	(1) set squeegees per clarifier	Yes
126	10% of the total number of each type of fastener	Yes
127	(1) drive main bearing (Incl liners, balls, drive seals)	Yes
128	(1) set seals for each wash water flocculation arm drive unit	Yes
129	Additional manufacturer recommended spare parts	NA
130	**Field Services (section 3.3)**	Yes
131	Installation/Startup Services: 2 trips, total time of three (eight hour) days per clarifier	Yes
132	In person operator training services: 8 hours	Yes
133	Textura Included (Total Under $2.2M add 0.22%, if total is Equal or More than $2.2M add $5,000)	Yes
134	Bond/CDI Cost	Yes

	ASSUMPTIONS & CLARIFICATIONS:
1	11335 – 2.7-A: This proposal excludes a clutch or load cell for overload protection. Westech utilizes electro-mechanical switches that can transmit alarm data to plant SCADA.
2	11335 – 2.11: In lieu of a sludge drum, Westech proposes a sludge withdrawal ring for OWRF clarifier.



City of Chandler

WRF Improvements Phase 3

WC11I – Aeration Systems

Solicitation Summary

Chandler Improvements Phase 3

Long Lead Procurement and Wilson Balance of Plant Proposal

Work Category: **11I - Aeration System**

Subcontractor/Supplier Name	***Status***
JCH (Aquarius)	*Recommended*
Coombs Hopkins (Sanitaire)	*Proposed*
Goble Sampson (SSI)	*Proposed*
Misco (EDI)	*Proposed*
JBI (OTT)	*Declined*

Chandler Improvements Phase 3

Work Category: 11I - Aeration System

WC Lead: Jennifer Lee

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		**$574,857**
MCCARTHY SUBCONTRACT & FRONT END TERMS		
1	Compliant with McCarthy Front Ends	Yes
2	Bid Submitted on McCarthy Bid Form	No
3	Bid Bond Included with Bid	No
4	Surety Company	NA
5	Surety AM Best Rating (Must be A- or Better)	NA
6	Bond/CDI Cost	Yes
7	Insurance Requirements Per Matrix	Yes
8	GL Insurance Company Name	Travelers
9	GL Insurance Carrier AM Best Rating (Must be A- or Better)	A++
10	E&O Insurance (If Required by Front Ends)	NA
11	Pollution Insurance (If Required by Front Ends)	NA
12	Tier 1 Approved	No
13	Tier 2 Approved	No
14	OSHA Recordable Incident Rate (Current)	N/A
15	Includes Hoisting for Sub's Own Work Scope	N/A
16	Acknowledges Soils Report	N/A
17	Acknowledges Addenda	N/A
18	Hold Bid for 150 Days	Yes
Scope of Work:		
19	Provide all labor, materials, tools, equipment and appurtenances as required to perform the **Work Category - 11I Aeration System**, in accordance with and reasonably inferable from the Contract Documents, complete and without exception unless otherwise noted below, including, but not limited to the following:	Yes
20	Per Plans & Specifications:	Yes
21	Division 1 General Requirements	Yes
22	01300 – Submittals	Yes
23	01640 – Materials and Equipment	Yes
24	01650 – Starting of Systems	Yes
25	11375 – Aeration Systems	Yes
26	Check to Spec completed and submitted to McCarthy	Yes
27	Includes all requirements from McCarthy Exhibits (as applicable)	Yes
30	Shipping shall be FOB jobsite	Yes
31	Lead time (wks):	
32	Submittals	4-6 weeks
33	Fabrication	10-12 weeks
34	Anchors and epoxy required for installation	Yes
35	**Scope per Specs and Drawings Including**	Yes

Chandler Improvements Phase 3

Work Category: 11I - Aeration System

WC Lead: Jennifer Lee

Bid Date: August 21, 2026

	TOTAL WORK CATEGORY PACKAGE VALUE	**$574,857**
36	Furnish Fine Bubble Aeration Systems for: -Airport Aeration Basins 5 and 6 -Ocotillo Zone 8 or MBR Bioreactor Basins 1 & 2	Yes
37	Including purge header on laterals (Alternative purge methods deviate from drawing design per manufacturer) Include Manual and continuous purge	Yes
38	**Submittals per section 1.4**	Yes
39	Engineering Calculations: Headloss calculations, Seismic	Yes
40	**Quality Assurance (section 1.6)**	Yes
41	5 reference installations operating at least 5 years	Yes
42	Fine Bubble Membrane Disc Diffuser Minimum Oxygen Transfer Rate at 2 scfm Air Flow Rate Per Diffuser: 32%	Yes
43	**Manufacturers (section 2.1)**	Yes
44	Aquarius, Sanitaire, Stamford Scientific International (SSI), Environmental Dynamics International (EDI)	Yes
45	**Design Criteria (section 2.2)**	Yes
46	Average Expected Water Temperature: 60° F - 90° F	Yes
47	Expected Ambient Air Temperature Range: 20° F - 120° F	Yes
48	Lateral Spacing per Drawings	Yes
49	Airport:	Yes
50	27 MGD Conditions	Yes
51	Total Basins: 2	Yes
52	Air Requirement per Basin: 5640 scfm	Yes
53	Max Anticipated Water Depth: 20'9"	Yes
54	Depth of Water from Top of Diffuser Plate: 19'6"	Yes
55	Elevation: 1,209	Yes
56	Ocotillo:	Yes
57	8.2 MGD Conditions	Yes
58	Total Basins: 2	Yes
59	Max Anticipated Water Depth: 17.3'	Yes
60	Depth of Water from Top of Diffuser Plate: 16.38'	Yes
61	Elevation: 1,174.5	Yes
62	**Materials per section 2.3**	Yes
63	**Components (section 2.4)**	Yes
64	Air Distribution Manifold: Sch 80 PVC	Yes
65	Air Distribution Lateral: SDR 18 Sch40 Equivilant	Yes
66	Metal supports included for laterals	Yes
67	Manifold Support Straps (Detail 5/S-003)	Yes
68	Diffusers per section 2.4-D: 9", EPDM membrane diffuser w/integral O-ring	Yes
69	Diffuser Baseplate per section 2.4-F: PVC	Yes
70	Elastomeric gaskets per section 2.4-G: Neoprene rubber, 4.5-inches I.D, durometer of 40 ±5	Yes
71	**Spare Equipment (section 2.5)**	Yes
72	10% of the total number of installed diffusers (Incl retainer rings and diffuser support plates)	Yes
73	1% of the total number of pipe supports (Incl anchor bolts)	Yes
74	1% of each type of diffuser lateral	Yes
75	50% of the total number of installed plugs for blank baseplates (Incl gaskets and accessory equipment)	Yes
76	**Field Services (section 3.2)**	Yes

Chandler Improvements Phase 3

Work Category: 11I - Aeration System

WC Lead: Jennifer Lee

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		**$574,857**
77	Installation/Startup Services for each basin: 4 trips, minimum 1 eight hour day per trip	Yes
78	In person operator training services: 4 hours	Yes
79	**Factory Certified Tests per section 3.3**	Yes
80	Textura Included (Total Under $2.2M add 0.22%, if total is Equal or More than $2.2M add $5,000)	Yes
81	Bond/CDI Cost	Yes



City of Chandler

WRF Improvements Phase 3

WC11J – Disc Filters

Solicitation Summary

Chandler Improvements Phase 3

Long Lead Procurement and Wilson Balance of Plant Proposal

Work Category: **11J - Disc Filter**

Subcontractor/Supplier Name	***Status***
IES Southwest (Aqua-Aerobics)	*Recommended*
Coombs Hopkins (Five Star Filtration)	*Declined*

Chandler Improvements Phase 3

Work Category: 11J - Disc Filter

WC Lead: Jennifer Lee

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		**$730,170**
MCCARTHY SUBCONTRACT & FRONT END TERMS		
1	Compliant with McCarthy Front Ends	Yes
2	Bid Submitted on McCarthy Bid Form	Yes
3	Bid Bond Included with Bid	N/A
4	Surety Company	Fidelity and Deposit Company of Maryland
5	Surety AM Best Rating (Must be A- or Better)	A+
6	Bond/CDI Cost	Yes
7	Insurance Requirements Per Matrix	Yes
8	GL Insurance Company Name	Colony
9	GL Insurance Carrier AM Best Rating (Must be A- or Better)	A-
10	E&O Insurance (If Required by Front Ends)	NA
11	Pollution Insurance (If Required by Front Ends)	NA
12	Tier 1 Approved	Yes
13	Tier 2 Approved	No
14	OSHA Recordable Incident Rate (Current)	N/A
15	Includes Hoisting for Sub's Own Work Scope	N/A
16	Acknowledges Soils Report	N/A
17	Acknowledges Addenda	N/A
18	Hold Bid for 150 Days	Yes
Scope of Work:		
19	Provide all labor, materials, tools, equipment and appurtenances as required to perform the **Work Category - 11J Disc Filter**, in accordance with and reasonably inferable from the Contract Documents, complete and without exception unless otherwise noted below, including, but not limited to the following:	Yes
20	**Per Plans & Specifications:**	Yes
21	Division 1 General Requirements	Yes
22	01300 – Submittals	Yes
23	01640 – Materials and Equipment	Yes
24	01650 – Starting of Systems	Yes
25	01660 – Field Tests of Equipment	Yes
26	03252 - Anchorage in Concrete	Yes
27	05501 - Miscellaneous Metal Fabrications	Yes
28	11295 - Hydraulic Valves	Yes
29	11400 - Disc Filter System	Yes
30	13447 - Electric Motor Actuators	Yes
31	16161 - Control Panels	Yes
32	16225 - Electric Motors 250 Horsepower or Less	Yes
33	17454 - Operation and Control Description	Yes

Chandler Improvements Phase 3

Work Category: 11J - Disc Filter

WC Lead: Jennifer Lee

Bid Date: August 21, 2026

	TOTAL WORK CATEGORY PACKAGE VALUE	**$730,170**
34	Check to Spec completed and submitted to McCarthy	Yes
35	Includes all requirements from McCarthy Exhibits (as applicable)	Yes
36	Shipping shall be FOB jobsite	Yes
37	Lead time (wks):	
38	Submittals	8-10 weeks
39	Fabrication	16-22 weeks
40	Anchors and epoxy required for installation	Yes
41	**Scope per Specs and Drawings Including**	Yes
42	Furnish (1) Disc Filter System with Filter Backwash and Solids Wasting Assembly	Yes
43	Centertube Assembly with Cloth Media Discs, Drive Assembly, Influent Weir, Basin Mounting Brackets and Hardware, Electrical Controls and Internal Components	Yes
44	Backwash/Solids Waste Pump Assembly, Valves, Pressure Gauges, Float Switch, Vacuum Gauges and Transmitter, Vendor Control Panel	Yes
45	**Submittals per section 1.5**	Yes
46	Engineering Calculations: Seismic Structural, Anchor Bolt, VPP and VCP Enclosure Heat Loads	Yes
47	**Quality Assurance per section 1.6**	Yes
48	Minimum 5 years of documented experience	Yes
49	Minimum 15 similar sized reference installations in service	Yes
50	Anchor Bolts: 316 SS	Yes
51	Wetted Parts: 316 SS, FRP, or Polypropylene	Yes
52	Parts Above Water Line (support steel, platforms, handrails): Aluminum	Yes
53	**Manufacturers (section 2.2)**	Yes
54	Aqua-Aerobic, Five Star Filtration, or Approved Equal	Yes
55	**Design Criteria per section 2.3**	Yes
56	Capacity:	Yes
57	Average Daily Flow: 5.4 MGD	Yes
58	Peak Hourly Flow: 6.6 MGD	Yes
59	Filter Loading Rate:	Yes
60	Average Hydraulic Loading: 4.98 gpm/ft^2	Yes
61	Peak Hydraulic Loading: 6.1 gpm/ft^2	Yes
62	Maximum Headloss through Filter: 18 in	Yes
63	Maximum Total Suspended Solids: 20 mg/l	Yes
64	Average Total Suspended Solids: 10 mg/l	Yes
65	Effluent Characteristics Meeting Average Daily Limit Under:	Yes
66	State of Arizona Class A+ Reclaimed Water	Yes
67	24-Hour Composite Average Turbidity: 2 NTU or Less	Yes
68	Anytime Maximum Turbidity: 5 NTU	Yes
69	Total Suspended Solids: 5 milligrams per liter or less	Yes
70	**Design Requirements per section 2.3-B**	Yes
71	**Components of Cloth Media Filter per section 2.4**	Yes
72	Material	Yes
73	Stainless Steel: 316 SS	Yes
74	Welded Stainless Steel: 316L SS	Yes
75	Passivated after Welding (spec 05501)	Yes
76	Drive Assembly	Yes

Chandler Improvements Phase 3

Work Category: 11J - Disc Filter

WC Lead: Jennifer Lee

Bid Date: August 21, 2026

	TOTAL WORK CATEGORY PACKAGE VALUE	**$730,170**
77	Gearbox: Parallel in-line helical-type, AGMA Class I drive motor, 460/3/60	Yes
78	Power: 1 HP	Yes
79	Output Speed: 4.4 RPM	Yes
80	Drive Sprocket: Nylon	Yes
81	Chain: Acctal with 316 SS link pins	Yes
82	Chain Guard: 316L SS	Yes
83	Centertube Assembly	Yes
84	Center Tube Weldment: 316L, minimum 3/16" thick	No
85	Drive Sprocket: Nylon	No
86	Wheel Assemblies	Yes
87	Frame and Cloth Assemblies	Yes
88	Mounting Brackets and Hardware: 316 SS	Yes
89	Filter Cloth Disc Assemblies: 14	Yes
90	Effective Submerged Filtration Area (per cloth disc assembly): 53.8 ft^2	Yes
91	Cloths: Chlorine-resistant polyester (PES) fiber pile with polyester backing	Yes
92	Cloth Filtration Rating: 10 microns	Yes
93	Cloth Media Active Filter Depth: 3-5 millimeters	Yes
94	Influent Weir Box: 316 SS	Yes
95	Backwash/Solids Wasting Assembly	Yes
96	Backwash System Assembly	Yes
97	External Piping Assembly: Pressure Gauges, Vacuum Gauges and Transducers, Throttling Gate Valves, 3" Manual Ball Valves	Yes
98	(3) Backwash Pumps: Gorman Rupp G-R 12B20-B, or Approved Equal	Yes
99	2HP/460 V/3 Phase/ 60 Hz	Yes
100	RPM: 1,740 RPM	Yes
101	130 GPM at 23 ft total dynamic head	Yes
102	Backwash Valves and Sludge Valves: TCI/RCI, Nibco, or Equal	Yes
103	2" electric ball (backwash/Solids) Valves: 2 piece, flanged, ASTM A351 Grade CF8M SS, 115V/1 phase/60 Hz	Yes
104	Actuator: Include compartment heater and limit switch feedback to microprocessor	Yes
105	Throttling Gate Valves:Nibco T-113 Threaded, or Approved Equal	Yes
106	MSS SP-80, class 125, screw in bonnet, non-rising stem, solid wedge	Yes
107	Body/Bonnet/Wedge: Bronze ASTM B-62	Yes
108	Stem: Silicon Bronze ASTM B-371 Alloy C6940 or ASTM B99 Alloy C65100	Yes
109	Packing: Aramid Fibers with Graphite	Yes
110	Anchor Bolts: 316 SS	Yes
111	Piping (section 2.4-K)	Yes
112	Finishes (section 2.4-L)	Yes
113	**Vendor Power Panel (VPP) and Vendor Control Panel (VCP) per section 2.5**	Yes
114	VPP: 480 V/3 Phase/60 Hz, NEMA 4X SS Enclosure	Yes
115	Control Power Transformer (CPT): 480 V/120 V, 1 Phase	Yes
116	VCP: NEMA 4X SS Enclosure	Yes
117	Minimum Short Circuit Current: 10 kA	Yes
118	Programmable Logic Controller (PLC): Modicon M340, or Approved Equal	Yes

Chandler Improvements Phase 3

Work Category: 11J - Disc Filter

WC Lead: Jennifer Lee

Bid Date: August 21, 2026

	TOTAL WORK CATEGORY PACKAGE VALUE	**$730,170**
119	Operator Interface Terminal (OIT): Modicon Magelix HMIGTO5310, or Approved Equal	Yes
120	**Instrumentation per section 2.6**	Yes
121	(1) Pressure Based Level Transducer	Yes
122	(1) High Level Float	Yes
123	(2) Pressure Gauges	Yes
124	(2) Vacuum Gauge and Transducers	Yes
125	**Controls per section 2.7**	Yes
126	(6) Additional Spare Dry Contacts	Yes
127	Main Breaker, Disconnect, Fuse, Fuse Block, Starter	Yes
128	Engraved Nameplates	Yes
129	**Delivery and Storage per section 2.8**	Yes
130	**Spare Parts (section 2.9)**	Yes
131	(2) Filter Frame and Cloth Assemblies	Yes
132	(1) Backwash/Solids Waste Valve and Actuator	Yes
133	(1) Backwash Pump	Yes
134	(1) Viton V-ring Effluent Port/Center Tube Seal	Yes
135	(1) Each PLC I/O Module	Yes
136	(1) Each Fuse, Control Relay, Indicating Light Replacement Bulb	Yes
137	(1) Cloth Repair Kit	No
138	(1) Set Special Tools, if required	NA
139	**Fields Tests per section 3.2**	Yes
140	Conducted under Supervision of Manufacturer's Representative	Yes
141	**Manufacturer's Field Services (section 3.3)**	Yes
142	Sampling/Testing and Classifying Filter Effluent: 1 day, total time of eight hours	Yes
143	Installation: 2 days, total time of 16 hours (eight hours per day)	Yes
144	Startup Services/Operator Training/Testing and Sampling Filter Effluent: 3 days, total time of 24 hours (eight hours per day)	Yes
145	Textura Included (Total Under $2.2M add 0.22%, if total is Equal or More than $2.2M add $5,000)	Yes
146	Bond/CDI Cost	Yes



City of Chandler
WRF Improvements Phase 3
WC16A.1 – Electrical Long Lead Equipment

Solicitation Summary

Chandler Improvements Phase 3

Long Lead Procurement and Wilson Balance of Plant Proposal

Work Category: 16A.1 Electrical Long Lead Equipment

Subcontractor/Supplier Name	***Status***
Eaton	*Recommended*
Schneider Electric	*Bid Received*
ABB	*No Bid*
Seimens	*Declined*

Chandler Improvements Phase 3

Work Category: **16A.1 - Electrical Long Lead Equipment**

WC Lead: **Kyle Roman**

Bid Date: **August 21, 2026**

TOTAL WORK CATEGORY PACKAGE VALUE		**$3,683,275**
MCCARTHY SUBCONTRACT & FRONT END TERMS		
1	Compliant with McCarthy Front Ends	NA
2	Bid Submitted on McCarthy Bid Form	NA
3	Bid Bond Included with Bid	NA
4	Surety Company	NA
5	Surety AM Best Rating (Must be A- or Better)	NA
6	Bond/CDI Cost	Yes
7	Insurance Requirements Per Matrix	NA
8	GL Insurance Company Name	NA
9	GL Insurance Carrier AM Best Rating (Must be A- or Better)	NA
10	GL Insurance (GL - $10MM)	NA
11	E&O Network Security and Privacy Liability Insurance (CYB - $5MM)	NA
12	Pollution Insurance (POL - $10MM)	NA
13	Automobile Liability Insurance (AUTO - $1MM)	NA
14	Tier 1 Approved	NA
15	Tier 2 Approved	
16	Hold Bid for 150 Days	No
17	Estimated Tax Exempt Value of Total Bid	Approx. 60%
18		
Scope of Work:		
21	Provide all materials, equipment and appurtenances as required to perform the **Work Category 16A - Electrical Long Lead Equipment** in accordance with and reasonably inferable from the Contract Documents, complete and without exception unless otherwise noted below including, but not limited to, the following:	
22	Division 1 General Requirements	
23	Section 01300 - Submittals	Yes
24	Section 01640 - Materials and Equipment	Yes
25	Section 01650 - Starting of Systems	Yes
26	Section 01660 - Field Tests of Equipment	Yes
27	Section 01720 - Record Documents	Yes
28	Section 01821 - Instruction of Operations and Maintenance Personnel	Yes
29	Section 13300 - Metal Building Systems	No

Chandler Improvements Phase 3

Work Category: 16A.1 - Electrical Long Lead Equipment

WC Lead: Kyle Roman

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		$3,683,275
30	Section 16001 - Packaged Systems And Packaged Control Panels	Yes
31	Section 16010 - Electrical - Basic Requirements	Yes
32	Section 16050 - Basic Materials And Methods	Yes
33	Section 16123 - 600 Volt Class Cable	Yes
34	Section 16124 - Instrumentation Class Cable	Yes
35	Section 16160 - Enclosures	Yes
36	Section 16161 - Control Panels	Yes
37	Section 16195 - Electrical Identification	Yes
38	Section 16282 - Surge Protective Device	Yes
39	Section 16321 - Oil Filled Substation Transformers	Yes
40	Section 16341 - Medium Voltage Switches	Yes
41	Section 16343 - Medium Voltage Metal Clad Switchgear	Yes
42	Section 16430 - Customer Power Metering System	Yes
43	Section 16431 - Low Voltage Drawout Switchgear	Yes
44	Section 16440 - Disconnect Switches	Yes
45	Section 16461 - Transformers - Dry Type	Yes
46	Section 16470 - Panelboards	Yes
47	Section 16474 - Motor Control Equipment (Separately Mounted)	Yes
48	Section 16475 - Mini Power Centers	Yes
49	Section 16476 - Low Voltage Circuit Breakers	Yes
50	Section 16477 - 600 V Fuses	Yes
51	Section 16480 - Motor Controllers	Yes
52	Section 16481 - Motor Control Centers (MCC)	Yes
53	Section 16482 - Solid State Motor Controllers	Yes
54	Section 16485 - Variable Frequency Drives – Low Voltage	Yes
55	Section 16611 - Static Uninterruptible Power Supply	Yes
56	Section 16920 - Electrical Acceptance Testing	Yes
57	Section 16951 - Short Circuit, Coordination And Arc Flash Hazard Report	Yes

Chandler Improvements Phase 3

Work Category: 16A.1 - Electrical Long Lead Equipment

WC Lead: Kyle Roman

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		**$3,683,275**
58	**Scope Items:**	
59	**Medium Voltage Bucket - OWRF** (New Buss attachment hardware, all associated provisions and new circuit breaker bucket) 1200AF/150AT in existing SGR-120-001 as required in 16343 section 2.2 and indicated on the drawings	Yes
60	**Medium Voltage Bucket - OWRF** (New Circuit Breaker installed in existing spare bucket) 1200AF/150AT in existing SGR-120-002 as required in 16343 section 2.2 and indicated on the drawings	Yes
61	**Medium Voltage Fused Disconnect - OWRF** DSC-1AA-001 - 600A, 150E, 12,470V DSC-1AB-002 - 600A, 150E, 12,470V	Yes
62	**Main Electrical Switchgear - OWRF** 480V Main Switchgear SWGR-1AA & SWGR-1AB - 3000AT/3200AF(1AA), 4000AF/4000AT(tie), 3000AT/3200AF(1AB) as required in 16343 section 2.2 and indicated on the drawings	Yes
63	**Prefabricated Electrical Building - OWRF** SWGR-1AA & SWGR-1AB Electrical Building	No
64	**Prefabricated Electrical Building - OWRF** Anoxic MCC Electrical Building	No
65	**MCC's - OWRF** 600A, 480v, EFF-MCC-001/002 600A, 480v, ANX-MCC-001/002	Yes
66	**PDP's and Panelboards - OWRF** 225A, 480V, Panelboard PDP-001 225A, 480V, Panelboard PDP-639-001 150A, 208V/120V, Panelboard Panel LS 150A, 208V/120V Panelboard LP-P1 100A, 208v/120v 3ph, 4w, Panelboard LP-419-001	Yes
67	**Mini Power Center - OWRF** 100A, 208V/120V 3ph, 4w NEMA 4X - FS-MPC-100 30KVA 480V-208V/120V Transformer XMFR FS-MPC-100	Yes

Chandler Improvements Phase 3

Work Category: **16A.1 - Electrical Long Lead Equipment**

WC Lead: **Kyle Roman**

Bid Date: **August 21, 2026**

TOTAL WORK CATEGORY PACKAGE VALUE		**$3,683,275**
68	**XMFR's - OWRF** 45kVA 480V-208V/120V Transformer XFR-Panel LS 30kVA 480V-208V/120V Transformer XFMR T-POC 15KVA 480v-208V/120V Transformer XMFR TRF-419-001 2.5MVA 12.47KV-277/480 Transformer XMFR TRF-1AA-001 2.5MVA 12.47KV-277/480 Transformer XMFR TRF-1AB-002	Yes
69	**ATS - OWRF** 70a, 4w, 480v, NEMA 3R - ATS-PANEL LS 25a, 4w, 480v, NEMA 3R - ATS-E 40a, 4w, 480v, NEMA 3R - ATS-419-001	Yes
70	**Stand Alone VFD's - OWRF** SEC-MTR-VFD-300 (CLARIFIER 3 MCP), NEMA 4X Enclosure	Yes
71	**Bucket Retrofit VFD's - OWRF** IMLP-410-101-VFD (MCC-410-001) IMLP-410-201-VFD (MCC-410-001)	Yes
72	**Disconnects - OWRF** ACU-DSC-102 - 60A, 480V, NEMA 4X ACU-DSC-101 - 60A, 480V, NEMA 4X DSC-410-181 - 30A, 480v, NEMA 4X DSC-410-281 - 30A, 480v, NEMA 4X DSC-410-101 - 60A, 480V, NEMA 4X DSC-410-201 - 60A, 480V, NEMA 4X ANX-MLR-PMP-DSC-007 - 100A, 480v, NEMA 4X	Yes
73	**Bucket Retrofit Motor Starters - OWRF** MIX-410-181 (MCC-410-001) MIX-410-281 in (MCC-410-002)	Yes
74	**Disconnects - AWRF** DSF06-MTR-DSC-600 - 30A, 480v, NEMA 4X DSF06-BWP-DSC-601 - 30A, 480v, NEMA 4X DSF06-BWP-DSC-602 - 30A, 480v, NEMA 4X	Yes
75	**Mini Power Center - AWRF** 100A, 208V/120V 3ph, 4w NEMA 4X - FS-MPC-100 30KVA 480V-208V/120V Transformer XMFR FS-MPC-100	Yes
76	Arc Flash/Power Coordination Studies	Yes
77	FAT Test, Startup and Training	Yes
78	FOB Jobsite included	Yes
79	Extended Warantees (through 6/30/2030)	Yes

Chandler Improvements Phase 3

Work Category: **16A.1 - Electrical Long Lead Equipment**

WC Lead: **Kyle Roman**

Bid Date: **August 21, 2026**

TOTAL WORK CATEGORY PACKAGE VALUE		**$3,683,275**
80	Textura Included (Total Under $2.2M add 0.22%, if total is Equal or More than $2.2M add $5,000)	Yes
81	Bond/CDI Cost	Yes
82	Travel for Witness Testing & Production Verification(10 Trips)	Yes

	ASSUMPTIONS & CLARIFICATIONS:
1	Electrical gear procurement is by McCarthy. McCarthy requires two collaborative submittal review sessions with Engineer and Vendor to ensure expedited review cycles.
2	Damages associated with the direct electrical procurement scope will not be assessed assuming that McCarthy has not been negligent in the management of the scope
3	Pricing is based upon Eaton's suggestions discussed with Wilson Engineers on 06/10/2026 Teams call. Discussed in this meeting was Definition of Services to be provided by Eaton Field Services, Requirements and Proposed Arrangement of SWGR-1AA & 1-AB, Size of Tie Breakers throughout SLD, and Medium Voltage Transformers and Switches. Reference Document: [City of Chandler SWGR 1AA 1AB with Provisions.pdf] provided to Wilson Engineers via email on 6/16/26
4	Due to the nature of electrical long-lead equipment procurement, once orders are released to production they are non-cancelable and non-returnable, and all costs associated with such equipment shall remain the Owner's responsibility. In addition, any major changes or additions to the electrical single line after initial design development may require revised equipment procurement, which can result in additional costs and extended lead times.
5	The Contractor's (McCarthy's) liability for damages arising out of the Direct Electrical Procurement Scope shall be limited to those damages resulting from the Contractor's negligence or other culpable acts or omissions in the management of such scope. The Limitations of Liability applicable to vendor delays associated with Work Categories 11E, 11H, 11I, 11J, and 16A.1 are contingent upon the extent of the Contractor's (McCarthy's) responsibility for the delay. For delays attributable to the Vendor, the Contractors liability shall be limited to 30% of the equipment value.
6	The pricing included in proposal is based upon the assumption that mutually acceptable contract terms will be reached with the selected electrical supplier. If the final negotiated terms materially differ from those assumed in establishing the proposal pricing, the Contractor (McCarthy) may, upon completion of such negotiations, submit a timely proposal for an adjustment to the proposal pricing. Any adjustment shall be subject to the Owner's review and written approval prior to becoming effective.
7	Cost for Programming or configuration of PLC and Electrical MLE and ANX Buildings is not included. Progamming cost covered under WC 16A in the Wilson Plant of Balance Scope.



City of Chandler
WRF Improvements Phase 3
Balance of Plant Work
Categories



City of Chandler
WRF Improvements Phase 3
WC 01A – General Requirements

Solicitation Summary

City of Chandler WRF Improvements Phase 3

Long Lead Procurement and Wilson Balance of Plant Proposal

Work Category: **01A.1 - General Requirements**

Subcontractor/Supplier Name	***Status***
McCarthy	*Recommended*

Chandler Phase 3

Work Category: 01A - General Requirements

WC Lead: Dominic McCarver

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		$1,366,558
Description		
1	Drinking Water/Cups/Hydration/Ice	Yes
2	Debris and Clean Up Both Sites	Yes
3	Owner Engineer Requirements	Yes
4	General Safety Support Requirements	Yes
5	CPM Schedule Progress Updates	Yes
6	Project Documentation and Photograph Requirements	Yes
7	Dust Control and SWPPP Requirements	Yes
8	Temporary Construction Access and Support	Yes
9	Temporary Construction Facilities	Yes

Chandler Phase 3

Work Category: 01A - General Requirements

WC Lead: Dominic McCarver

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE	$1,366,558

	ASSUMPTIONS & CLARIFICATIONS:
1	Monthly photos will be transmitted monthly via Procore using daily reports, and will not comply with specification 01380-1.1.B2. Quantity of photos required will depend on work performed that month and not in compliance with quantity provided in specification 01380-1.1.B.2.
2	As built documents to be captured using Procore drawing management system. Live access to as built documents will be made available to Engineer & Owner via Procore. Final As Built drawing turnover using Bluebeam session for final review. No hard copies of as built drawings will be maintained. Access to Procore to serve as monthly transmission of As Built documents. Additionally, no updates to Engineer CAD files will be completed with As Built deliverable.
3	For each unique piece of equipment, only one of the training sessions will be recorded.
4	Owner Engineer Requirements will include the following: office supplies, printer, appliances, desks, chairs, conference table, office furniture, TV, first-aid, and kitchen consummables. Engineer's trailer is NOT included. Owner to provide engineer's trailer and all associated hook-ups/maintenance or trailer.
5	The following are City of Chandler project costs and have not been included:
A.	Temporary/construction/startup use and permanent utility hookup and usage costs including power, sewer, reuse water, and chemicals.
B.	Building and Environmental Permits, MCDES and ADEQ permitting fees, plan review fees and impact costs.
C.	Special Inspection Fees.
D.	Furnishings, Fixtures, and Equipment (FFE) and design of FFE.
6	No costs have been carried for background checks for CMAR or trade partners as outlined in article 9 of the agreement. Based on previous projects no costs had been assessed for background checks.



City of Chandler

WRF Improvements Phase 3

WC 01B – MOPO Tie-Ins

Solicitation Summary
City of Chandler WRF Improvements Phase 3
Long Lead Procurement and Wilson Balance of Plant Proposal
Work Category: **01B - MOPOs Tie-Ins**

Subcontractor/Supplier Name	***Status***
McCarthy	*Recommended*

Chandler Phase 3

Work Category: 01B - MOPOs Tie-Ins

WC Lead: Dominic McCarver

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		**$720,296**
MCCARTHY SUBCONTRACT & FRONT END TERMS		
1	Compliant with McCarthy Front Ends	Yes
2	Bid Submitted on McCarthy Bid Form	NA
3	Bid Bond Included with Bid	NA
4	Surety Company	Traveler's Casualty
5	Surety AM Best Rating (Must be A- or Better)	A++
6	Bond/CDI Cost	No
7	Insurance Requirements Per Matrix	Yes
8	GL Insurance Company Name	Old Republic Insurance
9	GL Insurance Carrier AM Best Rating (Must be A- or Better)	A+
10	E&O Insurance (If Required by Front Ends)	Yes
11	Pollution Insurance (If Required by Front Ends)	Yes
12	Tier 1 Approved	Yes
13	Tier 2 Approved	Yes
14	OSHA Recordable Incident Rate (Current)	0.22
15	Includes Hoisting for Sub's Own Work Scope	Yes
16	Acknowledges Soils Report	Yes
17	Acknowledges Addenda	Yes
18	Hold Bid for 150 Days	Yes
Scope of Work:		
19	Per Plans & Specifications	
20	Division 1 as it relates to this scope of work	Yes
21	01012 Plant Operations During Construction	Yes
22	Provide all labor, materials, tools, equipment, and appurtenances as required to perform the Work Category 01B - Maintenance of Plant Operations, in accordance with and reasonably inferable from the Contract Documents, complete and without exception unless otherwise noted below, including, but not limited to the following:	Yes
23	**CMAR MOPO**	Yes
24	A-01 Influent Pump Station T-Lock Repair	Yes
25	Temporary ventilation	Yes
26	Hanging scaffolding	Yes
27	A-2 Parshall Flume Rehabilitation	Yes
28	Bypass pumping (with pump watch)	Yes
29	High pressure sewer plug rental	Yes

Chandler Phase 3

Work Category: 01B - MOPOs Tie-Ins

WC Lead: Dominic McCarver

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		**$720,296**
30	Road barricades	Yes
31	Light Plant	Yes
32	Temporary Ventilation	Yes
33	A-03 Installation of new FRP foul air piping in Headworks building	Yes
34	Temporary ventilation	Yes
35	A-04 Aeration Basins No. 5 & 6 new diffuser and piping installation	Yes
36	Hydrovacing services	Yes
37	Skid steer rental	Yes
38	Waste disposal after cleaning Basins 5 & 6	Yes
39	Labor & supplies to clean Basins 5 & 6	Yes
40	Temporary access & lighting for work	Yes
41	A-5 Secondary Clarifiers No. 1 - No. 4 mechanism Replacement	Yes
42	Hydrovacing services	Yes
43	Waste disposal after cleaning Secondary Clarifiers 1 - 4	Yes
44	Labor & supplies to clean Secondary Clarifiers 1 - 4	Yes
45	Labor and materials for temporary access into Secondary Clarifiers 1 - 4	Yes
46	A-6 Secondary Clarifiers No. 1 and No. 3 12-inch drain plug valve replacement	Yes
47	Inflatable plug rental to block flow to perform work	Yes
48	Diver to install plug for Secondary Clarifiers 1 & 3	Yes
49	A-8 Chemical feed loop	Yes
50	Bypass pumping (with pump watch)	Yes
51	Temporary piping materials	Yes
52	Labor to install temporary piping	Yes
53	Light Plant	Yes
54	O-1 MBR IMLR pump installation	Yes
55	Hydrovacing services	Yes
56	Waste disposal after cleaning Basins	Yes
57	Labor & supplies to clean Basins	Yes
58	Temporary access for work	Yes
59	Temporary ventilation	Yes
60	O-2 MLE IMLR pump No. 6	Yes
61	Hydrovacing services	Yes
62	Labor & supplies to clean Anoxic pit	Yes
63	Temporary access for work	Yes

Chandler Phase 3

Work Category: 01B - MOPOs Tie-Ins

WC Lead: Dominic McCarver

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		**$720,296**
64	Unistrut to aid in removal of core	Yes
65	O-3 Secondary Clarifier No. 3 mechanism replacement	Yes
66	Hydrovacing services	Yes
67	Inflatable plug rental to block flow to perform work	Yes
68	Labor & supplies to clean Secondary Clarifier 3	Yes
69	Labor to install inflatable plug	Yes
70	Labor and materials for temporary access into Secondary Clarifier 3	Yes
71	O-4 Effluent Pump Station beam repair	Yes
72	Coffer dam procurement	Yes
73	Labor to install coffer dam in wet well	Yes
74	anchor bolts to secure coffer dam in place	Yes
75	Crane rental to fly coffer dam in and out of wet well	Yes
76	Rolling scaffold to aid in performing work	Yes
77	Labor and materials for temporary access into wet well	Yes
78	AWRF/OWRF ELECTRICAL MOPOS	In WC 16A
79	Safety and Access equipment for work	Yes
80	Mobilization / demobilization included	Yes
81	Textura Included (Total Under $2.2M add 0.22%, if total is Equal or More than $2.2M add $5,000)	NA
82	Bond/CDI Cost	NA

Chandler Phase 3

Work Category: 01B - MOPOs Tie-Ins

WC Lead: Dominic McCarver

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE	$720,296

	ASSUMPTIONS & CLARIFICATIONS:
1	Costs carried in 01B are strictly costs that are needed to allow for isolation and work to safely take place. Performance of the work is carried in its respective WC.
2	A-02 - Parshall Flume Rehabilitation: Assuming 10MGD flow.
3	A-04 Aeration Basins: Both aeration basins will be down for the entire duration of work (10 months).
4	A-05 Secondary Clarifiers No. 1 - No. 4 mechanism replacement: it is assumed that any 2 of the clarifiers can be down at a time (no matter the time of year).
5	A-05 Secondary Clarifiers No. 1 - No. 4 mechanism replacement: Splitter box gates are assumed to be operational. No considerations made for back-up plugs.
6	A-05 Secondary Clarifiers No. 1 - No. 4 mechanism replacement: Existing RAS Valves for Clarifiers 2 &4 are assumed operational to prevent back flow. No considerations made for back-up plugs.
7	A-08 Chemical Feed Loop: Assuming shut-off valves on feed tanks are operational and will not leak.
8	O-01 MBR IMLR Pump Installation: Inlet gates are operational and will isolate the basin. No considerations for back-up plugs are included.
9	O-02 MLE IMLR Pump No. 7: All valves at headworks are assumed to be operation and will hold flow. Effluent gates at anoxic are operational and will hold flow. No considerations for back-up plugs are included.
10	O-02 MLE IMLR Pump No. 7: RAS Valves in the RAS Pump Station and the Anoxic gates are operational and will isolate the IMLR discharge basin. No considerations for back-up plugs are included.
11	O-03 – Secondary Clarifier Mechanism Replacement: Demoing Mechanism 2 months before installing mechanism for procurement scheduling reasons and to optimize craft labor on the project. Therefore clarifier will be unusable for six months.
12	O-04 Effluent Pump Station Beam Repairs: All valves at headworks are assumed to be operational and will hold flow. Effluent gates at anoxic are operational and will hold flow. No considerations for back-up plugs are included.
13	Seasonal Restrictions Assumed: None.



City of Chandler

WRF Improvements Phase 3

WC 01C – Quality Control Testing

Solicitation Summary
City of Chandler WRF Improvements Phase 3
Long Lead Procurement and Wilson Balance of Plant Proposal
Work Category: **01C - Quality Control**

Subcontractor/Supplier Name	***Status***
Ceterra Southwest LLC	*Recommended*
US Inspection and Consulting LLC	*Proposed*
Alpha Geotechnical and Materials Inc	*Proposed*
CMT Technical Services	*Declined*
QTO Solutions	*Declined*
Statewide Disinfection Services	*Declined*
Western Technologies	*Declined*
Field Verified Inc	*Declined*
Phoenix Testing & Inspection LLC	*Declined*

Chandler Phase 3

Work Category: 01C - Quality Control Testing

WC Lead: Dominic McCarver

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		$178,118
MCCARTHY SUBCONTRACT & FRONT END TERMS		
1	Compliant with McCarthy Front Ends	Yes
2	Bid Submitted on McCarthy Bid Form	Yes
3	Bid Bond Included with Bid	N/A
4	Surety Company	N/A
5	Surety AM Best Rating (Must be A- or Better)	N/A
6	Bond/CDI Cost	Yes
7	Insurance Requirements Per Matrix	Yes
8	GL Insurance Company Name	Travelers Property Casualty Co. of AZ
9	GL Insurance Carrier AM Best Rating (Must be A- or Better)	A++
10	E&O Insurance (If Required by Front Ends)	Admiral Insurance Company
11	Pollution Insurance (If Required by Front Ends)	Admiral Insurance Company
12	Tier 1 Approved	No
13	Tier 2 Approved	No
14	OSHA Recordable Incident Rate (Current)	1.01
15	Includes Hoisting for Sub's Own Work Scope	N/A
16	Acknowledges Soils Report	N/A
17	Acknowledges Addenda	Yes
18	Hold Bid for 150 Days	Yes
Scope of Work:		
20	Startup/testing records and reporting package	Yes
21	Cast in Place Concrete Testing	Yes
22	Soils Verification and Inspection	Yes
23	Structural Steel Special Inspections. (NOTE: 2 buildings)	Yes
24	Welding Inspection (Clarifier Mechanism QC)	Yes
25	Leak Testing existing Hydraulic Structures	No
26	Aeration basin field test (4 zones)	Yes
27	Bond/CDI Cost	Yes

ASSUMPTIONS & CLARIFICATIONS:	
1	McCarthy has removed the requirement to hydro-leak testing existing basins as a cost saving measure.

City of Chandler

WRF Improvements Phase 3

WC 01D – Surveying

Solicitation Summary
City of Chandler WRF Improvements Phase 3
Long Lead Procurement and Wilson Balance of Plant Proposal
Work Category: **01D - Surveying**

Subcontractor/Supplier Name	***Status***
Alta E&I Estimating	*Recommended*
Southwest Survey Solutions / S3 Arizona	*Proposed*
EPS Group	*Declined*
QTO Solutions	*Declined*
Vigilantex	*Declined*
D2 Surveying LLC	*Declined*
Holigraph VDC LLC	*Declined*
RNL Consultant	*Declined*

Chandler Phase 3

Work Category: 01D - Surveying

WC Lead: Dominic McCarver

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		$143,939
MCCARTHY SUBCONTRACT & FRONT END TERMS		
1	Compliant with McCarthy Front Ends	Yes
2	Bid Submitted on McCarthy Bid Form	NA
3	Bid Bond Included with Bid	No
4	Surety Company	CDI
5	Surety AM Best Rating (Must be A- or Better)	NA
6	Bond/CDI Cost	Yes
7	Insurance Requirements Per Matrix	Yes
8	GL Insurance Company Name	Travelers Indemnity Co of America
9	GL Insurance Carrier AM Best Rating (Must be A- or Better)	A++
10	E&O Insurance (If Required by Front Ends)	Yes
11	Pollution Insurance (If Required by Front Ends)	NA
12	Tier 1 Approved	NA
13	Tier 2 Approved	NA
14	OSHA Recordable Incident Rate (Current)	0.00
15	Includes Hoisting for Sub's Own Work Scope	NA
16	Acknowledges Soils Report	Yes
17	Acknowledges Addenda	Yes
18	Hold Bid for 150 Days	Yes
Scope of Work:		
19	**Per Plans & Specifications:**	
20	Division 1 General Requirements	Yes
21	Section 01050 Field Engineering, Surveying	Yes
22	AWRF - Layout control, horizontal / vertical control and staking (67 HRs)	Yes
23	AWRF - Existing conditions verification and tie-in verification (76 HRs)	Yes
24	AWRF - As-built survey, record data and closeout support (119 HRs)	Yes
25	AWRF - Removal of NHLW (-32 HRs)	Yes
26	OWRF - Layout control, horizontal / vertical control and staking (57 HRs)	Yes
27	OWRF - Existing conditions verification and tie-in verification (20 HRs)	Yes
28	OWRF - As-built survey, record data and closeout support (132 HRs)	Yes
29	OWRF - Survey for new SWGR electrical building (8 HRs)	Yes
30	OWRF - Survey for new ANX electrical building (8 HRs)	Yes
31	OWRF - Survey for new Duct banks	In WC 16A
32	AWRF - Survey for new Chemical trench location	In WC 02B

Chandler Phase 3

Work Category: 01D - Surveying

WC Lead: Dominic McCarver

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		$143,939
33	Both Sites - Any & all other new underground Civil structures	In WC 02B
34	Both Sites - Any & all other new underground Electrical structures	Yes
35	Textura Included (Total Under $2.2M add 0.22%, if total is Equal or More than $2.2M add $5,000)	Yes
36	Bond/CDI Cost	Yes

ASSUMPTIONS & CLARIFICATIONS:	
1	No as-builting of existing underground utilities is included in our survey cost. Surveying only covers as-builting new installations per the contract scope.



City of Chandler
WRF Improvements Phase 3
WC01F – Start-Up and Commissioning

Solicitation Summary

City of Chandler WRF Improvements Phase 3

Long Lead Procurement and Wilson Balance of Plant Proposal

Work Category: **01F - Start-Up and Commissioning**

Subcontractor/Supplier Name	***Status***
McCarthy	*Recommended*

Chandler Phase 3

Work Category: 01F - Start-Up & Commissioni

WC Lead: Dominic McCarver

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		$216,947
Description		
1	General start up and commissioning Plans and documentation	Yes
2	Training and Operation & Maintenance Validation	Yes
3	Clean Water Commisioning and Start up	Yes
4	HVAC start up and commissioning	Yes
5	Wilson Engineering Electrical Scope Start Up and Commissioning	Yes



City of Chandler

WRF Improvement Phase 3

WC 02A - Demolition

Solicitation Summary

Chandler Improvements Phase 3

Long Lead Procurement and Wilson Balance of Plant Proposal

Work Category: **02A - Demolition**

Subcontractor/Supplier Name	***Status***
Dickens Quality Demo	*Recommended*
EZARC Inc.	*Proposed*
Arizona Specialty Demo	*Declined*
August Building	*Declined*
Arrowmark LLC	*Declined*
ENG Systems	*Declined*
Freddy's Drywall LLC	*Declined*
OCM LLC	*Declined*

Chandler Improvements Phase 3

Work Category: 02A - Demolition

WC Lead: Dominic McCarver

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		**$54,427**
MCCARTHY SUBCONTRACT & FRONT END TERMS		
1	Compliant with McCarthy Front Ends	Yes
2	Bid Submitted on McCarthy Bid Form	Yes
3	Bid Bond Included with Bid	NA
4	Surety Company	Merchants Bonding
5	Surety AM Best Rating (Must be A- or Better)	A
6	Bond/CDI Cost	Yes
7	Insurance Requirements Per Matrix	Yes
8	GL Insurance Company Name	Homesite Insurance Company of Florida
9	GL Insurance Carrier AM Best Rating (Must be A- or Better)	A
10	E&O Insurance (If Required by Front Ends)	NA
11	Pollution Insurance (If Required by Front Ends)	Yes
12	Tier 1 Approved	Yes
13	Tier 2 Approved	NA
14	OSHA Recordable Incident Rate (Current)	1.00
15	Includes Hoisting for Sub's Own Work Scope	Yes
16	Acknowledges Soils Report	NA
17	Acknowledges Addenda	Yes
18	Hold Bid for 150 Days	Yes
Scope of Work:		
19	Provide all labor, materials, tools, equipment and appurtenances as required to perform the Work Category in accordance with and reasonably inferable from the Contract Documents, complete and without exception unless otherwise noted below, including, but not limited to the following:	Yes
20	**Per Plans & Specifications:**	
21	Division 1 General Requirements	Yes
22	Section 02050: Demolitions	Yes
23	Dispose of all removed materials and equipment per owners request	Yes
24	Items listed to be demolished shall be removed including all but not limited to:	Yes
25	OWRF - Demo of Housekeeping pad where VTP will sit	In WC 03A
26	OWRF - Demo of concrete pad in EFF Electrical Bldg	In WC 03A
27	OWRF - Demo of Electrical gear in EFF Electrical Bldg	In WC 16A
28	OWRF - Demo of HVAC system in EFF Electrical Bldg	In WC 15C
29	OWRF - Demo of Asphalt road near conveyor system	In WC 02B
30	OWRF - Demo of Conveyor system	Yes

Chandler Improvements Phase 3

Work Category: 02A - Demolition

WC Lead: Dominic McCarver

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		$54,427
31	OWRF - Demo of MBR Basin Diffusers, mixers and mixer rails	In WC 15A
32	OWRF - Demo of metal covers over MBR Basins	In WC 15A
33	AWRF - Demo of chemical trench	In WC 02B
34	AWRF - Demo of all chemical feed and return lines	In WC 15A
35	AWRF - Demo of chemical feed pumps	In WC 15A
36	AWRF - Demo of Clarifiers 1-3 and scum piping	In WC 15A
37	AWRF - Demo of Clarifier #4 and scum piping	In WC 15A
38	OWRF - Demo of Clarifier #3 and scum piping	In WC 15A
39	AWRF - Demo of A-Basin Diffuser system	In WC 15A
40	AWRF - Demo of Headworks grating	In WC 05A
41	AWRF - Demo of Headworks FRP pipe	In WC 15A
42	AWRF - Demo of curb at Fuel Storage Tank	In WC 02B
43	AWRF - Demo of Parshall Flume	In WC 02B
44	AWRF/OWRF - Demo of Clarifier Basin grout with scabbler	In WC 03A
45	AWRF/OWRF - Demo of Clarifier Trough grout with scabbler	In WC 03A
63	Both sites - Demo of stairs to clairifer (5 total, not including concrete landing)	Yes
64	AWRF - Demo of stairs at prestage basin #2.	Yes
46	Holding bid for 150 days	Yes
47	Haul off debris.	Yes
48	Provide dust control for building demolition scope of work	Yes
49	File NESHAP permit as needed for City & County requirements.	Yes
50	Protect existing owner property to remain, from demo as required.	Yes
51	Complete all demo work per drawings	Yes
52	Extra materials as required	Yes
53	Unloading and hoisting of own work	Yes
54	Subcontractor will perform work in phases in accordance with Exhibit E in the Front-End Documents	Yes
55	Shipping shall be FOB jobsite	Yes
56	Unloading & storage	Yes
57	Temporary protection & enclosure for the duration of the Scope Only	Yes
58	Textura Included (Total Under $2.2M add 0.22%, if total is Equal or More than $2.2M add $5,000)	Yes
59	Hazardous Materials Testing	Yes
60	Additional Mobilization	Yes
61	Bond/CDI Cost	Yes

Chandler Improvements Phase 3

Work Category: 02A - Demolition

WC Lead: Dominic McCarver

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE	$54,427

	ASSUMPTIONS & CLARIFICATIONS:
1	Hazardous waste removal including but not limited to asbestos, lead based products, substation demo materials, or plant waste is not included in this proposal.
2	This proposal includes trucking and disposal to a non-hazardous legally licensed landfill.



City of Chandler

WRF Improvements Phase 3

WC 02B – Earthwork & Yard Piping

Solicitation Summary

Chandler Improvements Phase 3

Long Lead Procurement and Wilson Balance of Plant Proposal

Work Category: **02B - Earthwork & Yard Piping**

Subcontractor/Supplier Name	***Status***
McCarthy Building Companies	*Recommended*

Chandler Phase 3

Work Category: 02B - Earthwork & Yard Pipe

WC Lead: Peyton Tucker

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		**$2,592,465**
MCCARTHY SUBCONTRACT & FRONT END TERMS		
1	Compliant with McCarthy Front Ends	Yes
2	Bid Submitted on McCarthy Bid Form	NA
3	Bid Bond Included with Bid	NA
4	Surety Company	NA
5	Surety AM Best Rating (Must be A- or Better)	NA
6	Bond/CDI Cost	Yes
7	Insurance Requirements Per Matrix	NA
8	GL Insurance Company Name	NA
9	GL Insurance Carrier AM Best Rating (Must be A- or Better)	NA
10	E&O Insurance (If Required by Front Ends)	NA
11	Pollution Insurance (If Required by Front Ends)	NA
12	Tier 1 Approved	NA
13	Tier 2 Approved	NA
14	OSHA Recordable Incident Rate (Current)	0.22
15	Includes Hoisting for Sub's Own Work Scope	Yes
16	Acknowledges Soils Report	Yes
17	Acknowledges Addenda	Yes
18	Hold Bid for 150 Days	Yes
19	Sales Tax Excluded for Non-Permanent Materials	Yes
Scope of Work:		
20	**Per Plans & Specifications:**	
21	Provide all labor, materials, tools, equipment and appurtenances as required to perform the Work Category in accordance with and reasonably inferable from the Contract Documents, complete and without exception unless otherwise noted below, including, but not limited to the following:	Yes
22	Division 1 General Requirements	Yes
23	Section 01414 - Earthmoving and Dust Control	Yes
24	Section 02050 - Demolitions	Yes
25	Section 02150 - Site Preperation	Yes
26	Section 02150 - Shoring	Yes
27	Section 02315 - Earthwork Excavation and Backfill	Yes

Chandler Phase 3

Work Category: 02B - Earthwork & Yard Pipe

WC Lead: Peyton Tucker

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		$2,592,465
28	Section 02319 - Rip Rap	Yes
29	Section 02371 - Filter Fabric for Rip Rap Channels	Yes
30	Section 15050 - Piping Systems	Yes
31	Section 15051 - Buried Piping	Yes
32	Section 15052 - Copper Pipe	Yes
33	Section 15053 - Thermoplastic Pipe and Accessories	Yes
34	Site Demo for Airport and Ocotillo Site	Yes
35	Subgrade Preperation and Placement of Aggregate for all Sitework at Airport and Ocotillo Site	Yes
36	General earthwork, excavation, backfill, subgrade prep, and localized exterior grading per civil/architectural/structural drawings. including, but not limited to the following:	Yes
37	Airport - Fuel Storage Tank	Yes
38	Airport - Site Pavement Excavations	Yes
39	Airport - Site Grading	Yes
40	Airport - Engineered Shoring for proposed Manhole 10	Yes
41	Ocotillo - Fuel Storage Tank	Yes
42	Ocotillo - Electrical Buildings	Yes
43	Ocotillo - Site Pavement Excavations	Yes
44	Ocotillo - Site Grading	Yes
45	General Yard Pipe, excavation, lay, bedding, and backfill per civil/architectural/structural drawings. including, but not limited to the following:	Yes
46	Drain Line (Excavate / Bed / Backfill)	Yes
47	Non-Potable Water Sprayer Line (Excavate / Bed / Backfill)	Yes
48	Non-Potable Water Sprayer Line (Excavate / Bed / Backfill)	Yes
49	Return Activated Sludge (Excavate / Bed / Backfill)	Yes
50	Scum (Excavate / Backfill)	Yes
51	Tank Drain (Excavate / Bed / Backfill)	Yes
52	Vent (Excavate / Backfill)	Yes
53	Precast Structures, excavation, set, and backfill per civil/architectural/structural drawings. including, but not limited to the following:	Yes
54	Manhole 10	Yes
55	Chemical Trench Sump Boxes	Yes
56	Miscellaneous items, including, but not limited to the following:	Yes
57	Open excavation protection around excavation	Yes
58	Dewatering of excavations for rain events	Yes

Chandler Phase 3

Work Category: 02B - Earthwork & Yard Pipe

WC Lead: Peyton Tucker

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		$2,592,465
59	Survey of own work	Yes
60	Haul off spoils	Yes
61	Extra materials as required	Yes
63	Textura Included	Yes
65	Bond/CDI Cost	Yes

Chandler Phase 3

Work Category: 02B - Earthwork & Yard Pipe

WC Lead: Peyton Tucker

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE	$2,592,465

	ASSUMPTIONS & CLARIFICATIONS:
1	Removal and Replacement of the existing rip rap east of the MLE Anoxic Basins has been included to match the existing limits for the area disturbed by the proposed Electrical Building earthwork.
2	Proposal includes beam & shotcrete shoring required for the Parshall Flume Demo/ MH 10. The north, east, and west sides of the shoring will be abandoned in-place 5' below finish grade. The south side of the shoring will be abandoned in-place full depth as it is adjacent to the Electrical Building and within the zone of influence.
3	Parshall Flume manhole base removal calls out an existing base slab for demo. Team is unable to verify the existing conditions. Demolition is priced as shown on the drawings. Any additional demolition will be at the owner's expense.
4	Replacement of Trees being removed at Electrical building on sheet C-23.05 of OWRF Drawing Set and at Manhole 10, has not been included.
5	Hard dig/rock excavation has not been included. Hard dig scenarios will be addressed with the project team to determine when the hard dig is established and begin to impact the project.
6	Pipe backfill material has been included per specification 02315-8. Full depth CLSM backfill as noted in General Notes on the plan sheets has not been included.
7	Civil detail 302 does not provide termination distance for trench drain lines. Bid includes 14 LF per location with a sump box.



City of Chandler

WRF Improvements Phase 3

WC 02C – Asphalt Paving

Solicitation Summary
Chandler Improvements Phase 3
Long Lead Procurement and Wilson Balance of Plant Proposal

Work Category: **02C - Asphalt Paving**

Subcontractor/Supplier Name	***Status***
L&L Asphalt	*Recommended*
Copper State Paving	*Proposed*
Alk Asphalt	*Proposed*
Cactus Asphalt	*Proposed*
Viasun	*Proposed*

Chandler Improvements Phase 3

Work Category: 02C - Asphalt Paving

WC Lead: Peyton Tucker

Bid Date: 8/21/2026

TOTAL WORK CATEGORY PACKAGE VALUE		**$166,249**
MCCARTHY SUBCONTRACT & FRONT END TERMS		
1	Compliant with McCarthy Front Ends	Yes
2	Bid Submitted on McCarthy Bid Form	Yes
3	Bid Bond Included with Bid	Yes
4	Surety Company	Paffenbarger & Walden
5	Surety AM Best Rating (Must be A- or Better)	A
6	Bond/CDI Cost	Yes
7	Insurance Requirements Per Matrix	Yes
8	GL Insurance Company Name	United Fire & Casualty
9	GL Insurance Carrier AM Best Rating (Must be A- or Better)	A-
10	E&O Insurance (If Required by Front Ends)	NA
11	Pollution Insurance (If Required by Front Ends)	NA
12	Tier 1 Approved	Yes
13	Tier 2 Approved	No
14	OSHA Recordable Incident Rate (Current)	0.84
15	Includes Hoisting for Sub's Own Work Scope	Yes
16	Acknowledges Soils Report	Yes
17	Acknowledges Addenda	Yes
18	Hold Bid for 150 Days	Yes
Scope of Work:		
20	Provide all labor, materials, tools, equipment and appurtenances as required to perform the Work Category 02C - Asphalt Paving, in accordance with and reasonably inferable from the Contract Documents, complete and without exception unless otherwise noted below, including, but not limited to the following:	Yes
21	**Per Plans & Specifications:**	Yes
22	Division 1 General Requirements	Yes
23	Section 02500: Asphalt Pavement	Yes
24	Section 02580: Pavement Markings	Yes
25	Check to Spec completed and submitted to McCarthy	Yes
26	Airport - 4" Asphalt Road Paving	Yes
27	Airport - 4" Asphalt Trench Patching	Yes
28	Airport - 4" Asphalt Road Paving	Yes
29	Slurry Seal	Yes
30	Additional Mobilizations	Yes
31	Placement of Aggregate Base Course	Yes

Chandler Improvements Phase 3

Work Category: 02C - Asphalt Paving

WC Lead: Peyton Tucker

Bid Date: 8/21/2026

TOTAL WORK CATEGORY PACKAGE VALUE		**$166,249**
32	Fine grading of surface coarse	Yes
33	Verification of subbase coarse	Yes
34	Textura Included (Total Under $2.2M add 0.22%, if total is Equal or More than $2.2M add $5,000)	Yes
35	Survey and Layout	Yes
36	Traffic Control	Yes
37	General Foreman Supervision	Yes
38	Bond/CDI Cost	Yes



City of Chandler

WRF Improvements Phase 3

WC 02D – Site Concrete

Solicitation Summary
Chandler Improvements Phase 3
Long Lead Procurement and Wilson Balance of Plant Proposal

Work Category: **02D - Site Concrete**

Subcontractor/Supplier Name	***Status***
Buesing Corp	*Recommended*
Alk Asphalt	*Proposed*
Keystone	*Proposed*
Viasun	*Proposed*

Chandler Improvements Phase 3

Work Category: 02D - Site Concrete

WC Lead: Peyton Tucker

Bid Date: 8/21/2026

TOTAL WORK CATEGORY PACKAGE VALUE		**$176,169**
MCCARTHY SUBCONTRACT & FRONT END TERMS		
1	Compliant with McCarthy Front Ends	Yes
2	Bid Submitted on McCarthy Bid Form	Yes
3	Bid Bond Included with Bid	Yes
4	Surety Company	Holmes Murphy
5	Surety AM Best Rating (Must be A- or Better)	A
6	Bond/CDI Cost	Yes
7	Insurance Requirements Per Matrix	Yes
8	GL Insurance Company Name	Navigators Insurance Company
9	GL Insurance Carrier AM Best Rating (Must be A- or Better)	A+
10	E&O Insurance (If Required by Front Ends)	NA
11	Pollution Insurance (If Required by Front Ends)	NA
12	Tier 1 Approved	Yes
13	Tier 2 Approved	No
14	OSHA Recordable Incident Rate (Current)	0.57
15	Includes Hoisting for Sub's Own Work Scope	Yes
16	Acknowledges Soils Report	Yes
17	Acknowledges Addenda	Yes
18	Hold Bid for 150 Days	Yes
Scope of Work:		
20	Provide all labor, materials, tools, equipment and appurtenances as required to perform the Work Category 02D - Site Concrete, in accordance with and reasonably inferable from the Contract Documents, complete and without exception unless otherwise noted below, including, but not limited to the following:	Yes
21	**Per Plans & Specifications:**	Yes
22	Division 1 General Requirements	Yes
23	Section 02751: Portland Cement Concrete Paving	Yes
24	Check to Spec completed and submitted to McCarthy	Yes
25	Airport - Curb & Gutter	Yes
26	Ocotillo - Curb & Gutter Replacement	Yes
27	Airport - Valley Gutter	Yes
28	Ocotillo - Sidewalk	Yes
29	Airport - Manhole/Valve Box Adjustment Collars	Yes
30	Ocotillo - Manhole/Valve Box Adjustment Collars	Yes
31	Airport - Bollard Bases	Yes

Chandler Improvements Phase 3

Work Category: 02D - Site Concrete

WC Lead: Peyton Tucker

Bid Date: 8/21/2026

TOTAL WORK CATEGORY PACKAGE VALUE		**$176,169**
32	Ocotillo - Bollard Bases	Yes
33	All ready-mix per structural Notes and Spec including all applicable admixtures as part of each mix	Yes
34	Reinforcment as required	Yes
35	Additional Mobilizations	Yes
36	Verification of subbase coarse	Yes
37	Textura Included (Total Under $2.2M add 0.22%, if total is Equal or More than $2.2M add $5,000)	Yes
38	Survey and Layout	Yes
39	Traffic Control	Yes
40	General Foreman Supervision	Yes
41	Bond/CDI Cost	Yes



City of Chandler

WRF Improvements Phase 3

WC 02E – Landscaping

Solicitation Summary
Chandler Improvements Phase 3
Long Lead Procurement and Wilson Balance of Plant Proposal

Work Category: **02E - Landscaping**

Subcontractor/Supplier Name	***Status***
OCM	*Recommended*
Gothic Landscape	*Proposed*
Sunburst Landscaping	*Proposed*
Brightview	*Proposed*

Chandler Improvements Phase 3

Work Category: 02E - Landscaping

WC Lead: Peyton Tucker

Bid Date: 8/21/2026

TOTAL WORK CATEGORY PACKAGE VALUE		**$105,751**
MCCARTHY SUBCONTRACT & FRONT END TERMS		
1	Compliant with McCarthy Front Ends	Yes
2	Bid Submitted on McCarthy Bid Form	Yes
3	Bid Bond Included with Bid	No
4	Surety Company	CDI
5	Surety AM Best Rating (Must be A- or Better)	NA
6	Bond/CDI Cost	Yes
7	Insurance Requirements Per Matrix	Yes
8	GL Insurance Company Name	Upland Specialty Insurance Company
9	GL Insurance Carrier AM Best Rating (Must be A- or Better)	A-
10	E&O Insurance (If Required by Front Ends)	NA
11	Pollution Insurance (If Required by Front Ends)	NA
12	Tier 1 Approved	Yes
13	Tier 2 Approved	No
14	OSHA Recordable Incident Rate (Current)	0.70
15	Includes Hoisting for Sub's Own Work Scope	Yes
16	Acknowledges Soils Report	Yes
17	Acknowledges Addenda	Yes
18	Hold Bid for 150 Days	Yes
Scope of Work:		
20	Provide all labor, materials, tools, equipment and appurtenances as required to perform the Work Category 02E - Landscaping, in accordance with and reasonably inferable from the Contract Documents, complete and without exception unless otherwise noted below, including, but not limited to the following:	Yes
21	**Per Plans & Specifications:**	Yes
22	Division 1 General Requirements	Yes
23	Section 02315: Earthwork Excavation and Backfill	Yes
24	Section 02318: Crushed Stone, Gravel and Decomposed Granite	Yes
25	Check to Spec completed and submitted to McCarthy	Yes
26	Airport - Decomposed Granite	Yes
27	Ocotillo - Decomposed Granite	Yes
28	Ocotillo - Retaining Wall	Yes
29	Samples of material	Yes
30	Cleanup of spilled material on asphalt and concrete a. Include sweeping of the asphalt, concrete, sidewalks, etc. Upon completion of this scope of work	Yes
31	Mobilizations	Yes

Chandler Improvements Phase 3

Work Category: 02E - Landscaping

WC Lead: Peyton Tucker

Bid Date: 8/21/2026

TOTAL WORK CATEGORY PACKAGE VALUE		$105,751
32	Cost to hold bid	Yes
33	Textura Included (Total Under $2.2M add 0.22%, if total is Equal or More than $2.2M add $5,000)	Yes
36	General Foreman Supervision	Yes
37	Bond/CDI Cost	Yes



City of Chandler

WRF Improvements Phase 3

WC 03A - Concrete

Solicitation Summary

Chandler Improvements Phase 3

Long Lead Procurement and Wilson Balance of Plant Proposal

Work Category: **03A - Concrete**

Subcontractor/Supplier Name	***Status***
McCarthy Building Companies	*Recommended*

Chandler Improvements Phase 3

Work Category: 03A - Concrete
WC Lead: David Gonzalez
Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		**$2,148,774**
MCCARTHY SUBCONTRACT & FRONT END TERMS		
1	Compliant with McCarthy Front Ends	Yes
2	Bid Submitted on McCarthy Bid Form	NA
3	Bid Bond Included with Bid	NA
4	Surety Company	NA
5	Surety AM Best Rating (Must be A- or Better)	NA
6	Bond/CDI Cost	Yes
7	Insurance Requirements Per Matrix	NA
8	GL Insurance Company Name	NA
9	GL Insurance Carrier AM Best Rating (Must be A- or Better)	NA
10	E&O Insurance (If Required by Front Ends)	NA
11	Pollution Insurance (If Required by Front Ends)	NA
12	Tier 1 Approved	NA
13	Tier 2 Approved	NA
14	OSHA Recordable Incident Rate (Current)	0.22
15	Includes Hoisting for Sub's Own Work Scope	Yes
16	Acknowledges Soils Report	Yes
17	Acknowledges Addenda	Yes
18	Hold Bid for 150 Days	Yes
Scope of Work:		
19	**Per Plans & Specifications:**	Yes
20	Division 1 General Requirements	Yes
21	03100 - Concrete Formwork	Yes
22	03200 - Concrete Reinforcement	Yes
23	03251 - Concrete Joints	Yes
24	03252 - Anchorage in Concrete	Yes
25	0300 - Cast-in-Place Concrete	Yes
26	03600 - Grout	Yes
27	Provide all labor, materials, tools, equipment and appurtenances as required to perform the Work Category - 03A Concrete, in accordance with and reasonably inferable from the Contract Documents, complete and without exception unless otherwise noted below, but not limited to the following:	Yes
28	Airport WRF	Yes
29	Aeration Basins	Yes
30	Form, place and finish 2'-10" x 1'-0" x 1'-6", and 3'-6" x 1'-0" x 7'-0" concrete pipe supports	Yes
31	Roughen existing bonding surface	Yes
32	Drill and epoxy #5 reinforcing bars at existing slab	Yes
33	Blower Building	Yes
34	Sawcut 1'-0" x 1'-0" x 1'-0" opening at existing slab	Yes

Chandler Improvements Phase 3

Work Category: 03A - Concrete
WC Lead: David Gonzalez
Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		$2,148,774
35	Prepare surface and pourback opening using structural grout	Yes
36	Chemical Improvements	Yes
37	Concrete and reinforcement repairs at existing Scrubber pad	Yes
38	Furnish and install precast polymer	Yes
39	Form, place and finish chemical trench	Yes
40	Disc Filters	Yes
41	Roughen existing bonding surfaces for Disc Filter No. 6 pad, and pump pads	Yes
42	Form, place and finish equipment pads	Yes
43	Fuel Storage Tank	Yes
44	Form, place and finish 1'-4" slab on grade with 10" x 6" curbs	Yes
45	Furnish and install 6" PVC waterstop at curbs	Yes
46	Furnish, place, and grout fill pipe bollards originating in the structural slab	Yes
47	Headworks	Yes
48	Grouting at all new penetrations	Yes
49	IPS	Yes
50	Set up working platform for safe and proper access	Yes
51	Concrete surface and reinforcement repairs at all openings that require T-Lock repairs	Yes
52	Furnish and install T-Lock at all openings	Yes
53	Overall Site	Yes
54	Form, place and finish slabs and concrete pipe supports at all buried RAS plugs	Yes
55	Form, place and finish slab and grout at Parshall Flume	Yes
56	Secondary Clarifiers	Yes
57	Roughen existing slab using scabbler, and removal of debris	Yes
58	Form, place, and finish new 2" grout topping at slabs at Secondary Clarifier No. 1, and 4	Yes
59	Roughen existing launder deck using scabbler, and removal of debris	Yes
60	Not used	N/A
61	Grout at scum line penetrations	Yes
62	Ocotillo	Yes
63	MBR Aeration Basins	Yes
64	Chip and sawcut beam pockets at existing walls	Yes
65	Drill and epoxy #4 dowels bars at existing walls	Yes
66	Set up 21'-0" tall shoring system for (2) elevated walkways	Yes
67	Form, place and finish elevated walkways	Yes
68	Roughen existing bonding surface for new concrete pipe supports	Yes
69	Drill and epoxy #5 dowels at existing slab	Yes
70	Form, place and finish (8) concrete pipe supports	Yes
71	Anoxic Basins	Yes
72	Roughen existing bonding surface	Yes
73	Drill and epoxy #5 dowels at existing elevated slab	Yes
74	Form, place and finish pipe support and equipment pad	Yes
75	Effluent Pump Station	Yes
76	Remove existing electrical pad	Yes
77	Fill and abandon existing conduit	Yes
78	Form, place and finish concrete pad at existing conduit	Yes
79	Chip, sawcut, and surface preparation at bottom of existing beam	Yes

Chandler Improvements Phase 3

Work Category: 03A - Concrete
WC Lead: David Gonzalez
Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		$2,148,774
80	Drill and epoxy #3 dowels at existing beam	Yes
81	Concrete and reinforcement repairs	Yes
82	Furnish and install QuakeWrap FRP	Yes
83	Switchgear and Anoxic Electrical Buildings	Yes
84	Form, place and finish slabs on grade and pads on grade	Yes
85	Form, place and finish housekeeping pads	Yes
86	Fuel Storage Tank	Yes
87	Form, place and finish 12" pit slab, 1'-4" slab on grade, and 10" x 6" curbs	Yes
88	Furnish and install 6" TPV waterstop at curbs	Yes
89	Furnish, place, and grout fill pipe bollards originating in the structural slab	Yes
90	Secondary Clarifiers	Yes
91	Form, place and finish 6" stair landing	Yes
92	Roughen existing slab using scabbler, and removal of debris	Yes
93	Form, place, and finish new 2" grout topping at slabs at Secondary Clarifier No. 3	Yes
94	Roughen existing launder deck using scabbler, and removal of debris	Yes
95	Not used	N/A
96	Grout at scum line penetration	Yes
97	Textura Included for T-Lock and SPiRe+ vendors	Yes
98	Bond/CDI Cost for T-Lock and SPiRe+ vendors	Yes

Chandler Improvements Phase 3

Work Category: 03A - Concrete
WC Lead: David Gonzalez
Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE	$2,148,774

	ASSUMPTIONS & CLARIFICATIONS:
1	All concrete mix designs include retarding admixture as necessary. Any changes to design will be additional cost.
2	Membrane cure at all non water bearing structures using spray can in lieu of power spray
3	SF 1.0, class D finish for non exposed wall surfaces and SF 2.0, class C finish for exposed wall surfaces (Reference ACI 301 & 317)
4	The bottom of elevated concrete deck surfaces will be SF 2.0. Class finishes do not apply.
5	Roughening of existing slab grout topping to achieve an 1/8” amplitude using a scabbler, and new 2” thick grout topping at Airport WRF Secondary Clarifier No.1, and 4
6	Not used
7	Rebar corrosion repairs at elevated beam at Ocotillo WRF EFF Electrical Building and access hatch openings at Airport WRF Influent Pump Station, including the application of one coat of Sika FerroGard 903, and two coats of Sikatop Seal 107-
8	Concrete repairs at elevated beam at Ocotillo WRF EFF Electrical Building and access hatch openings at Airport WRF Influent Pump Station, including the application of 1” of SikaTop 123 Plus
9	Repairs to existing manholes and any existing structures not called out on the drawings are not included in the project scope.
10	Not used



City of Chandler

WRF Improvements Phase 3

WC 03B – Concrete Reinforcement

Solicitation Summary

Chandler Improvements Phase 3

Long Lead Procurement and Wilson Balance of Plant Proposal

Work Category: **03B - Concrete Reinforcement**

Subcontractor/Supplier Name	***Status***
Nucor	*Recommended*
CMC	*Proposed*
Tyler Reinforcing	*Declined*
Endo Steel	*Declined*
Paradise Steel	*Declined*

Chandler Improvements Phase 3

Work Category: 03B - Concrete Reinforcement

WC Lead: David Gonzalez

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		**$126,436**
MCCARTHY SUBCONTRACT & FRONT END TERMS		
1	Compliant with McCarthy Front Ends	Yes
2	Bid Submitted on McCarthy Bid Form	Yes
3	Bid Bond Included with Bid	NA
4	Surety Company	CDI
5	Surety AM Best Rating (Must be A- or Better)	NA
6	Bond/CDI Cost	Yes
7	Insurance Requirements Per Matrix	Yes
8	GL Insurance Company Name	Zurich
9	GL Insurance Carrier AM Best Rating (Must be A- or Better)	A++
10	E&O Insurance (If Required by Front Ends)	NA
11	Pollution Insurance (If Required by Front Ends)	NA
12	Tier 1 Approved	Yes
13	Tier 2 Approved	No
14	OSHA Recordable Incident Rate (Current)	0.00
15	Includes Hoisting for Sub's Own Work Scope	NA
16	Acknowledges Soils Report	NA
17	Acknowledges Addenda	Yes
18	Hold Bid for 150 Days	Yes
Scope of Work:		
19	Per Plans & Specifications:	Yes
20	**Division 1 General Requirements**	Yes
21	03200 - Concrete Reinforcement	Yes
22	03251 - Concrete Joints	Yes
23	0300 - Cast-in-Place Concrete	Yes
24	Provide all labor, materials, tools, equipment and appurtenances as required to provide all Concrete Reinforcement, in accordance with and reasonably inferable from the Contract Documents, complete and without exception unless otherwise noted below, but not limited to the following:	Yes
25	Airport WRF	Yes
26	Aeration Basins	Yes
27	Concrete Pipe Supports	Yes
28	Large Concrete Pipe Supports	Yes
29	Chemical Improvements	Yes
30	271 LF of Chemical Trench per C-02.04 and Detail 5 in S-00.04	Yes

Chandler Improvements Phase 3

Work Category: 03B - Concrete Reinforcement

WC Lead: David Gonzalez

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		$126,436
31	RWF Blower Building	Yes
32	12" x 12" x 12" Pourback	Yes
33	Disc Filter No. 6	Yes
34	10" Concrete Pads	Yes
35	Fuel Storage Tanks	Yes
36	18" Slab on Grade per Addendum #1 C-01.05 & S-33.02	Yes
37	10" x 6" Curb per Addendum #1 C-01.05 & S-33.02	Yes
38	Overall Site	Yes
39	5' x 5' x 12" Thick Transmitter Concrete Pad - Assuming #5@12 EW T&B	Yes
40	12" Slab @ Parshall Flume per S-01.01	Yes
41	8" Slab @ Buried RAS Plug per Detail 104 in C-40.01	Yes
42	Concrete Pipe Support @ Buried RAS Plug	Yes
43	Grout @ Parshall Flume	Yes
44	Secondary Clarifier No. 2	Yes
45	4' x 4' x 8" Stair support pad per Vol 3 Detail 3 in S-00.04	Yes
46	Ocotillo WRF	Yes
47	A-Basins	Yes
48	24" Elevated Walkway	Yes
49	Concrete Pipe Supports	Yes
50	Anoxic Basins	Yes
51	2'-9" x 3'-0" x 1'-0" Pipe Support per Addendum #1, Detail 6 in S-20.02	Yes
52	4' x 4' x 6" Concrete Pad per Addendum #1 Detail 7 in S-20.02	Yes
53	Electrical	Yes
54	8" Slab @ Switchgear Building	Yes
55	Concrete Pads on Grade @ Switchgear Bldg	Yes
56	6" Housekeeping Pad @ Switchgear Bldg	Yes
57	8" Slab on Grade @ Anoxic MCC Bldg	Yes
58	Concrete Pads on Grade @ Anoxic MCC Bldg	Yes
59	6" Housekeeping Pad @ Anoxic MCC Bldg	Yes
60	Fuel Storage Tank	Yes
61	12" Pit Slab per Addendum #1 S-33.01 & S-33.02	Yes
62	18" Slab on Grade per Addendum #1 S-33.01 & S-33.02	Yes
63	10" x 6" Curb per Addendum #1 S-33.01 & S-33.02	Yes
64	Secondary Clarifiers	Yes

Chandler Improvements Phase 3

Work Category: 03B - Concrete Reinforcement

WC Lead: David Gonzalez

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		**$126,436**
65	6" Stair Landing	Yes
66	Hoisting & Handling of Steel Reinforcement Material	In WC03A
67	Supply and installation of acceptable spacers, standees, and chairs to meet required spacing	Yes
68	Textura Included (Total Under $2.2M add 0.22%, if total is Equal or More than $2.2M add $5,000)	Yes
69	Bond/CDI Cost	Yes



City of Chandler

WRF Improvements Phase 3

WC 05A – Misc Metals

Solicitation Summary

Chandler Improvements Phase 3

Long Lead Procurement and Wilson Balance of Plant Proposal

Work Category: **05A - Misc Metals**

Subcontractor/Supplier Name	***Status***
Resolute Performance Iron Inc.	*Recommended*
Loenbro LLC	*Proposed*
EZARC	*Proposed*
Southwest Metalsmiths, Inc.	*Declined*
Professional Piping Systems	*Declined*

Chandler Improvements Phase 3

Work Category: 05A - Misc Metals

WC Lead: Patrick Conlon

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		**$372,427**
MCCARTHY SUBCONTRACT & FRONT END TERMS		
1	Compliant with McCarthy Front Ends	Yes
2	Bid Submitted on McCarthy Bid Form	Yes
3	Bid Bond Included with Bid	NA
4	Surety Company	Travelers Insurance
5	Surety AM Best Rating (Must be A- or Better)	A++
6	Bond/CDI Cost	0.520%
7	Insurance Requirements Per Matrix	Yes
8	GL Insurance Company Name	The Phoenix
9	GL Insurance Carrier AM Best Rating (Must be A- or Better)	A++
10	E&O Insurance (If Required by Front Ends)	NA
11	Pollution Insurance (If Required by Front Ends)	Yes
12	Tier 1 Approved	Yes
13	Tier 2 Approved	NA
14	OSHA Recordable Incident Rate (Current)	0.00
15	Includes Hoisting for Sub's Own Work Scope	Yes
16	Acknowledges Soils Report	NA
17	Acknowledges Addenda	Yes
18	Hold Bid for 150 Days	Yes
Scope of Work:		
19	Provide all labor, materials, tools, equipment and appurtenances as required to perform the Work Category in accordance with and reasonably inferable from the Contract Documents, complete and without exception unless otherwise noted below, including, but not limited to the following:	Yes
20	**Per Plans & Specifications:**	
21	Division 1 General Requirements	Yes
22	05120 Structural Steel	Yes
23	05500 Metal Fabrications	Yes
24	05501 Miscellaneous Metal Fabrications	Yes
25	05510 Metal Stairs	Yes
26	05522 Aluminum Railings	Yes
27	05532 Aluminum Grating and Checker Plate	Yes
28	**Miscellaneous Metal**	
29	**AWRF**	

Chandler Improvements Phase 3

Work Category: 05A - Misc Metals

WC Lead: Patrick Conlon

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		**$372,427**
30	Parshall Flume Manhole	
31	Supply equipment supports, hardware, and anchors for laser flowmeter	Yes
32	Installation (by McCarthy Craft)	Yes
33	Secondary Clarifiers #1,2,3,& 4:	
34	Supply access stairs associated with basin/clarifier work areas where shown	Yes
35	Supply aluminum guardrail needed for clarifier modifications	Yes
36	Installation	Yes
37	Disc Filter Basin #6:	
38	Furnish and install stainless steel maintenance access platform with stainless steel ladder and aluminum handrail system	Yes
39	Stainless steel hardware	Yes
40	316 Stainless steel weir plate	Yes
41	Installation (by McCarthy Craft)	Yes
42	Pre-Stage Basin No. 2:	
43	Metal access bridge with aluminum grating and guardrail	Yes
44	Metal access stairs with aluminum grating and guardrail	Yes
45	Installation	Yes
46	Headworks:	
47	Supply aluminum flush mounted angle (2"x2.5"x1/4")	Yes
48	Plant Sitework:	
49	Supply all Sch. 40 black steel bollards at fuel storage tank areas (Install in 03A)	Yes
50	**OWRF**	
51	MBR Bioreactor Basins:	
52	D-Ring anchor plates with appropriate embeds to allow fall protection attachment adjacent to each access hatch (x6)	Yes
53	Hoist socket for davit crane attachment with appropriate embeds(x2)	Yes
54	Installation (by McCarthy Craft)	Yes
55	Supply aluminum guardrail needed for clarifier modifications	Yes
56	Installation	Yes
57	All anchors, embeds, epoxy anchors, bolts, fasteners, plates, clips, shims, weld tabs, and incidental metals required for complete installation	Yes
58	Include all bolted and welded connections required to complete the scope.	Yes
59	Field verify dimensions, elevations, attachment points, and existing conditions prior to fabrication.	Yes
60	Steel primer to accommodate finish painting systems manufacturers' requirements.	Yes
61	3rd Party Welding Inspector	Yes
62	Adjacent areas protection as required when welding.	Yes

Chandler Improvements Phase 3

Work Category:	**05A - Misc Metals**
WC Lead:	**Patrick Conlon**
Bid Date:	**August 21, 2026**

TOTAL WORK CATEGORY PACKAGE VALUE		**$372,427**
63	Hoisting and rigging for own scope of work.	Yes
64	Textura Included (Total Under $2.2M add 0.22%, if total is Equal or More than $2.2M add $5,000)	Yes
65	Bond/CDI Cost	Yes
66	McCarthy SP Install of Vendor Supplied Items	
67	Laser Flow Meter Supports Installation	Yes
68	Disc Filter Basin #6 Weir Installation	Yes
69	MBR D-Rings and Davit Sockets Installation	Yes
70	Rotate Influent Pump Station Hatches	Yes

	ASSUMPTIONS & CLARIFICATIONS:
1	Shop primed coatings carried under 05A as required.
2	Specialty coatings carried under 09C.
3	Per spec section 14610, 1.1B & 2.2A state to provide portable davit crane systems as shown on the drawings at the AWRF Disc Filter Basins. No items are shown on the drawings. Proposal only includes davit crane socket embedded into concrete.



City of Chandler

WRF Improvements Phase 3

WC 05C – Extruded Flat Panel Covers

Solicitation Summary

Chandler Improvements Phase 3

Long Lead Procurement and Wilson Balance of Plant Proposal

Work Category: **05C - Extruded Flat Panel Covers**

Subcontractor/Supplier Name	***Status***
Coombs Hopkins (CST) *CST purchased Conservatek	*Recommended*

Chandler Improvements Phase 3

Work Category: 05C - Extruded Flat Panel Covers

WC Lead: Jennifer Lee

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		**$290,506**
MCCARTHY SUBCONTRACT & FRONT END TERMS		
1	Compliant with McCarthy Front Ends	No
2	Bid Submitted on McCarthy Bid Form	Yes
3	Bid Bond Included with Bid	N/A
4	Surety Company	N/A
5	Surety AM Best Rating (Must be A- or Better)	N/A
6	Bond/CDI Cost	Yes
7	Insurance Requirements Per Matrix	N/A
8	GL Insurance Company Name	N/A
9	GL Insurance Carrier AM Best Rating (Must be A- or Better)	N/A
10	E&O Insurance (If Required by Front Ends)	N/A
11	Pollution Insurance (If Required by Front Ends)	N/A
12	Tier 1 Approved	No
13	Tier 2 Approved	No
14	OSHA Recordable Incident Rate (Current)	0.00
15	Includes Hoisting for Sub's Own Work Scope	N/A
16	Acknowledges Soils Report	N/A
17	Acknowledges Addenda	N/A
18	Hold Bid for 150 Days	Yes
Scope of Work:		
19	**Per Plans & Specifications:**	
20	Provide all labor, materials, tools, equipment and appurtenances as required to perform the **Work Category - 05C Extruded Flat Panel Covers**, in accordance with and reasonably inferable from the Contract Documents, complete and without exception unless otherwise noted below, including, but not limited to the following:	Yes
21	Reflect Construction Schedule	Yes
22	Warranty - 1 year from Installation	Yes
23	**Scope per Specs Drawings Including:**	Yes
24	Furnish and install (4) flush mounted flat cover structures for MBR Basins 1 and 2, zone 8	Yes
25	**Submittals per section 1.2**	Yes
26	Calculations: Stamped by AZ PE	Yes
27	**Manufacturers (section 2.1)**	Yes
28	CST Industries, Conservatek Industries, or Approved Equal	Yes
29	**Construction per section 2.2**	Yes
30	Maximum weight: 150 lbs	Yes
31	Metal Components: Aluminum or 300 series stainless steel	Yes
32	**Manufacturer Experience per section 2.3**	Yes
33	**Materials (section 2.4)**	Yes

Chandler Improvements Phase 3

Work Category: 05C - Extruded Flat Panel Covers

WC Lead: Jennifer Lee

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		**$290,506**
34	Bolts and Fasteners: 2024-T4 or 7075-T73 aluminum, or series 300 stainless steel	Yes
35	Structural and Miscellaneous Shapes: Alloy 6061-T6, 6005A-T6, or 6063-T6	Yes
36	Gaskets: Neoprene (ASTM C864-90, resistant to ozone and shielded from UV light)	Yes
37	Sealant: Ozone/UV light resistant, Federal Specification TT-S-00230C	Yes
38	**Design Loads per section 2.5**	Yes
39	Deflections: L/240	Yes
40	Maximum Weight Access Hatches: 50 lbs	Yes
41	**Connections per section 2.6**	Yes
42	Allowable Shear Stress:	Yes
43	Series 300 Stainless Steel Fasteners: 20% of minimum tensile strength	Yes
44	6061-T6 Aluminum Fasteners: 11 ksi	Yes
45	7075-T73 Fasteners: 18 ksi	Yes
46	Subcontractor Site Visit	Yes
47	Mob/Demob: 2	Yes
48	Textura Included (Total Under $2.2M add 0.22%, if total is Equal or More than $2.2M add $5,000)	Yes
49	Bond/CDI Cost	Yes



City of Chandler

WRF Improvements Phase 3

WC 06B – FRP

Solicitation Summary

Chandler Improvements Phase 3

Long Lead Procurement and Wilson Balance of Plant Proposal

Work Category: **06B - FRP**

Subcontractor/Supplier Name	***Status***
Grating Pacific, Inc.	*Recommended*
Fibergrate Composite Structures	*Proposed*
American Grating, LLC	*Proposed*
Brown-Campbell Co.	*Declined*
Loenbro LLC	*Declined*

Chandler Improvements Phase 3

Work Category: 06B - FRP

WC Lead: Patrick Conlon

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		**$193,972**
MCCARTHY SUBCONTRACT & FRONT END TERMS		
1	Compliant with McCarthy Front Ends	Yes
2	Bid Submitted on McCarthy Bid Form	Yes
3	Bid Bond Included with Bid	NA
4	Surety Company	CDI
5	Surety AM Best Rating (Must be A- or Better)	NA
6	Bond/CDI Cost	Yes
7	Insurance Requirements Per Matrix	Yes
8	GL Insurance Company Name	Travelers
9	GL Insurance Carrier AM Best Rating (Must be A- or Better)	A++
10	E&O Insurance (If Required by Front Ends)	NA
11	Pollution Insurance (If Required by Front Ends)	Yes
12	Tier 1 Approved	Yes
13	Tier 2 Approved	NA
14	OSHA Recordable Incident Rate (Current)	NA
15	Includes Hoisting for Sub's Own Work Scope	NA
16	Acknowledges Soils Report	NA
17	Acknowledges Addenda	Yes
18	Hold Bid for 150 Days	Yes
Scope of Work:		
19	**Per Plans & Specifications:**	
20	Division 1 General Requirements	Yes
21	06611 - Fiberglass Reinforced Plastic Fabrications	Yes
22	FRP Grating systems at AWRF:	
23	Headworks Building Platform	Yes
24	Disc Filter No. 6 Maintenance Access Platform	Yes
25	Aluminum cover side plates for valve openings	Yes
26	Furnish all FRP grating and related accessories, including clips, bolts, washers, hold-downs, anchors, embeds, epoxy, and FRP-to-concrete fasteners.	Yes
27	Verification of bearing seat dimensions and hold-down clip requirements	Yes
28	Domestic fabrication	Yes
29	Shipping shall be FOB jobsite	Yes
30	Spare resin and repair materials	Yes

Chandler Improvements Phase 3

Work Category:	**06B - FRP**
WC Lead:	**Patrick Conlon**
Bid Date:	**August 21, 2026**

TOTAL WORK CATEGORY PACKAGE VALUE		**$193,972**
31	Lead time	12-14 weeks
32	Samples	Yes
33	Textura Included (Total Under $2.2M add 0.22%, if total is Equal or More than $2.2M add $5,000)	Yes
34	Bond/CDI Cost	Yes
35	Installation of FRP grating by McCarthy Craft	Yes

	ASSUMPTIONS & CLARIFICATIONS:
1	Existing Headworks grating beams and columns are assumed to be adequate to support the new grating; no structural rehabilitation is included.



City of Chandler

WRF Improvements Phase 3

WC 09C – Paintings/Coatings Industrial

Solicitation Summary

Chandler Improvements Phase 3

Long Lead Procurement and Wilson Balance of Plant Proposal

Work Category: **09C - Painting/Coatings Industrial**

Subcontractor/Supplier Name	***Status***
Professional Piping Systems, LLC	*Recommended*
Loenbro LLC	*Proposed*
Penington Painting Company	*Proposed*
L&M Painting	*Proposed*
Envision Painting & Roofing	*Declined*

Chandler Improvements Phase 3

Work Category: 09C - Paintings/Coatings Ind

WC Lead: Patrick Conlon

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		$258,615
MCCARTHY SUBCONTRACT & FRONT END TERMS		
1	Compliant with McCarthy Front Ends	Yes
2	Bid Submitted on McCarthy Bid Form	Yes
3	Bid Bond Included with Bid	NA
4	Surety Company	CDI
5	Surety AM Best Rating (Must be A- or Better)	A
6	Bond/CDI Cost	Yes
7	Insurance Requirements Per Matrix	Yes
8	GL Insurance Company Name	Zurich American
9	GL Insurance Carrier AM Best Rating (Must be A- or Better)	A+
10	E&O Insurance (If Required by Front Ends)	Yes
11	Pollution Insurance (If Required by Front Ends)	Yes
12	Tier 1 Approved	Yes
13	Tier 2 Approved	NA
14	OSHA Recordable Incident Rate (Current)	0.68
15	Includes Hoisting for Sub's Own Work Scope	Yes
16	Acknowledges Soils Report	NA
17	Acknowledges Addenda	Yes
18	Hold Bid for 150 Days	Yes
Scope of Work:		
19	Provide all labor, materials, tools, equipment and appurtenances as required to perform the Work Category - 09 Paintings / Coatings Industrial, in accordance with and reasonably inferable from the Contract Documents, complete and without exception unless otherwise noted below, including, but not limited to the following:	Yes
20	**Per Plans & Specifications:**	
21	Division 1 General Requirements	Yes
22	09900 - Painting	Yes
23	09920 - Coating Systems	Yes
24	Furnish and install of a fully functional painting & coating system. Scope shall be complete and without exception unless noted below.	Yes
25	Protect adjacent surfaces from paint and damage. Repair damage resulting from inadequate or unsuitable protection.	Yes
26	Painting/coating materials shall be formulated for environments encountered in water and wastewater treatment processes	Yes
27	Provide cleaning solvents for surface preparation	Yes

Chandler Improvements Phase 3

Work Category: 09C - Paintings/Coatings Ind

WC Lead: Patrick Conlon

Bid Date: August 21, 2026

	TOTAL WORK CATEGORY PACKAGE VALUE	**$258,615**
28	Material and equipment handling for large area coatings required for clarifier walkways/platforms	Yes
29	3rd Party NACE Inspection	Yes
30	Provide painting for all new exposed and/or submerged piping with corrosion resistant labeling including but not limited to:	
31	Air Piping	Yes
32	Non-potable water lines	Yes
33	Potable water lines	Yes
34	Sample Piping	Yes
35	IMLR Piping	Yes
36	Odor Control	Yes
37	Backwash Washwater	Yes
38	Tank Drain / Sump Drain	Yes
39	Sodium Hypochlorite	Yes
40	Sodium Hydroxide	Yes
41	Provide painting for factory primed equipment items including but not limited to:	
42	All New Secondary Clarifier Walkways with associated handrail at AWRF & OWRF	Yes
43	All New Secondary Clarifier Drive Platforms at AWRF & OWRF	Yes
44	Provide painting for all new site bollards on AWRF & OWRF	Yes
45	Paint new hollow metal doors & frames	Yes
46	High-Performance Coatings:	
47	**AWRF**	Yes
48	Parshall Flume Manhole	
49	Provide coating to exposed concrete fill surface w/ polymer modified resin w/ non-slip finish	Yes
50	Spark testing	Yes
51	**OWRF**	
52	Anoxic MCC Eletrical Room	
53	Furnish and install concrete sealer flooring system	Yes
54	Provide final coating to primed exposed structural steel	Yes
55	Switchgear Electrical Room	
56	Furnish and install concrete sealer flooring system	Yes
57	Provide final coating to primed exposed structural steel	Yes
58	Include final touch up for painting and coatings	Yes
59	Unloading and storage	Yes
60	Mock ups for scope of work	Yes

Chandler Improvements Phase 3

Work Category: 09C - Paintings/Coatings Ind

WC Lead: Patrick Conlon

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		$258,615
61	Spare touch-up materials	Yes
62	Hoisting and rigging for your scope of work	Yes
63	Subcontractor responsible for access to work area	Yes
64	AWRF Emergency Fuel Storage Painting scope removal	Yes
65	OWRF Emergency Fuel Storage Painting scope removal	Yes
66	Textura Included (Total Under $2.2M add 0.22%, if total is Equal or More than $2.2M add $5,000)	Yes
67	Bond/CDI Cost	Yes

ASSUMPTIONS & CLARIFICATIONS:	
1	Excludes coating of factory-finished equipment, process pumps, process equipment motors, hydraulic valves, fuel storage tanks, and appurtenances; proposal includes touch-up only unless noted otherwise.



City of Chandler
WRF Improvements Phase 3
WC 11A – Chemical Feed Pumps

Solicitation Summary

Chandler Improvements Phase 3

Long Lead Procurement and Wilson Balance of Plant Proposal

Work Category: **11A - Magnetic Drive Sealless End Suction Pumps**

Subcontractor/Supplier Name	***Status***
Harrington (Finish Thompson)	*Recommended*
Pheonix Pumps (March)	*Proposed*
Misco (Lutz Jesco)	*Proposed*
Pioneer Equipment (Flowserve)	*Proposed*
JCH (ANSIMAG)	*No Bid*

Chandler Improvements Phase 3

Work Category: 11A - Magnetic Drive Sealless End Suction Pumps

WC Lead: Jennifer Lee

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		**$149,253**
MCCARTHY SUBCONTRACT & FRONT END TERMS		
1	Compliant with McCarthy Front Ends	Yes
2	Bid Submitted on McCarthy Bid Form	Yes
3	Bid Bond Included with Bid	N/A
4	Surety Company	N/A
5	Surety AM Best Rating (Must be A- or Better)	N/A
6	Bond/CDI Cost	Yes
7	Insurance Requirements Per Matrix	N/A
8	GL Insurance Company Name	N/A
9	GL Insurance Carrier AM Best Rating (Must be A- or Better)	N/A
10	E&O Insurance (If Required by Front Ends)	N/A
11	Pollution Insurance (If Required by Front Ends)	N/A
12	Tier 1 Approved	No
13	Tier 2 Approved	No
14	OSHA Recordable Incident Rate (Current)	N/A
15	Includes Hoisting for Sub's Own Work Scope	N/A
16	Acknowledges Soils Report	N/A
17	Acknowledges Addenda	Yes
18	Hold Bid for 150 Days	Yes
Scope of Work:		
19	**Per Plans & Specifications:**	
20	Provide all labor, materials, tools, equipment and appurtenances as required to perform the **Work Category - 11A Magnetic Drive Sealless End Suction Pumps**, in accordance with and reasonably inferable from the Contract Documents, complete and without exception unless otherwise noted below, including, but not limited to the following:	Yes
21	Division 1 General Requirements	Yes
22	11218 - Magnetic Drive Sealless End Suction Pumps and Appurtenances	Yes
23	Check to Spec completed and submitted to McCarthy	Yes
24	Warranty - 2 year	Yes
25	Shipping shall be FOB jobsite	Yes
26	Lead time (wks):	
27	Submittals	1 week
28	Fabrication	3 weeks
29	Anchors and epoxy required for installation	Yes
30	**Scope per Specs Drawings Including:**	
31	Furnish (6) magnetic drive sealless end suction pumps with separate motor	Yes
32	Include any required grease and oil for initial installation	Yes
33	**Quality Assurance per section 1.2**	Yes

Chandler Improvements Phase 3

Work Category: 11A - Magnetic Drive Sealless End Suction Pumps

WC Lead: Jennifer Lee

Bid Date: August 21, 2026

	TOTAL WORK CATEGORY PACKAGE VALUE	**$149,253**
34	Manufacturer's Qualifications: Minimum 5 years experience producing similar equipment	Yes
35	Shop testing witnessed by Registered Professional Engineer	Yes
36	Provide Certificate of Unit Responsibility	Yes
37	**Submittals per section 1.3**	Yes
38	Calculations: Anchorage	Yes
39	**Ambient Conditions per section 1.4**	Yes
40	**Service Conditions per section 2.1**	
41	Close coupled, end suction, side discharge (rotated 90 degrees) back pullout design	See Clarifications
42	NaOH Service: Quantity 3	Yes
43	Chemical Concentration: 25%	Yes
44	Specific Gravity (68° F): 1.25	Yes
45	NaOCL Service: Quantity 3	Yes
46	Chemical Concentration: 15%	Yes
47	Specific Gravity (68° F): 1.2	Yes
48	Liquid Temperature Range: 40-120° F	Yes
49	Design Flow: 20 gpm	Yes
50	Design Discharge Head: 38 ft	Yes
51	Minimum Flow at Second Design Point: 25 gpm	Yes
52	Minimum Head at Second Design Point: 36 ft	Yes
53	Shutoff Head: 45 ft	Yes
54	Maximum Pump Speed: 3450 RPM	Yes
55	Efficiency at Design: 55%	Yes
56	Motor Horsepower: 0.3 HP	See Clarifications
57	Motor Volts/Phase/Hertz: 208v/3/60Hz	Yes
58	Seal Type: NaOH-EPDM; NaOCL-FKM	See Clarifications
59	Chemical Feed Pump System Curves per section 2.1-B	See Clarifications
60	Backpressure for Loop: 10-15 psi +/-5	Yes
61	**Manufacturers (section 2.1 C)**	
62	Finish Thompson, March, or Approved Equal	Yes
63	**Details of Construction per section 2.2**	Yes
64	Dimension Standards: ASME Specification B 73.3	Yes
65	Dimensionally interchangeable with standard sealed ASME pump of the same size designation	Yes
66	Pump Materials of Construction (Section 2.2 B)	
67	Outer Magnet Carrier: Carbon steel	Yes
68	Magnet Attachment to Outer Magnet Carrier: High temperature epoxy	Yes
69	Magnet Cover: Stainless steel cup	See Clarifications
70	Magnets: Rare earth, made of Neodymium Iron Boron, designed for zero slippage for full range of operation	Yes
71	Containment Shell: Nonmetallic material, maximum operating pressure 75 psi	Yes
72	Liquid Gap: Minimum 0.045 inch side or 0.09 inch diametral clearance	Yes
73	Containment Shell Attachment to Rear Casing Cover: SS cap screws	Yes
74	Inner Bearings: Product lubricated	Yes
75	Impeller: Enclosed design	Yes

Chandler Improvements Phase 3

Work Category: 11A - Magnetic Drive Sealless End Suction Pumps

WC Lead: Jennifer Lee

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		**$149,253**
76	Construction: Non-rotating, minimum 1-1/4 inch diameter, minimum 1/16 inch groove along length of shaft or bypass channels for passage of solids	Yes
77	Material: Non-metallic, suitable for intended service	Yes
78	Mouth Ring: Silicon carbide fiber reinforced, removable and replaceable	Yes
79	Casing: Minimum 150 lb ANSI flanges, casing and lining material suitable for intended service	Yes
80	Includes drain and removable silicon carbide thrust ring pressfit into casing	Yes
81	Bedplate: FRP composite or Type 316 SS	Yes
82	Hardware: Molded-in 316 stainless steel	Yes
83	Motors per section 2.2 C and specification 16225	Yes
84	NEMA frame, TEFC, severe duty, horizontal	Yes
85	Minimum Service Factor: 1.15	Yes
86	Insulation: Class B	Yes
87	Windings: Coppers	Yes
88	Rating: NEMA standard MG 1, paragraph 10.35	Yes
89	Enclosures: Totally enclosed fan cooled or totally enclosed non-ventilated	Yes
90	**Tools, Spare Parts, and Maintenance Materials (section 2.5)**	
91	Sparts Parts furnished for Each Pump:	Yes
92	(1) recommended spare parts kit	Yes
93	(1) set of special tools for maintenance or operations	N/A
94	**Surface Preparation and Shop Painting per section 2.6**	See Clarifications
95	**Field Services (section 3.4)**	
96	Installation/Startup/Training Services: Total 3 trips	Yes
97	Textura Included (Total Under $2.2M add 0.22%, if total is Equal or More than $2.2M add $5,000)	Yes
98	Bond/CDI Cost	Yes

Chandler Improvements Phase 3

Work Category: 11A - Magnetic Drive Sealless End Suction Pumps

WC Lead: Jennifer Lee

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE	$149,253

	ASSUMPTIONS & CLARIFICATIONS:
1	Not used
2	Not used
3	Specification 11218 2.1-B Pumps shall have a vertical discharge.
4	Specification 11218 2.1-B Pumps are suitable for a liquid temperature range of 40-104 °F.
5	Not used
6	Not used
7	Specification 11218 2.1-B Motors are 1 HP with FEP seals.
8	Not used
9	Specification 11218 2.2-B-4 Outer drive magnets shall be nickel plated and do not utilize a stainless steel cup to cover them.
10	Specification 11218 2.6 Pumps include manufacturers standard PPG epoxy primer and polyurethane coating.



City of Chandler

WRF Improvements Phase 3

WC 11G – Low Flow Propeller (IMLR) Pumps

Solicitation Summary

Chandler Improvements Phase 3

Long Lead Procurement and Wilson Balance of Plant Proposal

Work Category: **11G - Low Flow Propeller (IMLR) Pumps**

Subcontractor/Supplier Name	***Status***
JCH (Flygt)	*Recommended*
Phoenix Pumps (Grundfos)	*Not Compliant*

Chandler Improvements Phase 3

Work Category: 11G - Low-Flow Propeller (IMLR) Pumps

WC Lead: Jennifer Lee

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		**$401,101**
MCCARTHY SUBCONTRACT & FRONT END TERMS		
1	Compliant with McCarthy Front Ends	Yes
2	Bid Submitted on McCarthy Bid Form	Yes
3	Bid Bond Included with Bid	NA
4	Surety Company	NA
5	Surety AM Best Rating (Must be A- or Better)	NA
6	Bond/CDI Cost	Yes
7	Insurance Requirements Per Matrix	NA
8	GL Insurance Company Name	NA
9	GL Insurance Carrier AM Best Rating (Must be A- or Better)	NA
10	E&O Insurance (If Required by Front Ends)	NA
11	Pollution Insurance (If Required by Front Ends)	NA
12	Tier 1 Approved	No
13	Tier 2 Approved	No
14	OSHA Recordable Incident Rate (Current)	NA
15	Includes Hoisting for Sub's Own Work Scope	NA
16	Acknowledges Soils Report	NA
17	Acknowledges Addenda	NA
18	Hold Bid for 150 Days	Yes
Scope of Work:		
19	**Per Plans & Specifications:**	Yes
20	Provide all labor, materials, tools, equipment and appurtenances as required to perform the **Work Category - 15A Low-Flow Propeller (IMLR) Pumps**, in accordance with and reasonably inferable from the Contract Documents, complete and without exception unless otherwise noted below, including, but not limited to the following:	Yes
21	Division 1 General Requirements	Yes
22	01300 – Submittals	Yes
23	01640 – Materials and Equipment	Yes
24	01650 – Starting of Systems	Yes
25	11313 - Low-Flow Propeller (IMLR) Pumps	Yes
26	Check to Spec completed and submitted to McCarthy	Yes
27	Includes all requirements from McCarthy Exhibits (as applicable)	Yes
28	Warranty - 1 year from Startup	Yes
29	Shipping shall be FOB jobsite	Yes
30	Lead time (wks):	
31	Submittals	1-2 weeks
32	Fabrication	12-14 weeks
33	Anchors and epoxy required for installation	N/A

Chandler Improvements Phase 3

Work Category: 11G - Low-Flow Propeller (IMLR) Pumps

WC Lead: Jennifer Lee

Bid Date: August 21, 2026

	TOTAL WORK CATEGORY PACKAGE VALUE	**$401,101**
34	**Scope per Specs Drawings Including:**	Yes
35	Furnish (3) low flow propeller (IMLR) pumps (2 duty, 1 spare) with appurtenances	Yes
36	**Submittals per section 1.4**	Yes
37	AZ PE Stamped: Certified Drawings and Calculations	Yes
38	**Manufacturers (section 2.2)**	Yes
39	ITT Flygt, Grundfos, or Approved Equal	Yes
40	**Design Criteria (section 2.3)**	Yes
41	Flow: 11,389 gpm	Yes
42	Total Dynamic Head: 3.4 ft	Yes
43	Pump Curve Operating Points (Flow at Head):	Yes
44	5,700 gpm at 1.0 ft	Yes
45	11,389 gpm at 3.4 ft	Yes
46	Minimum Overall Pump Efficiency @ Rated Design Point: 44%	Yes
47	Motor Efficiency: 82%	Yes
48	Pump Efficiency @ Rated Design Point: 50%	Yes
49	Minimum Shutoff Head: 10 ft	Yes
50	Maximum Motor HP: 30 HP	Yes
51	Maximum Speed: 440 rpm	Yes
52	Voltage: 460 V	Yes
53	Power Phase: 3	Yes
54	Power Frequency: 60 Hz	Yes
55	Minimum Power Cable Length: 60 ft	Yes
56	Pipe Mount Discharge Connection Size: 30 in	Yes
57	**Materials (section 2.4)**	Yes
58	Major Pump Components: 316 SS	Yes
59	Propeller: 316 SS (ASTM A276)	Yes
60	Stationary Pump Mounting Flange: 30" 316 SS (ASTM A276)	Yes
61	Pump Casing Ring and Supports: 316 SS (ASTM A276)	Yes
62	Propeller Drive Shaft: 420 SS (ASTM A286)	Yes
63	Motor Shaft: 420 SS (ASTM A286)	Yes
64	O-Rings: Fluorinated Rubber (Viton)	Yes
65	Fasteners: 316T SS (ASTM A276)	Yes
66	Outer Seal Faces: Tungsten Carbide/Tungsten Carbide (WCCR)	Yes
67	Inner Seal Faces: Tungsten Carbide/Tungsten Carbide (WCCR)	Yes
68	Guide Rail and Upper Support Brackets: 2" 316 SS Sch 40	Yes
69	Lifting Chain or Cable: 40 ft 316 SS (ASTM A276)	Yes
70	Oil (Seal Lubrication): Ecologically safe, mineral base	Yes
71	Power/Control Cable Jacket: Chloroprene Rubber Jacketed	Yes
72	Lighting Handler: 1 per pump	Yes
73	**Design per section 2.5**	Yes
74	Exposed Nuts and Bolts: Stainless Steel	Yes
75	Capable of Continuous Submergence to a Depth of: 130 ft	Yes
76	Non-Stainless Steel Surfaces in Contact w/Pumped Media: Factory Applied Acrylic Dispersion Zinc Phosphate Primer w/Plaster Resin Paint Finish	Yes
77	Mounting Clips: Integral to Casing	Yes
78	**Propeller per section 2.6**	Yes

Chandler Improvements Phase 3

Work Category: 11G - Low-Flow Propeller (IMLR) Pumps

WC Lead: Jennifer Lee

Bid Date: August 21, 2026

	TOTAL WORK CATEGORY PACKAGE VALUE	**$401,101**
79	**Shaft per section 2.7**	Yes
80	Maximum Deflection: 0.002 in	Yes
81	**Shaft Seal per section 2.8**	Yes
82	(2) mechanical shaft seals w/independent spring system	Yes
83	**Bearings per section 2.9**	Yes
84	Minimum B-10 Rated Life: 100,000 hours	Yes
85	**Thermal Sensors per section 2.10**	Yes
86	(3) thermal switches embedded in end coils of stator winding	Yes
87	**Shroud Assembly per section 2.11**	Yes
88	Bell Shaped, 360 degrees around the propeller	Yes
89	**Lubricant Housing per section 2.12**	Yes
90	Two compartments with four ports	Yes
91	Lubricant: FDA Approved Non-Toxic	Yes
92	**Mechanical Seals per section 2.13**	Yes
93	2 set of Lapped End Face Type Mechanical Seals	Yes
94	**Motor per section 2.14**	Yes
95	Maximum Propeller Speed: 440 rpm	Yes
96	Stator Winding Insulation: Class F	Yes
97	Pump Rating: 40° C	Yes
98	Pump Service Factor:1.15	Yes
99	Stator Varnish: Dipped and Baked 3 times in Class H Varnish	Yes
100	Starts per Hour: 10	Yes
101	Leakage and Over-Temperature Protection System	Yes
102	Control Module: Flygt Mini-CASII, or equal	Flygt
103	**Elastomers per section 2.15**	Yes
104	O-Rings: Nitrile Rubber or Viton	Viton
105	**Cable Entry per section 2.16**	Yes
106	Integral to Back Plate	Yes
107	Double set of Elastomer Grommets	Yes
108	**IMLR Pump Mount Assembly per section 2.17**	Yes
109	**Factory Pump Test per section 3.1**	
110	Field Verification of Performance	No
111	**Manufacturer Field Services (section 3.3)**	Yes
112	Installation/Startup Services	Yes
113	In person operator training services: 8 hours	Yes
114	Textura Included (Total Under $2.2M add 0.22%, if total is Equal or More than $2.2M add $5,000)	Yes
115	Bond/CDI Cost	Yes

Chandler Improvements Phase 3

Work Category: 11G - Low-Flow Propeller (IMLR) Pumps

WC Lead: Jennifer Lee

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE	$401,101

	ASSUMPTIONS & CLARIFICATIONS:
1	Not used
2	Specification 11313 3.1 Field testing of low-flow propeller (IMLR) pumps is not included. Per Flygt, it is not possible to isolate and test output flow, power use, discharge pressure, vibration, etc. in the field as these operate in a submerged application. Performance shall be verified through factory inspections and testing in accordance with ANSI/HI 14.6 Test Grade 1U.

City of Chandler

WRF Improvements Phase 3

WC 13A – Metal Canopies

Solicitation Summary
City of Chandler WRF Improvements Phase 3
Long Lead Procurement and Wilson Balance of Plant Proposal
Work Category: **13A - Metal Canopies**

Subcontractor/Supplier Name	***Status***
General Metal Construction	*Recommended*
Conwear	*Proposed*
Loenbro LLC	*Proposed*
EZARC	*Proposed*
Agate Steel	*Declined*
KDM Steelwork	*Declined*
Blast Resource Group	*Declined*
Hart Carport Solutions	*Declined*

Chandler Phase 3

Work Category: 13A - Metal Canopies

WC Lead: Dominic McCarver

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		**$176,368**
MCCARTHY SUBCONTRACT & FRONT END TERMS		
1	Compliant with McCarthy Front Ends	Yes
2	Bid Submitted on McCarthy Bid Form	Yes
3	Bid Bond Included with Bid	No
4	Surety Company	CDI
5	Surety AM Best Rating (Must be A- or Better)	NA
6	Bond/CDI Cost	Yes
7	Insurance Requirements Per Matrix	Yes
8	GL Insurance Company Name	American Builders Insurance Company
9	GL Insurance Carrier AM Best Rating (Must be A- or Better)	A
10	E&O Insurance (If Required by Front Ends)	NA
11	Pollution Insurance (If Required by Front Ends)	Yes
12	Tier 1 Approved	No
13	Tier 2 Approved	No
14	OSHA Recordable Incident Rate (Current)	0.00
15	Acknowledges Soils Report	NA
16	Acknowledges Addenda	Yes
17	Hold Bid for 150 Days	Yes
Scope of Work:		
19	**Per Plans & Specifications:**	Yes
20	Division 1 General Requirements	Yes
21	Volume 2 – Technical Specification	Yes
22	01012 – PLANT OPERATION DURING CONSTRUCTION	Yes
23	01416 – SPECIAL INSPECTIONS	Yes
24	01500 – CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS	Yes
25	01700 – CONTRACT CLOSEOUT	Yes
26	01710 – CLEANING	Yes
27	09900 – PAINTING	Yes
28	11335 – SECONDARY CLARIFIER MECHANISM	Yes
29	11375 – AERATION SYSTEMS	Yes
30	Volume 3 – AWRF Drawings	Yes
31	Scope includes, but is not limited to:	
32	AWRF - Removal of canopies over Secondary Clarifiers 1-3	Yes
33	AWRF - Reinstallation of canopies over Secondary Clarifiers 1-3	Yes

Chandler Phase 3

Work Category: 13A - Metal Canopies

WC Lead: Dominic McCarver

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		$176,368
34	AWRF - Removal of canopy over Secondary Clarifier 4	Yes
35	AWRF - Removal of structural beam over Clarifier 4	Yes
36	AWRF - Reinstallation of canopy over Secondary Clarifier 4	Yes
37	AWRF - Renstallation of structural beam over Clarifier 4	Yes
38	AWRF - Removal of canopies over A-Basins 5 & 6	Yes
39	AWRF - Reinstallation of canopies over A-Basins 5 & 6	Yes
40	Paint Touch ups	Yes
41	Plug & Redrill Anchor Holes if necessary	Yes
42	Hold Bid for 150 Days	Yes
43	Provide all labor, material, equipment, rigging, hoisting, lifts, scaffolding, and temporary bracing required for complete work	Yes
44	Field verify existing canopy conditions, dimensions, supports, and connections prior to removal	Yes
45	Protect, label, store, and maintain removed canopy components for reinstallation	Yes
46	Include incidental replacement hardware, fasteners, anchors, clips, shims, and sealants required for complete reinstallation	Yes
47	Maintain alignment, fit-up, and complete functioning/finish of canopy assemblies after reinstall	Yes
48	Coordinate removal/reinstallation sequencing with Secondary Clarifier 1-4 mechanism replacement activities	Yes
49	Coordinate removal/reinstallation sequencing with Aeration Basin 5 & 6 diffuser/piping work	Yes
50	Flagging / Safety Protection	Yes
51	Coordinate required access restrictions, shutdowns, and MOPO requirements with McCarthy / Owner / Engineer	Yes
52	Maintain plant operations and protect adjacent operating facilities during work	Yes
53	Prevent debris from entering basins and process areas; keep work areas clean	Yes
54	Provide required submittals / shop drawings for removal / reinstallation procedures and materials	Yes
55	General Warranty – 1 year past Final Completion	Yes
56	Mobilization / demobilization included (include cost per MOB)	Yes
57	McCarthy: Crane & Operator	In WC 15A
58	Textura Included (Total Under $2.2M add 0.22%, if total is Equal or More than $2.2M add $5,000)	Yes
59	Bond/CDI Cost	Yes

Chandler Phase 3

Work Category: 13A - Metal Canopies

WC Lead: Dominic McCarver

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE	$176,368

	ASSUMPTIONS & CLARIFICATIONS:
1	Clarifiers must be fully drained during canopy removal, clarifier mechanism replacement, and installation.
2	Canopies will be laid down in the lot south of the aeration basin and north of the reservoir. Area will be flagged off for protection.



City of Chandler
WRF Improvements Phase 3
WC 13C – Fuel Storage Tank System

Solicitation Summary
City of Chandler WRF Improvements Phase 3
Long Lead Procurement and Wilson Balance of Plant Proposal
Work Category: **13C - Fuel Storage Tank System**

Subcontractor/Supplier Name	***Status***
Arizona Fuel Systems	*Recommended*
Western Pumps	*Proposed*
Eagle Environmental	*Non-Responsive*
ASR Construction Group	*Declined*
MMI Tank & Industrial Services	*Declined*
Professional Piping Services	*Declined*

Chandler Phase 3

Work Category: 13C - Fuel Storage Tank System

WC Lead: Jenna Soltwedel

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		**$549,866**
MCCARTHY SUBCONTRACT & FRONT END TERMS		
1	Compliant with McCarthy Front Ends	Yes
2	Bid Submitted on McCarthy Bid Form	Yes
3	Bid Bond Included with Bid	NA
4	Surety Company	CDI
5	Surety AM Best Rating (Must be A- or Better)	NA
6	Bond/CDI Cost	Yes
7	Insurance Requirements Per Matrix	Yes
8	GL Insurance Company Name	AXIS Surplus Insurance Company
9	GL Insurance Carrier AM Best Rating (Must be A- or Better)	A
10	E&O Insurance (If Required by Front Ends)	Yes
11	Pollution Insurance (If Required by Front Ends)	Yes
12	Tier 1 Approved	Yes
13	Tier 2 Approved	NA
14	OSHA Recordable Incident Rate (Current)	0
15	Includes Material Management for Sub's Own Work Scope	Yes
16	Acknowledges Soils Report	Yes
17	Acknowledges Addenda	Yes
18	Hold Bid for 150 Days	Yes
Scope of Work:		
19	**Per Plans & Specifications:**	Yes
20	Division 1 General Requirements	Yes
21	Volume 2 – Technical Specification	Yes
22	01800 – EQUIPMENT SCHEUDLE	Yes
23	13400 – ABOVE GROUND FUEL STORAGE TANK	Yes
24	01650 - STARTING OF SYSTEMS	Yes
25	01750 – SPARE PARTS AND MAINTENANCE MATERIALS	Yes
26	17454 - OPERATIONS AND CONTROL DESCRIPTIONS	Yes
27	Volume 3 – AWRF Drawings	Yes
28	Volume 4 – OWRF Drawings	Yes
29	Supply and install material which includes but not limited to:	Yes
30	Fuel dispenser	Yes
31	1-Hose Fleet Fueling Dispensers w/ 75' hose reels	Yes
32	Include 30 manufacture year warrenty (per spec)	Yes

Chandler Phase 3

Work Category: 13C - Fuel Storage Tank System

WC Lead: Jenna Soltwedel

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		**$549,866**
33	10,000 Gallon UL-2085 Tank and its accessories	Yes
34	12,000 Gallon UL-2085 Tank and its accessories	Yes
35	Off-Load Crane	Yes
36	Tank Ladder	Yes
37	Ground Level Remote Fill	Yes
38	Overfill Stop Valve	Yes
39	In-Tank Turbin Pump	Yes
40	Shear/Fire Valve	Yes
41	Dispensing Hardware	Yes
42	Fuel Polisher & Required FOR & FOS Piping & Valves	Yes
43	All anchors and bolts needed for securing tank into concrete pad	Yes
44	Furnish and Install equipment	Yes
45	Startup/commissioning of systems Fuel storage tank system	Yes
46	Involvement in all fire/life safety inspections and meetings	Yes
47	Ensure all items in "Volume 2,3, & 4 Drawings" are captures in proposal	Yes
48	General Warranty – 1 year past Final Completion	Yes
49	Owner training	Yes
50	Textura Included (Total Under $2.2M add 0.22%, if total is Equal or More than $2.2M add $5,000)	Yes
51	Preventative maintenance	Yes
52	Extended Warranty	Yes
53	Bond/CDI Cost	Yes
54	Crane for Setting Tank	Yes
55	General Foreman Coordination	Yes

	ASSUMPTIONS & CLARIFICATIONS:
1	City of Chandler is responsible for filling the storage tank at both AWRF & OWRF locations. No initial fill for start-up and testing will be provided.
2	Fuel Tank will be turned over to City of Chandler for Beneficial Use. Fuel system warranty is for 1 year after start-up.



City of Chandler
WRF Improvements Phase 3
WC 13D – Pre-Engineered Structures

Solicitation Summary
City of Chandler WRF Improvements Phase 3
Long Lead Procurement and Wilson Balance of Plant Proposal
Work Category: **13D - Pre-Engineered Structures**

Subcontractor/Supplier Name	***Status***
Arizona Corporate Builders	*Recommended*
August Building	*Proposed*
Resolute Performance Iron	*Declined*
ASR Construction Group	*Declined*
Loenbro LLC	*Declined*
Blox	*Declined*
Bunger Steel Inc	*Declined*
Metal Building Industries	*Declined*

Chandler Phase 3

Work Category: 13D Pre-engineered Structures

WC Lead: Dominic McCarver

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		$363,432
MCCARTHY SUBCONTRACT & FRONT END TERMS		
1	Compliant with McCarthy Front Ends	Yes
2	Bid Submitted on McCarthy Bid Form	Yes
3	Bid Bond Included with Bid	Yes
4	Surety Company	Travelers Insurance
5	Surety AM Best Rating (Must be A- or Better)	A++
6	Bond/CDI Cost	Yes
7	Insurance Requirements Per Matrix	Yes
8	GL Insurance Company Name	Palomar Specialty Insurance Company
9	GL Insurance Carrier AM Best Rating (Must be A- or Better)	A-
10	E&O Insurance (If Required by Front Ends)	NA
11	Pollution Insurance (If Required by Front Ends)	Yes
12	Tier 1 Approved	Yes
13	Tier 2 Approved	NA
14	OSHA Recordable Incident Rate (Current)	No
15	Includes Hoisting for Sub's Own Work Scope	Yes
16	Acknowledges Soils Report	Yes
17	Acknowledges Addenda	Yes
18	Hold Bid for 150 Days	Yes
Scope of Work:		
19	**Per Plans & Specifications:**	Yes
20	Division 1 General Requirements	Yes
21	Volume 2 – Technical Specification	Yes
22	01300 – SUBMITTALS	Yes
23	01416 – SPECIAL INSPECTIONS	Yes
24	01500 – CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS	Yes
25	01700 – CONTRACT CLOSEOUT	Yes
26	01710 – CLEANING	Yes
27	01800 – EQUIPMENT SCHEDULE	Yes
28	05120 – STRUCTURAL STEEL	Yes
29	05500 – METAL FABRICATIONS	Yes
30	09900 – PAINTING	Yes
31	13300 – METAL BUILDING SYSTEMS	Yes

Chandler Phase 3

Work Category: 13D Pre-engineered Structures

WC Lead: Dominic McCarver

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		**$363,432**
32	Volume 4 – OWRF Drawings	Yes
33	Scope includes, but is not limited to:	Yes
34	OWRF - Procurement / fabrication of Switchgear Building materials	Yes
35	OWRF - Construction of Switchgear Building (HVAC not included)	Yes
36	OWRF - Procurement / fabrication of Anoxic Basin Electrical Building materials	Yes
37	OWRF - Construction of Anoxic Basin Electrical Building (HVAC not included)	Yes
38	Labor and materials to clean and protect concrete	Yes
39	GF Supervision (GF for 80 hrs)	Yes
40	Provide option for including HVAC	In WC 15C
41	Furnish all labor, materials, equipment, tools, fasteners, anchors, embeds, and incidentals required for complete pre-engineered structures scope	Yes
42	Provide complete pre-engineered metal building systems and associated structural components required by plans and specifications	Yes
43	Include structural steel, framing, girts, purlins, wall and roof panels, trim, flashing, closures, sealants, doors / framed openings, and accessories required for complete building shells	Yes
44	Include shop fabrication, shop priming / coatings, delivery, unloading, staging, erection, field assembly, alignment, and temporary bracing	Yes
45	Coordinate all required openings, embeds, anchor bolts, attachments, and interfaces with concrete, structural, electrical, and other adjacent trades	Yes
46	Provide setting templates and required information for items to be cast into concrete or otherwise embedded	Yes
47	Field verify dimensions and conditions prior to fabrication and installation	Yes
48	Coordinate erection sequencing with McCarthy and other trades to maintain project schedule and site access	Yes
49	Provide hoisting, rigging, cranes, lifts, scaffolding, and access required for subcontractor's own work scope	Yes
50	Include all required submittals / shop drawings / erection drawings / product data for materials and assemblies in this scope	Yes
51	Coordinate special inspections, testing, and quality-control requirements applicable to structural steel / metal building work	In WC 01C
52	Touch up / repair damaged primer, galvanizing, and coatings caused by this scope; protect installed work and stored materials from moisture and weather exposure	Yes
53	Provide complete weather-tight exterior building envelope for scope items included in plans / specifications	Yes
54	Final cleaning and punchlist completion for this scope	Yes
55	General Warranty – 1 year past Final Completion	Yes
56	McCarthy WC Support: Layout, electrical coordination, inspection coordination, HVAC	Yes

Chandler Phase 3

Work Category: 13D Pre-engineered Structures

WC Lead: Dominic McCarver

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		$363,432
57	35 year manufacturer warranty for high performance coatings	Yes
58	Gutters & downspouts	Yes
59	Sealants, gaps, & Caulking	Yes
60	Mobilization / demobilization included	Yes
61	Textura Included (Total Under $2.2M add 0.22%, if total is Equal or More than $2.2M add $5,000)	Yes
62	Bond Carried in Base Bid	Yes
63	Bond/CDI Cost	Yes



City of Chandler

WRF Improvements Phase 3

WC 14A – Monorail Festoon Replacement

Solicitation Summary
City of Chandler WRF Improvements Phase 3
Long Lead Procurement and Wilson Balance of Plant Proposal
Work Category: **14A - Monorail Festoon Replacement**

Subcontractor/Supplier Name	***Status***
MMI Hoist Systems	*Recommended*
Brand Safway LLC	*Declined*
Crane & Hoist of Arizona Inc	*Declined*

Chandler Phase 3

Work Category: 14A Monorail Festoon Replacement

WC Lead: Dominic McCarver

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		$17,112
MCCARTHY SUBCONTRACT & FRONT END TERMS		
1	Compliant with McCarthy Front Ends	Yes
2	Bid Submitted on McCarthy Bid Form	Yes
3	Bid Bond Included with Bid	No
4	Surety Company	CDI
5	Surety AM Best Rating (Must be A- or Better)	NA
6	Bond/CDI Cost	Yes
7	Insurance Requirements Per Matrix	Yes
8	GL Insurance Company Name	Middlesex Insurance Company
9	GL Insurance Carrier AM Best Rating (Must be A- or Better)	A+
10	E&O Insurance (If Required by Front Ends)	No
11	Pollution Insurance (If Required by Front Ends)	Yes
12	Tier 1 Approved	No
13	Tier 2 Approved	No
14	OSHA Recordable Incident Rate (Current)	1.64
15	Includes Hoisting for Sub's Own Work Scope	Yes
16	Acknowledges Soils Report	No
17	Acknowledges Addenda	Yes
18	Hold Bid for 150 Days	Yes
Scope of Work:		
21	**Per Plans & Specifications:**	Yes
21	Division 1 General Requirements	Yes
22	Volume 2 – Technical Specification	Yes
23	01300 – Submittals	Yes
24	14630 - Hoists, Trolleys and Monorails	Yes
25	Scope includes, but is not limited to:	
26	Furnish all labor, materials, equipment, tools, fasteners, anchors, embeds, and incidentals required for complete Monorail Hoist System	Yes
27	Field verify dimensions and conditions prior to fabrication and installation	Yes
28	Coordinate erection sequencing with McCarthy and other trades to maintain project schedule and site access	Yes
29	Provide hoisting, rigging, cranes, lifts, scaffolding, and access required for subcontractor's own work scope	Yes
30	Include all required submittals / shop drawings / product data for materials and assemblies in this scope	Yes

Chandler Phase 3

Work Category: 14A Monorail Festoon Replacement

WC Lead: Dominic McCarver

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		**$17,112**
31	Coordinate special inspections, testing, and quality-control requirements applicable to scope of work	Yes
32	General Warranty – 1 year past Final Completion	Yes
33	Mobilization / demobilization included	Yes
34	Textura Included (Total Under $2.2M add 0.22%, if total is Equal or More than $2.2M add $5,000)	Yes
35	End of Scope (Add New Rows Above This Line)	Yes
36	Bond/CDI Cost	Yes



City of Chandler

WRF Improvements Phase 3

WC15A – Process Piping and Equipment Installation

Solicitation Summary

Chandler Improvements Phase 3

Long Lead Procurement and Wilson Balance of Plant Proposal

Work Category: **15A - Process Piping and Equipment Installation**

Subcontractor/Supplier Name	***Status***
McCarthy Building Companies	*Recommended*

Chandler Improvements Phase 3

Work Category: 15A - Process Piping and Equipment Installation

WC Lead: Jennifer Lee

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		**$7,874,238**
MCCARTHY SUBCONTRACT & FRONT END TERMS		
1	Compliant with McCarthy Front Ends	Yes
2	Bid Submitted on McCarthy Bid Form	N/A
3	Bid Bond Included with Bid	N/A
4	Surety Company	N/A
5	Surety AM Best Rating (Must be A- or Better)	N/A
6	Bond/CDI Cost	Yes
7	Insurance Requirements Per Matrix	N/A
8	GL Insurance Company Name	N/A
9	GL Insurance Carrier AM Best Rating (Must be A- or Better)	N/A
10	E&O Insurance (If Required by Front Ends)	N/A
11	Pollution Insurance (If Required by Front Ends)	N/A
12	Tier 1 Approved	N/A
13	Tier 2 Approved	N/A
14	OSHA Recordable Incident Rate (Current)	0.22
15	Includes Hoisting for Sub's Own Work Scope	Yes
16	Acknowledges Soils Report	Yes
17	Acknowledges Addenda	Yes
18	Hold Bid for 150 Days	Yes
Scope of Work:		
19	**Per Plans & Specifications:**	
20	Provide all labor, materials, tools, equipment and appurtenances as required to perform the **Work Category - 15A Process Piping and Equipment**, in accordance with and reasonably inferable from the Contract Documents, complete and without exception unless otherwise noted below, including, but not limited to the following:	Yes
21	Division 1 General Requirements	Yes
22	01013 – Engineering Services	Yes
23	01300 – Submittals	Yes
24	01640 – Material and Equipment	Yes
25	01650 – Stating of Systems	Yes
26	01730 –Operation and Maintenance Data	Yes
27	01750 – Spare Parts and Maintenance Materials	Yes
28	01800 – Equipment Schedule	Yes
29	02050 – Demolitions	Yes
30	03252 – Anchorage in Concrete	Yes
31	05501 – Miscellaneous Metal Fabrication	Yes
32	09900 – Painting	Yes
33	11218 – Magnetic Drive Sealless End Suction Pumps	Yes

Chandler Improvements Phase 3

Work Category: 15A - Process Piping and Equipment Installation

WC Lead: Jennifer Lee

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		$7,874,238
34	11221 – Submersible Mixers and Accessories	Yes
35	11295 – Hydraulic Valves	Yes
36	11310 – Vertical Turbine Pumps	Yes
37	11313 – Low-Flow Propelled (IMLR) Pumps	Yes
38	11335 – Secondary Clarifier Mechanism	Yes
39	11375 – Aeration Systems	Yes
40	11400 – Disc Filter System	Yes
41	13447 – Electric Motor Actuators	Yes
42	15050 – Piping Systems	Yes
43	15052 – Exposed Piping	Yes
44	15061 – Ductile Iron Pipe	Yes
45	15064 – Copper Pipe	Yes
46	15065 – Thermoplastic Pipe and Accessories	Yes
47	15066 – Stainless Steel Pipe	Yes
48	15067 – Fiberglass Reinforced Plastic Pipe and Accessories	Yes
49	15120 – Piping Specialties and Accessories	Yes
50	15140 – Supports and Anchors	Yes
51	15950 – Testing Mechanical Systems	Yes
52	16000 – General Electrical Requirements	Yes
53	16161 – Control Panels	Yes
54	16225 – Electric Motors 250 Horsepower and Less	Yes
55	17000 – Instrumentation	Yes
56	17111 – Float Switches	Yes
57	17120 – Pressure Transmitters	Yes
58	17121 – Pressure Switches and Gauges	Yes
59	17124 – Submersible Level Transmitter	Yes
60	17134 – Flow Switches	Yes
61	17137 – Magnetic Flow Meters	Yes
62	17150 – Limit and Position Switches	Yes
63	Warranty - 1 year from Project Final Completion	Yes
64	Core Drilling and Penetrations as required.	Yes
65	**AWRF - Headworks**	
66	Demolish existing FA line per plans	Yes
67	Furnish & install exposed FA line(s) complete, including but not limited to pipe and fitting (s), valve(s), hangers/supports, penetration (s), etc.	Yes
68	**AWRF - Aeration Basin**	
69	Demolish existing aeration system per plans.	Yes
70	Installation, and start-up per the specifications and manufacturer's recommendations, for WC 11I – Aeration Systems per Specification 11375	Yes
71	**AWRF - Secondary Clarifiers**	
72	Demolish existing clarifiers 1-4.	Yes
73	Demolish existing DR, SCUM, and spray system lines per plans.	Yes
74	Furnish & install exposed DR line(s) complete, including but not limited to pipe and fitting (s), valve(s), hangers/supports, penetration (s), etc.	Yes
75	Furnish & install exposed SCUM line(s) complete, including but not limited to pipe and fitting (s), valve(s), hangers/supports, penetration (s), etc.	Yes

Chandler Improvements Phase 3

Work Category: 15A - Process Piping and Equipment Installation

WC Lead: Jennifer Lee

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		$7,874,238
76	Furnish & install exposed NPW spray system line(s) complete, including but not limited to pipe and fitting (s), valve(s), hangers/supports, penetration (s), etc.	Yes
77	Installation, and start-up per the specifications and manufacturer's recommendations, for WC 11H – Secondary Clarifier per Specification 11335	Yes
78	**AWRF - Disc Filter**	
79	Furnish & install exposed D line(s) complete, including but not limited to pipe and fitting (s), valve(s), hangers/supports, penetration (s), etc.	Yes
80	Furnish & install exposed BWW line(s) complete, including but not limited to pipe and fitting (s), valve(s), hangers/supports, penetration (s), etc.	Yes
81	Furnish & install exposed SW line(s) complete, including but not limited to pipe and fitting (s), valve(s), hangers/supports, penetration (s), etc.	Yes
82	Install instrumentation as required per drawings and P&IDs for all pipelines and as indicated on the P&ID Responsibility Matrix.	Yes
83	Installation, and start-up per the specifications and manufacturer's recommendations, for WC 11J – Disc Filter per Specification 11400	Yes
84	**AWRF - Chemical Storage Facility**	
85	Demolish six (6) existing chemical metering pumps and associated piping connections.	Yes
86	Demolish existing chemical pipe, fitting(s), valve(s), hangers/supports, penetrations, etc. per plans.	Yes
87	Furnish & install exposed NaOCL line(s) complete, including but not limited to pipe and fitting (s), valve(s), hangers/supports, penetration (s), etc.	Yes
88	Furnish & install exposed NaOH line(s) complete, including but not limited to pipe and fitting (s), valve(s), hangers/supports, penetration (s), etc.	Yes
89	Install instrumentation as required per drawings and P&IDs for all pipelines and as indicated on the P&ID Responsibility Matrix.	Yes
90	Installation, and start-up per the specifications and manufacturer's recommendations, for WC 11A – Magnetic Drive Sealless End Suction Pumps per specification 11218	Yes
91	**AWRF - RWIF Blower Building**	
92	Demolish existing vent line per plans.	Yes
93	Furnish & install exposed vent line(s) complete, including but not limited to pipe and fitting (s), valve(s), hangers/supports, penetration (s), etc.	Yes
94	**AWRF - Overall Site**	
95	Demolish existing chemical pipe, fitting(s), valve(s), hangers/supports, penetrations, etc. per plans.	Yes
96	Furnish & install NaOCL line(s) complete, including but not limited to pipe and fitting (s), valve(s), hangers/supports, penetration (s), etc.	Yes
97	Furnish & install NaOH line(s) complete, including but not limited to pipe and fitting (s), valve(s), hangers/supports, penetration (s), etc.	Yes
98	**OWRF - MBR Aeration Basins**	
99	Relocate existing submersible mixers per plans.	Yes
100	Demolish existing MBR Bioreactor Basin covers per plans.	Yes
101	Demolish existing aeration system per plans.	Yes
102	Furnish & install submerged MLR line(s) complete, including but not limited to pipe and fitting (s), valve(s), hangers/supports, penetration (s), etc.	Yes
103	Installation, and start-up per the specifications and manufacturer's recommendations, for WC 11I – Aeration Systems per Specification 11375	Yes
104	Installation, and start-up per the specifications and manufacturer's recommendations, for WC 11I – Low-flow Propeller (IMLR) Pumps per specification 11313	Yes
105	**OWRF - Anoxic Basins**	
106	Furnish & install exposed seal water line(s) complete, including but not limited to pipe and fitting (s), valve(s), hangers/supports, penetration (s), etc.	Yes

Chandler Improvements Phase 3

Work Category: 15A - Process Piping and Equipment Installation

WC Lead: Jennifer Lee

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		**$7,874,238**
107	Furnish & install exposed MLR line(s) complete, including but not limited to pipe and fitting (s), valve(s), hangers/supports, penetration (s), etc.	Yes
108	Install instrumentation as required per drawings and P&IDs for all pipelines and as indicated on the P&ID Responsibility Matrix.	Yes
109	Installation, and start-up per the specifications and manufacturer's recommendations, for WC 11E – Vertical Turbine Pump per Specification 11310	Yes
110	**OWRF - Secondary Clarifiers**	
111	Demolish existing clarifier 3	Yes
112	Demolish existing DR, SCUM, and spray system per plans	Yes
113	Furnish & install exposed DR line(s) complete, including but not limited to pipe and fitting (s), valve(s), hangers/supports, penetration (s), etc.	Yes
114	Furnish & install exposed SCUM line(s) complete, including but not limited to pipe and fitting (s), valve(s), hangers/supports, penetration (s), etc.	Yes
115	Furnish & install exposed NPW spray system line(s) complete, including but not limited to pipe and fitting (s), valve(s), hangers/supports, penetration (s), etc.	Yes
116	Installation, and start-up per the specifications and manufacturer's recommendations, for WC 11H – Secondary Clarifier per Specification 11335	Yes
117	All tie-ins to process equipment	Yes
118	Testing of new and re-used exiting piping	Yes
119	Coordination with CMAR for exposed piping MOPOs	Yes
120	Scope coordination between all other work categories	Yes
121	All equipment for hoisting, lifting, and setting materials	Yes
122	Purchase of all process mechanical piping materials	Yes
123	Shipping shall be FOB jobsite	Yes
124	Unloading & storage including CMAR supplied equipment	Yes
125	Temporary protection & enclosure including CMAR supplied equipment	Yes
126	Training: per the Spec	Yes
127	Manufactures Services	Yes

Chandler Improvements Phase 3

Work Category: 15A - Process Piping and Equipment Installation

WC Lead: Jennifer Lee

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE	$7,874,238

ASSUMPTIONS & CLARIFICATIONS:

1. Proposal assumes that all existing pipes that new piping connects to will pass leak testing. Cost of testing or repairing existing piping has not been included.
2. The re-balancing of Foul Air lines has been included, but performanc of the existing blower cannot be guaranteed with the new FRP suction pipe design.
3. Existing pipe support anchorage in aeration basins shall be burned and grouted.
4. Engineering for pipe supports has not been included. Pipe supports shall be supplied per details referenced in the Contract Drawings.
5. Proposed valves per table below:

System	Diameter	Valve	Manufacturer
D	3”	Mud Valve	Trumbull
NPW	2”	SS Globe Valve	Sharpe
NPW	½”	Bronze Globe Valve	Apollo
NPW	½”	Solenoid Valve	ASCO
NPW	½”	Bronze Ball Valve	Matco Norca
WW – Pressure Gauge	½”	SS Ball Valve	Matco Norca

6. Manufacturer Warranties on existing equipment that will be relocated are not provided. This is applicable to the mixers at the MBR Basins. Standard workmanship warranty for one year after beneficial use is included. Contractor to ensure mixers are functional in the same capacity as prior to relocation.



City of Chandler

WRF Improvements Phase 3

WC 15C - HVAC

Solicitation Summary
City of Chandler WRF Improvements Phase 3
Long Lead Procurement and Wilson Balance of Plant Proposal
Work Category: **15C - HVAC**

Subcontractor/Supplier Name	***Status***
Professional Piping Systems	*Recommended*
Pueblo Mechanical and Controls	*Proposed*
Tempe Mechanical	*Proposed*
Karber Corporation	*Declined*
Comfort Systems	*Declined*

Chandler Improvements Phase 3

Work Category: 15C - HVAC

WC Lead: Jenna Soltwedel

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		**$262,492**
MCCARTHY SUBCONTRACT & FRONT END TERMS		
1	Compliant with McCarthy Front Ends	Yes
2	Bid Submitted on McCarthy Bid Form	Yes
3	Bid Bond Included with Bid	NA
4	Surety Company	Ascot Surety & Casualty Company
5	Surety AM Best Rating (Must be A- or Better)	A
6	Bond/CDI Cost	Yes
7	Insurance Requirements Per Matrix	Yes
8	GL Insurance Company Name	Continental Casualty
9	GL Insurance Carrier AM Best Rating (Must be A- or Better)	A+
10	E&O Insurance (If Required by Front Ends)	Yes
11	Pollution Insurance (If Required by Front Ends)	Yes
12	Tier 1 Approved	Yes
13	Tier 2 Approved	NA
14	OSHA Recordable Incident Rate (Current)	0.26
15	Includes Hoisting for Sub's Own Work Scope	Yes
16	Acknowledges Soils Report	NA
17	Acknowledges Addenda	Yes
18	Hold Bid for 150 Days	Yes
Scope of Work:		
19	Provide all labor, materials, tools, equipment and appurtenances as required to perform the Work Category in accordance with and reasonably inferable from the Contract Documents, complete and without exception unless otherwise noted below, including, but not limited to the following:	Yes
20	**General Conditions/General Requirements**	
21	MOPO/Shutdown - The site-wide HVAC distribution and equipment shall be operational during this Project. The contractor will participate in the MOPO process as described in Section 01 of the specifications and obtain approval prior to disconnecting any HVAC services that are currently in operations at the plant.	Yes
22	Working Hours - Assume that tie-ins and shutdowns will be performed after hours or on weekends	Yes
23	Protect in Place/ Salvage - Remove, protect, relocate, re-install, and adjust Site HVAC including but not limited to HVAC Structures, Equipment, fittings, etc. as required to support the work of others	Yes
24	Signage/Labelling - Equipment and instrument tags, and signage as required and specified in the contract documents	Yes

Chandler Improvements Phase 3

Work Category: 15C - HVAC

WC Lead: Jenna Soltwedel

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		**$262,492**
25	Testing/Commissioning - Startup and Commissioning for new equipment & equipment modified by this scope of work	Yes
26	Final acceptance filter replacement	Yes
27	3rd Party testing as required and specified in the contract documents	Yes
28	Verify space requirements of materials and equipment before ordering	Yes
29	Dispose of all removed materials and equipment	Yes
30	Coordinate connection of mechanical systems with exterior underground and overhead utilities and services.	Yes
31	Balancing contractor to conduct "pre-reads" to document the current air balance of the building prior to construction.	Yes
32	Temperature control requirements are included in this scope of work.	Yes
33	**Per Plans & Specifications**	Yes
34	**Division 16 - General Electrical Requirements - as it relates to this scope of work, including, but not limited to the following:**	Yes
35	Section 16001 - PACKAGED SYSTEMS AND PACKAGED CONTROL PANELS	Yes
36	Section 16010 - ELECTRICAL: BASIC REQUIREMENTS	Yes
37	**Division 15 General Requirements - as it relates to this scope of work, including, but not limited to the following:**	Yes
38	Spec Section 15700 - GENERAL HVAC REQUIREMENTS	Yes
39	Spec Section 15710 - SUMMARY OF WORK FOR HEATING, VENTILATING AND AIR CONDITIONING	Yes
40	Spec Section 15720 - AIR HANDLING AND AIR DISTRIBUTION SPECIALTIES	Yes
41	Spec Section 15730 - CLEANING MECHANICAL SYSTEMS	Yes
42	Spec Section 15732 - PACKAGE HEAT PUMP AIR CONDITIONING UNITS	Yes
43	Spec Section 15734 - SPLIT SYSTEM AIR CONDITIONING UNITS (DUCTLESS)	Yes
44	Spec Section 15736 - VARIABLE REFRIGERANT VOLUME SYSTEMS AND CONTROLS	Yes
45	Spec Section 15738 - DEDICATED OUTDOOR AIR SYSTEM	Yes
46	Spec Section 15780 - CONDENSATE AND EQUIPMENT DRAIN SYSTEMS	Yes
47	Spec Section 15890 - SHEET METAL DUCTWORK	Yes
48	Spec Section 15910 - MECHANICAL SYSTEMS INSULATION	Yes
49	Spec Section 15950 - TESTING MECHANICAL SYSTEMS	Yes
50	Spec Section 15951 - TESTING, ADJUSTING AND BALANCING OF MECHANICAL SYSTEMS	Yes

Chandler Improvements Phase 3

Work Category: 15C - HVAC

WC Lead: Jenna Soltwedel

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		**$262,492**
51	The following items should be included into proposal, including but not limited to:	Yes
52	All necessary core drilling/demolition and means to route piping is included in this scope.	Yes
53	Supply all access panels/doors required for this scope of work.	Yes
54	Temperature control requirements are included in this scope of work.	Yes
55	Provide blocking/backing for this scope of work.	Yes
56	Furnish, install, and replace construction filters as needed. Final filters to be installed after final clean	Yes
57	Temporary sealing/protection of existing supply and return vents during construction activities.	Yes
58	Tie-Up Existing Equipment in each space that is not to be removed during demo.	Yes
59	Make-Safe and cutting ductwork at point of demolition lower to the ground. Demo and haul off by others.	Yes
60	Hoisting and rigging for your own scope of work.	Yes
61	Involvement in all fire/life safety inspections and meetings.	Yes
62	Startup/commissioning of mechanical systems.	Yes
63	Furnish/install all units as indicated on contract documents and drawings, Mechanical Schedules and General Notes, including but not limited to:	Yes
64	Air Handling Unit	Yes
65	Grilles	Yes
66	Registers	Yes
67	New Condensing Units	Yes
68	Refrigerant Piping	Yes
69	Equipment Supports	Yes
70	Condensate Drain Piping	Yes
71	Wall mounted Thermostat	Yes
72	Air Conditioning Unit	Yes
73	Full size copper condensate drain piping	Yes
74	Hub Drain assembly	Yes
75	Air ductwork	Yes
76	Outside air economizer assembly	Yes
77	Ductwork supports	Yes
78	PVC drain line	Yes
79	Duct Smoke detector (Detail 8 H-34.04)	Yes
80	All other equipment, attachments, items needed to place HVAC equipment listed in HVAC schedule	Yes

Chandler Improvements Phase 3

Work Category: 15C - HVAC

WC Lead: Jenna Soltwedel

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		**$262,492**
81	Install and size the refrigerant piping from the outdoor condensing unit to the indoor d/x cooling coil	Yes
82	Air Balance report	Yes
83	All ductwork to be Class 0 or 1	Yes
84	Demo all existing HVAC equipment that is stated in all mechanical HVAC floor plans/Schedules	Yes
85	Extended Warranty	No
86	Owner training	Yes
87	Holding Bid	Yes
88	Textura Included (Total Under $2.2M add 0.22%, if total is Equal or More than $2.2M add $5,000)	Yes
89	Preventative maintenance	Yes
90	Cross Disipline Work	Yes
91	Bond/CDI Cost	Yes

	ASSUMPTIONS & CLARIFICATIONS:
1	Not used
2	Refrigerant piping per plans.
3	This proposal includes supports for the HVAC system as indicated on the drawings. Supplemental structural supports if required have not been included.
4	Pricing only includes local unit controls, not full system integration implied by specs and scope matrix.
5	HVAC to only cover the buildings at OWRF. AWRF Administration Building upgrades are not included.



City of Chandler
WRF Improvements Phase 3
WC16A – Electrical, Instrumentation, and Controls

Solicitation Summary

Chandler Improvements Phase 3

Long Lead Procurement and Wilson Balance of Plant Proposal

Work Category: **16A Electrical, Instrumentation & Controls**

Subcontractor/Supplier Name	***Status***
Loenbro	*Recommended*
Industrial Power Solutions	*Bid Received*
Skyline Electric	*Bid Received*
Bombard Electric	*No Bid*

Chandler Improvements Phase 3

Work Category: 16A Electrical, Instrumentations & Controls

WC Lead: Kyle Roman

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		**$9,602,875**
MCCARTHY SUBCONTRACT & FRONT END TERMS		
1	Compliant with McCarthy Front Ends	Yes
2	Bid Submitted on McCarthy Bid Form	Yes
3	Bid Bond Included with Bid	Yes
4	Surety Company	West Bend
5	Surety AM Best Rating (Must be A- or Better)	A+
6	Bond/CDI Cost	Yes
7	Insurance Requirements Per Matrix	Yes
8	GL Insurance Company Name	Zurich American
9	GL Insurance Carrier AM Best Rating (Must be A- or Better)	A+
10	GL Insurance (GL - $10MM)	Yes
11	E&O Network Security and Privacy Liability Insurance (CYB - $5MM)	Yes
12	Pollution Insurance (POL - $10MM)	Yes
13	Automobile Liability Insurance (AUTO - $1MM)	Yes
14	Tier 1 Approved	Yes
15	Tier 2 Approved	
16	Safety Items:	
17	OSHA Recordable Incident Rate (2025)	0.50
18	Agrees to comply with PPE requirements including 100% glove policy	Yes
19	Acknowledges updated ladder policy (platform ladders)	Yes
20	Task Hazard Analysis included for all tasks	Yes
21	Tie-off above 6' required	Yes
22	New Helmet Policy	Yes
23	Participate in weekly safety meeting.	Yes
24	Includes Hoisting for Sub's Own Work Scope	Yes
25	Acknowledges Soils Report	N/A
26	Acknowledges Addenda (#1 & #2, and Answers to Pre-bid RFI's)	Yes
27	Hold Bid for 150 Days	Yes
28	Estimated Tax Exempt Value of Total Bid	Approx. 20%
29		
Scope of Work:		

Chandler Improvements Phase 3

Work Category: **16A Electrical, Instrumentations & Controls**

WC Lead: **Kyle Roman**

Bid Date: **August 21, 2026**

	TOTAL WORK CATEGORY PACKAGE VALUE	**$9,602,875**
32	Provide all labor, materials, tools, equipment and appurtenances as required to perform the **Work Category 16A - Electrical, Instrumentation & Controls**, in accordance with and reasonably inferable from the Contract Documents, complete and without exception unless otherwise noted below including, but not limited to, the following:	Yes
33	**General Conditions/General Requirements**	
34	Temporary Construction Power - provide power outlets for construction operations, with branch wiring and distribution boxes located as required and provide flexible power cords as required. Coordinate use the existing electric utility service at the site at the discretion and acceptance of the CoC Field Operations Staff.	Yes
35	MOPO/Shutdowns - The site-wide electrical distribution, instrumentation and communication system shall be operational during this Project. Any shutdowns related to electrical connections shall be coordinated with the plant shutdown schedule. Include temporary electrical and communication conduits, wiring and temporary setup during longer periods of outages	Yes
36	Working Hours - Assume that tie-ins and shutdowns will be performed after hours or on weekends	Yes
37	Protect in Place/ Salvage - Remove, protect, relocate, re-install, and adjust Site Electrical including but not limited to Electrical Structures, Equipment, Duct Banks, UGE Lines, Branch Circuits, Light Poles, etc. as required to support the work of others	Yes
38	Selective Demolition - Disconnect and disassemble distribution inside electrical rooms and other enclosures and move to exterior of buildings for removal and disposal by others	Yes
39	**Trenching for Electrical and Fiber Duct Banks -** Duct bank civil work including excavation, spoils removal and backfill. *(Refer to Electrical Duct Bank Excluded Items Estimate for further detail)*	Yes
40	Underground - Duct bank work including rebar and spacers as per plan drawings and specifications. All manholes and handholes to be furnished and installed as part of this scope of work with all damp proofing and grounding required.	Yes
41	General earthwork, excavation, backfill, subgrade prep, and localized exterior grading per civil/architectural/structural drawings. including, but not limited to the following:	Yes
42	Demo/Replacment of all Asphalt due to Electrical Trenching	Yes
43	Demo/Replacment of all Site Concrete due to Electrical Trenching	Yes
44	Demo/Replacment of all Landscaping due to Electrical Trenching	Yes
45	Open excavation protection around excavations	Yes
46	Dewatering of excavations for rain events	Yes
47	Potholing per McCarthy Policies and Procedures	Yes
48	Soft Digging and Hydroexcavation around existing known utilities	Yes
49	Undermining, Bracing, Reshoring, and Grouting where Ductbanks pass below existing Utilities	Yes
50	Equipment and Operator idle time, for redesign of layout	Yes
51	Ductbank Concrete Material (Fiber Reinforced Red Dyed Concrete)	Yes
52	Ocotillo - CLSM around and under New Electrical Buildings	Yes
53	Miscellaneous Civil Scope items, including, but not limited to the following:	

Chandler Improvements Phase 3

Work Category: 16A Electrical, Instrumentations & Controls

WC Lead: Kyle Roman

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		**$9,602,875**
54	Daily Dust control	Yes
55	Survey and Layout (300 hours @ $175.00/hr.)	Yes
56	Road Plates	Yes
57	Site Clean up	Yes
58	Spoils Haul Away & Disposal	Yes
59	Dedicated Onsite Civil Scope Supervision	Yes
60	Coordination & Ancillary work - Provide necessary block-outs, sleeves, coring, etc. for instrument installation as necessary for complete instrument installation, coordinate with Process Mechanical contractor for locations & mechanical equipment vendors, for a fully integrated electrical and instrumentation system. Furnish and install all electrical & instrumentation racks, termination of all electrical equipment, layout of electrical equipment, control panels, and PLC's equipment pads.	Yes
61	Electrical Equipment - Coordinate and Install Long Lead Electrical Equipment all the requirements for Electrical, Instrumentation and Controls including but not limited to, receiving, storing, O&M related (pre-installation) maintenance, and start-up per the specifications and manufacturer's recommendations	Yes
62	Instrumentation & Controls - included but are not limited to: a) Installation of instruments and control devices furnished by others as shown and specified. Refer to P&ID Matrix. Provide and install all supports and hardware for a complete installation. b) Furnish and install all raceways, including supports and wire for instruments and control devices, label wire at both ends per termination schedules. c) Terminate wire at field device after testing. Terminate the wire at PLC's and control panels. Create and maintain testing and termination logs	Yes
63	Signage/Labelling - Equipment and instrument tags, and signage as required and specified in the contract documents	Yes
64	Testing/Commissioning - Startup and Commissioning for new equipment & equipment modified by this scope of work	Yes
65	3rd Party testing - Arc Flash Coordination, Harmonic Studies, Power Studies, Ground Grid, Lighting Protection and Acceptance Testing for new equipment as required and specified in the contract documents	Yes
66	**Per Plans & Specifications (Wilson 100% IFC Submittal)**	Yes
67	**Division 01 - General Requirements - as it relates to this scope of work**	Yes
68	**Division 02 - Site Construction & Demolition - as it relates to this scope of work**	Yes
69	**Division 03 - Concrete - as it relates to this scope of work**	Yes
70	**Division 05 - Metals - as it relates to this scope of work**	Yes
71	**Division 10 - Specialties - as it relates to this scope of work**	Yes
72	**Division 11 - Equipment - as it relates to this scope of work**	Yes
73	**Division 13 - Special Construction - as it relates to this scope of work**	Yes
74	**Division 14 - Hoisting and Conveying - as it relates to this scope of work**	Yes
75	**Division 15 - Mechanical - as it relates to this scope of work**	Yes
76	**Division 16 - Electrical - as it relates to this scope of work**	Yes

Chandler Improvements Phase 3

Work Category: **16A Electrical, Instrumentations & Controls**

WC Lead: **Kyle Roman**

Bid Date: **August 21, 2026**

	TOTAL WORK CATEGORY PACKAGE VALUE	**$9,602,875**
77	**Division 17 - Instrumentation - as it relates to this scope of work**	Yes
78	**Wilson Engineers - 100% Drawings**	
79	**AWRF Summary of General EI&C Work -** as it relates to this scope of work, including, but not limited to the following:	
80	Overall Site - EI&C Demolition, Modification, Installation and wiring of devices, Instruments, circuits, PLC I/O, etc.	Yes
81	Parshall Flume - EI&C Demolition, Modification, Installation and wiring of devices, Instruments, circuits, PLC I/O, etc.	Yes
82	Secondary Clarifiers No.1& No.3 - Replace the underground RAS control/isolation valve - EI&C Demolition, Modification, Installation and wiring of devices, Instruments, circuits, PLC I/O, etc.	Yes
83	Secondary Clarifiers No.1 through No.4 - EI&C Demolition, Modification, Installation and wiring of devices, Instruments, circuits, PLC I/O, etc.	Yes
84	Disk Filter Area - EI&C Demolition, Modification, Installation and wiring of devices, Instruments, circuits, PLC I/O, etc.	Yes
85	NHLW Disposal Station - EI&C Demolition, Modification, Installation and wiring of devices, Instruments, circuits, PLC I/O, etc.	**No**
86	Headworks - EI&C Demolition, Modification, Installation and wiring of devices, Instruments, circuits, PLC I/O, etc.	Yes
87	Odor Control - EI&C Demolition, Modification, Installation and wiring of devices, Instruments, circuits, PLC I/O, etc.	Yes
88	Pre-Stage Basins - EI&C Demolition, Modification, Installation and wiring of devices, Instruments, circuits, PLC I/O, etc.	Yes
89	Chemical Storage Area - EI&C Demolition, Modification, Installation and wiring of devices, Instruments, circuits, PLC I/O, etc.	Yes
90	Fuel Storage Station - EI&C Demolition, Modification, Installation and wiring of devices, Instruments, circuits, PLC I/O, etc.	Yes
91	**AWRF Summary of Instrumentation, Controls, & Programming Work -** as it relates to this scope of work, including, but not limited to the following:	
92	**Furnish, Install, Program, Calibrate, Activate & Test all new wired Instruments and Local Control Panels as indicated within project documents at the following locations:**	Yes
93	Parshall Flume, Secondary Clarifiers(#1-#4), Disk Filter #6, NHLW Station, Headworks, Odor Control, Pre-Stage Basins, Chemical Storage, Chemical Feed, Fuel Storage Tank	Yes
94	**AWRF Summary of Hoisting and Conveying Work -** as it relates to this scope of work, including, but not limited to the following:	
95	Disc Filter Monorail Electrification - (14630-2.3) Replace existing festoon system for the existing monorail Trolley and hoists with a new Conductor Bar System. Furnish and install by Division 14. Disconnect & Reconnect by EI&C	Yes
96	**AWRF Summary of Network & Fiber Work -** as it relates to this scope of work, including, but not limited to the following:	
97	Fuel Storage Station - Installation and wiring of Network capability & Ethernet switch w/ Fiber Connection	Yes
98	Disk Filter 6 VCP - Installation and wiring of Network capability & Ethernet switch w/ Fiber Connection	Yes
99	Network communication extension to Maintenance Building Fire Alarm	**No**
100	**AWRF Summary of Fire Alarm Work -** as it relates to this scope of work, including, but not limited to the following:	

Chandler Improvements Phase 3

Work Category: 16A Electrical, Instrumentations & Controls

WC Lead: Kyle Roman

Bid Date: August 21, 2026

	TOTAL WORK CATEGORY PACKAGE VALUE	**$9,602,875**
101	Fire Alarm System - (16720) Complete Fire Surveillance and alarm system at Maintenance Building. Interface with exisiting (Simplex) system at Thickening Building	**No**
102	**Instrumentation List - AWRF -** Furnish Process instruments and Control Panels as indicated in the contract documents resulting in a complete instrumentation and control system including, but not limited to the following:	
103	**Parshall Flume - Influent Pump Station - AWRF (I-01.02)**	
104	Flow Indicator Transmitter - FIT-001	Yes
105	Flow Element - FE-001	Yes
106	Laser Flow Sensor - IPS-001-SLM	Yes
107	**Disc Filter DS6 - AWRF (I-05.03)**	
108	Analyzer Element - AE-600	Yes
109	Analyzer Indicator/Transmitter - DSF06-AIT-600	Yes
110	**NHLW Disposal Station - AWRF (I-08.01) - (ALTERNATE #1)**	
111	Level Switch High-High - LSHH-100 - (ALTERNATE #1)	**No**
112	H2S Control Panel & Alarm - (Refer to 17321) - (ALTERNATE #1)	**No**
113	H2S Sensor - (Refer to 17321) - (ALTERNATE #1)	**No**
114	**Chemical Storage Facility (NaOCL) - AWRF (I-11.02)**	
115	Local Control Panel - CFS-LCP-001	Yes
116	Emergency Stop Hand Switch - NaOCL-HS-001	Yes
117	Level Switch High - NaOH-LSH-775 (See detail C-40.03)	Yes
118	Pressure Switch High - NaOCL-PSH-001	Yes
119	Pressure Switch Low - NaOCL-PSL-001	Yes
120	Pressure Indicator/Transmitter - NaOCL-PIT-001	Yes
121	Pressure Indicator - NaOCL-PI-001	Yes
122	Pressure Switch High - NaOCL-PSH-002	Yes
123	Pressure Indicator - NaOCL-PI-002	Yes
124	Pressure Switch High - NaOCL-PSH-003	Yes
125	Pressure Indicator - NaOCL-PI-003	Yes
126	**Chemical Storage Facility (NaOH) - AWRF (I-11.03)**	
127	Emergency Stop Hand Switch - NaOH-HS-001	Yes
128	Level Switch High - NaOH-LSH-776 (See detail C-40.03)	Yes
129	Pressure Switch High - NaOH-PSH-001	Yes
130	Pressure Switch Low - NaOH-PSL-001	Yes
131	Pressure Indicator/Transmitter - NaOH-PIT-001	Yes
132	Pressure Indicator - NaOH-PI-001	Yes
133	Pressure Switch High - NaOH-PSH-002	Yes
134	Pressure Indicator - NaOH-PI-002	Yes

Chandler Improvements Phase 3

Work Category: 16A Electrical, Instrumentations & Controls

WC Lead: Kyle Roman

Bid Date: August 21, 2026

	TOTAL WORK CATEGORY PACKAGE VALUE	**$9,602,875**
135	Pressure Switch High - NaOH-PSH-003	Yes
136	Pressure Indicator - NaOH-PI-003	Yes
137	**Pre-Stage Basin No. 2 Odor Control Modification - AWRF (I-11.07)**	
138	Level Switch High - NaOH-LSH-### (See detail C-40.03)	Yes
139	**Pre-Stage Basin No. 1 Odor Control Modification - AWRF (I-11.09)**	
140	Level Switch High - NaOH-LSH-### (See detail C-40.03)	Yes
141	**AWRF MOPO's -** Actively participate in the MOPO process including, but not limited to, creating step by step plans, hosting/attending meetings, coordination, identifying and furnishing temporary power and controls and direct execution of means and measures nessesary to accomplish each MOPO successfully as provided in the Specifications and confirmed by Plant Operations.	
142	A-2 Parshall Flume Rehabilitation(60 days) - Laser flow meter replacement & support temp EI&C measures as needed for IPS process	Yes
143	A-5 Secondary Clarifiers Mechanism Replacement(93 days) - Support Temp EI&C measures as needed to maintain 2 Clarifiers operable. Assume temporary power connections to be made via SO cord and connections at Clarifier Junction Boxes for minimum 2 Clarifiers at a time	Yes
144	A-6 Secondary Clarifiers drain 12" plug valve replacement(6 days) - De-term, replace disconnect and electrical wiring, re-term and support temp EI&C measures as needed to maintain minimum 2 Clarifiers operable	Yes
145	A-7 Secondary Clarifiers drain 16" plug valve replacement(3 days) - Determ, replace disconnect and electrical wiring, retern and support temp EI&C measures as needed to maintain min.Clarifiers operable	Yes
146	A-8 Chemical Feed Loop(180 days) - Chem panels interact with multiple pumps each. This MOPO will likely contain as many as 9 separate shutdowns (1 pump at a time, 1 panel at a time) provide temporary connections of power and controls as needed to maintain min chemical process	Yes
147	A-8.1 Chemical Feed Loop(1/2 day) - Shutdown and electrical Tie-ins for PP-HW2. Provide temporary connections of power and controls as needed to maintain min chemical process	Yes
148	A-9.1 Disk Filter #6 Installation(1/2 day) - Shutdown and electrical Tie-ins for DSF-LP-400. provide temporary connections of power and controls as needed to maintain min disk filter process	Yes
149	A-9.2 Disk Filter #6 Installation(1/2 day) - Shutdown and electrical Tie-ins for DSF-PP-300. provide temporary connections of power and controls as needed to maintain min disk filter process	Yes
150	A-12 NHLW Station - Shutdown and electrical Tie-ins at PP-DW3. Provide temporary connections of 120v power for PLC and/or Network controls to maintain min process in affected area	Yes
151	A-13 Fuel Storage Station - Shutdown and electrical Tie-ins for MPC feeding Fuel Storage Station. Provide temporary connections of 120v power for PLC and/or Network controls to maintain min process in affected area	Yes
152	**Ocotillo WRF Summary of General EI&C Work -** as it relates to this scope of work, including, but not limited to the following:	
153	Overall Site - EI&C Demolition, Modification, Installation and wiring of devices, Instruments, circuits, PLC I/O, etc.	Yes

Chandler Improvements Phase 3

Work Category: 16A Electrical, Instrumentations & Controls

WC Lead: Kyle Roman

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		**$9,602,875**
154	New Duct banks - New Concrete encased pathways for electrical distribution as follows: SGR-120-001&002 to SWGR-1AA&1AB - MV to MLE SWGR-1AA&1AB to PDP-639-001 - Sludge Building SWGR-1AA&1AB to EFF-MCC-001&002 - Effluent Pump Station SWGR-1AA&1AB to ANX-MCC-001&002 - Anoxic Basin SWGR-1AA&1AB to EMH-17 - Refeed MCC AER-BLR-001&002 (Aeration Blower Building) SWGR-1AA&1AB to EMH-17 - Refeed MCC D1&D2 (Old Dewatering Building) SWGR-1AA&1AB to EMH-17 - Feed to PDP-001 (Old Headworks) EMH-19 to T-POC - LP-P1 conduit block diagram	Yes
155	**Duct bank Reuse - Reuse of existing infrastructure of Duct bank and Manholes as follows:**	
156	EMH-17 to EMH-19 - Refeed MCC D1&D2	Yes
157	EMH-17 to EMH-31 - Refeed MCC AER-BLR-001&002	Yes
158	EMH-28 to EMH-10 - MCC EFF-001&002 conduit block diagram	Yes
159	EMH&CMH(ANX) to EPB's&CPB's(1-3) - ANX-MCC-001&002 conduit block diagram	Yes
160	EMH&CMH-03 to EMH&CMH-04 - MCC-410-001&002 conduit block diagram	Yes
161	MV Switchgear Bucket Tie-ins (SGR-120-001&002) - EI&C Modification, Installation and wiring of devices, Instruments, circuits, etc. (Switchgear modifications by Eaton, FBO)	Yes
162	New MV Switches (DSC-1AA-001& DSC-1AB-002) & Liquid Filled Substation XMFR's (TRF-1AA-0011&TRF-1AB-002) - EI&C Installation of equipment and wiring of devices, Instruments, circuits, etc. (Equipment by Eaton, FBO)	Yes
163	New Main Electrical Building, Switchgear(SWGR-1AA & SWGR1-AB), Panel(LS), XMFR(XFR-Panel LS), ATS(LS) - EI&C Installation of equipment and wiring of devices, Instruments, circuits, etc. (Building by TBD, Equipment by Eaton, all FBO)	Yes
164	Bioreactor Basins MCC Upgrades, Aeration Mixers & IMLR Pumps - EI&C Demolition, Modification, Remove/Replace of Buckets & install of Disconnects and wiring of devices, Instruments, circuits, PLC I/O, etc. (MCC Buckets and Disconnects by Eaton, FBO)	Yes
165	South Sludge Holding - Demolish MCC-639-001&002, EI&C Modification, Installation of new PDP(639-001) Refeed, Rewiring of equipment, devices, Instruments, circuits, PLC I/O, etc. (Equipment by Eaton, FBO)	Yes
166	Anoxic Aeration Basin - New Electrical Building, MCC(ANX-001&002), Panel(419-001), XMFR(TRF-419-001), ATS(419-001) IMLR Pump 7 - EI&C Demolition, Modification, Installation, Refeed, and Rewiring of equipment, devices, Instruments, circuits, PLC I/O, etc. (Electrical Building by TBD, Equipment by Eaton, all FBO)	Yes
167	Secondary Clarifiers No.3 - EI&C Demolition, Modification, Installation of MCP(SEC-MTR-MCP-300) and Fixtures, wiring of devices, Instruments, circuits, PLC I/O, etc. (Equipment by Eaton, FBO)	Yes

Chandler Improvements Phase 3

Work Category: **16A Electrical, Instrumentations & Controls**

WC Lead: **Kyle Roman**

Bid Date: **August 21, 2026**

TOTAL WORK CATEGORY PACKAGE VALUE		**$9,602,875**
168	Effluent Pump Station - MCC(EFF-001&002) Replacement, EI&C Demolition, Modification, Remove/replace of ATS(E), intallation and Refeed from SWGR-1AA&1AB, Rewiring of equipment, devices, Instruments, circuits, PLC I/O, etc. (Equipment by Eaton, FBO)	Yes
169	Aeration Blower MCC's(AER-BLR-MCC-001&002) - Disconnect, Demolition and Refeed from new SWGR-1AA&1AB	Yes
170	Old Dewatering Building MCC's(MCC-D1 & MCC-D2) - Disconnect and Demolition of existing Circuits, feeders, etc. back to MCC. Install, Rewire, & Refeed MCC from SWGR-1AA&1AB	Yes
171	MCC-SOC-400A - Disconnection, Demolition of Existing Circuits, feeders, etc. back to MCC-SOC-400A	Yes
172	MCC-P & MCC-POC - Demolish MCC-P & MCC-POC. Install new XMFR (T-POC), Panel (LP-P1). Feed from MCC-D1. Refeed, Rewiring of equipment, devices, Instruments, circuits, PLC I/O, etc. (Equipment by Eaton, FBO)	Yes
173	Old Headworks MCC Replacement - Demolish MCC-H1&H2. EI&C Modification, Installation of new PDP(001) Refeed from SWGR-1AA&1AB, Rewiring of equipment, devices, Instruments, circuits, PLC I/O, etc. (Equipment by Eaton, FBO)	Yes
174	Fuel Storage Station - New MPC(FS-MPC-100) Feed from DP-120-001. Installation and wiring of equipment, VCP, devices, Instruments, circuits, PLC I/O, etc. (Equipment by Eaton, FBO)	Yes
175	Demo Existing SES-1- Remove SES-1 Entirely, Including Existing Panel LS, PCP-129-001, 750kw Gen No.1, 750kw Gen No.2, Existing SES Substation. Move all ro exterior of SES yard for removal and disposal by others	Yes
176	**OWRF Summary of Instrumentation, Controls, & Programming Work -** as it relates to this scope of work, including, but not limited to the following:	
177	Furnish, Install, Program, Calibrate, Activate & Test all new wired Instruments as shown on Instrumentation drawings at the following locations:	Yes
178	Bioreactor Basins, Anoxic Basins, Secondary Clarifier No. 3, Fuel Storage Tank	Yes
179	**OWRF Summary of Grounding and Lighting Protection Work -** as it relates to this scope of work, including, but not limited to the following:	
180	New Electrical Equipment and New Buildings - Furnish, install, Modify and test Ground Grid	Yes
181	New Electrical Equipment and New Buildings - Furnish, install, Modify and test External Building Lighting Protection	**No**
182	**OWRF Summary of Network & Fiber Work -** as it relates to this scope of work, including, but not limited to the following:	
183	Fuel Storage Station - Installation and wiring of Network capability & Ethernet switch w/ Fiber Connection	Yes
184	New ANX PLC - Installation and wiring of Network capability & Ethernet switch w/ Fiber Connection	Yes
185	Extend Network to Fire Alarm Panels at Anoxic Electrial Building and New Electrical Building	Yes
186	Network communication extension to Sludge Building Fire Alarm	**No**

Chandler Improvements Phase 3

Work Category: **16A Electrical, Instrumentations & Controls**

WC Lead: **Kyle Roman**

Bid Date: **August 21, 2026**

	TOTAL WORK CATEGORY PACKAGE VALUE	**$9,602,875**
187	**OWRF Summary of Fire Alarm Work -** as it relates to this scope of work, including, but not limited to the following:	
188	Sludge Building - (16720) Complete Fire Surveillance and alarm system for Sludge Holding Tank Blower Building No.2 Interface with existing (simplex) system at South Admin Building. New System to communicate with all existing zones in south plant	**No**
189	New Electrical Buildings - (16720) Fire Surveillance and alarm system for New Electrical Interface with existing (simplex) system. New System to communicate with all existing zones in south plant	Yes
190	**Instrumentation List - OWRF -** Furnish Process instruments and Control Panels as indicated in the contract documents resulting in a complete instrumentation and control system including, but not limited to the following:	
191	**MBR Aeration Basin No. 1 Modification - OWRF (I-23.03)**	
192	Local Control Panel - LCP-410-101	Yes
193	**MBR Aeration Basin No. 2 Modification - OWRF (I-23.06)**	
194	Local Control Panel - LCP-410-201	Yes
195	**Anoxic Basins Modifications - OWRF (I-25.01)**	
196	Local Control Panel - ANX-MLR-PMP-LCP-007	Yes
197	Flow Switch Low - ANX-MLR-FSL-007	Yes
198	Pressure Indicator - PI-007	Yes
199	Flush Water Flow Switch - FSL-701A	Yes
200	Seal Water Flow Switch - FSL-701B	Yes
201	Pressure Indicator - PI-701	Yes
202	**Secondary Clarifiers No. 3 - OWRF (I-27.01)**	
203	Torque Indicator - OT-300	Yes
204	Torque Element - OE-300	Yes
205	**OWRF MOPO's -** Actively participate in the MOPO process including, but not limited to, creating step by step plans, hosting/attending meetings, coordination, identifying and furnishing temporary power and controls and direct execution of means and measures nessesary to accomplish each MOPO successfully as provided in the Specifications and confirmed by Plant Operations.	
206	O-1.1 MBR IMLR Pump Installation - Shutdown and electrical Tie-ins at MCC-410-001/002. Replace existing NEMA 1 Starter Buckets with NEMA 2 Starter Buckets. Install new VFD Bucket for IMLR Pumps. Buckets and provisions furnished by Eaton, to be installed by EC. Only 1 side of MCC-410-001/002 can be down at a time. Coordinate with installation of new diffusers while basin is drained.	Yes
207	O-2 Anoxic Basin IMLR Pump No.7 - Shutdown and electrical Tie-ins at MCC-ANX-002. Coordination with O-10 required. Connect IMLR Pump No. 7 to new MCC-ANX-002 and complete startup prior to proceeding with O-10	Yes
208	O-3 Secondary Clarifier No.3 Mechanism Replacement - Support Temp EI&C measures as needed to maintain 2 Clarifiers operable. Only 1 side of each Clarifier MCC can be shut down at a time for installation of new equipment. Coordianation with O-8 required to determine if this MOPO must be completed prior to MCC re-feed in O-8	Yes

Chandler Improvements Phase 3

Work Category: 16A Electrical, Instrumentations & Controls

WC Lead: Kyle Roman

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE	$9,602,875

	ASSUMPTIONS & CLARIFICATIONS:
1	Electrical instrumentation and Controls scope included per Wilson For Construction submittal as indicated below:
2	Includes all labor, materials, equipment, supervision, coordination, testing, and programming required for this work category in accordance with the contract documents.
3	Wire and Cable pricing is based upon the June 12th, 2026 $6.43/lb. Copper Index.
4	Includes instrumentation devices, control wiring, raceways, panels, terminations, programming, integration, testing, and calibration. Integration is limited to the defined electrical and I&C scope.
5	Mechanical, process piping, and nonelectrical instrumentation installation is by others, unless specifically noted.
6	It is assumed that all existing electrical single-line equipment designated in the Contract Documents for modification and reuse has been verified by the City of Chandler as operational and suitable for continued service. We further assume that all manufacturer-recommended maintenance and service requirements have been performed throughout the equipment's service life up to the point at which McCarthy begins work on the equipment.
7	Our scope includes only the modifications and connections required by the Contract Documents. If functional testing, energization, startup, or commissioning reveals damaged, worn, failed, or otherwise defective internal components or conditions not caused by McCarthy's or its subcontractors' negligence, such repair or replacement work is excluded.
8	It is understood that per site coordination and preconstruction walk between Wilson, CoC and McCarthy that work may be performed in live existing manholes containing systems 600V or less, with appropriate safety measures as per NFPA 70 with no formal MOPO required.
9	Contractor will UL certify any modiciations that are completed as a part of this GMP. If previous work completed on the panels will not allow for the panel to be UL certified then recertification will not be required or change order will be provided by the City to the contractor to further modify the compnents that are not compliant.
10	Electrical and Communications Duct Banks Include furnishing, layout, survey, coordination, demolition, modification and installation of Raceways, Handholes and Manholes as shown in contract documents unless existing sections of duct bank are specifically identified for reuse, as indicated herein.
11	According to Section 16137. Underground conduits grouped together (3) or fewer will be PVC Coated GRC and buried at required minimum depth without rebar reinforcement or concrete encasement. Conduits grouped together (4) or more will include reinforcement and encasement according to detail 188 on E-35.01
12	Some existing underground duct bank conduits have been investigated and found to be intact, of adequate size for new wiring, and routing is practical to refeed or serve new loads as required in the project documents. These conduits are planned for reuse. A formal submittal map and conduit block diagram will be submitted to engineer for information prior to installation in each process area.
13	Conduit Seal offs will be furnished and installed in locations as indicated and implied within the contract documents, and as required by applicable NEC.
14	Handling, removal and disposal of hazardous materials associated with existing transformers, generators and substations is not included in the project scope.

Chandler Improvements Phase 3

Work Category: **16A Electrical, Instrumentations & Controls**

WC Lead: **Kyle Roman**

Bid Date: **August 21, 2026**

TOTAL WORK CATEGORY PACKAGE VALUE	**$9,602,875**

15	
16	AWRF Airport Water Reclamation Facility
17	Secondary Clarifiers: Disconnect Switches are not shown on Clarifier Motors power conduit block diagrams. Based on Response from Wilson on Agency Review log, we will assume to reuse existing disconnect switches at clarifier 1-3 and replace toggle switch at Clarifier 4 with a disconnect of matching rating and type.
18	Disc Filter No. 6: Regarding Power and Control pull boxes; New pull boxes for Disc Filter No. 6 will be furnished and installed to mirror placement and routing of existing filters 1-5. Deviation from drawings; to be confirmed in submittal drawing during construction.
19	Fuel Storage Station: Includes terminations and connections for Network, Electrical, and Controls from field panels to the Vendor Control Panel under 16A.
20	Parshall Flume: Replace as indicated in the contract documents.
21	MOPO Provisions: Included are temporary provisions for instrumentation and controls and temp power connections extending from existing nearby 120v sources, 20A and smaller, as needed to maintain plant process operations.
22	
23	Excluded from AWRF Pricing:
24	Fire Alarm System upgrades at Maintenance building. We believe this summary of work in specification 16720 is unintended carryover from a previous phase of work and is not required to be part of this project. Therefore, any work related to or associated with fire alarm is excluded. Suggested budget values have been provided in the Risk Register, included herein
25	Disc Filter Monorail Power System will be furnished and installed under WC 14A. Only electrical make safe and reconnect to existing circuitry is included under 16A
26	Not used
27	All work supporting Jacobs EI&C, I/O Panel replacement and SCADA Network upgrades are not included.
28	All work supporting Volume 5 (Administration Building Remodel) is not included.

Chandler Improvements Phase 3

Work Category: **16A Electrical, Instrumentations & Controls**

WC Lead: **Kyle Roman**

Bid Date: **August 21, 2026**

TOTAL WORK CATEGORY PACKAGE VALUE	**$9,602,875**

29	
30	OWRF Ocotillo Water Reclamation Facility
31	Effluent Pump Station: DSF-MTS-100 and ATS-E are located within the electrical room. Raceways for this equipment will not leave the building and route through existing manholes as indicated on the Conduit Block Diagrams
32	SGR-120-001/002 to SWGR 1AA/1AB: A Side and B Side duct banks will occupy the same trench and encasement for the full distance between existing buildings and new switchgear building. A side and B side conduits will be separated at manholes only.
33	Lightning Protection System: It is assumed that the extent of Lightning Protection is limited to the counterpoise and pigtail tie-ins to interior equipment only as detailed in the E drawings. No further exterior building mounted system is included. Additional cost alternate provided in Work Category Description.
34	Typical MOPO Provisions: Included are temporary provisions for instrumentation and controls and temp power connections extending from existing nearby 120v sources, 20A and smaller, as needed to maintain plant process operations.
35	MOPO Sequence: It is assumed that electrical service cutovers to existing and new replacement equipment (MCC's and SWGR's) can be performed by isolating and deenergizing 1 side of each associated main-tie-main at a time. It is assumed that no additional 3 phase temp power generation or provisions will be required unless specifically noted under 'Expanded MOPO Provisions'.
36	Expanded MOPO Provisions: DP-710-001 feeds the current Administration building, which is in use continually and houses critical network infrastructure which must remain energized for the MOPO O-5 duration (3 Days) Temp Generator or equal provision will be provided.
37	
38	Excluded from OWRF Pricing:
39	Fire Alarm system upgrades at the Sludge Holding Building. We interpret that the provided summary of work in specification 16720 is unintended carryover from a previous phase of work and is not required to be part of this project. Therefore, any work related to or associated with fire alarm is excluded. Suggested budget values have been provided in the Risk Register, included herein.
40	Fire Surveillance and Alarm Systems at new Electrical Buildings: There is insufficient information to determine if new Fire Surveillance and Alarm system is required inside of the 2 new electrical buildings (Anoxic MCC) & (SWGR-1AA/1AB) Therefore, any work related to or associated with fire alarm is excluded. Suggested budget values have been provided in the Risk Register, included herein
41	Not used
42	Ductbank Clarifications

Chandler Improvements Phase 3

Work Category: 16A Electrical, Instrumentations & Controls

WC Lead: Kyle Roman

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE	$9,602,875

43	Duct bank sections will be reused as defined by the attached Utility Exhibit. Utility Exhibit was developed in conjunction with design engineer through field walks, and confirmed over the course of several meetings. Official submittal with duct bank routing will define the conduit runs and wire pulls utilizing existing for final confirmation.
44	Minor field adjustments within the intended corridor are covered under the WC cost. Major relocation outside of the intended corridor, redesign due to unforeseen obstruction, or added length/structure beyond the current basis.
45	Existing duct bank identified for reuse are assumed to be accessible, structurally serviceable, reasonably clean, and capable of accommodating the planned conductors/raceways after normal verification. Remediation for collapsed, blocked, flooded, undersized, inaccessible, structurally deficient, or otherwise unusable will trigger a contingency request. If new conduit is needed for areas identified as reuse conduit per the attached Utility Exhibit, then a contingency request will be initiated. Any investigation/verification of the existing conduits beyond a mandrel will incur additional cost.
46	Demolition of Existing duct bank will be limited to locations where new duct bank must be installed in the same civil elevation of existing duct bank underground. All other existing underground duct bank, handholes and manholes will be marked as spare, conduit ends sealed and abandoned in place .
47	Utility relocation or replacement are not planned to accommodate any duct banks. Duct banks will need to be adjusted around existing utilities.
48	Dewatering includes ordinary rainwater, surface water, and localized ground water management necessary to install the work. Persistent groundwater, perched water, contaminated water, high-volume pumping, treatment, discharge permitting, offsite disposal, well points, or dewatering that materially extends the work duration is required will trigger a contingency request.
49	Soil report for the project was not available upon request from Engineers. Soil conditions have been assumed to be typical for Chandler construction projects based on previous job experience. Trenching operations that encounter unsuitable soil the requires over excavation/engineered fill, hard dig conditions, shoring beyond typical measures, or contamination disposal will trigger a contingency request.

GENERAL NOTES:

1. This plan was prepared in conformance with ASCE standard CI/ASCE 38-22 "American Society of Civil Engineers Standard Guideline for Investigating and Documenting Existing Utilities".
2. WE will only warrant the three dimensional location of utility lines based on quality level A information. QL "A" information is only valid within the visible limits of the test hole.
3. WE will advance a vacuum test hole until a condition of practical refusal for vacuum excavation is reached. Practical refusal is defined as any of the following conditions occurring: bedrock, water table or reaching a depth of 12'.
4. Below ground structures, unless dimensioned, are symbolic only.
5. Prior to excavation utility owners shall review and approve this drawing.
6. This drawing is prepared in color. Reproduction may alter the information contained herein. WE do not warrant the information contained herein in the event of reproduction.
7. Base mapping/survey control is shown for information only and is not warranted.
8. WE recommend that all existing utilities critical to proposed construction activities be located by vacuum excavation (quality level A) prior to any excavation (if not already located by vacuum excavation).
9. Utility Lines shown on the plans labeled as Quality Level B have been traced and surveyed using various geophysical instruments. Unless noted as Quality Level B it should be assumed that lines are shown as approximate only.
10. Utility Lines depicted on the plan as ASCE Quality Level D are from various plans and records from public or private stakeholders. WE requested that all available plans and records be provided from all of the known stakeholders.
11. WE obtained numerous One Call design tickets for this project and the locations of all markouts have been surveyed and documented.
12. Electrical lines shown on the plans were traced using hand held locators by indirect induction methods. The lines traced are depicted as ASCE 38-22 Quality Level B.
13. Telephone and communication lines shown on the plans were traced using direct and indirect connections through building basements, vaults, and hand holes. The lines traced are depicted as ASCE 38-22 Quality Level B.
14. Water lines were traced using direct and indirect induction methods. The lines traced are depicted as ASCE 38-22 Quality Level B.
15. Underground structural elements such as tie backs, sheeting, shoring, framing, piles or pile caps have not been plotted within this set. The respective public and private plans should be reviewed prior to demolition and construction in order to identify underground structural elements.
16. Utilities located within fenced in electrical sub-stations are not accessible by field personnel, therefore can not be field located.
17. Utility vault structures are shown using best available information collected at the time of the survey/investigation. However, data may be limited by accessibility and measurement accuracies. All below grade utility vaults structures shown hereon should be considered approximate and are depicted as ASCE 38-22 Quality Level C.
18. Any and all depth of utilities depicted at a QL-B standard of care hereon shall be considered approximate as of the date of the investigation and [illegible] re used as a basis of design, construction, and/or construction methodology without further investigation to expose the utility in question and obtain a hard measurement. It is the responsibility of the contractor to utilize soft digging best practices to expose all utilities having a potential for conflict within the area of excavation prior to any hard digging excavation. McCarthy shall not be held liable for any decisions of incidents that result from the reliance upon any of the QL-B provided depth information.
19. All easement lines depicted hereon are shown per provided record documents and approximately plotted per available GIS parcel information or survey by others. These lines are approximate and should be considered for reference only. The purpose of this depiction is to show the possibility of the existence of utilities that may or may not exist within said easements and should not be relied upon for any other purpose. A title report has not been procured as a part of this scope and therefore additional easements may exist beyond what has been depicted.

conventional excavation

potholing & hydro excavation

duct bank identified for reuse

UTILITY COMPANY STAKEHOLDERS:

ELECTRIC
City of Chandler
175 S ARIZONA AVE.
CHANDLER, AZ 85225
480-782-3000

SALT RIVER PROJECT - MARICOPA COUNTY
1500 N. MILL AVE.
TEMPE, AZ 85288
602-236-8888

TELEPHONE
City of Chandler
175 S ARIZONA AVE.
CHANDLER, AZ 85225
480-782-3000

SALT RIVER PROJECT - MARICOPA COUNTY
1500 N. MILL AVE.
TEMPE, AZ 85288
602-236-8888

FIBER OPTIC
City of Chandler TRAFFIC SIGNALS
175 S ARIZONA AVE.
CHANDLER, AZ 85225
480-782-3000

SALT RIVER PROJECT - MARICOPA COUNTY
1500 N. MILL AVE.
TEMPE, AZ 85288
602-236-8888

CENTURYLINK
2942 N HARTFORD ST.
CHANDLER, AZ 85225
888-660-1244

STORM & SANITARY SEWER
City of Chandler
175 S ARIZONA AVE.
CHANDLER, AZ 85225
480-782-3000

We have contacted the listed utility stakeholders and have requested and and all available utility records. The provided records have be depicted hereon at the appropriate quality level.

ARIZONA811
Know what's below.
Call before you dig.

ARIZONA LAW REQUIRES THAT A UTILITY LOCATE REQUEST BE PLACED 2 WORKING DAYS BEFORE BEGINNING ANY EXCAVATION. CALL (602) 659-7500 OR 811 OR PLACE A REQUEST ONLINE BY CLICKING AT WWW.AZBLUESTAKE.COM.

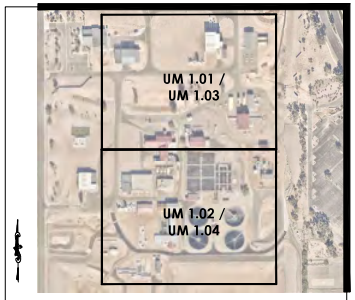
Chandler • Arizona
Where Values Make The Difference

CHANDLER WTP OWRF
2737 S OLD PRINCE RD., CHANDLER AZ, 85248
EXISTING SUBSURFACE UTILITY EXHIBIT

MAPPING NUMBER:
004006.SUM

PROJECT DIRECTORY

PROJECT MANAGER CONTACT
McCARTHY MAPPING
Elijah Enos
PHONE: 480-851-1722
WEBSITE: http://www.mcmapping.mccarthy.com
Email: eenos@mccarthy.com



KEY PLAN
NOT TO SCALE

DRAWING INDEX

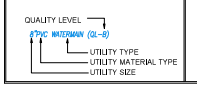
SHEET #	SHEET NAME
UM 1.00	COVER SHEET
UM 1.01 - UM 1.02	EXISTING COMPOSITE UTILITY PLAN - QL-B
UM 1.03 - UM 1.04	PROPOSED COMPOSITE UTILITY PLAN - QL-B

LEGEND:

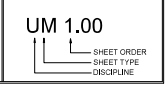


* NOTE: END OF INFORMATION INDICATES THAT EITHER THE LINE COULD NOT BE LOCATED BEYOND THIS POINT USING ANY RESPONSIVE UTILITY PROSPECTING TOOL OR THAT THE Q-B INFORMATION ENDED AT THIS POINT AND THE CONTINUATION OF THE UTILITY COULD NOT BE DETERMINED. IT SHOULD NOT BE ASSUMED THAT THE UTILITY IS CAPPED AT THIS POINT

TYPICAL UTILITY CALLOUT:



TYPICAL SHEET CALLOUT:



UTILITY QUALITY LEVEL INFORMATION INDEX:

QUALITY LEVEL D: "QL-D": Records Search: This level of service provides information that has been obtained from existing records, which includes utilizing existing plans, contacting utility companies, verbal recollections, obtaining access rights and researching prior rights (i.e. easements, deeds).

QUALITY LEVEL C: "QL-C": This level adds field surveys of visible above-ground utility systems such as maintenance holes, valve boxes, fire hydrants, etc., and reconciles this information to existing utility records. (Quality Level D)

QUALITY LEVEL B: "QL-B": Designating Underground Utility Systems: This level includes using surface geophysical prospecting techniques, including electromagnetic, magnetic, sonic, or other energy fields to determine the existence, horizontal position of underground utility systems, approximate vertical positions of subsurface utilities can be identified depending on the specific subsurface prospecting technique utilized.

QUALITY LEVEL A: "QL-A": Locating Underground Utility Systems: This level is the highest level of accuracy, which includes obtaining precise horizontal and vertical position of the utility line by excavating a test hole. The test hole shall be done using vacuum excavation or comparable nondestructive equipment in a manner as to cause no damage to the utility line. After excavating a test hole, a field survey was performed to determine the exact location and position of the utility line, type, size, condition, material, and other characteristics of underground utility system.



LOCATOR MAP
NOT TO SCALE

3737
S OLD PRICE RD.

CHANDLER, AZ
MARICOPA CO.

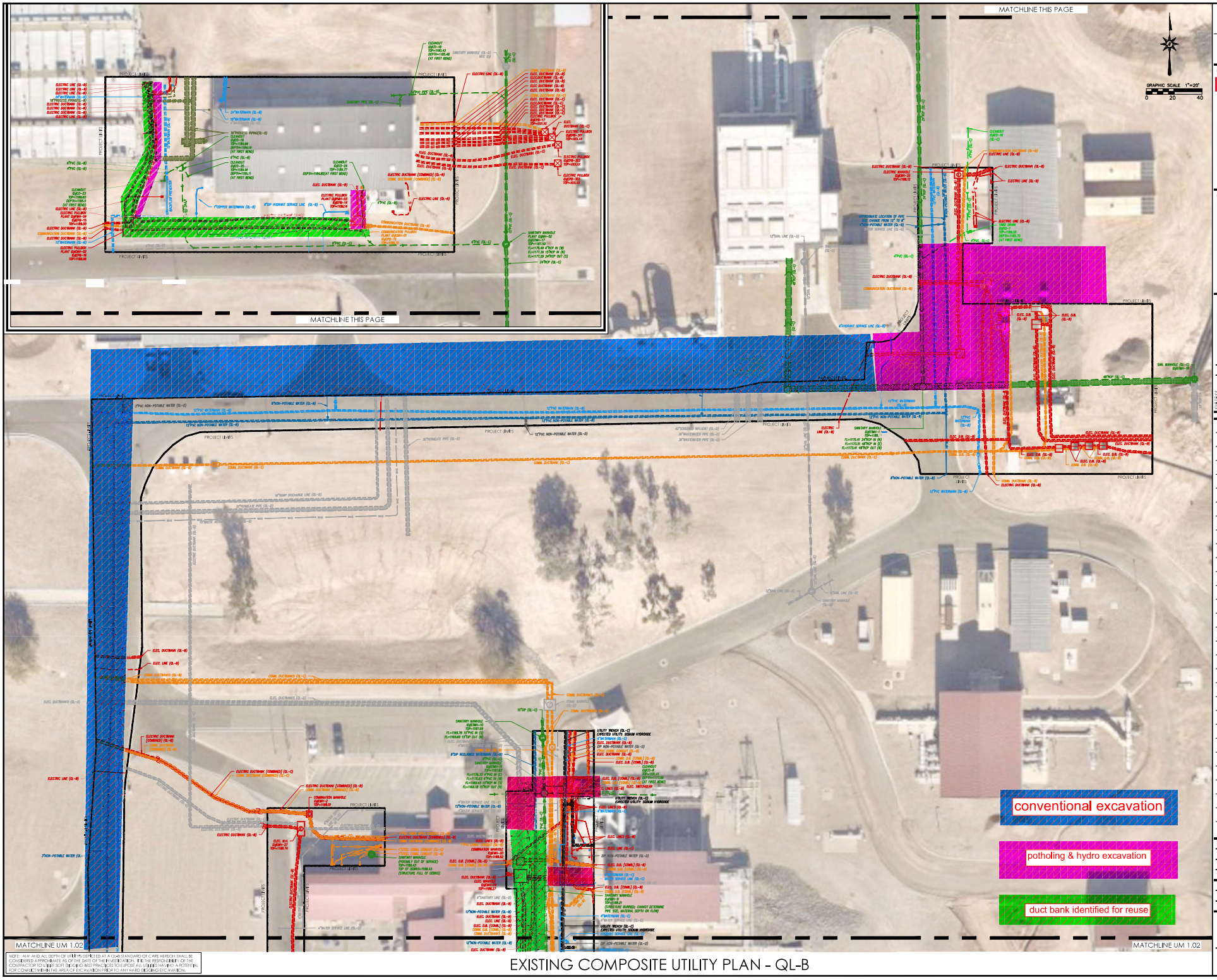
PREPARED FOR:
McCARTHY
McCARTHY BUILDING COMPANIES, Inc
4225 N. 24th St., Suite 300,
Phoenix, AZ 85016

PREPARED BY:
McCARTHY
McCARTHY MAPPING
18440 SW Bardy Dr.
Newport Beach, California 92660
(949) MCCARTHY
http://www.mccarthy.com

SIGNATURE
DATE

THE SEAL AND SIGNATURE APPEARING ON THIS DOCUMENT WERE AUTHORIZED BY [illegible] ON THE DATE ADJACENT TO THE SEAL. IT IS NOT GUARANTEED THAT THE SEALED AND SIGNED INFORMATION CONTAINED IN THIS DOCUMENT WILL BE THE SAME AS THE INFORMATION USED TO CONSTRUCT THE PROJECT. HOWEVER, THE SEALED AND SIGNED INFORMATION CONTAINED IN THIS DOCUMENT IS REPRESENTED TO BE VALID FOR THIS PROJECT.

ISSUE/REVISION	
NO.	DATE
NO.	DATE
NO.	DATE



3737
OLD PRICE RD.

CHANDLER, AZ
MARICOPA CO.

PREPARED FOR:

McCARTHY BUILDING COMPANIES, INC
4225 N. 24th St., Suite 300
Phoenix, AZ 85016

PREPARED BY:

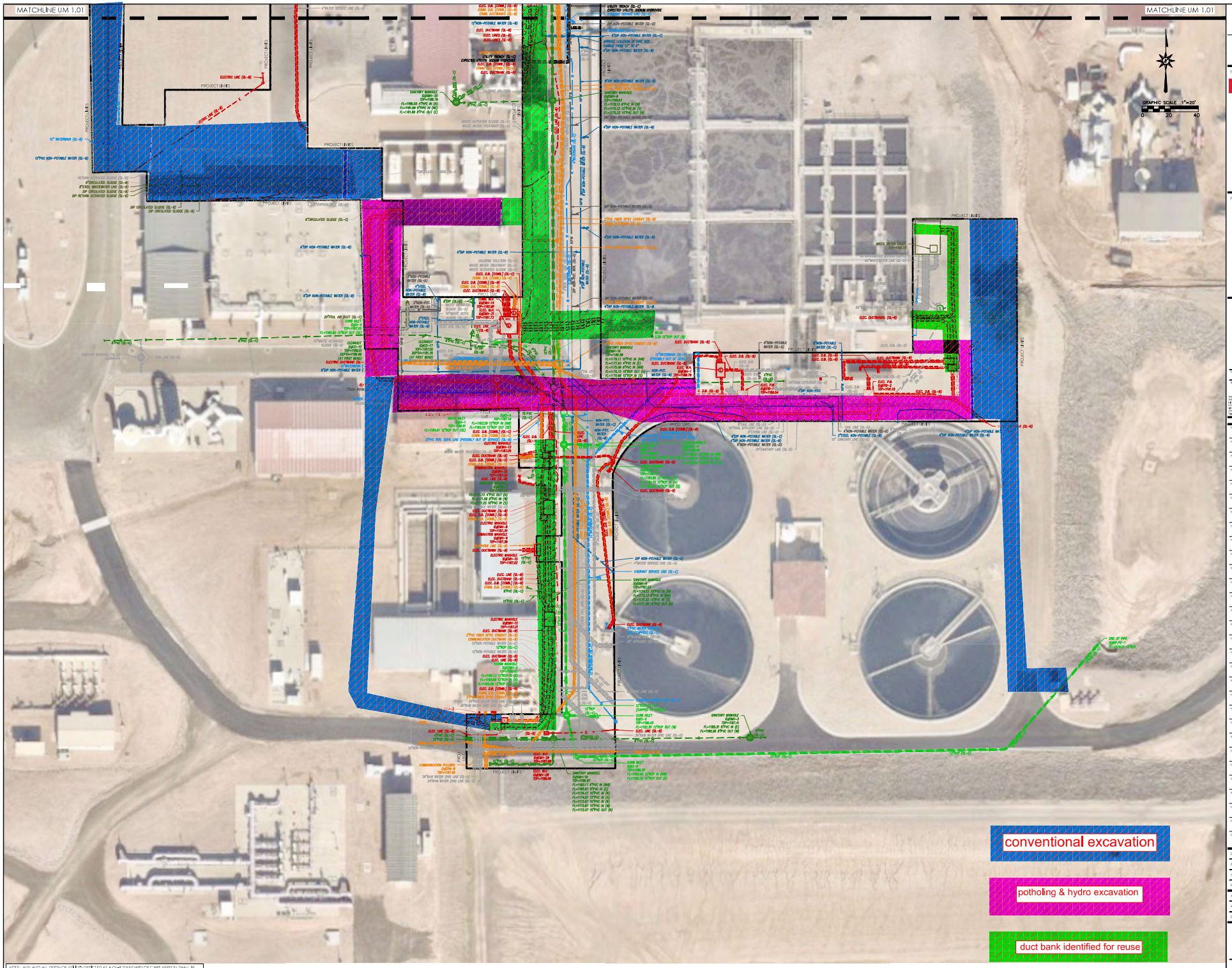
McCARTHY MARTINO
2040 SW 16th St.
Newport Beach, California 92660
(949) 474-4444
http://www.mccarthy.com

SIGNATURE

DATE

THE SEAL AND SIGNATURE APPEARING ON THIS DOCUMENT WERE AUTHORIZED BY [illegible] ON THE DATE ADJACENT TO THE SEAL. PRINTED COPIES OF THIS DOCUMENT ARE NOT CONSIDERED SIGNED AND SEALED AND THE SIGNATURE MUST BE VERIFIED ON ANY ELECTRONIC COPIES. [illegible] SHALL NOT BE HELD LIABLE FOR ANY CHANGES MADE TO THIS DOCUMENT BY OTHERS WITHOUT HIS/HER EXPRESS WRITTEN CONSENT. THE INFORMATION CONTAINED IN THIS DOCUMENT IS INTENDED TO BE USED FOR THE PROJECT.

DRAWING ISSUE	
NO.	DATE
NO.	DATE
NO.	DATE



NOTE: ANY AND ALL DEPTH OF UTILITIES DEPICTED AT A QL-B STANDARDS OF CARE HEREON SHALL BE CONSIDERED APPROXIMATE AS OF THE DATE OF THE INVESTIGATION. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO UTILIZE SOFT DIGGING BEST PRACTICES TO EXPOSE ALL UTILITIES HAVING A POTENTIAL FOR CONFLICT WITHIN THE AREA OF EXCAVATION PRIOR TO ANY HARD DIGGING EXCAVATION.

EXISTING COMPOSITE UTILITY PLAN - QL-B

3737
OLD PRICE RD.

CHANDLER, AZ
MARICOPA CO.

PREPARED FOR:

McCARTHY BUILDING COMPANIES, INC
4225 N. 24th St., Suite 300
Phoenix, AZ 85016

GRAPHIC SCALE 1"=20'
0 20 40

PREPARED BY:

McCARTHY MARTINO
2040 W Baker Ln
Newport Beach, California 92660
http://www.mccarthy.com

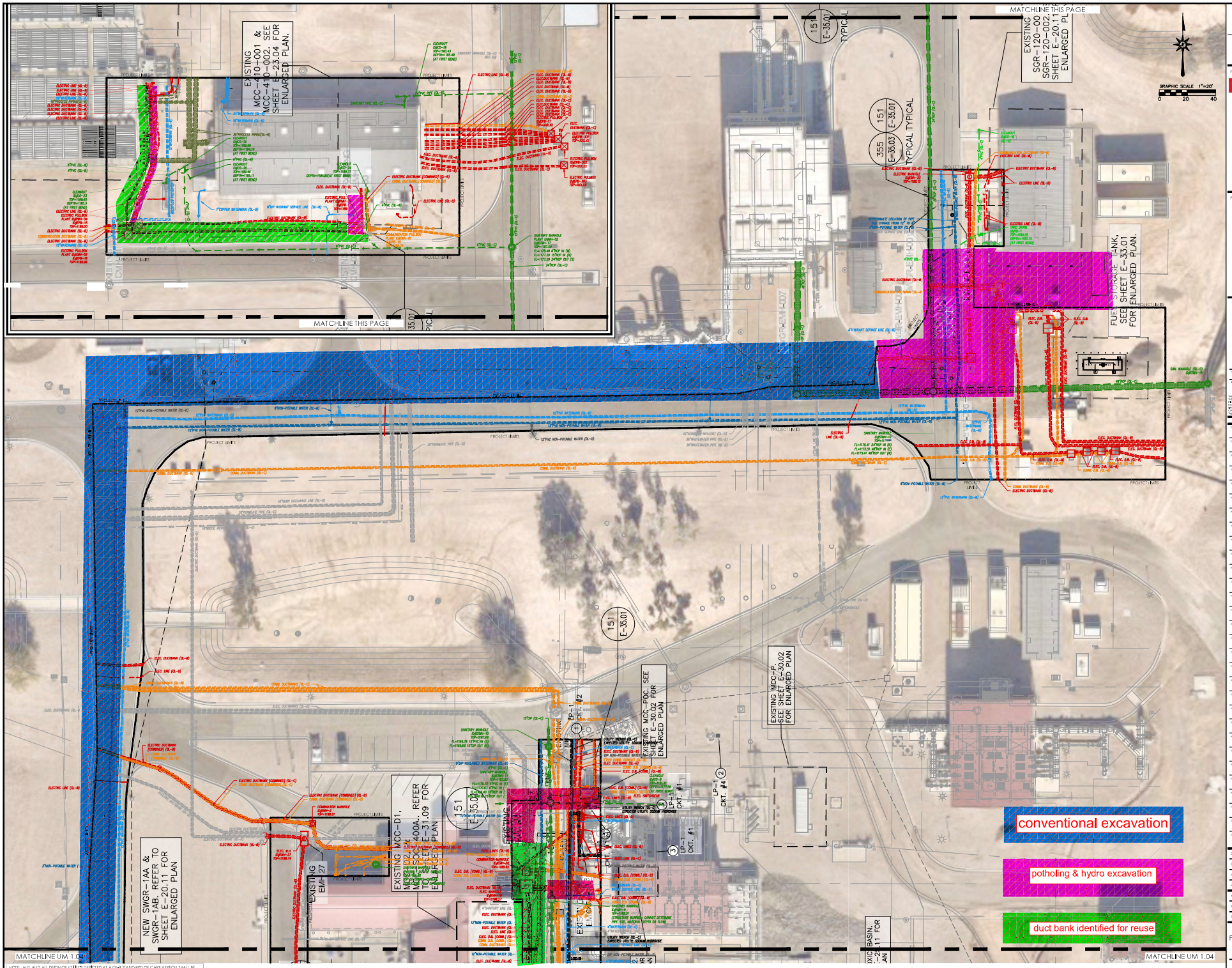
SIGNATURE

DATE

THIS SEAL AND SIGNATURE APPLY ONLY TO THE DOCUMENT TO WHICH IT IS AFFIXED. THE ENGINEER SHALL NOT BE RESPONSIBLE FOR ANY UNAUTHORIZED ALTERATIONS OF THE DOCUMENT, OR FOR ANY REUSE OF THE DOCUMENT WITHOUT WRITTEN VERIFICATION OR ADAPTATION BY THE ENGINEER FOR THE SPECIFIC PURPOSE INTENDED. ANY REUSE WITHOUT WRITTEN VERIFICATION OR ADAPTATION BY THE ENGINEER FOR THE SPECIFIC PURPOSE INTENDED WILL BE AT USER'S SOLE RISK AND WITHOUT LIABILITY OR LEGAL EXPOSURE TO THE ENGINEER. USER SHALL INDEMNIFY AND HOLD HARMLESS THE ENGINEER FROM ALL CLAIMS, DAMAGES, LOSSES AND EXPENSES INCLUDING ATTORNEYS' FEES ARISING OUT OF OR RESULTING THEREFROM. ANY REUSE OF THE DOCUMENTS WITHOUT WRITTEN VERIFICATION OR ADAPTATION BY THE ENGINEER FOR THE SPECIFIC PROJECT.

DRAWING ISSUE

NO.	DATE
NO.	DATE
NO.	DATE
NO.	DATE



3737
OLD PRICE RD.

CHANDLER,AZ
MARICOPA CO.

PREPARED FOR:

McCARTHY

McCARTHY BUILDING COMPANIES, INC
4225 N. 24th St., Suite 300
Phoenix, AZ 85016

PREPARED BY:

McCARTHY

McCARTHY MARTINO
2040 W Rich St
Newport Beach, California 92660
(949) 474-0444
http://www.mccarthy.com

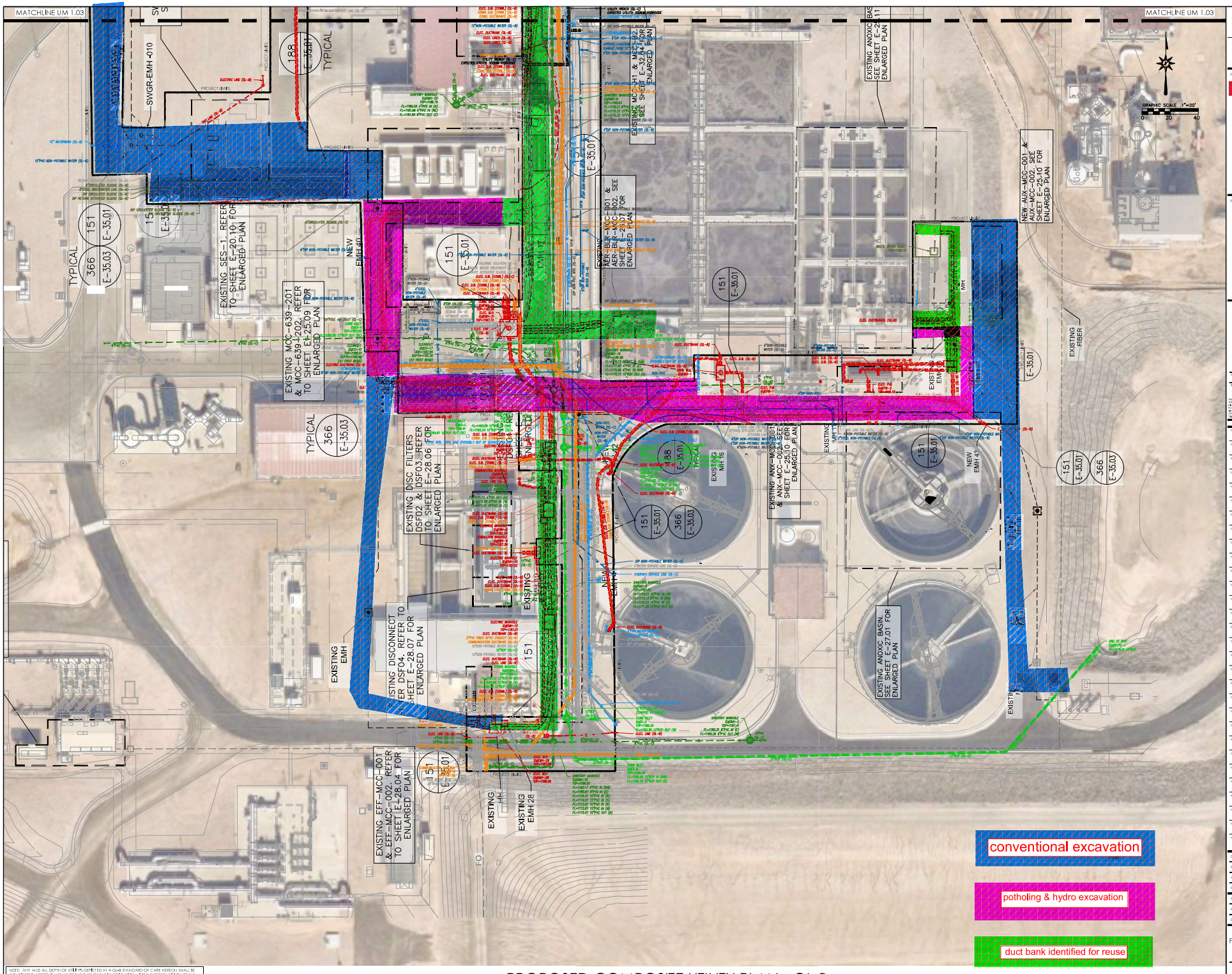
SIGNATURE

DATE

THE SEAL AND SIGNATURE APPEARING ON THIS DOCUMENT TO WHICH THIS STAMP IS AFFIXED SHALL BE THE RESPONSIBILITY OF THE PERSON WHOSE SEAL AND SIGNATURE APPEARS. ANY ALTERATIONS, CHANGES OR ADDITIONS TO THIS DOCUMENT WITHOUT THE SEAL AND SIGNATURE OF THE PERSON RESPONSIBLE FOR SUCH ALTERATIONS, CHANGES OR ADDITIONS SHALL BE THE RESPONSIBILITY OF THE PERSON MAKING SUCH ALTERATIONS, CHANGES OR ADDITIONS AND SHALL RELIEVE THE ORIGINAL PREPARER OF THE DOCUMENT OF ANY RESPONSIBILITY FOR THE ACCURACY OF THE DOCUMENT AS ALTERED, CHANGED OR ADDED TO.

DRAWING ISSUE

NO.	DATE
NO.	DATE
NO.	DATE
NO.	DATE



NOTE: ANY AND ALL DEPTH OR UTILITIES DEPICTED AT A QL-B STANDARDS OF CARE HEREON SHALL BE CONSIDERED APPROXIMATE AS OF THE DATE OF THE INVESTIGATION. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO UTILIZE SOFT DIGGING BEST PRACTICES TO EXPOSE ALL UTILITIES PRIOR TO A POTENTIAL FOR CONFLICT WITHIN THE AREA OF EXCAVATION PRIOR TO ANY HARD DIGGING EXCAVATION.

PROPOSED COMPOSITE UTILITY PLAN - QL-B

3737
OLD PRICE RD.

CHANDLER, AZ
MARICOPA CO.

PREPARED FOR:

McCARTHY BUILDING COMPANIES, INC
4225 N. 24th St., Suite 300
Phoenix, AZ 85016

PREPARED BY:

McCARTHY MARTINO
2040 W. Baker Ln.
Newport Beach, California 92660
(949) 752-0444
http://www.mccarthy.com

SIGNATURE

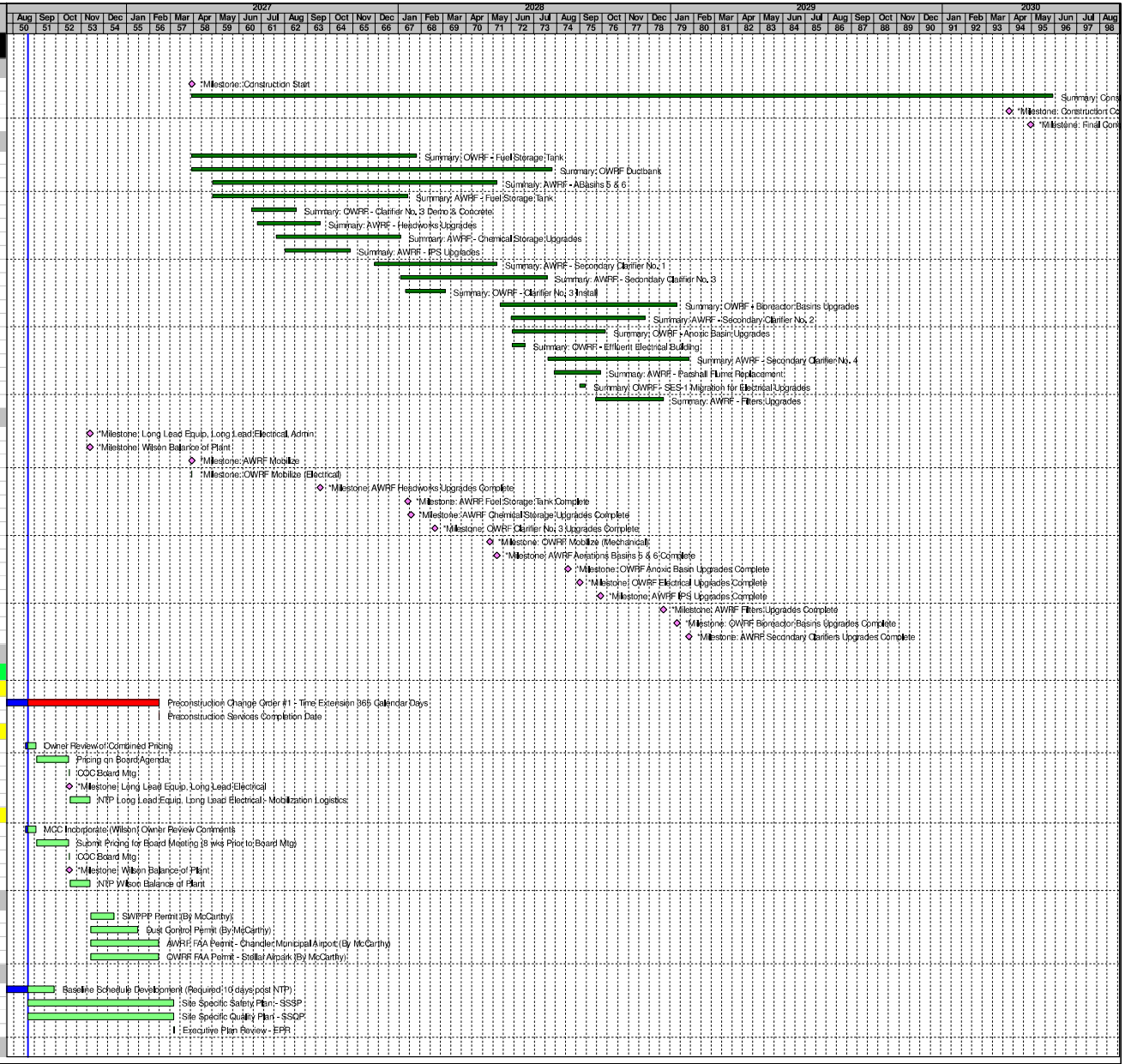
DATE

NO.	DATE
NO.	DATE
NO.	DATE
NO.	DATE

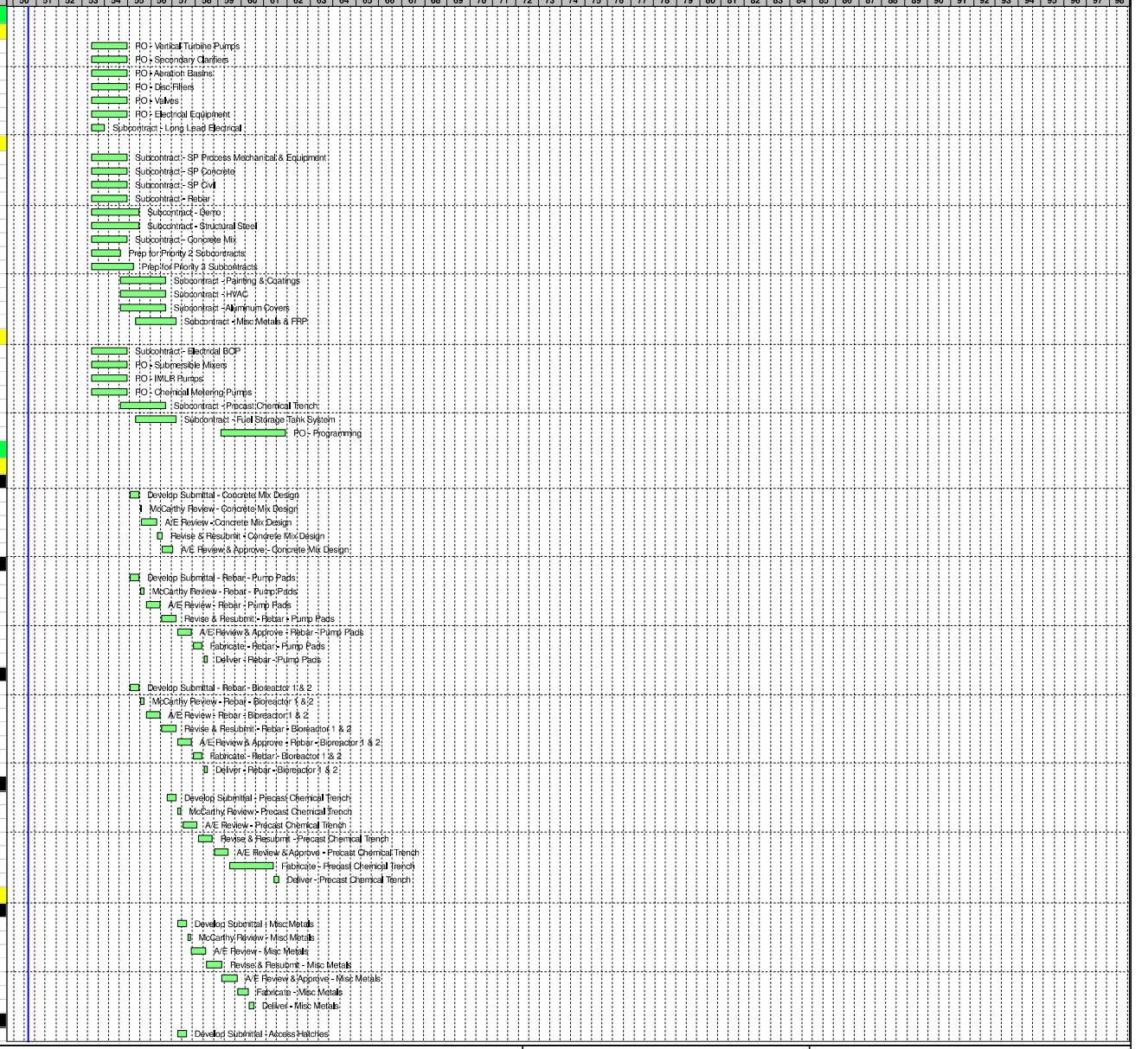


City of Chandler
WRF Improvements Phase 3
Project Schedule

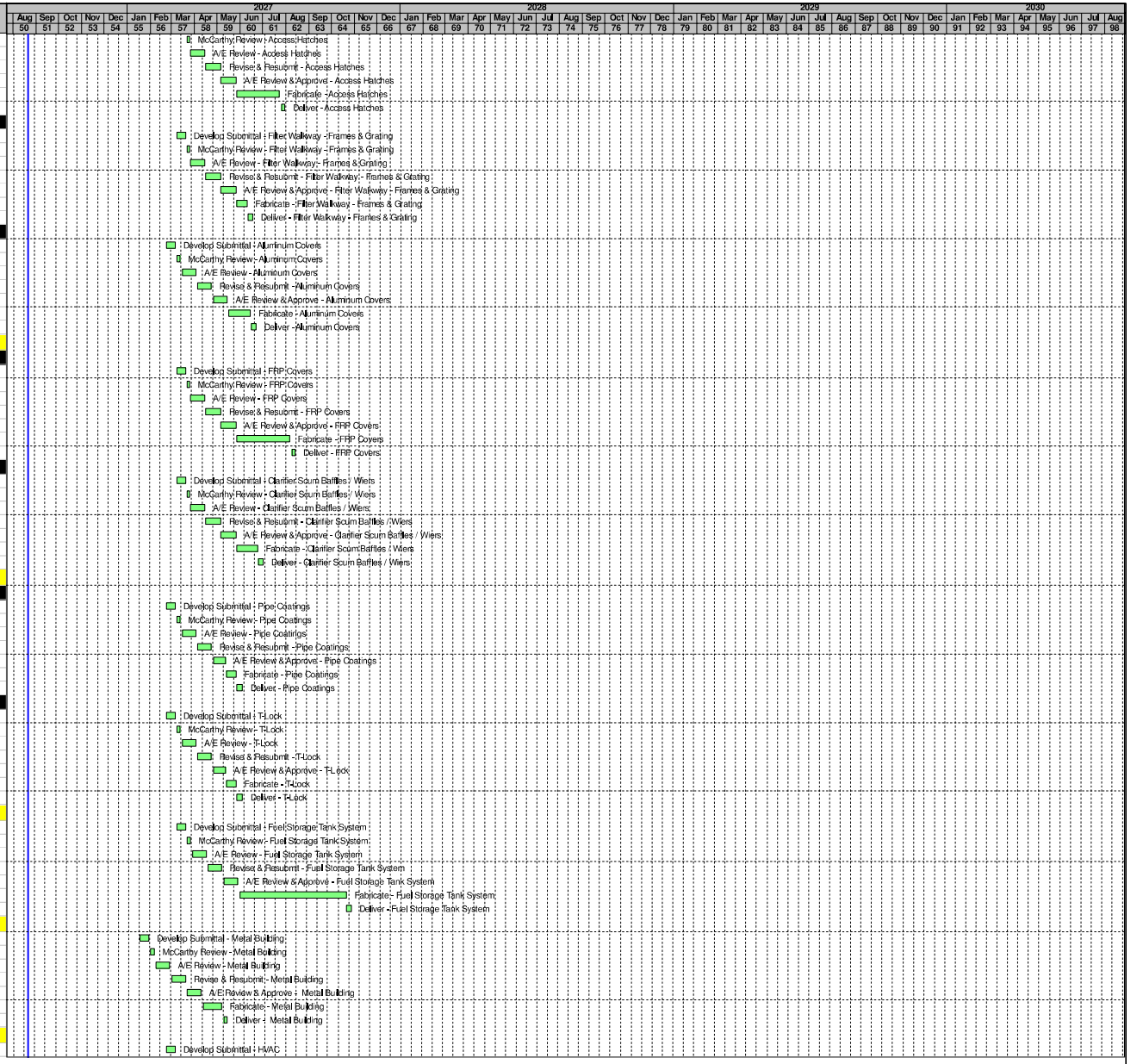
Activity ID	Activity Name	Orig Dur	Start	Finish
Chandler Improvements Phase 3		1277	25-Apr-25 A	29-May-30
Contract Summary & Milestones		805	29-Mar-27	29-May-30
MIL-1020	*Milestone: Construction Start	0	29-Mar-27	
SUM-DUR-B	Summary: Construction Duration (Calendar Days)	1158	29-Mar-27	29-May-30
MIL-1000	*Milestone: Construction Complete - Substantial Completion	0		01-Apr-30
MIL-1010	*Milestone: Final Completion	0		29-Apr-30
Area Summaries		464	29-Mar-27	25-Jan-29
SUM-3150	Summary: OWRF - Fuel Storage Tank	210	29-Mar-27	25-Jan-28
SUM-3260	Summary: OWRF Ductbank	337	29-Mar-27	25-Jul-28
SUM-3010	Summary: AWRF - ABasins 5 & 6	268	26-Apr-27	12-May-28
SUM-3020	Summary: AWRF - Fuel Storage Tank	182	26-Apr-27	13-Jan-28
SUM-3110	Summary: OWRF - Clarifier No. 3 Demo & Concrete	41	18-Jun-27	16-Aug-27
SUM-3090	Summary: AWRF - Headworks Upgrades	59	25-Jun-27	17-Sep-27
SUM-3070	Summary: AWRF - Chemical Storage Upgrades	114	21-Jul-27	03-Jan-28
SUM-3100	Summary: AWRF - IPS Upgrades	63	02-Aug-27	28-Oct-27
SUM-3040	Summary: AWRF - Secondary Clarifier No. 1	118	29-Nov-27	12-May-28
SUM-3220	Summary: AWRF - Secondary Clarifier No. 3	139	04-Jan-28	19-Jul-28
SUM-3230	Summary: OWRF - Clarifier No. 3 Install	40	10-Jan-28	03-Mar-28
SUM-3060	Summary: OWRF - Bioreactor Basins Upgrades	162	17-May-28	09-Jan-29
SUM-3210	Summary: AWRF - Secondary Clarifier No. 2	123	01-Jun-28	27-Nov-28
SUM-3050	Summary: OWRF - Anoxic Basin Upgrades	87	02-Jun-28	05-Oct-28
SUM-3250	Summary: OWRF - Effluent Electrical Building	12	02-Jun-28	19-Jun-28
SUM-3030	Summary: AWRF - Secondary Clarifier No. 4	131	20-Jul-28	25-Jan-29
SUM-3240	Summary: AWRF - Parshall Flume Replacement	44	28-Jul-28	28-Sep-28
SUM-3120	Summary: OWRF - SES-1 Migration for Electrical Upgrades	5	01-Sep-28	08-Sep-28
SUM-3080	Summary: AWRF - Filters Upgrades	64	22-Sep-28	22-Dec-28
Team Milestones		554	12-Nov-26	25-Jan-29
MIL-1050	*Milestone: Long Lead Equip, Long Lead Electrical, Admin	0		12-Nov-26
MIL-1070	*Milestone: Wilson Balance of Plant	0		12-Nov-26
MIL-1100	*Milestone: AWRF Mobilize	0	29-Mar-27	
MIL-1240	*Milestone: OWRF Mobilize (Electrical)	0	29-Mar-27	29-Mar-27
MIL-1140	*Milestone: AWRF Headworks Upgrades Complete	0		17-Sep-27
MIL-1120	*Milestone: AWRF Fuel Storage Tank Complete	0		13-Jan-28
MIL-1170	*Milestone: AWRF Chemical Storage Upgrades Complete	0		17-Jan-28
MIL-1200	*Milestone: OWRF Clarifier No. 3 Upgrades Complete	0		18-Feb-28
MIL-1090	*Milestone: OWRF Mobilize (Mechanical)	0	03-May-28	
MIL-1130	*Milestone: AWRF Aerations Basins 5 & 6 Complete	0		12-May-28
MIL-1210	*Milestone: OWRF Anoxic Basin Upgrades Complete	0		15-Aug-28
MIL-1230	*Milestone: OWRF Electrical Upgrades Complete	0		31-Aug-28
MIL-1180	*Milestone: AWRF IPS Upgrades Complete	0		28-Sep-28
MIL-1160	*Milestone: AWRF Filters Upgrades Complete	0		22-Dec-28
MIL-1220	*Milestone: OWRF Bioreactor Basins Upgrades Complete	0		09-Jan-29
MIL-1150	*Milestone: AWRF Secondary Clarifiers Upgrades Complete	0		25-Jan-29
Preconstruction		252	14-Feb-26 A	13-Feb-27
Preconstruction		252	14-Feb-26 A	13-Feb-27
Preconstruction		365	14-Feb-26 A	13-Feb-27
PRECN-1075	Preconstruction Change Order #1 - Time Extension 365 Calendar Days	365	14-Feb-26 A	13-Feb-27
PRECN-1070	Preconstruction Services Completion Date	1	13-Feb-27	13-Feb-27*
Long Lead Equip, Long Lead Electrical, Admin		59	18-Aug-26 A	12-Nov-26
PRECN-1105	Owner Review of Combined Pricing	7	18-Aug-26 A	31-Aug-26
PRECN-1115	Pricing on Board Agenda	31	01-Sep-26	14-Oct-26
PRECN-1045	COC Board Mtg	1	15-Oct-26	15-Oct-26
PRECN-1055	*Milestone: Long Lead Equip, Long Lead Electrical	0		15-Oct-26
PRECN-1065	NTP Long Lead Equip, Long Lead Electrical - Mobilization Logistics	20	16-Oct-26	12-Nov-26
Wilson Balance of Plant		59	18-Aug-26 A	12-Nov-26
PRECN-2055	MCC Incorporate (Wilson) Owner Review Comments	7	18-Aug-26 A	31-Aug-26
PRECN-2025	Submit Pricing for Board Meeting (8 wks Prior to Board Mtg)	31	01-Sep-26	14-Oct-26
PRECN-2035	COC Board Mtg	1	15-Oct-26	15-Oct-26
PRECN-2045	*Milestone: Wilson Balance of Plant	0		15-Oct-26
PRECN-2065	NTP Wilson Balance of Plant	20	16-Oct-26	12-Nov-26
Permitting		60	13-Nov-26	12-Feb-27
PRMT-1000	SWPPP Permit (By McCarthy)	20	13-Nov-26	14-Dec-26
PRMT-1050	Dust Control Permit (By McCarthy)	40	13-Nov-26	15-Jan-27
PRMT-1060	AWRF FAA Permit - Chandler Municipal Airport (By McCarthy)	60	13-Nov-26	12-Feb-27
PRMT-1070	OWRF FAA Permit - Stellar Airpark (By McCarthy)	60	13-Nov-26	12-Feb-27
Administration		457	25-Apr-25 A	05-Mar-27
SCHED-1000	Baseline Schedule Development (Required 10 days post NTP)	155	25-Apr-25 A	25-Sep-26
SSSP-1000	Site Specific Safety Plan - SSSP	133	21-Aug-26	04-Mar-27
SSQP-1000	Site Specific Quality Plan - SSQP	133	21-Aug-26	04-Mar-27
EPR-1000	Executive Plan Review - EPR	1	05-Mar-27	05-Mar-27
Procurement		435	13-Nov-26	04-Aug-28



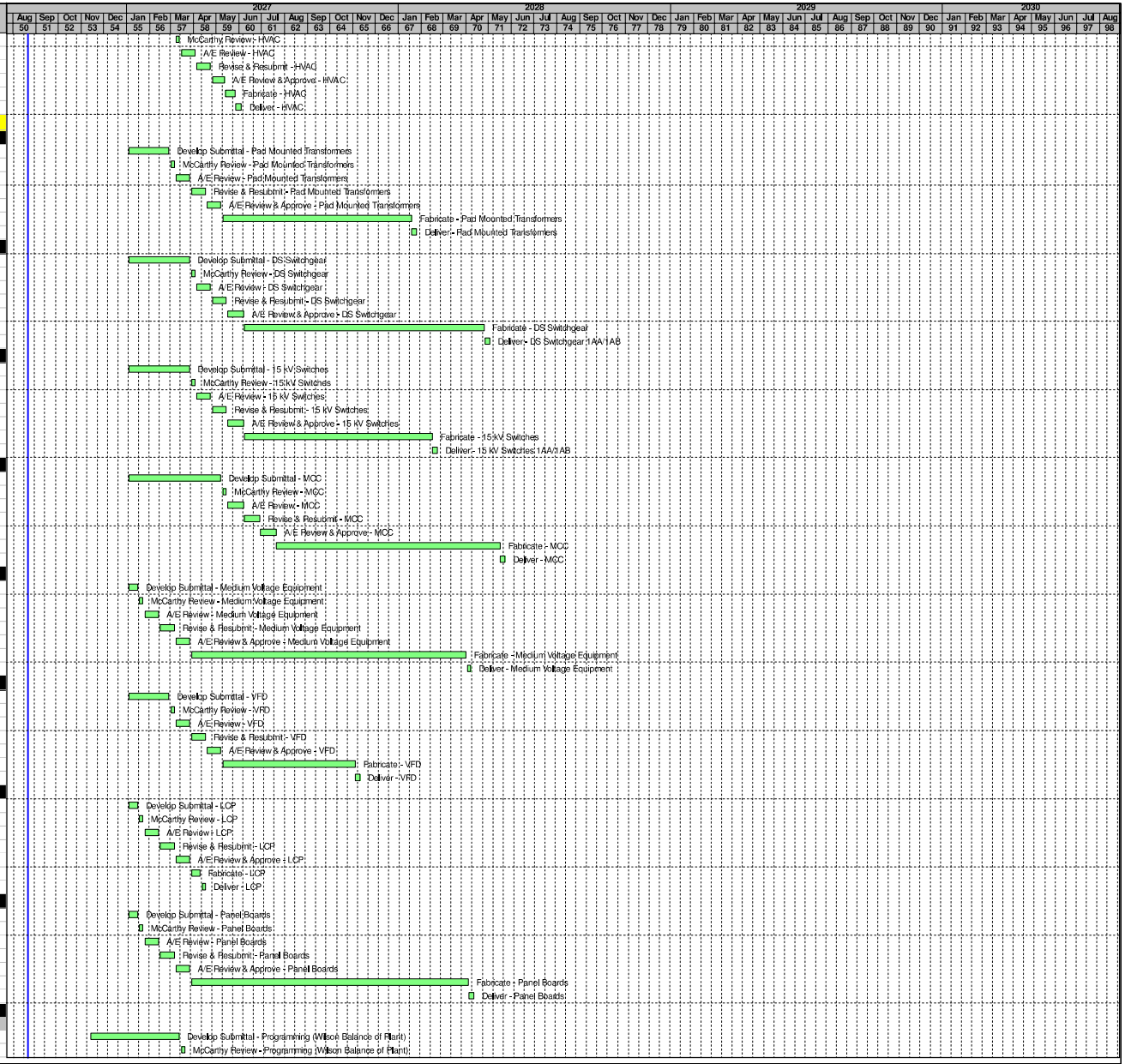
Activity ID	Activity Name	Orig Dur	Start	Finish
Subcontracts		177	13-Nov-26	29-Jul-27
Early Procurement		30	13-Nov-26	30-Dec-26
SBCN-1170	PO - Vertical Turbine Pumps	30	13-Nov-26	30-Dec-26
SBCN-1190	PO - Secondary Clarifiers	30	13-Nov-26	30-Dec-26
SBCN-1200	PO - Aeration Basins	30	13-Nov-26	30-Dec-26
SBCN-1210	PO - Disc Filters	30	13-Nov-26	30-Dec-26
SBCN-1250	PO - Valves	30	13-Nov-26	30-Dec-26
SBCN-1140	PO - Electrical Equipment	30	13-Nov-26	30-Dec-26
SBCN-1280	Subcontract - Long Lead Electrical	10	13-Nov-26	30-Nov-26
Priority 2 Subcontracts		75	13-Nov-26	05-Mar-27
SBCN-1000	Subcontract - SP Process Mechanical & Equipment	30	13-Nov-26	30-Dec-26
SBCN-1020	Subcontract - SP Concrete	30	13-Nov-26	30-Dec-26
SBCN-1030	Subcontract - SP Civil	30	13-Nov-26	30-Dec-26
SBCN-1240	Subcontract - Rebar	30	13-Nov-26	30-Dec-26
SBCN-1270	Subcontract - Demo	40	13-Nov-26	15-Jan-27
SBCN-1290	Subcontract - Structural Steel	40	13-Nov-26	15-Jan-27
SBCN-1400	Subcontract - Concrete Mix	30	13-Nov-26	30-Dec-26
SBCN-1050	Prep for Priority 2 Subcontracts	25	13-Nov-26	21-Dec-26
SBCN-1090	Prep for Priority 3 Subcontracts	35	13-Nov-26	08-Jan-27
SBCN-1040	Subcontract - Painting & Coatings	40	22-Dec-26	19-Feb-27
SBCN-1120	Subcontract - HVAC	40	22-Dec-26	19-Feb-27
SBCN-1430	Subcontract - Aluminum Covers	40	22-Dec-26	19-Feb-27
SBCN-1060	Subcontract - Misc Metals & FRP	40	11-Jan-27	05-Mar-27
Priority 3 Subcontracts		177	13-Nov-26	29-Jul-27
SBCN-1010	Subcontract - Electrical BOP	30	13-Nov-26	30-Dec-26
SBCN-1160	PO - Submersible Mixers	30	13-Nov-26	30-Dec-26
SBCN-1180	PO - IMLR Pumps	30	13-Nov-26	30-Dec-26
SBCN-1220	PO - Chemical Metering Pumps	30	13-Nov-26	30-Dec-26
SBCN-1150	Subcontract - Precast Chemical Trench	40	22-Dec-26	19-Feb-27
SBCN-1260	Subcontract - Fuel Storage Tank System	40	11-Jan-27	05-Mar-27
SBCN-1390	PO - Programming	60	05-May-27	29-Jul-27
Submittals		435	13-Nov-26	04-Aug-28
03 Concrete		140	04-Jan-27	20-Jul-27
03 Concrete Mix Design		41	04-Jan-27	01-Mar-27
000.03-1000	Develop Submittal - Concrete Mix Design	10	04-Jan-27	15-Jan-27
000.03-1010	McCarthy Review - Concrete Mix Design	1	18-Jan-27	18-Jan-27
000.03-1080	A/E Review - Concrete Mix Design	15	19-Jan-27	08-Feb-27
000.03-1120	Revise & Resubmit - Concrete Mix Design	5	09-Feb-27	15-Feb-27
000.03-1160	A/E Review & Approve - Concrete Mix Design	10	16-Feb-27	01-Mar-27
03 Rebar - Pump Pads		75	04-Jan-27	16-Apr-27
000.03-1020	Develop Submittal - Rebar - Pump Pads	10	04-Jan-27	15-Jan-27
000.03-1050	McCarthy Review - Rebar - Pump Pads	5	18-Jan-27	22-Jan-27
000.03-1090	A/E Review - Rebar - Pump Pads	15	25-Jan-27	12-Feb-27
000.03-1130	Revise & Resubmit - Rebar - Pump Pads	15	15-Feb-27	05-Mar-27
000.03-1170	A/E Review & Approve - Rebar - Pump Pads	15	08-Mar-27	26-Mar-27
000.03-1200	Fabricate - Rebar - Pump Pads	10	29-Mar-27	09-Apr-27
000.03-1230	Deliver - Rebar - Pump Pads	5	12-Apr-27	16-Apr-27
03 Rebar - Bioreactor 1 & 2		75	04-Jan-27	16-Apr-27
000.03-1260	Develop Submittal - Rebar - Bioreactor 1 & 2	10	04-Jan-27	15-Jan-27
000.03-1270	McCarthy Review - Rebar - Bioreactor 1 & 2	5	18-Jan-27	22-Jan-27
000.03-1280	A/E Review - Rebar - Bioreactor 1 & 2	15	25-Jan-27	12-Feb-27
000.03-1290	Revise & Resubmit - Rebar - Bioreactor 1 & 2	15	15-Feb-27	05-Mar-27
000.03-1300	A/E Review & Approve - Rebar - Bioreactor 1 & 2	15	08-Mar-27	26-Mar-27
000.03-1310	Fabricate - Rebar - Bioreactor 1 & 2	10	29-Mar-27	09-Apr-27
000.03-1320	Deliver - Rebar - Bioreactor 1 & 2	5	12-Apr-27	16-Apr-27
03 Precast Chemical Trench		105	22-Feb-27	20-Jul-27
000.03-1030	Develop Submittal - Precast Chemical Trench	10	22-Feb-27	05-Mar-27
000.03-1060	McCarthy Review - Precast Chemical Trench	5	08-Mar-27	12-Mar-27
000.03-1100	A/E Review - Precast Chemical Trench	15	15-Mar-27	02-Apr-27
000.03-1140	Revise & Resubmit - Precast Chemical Trench	15	05-Apr-27	23-Apr-27
000.03-1180	A/E Review & Approve - Precast Chemical Trench	15	26-Apr-27	14-May-27
000.03-1210	Fabricate - Precast Chemical Trench	40	17-May-27	13-Jul-27
000.03-1240	Deliver - Precast Chemical Trench	5	14-Jul-27	20-Jul-27
05 Metals		113	22-Feb-27	30-Jul-27
05 Misc Metals		73	08-Mar-27	17-Jun-27
000.05-1040	Develop Submittal - Misc Metals	10	08-Mar-27	19-Mar-27
000.05-1070	McCarthy Review - Misc Metals	4	22-Mar-27	25-Mar-27
000.05-1110	A/E Review - Misc Metals	14	26-Mar-27	14-Apr-27
000.05-1140	Revise & Resubmit - Misc Metals	15	15-Apr-27	05-May-27
000.05-1170	A/E Review & Approve - Misc Metals	15	06-May-27	26-May-27
000.05-1200	Fabricate - Misc Metals	10	27-May-27	10-Jun-27
000.05-1220	Deliver - Misc Metals	5	11-Jun-27	17-Jun-27
05 Access Hatches		103	08-Mar-27	30-Jul-27
000.05-1050	Develop Submittal - Access Hatches	10	08-Mar-27	19-Mar-27



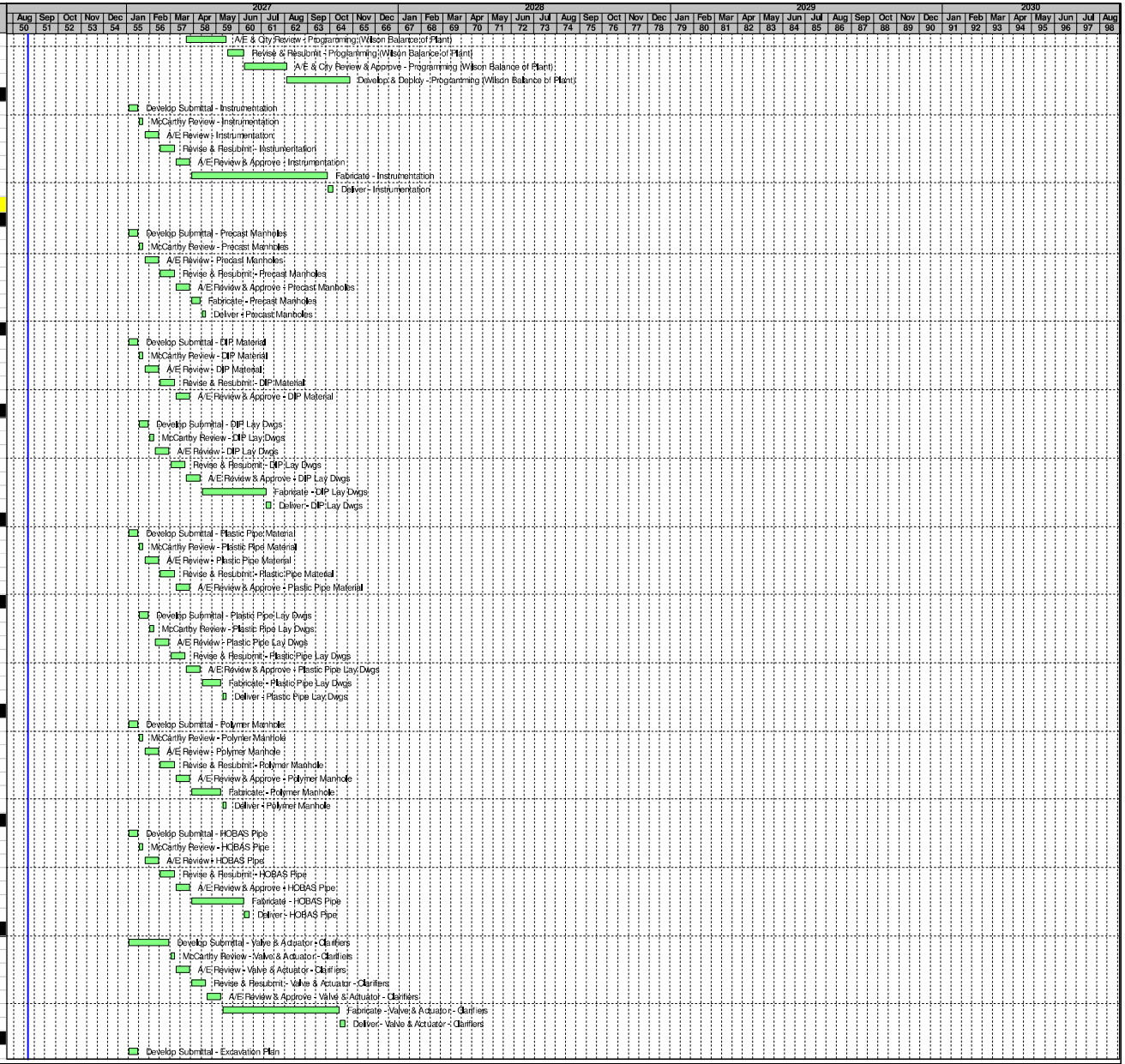
Activity ID	Activity Name	Orig Dur	Start	Finish
000.05-1080	McCarthy Review - Access Hatches	4	22-Mar-27	25-Mar-27
000.05-1120	A/E Review - Access Hatches	14	26-Mar-27	14-Apr-27
000.05-1150	Revise & Resubmit - Access Hatches	15	15-Apr-27	05-May-27
000.05-1180	A/E Review & Approve - Access Hatches	15	06-May-27	26-May-27
000.05-1260	Fabricate - Access Hatches	40	27-May-27	23-Jul-27
000.05-1270	Deliver - Access Hatches	5	26-Jul-27	30-Jul-27
05 Filter Walkway - Frames & Grating		73	08-Mar-27	17-Jun-27
000.05-1060	Develop Submittal - Filter Walkway - Frames & Grating	10	08-Mar-27	19-Mar-27
000.05-1090	McCarthy Review - Filter Walkway - Frames & Grating	4	22-Mar-27	25-Mar-27
000.05-1130	A/E Review - Filter Walkway - Frames & Grating	14	26-Mar-27	14-Apr-27
000.05-1160	Revise & Resubmit - Filter Walkway - Frames & Grating	15	15-Apr-27	05-May-27
000.05-1190	A/E Review & Approve - Filter Walkway - Frames & Grating	15	06-May-27	26-May-27
000.05-1210	Fabricate - Filter Walkway - Frames & Grating	10	27-May-27	10-Jun-27
000.05-1230	Deliver - Filter Walkway - Frames & Grating	5	11-Jun-27	17-Jun-27
05 Aluminum Covers		85	22-Feb-27	21-Jun-27
000.05-1280	Develop Submittal - Aluminum Covers	10	22-Feb-27	05-Mar-27
000.05-1290	McCarthy Review - Aluminum Covers	5	08-Mar-27	12-Mar-27
000.05-1300	A/E Review - Aluminum Covers	15	15-Mar-27	02-Apr-27
000.05-1310	Revise & Resubmit - Aluminum Covers	15	05-Apr-27	23-Apr-27
000.05-1320	A/E Review & Approve - Aluminum Covers	15	26-Apr-27	14-May-27
000.05-1330	Fabricate - Aluminum Covers	20	17-May-27	14-Jun-27
000.05-1340	Deliver - Aluminum Covers	5	15-Jun-27	21-Jun-27
06 Wood / Carpentry		113	08-Mar-27	13-Aug-27
06 FRP Covers		113	08-Mar-27	13-Aug-27
000.06-1000	Develop Submittal - FRP Covers	10	08-Mar-27	19-Mar-27
000.06-1030	McCarthy Review - FRP Covers	4	22-Mar-27	25-Mar-27
000.06-1060	A/E Review - FRP Covers	14	26-Mar-27	14-Apr-27
000.06-1090	Revise & Resubmit - FRP Covers	15	15-Apr-27	05-May-27
000.06-1120	A/E Review & Approve - FRP Covers	15	06-May-27	26-May-27
000.06-1150	Fabricate - FRP Covers	50	27-May-27	06-Aug-27
000.06-1160	Deliver - FRP Covers	5	09-Aug-27	13-Aug-27
06 Clarifier Scum Baffles / Wiers		83	08-Mar-27	01-Jul-27
000.06-1010	Develop Submittal - Clarifier Scum Baffles / Wiers	10	08-Mar-27	19-Mar-27
000.06-1040	McCarthy Review - Clarifier Scum Baffles / Wiers	4	22-Mar-27	25-Mar-27
000.06-1070	A/E Review - Clarifier Scum Baffles / Wiers	14	26-Mar-27	14-Apr-27
000.06-1100	Revise & Resubmit - Clarifier Scum Baffles / Wiers	15	15-Apr-27	05-May-27
000.06-1130	A/E Review & Approve - Clarifier Scum Baffles / Wiers	15	06-May-27	26-May-27
000.06-1170	Fabricate - Clarifier Scum Baffles / Wiers	20	27-May-27	24-Jun-27
000.06-1180	Deliver - Clarifier Scum Baffles / Wiers	5	25-Jun-27	01-Jul-27
09 Finishes		73	22-Feb-27	03-Jun-27
09 Pipe Coatings		73	22-Feb-27	03-Jun-27
000.09-1000	Develop Submittal - Pipe Coatings	10	22-Feb-27	05-Mar-27
000.09-1030	McCarthy Review - Pipe Coatings	5	08-Mar-27	12-Mar-27
000.09-1060	A/E Review - Pipe Coatings	15	15-Mar-27	02-Apr-27
000.09-1090	Revise & Resubmit - Pipe Coatings	15	05-Apr-27	23-Apr-27
000.09-1160	A/E Review & Approve - Pipe Coatings	13	26-Apr-27	12-May-27
000.09-1190	Fabricate - Pipe Coatings	10	13-May-27	26-May-27
000.09-1240	Deliver - Pipe Coatings	5	27-May-27	03-Jun-27
09 T-Lock		73	22-Feb-27	03-Jun-27
000.09-1010	Develop Submittal - T-Lock	10	22-Feb-27	05-Mar-27
000.09-1040	McCarthy Review - T-Lock	5	08-Mar-27	12-Mar-27
000.09-1070	A/E Review - T-Lock	15	15-Mar-27	02-Apr-27
000.09-1100	Revise & Resubmit - T-Lock	15	05-Apr-27	23-Apr-27
000.09-1170	A/E Review & Approve - T-Lock	13	26-Apr-27	12-May-27
000.09-1200	Fabricate - T-Lock	10	13-May-27	26-May-27
000.09-1250	Deliver - T-Lock	5	27-May-27	03-Jun-27
13 Fuel Storage Tank System		165	08-Mar-27	27-Oct-27
000.13-1000	Develop Submittal - Fuel Storage Tank System	10	08-Mar-27	19-Mar-27
000.13-1010	McCarthy Review - Fuel Storage Tank System	5	22-Mar-27	26-Mar-27
000.13-1020	A/E Review - Fuel Storage Tank System	15	29-Mar-27	16-Apr-27
000.13-1030	Revise & Resubmit - Fuel Storage Tank System	15	19-Apr-27	07-May-27
000.13-1040	A/E Review & Approve - Fuel Storage Tank System	15	10-May-27	28-May-27
000.13-1050	Fabricate - Fuel Storage Tank System	100	01-Jun-27	20-Oct-27
000.13-1060	Deliver - Fuel Storage Tank System	5	21-Oct-27	27-Oct-27
15 Metal Buildings		85	18-Jan-27	14-May-27
000.13-1070	Develop Submittal - Metal Building	10	18-Jan-27	29-Jan-27
000.13-1080	McCarthy Review - Metal Building	5	01-Feb-27	05-Feb-27
000.13-1090	A/E Review - Metal Building	15	08-Feb-27	26-Feb-27
000.13-1100	Revise & Resubmit - Metal Building	15	01-Mar-27	19-Mar-27
000.13-1110	A/E Review & Approve - Metal Building	15	22-Mar-27	09-Apr-27
000.13-1120	Fabricate - Metal Building	20	12-Apr-27	07-May-27
000.13-1130	Deliver - Metal Building	5	10-May-27	14-May-27
23 HVAC		73	22-Feb-27	03-Jun-27
000.23-1000	Develop Submittal - HVAC	10	22-Feb-27	05-Mar-27



Activity ID	Activity Name	Orig Dur	Start	Finish
000.23-1010	McCarthy Review - HVAC	5	08-Mar-27	12-Mar-27
000.23-1020	A/E Review - HVAC	15	15-Mar-27	02-Apr-27
000.23-1030	Revise & Resubmit - HVAC	15	05-Apr-27	23-Apr-27
000.23-1040	A/E Review & Approve - HVAC	13	26-Apr-27	12-May-27
000.23-1050	Fabricate - HVAC	10	13-May-27	26-May-27
000.23-1060	Deliver - HVAC	5	27-May-27	03-Jun-27
26 Electrical		385	13-Nov-26	23-May-28
26 Transformers		270	04-Jan-27	25-Jan-28
000.26-2090	Develop Submittal - Pad Mounted Transformers	40	04-Jan-27	26-Feb-27
000.26-2120	McCarthy Review - Pad Mounted Transformers	5	01-Mar-27	05-Mar-27
000.26-2150	A/E Review - Pad Mounted Transformers	15	08-Mar-27	26-Mar-27
000.26-2200	Revise & Resubmit - Pad Mounted Transformers	15	29-Mar-27	16-Apr-27
000.26-2240	A/E Review & Approve - Pad Mounted Transformers	15	19-Apr-27	07-May-27
000.26-2400	Fabricate - Pad Mounted Transformers	175	10-May-27	18-Jan-28
000.26-2410	Deliver - Pad Mounted Transformers	5	19-Jan-28	25-Jan-28
26 DS Switchgear		340	04-Jan-27	02-May-28
000.26-2160	Develop Submittal - DS Switchgear	60	04-Jan-27	26-Mar-27
000.26-2170	McCarthy Review - DS Switchgear	5	29-Mar-27	02-Apr-27
000.26-2210	A/E Review - DS Switchgear	15	05-Apr-27	23-Apr-27
000.26-2260	Revise & Resubmit - DS Switchgear	15	26-Apr-27	14-May-27
000.26-2300	A/E Review & Approve - DS Switchgear	15	17-May-27	07-Jun-27
000.26-2360	Fabricate - DS Switchgear	225	08-Jun-27	25-Apr-28
000.26-2370	Deliver - DS Switchgear 1AA/1AB	5	26-Apr-28	02-May-28
26 15 kV Switches		290	04-Jan-27	22-Feb-28
000.26-3430	Develop Submittal - 15 kV Switches	60	04-Jan-27	26-Mar-27
000.26-3440	McCarthy Review - 15 kV Switches	5	29-Mar-27	02-Apr-27
000.26-3450	A/E Review - 15 kV Switches	15	05-Apr-27	23-Apr-27
000.26-3460	Revise & Resubmit - 15 kV Switches	15	26-Apr-27	14-May-27
000.26-3470	A/E Review & Approve - 15 kV Switches	15	17-May-27	07-Jun-27
000.26-3480	Fabricate - 15 kV Switches	175	08-Jun-27	15-Feb-28
000.26-3490	Deliver - 15 kV Switches 1AA/1AB	5	16-Feb-28	22-Feb-28
26 MCC		355	04-Jan-27	23-May-28
000.26-2250	Develop Submittal - MCC	90	04-Jan-27	07-May-27
000.26-2270	McCarthy Review - MCC	5	10-May-27	14-May-27
000.26-2310	A/E Review - MCC	15	17-May-27	07-Jun-27
000.26-2320	Revise & Resubmit - MCC	15	08-Jun-27	28-Jun-27
000.26-2350	A/E Review & Approve - MCC	15	29-Jun-27	20-Jul-27
000.26-2380	Fabricate - MCC	210	21-Jul-27	16-May-28
000.26-2390	Deliver - MCC	5	17-May-28	23-May-28
26 Medium Voltage Equipment		323	04-Jan-27	07-Apr-28
000.26-2480	Develop Submittal - Medium Voltage Equipment	10	04-Jan-27	15-Jan-27
000.26-2490	McCarthy Review - Medium Voltage Equipment	5	18-Jan-27	22-Jan-27
000.26-2500	A/E Review - Medium Voltage Equipment	15	25-Jan-27	12-Feb-27
000.26-2510	Revise & Resubmit - Medium Voltage Equipment	15	15-Feb-27	05-Mar-27
000.26-2520	A/E Review & Approve - Medium Voltage Equipment	15	08-Mar-27	26-Mar-27
000.26-2530	Fabricate - Medium Voltage Equipment	258	29-Mar-27	31-Mar-28
000.26-2540	Deliver - Medium Voltage Equipment	5	03-Apr-28	07-Apr-28
26 VFD		220	04-Jan-27	10-Nov-27
000.26-3360	Develop Submittal - VFD	40	04-Jan-27	26-Feb-27
000.26-3370	McCarthy Review - VFD	5	01-Mar-27	05-Mar-27
000.26-3380	A/E Review - VFD	15	08-Mar-27	26-Mar-27
000.26-3390	Revise & Resubmit - VFD	15	29-Mar-27	16-Apr-27
000.26-3400	A/E Review & Approve - VFD	15	19-Apr-27	07-May-27
000.26-3410	Fabricate - VFD	125	10-May-27	03-Nov-27
000.26-3420	Deliver - VFD	5	04-Nov-27	10-Nov-27
26 LCP		75	04-Jan-27	16-Apr-27
000.26-2070	Develop Submittal - LCP	10	04-Jan-27	15-Jan-27
000.26-2100	McCarthy Review - LCP	5	18-Jan-27	22-Jan-27
000.26-2130	A/E Review - LCP	15	25-Jan-27	12-Feb-27
000.26-2180	Revise & Resubmit - LCP	15	15-Feb-27	05-Mar-27
000.26-2220	A/E Review & Approve - LCP	15	08-Mar-27	26-Mar-27
000.26-2280	Fabricate - LCP	10	29-Mar-27	09-Apr-27
000.26-2290	Deliver - LCP	5	12-Apr-27	16-Apr-27
26 Panel Boards		325	04-Jan-27	11-Apr-28
000.26-2630	Develop Submittal - Panel Boards	10	04-Jan-27	15-Jan-27
000.26-2640	McCarthy Review - Panel Boards	5	18-Jan-27	22-Jan-27
000.26-2650	A/E Review - Panel Boards	15	25-Jan-27	12-Feb-27
000.26-2660	Revise & Resubmit - Panel Boards	15	15-Feb-27	05-Mar-27
000.26-2670	A/E Review & Approve - Panel Boards	15	08-Mar-27	26-Mar-27
000.26-2680	Fabricate - Panel Boards	260	29-Mar-27	04-Apr-28
000.26-2690	Deliver - Panel Boards	5	05-Apr-28	11-Apr-28
26 PLC / Instrumentation		240	13-Nov-26	27-Oct-27
26 SCADA Programming (Wilson Balance of Plant)		240	13-Nov-26	27-Oct-27
000.26-3500	Develop Submittal - Programming (Wilson Balance of Plant)	80	13-Nov-26	12-Mar-27
000.26-3510	McCarthy Review - Programming (Wilson Balance of Plant)	5	15-Mar-27	19-Mar-27



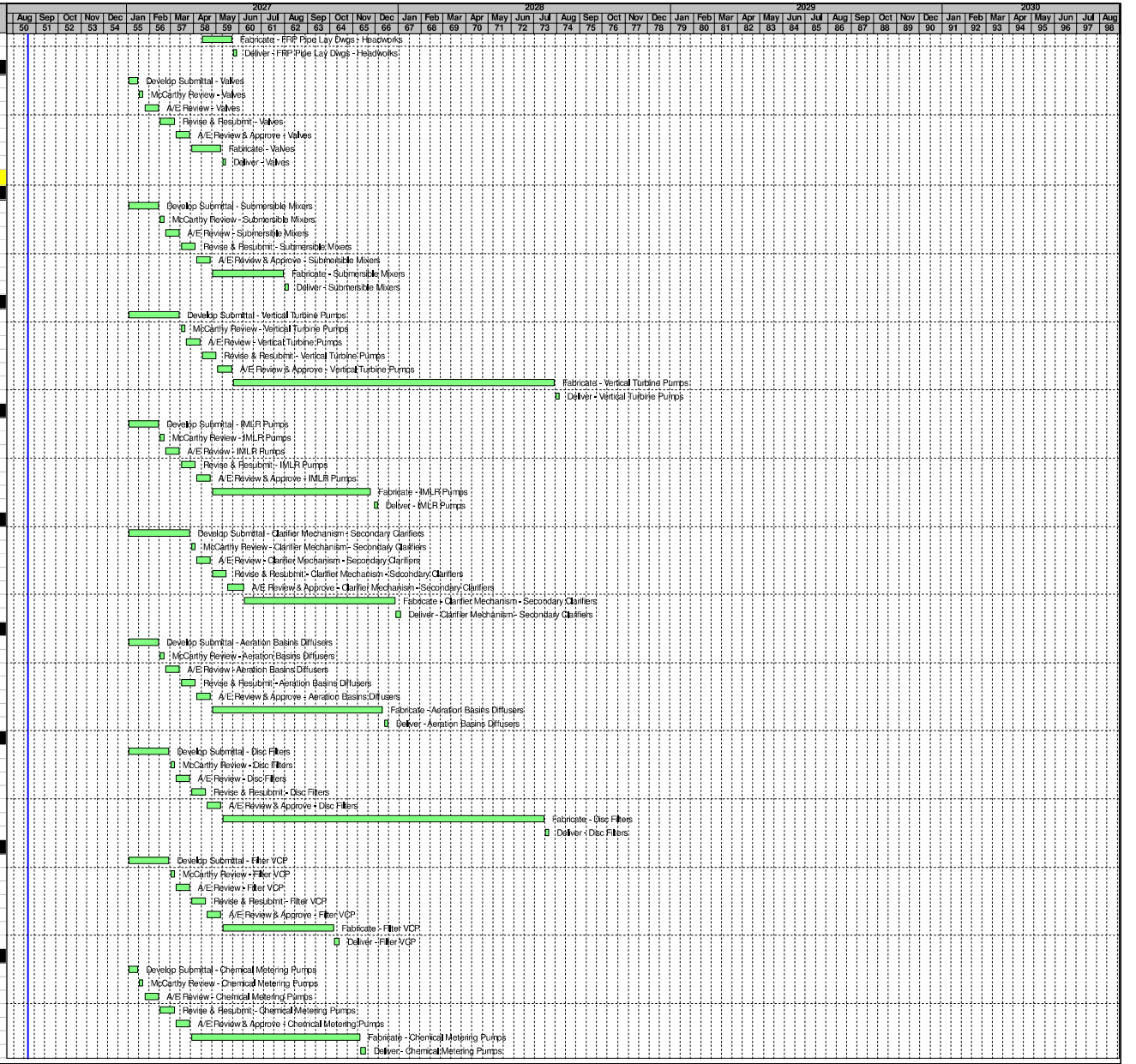
Activity ID	Activity Name	Orig Dur	Start	Finish
000.26-3520	A/E & City Review - Programming (Wilson Balance of Plant)	40	22-Mar-27	14-May-27
000.26-3530	Revise & Resubmit - Programming (Wilson Balance of Plant)	15	17-May-27	07-Jun-27
000.26-3550	A/E & City Review & Approve - Programming (Wilson Balance of Plant)	40	08-Jun-27	03-Aug-27
000.26-3540	Develop & Deploy - Programming (Wilson Balance of Plant)	60	04-Aug-27	27-Oct-27
26 Instrumentation		193	04-Jan-27	04-Oct-27
000.26-2550	Develop Submittal - Instrumentation	10	04-Jan-27	15-Jan-27
000.26-2560	McCarthy Review - Instrumentation	5	18-Jan-27	22-Jan-27
000.26-2570	A/E Review - Instrumentation	15	25-Jan-27	12-Feb-27
000.26-2580	Revise & Resubmit - Instrumentation	15	15-Feb-27	05-Mar-27
000.26-2590	A/E Review & Approve - Instrumentation	15	08-Mar-27	26-Mar-27
000.26-2600	Fabricate - Instrumentation	128	29-Mar-27	27-Sep-27
000.26-2610	Deliver - Instrumentation	5	28-Sep-27	04-Oct-27
31 Civil		205	04-Jan-27	20-Oct-27
31 Precast Manholes		75	04-Jan-27	16-Apr-27
000.31-1020	Develop Submittal - Precast Manholes	10	04-Jan-27	15-Jan-27
000.31-1050	McCarthy Review - Precast Manholes	5	18-Jan-27	22-Jan-27
000.31-1120	A/E Review - Precast Manholes	15	25-Jan-27	12-Feb-27
000.31-1170	Revise & Resubmit - Precast Manholes	15	15-Feb-27	05-Mar-27
000.31-1220	A/E Review & Approve - Precast Manholes	15	08-Mar-27	26-Mar-27
000.31-1250	Fabricate - Precast Manholes	10	29-Mar-27	09-Apr-27
000.31-1260	Deliver - Precast Manholes	5	12-Apr-27	16-Apr-27
31 Ductile Iron Pipe Material		60	04-Jan-27	26-Mar-27
000.31-1000	Develop Submittal - DIP Material	10	04-Jan-27	15-Jan-27
000.31-1030	McCarthy Review - DIP Material	5	18-Jan-27	22-Jan-27
000.31-1100	A/E Review - DIP Material	15	25-Jan-27	12-Feb-27
000.31-1150	Revise & Resubmit - DIP Material	15	15-Feb-27	05-Mar-27
000.31-1200	A/E Review & Approve - DIP Material	15	08-Mar-27	26-Mar-27
31 DIP Lay Dwgs		125	18-Jan-27	13-Jul-27
000.31-1060	Develop Submittal - DIP Lay Dwgs	10	18-Jan-27	29-Jan-27
000.31-1080	McCarthy Review - DIP Lay Dwgs	5	01-Feb-27	05-Feb-27
000.31-1130	A/E Review - DIP Lay Dwgs	15	08-Feb-27	26-Feb-27
000.31-1180	Revise & Resubmit - DIP Lay Dwgs	15	01-Mar-27	19-Mar-27
000.31-1230	A/E Review & Approve - DIP Lay Dwgs	15	22-Mar-27	09-Apr-27
000.31-1270	Fabricate - DIP Lay Dwgs	60	12-Apr-27	06-Jul-27
000.31-1290	Deliver - DIP Lay Dwgs	5	07-Jul-27	13-Jul-27
31 Plastic Pipe Material		60	04-Jan-27	26-Mar-27
000.31-1010	Develop Submittal - Plastic Pipe Material	10	04-Jan-27	15-Jan-27
000.31-1040	McCarthy Review - Plastic Pipe Material	5	18-Jan-27	22-Jan-27
000.31-1110	A/E Review - Plastic Pipe Material	15	25-Jan-27	12-Feb-27
000.31-1160	Revise & Resubmit - Plastic Pipe Material	15	15-Feb-27	05-Mar-27
000.31-1210	A/E Review & Approve - Plastic Pipe Material	15	08-Mar-27	26-Mar-27
31 Plastic Pipe Lay Dwgs		85	18-Jan-27	14-May-27
000.31-1070	Develop Submittal - Plastic Pipe Lay Dwgs	10	18-Jan-27	29-Jan-27
000.31-1090	McCarthy Review - Plastic Pipe Lay Dwgs	5	01-Feb-27	05-Feb-27
000.31-1140	A/E Review - Plastic Pipe Lay Dwgs	15	08-Feb-27	26-Feb-27
000.31-1190	Revise & Resubmit - Plastic Pipe Lay Dwgs	15	01-Mar-27	19-Mar-27
000.31-1240	A/E Review & Approve - Plastic Pipe Lay Dwgs	15	22-Mar-27	09-Apr-27
000.31-1280	Fabricate - Plastic Pipe Lay Dwgs	20	12-Apr-27	07-May-27
000.31-1300	Deliver - Plastic Pipe Lay Dwgs	5	10-May-27	14-May-27
Polymer Manhole		95	04-Jan-27	14-May-27
000.31-1380	Develop Submittal - Polymer Manhole	10	04-Jan-27	15-Jan-27
000.31-1390	McCarthy Review - Polymer Manhole	5	18-Jan-27	22-Jan-27
000.31-1400	A/E Review - Polymer Manhole	15	25-Jan-27	12-Feb-27
000.31-1410	Revise & Resubmit - Polymer Manhole	15	15-Feb-27	05-Mar-27
000.31-1420	A/E Review & Approve - Polymer Manhole	15	08-Mar-27	26-Mar-27
000.31-1430	Fabricate - Polymer Manhole	30	29-Mar-27	07-May-27
000.31-1500	Deliver - Polymer Manhole	5	10-May-27	14-May-27
HOBAS Pipe		115	04-Jan-27	14-Jun-27
000.31-1440	Develop Submittal - HOBAS Pipe	10	04-Jan-27	15-Jan-27
000.31-1450	McCarthy Review - HOBAS Pipe	5	18-Jan-27	22-Jan-27
000.31-1460	A/E Review - HOBAS Pipe	15	25-Jan-27	12-Feb-27
000.31-1470	Revise & Resubmit - HOBAS Pipe	15	15-Feb-27	05-Mar-27
000.31-1480	A/E Review & Approve - HOBAS Pipe	15	08-Mar-27	26-Mar-27
000.31-1490	Fabricate - HOBAS Pipe	50	29-Mar-27	07-Jun-27
000.31-1510	Deliver - HOBAS Pipe	5	08-Jun-27	14-Jun-27
31 Valve & Actuator		205	04-Jan-27	20-Oct-27
000.31-1310	Develop Submittal - Valve & Actuator - Clarifiers	40	04-Jan-27	26-Feb-27
000.31-1320	McCarthy Review - Valve & Actuator - Clarifiers	5	01-Mar-27	05-Mar-27
000.31-1330	A/E Review - Valve & Actuator - Clarifiers	15	08-Mar-27	26-Mar-27
000.31-1340	Revise & Resubmit - Valve & Actuator - Clarifiers	15	29-Mar-27	16-Apr-27
000.31-1350	A/E Review & Approve - Valve & Actuator - Clarifiers	15	19-Apr-27	07-May-27
000.31-1360	Fabricate - Valve & Actuator - Clarifiers	110	10-May-27	13-Oct-27
000.31-1370	Deliver - Valve & Actuator - Clarifiers	5	14-Oct-27	20-Oct-27
Excavation Plan		60	04-Jan-27	26-Mar-27
000.31-1520	Develop Submittal - Excavation Plan	10	04-Jan-27	15-Jan-27



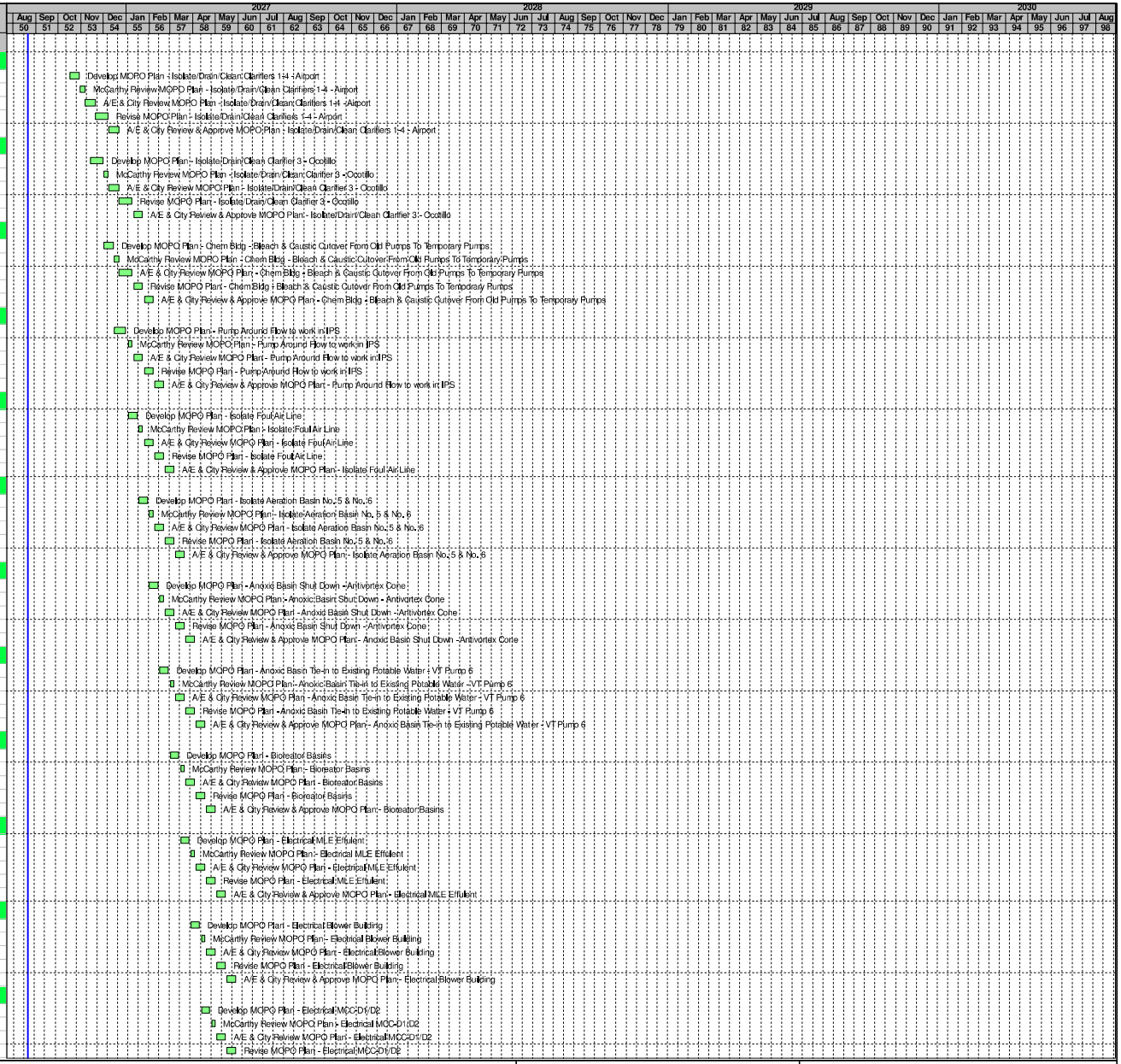
Activity ID	Activity Name	Orig Dur	Start	Finish
000.31-1530	McCarthy Review - Excavation Plan	5	18-Jan-27	22-Jan-27
000.31-1540	A/E Review - Excavation Plan	15	25-Jan-27	12-Feb-27
000.31-1550	Revise & Resubmit - Excavation Plan	15	15-Feb-27	05-Mar-27
000.31-1560	A/E Review & Approve - Excavation Plan	15	08-Mar-27	26-Mar-27
40 Process Piping		173	04-Jan-27	03-Sep-27
40 Ductile Iron Pipe Material		60	04-Jan-27	26-Mar-27
000.40-1000	Develop Submittal - DIP Material	10	04-Jan-27	15-Jan-27
000.40-1030	McCarthy Review - DIP Material	5	18-Jan-27	22-Jan-27
000.40-1220	A/E Review - DIP Material	15	25-Jan-27	12-Feb-27
000.40-1340	Revise & Resubmit - DIP Material	15	15-Feb-27	05-Mar-27
000.40-1460	A/E Review & Approve - DIP Material	15	08-Mar-27	26-Mar-27
40 DIP Lay Dwgs		105	18-Jan-27	14-Jun-27
000.40-1060	Develop Submittal - DIP Lay Dwgs	10	18-Jan-27	29-Jan-27
000.40-1140	McCarthy Review - DIP Lay Dwgs	5	01-Feb-27	05-Feb-27
000.40-1250	A/E Review - DIP Lay Dwgs	15	08-Feb-27	26-Feb-27
000.40-1380	Revise & Resubmit - DIP Lay Dwgs	15	01-Mar-27	19-Mar-27
000.40-1500	A/E Review & Approve - DIP Lay Dwgs	15	22-Mar-27	09-Apr-27
000.40-1590	Fabricate - DIP Lay Dwgs	40	12-Apr-27	07-Jun-27
000.40-1670	Deliver - DIP Lay Dwgs	5	08-Jun-27	14-Jun-27
40 Stainless Steel Pipe Material		60	04-Jan-27	26-Mar-27
000.40-1780	Develop Submittal - SST Material	10	04-Jan-27	15-Jan-27
000.40-1790	McCarthy Review - SST Material	5	18-Jan-27	22-Jan-27
000.40-1800	A/E Review - SST Material	15	25-Jan-27	12-Feb-27
000.40-1810	Revise & Resubmit - SST Material	15	15-Feb-27	05-Mar-27
000.40-1820	A/E Review & Approve - SST Material	15	08-Mar-27	26-Mar-27
40 SST Lay Dwgs		163	18-Jan-27	03-Sep-27
000.40-1830	Develop Submittal - SST Lay Dwgs - Bioractor 1 & 2	10	18-Jan-27	29-Jan-27
000.40-1840	McCarthy Review - SST Lay Dwgs - Bioractor 1 & 2	5	01-Feb-27	05-Feb-27
000.40-1850	A/E Review - SST Lay Dwgs - Bioractor 1 & 2	15	08-Feb-27	26-Feb-27
000.40-1860	Revise & Resubmit - SST Lay Dwgs - Bioractor 1 & 2	15	01-Mar-27	19-Mar-27
000.40-1870	A/E Review & Approve - SST Lay Dwgs - Bioractor 1 & 2	15	22-Mar-27	09-Apr-27
000.40-1880	Fabricate - SST Lay Dwgs - Bioractor 1 & 2	98	12-Apr-27	27-Aug-27
000.40-1890	Deliver - SST Lay Dwgs - Bioractor 1 & 2	5	30-Aug-27	03-Sep-27
40 Plastic Pipe Material		60	04-Jan-27	26-Mar-27
000.40-1010	Develop Submittal - Plastic Pipe Material	10	04-Jan-27	15-Jan-27
000.40-1040	McCarthy Review - Plastic Pipe Material	5	18-Jan-27	22-Jan-27
000.40-1230	A/E Review - Plastic Pipe Material	15	25-Jan-27	12-Feb-27
000.40-1350	Revise & Resubmit - Plastic Pipe Material	15	15-Feb-27	05-Mar-27
000.40-1470	A/E Review & Approve - Plastic Pipe Material	15	08-Mar-27	26-Mar-27
40 Plastic Pipe Lay Dwgs - Chemical Storage		95	18-Jan-27	28-May-27
000.40-1070	Develop Submittal - Plastic Pipe Lay Dwgs - Chemical Storage	10	18-Jan-27	29-Jan-27
000.40-1150	McCarthy Review - Plastic Pipe Lay Dwgs - Chemical Storage	5	01-Feb-27	05-Feb-27
000.40-1260	A/E Review - Plastic Pipe Lay Dwgs - Chemical Storage	15	08-Feb-27	26-Feb-27
000.40-1390	Revise & Resubmit - Plastic Pipe Lay Dwgs - Chemical Storage	15	01-Mar-27	19-Mar-27
000.40-1510	A/E Review & Approve - Plastic Pipe Lay Dwgs - Chemical Storage	15	22-Mar-27	09-Apr-27
000.40-1600	Fabricate - Plastic Pipe Lay Dwgs - Chemical Storage	30	12-Apr-27	21-May-27
000.40-1680	Deliver - Plastic Pipe Lay Dwgs - Chemical Storage	5	24-May-27	28-May-27
40 Plastic Pipe Lay Dwgs - Aeration Basins No. 5 & No. 6		95	18-Jan-27	28-May-27
000.40-1090	Develop Submittal - Plastic Pipe Lay Dwgs - Aeration Basins No. 5 & No. 6	10	18-Jan-27	29-Jan-27
000.40-1170	McCarthy Review - Plastic Pipe Lay Dwgs - Aeration Basins No. 5 & No. 6	5	01-Feb-27	05-Feb-27
000.40-1280	A/E Review - Plastic Pipe Lay Dwgs - Aeration Basins No. 5 & No. 6	15	08-Feb-27	26-Feb-27
000.40-1410	Revise & Resubmit - Plastic Pipe Lay Dwgs - Aeration Basins No. 5 & No. 6	15	01-Mar-27	19-Mar-27
000.40-1530	A/E Review & Approve - Plastic Pipe Lay Dwgs - Aeration Basins No. 5 & No. 6	15	22-Mar-27	09-Apr-27
000.40-1620	Fabricate - Plastic Pipe Lay Dwgs - Aeration Basins No. 5 & No. 6	30	12-Apr-27	21-May-27
000.40-1700	Deliver - Plastic Pipe Lay Dwgs - Aeration Basins No. 5 & No. 6	5	24-May-27	28-May-27
40 Plastic Pipe Lay Dwgs - Filters		95	18-Jan-27	28-May-27
000.40-1130	Develop Submittal - Plastic Pipe Lay Dwgs - Filters	10	18-Jan-27	29-Jan-27
000.40-1210	McCarthy Review - Plastic Pipe Lay Dwgs - Filters	5	01-Feb-27	05-Feb-27
000.40-1320	A/E Review - Plastic Pipe Lay Dwgs - Filters	15	08-Feb-27	26-Feb-27
000.40-1450	Revise & Resubmit - Plastic Pipe Lay Dwgs - Filters	15	01-Mar-27	19-Mar-27
000.40-1570	A/E Review & Approve - Plastic Pipe Lay Dwgs - Filters	15	22-Mar-27	09-Apr-27
000.40-1660	Fabricate - Plastic Pipe Lay Dwgs - Filters	30	12-Apr-27	21-May-27
000.40-1740	Deliver - Plastic Pipe Lay Dwgs - Filters	5	24-May-27	28-May-27
40 FRP Pipe Material		60	04-Jan-27	26-Mar-27
000.40-1020	Develop Submittal - FRP Pipe Material	10	04-Jan-27	15-Jan-27
000.40-1050	McCarthy Review - FRP Pipe Material	5	18-Jan-27	22-Jan-27
000.40-1240	A/E Review - FRP Pipe Material	15	25-Jan-27	12-Feb-27
000.40-1360	Revise & Resubmit - FRP Pipe Material	15	15-Feb-27	05-Mar-27
000.40-1480	A/E Review & Approve - FRP Pipe Material	15	08-Mar-27	26-Mar-27
40 FRP Pipe Lay Dwgs - Headworks		95	18-Jan-27	28-May-27
000.40-1100	Develop Submittal - FRP Pipe Lay Dwgs - Headworks	10	18-Jan-27	29-Jan-27
000.40-1180	McCarthy Review - FRP Pipe Lay Dwgs - Headworks	5	01-Feb-27	05-Feb-27
000.40-1290	A/E Review - FRP Pipe Lay Dwgs - Headworks	15	08-Feb-27	26-Feb-27
000.40-1420	Revise & Resubmit - FRP Pipe Lay Dwgs - Headworks	15	01-Mar-27	19-Mar-27
000.40-1540	A/E Review & Approve - FRP Pipe Lay Dwgs - Headworks	15	22-Mar-27	09-Apr-27



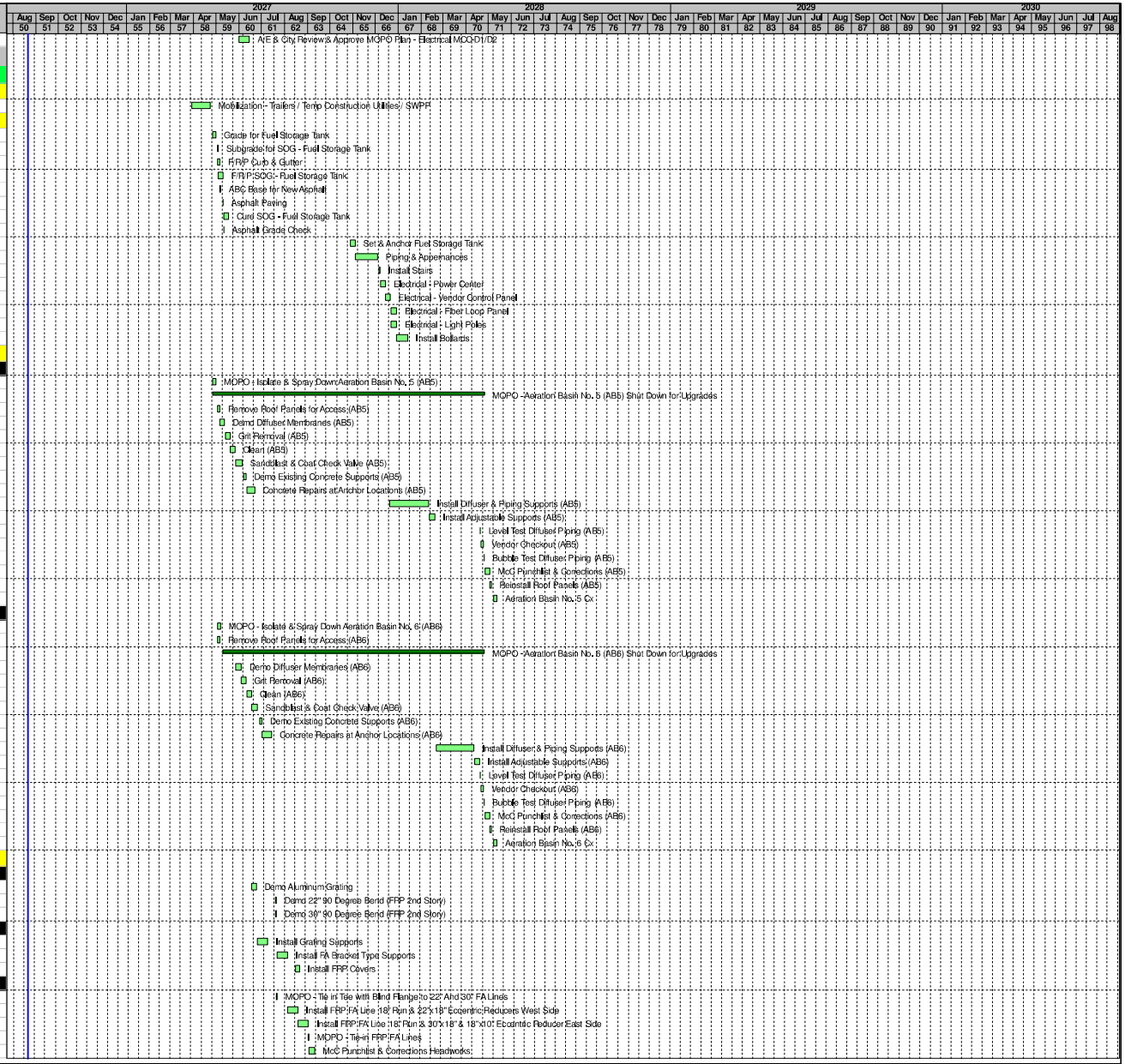
Activity ID	Activity Name	Orig Dur	Start	Finish
000.46-1630	Fabricate - FRP Pipe Lay Dwgs - Headworks	30	12-Apr-27	21-May-27
000.46-1710	Deliver - FRP Pipe Lay Dwgs - Headworks	5	24-May-27	28-May-27
40 Valves		94	04-Jan-27	13-May-27
000.46-1330	Develop Submittal - Valves	10	04-Jan-27	15-Jan-27
000.46-1370	McCarthy Review - Valves	5	18-Jan-27	22-Jan-27
000.46-1490	A/E Review - Valves	15	25-Jan-27	12-Feb-27
000.46-1580	Revise & Resubmit - Valves	15	15-Feb-27	05-Mar-27
000.46-1750	A/E Review & Approve - Valves	15	08-Mar-27	26-Mar-27
000.46-1760	Fabricate - Valves	30	29-Mar-27	07-May-27
000.46-1770	Deliver - Valves	4	10-May-27	13-May-27
46 Process Equipment		405	04-Jan-27	04-Aug-28
46 Submersible Mixers		153	04-Jan-27	06-Aug-27
000.46-1050	Develop Submittal - Submersible Mixers	30	04-Jan-27	12-Feb-27
000.46-1100	McCarthy Review - Submersible Mixers	5	15-Feb-27	19-Feb-27
000.46-1170	A/E Review - Submersible Mixers	15	22-Feb-27	12-Mar-27
000.46-1270	Revise & Resubmit - Submersible Mixers	15	15-Mar-27	02-Apr-27
000.46-1370	A/E Review & Approve - Submersible Mixers	15	05-Apr-27	23-Apr-27
000.46-1500	Fabricate - Submersible Mixers	68	26-Apr-27	30-Jul-27
000.46-1530	Deliver - Submersible Mixers	5	02-Aug-27	06-Aug-27
46 Vertical Turbine Pumps		405	04-Jan-27	04-Aug-28
000.46-1180	Develop Submittal - Vertical Turbine Pumps	50	04-Jan-27	12-Mar-27
000.46-1200	McCarthy Review - Vertical Turbine Pumps	5	15-Mar-27	19-Mar-27
000.46-1300	A/E Review - Vertical Turbine Pumps	15	22-Mar-27	09-Apr-27
000.46-1390	Revise & Resubmit - Vertical Turbine Pumps	15	12-Apr-27	30-Apr-27
000.46-1430	A/E Review & Approve - Vertical Turbine Pumps	15	03-May-27	21-May-27
000.46-1610	Fabricate - Vertical Turbine Pumps	300	24-May-27	28-Jul-28
000.46-1620	Deliver - Vertical Turbine Pumps	5	31-Jul-28	04-Aug-28
46 IMLR Pumps		235	04-Jan-27	03-Dec-27
000.46-1060	Develop Submittal - IMLR Pumps	30	04-Jan-27	12-Feb-27
000.46-1110	McCarthy Review - IMLR Pumps	5	15-Feb-27	19-Feb-27
000.46-1190	A/E Review - IMLR Pumps	15	22-Feb-27	12-Mar-27
000.46-1280	Revise & Resubmit - IMLR Pumps	15	15-Mar-27	02-Apr-27
000.46-1380	A/E Review & Approve - IMLR Pumps	15	05-Apr-27	23-Apr-27
000.46-1510	Fabricate - IMLR Pumps	150	26-Apr-27	24-Nov-27
000.46-1540	Deliver - IMLR Pumps	5	29-Nov-27	03-Dec-27
46 Clarifier Mechanism - Secondary Clarifiers		255	04-Jan-27	04-Jan-28
000.46-1210	Develop Submittal - Clarifier Mechanism - Secondary Clarifiers	60	04-Jan-27	26-Mar-27
000.46-1260	McCarthy Review - Clarifier Mechanism - Secondary Clarifiers	5	29-Mar-27	02-Apr-27
000.46-1360	A/E Review - Clarifier Mechanism - Secondary Clarifiers	15	05-Apr-27	23-Apr-27
000.46-1420	Revise & Resubmit - Clarifier Mechanism - Secondary Clarifiers	15	26-Apr-27	14-May-27
000.46-1450	A/E Review & Approve - Clarifier Mechanism - Secondary Clarifiers	15	17-May-27	07-Jun-27
000.46-1590	Fabricate - Clarifier Mechanism - Secondary Clarifiers	140	08-Jun-27	27-Dec-27
000.46-1600	Deliver - Clarifier Mechanism - Secondary Clarifiers	5	28-Dec-27	04-Jan-28
46 Aeration Basins		245	04-Jan-27	17-Dec-27
000.46-1040	Develop Submittal - Aeration Basins Diffusers	30	04-Jan-27	12-Feb-27
000.46-1070	McCarthy Review - Aeration Basins Diffusers	5	15-Feb-27	19-Feb-27
000.46-1130	A/E Review - Aeration Basins Diffusers	15	22-Feb-27	12-Mar-27
000.46-1220	Revise & Resubmit - Aeration Basins Diffusers	15	15-Mar-27	02-Apr-27
000.46-1330	A/E Review & Approve - Aeration Basins Diffusers	15	05-Apr-27	23-Apr-27
000.46-1490	Fabricate - Aeration Basins Diffusers	160	26-Apr-27	10-Dec-27
000.46-1520	Deliver - Aeration Basins Diffusers	5	13-Dec-27	17-Dec-27
46 Disc Filters		395	04-Jan-27	21-Jul-28
000.46-1120	Develop Submittal - Disc Filters	40	04-Jan-27	26-Feb-27
000.46-1140	McCarthy Review - Disc Filters	5	01-Mar-27	05-Mar-27
000.46-1230	A/E Review - Disc Filters	15	08-Mar-27	26-Mar-27
000.46-1340	Revise & Resubmit - Disc Filters	15	29-Mar-27	16-Apr-27
000.46-1410	A/E Review & Approve - Disc Filters	15	19-Apr-27	07-May-27
000.46-1570	Fabricate - Disc Filters	300	10-May-27	14-Jul-28
000.46-1580	Deliver - Disc Filters	5	17-Jul-28	21-Jul-28
46 Filter VCP		200	04-Jan-27	13-Oct-27
000.46-1010	Develop Submittal - Filter VCP	40	04-Jan-27	26-Feb-27
000.46-1030	McCarthy Review - Filter VCP	5	01-Mar-27	05-Mar-27
000.46-1090	A/E Review - Filter VCP	15	08-Mar-27	26-Mar-27
000.46-1160	Revise & Resubmit - Filter VCP	15	29-Mar-27	16-Apr-27
000.46-1250	A/E Review & Approve - Filter VCP	15	19-Apr-27	07-May-27
000.46-1550	Fabricate - Filter VCP	105	10-May-27	06-Oct-27
000.46-1560	Deliver - Filter VCP	5	07-Oct-27	13-Oct-27
46 Chemical Metering Pumps		225	04-Jan-27	17-Nov-27
000.46-1000	Develop Submittal - Chemical Metering Pumps	10	04-Jan-27	15-Jan-27
000.46-1020	McCarthy Review - Chemical Metering Pumps	5	18-Jan-27	22-Jan-27
000.46-1080	A/E Review - Chemical Metering Pumps	15	25-Jan-27	12-Feb-27
000.46-1150	Revise & Resubmit - Chemical Metering Pumps	15	15-Feb-27	05-Mar-27
000.46-1240	A/E Review & Approve - Chemical Metering Pumps	15	08-Mar-27	26-Mar-27
000.46-1310	Fabricate - Chemical Metering Pumps	160	29-Mar-27	10-Nov-27
000.46-1350	Deliver - Chemical Metering Pumps	5	11-Nov-27	17-Nov-27



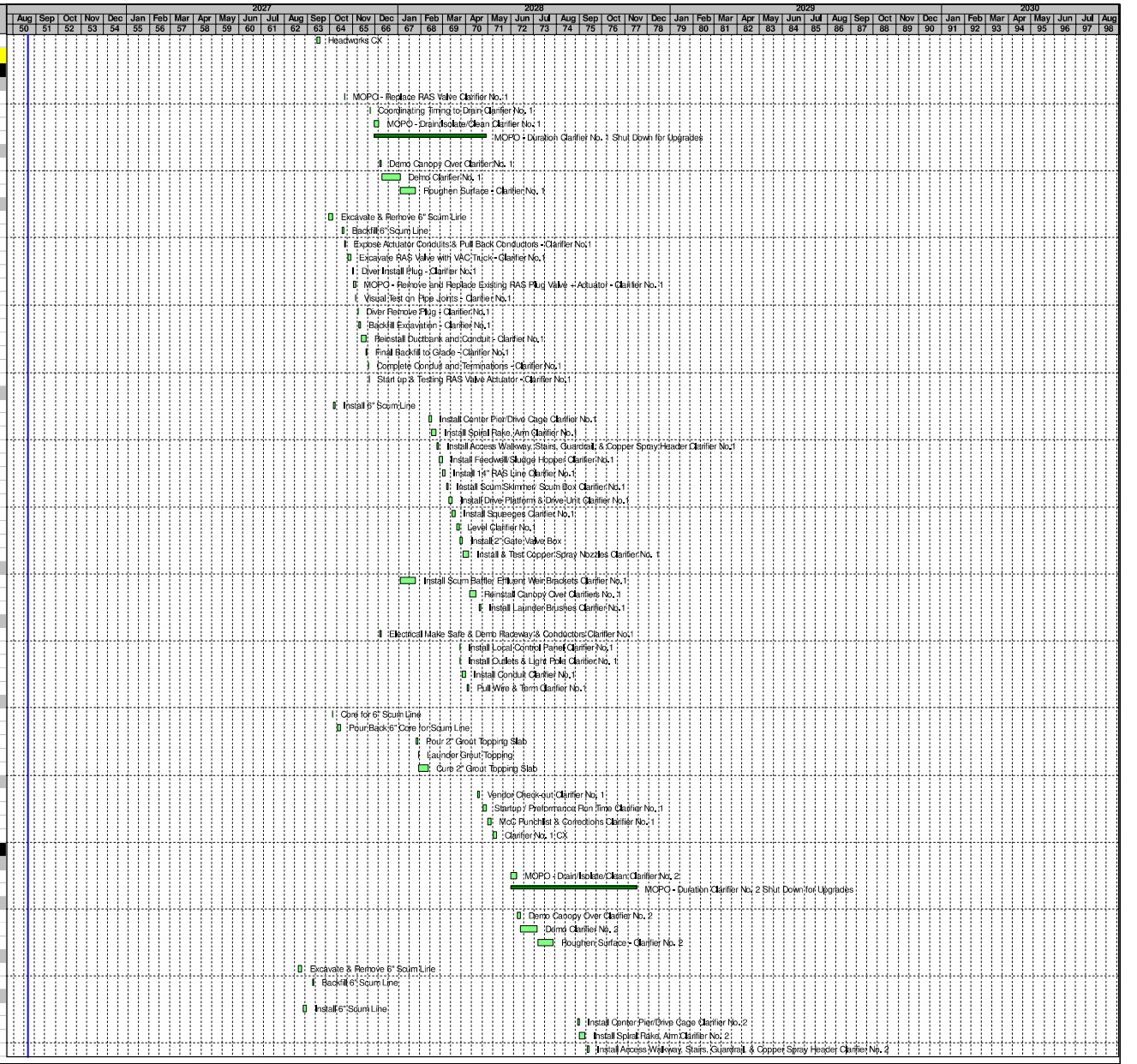
Activity ID	Activity Name	Orig Dur	Start	Finish
MOPO Planning		165	16-Oct-26	14-Jun-27
MOPO - Isolate/Drain/Clean Clarifiers 1-4 - Airport		45	16-Oct-26	21-Dec-26
000.MOPO-1000	Develop MOPO Plan - Isolate/Drain/Clean Clarifiers 1-4 - Airport	10	16-Oct-26	29-Oct-26
000.MOPO-1160	McCarthy Review MOPO Plan - Isolate/Drain/Clean Clarifiers 1-4 - Airport	5	30-Oct-26	05-Nov-26
000.MOPO-1320	A/E & City Review MOPO Plan - Isolate/Drain/Clean Clarifiers 1-4 - Airport	10	06-Nov-26	19-Nov-26
000.MOPO-1480	Revise MOPO Plan - Isolate/Drain/Clean Clarifiers 1-4 - Airport	10	20-Nov-26	07-Dec-26
000.MOPO-1640	A/E & City Review & Approve MOPO Plan - Isolate/Drain/Clean Clarifiers 1-4 - Airp	10	08-Dec-26	21-Dec-26
MOPO - Isolate/Drain/Clean Clarifier 3 - Ocotillo		45	13-Nov-26	22-Jan-27
000.MOPO-1100	Develop MOPO Plan - Isolate/Drain/Clean Clarifier 3 - Ocotillo	10	13-Nov-26	30-Nov-26
000.MOPO-1260	McCarthy Review MOPO Plan - Isolate/Drain/Clean Clarifier 3 - Ocotillo	5	01-Dec-26	07-Dec-26
000.MOPO-1420	A/E & City Review MOPO Plan - Isolate/Drain/Clean Clarifier 3 - Ocotillo	10	08-Dec-26	21-Dec-26
000.MOPO-1580	Revise MOPO Plan - Isolate/Drain/Clean Clarifier 3 - Ocotillo	10	22-Dec-26	08-Jan-27
000.MOPO-1740	A/E & City Review & Approve MOPO Plan - Isolate/Drain/Clean Clarifier 3 - Ocotill	10	11-Jan-27	22-Jan-27
MOPO - Chem Bldg - Bleach & Caustic Cutover From Old Pumps To Tempora		45	01-Dec-26	05-Feb-27
000.MOPO-1010	Develop MOPO Plan - Chem Bldg - Bleach & Caustic Cutover From Old Pumps To	10	01-Dec-26	14-Dec-26
000.MOPO-1170	McCarthy Review MOPO Plan - Chem Bldg - Bleach & Caustic Cutover From Old	5	15-Dec-26	21-Dec-26
000.MOPO-1330	A/E & City Review MOPO Plan - Chem Bldg - Bleach & Caustic Cutover From Old	10	22-Dec-26	08-Jan-27
000.MOPO-1490	Revise MOPO Plan - Chem Bldg - Bleach & Caustic Cutover From Old Pumps To	10	11-Jan-27	22-Jan-27
000.MOPO-1650	A/E & City Review & Approve MOPO Plan - Chem Bldg - Bleach & Caustic Cutove	10	25-Jan-27	05-Feb-27
MOPO - Pump Around Flow to work in IPS		45	15-Dec-26	19-Feb-27
000.MOPO-1030	Develop MOPO Plan - Pump Around Flow to work in IPS	10	15-Dec-26	30-Dec-26
000.MOPO-1190	McCarthy Review MOPO Plan - Pump Around Flow to work in IPS	5	04-Jan-27	08-Jan-27
000.MOPO-1350	A/E & City Review MOPO Plan - Pump Around Flow to work in IPS	10	11-Jan-27	22-Jan-27
000.MOPO-1510	Revise MOPO Plan - Pump Around Flow to work in IPS	10	25-Jan-27	05-Feb-27
000.MOPO-1670	A/E & City Review & Approve MOPO Plan - Pump Around Flow to work in IPS	10	08-Feb-27	19-Feb-27
MOPO - Isolate Foul Air Line		45	04-Jan-27	05-Mar-27
000.MOPO-1050	Develop MOPO Plan - Isolate Foul Air Line	10	04-Jan-27	15-Jan-27
000.MOPO-1210	McCarthy Review MOPO Plan - Isolate Foul Air Line	5	18-Jan-27	22-Jan-27
000.MOPO-1370	A/E & City Review MOPO Plan - Isolate Foul Air Line	10	25-Jan-27	05-Feb-27
000.MOPO-1530	Revise MOPO Plan - Isolate Foul Air Line	10	08-Feb-27	19-Feb-27
000.MOPO-1690	A/E & City Review & Approve MOPO Plan - Isolate Foul Air Line	10	22-Feb-27	05-Mar-27
MOPO - Isolate Aeration Basin No. 5 & No. 6		45	18-Jan-27	19-Mar-27
000.MOPO-1060	Develop MOPO Plan - Isolate Aeration Basin No. 5 & No. 6	10	18-Jan-27	29-Jan-27
000.MOPO-1220	McCarthy Review MOPO Plan - Isolate Aeration Basin No. 5 & No. 6	5	01-Feb-27	05-Feb-27
000.MOPO-1380	A/E & City Review MOPO Plan - Isolate Aeration Basin No. 5 & No. 6	10	08-Feb-27	19-Feb-27
000.MOPO-1540	Revise MOPO Plan - Isolate Aeration Basin No. 5 & No. 6	10	22-Feb-27	05-Mar-27
000.MOPO-1700	A/E & City Review & Approve MOPO Plan - Isolate Aeration Basin No. 5 & No. 6	10	08-Mar-27	19-Mar-27
MOPO - Anoxic Basin Shut Down - Antivortex Cone		45	01-Feb-27	02-Apr-27
000.MOPO-1110	Develop MOPO Plan - Anoxic Basin Shut Down - Antivortex Cone	10	01-Feb-27	12-Feb-27
000.MOPO-1270	McCarthy Review MOPO Plan - Anoxic Basin Shut Down - Antivortex Cone	5	15-Feb-27	19-Feb-27
000.MOPO-1430	A/E & City Review MOPO Plan - Anoxic Basin Shut Down - Antivortex Cone	10	22-Feb-27	05-Mar-27
000.MOPO-1590	Revise MOPO Plan - Anoxic Basin Shut Down - Antivortex Cone	10	08-Mar-27	19-Mar-27
000.MOPO-1750	A/E & City Review & Approve MOPO Plan - Anoxic Basin Shut Down - Antivortex (	10	22-Mar-27	02-Apr-27
MOPO - Anoxic Basin Tie-in to Existing Potable Water - VT Pump 6		45	15-Feb-27	16-Apr-27
000.MOPO-1120	Develop MOPO Plan - Anoxic Basin Tie-in to Existing Potable Water - VT Pump 6	10	15-Feb-27	26-Feb-27
000.MOPO-1280	McCarthy Review MOPO Plan - Anoxic Basin Tie-in to Existing Potable Water - VT	5	01-Mar-27	05-Mar-27
000.MOPO-1440	A/E & City Review MOPO Plan - Anoxic Basin Tie-in to Existing Potable Water - V	10	08-Mar-27	19-Mar-27
000.MOPO-1600	Revise MOPO Plan - Anoxic Basin Tie-in to Existing Potable Water - VT Pump 6	10	22-Mar-27	02-Apr-27
000.MOPO-1760	A/E & City Review & Approve MOPO Plan - Anoxic Basin Tie-in to Existing Potable	10	05-Apr-27	16-Apr-27
MOPO - Bioreator Basins		45	01-Mar-27	30-Apr-27
000.MOPO-1150	Develop MOPO Plan - Bioreator Basins	10	01-Mar-27	12-Mar-27
000.MOPO-1310	McCarthy Review MOPO Plan - Bioreator Basins	5	15-Mar-27	19-Mar-27
000.MOPO-1470	A/E & City Review MOPO Plan - Bioreator Basins	10	22-Mar-27	02-Apr-27
000.MOPO-1630	Revise MOPO Plan - Bioreator Basins	10	05-Apr-27	16-Apr-27
000.MOPO-1790	A/E & City Review & Approve MOPO Plan - Bioreator Basins	10	19-Apr-27	30-Apr-27
MOPO - Electrical MLE Effulent		45	15-Mar-27	14-May-27
000.MOPO-1800	Develop MOPO Plan - Electrical MLE Effulent	10	15-Mar-27	26-Mar-27
000.MOPO-1810	McCarthy Review MOPO Plan - Electrical MLE Effulent	5	29-Mar-27	02-Apr-27
000.MOPO-1820	A/E & City Review MOPO Plan - Electrical MLE Effulent	10	05-Apr-27	16-Apr-27
000.MOPO-1830	Revise MOPO Plan - Electrical MLE Effulent	10	19-Apr-27	30-Apr-27
000.MOPO-1840	A/E & City Review & Approve MOPO Plan - Electrical MLE Effulent	10	03-May-27	14-May-27
MOPO - Electrical Blower Building		45	29-Mar-27	28-May-27
000.MOPO-1850	Develop MOPO Plan - Electrical Blower Building	10	29-Mar-27	09-Apr-27
000.MOPO-1860	McCarthy Review MOPO Plan - Electrical Blower Building	5	12-Apr-27	16-Apr-27
000.MOPO-1870	A/E & City Review MOPO Plan - Electrical Blower Building	10	19-Apr-27	30-Apr-27
000.MOPO-1880	Revise MOPO Plan - Electrical Blower Building	10	03-May-27	14-May-27
000.MOPO-1890	A/E & City Review & Approve MOPO Plan - Electrical Blower Building	10	17-May-27	28-May-27
MOPO - Electrical MCC-D1/D2		45	12-Apr-27	14-Jun-27
000.MOPO-1900	Develop MOPO Plan - Electrical MCC-D1/D2	10	12-Apr-27	23-Apr-27
000.MOPO-1910	McCarthy Review MOPO Plan - Electrical MCC-D1/D2	5	26-Apr-27	30-Apr-27
000.MOPO-1920	A/E & City Review MOPO Plan - Electrical MCC-D1/D2	10	03-May-27	14-May-27
000.MOPO-1930	Revise MOPO Plan - Electrical MCC-D1/D2	10	17-May-27	28-May-27



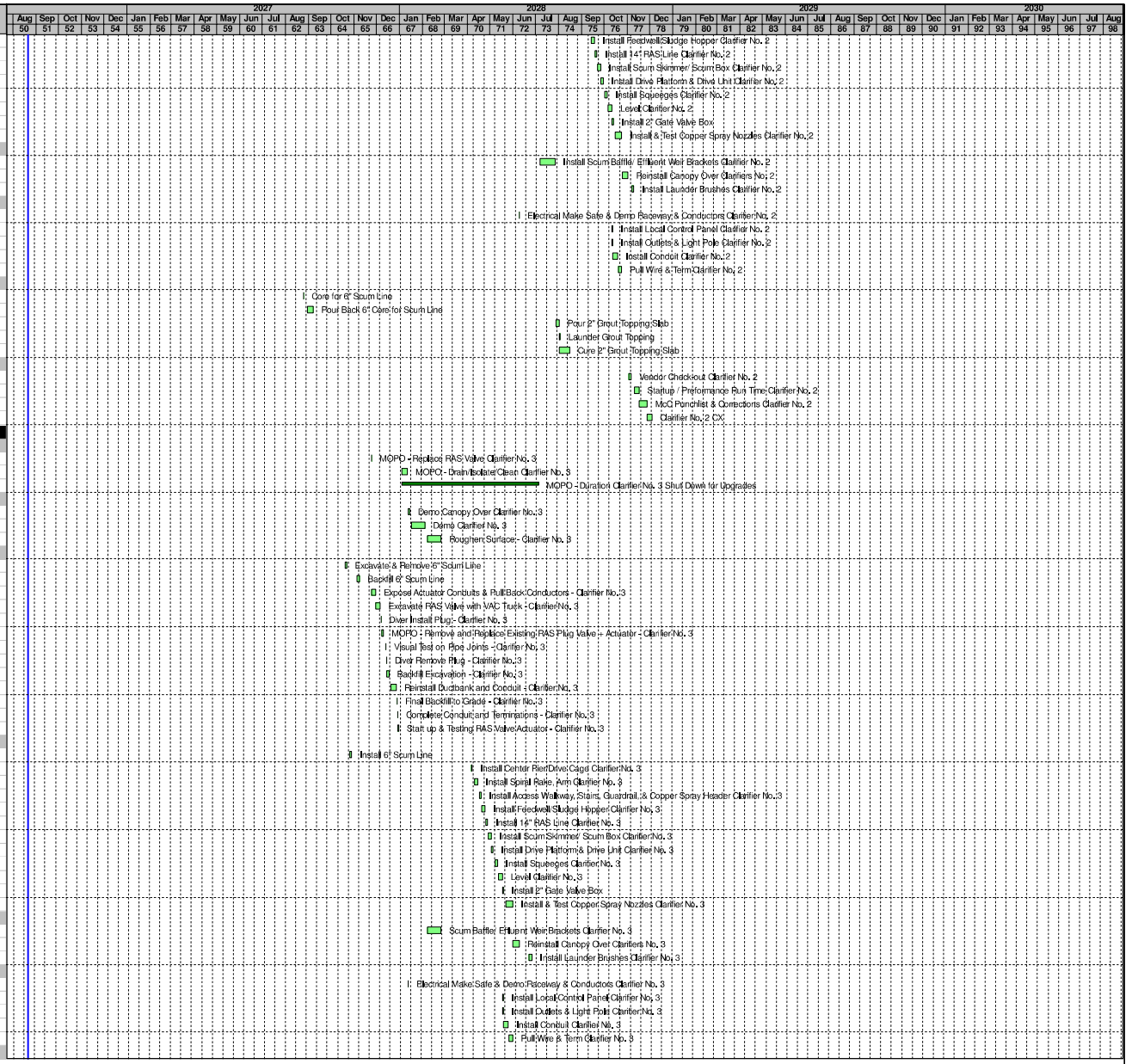
Activity ID	Activity Name	Orig Dur	Start	Finish
000.MOPO-1940	A/E & City Review & Approve MOPO Plan - Electrical MCC-D1/D2	10	01-Jun-27	14-Jun-27
Construction		819	08-Feb-27	29-Apr-30
Airport - Construction		730	08-Feb-27	21-Dec-29
Mobilization		20	29-Mar-27	23-Apr-27
A-MOB-1000	Mobilization - Trailers / Temp Construction Utilities / SWPP	20	29-Mar-27	23-Apr-27
Fuel Storage Tank		182	26-Apr-27	13-Jan-28
A-FUEL-1000	Grade for Fuel Storage Tank	5	26-Apr-27	30-Apr-27
A-FUEL-1010	Subgrade for SOG - Fuel Storage Tank	1	03-May-27	03-May-27
A-FUEL-1020	F/R/P Curb & Gutter	3	03-May-27	05-May-27
A-FUEL-1040	F/R/P SOG - Fuel Storage Tank	5	04-May-27	10-May-27
A-FUEL-1030	ABC Base for New Asphalt	2	06-May-27	07-May-27
A-FUEL-1050	Asphalt Paving	1	10-May-27	10-May-27
A-FUEL-1070	Cure SOG - Fuel Storage Tank	5	11-May-27	17-May-27
A-FUEL-1060	Asphalt Grade Check	1	11-May-27	11-May-27
A-FUEL-1080	Set & Anchor Fuel Storage Tank	5	28-Oct-27	03-Nov-27
A-FUEL-1090	Piping & Appemances	20	04-Nov-27	03-Dec-27
A-FUEL-1100	Install Stairs	2	06-Dec-27	07-Dec-27
A-FUEL-1110	Electrical - Power Center	5	08-Dec-27	14-Dec-27
A-FUEL-1130	Electrical - Vendor Control Panel	5	15-Dec-27	21-Dec-27
A-FUEL-1140	Electrical - Fiber Loop Panel	5	22-Dec-27	29-Dec-27
A-FUEL-1150	Electrical - Light Poles	5	22-Dec-27	29-Dec-27
A-FUEL-1120	Install Bollards	10	30-Dec-27	13-Jan-28
Aeration Basin		268	26-Apr-27	12-May-28
Aeration Basin No. 5		268	26-Apr-27	12-May-28
A-AB5-1000	MOPO - Isolate & Spray Down Aeration Basin No. 5 (AB5)	5	26-Apr-27	30-Apr-27
A-AB5-1130	MOPO - Aeration Basin No. 5 (AB5) Shut Down for Upgrades	255	26-Apr-27	25-Apr-28
A-AB5-1140	Remove Roof Panels for Access (AB5)	3	03-May-27	05-May-27
A-AB5-1010	Demo Diffuser Membranes (AB5)	5	06-May-27	12-May-27
A-AB5-1020	Grit Removal (AB5)	5	13-May-27	19-May-27
A-AB5-1030	Clean (AB5)	5	20-May-27	26-May-27
A-AB5-1040	Sandblast & Coat Check Valve (AB5)	6	27-May-27	04-Jun-27
A-AB5-1050	Demo Existing Concrete Supports (AB5)	4	07-Jun-27	10-Jun-27
A-AB5-1060	Concrete Repairs at Anchor Locations (AB5)	8	11-Jun-27	22-Jun-27
A-AB5-1070	Install Diffuser & Piping Supports (AB5)	37	20-Dec-27	10-Feb-28
A-AB5-1080	Install Adjustable Supports (AB5)	6	11-Feb-28	18-Feb-28
A-AB5-1100	Level Test Diffuser Piping (AB5)	1	20-Apr-28	20-Apr-28
A-AB5-1110	Vendor Checkout (AB5)	2	21-Apr-28	24-Apr-28
A-AB5-1120	Bubble Test Diffuser Piping (AB5)	1	25-Apr-28	25-Apr-28
A-AB5-1160	McC Punchlist & Corrections (AB5)	5	26-Apr-28	02-May-28
A-AB5-1170	Reinstall Roof Panels (AB5)	3	03-May-28	05-May-28
A-AB5-1150	Aeration Basin No. 5 Cx	5	08-May-28	12-May-28
Aeration Basin No. 6		263	03-May-27	12-May-28
A-AB6-1000	MOPO - Isolate & Spray Down Aeration Basin No. 6 (AB6)	5	03-May-27	07-May-27
A-AB6-1140	Remove Roof Panels for Access (AB6)	3	03-May-27	05-May-27
A-AB6-1130	MOPO - Aeration Basin No. 6 (AB6) Shut Down for Upgrades	245	10-May-27	25-Apr-28
A-AB6-1010	Demo Diffuser Membranes (AB6)	5	27-May-27	03-Jun-27
A-AB6-1020	Grit Removal (AB6)	5	04-Jun-27	10-Jun-27
A-AB6-1030	Clean (AB6)	5	11-Jun-27	17-Jun-27
A-AB6-1040	Sandblast & Coat Check Valve (AB6)	6	18-Jun-27	25-Jun-27
A-AB6-1050	Demo Existing Concrete Supports (AB6)	4	28-Jun-27	01-Jul-27
A-AB6-1060	Concrete Repairs at Anchor Locations (AB6)	8	02-Jul-27	14-Jul-27
A-AB6-1070	Install Diffuser & Piping Supports (AB6)	37	21-Feb-28	11-Apr-28
A-AB6-1080	Install Adjustable Supports (AB6)	6	12-Apr-28	19-Apr-28
A-AB6-1100	Level Test Diffuser Piping (AB6)	1	20-Apr-28	20-Apr-28
A-AB6-1110	Vendor Checkout (AB6)	2	21-Apr-28	24-Apr-28
A-AB6-1120	Bubble Test Diffuser Piping (AB6)	1	25-Apr-28	25-Apr-28
A-AB6-1160	McC Punchlist & Corrections (AB6)	5	26-Apr-28	02-May-28
A-AB6-1170	Reinstall Roof Panels (AB6)	3	03-May-28	05-May-28
A-AB6-1150	Aeration Basin No. 6 Cx	5	08-May-28	12-May-28
Headworks		64	18-Jun-27	17-Sep-27
Demo		22	18-Jun-27	20-Jul-27
A-HW-DEMO-1020	Demo Aluminum Grating	5	18-Jun-27	24-Jun-27
A-HW-DEMO-1000	Demo 22" 90 Degree Bend (FRP 2nd Story)	1	20-Jul-27	20-Jul-27
A-HW-DEMO-1010	Demo 30" 90 Degree Bend (FRP 2nd Story)	1	20-Jul-27	20-Jul-27
Architectural		40	25-Jun-27	20-Aug-27
A-HW-ARCH-1000	Install Grating Supports	10	25-Jun-27	09-Jul-27
A-HW-ARCH-1010	Install FA Bracket Type Supports	10	22-Jul-27	04-Aug-27
A-HW-ARCH-1020	Install FRP Covers	5	16-Aug-27	20-Aug-27
Mechanical		42	21-Jul-27	17-Sep-27
A-HW-PM-1030	MOPO - Tie in Tee with Blind Flange to 22" And 30" FA Lines	1	21-Jul-27	21-Jul-27
A-HW-PM-1000	Install FRP FA Line 18" Run & 22"x18" Eccentric Reducers West Side	10	05-Aug-27	18-Aug-27
A-HW-PM-1020	Install FRP FA Line 18" Run & 30"x18" & 18"x10" Eccentric Reducer East Side	10	19-Aug-27	01-Sep-27
A-HW-PM-1050	MOPO - Tie-in FRP FA Lines	1	02-Sep-27	02-Sep-27
A-HW-PM-1070	McC Punchlist & Corrections Headworks	5	03-Sep-27	10-Sep-27



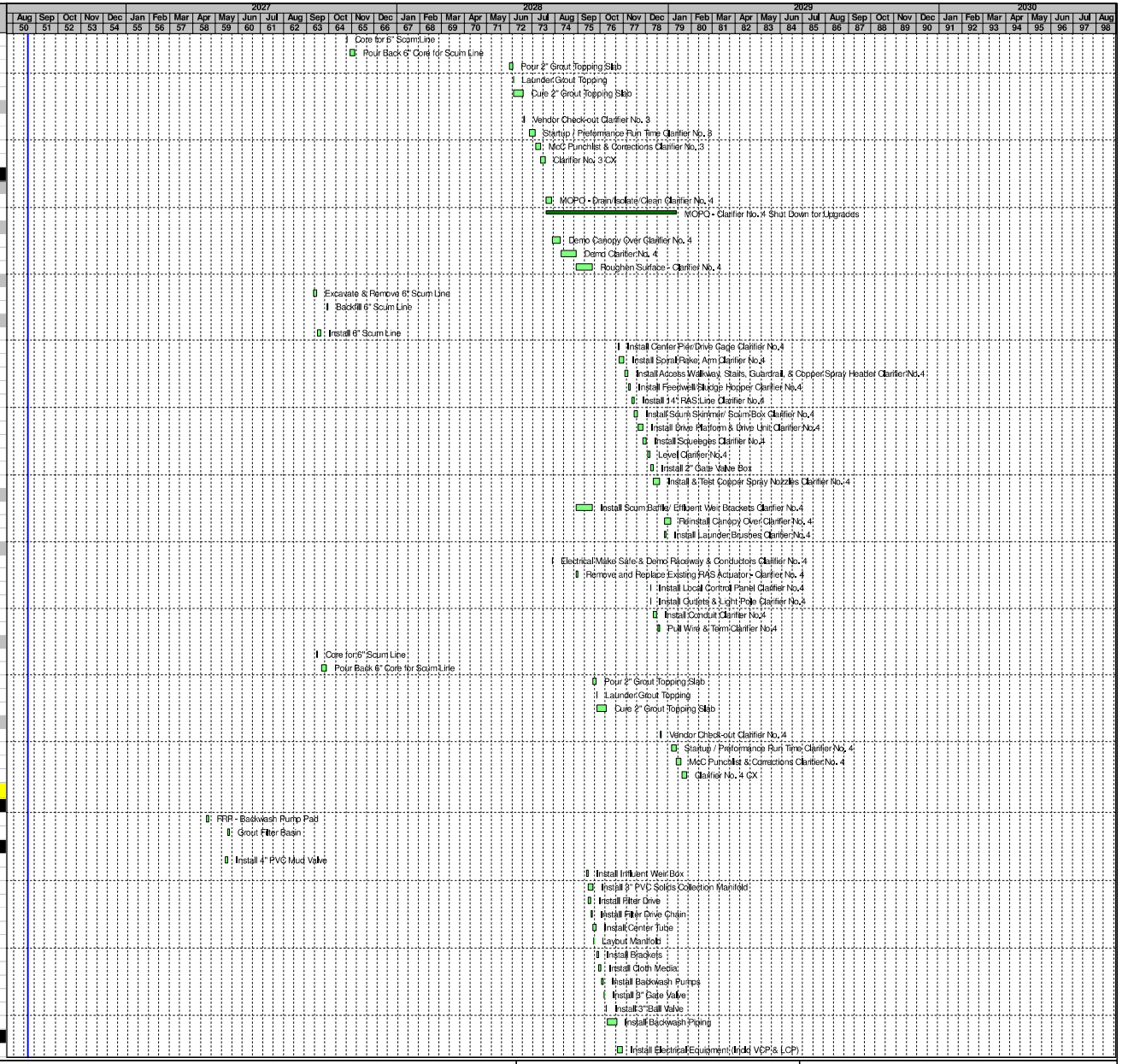
Activity ID	Activity Name	Orig Dur	Start	Finish
A-HW-PM-1060	Headworks CX	5	13-Sep-27	17-Sep-27
Secondary Clarifiers		362	20-Aug-27	25-Jan-29
Clarifier No. 1		158	30-Sep-27	12-May-28
MOPO		133	21-Oct-27	28-Apr-28
A-SC1-MOPO-1030	MOPO - Replace RAS Valve Clarifier No. 1	0	21-Oct-27	21-Oct-27
A-SC1-MOPO-1020	Coordinating Timing to Drain Clarifier No. 1	1	24-Nov-27	24-Nov-27
A-SC1-MOPO-1000	MOPO - Drain/Isolate/Clean Clarifier No. 1	6	29-Nov-27	06-Dec-27
A-SC1-MOPO-1010	MOPO - Duration Clarifier No. 1 Shut Down for Upgrades	108	29-Nov-27	28-Apr-28
Demo		33	07-Dec-27	24-Jan-28
A-SC1-DEMO-1000	Demo Canopy Over Clarifier No. 1	3	07-Dec-27	09-Dec-27
A-SC1-DEMO-1010	Demo Clarifier No. 1	15	10-Dec-27	03-Jan-28
A-SC1-DEMO-1020	Roughen Surface - Clarifier No. 1	15	04-Jan-28	24-Jan-28
Civil		39	30-Sep-27	23-Nov-27
A-SC1-CVL-1220	Excavate & Remove 6" Scum Line	3	30-Sep-27	04-Oct-27
A-SC1-CVL-1230	Backfill 6" Scum Line	2	18-Oct-27	19-Oct-27
A-SC1-CVL-1010	Expose Actuator Conduits & Pull Back Conductors - Clarifier No.1	2	21-Oct-27	22-Oct-27
A-SC1-CVL-1020	Excavate RAS Valve with VAC Truck - Clarifier No.1	5	25-Oct-27	29-Oct-27
A-SC1-CVL-1030	Diver Install Plug - Clarifier No.1	1	01-Nov-27	01-Nov-27
A-SC1-CVL-1000	MOPO - Remove and Replace Existing RAS Plug Valve + Actuator - Clarifier No. 1	3	02-Nov-27	04-Nov-27
A-SC1-CVL-1040	Visual Test on Pipe Joints - Clarifier No.1	1	05-Nov-27	05-Nov-27
A-SC1-CVL-1050	Diver Remove Plug - Clarifier No.1	1	08-Nov-27	08-Nov-27
A-SC1-CVL-1060	Backfill Excavation - Clarifier No.1	3	09-Nov-27	11-Nov-27
A-SC1-CVL-1070	Reinstall Ductbank and Conduit - Clarifier No.1	5	12-Nov-27	18-Nov-27
A-SC1-CVL-1080	Final Backfill to Grade - Clarifier No.1	1	19-Nov-27	19-Nov-27
A-SC1-CVL-1090	Complete Conduit and Terminations - Clarifier No.1	1	22-Nov-27	22-Nov-27
A-SC1-CVL-1100	Start up & Testing RAS Valve Actuator - Clarifier No.1	1	23-Nov-27	23-Nov-27
Mechanical Equipment		127	06-Oct-27	05-Apr-28
A-SC1-PM-1120	Install 6" Scum Line	3	06-Oct-27	08-Oct-27
A-SC1-PM-1000	Install Center Pier/Drive Cage Clarifier No.1	2	11-Feb-28	14-Feb-28
A-SC1-PM-1010	Install Spiral Rake, Arm Clarifier No.1	5	15-Feb-28	21-Feb-28
A-SC1-PM-1020	Install Access Walkway, Stairs, Guardrail, & Copper Spray Header Clarifier No.1	3	22-Feb-28	24-Feb-28
A-SC1-PM-1030	Install Feedwell/Sludge Hopper Clarifier No.1	3	25-Feb-28	29-Feb-28
A-SC1-PM-1040	Install 14" RAS Line Clarifier No.1	3	01-Mar-28	03-Mar-28
A-SC1-PM-1050	Install Scum Skimmer/ Scum Box Clarifier No.1	3	06-Mar-28	08-Mar-28
A-SC1-PM-1060	Install Drive Platform & Drive Unit Clarifier No.1	3	09-Mar-28	13-Mar-28
A-SC1-PM-1070	Install Squeegee Clarifier No.1	4	14-Mar-28	17-Mar-28
A-SC1-PM-1080	Level Clarifier No.1	4	20-Mar-28	23-Mar-28
A-SC1-PM-1100	Install 2" Gate Valve Box	2	24-Mar-28	27-Mar-28
A-SC1-PM-1090	Install & Test Copper Spray Nozzles Clarifier No. 1	7	28-Mar-28	05-Apr-28
Architectural		79	04-Jan-28	21-Apr-28
A-SC1-ARCH-1000	Install Scum Baffle/ Effluent Weir Brackets Clarifier No.1	15	04-Jan-28	24-Jan-28
A-SC1-ARCH-1010	Reinstall Canopy Over Clarifiers No. 1	7	06-Apr-28	14-Apr-28
A-SC1-ARCH-1040	Install Launder Brushes Clarifier No.1	3	19-Apr-28	21-Apr-28
Electrical		85	07-Dec-27	05-Apr-28
A-SC1-ELEC-1000	Electrical Make Safe & Demo Raceway & Conductors Clarifier No.1	3	07-Dec-27	09-Dec-27
A-SC1-ELEC-1010	Install Local Control Panel Clarifier No.1	1	24-Mar-28	24-Mar-28
A-SC1-ELEC-1040	Install Outlets & Light Pole Clarifier No. 1	1	24-Mar-28	24-Mar-28
A-SC1-ELEC-1020	Install Conduit Clarifier No.1	5	27-Mar-28	31-Mar-28
A-SC1-ELEC-1030	Pull Wire & Term Clarifier No.1	3	03-Apr-28	05-Apr-28
Concrete		89	05-Oct-27	10-Feb-28
A-SC1-CONC-1050	Core for 6" Scum Line	1	05-Oct-27	05-Oct-27
A-SC1-CONC-1060	Pour Back 6" Core for Scum Line	5	11-Oct-27	15-Oct-27
A-SC1-CONC-1000	Pour 2" Grout Topping Slab	3	25-Jan-28	27-Jan-28
A-SC1-CONC-1010	Launder Grout Topping	1	28-Jan-28	28-Jan-28
A-SC1-CONC-1020	Cure 2" Grout Topping Slab	10	28-Jan-28	10-Feb-28
Startup		20	17-Apr-28	12-May-28
A-SC1-CX-1000	Vendor Check-out Clarifier No. 1	2	17-Apr-28	18-Apr-28
A-SC1-CX-1010	Startup / Preformance Run Time Clarifier No. 1	5	24-Apr-28	28-Apr-28
A-SC1-CX-1020	McC Punchlist & Corrections Clarifier No. 1	5	01-May-28	05-May-28
A-SC1-CX-1030	Clarifier No. 1 CX	5	08-May-28	12-May-28
Clarifier No. 2		326	20-Aug-27	04-Dec-28
MOPO		118	01-Jun-28	16-Nov-28
A-SC2-MOPO-1000	MOPO - Drain/Isolate/Clean Clarifier No. 2	6	01-Jun-28	08-Jun-28
A-SC2-MOPO-1020	MOPO - Duration Clarifier No. 2 Shut Down for Upgrades	118	01-Jun-28	16-Nov-28
Demo		33	09-Jun-28	27-Jul-28
A-SC2-DEMO-1020	Demo Canopy Over Clarifier No. 2	3	09-Jun-28	13-Jun-28
A-SC2-DEMO-1010	Demo Clarifier No. 2	15	14-Jun-28	06-Jul-28
A-SC2-DEMO-1030	Roughen Surface - Clarifier No. 2	15	07-Jul-28	27-Jul-28
Civil		14	20-Aug-27	09-Sep-27
A-SC2-CVL-1240	Excavate & Remove 6" Scum Line	3	20-Aug-27	24-Aug-27
A-SC2-CVL-1250	Backfill 6" Scum Line	2	08-Sep-27	09-Sep-27
Mechanical Equipment		295	26-Aug-27	24-Oct-28
A-SC2-PM-1130	Install 6" Scum Line	3	26-Aug-27	30-Aug-27
A-SC2-PM-1000	Install Center Pier/Drive Cage Clarifier No. 2	2	30-Aug-28	31-Aug-28
A-SC2-PM-1010	Install Spiral Rake, Arm Clarifier No. 2	5	01-Sep-28	08-Sep-28
A-SC2-PM-1020	Install Access Walkway, Stairs, Guardrail, & Copper Spray Header Clarifier No. 2	3	11-Sep-28	13-Sep-28



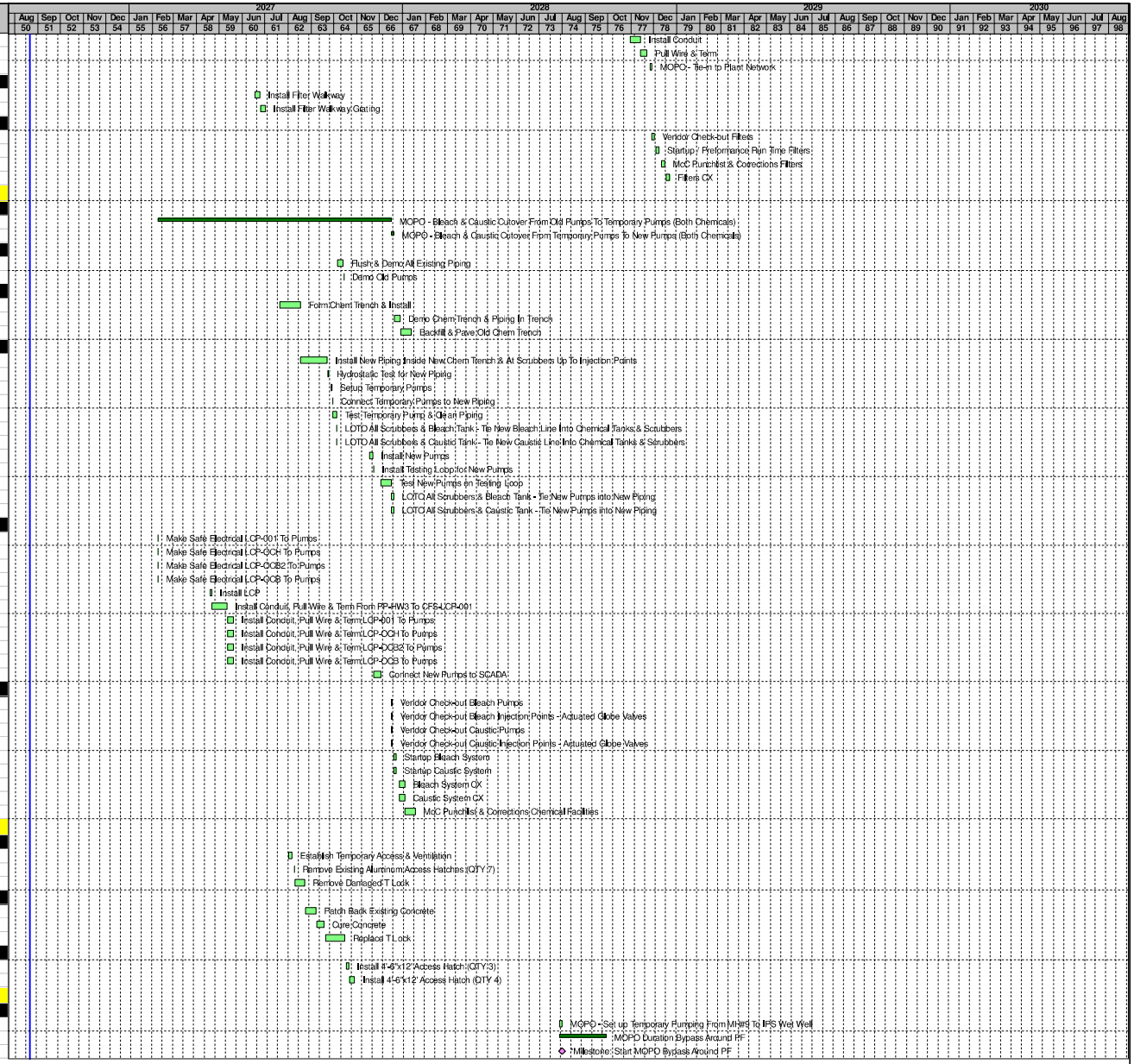
Activity ID	Activity Name	Orig Dur	Start	Finish
A-SC2-PM-1030	Install Feedwell/Sludge Hopper Clarifier No. 2	3	14-Sep-28	18-Sep-28
A-SC2-PM-1040	Install 14" RAS Line Clarifier No. 2	3	19-Sep-28	21-Sep-28
A-SC2-PM-1050	Install Scum Skimmer/ Scum Box Clarifier No. 2	3	22-Sep-28	26-Sep-28
A-SC2-PM-1060	Install Drive Platform & Drive Unit Clarifier No. 2	3	27-Sep-28	29-Sep-28
A-SC2-PM-1070	Install Squeegee Clarifier No. 2	4	02-Oct-28	05-Oct-28
A-SC2-PM-1080	Level Clarifier No. 2	4	06-Oct-28	11-Oct-28
A-SC2-PM-1100	Install 2" Gate Valve Box	2	12-Oct-28	13-Oct-28
A-SC2-PM-1090	Install & Test Copper Spray Nozzles Clarifier No. 2	7	16-Oct-28	24-Oct-28
Architectural		89	07-Jul-28	09-Nov-28
A-SC2-ARCH-1000	Install Scum Baffle/ Effluent Weir Brackets Clarifier No. 2	15	07-Jul-28	27-Jul-28
A-SC1-ARCH-1020	Reinstall Canopy Over Clarifiers No. 2	7	25-Oct-28	02-Nov-28
A-SC2-ARCH-1010	Install Launder Brushes Clarifier No. 2	3	07-Nov-28	09-Nov-28
Electrical		95	09-Jun-28	24-Oct-28
A-SC2-ELEC-1000	Electrical Make Safe & Demo Raceway & Conductors Clarifier No. 2	1	09-Jun-28	09-Jun-28
A-SC2-ELEC-1010	Install Local Control Panel Clarifier No. 2	1	12-Oct-28	12-Oct-28
A-SC2-ELEC-1040	Install Outlets & Light Pole Clarifier No. 2	1	12-Oct-28	12-Oct-28
A-SC2-ELEC-1020	Install Conduit Clarifier No. 2	5	13-Oct-28	19-Oct-28
A-SC2-ELEC-1030	Pull Wire & Term Clarifier No. 2	3	20-Oct-28	24-Oct-28
Concrete		247	25-Aug-27	15-Aug-28
A-SC2-CONC-1070	Core for 6" Scum Line	1	25-Aug-27	25-Aug-27
A-SC2-CONC-1080	Pour Back 6" Core for Scum Line	5	31-Aug-27	07-Sep-27
A-SC2-CONC-1000	Pour 2" Grout Topping Slab	3	28-Jul-28	01-Aug-28
A-SC2-CONC-1010	Launder Grout Topping	1	02-Aug-28	02-Aug-28
A-SC2-CONC-1020	Cure 2" Grout Topping Slab	10	02-Aug-28	15-Aug-28
Startup		20	03-Nov-28	04-Dec-28
A-SC2-CX-1000	Vendor Check-out Clarifier No. 2	2	03-Nov-28	06-Nov-28
A-SC2-CX-1010	Startup / Preformance Run Time Clarifier No. 2	5	10-Nov-28	16-Nov-28
A-SC2-CX-1020	McC Punchlist & Corrections Clarifier No. 2	5	17-Nov-28	27-Nov-28
A-SC2-CX-1030	Clarifier No. 2 CX	5	28-Nov-28	04-Dec-28
Clarifier No. 3		189	20-Oct-27	19-Jul-28
MOPO		154	24-Nov-27	05-Jul-28
A-SC3-MOPO-1010	MOPO - Replace RAS Valve Clarifier No. 3	0	24-Nov-27	24-Nov-27
A-SC3-MOPO-1000	MOPO - Drain/Isolate/Clean Clarifier No. 3	6	04-Jan-28	11-Jan-28
A-SC3-MOPO-1020	MOPO - Duration Clarifier No. 3 Shut Down for Upgrades	129	04-Jan-28	05-Jul-28
Demo		33	12-Jan-28	25-Feb-28
A-SC3-DEMO-1030	Demo Canopy Over Clarifier No. 3	3	12-Jan-28	14-Jan-28
A-SC3-DEMO-1010	Demo Clarifier No. 3	15	17-Jan-28	04-Feb-28
A-SC3-DEMO-1020	Roughen Surface - Clarifier No. 3	15	07-Feb-28	25-Feb-28
Civil		49	20-Oct-27	30-Dec-27
A-SC3-CVL-1260	Excavate & Remove 6" Scum Line	3	20-Oct-27	22-Oct-27
A-SC3-CVL-1270	Backfill 6" Scum Line	2	05-Nov-27	08-Nov-27
A-SC3-CVL-1010	Expose Actuator Conduits & Pull Back Conductors - Clarifier No. 3	2	24-Nov-27	29-Nov-27
A-SC3-CVL-1020	Excavate RAS Valve with VAC Truck - Clarifier No. 3	5	30-Nov-27	06-Dec-27
A-SC3-CVL-1030	Diver Install Plug - Clarifier No. 3	1	07-Dec-27	07-Dec-27
A-SC3-CVL-1000	MOPO - Remove and Replace Existing RAS Plug Valve + Actuator - Clarifier No. 3	3	08-Dec-27	10-Dec-27
A-SC3-CVL-1040	Visual Test on Pipe Joints - Clarifier No. 3	1	13-Dec-27	13-Dec-27
A-SC3-CVL-1050	Diver Remove Plug - Clarifier No. 3	1	14-Dec-27	14-Dec-27
A-SC3-CVL-1060	Backfill Excavation - Clarifier No. 3	3	15-Dec-27	17-Dec-27
A-SC3-CVL-1070	Reinstall Ductbank and Conduit - Clarifier No. 3	5	20-Dec-27	27-Dec-27
A-SC3-CVL-1080	Final Backfill to Grade - Clarifier No. 3	1	28-Dec-27	28-Dec-27
A-SC3-CVL-1090	Complete Conduit and Terminations - Clarifier No. 3	1	29-Dec-27	29-Dec-27
A-SC3-CVL-1100	Start up & Testing RAS Valve Actuator - Clarifier No. 3	1	30-Dec-27	30-Dec-27
Mechanical Equipment		152	26-Oct-27	31-May-28
A-SC3-PM-1140	Install 6" Scum Line	3	26-Oct-27	28-Oct-27
A-SC3-PM-1000	Install Center Pier/Drive Cage Clarifier No. 3	2	06-Apr-28	07-Apr-28
A-SC3-PM-1010	Install Spiral Rake, Arm Clarifier No. 3	5	10-Apr-28	14-Apr-28
A-SC3-PM-1020	Install Access Walkway, Stairs, Guardrail, & Copper Spray Header Clarifier No. 3	3	17-Apr-28	19-Apr-28
A-SC3-PM-1030	Install Feedwell/Sludge Hopper Clarifier No. 3	3	20-Apr-28	24-Apr-28
A-SC3-PM-1040	Install 14" RAS Line Clarifier No. 3	3	25-Apr-28	27-Apr-28
A-SC3-PM-1050	Install Scum Skimmer/ Scum Box Clarifier No. 3	3	28-Apr-28	02-May-28
A-SC3-PM-1060	Install Drive Platform & Drive Unit Clarifier No. 3	3	03-May-28	05-May-28
A-SC3-PM-1070	Install Squeegee Clarifier No. 3	4	08-May-28	11-May-28
A-SC3-PM-1080	Level Clarifier No. 3	4	12-May-28	17-May-28
A-SC3-PM-1100	Install 2" Gate Valve Box	2	18-May-28	19-May-28
A-SC3-PM-1090	Install & Test Copper Spray Nozzles Clarifier No. 3	7	22-May-28	31-May-28
Architectural		100	07-Feb-28	26-Jun-28
A-SC3-ARCH-1000	Scum Baffle/ Effluent Weir Brackets Clarifier No. 3	15	07-Feb-28	25-Feb-28
A-SC1-ARCH-1030	Reinstall Canopy Over Clarifiers No. 3	7	01-Jun-28	09-Jun-28
A-SC3-ARCH-1010	Install Launder Brushes Clarifier No. 3	3	22-Jun-28	26-Jun-28
Electrical		100	12-Jan-28	31-May-28
A-SC3-ELEC-1000	Electrical Make Safe & Demo Raceway & Conductors Clarifier No. 3	1	12-Jan-28	12-Jan-28
A-SC3-ELEC-1010	Install Local Control Panel Clarifier No. 3	1	18-May-28	18-May-28
A-SC3-ELEC-1040	Install Outlets & Light Pole Clarifier No. 3	1	18-May-28	18-May-28
A-SC3-ELEC-1020	Install Conduit Clarifier No. 3	5	19-May-28	25-May-28
A-SC3-ELEC-1030	Pull Wire & Term Clarifier No. 3	3	26-May-28	31-May-28
Concrete		166	25-Oct-27	19-Jun-28



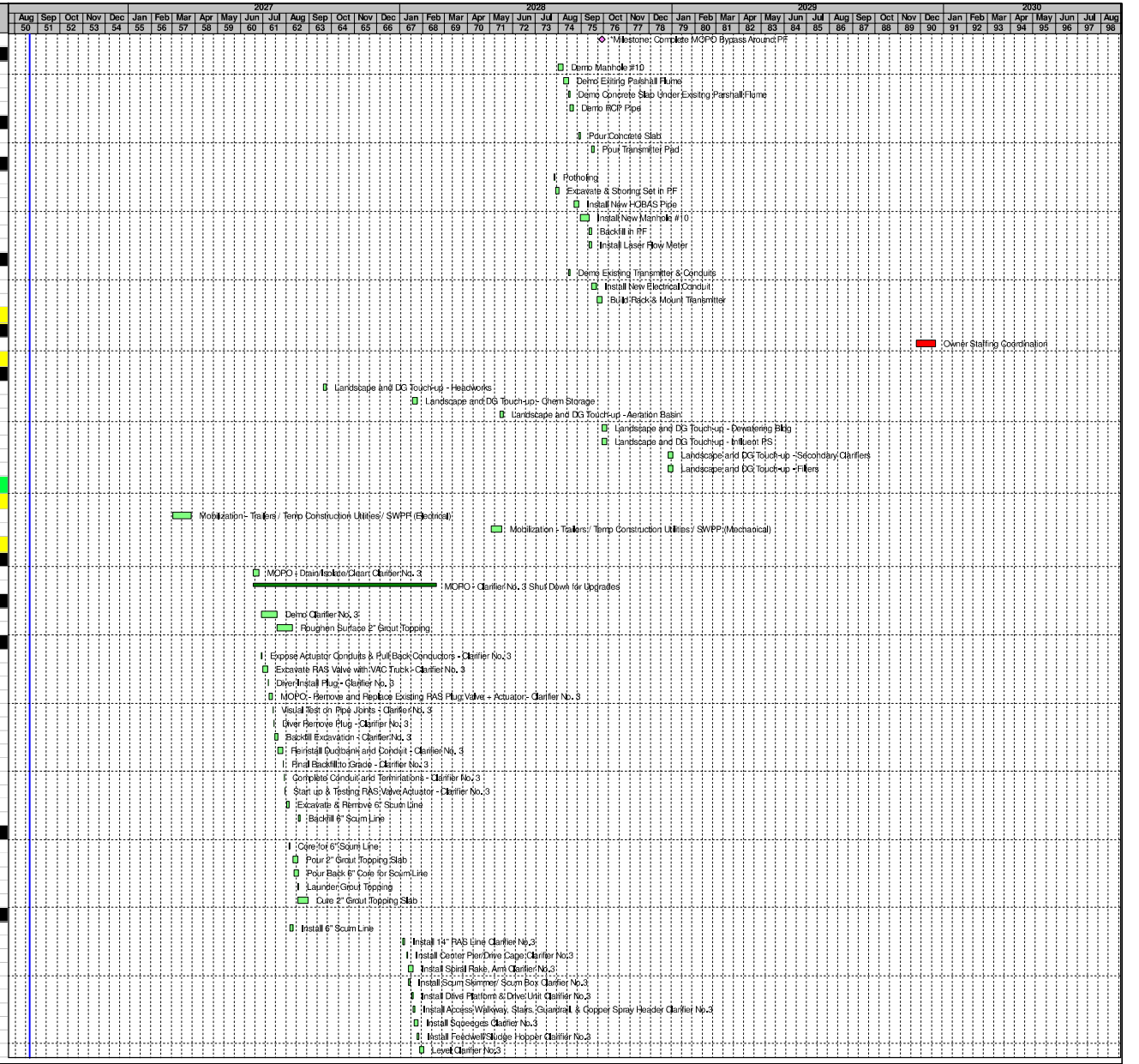
Activity ID	Activity Name	Orig Dur	Start	Finish
A-SC3-CONC-1090	Core for 6" Scum Line	1	25-Oct-27	25-Oct-27
A-SC3-CONC-1100	Pour Back 6" Core for Scum Line	5	29-Oct-27	04-Nov-27
A-SC3-CONC-1000	Pour 2" Grout Topping Slab	3	01-Jun-28	05-Jun-28
A-SC3-CONC-1010	Launder Grout Topping	1	06-Jun-28	06-Jun-28
A-SC3-CONC-1020	Cure 2" Grout Topping Slab	10	06-Jun-28	19-Jun-28
Startup		20	20-Jun-28	19-Jul-28
A-SC3-CX-1000	Vendor Check-out Clarifier No. 3	2	20-Jun-28	21-Jun-28
A-SC3-CX-1010	Startup / Preformance Run Time Clarifier No. 3	5	27-Jun-28	05-Jul-28
A-SC3-CX-1020	McC Punchlist & Corrections Clarifier No. 3	5	06-Jul-28	12-Jul-28
A-SC3-CX-1030	Clarifier No. 3 CX	5	13-Jul-28	19-Jul-28
Clarifier No. 4		348	10-Sep-27	25-Jan-29
MOPO		121	20-Jul-28	11-Jan-29
A-SC4-MOPO-1000	MOPO - Drain/Isolate/Clean Clarifier No. 4	6	20-Jul-28	27-Jul-28
A-SC4-MOPO-1010	MOPO - Clarifier No. 4 Shut Down for Upgrades	121	20-Jul-28	11-Jan-29
Demo		38	28-Jul-28	20-Sep-28
A-SC4-DEMO-1000	Demo Canopy Over Clarifier No. 4	8	28-Jul-28	08-Aug-28
A-SC4-DEMO-1010	Demo Clarifier No. 4	15	09-Aug-28	29-Aug-28
A-SC4-DEMO-1020	Roughen Surface - Clarifier No. 4	15	30-Aug-28	20-Sep-28
Civil		14	10-Sep-27	29-Sep-27
A-SC4-CVL-1280	Excavate & Remove 6" Scum Line	3	10-Sep-27	14-Sep-27
A-SC4-CVL-1290	Backfill 6" Scum Line	2	28-Sep-27	29-Sep-27
Mechanical Equipment		320	16-Sep-27	20-Dec-28
A-SC4-PM-1150	Install 6" Scum Line	3	16-Sep-27	20-Sep-27
A-SC4-PM-1000	Install Center Pier/Drive Cage Clarifier No.4	2	25-Oct-28	26-Oct-28
A-SC4-PM-1010	Install Spiral Rake, Arm Clarifier No.4	5	27-Oct-28	02-Nov-28
A-SC4-PM-1020	Install Access Walkway, Stairs, Guardrail, & Copper Spray Header Clarifier No.4	3	03-Nov-28	07-Nov-28
A-SC4-PM-1030	Install Feedwell/Sludge Hopper Clarifier No.4	3	08-Nov-28	10-Nov-28
A-SC4-PM-1040	Install 14" RAS Line Clarifier No.4	3	13-Nov-28	15-Nov-28
A-SC4-PM-1050	Install Scum Skimmer/ Scum Box Clarifier No.4	3	16-Nov-28	20-Nov-28
A-SC4-PM-1060	Install Drive Platform & Drive Unit Clarifier No.4	3	21-Nov-28	27-Nov-28
A-SC4-PM-1070	Install Squeegee Clarifier No.4	4	28-Nov-28	01-Dec-28
A-SC4-PM-1080	Level Clarifier No.4	4	04-Dec-28	07-Dec-28
A-SC4-PM-1100	Install 2" Gate Valve Box	2	08-Dec-28	11-Dec-28
A-SC4-PM-1090	Install & Test Copper Spray Nozzles Clarifier No. 4	7	12-Dec-28	20-Dec-28
Architectural		87	30-Aug-28	04-Jan-29
A-SC4-ARCH-1000	Install Scum Baffle/ Effluent Weir Brackets Clarifier No.4	15	30-Aug-28	20-Sep-28
A-SC4-ARCH-1010	Reinstall Canopy Over Clarifier No. 4	7	26-Dec-28	04-Jan-29
A-SC4-ARCH-1020	Install Launder Brushes Clarifier No.4	3	26-Dec-28	28-Dec-28
Electrical		101	28-Jul-28	20-Dec-28
A-SC4-ELEC-1000	Electrical Make Safe & Demo Raceway & Conductors Clarifier No. 4	1	28-Jul-28	28-Jul-28
A-SC4-ELEC-1040	Remove and Replace Existing RAS Actuator - Clarifier No. 4	2	30-Aug-28	31-Aug-28
A-SC4-ELEC-1010	Install Local Control Panel Clarifier No.4	1	08-Dec-28	08-Dec-28
A-SC4-ELEC-1050	Install Outlets & Light Pole Clarifier No.4	1	08-Dec-28	08-Dec-28
A-SC4-ELEC-1020	Install Conduit Clarifier No.4	5	11-Dec-28	15-Dec-28
A-SC4-ELEC-1030	Pull Wire & Term Clarifier No.4	3	18-Dec-28	20-Dec-28
Concrete		271	15-Sep-27	09-Oct-28
A-SC4-CONC-1110	Core for 6" Scum Line	1	15-Sep-27	15-Sep-27
A-SC4-CONC-1120	Pour Back 6" Core for Scum Line	5	21-Sep-27	27-Sep-27
A-SC4-CONC-1000	Pour 2" Grout Topping Slab	3	21-Sep-28	25-Sep-28
A-SC4-CONC-1010	Launder Grout Topping	1	26-Sep-28	26-Sep-28
A-SC4-CONC-1020	Cure 2" Grout Topping Slab	10	26-Sep-28	09-Oct-28
Startup		24	21-Dec-28	25-Jan-29
A-SC4-CX-1000	Vendor Check-out Clarifier No. 4	2	21-Dec-28	22-Dec-28
A-SC4-CX-1010	Startup / Preformance Run Time Clarifier No. 4	5	05-Jan-29	11-Jan-29
A-SC4-CX-1020	McC Punchlist & Corrections Clarifier No. 4	5	12-Jan-29	18-Jan-29
A-SC4-CX-1030	Clarifier No. 4 CX	5	19-Jan-29	25-Jan-29
Filters		427	19-Apr-27	22-Dec-28
Concrete		23	19-Apr-27	19-May-27
A-FLT-CONC-1010	FRP - Backwash Pump Pad	4	19-Apr-27	22-Apr-27
A-FLT-CONC-1000	Grout Filter Basin	2	18-May-27	19-May-27
Mechanical		366	14-May-27	23-Oct-28
A-FLT-PM-1130	Install 4" PVC Mud Valve	2	14-May-27	17-May-27
A-FLT-PM-1020	Install Influent Weir Box	2	13-Sep-28	14-Sep-28
A-FLT-PM-1010	Install 3" PVC Solids Collection Manifold	5	15-Sep-28	21-Sep-28
A-FLT-PM-1030	Install Filter Drive	2	15-Sep-28	18-Sep-28
A-FLT-PM-1040	Install Filter Drive Chain	2	19-Sep-28	20-Sep-28
A-FLT-PM-1060	Install Center Tube	3	21-Sep-28	25-Sep-28
A-FLT-PM-1000	Layout Manifold	1	22-Sep-28	22-Sep-28
A-FLT-PM-1070	Install Brackets	3	26-Sep-28	28-Sep-28
A-FLT-PM-1080	Install Cloth Media	2	29-Sep-28	02-Oct-28
A-FLT-PM-1090	Install Backwash Pumps	3	03-Oct-28	05-Oct-28
A-FLT-PM-1100	Install 3" Gate Valve	1	06-Oct-28	06-Oct-28
A-FLT-PM-1110	Install 3" Ball Valve	1	09-Oct-28	09-Oct-28
A-FLT-PM-1120	Install Backwash Piping	10	10-Oct-28	23-Oct-28
Electrical		24	24-Oct-28	28-Nov-28
A-FLT-ELEC-1000	Install Electrical Equipment (Incld VCP & LCP)	5	24-Oct-28	30-Oct-28



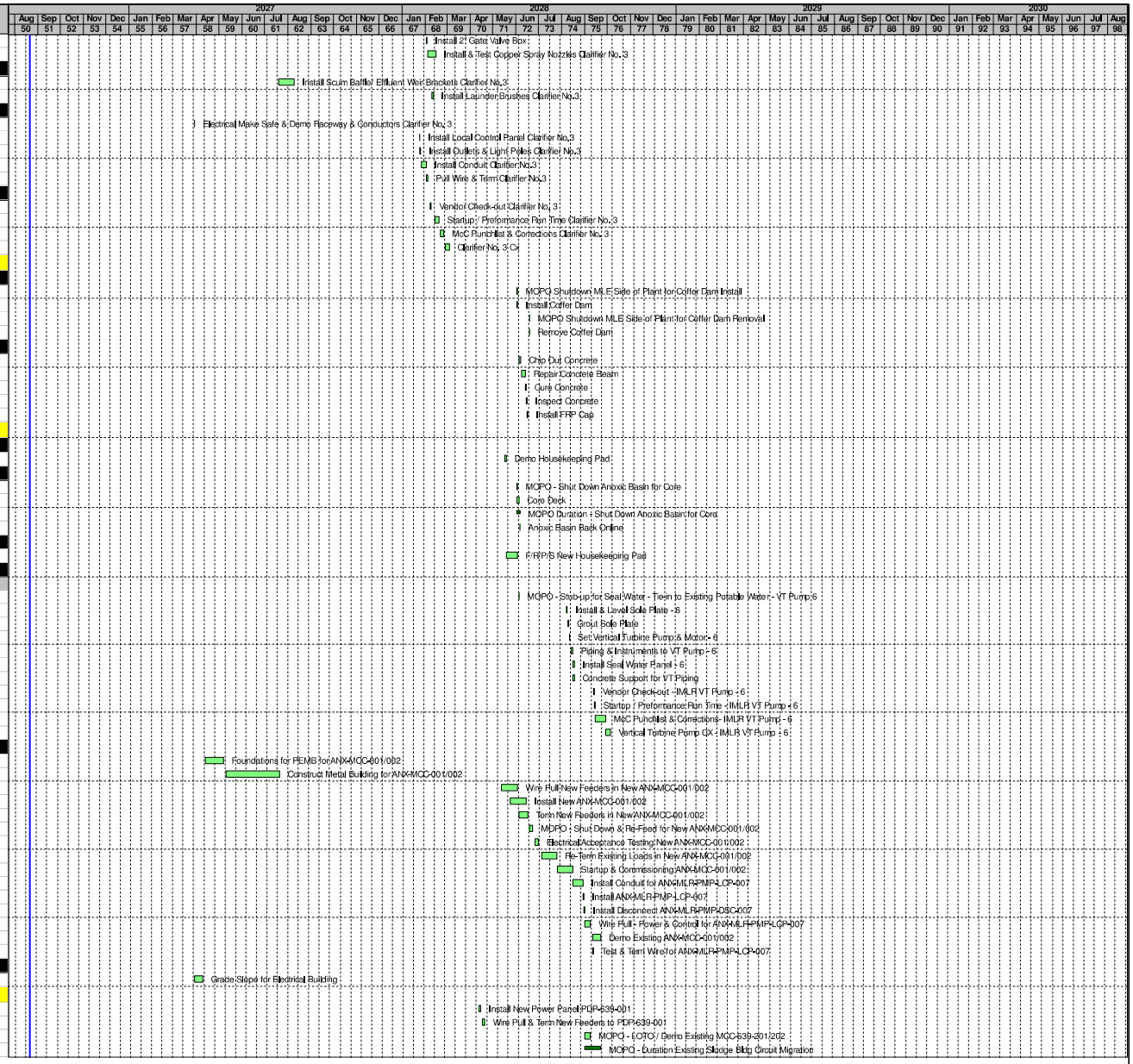
Activity ID	Activity Name	Orig Dur	Start	Finish
A-FLT-ELEC-1010	Install Conduit	10	31-Oct-28	13-Nov-28
A-FLT-ELEC-1020	Pull Wire & Term	7	14-Nov-28	22-Nov-28
A-FLT-ELEC-1030	MOPO - Tie-in to Plant Network	2	27-Nov-28	28-Nov-28
Architectural		10	18-Jun-27	01-Jul-27
A-FLT-ARCH-1000	Install Filter Walkway	5	18-Jun-27	24-Jun-27
A-FLT-ARCH-1010	Install Filter Walkway Grating	5	25-Jun-27	01-Jul-27
Startup		18	29-Nov-28	22-Dec-28
A-FLT-CX-1000	Vendor Check-out Filters	3	29-Nov-28	01-Dec-28
A-FLT-CX-1010	Startup / Preformance Run Time Filters	5	04-Dec-28	08-Dec-28
A-FLT-CX-1030	McC Punchlist & Corrections Filters	5	11-Dec-28	15-Dec-28
A-FLT-CX-1020	Filters CX	5	18-Dec-28	22-Dec-28
Chem Storage		239	08-Feb-27	17-Jan-28
MOPO		221	08-Feb-27	20-Dec-27
A-CHEM-MOPO-3000	MOPO - Bleach & Caustic Cutover From Old Pumps To Temporary Pumps (Both C	219	08-Feb-27	16-Dec-27
A-CHEM-MOPO-3010	MOPO - Bleach & Caustic Cutover From Temporary Pumps To New Pumps (Both (	2	17-Dec-27	20-Dec-27
Demo		7	06-Oct-27	14-Oct-27
A-CHEM-DEMO-3000	Flush & Demo All Existing Piping	6	06-Oct-27	13-Oct-27
A-CHEM-DEMO-3010	Demo Old Pumps	1	14-Oct-27	14-Oct-27
Concrete		121	21-Jul-27	12-Jan-28
A-CHEM-CONC-1000	Form Chem Trench & Install	20	21-Jul-27	17-Aug-27
A-CHEM-CONC-1010	Demo Chem Trench & Piping In Trench	5	21-Dec-27	28-Dec-27
A-CHEM-CONC-1020	Backfill & Pave Old Chem Trench	10	29-Dec-27	12-Jan-28
Mechanical		86	18-Aug-27	20-Dec-27
A-CHEM-PM-4000	Install New Piping Inside New Chem Trench & At Scrubbers Up To Injection Points	25	18-Aug-27	22-Sep-27
A-CHEM-PM-4010	Hydrostatic Test for New Piping	2	23-Sep-27	24-Sep-27
A-CHEM-PM-4020	Setup Temporary Pumps	2	27-Sep-27	28-Sep-27
A-CHEM-PM-4030	Connect Temporary Pumps to New Piping	1	29-Sep-27	29-Sep-27
A-CHEM-PM-4040	Test Temporary Pump & Clean Piping	3	30-Sep-27	04-Oct-27
A-CHEM-PM-4050	LOTO All Scrubbers & Bleach Tank - Tie New Bleach Line Into Chemical Tanks & S	1	05-Oct-27	05-Oct-27
A-CHEM-PM-4060	LOTO All Scrubbers & Caustic Tank - Tie New Caustic Line Into Chemical Tanks &	1	05-Oct-27	05-Oct-27
A-CHEM-PM-4070	Install New Pumps	3	18-Nov-27	22-Nov-27
A-CHEM-PM-4080	Install Testing Loop for New Pumps	1	23-Nov-27	23-Nov-27
A-CHEM-PM-4090	Test New Pumps on Testing Loop	10	03-Dec-27	16-Dec-27
A-CHEM-PM-4100	LOTO All Scrubbers & Bleach Tank - Tie New Pumps into New Piping	2	17-Dec-27	20-Dec-27
A-CHEM-PM-4110	LOTO All Scrubbers & Caustic Tank - Tie New Pumps into New Piping	2	17-Dec-27	20-Dec-27
Electrical		209	08-Feb-27	02-Dec-27
A-CHEM-ELEC-1000	Make Safe Electrical LCP-001 To Pumps	1	08-Feb-27	08-Feb-27
A-CHEM-ELEC-1040	Make Safe Electrical LCP-OCH To Pumps	1	08-Feb-27	08-Feb-27
A-CHEM-ELEC-1060	Make Safe Electrical LCP-OCB2 To Pumps	1	08-Feb-27	08-Feb-27
A-CHEM-ELEC-1080	Make Safe Electrical LCP-OCB To Pumps	1	08-Feb-27	08-Feb-27
A-CHEM-ELEC-1010	Install LCP	2	19-Apr-27	20-Apr-27
A-CHEM-ELEC-1020	Install Conduit, Pull Wire & Term From PP-HW3 To CFS-LCP-001	15	21-Apr-27	11-May-27
A-CHEM-ELEC-1030	Install Conduit, Pull Wire & Term LCP-001 To Pumps	6	12-May-27	19-May-27
A-CHEM-ELEC-1050	Install Conduit, Pull Wire & Term LCP-OCH To Pumps	6	12-May-27	19-May-27
A-CHEM-ELEC-1070	Install Conduit, Pull Wire & Term LCP-OCB2 To Pumps	6	12-May-27	19-May-27
A-CHEM-ELEC-1090	Install Conduit, Pull Wire & Term LCP-OCB To Pumps	6	12-May-27	19-May-27
A-CHEM-ELEC-1100	Connect New Pumps to SCADA	6	23-Nov-27	02-Dec-27
Startup		20	17-Dec-27	17-Jan-28
A-CHEM-CX-3000	Vendor Check-out Bleach Pumps	1	17-Dec-27	17-Dec-27
A-CHEM-CX-3010	Vendor Check-out Bleach Injection Points - Actuated Globe Valves	1	17-Dec-27	17-Dec-27
A-CHEM-CX-3020	Vendor Check-out Caustic Pumps	1	17-Dec-27	17-Dec-27
A-CHEM-CX-3030	Vendor Check-out Caustic Injection Points - Actuated Globe Valves	1	17-Dec-27	17-Dec-27
A-CHEM-CX-3040	Startup Bleach System	4	20-Dec-27	23-Dec-27
A-CHEM-CX-3050	Startup Caustic System	4	20-Dec-27	23-Dec-27
A-CHEM-CX-3060	Bleach System CX	5	27-Dec-27	03-Jan-28
A-CHEM-CX-3070	Caustic System CX	5	27-Dec-27	03-Jan-28
A-CHEM-CX-3080	McC Punchlist & Corrections Chemical Facilities	10	04-Jan-28	17-Jan-28
Influent Pump Station		63	02-Aug-27	28-Oct-27
Demo		16	02-Aug-27	23-Aug-27
A-IPS-DEMO-1020	Establish Temporary Access & Ventilation	5	02-Aug-27	06-Aug-27
A-IPS-DEMO-1000	Remove Existing Aluminum Access Hatches (QTY 7)	1	09-Aug-27	09-Aug-27
A-IPS-DEMO-1010	Remove Damaged T Lock	10	10-Aug-27	23-Aug-27
Concrete		38	24-Aug-27	15-Oct-27
A-IPS-CONC-1000	Patch Back Existing Concrete	10	24-Aug-27	07-Sep-27
A-IPS-CONC-1010	Cure Concrete	8	08-Sep-27	17-Sep-27
A-IPS-CONC-1020	Replace T Lock	20	20-Sep-27	15-Oct-27
Architectural		9	18-Oct-27	28-Oct-27
A-IPS-ARCH-1020	Install 4'-6"x12' Access Hatch (QTY 3)	4	18-Oct-27	21-Oct-27
A-IPS-ARCH-1030	Install 4'-6"x12' Access Hatch (QTY 4)	5	22-Oct-27	28-Oct-27
Parshall Flume		46	26-Jul-28	28-Sep-28
MOPO		44	28-Jul-28	28-Sep-28
A-PF-MOPO-1000	MOPO - Set up Temporary Pumping From MH#9 To IPS Wet Well	2	28-Jul-28	31-Jul-28
A-PF-MOPO-1030	MOPO Duration Bypass Around PF	44	28-Jul-28	28-Sep-28
A-PF-MOPO-1010	*Milestone: Start MOPO Bypass Around PF	0	01-Aug-28	



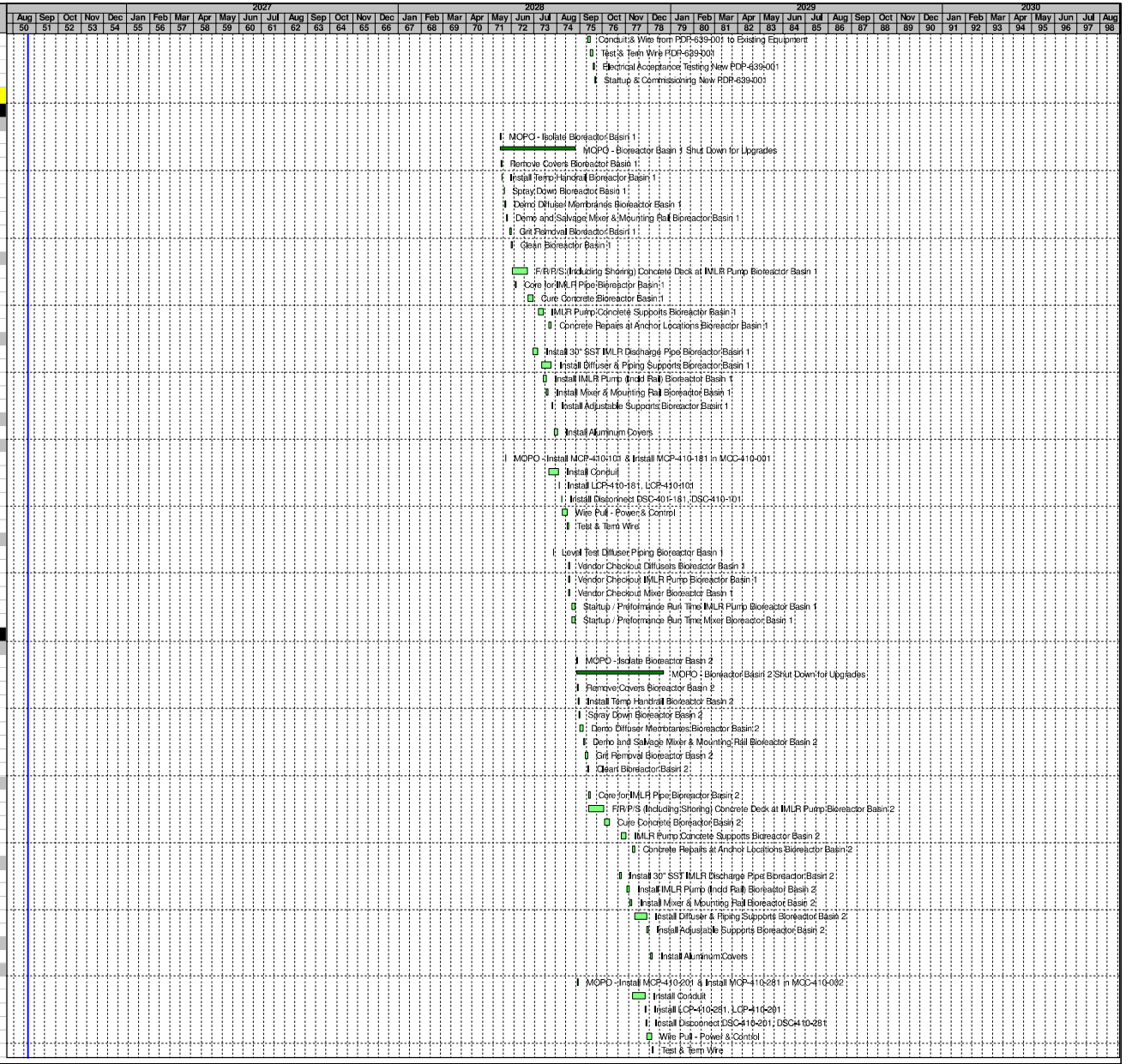
Activity ID	Activity Name	Orig Dur	Start	Finish
A-PF-MOPO-1020	*Milestone: Complete MOPO Bypass Around PF	0		28-Sep-28
Demo		15	01-Aug-28	21-Aug-28
A-PF-MOPO-1050	Demo Manhole #10	5	01-Aug-28	07-Aug-28
A-PF-MOPO-1040	Demo Exiting Parshall Flume	5	08-Aug-28	14-Aug-28
A-PF-MOPO-1060	Demo Concrete Slab Under Exisitng Parshall Flume	2	15-Aug-28	16-Aug-28
A-PF-MOPO-1120	Demo RCP Pipe	3	17-Aug-28	21-Aug-28
Concrete		14	29-Aug-28	18-Sep-28
A-PF-MOPO-1070	Pour Concrete Slab	2	29-Aug-28	30-Aug-28
A-PF-MOPO-1140	Pour Transmitter Pad	2	15-Sep-28	18-Sep-28
Civil		36	26-Jul-28	14-Sep-28
A-PF-MOPO-1150	Potholing	2	26-Jul-28	27-Jul-28
A-PF-MOPO-1080	Excavate & Shoring Set in PF	3	28-Jul-28	01-Aug-28
A-PF-MOPO-1130	Install New HOBAS Pipe	5	22-Aug-28	28-Aug-28
A-PF-MOPO-1100	Install New Manhole #10	7	31-Aug-28	11-Sep-28
A-PF-MOPO-1090	Backfill in PF	3	12-Sep-28	14-Sep-28
A-PF-MOPO-1110	Install Laser Flow Meter	3	12-Sep-28	14-Sep-28
Electrical		32	15-Aug-28	28-Sep-28
A-PF-MOPO-1200	Demo Existing Transmitter & Conduits	2	15-Aug-28	16-Aug-28
A-PF-MOPO-1210	Install New Electrical Conduit	5	15-Sep-28	21-Sep-28
A-PF-MOPO-1220	Build Rack & Mount Transmitter	5	22-Sep-28	28-Sep-28
PLC - Construction		20	26-Nov-29	21-Dec-29
IO Panel - EP - EFF-CPL02		20	26-Nov-29	21-Dec-29
PLC-EP-IO-1060	Owner Staffing Coordination	20	26-Nov-29	21-Dec-29
Site Plan 3		325	20-Sep-27	02-Jan-29
Site Finishes		325	20-Sep-27	02-Jan-29
A-SITE-CVL-1290	Landscape and DG Touch-up - Headworks	5	20-Sep-27	24-Sep-27
A-SITE-CVL-1270	Landscape and DG Touch-up - Chem Storage	5	18-Jan-28	24-Jan-28
A-SITE-CVL-1320	Landscape and DG Touch-up - Aeration Basin	5	15-May-28	19-May-28
A-SITE-CVL-1260	Landscape and DG Touch-up - Dewatering Bldg	5	29-Sep-28	05-Oct-28
A-SITE-CVL-1300	Landscape and DG Touch-up - Influent PS	5	29-Sep-28	05-Oct-28
A-SITE-CVL-1280	Landscape and DG Touch-up - Secondary Clarifiers	5	26-Dec-28	02-Jan-29
A-SITE-CVL-1330	Landscape and DG Touch-up - Filters	5	26-Dec-28	02-Jan-29
Ocotillo - Construction		504	01-Mar-27	22-Feb-29
Mobilization		310	01-Mar-27	16-May-28
O-MOB-1020	Mobilization - Trailers / Temp Construction Utilities / SWPP (Electrical)	20	01-Mar-27	26-Mar-27
O-MOB-1000	Mobilization - Trailers / Temp Construction Utilities / SWPP (Mechanical)	10	03-May-28	16-May-28
Clarifier No. 3		238	29-Mar-27	03-Mar-28
MOPO		170	18-Jun-27	18-Feb-28
O-SC3-MOPO-1000	MOPO - Drain/Isolate/Clean Clarifier No. 3	6	18-Jun-27	25-Jun-27
O-SC3-MOPO-1010	MOPO - Clarifier No. 3 Shut Down for Upgrades	170	18-Jun-27	18-Feb-28
Demo		30	28-Jun-27	09-Aug-27
O-SC3-DEMO-1000	Demo Clarifier No. 3	15	28-Jun-27	19-Jul-27
O-SC3-DEMO-1010	Roughen Surface 2" Grout Topping	15	20-Jul-27	09-Aug-27
Civil		38	28-Jun-27	19-Aug-27
O-SC3-CVL-1110	Expose Actuator Conduits & Pull Back Conductors - Clarifier No. 3	2	28-Jun-27	29-Jun-27
O-SC3-CVL-1120	Excavate RAS Valve with VAC Truck - Clarifier No. 3	5	30-Jun-27	07-Jul-27
O-SC3-CVL-1130	Diver Install Plug - Clarifier No. 3	1	08-Jul-27	08-Jul-27
O-SC3-CVL-1140	MOPO - Remove and Replace Existing RAS Plug Valve + Actuator - Clarifier No. 3	3	09-Jul-27	13-Jul-27
O-SC3-CVL-1150	Visual Test on Pipe Joints - Clarifier No. 3	1	14-Jul-27	14-Jul-27
O-SC3-CVL-1160	Diver Remove Plug - Clarifier No. 3	1	15-Jul-27	15-Jul-27
O-SC3-CVL-1170	Backfill Excavation - Clarifier No. 3	3	16-Jul-27	20-Jul-27
O-SC3-CVL-1180	Reinstall Ductbank and Conduit - Clarifier No. 3	5	21-Jul-27	27-Jul-27
O-SC3-CVL-1190	Final Backfill to Grade - Clarifier No. 3	1	28-Jul-27	28-Jul-27
O-SC3-CVL-1200	Complete Conduit and Terminations - Clarifier No. 3	1	29-Jul-27	29-Jul-27
O-SC3-CVL-1210	Start up & Testing RAS Valve Actuator - Clarifier No. 3	1	30-Jul-27	30-Jul-27
O-SC3-CVL-1000	Excavate & Remove 6" Scum Line	3	02-Aug-27	04-Aug-27
O-SC3-CVL-1010	Backfill 6" Scum Line	2	18-Aug-27	19-Aug-27
Concrete		18	05-Aug-27	30-Aug-27
O-SC3-CONC-1030	Core for 6" Scum Line	1	05-Aug-27	05-Aug-27
O-SC3-CONC-1000	Pour 2" Grout Topping Slab	5	10-Aug-27	16-Aug-27
O-SC3-CONC-1040	Pour Back 6" Core for Scum Line	5	11-Aug-27	17-Aug-27
O-SC3-CONC-1010	Launder Grout Topping	1	17-Aug-27	17-Aug-27
O-SC3-CONC-1020	Cure 2" Grout Topping Slab	10	17-Aug-27	30-Aug-27
Mechanical Equipment		132	06-Aug-27	14-Feb-28
O-SC3-PM-1100	Install 6" Scum Line	3	06-Aug-27	10-Aug-27
O-SC3-PM-1040	Install 14" RAS Line Clarifier No.3	3	05-Jan-28	07-Jan-28
O-SC3-PM-1000	Install Center Pier/Drive Cage Clarifier No.3	2	10-Jan-28	11-Jan-28
O-SC3-PM-1010	Install Spiral Rake, Arm Clarifier No.3	5	12-Jan-28	18-Jan-28
O-SC3-PM-1050	Install Scum Skimmer/ Scum Box Clarifier No.3	3	12-Jan-28	14-Jan-28
O-SC3-PM-1060	Install Drive Platform & Drive Unit Clarifier No.3	3	17-Jan-28	19-Jan-28
O-SC3-PM-1020	Install Access Walkway, Stairs, Guardrail, & Copper Spray Header Clarifier No.3	3	19-Jan-28	21-Jan-28
O-SC3-PM-1070	Install Squeegee Clarifier No.3	4	20-Jan-28	25-Jan-28
O-SC3-PM-1030	Install Feedwell/Sludge Hopper Clarifier No.3	3	24-Jan-28	26-Jan-28
O-SC3-PM-1080	Level Clarifier No.3	4	27-Jan-28	01-Feb-28



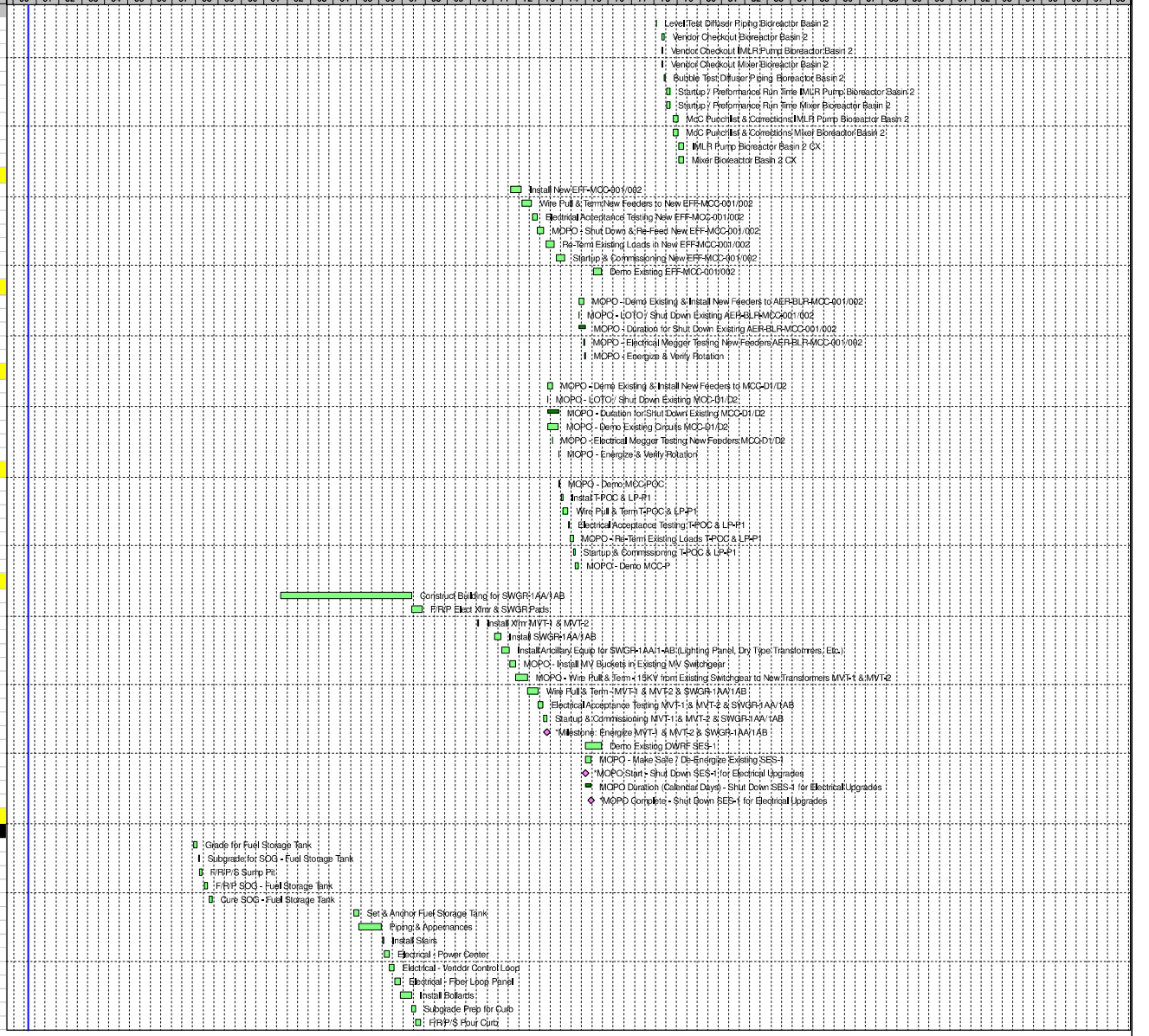
Activity ID	Activity Name	Orig Dur	Start	Finish
O-SC3-PM-1110	Install 2" Gate Valve Box	2	02-Feb-28	03-Feb-28
O-SC3-PM-1090	Install & Test Copper Spray Nozzles Clarifier No. 3	7	04-Feb-28	14-Feb-28
Architectural		144	20-Jul-27	11-Feb-28
O-SC3-ARCH-1000	Install Scum Baffle/ Effluent Weir Brackets Clarifier No.3	15	20-Jul-27	09-Aug-27
O-SC3-ARCH-1010	Install Launder Brushes Clarifier No.3	3	09-Feb-28	11-Feb-28
Electrical		218	29-Mar-27	04-Feb-28
O-SC3-ELEC-1000	Electrical Make Safe & Demo Raceway & Conductors Clarifier No. 3	1	29-Mar-27	29-Mar-27
O-SC3-ELEC-1010	Install Local Control Panel Clarifier No.3	1	24-Jan-28	24-Jan-28
O-SC3-ELEC-1040	Install Outlets & Light Poles Clarifier No.3	2	24-Jan-28	25-Jan-28
O-SC3-ELEC-1020	Install Conduit Clarifier No.3	5	26-Jan-28	01-Feb-28
O-SC3-ELEC-1030	Pull Wire & Term Clarifier No.3	3	02-Feb-28	04-Feb-28
Startup		20	07-Feb-28	03-Mar-28
O-SC3-CX-1000	Vendor Check-out Clarifier No. 3	2	07-Feb-28	08-Feb-28
O-SC3-CX-1010	Startup / Preformance Run Time Clarifier No. 3	5	14-Feb-28	18-Feb-28
O-SC3-CX-1120	McC Punchlist & Corrections Clarifier No. 3	5	21-Feb-28	25-Feb-28
O-SC3-CX-1130	Clarifier No. 3 Cx	5	28-Feb-28	03-Mar-28
Effluent Electrical Building		12	02-Jun-28	19-Jun-28
MOPO		12	02-Jun-28	19-Jun-28
O-EFL-MOPO-1000	MOPO Shutdown MLE Side of Plant for Coffer Dam Install	1	02-Jun-28	02-Jun-28
O-EFL-MOPO-1010	Install Coffer Dam	1	02-Jun-28	02-Jun-28
O-EFL-MOPO-1020	MOPO Shutdown MLE Side of Plant for Coffer Dam Removal	1	19-Jun-28	19-Jun-28
O-EFL-MOPO-1030	Remove Coffer Dam	1	19-Jun-28	19-Jun-28
Concrete		10	05-Jun-28	16-Jun-28
O-EFL-CONC-1000	Chip Out Concrete	3	05-Jun-28	07-Jun-28
O-EFL-CONC-1010	Repair Concrete Beam	4	08-Jun-28	13-Jun-28
O-EFL-CONC-1020	Cure Concrete	1	14-Jun-28	14-Jun-28
O-EFL-CONC-1030	Inspect Concrete	1	15-Jun-28	15-Jun-28
O-EFL-CONC-1040	Install FRP Cap	1	16-Jun-28	16-Jun-28
Anoxic Basin		388	29-Mar-27	05-Oct-28
Demo		2	17-May-28	18-May-28
O-ANX-DEMO-1000	Demo Housekeeping Pad	2	17-May-28	18-May-28
MOPO		3	02-Jun-28	06-Jun-28
O-ANX-MOPO-1000	MOPO - Shut Down Anoxic Basin for Core	1	02-Jun-28	02-Jun-28
O-ANX-MOPO-1040	Core Deck	2	02-Jun-28	05-Jun-28
O-ANX-MOPO-1060	MOPO Duration - Shut Down Anoxic Basin for Core	3	02-Jun-28	06-Jun-28
O-ANX-MOPO-1050	Anoxic Basin Back Online	1	06-Jun-28	06-Jun-28
Concrete		10	19-May-28	02-Jun-28
O-ANX-CONC-1000	F/R/P/S New Housekeeping Pad	10	19-May-28	02-Jun-28
Mechanical		86	05-Jun-28	05-Oct-28
New IMLR VT Pump 6		86	05-Jun-28	05-Oct-28
O-ANX-PM-1060	MOPO - Stub-up for Seal Water - Tie-in to Existing Potable Water - VT Pump 6	1	05-Jun-28	05-Jun-28
O-ANX-PM-1000	Install & Level Sole Plate - 6	2	07-Aug-28	08-Aug-28
O-ANX-PM-1010	Grout Sole Plate	2	09-Aug-28	10-Aug-28
O-ANX-PM-1020	Set Vertical Turbine Pump & Motor - 6	1	11-Aug-28	11-Aug-28
O-ANX-PM-1030	Piping & Instruments to VT Pump - 6	2	14-Aug-28	15-Aug-28
O-ANX-PM-1040	Install Seal Water Panel - 6	3	16-Aug-28	18-Aug-28
O-ANX-PM-1050	Concrete Support for VT Piping	3	16-Aug-28	18-Aug-28
O-ANX-PM-1070	Vendor Check-out - IMLR VT Pump - 6	1	13-Sep-28	13-Sep-28
O-ANX-PM-1080	Startup / Preformance Run Time - IMLR VT Pump - 6	1	14-Sep-28	14-Sep-28
O-ANX-PM-1100	McC Punchlist & Corrections- IMLR VT Pump - 6	10	15-Sep-28	28-Sep-28
O-ANX-PM-1090	Vertical Turbine Pump CX - IMLR VT Pump - 6	5	29-Sep-28	05-Oct-28
Electrical		369	12-Apr-27	22-Sep-28
O-ANX-ELEC-2110	Foundations for PEMB for ANX-MCC-001/002	20	12-Apr-27	07-May-27
O-ANX-ELEC-2120	Construct Metal Building for ANX-MCC-001/002	50	10-May-27	20-Jul-27
O-ANX-ELEC-2030	Wire Pull New Feeders in New ANX-MCC-001/002	15	12-May-28	02-Jun-28
O-ANX-ELEC-2010	Install New ANX-MCC-001/002	15	24-May-28	14-Jun-28
O-ANX-ELEC-2150	Term New Feeders in New ANX-MCC-001/002	10	05-Jun-28	16-Jun-28
O-ANX-ELEC-2140	MOPO - Shut Down & Re-Feed for New ANX-MCC-001/002	5	19-Jun-28	23-Jun-28
O-ANX-ELEC-2020	Electrical Acceptance Testing New ANX-MCC-001/002	5	26-Jun-28	30-Jun-28
O-ANX-ELEC-2050	Re-Term Existing Loads in New ANX-MCC-001/002	15	05-Jul-28	25-Jul-28
O-ANX-ELEC-2040	Startup & Commissioning ANX-MCC-001/002	15	26-Jul-28	15-Aug-28
O-ANX-ELEC-2060	Install Conduit for ANX-MLR-PMP-LCP-007	10	16-Aug-28	29-Aug-28
O-ANX-ELEC-2070	Install ANX-MLR-PMP-LCP-007	1	30-Aug-28	30-Aug-28
O-ANX-ELEC-2080	Install Disconnect ANX-MLR-PMP-DSC-007	1	31-Aug-28	31-Aug-28
O-ANX-ELEC-2090	Wire Pull - Power & Control for ANX-MLR-PMP-LCP-007	5	01-Sep-28	08-Sep-28
O-ANX-ELEC-2000	Demo Existing ANX-MCC-001/002	10	11-Sep-28	22-Sep-28
O-ANX-ELEC-2100	Test & Term Wire for ANX-MLR-PMP-LCP-007	2	11-Sep-28	12-Sep-28
Civil		10	29-Mar-27	09-Apr-27
O-ANX-CVL-1000	Grade Slope for Electrical Building	10	29-Mar-27	09-Apr-27
Electrical Upgrades Power Panel PDP-639-001 (MCC-639-201/202)		114	12-Apr-28	22-Sep-28
O-ELEC-1240	Install New Power Panel PDP-639-001	3	12-Apr-28	14-Apr-28
O-ELEC-5020	Wire Pull & Term New Feeders to PDP-639-001	4	17-Apr-28	20-Apr-28
O-ELEC-1270	MOPO - LOTO / Demo Existing MCC-639-201/202	5	01-Sep-28	08-Sep-28
O-ELEC-5010	MOPO - Duration Existing Sludge Bldg Circuit Migration	15	01-Sep-28	22-Sep-28



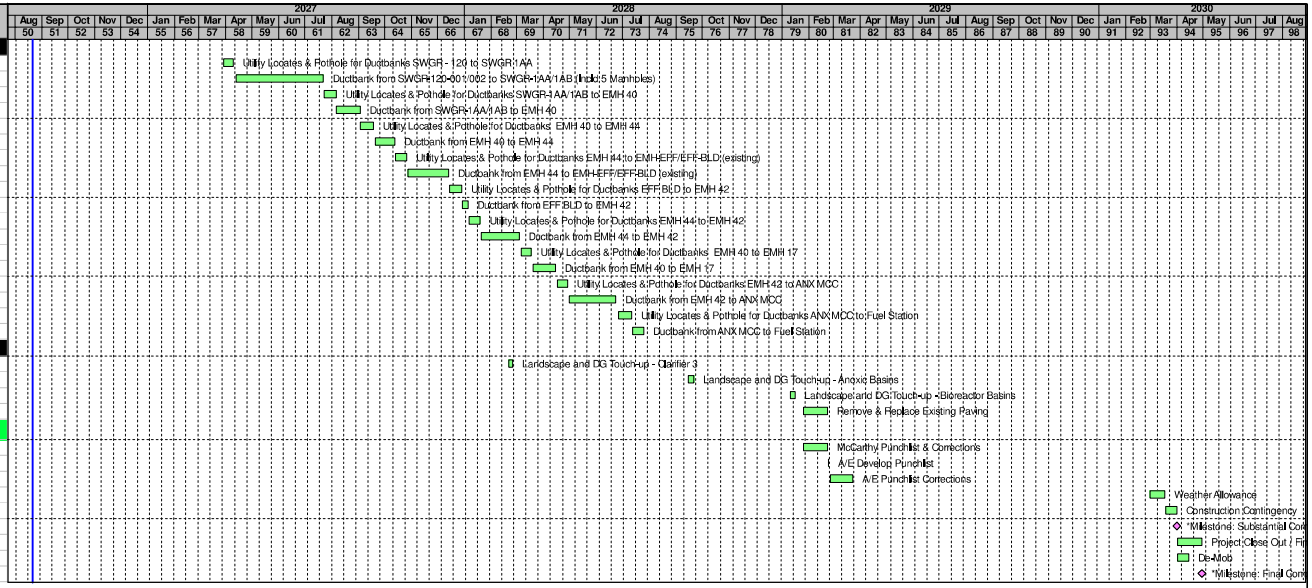
Activity ID	Activity Name	Orig Dur	Start	Finish
O-ELEC-1260	Conduit & Wire from PDP-639-001 to Existing Equipment	4	11-Sep-28	14-Sep-28
O-ELEC-1280	Test & Term Wire PDP-639-001	2	15-Sep-28	18-Sep-28
O-ELEC-1290	Electrical Acceptance Testing New PDP-639-001	2	19-Sep-28	20-Sep-28
O-ELEC-1300	Startup & Commissioning New PDP-639-001	2	21-Sep-28	22-Sep-28
Bioreator Basins		162	17-May-28	09-Jan-29
Bioreator Basin 1		70	17-May-28	25-Aug-28
Demo & Clean		70	17-May-28	25-Aug-28
O-BR1-DEMO-1000	MOPO - Isolate Bioreactor Basin 1	1	17-May-28	17-May-28
O-BR1-DEMO-1070	MOPO - Bioreactor Basin 1 Shut Down for Upgrades	70	17-May-28	25-Aug-28
O-BR1-DEMO-1010	Remove Covers Bioreactor Basin 1	1	18-May-28	18-May-28
O-BR1-DEMO-1020	Install Temp Handrail Bioreactor Basin 1	1	19-May-28	19-May-28
O-BR1-DEMO-1030	Spray Down Bioreactor Basin 1	1	22-May-28	22-May-28
O-BR1-DEMO-1040	Demo Diffuser Membranes Bioreactor Basin 1	2	23-May-28	24-May-28
O-BR1-DEMO-1080	Demo and Salvage Mixer & Mounting Rail Bioreactor Basin 1	2	25-May-28	26-May-28
O-BR1-DEMO-1050	Grit Removal Bioreactor Basin 1	2	30-May-28	31-May-28
O-BR1-DEMO-1060	Clean Bioreactor Basin 1	1	01-Jun-28	01-Jun-28
Concrete		35	02-Jun-28	24-Jul-28
O-BR1-CONC-1000	F/R/P/S (Including Shoring) Concrete Deck at IMLR Pump Bioreactor Basin 1	15	02-Jun-28	22-Jun-28
O-BR1-CONC-1030	Core for IMLR Pipe Bioreactor Basin 1	2	06-Jun-28	07-Jun-28
O-BR1-CONC-1010	Cure Concrete Bioreactor Basin 1	5	23-Jun-28	29-Jun-28
O-BR1-CONC-1090	IMLR Pump Concrete Supports Bioreactor Basin 1	5	07-Jul-28	13-Jul-28
O-BR1-CONC-1060	Concrete Repairs at Anchor Locations Bioreactor Basin 1	2	21-Jul-28	24-Jul-28
Process Mechanical		17	30-Jun-28	26-Jul-28
O-BR1-PM-1020	Install 30" SST IMLR Discharge Pipe Bioreactor Basin 1	3	30-Jun-28	06-Jul-28
O-BR1-PM-1070	Install Diffuser & Piping Supports Bioreactor Basin 1	10	11-Jul-28	24-Jul-28
O-BR1-PM-1040	Install IMLR Pump (Indd Rail) Bioreactor Basin 1	2	14-Jul-28	17-Jul-28
O-BR1-PM-1050	Install Mixer & Mounting Rail Bioreactor Basin 1	3	18-Jul-28	20-Jul-28
O-BR1-PM-1080	Install Adjustable Supports Bioreactor Basin 1	2	25-Jul-28	26-Jul-28
Architectural		3	28-Jul-28	01-Aug-28
O-BR1-ARCH-1000	Install Aluminum Covers	3	28-Jul-28	01-Aug-28
Electrical		58	24-May-28	16-Aug-28
O-BR1-ELEC-1050	MOPO - Install MCP-410-101 & Install MCP-410-181 in MCC-410-001	1	24-May-28	24-May-28
O-BR1-ELEC-1000	Install Conduit	10	21-Jul-28	03-Aug-28
O-BR1-ELEC-1010	Install LCP-410-181, LCP-410-101	1	04-Aug-28	04-Aug-28
O-BR1-ELEC-1020	Install Disconnect DSC-401-181, DSC-410-101	1	07-Aug-28	07-Aug-28
O-BR1-ELEC-1030	Wire Pull - Power & Control	5	08-Aug-28	14-Aug-28
O-BR1-ELEC-1040	Test & Term Wire	2	15-Aug-28	16-Aug-28
Startup & Commissioning		22	27-Jul-28	25-Aug-28
O-BR1-CX-1030	Level Test Diffuser Piping Bioreactor Basin 1	1	27-Jul-28	27-Jul-28
O-BR1-CX-1040	Vendor Checkout Diffusers Bioreactor Basin 1	1	17-Aug-28	17-Aug-28
O-BR1-CX-1000	Vendor Checkout IMLR Pump Bioreactor Basin 1	2	17-Aug-28	18-Aug-28
O-BR1-CX-1010	Vendor Checkout Mixer Bioreactor Basin 1	2	17-Aug-28	18-Aug-28
O-BR1-CX-1060	Startup / Preformance Run Time IMLR Pump Bioreactor Basin 1	5	21-Aug-28	25-Aug-28
O-BR1-CX-1070	Startup / Preformance Run Time Mixer Bioreactor Basin 1	5	21-Aug-28	25-Aug-28
Bioreator Basin 2		92	28-Aug-28	09-Jan-29
Demo & Clean		82	28-Aug-28	22-Dec-28
O-BR2-DEMO-1000	MOPO - Isolate Bioreactor Basin 2	1	28-Aug-28	28-Aug-28
O-BR2-DEMO-1070	MOPO - Bioreactor Basin 2 Shut Down for Upgrades	82	28-Aug-28	22-Dec-28
O-BR2-DEMO-1010	Remove Covers Bioreactor Basin 2	1	29-Aug-28	29-Aug-28
O-BR2-DEMO-1020	Install Temp Handrail Bioreactor Basin 2	1	30-Aug-28	30-Aug-28
O-BR2-DEMO-1030	Spray Down Bioreactor Basin 2	1	31-Aug-28	31-Aug-28
O-BR2-DEMO-1040	Demo Diffuser Membranes Bioreactor Basin 2	2	01-Sep-28	05-Sep-28
O-BR2-DEMO-1080	Demo and Salvage Mixer & Mounting Rail Bioreactor Basin 2	2	06-Sep-28	07-Sep-28
O-BR2-DEMO-1050	Grit Removal Bioreactor Basin 2	2	08-Sep-28	11-Sep-28
O-BR2-DEMO-1060	Clean Bioreactor Basin 2	1	12-Sep-28	12-Sep-28
Concrete		44	13-Sep-28	13-Nov-28
O-BR2-CONC-1030	Core for IMLR Pipe Bioreactor Basin 2	2	13-Sep-28	14-Sep-28
O-BR2-CONC-1000	F/R/P/S (Including Shoring) Concrete Deck at IMLR Pump Bioreactor Basin 2	15	13-Sep-28	03-Oct-28
O-BR2-CONC-1010	Cure Concrete Bioreactor Basin 2	5	04-Oct-28	10-Oct-28
O-BR2-CONC-1090	IMLR Pump Concrete Supports Bioreactor Basin 2	5	27-Oct-28	02-Nov-28
O-BR2-CONC-1060	Concrete Repairs at Anchor Locations Bioreactor Basin 2	2	10-Nov-28	13-Nov-28
Process Mechanical		27	24-Oct-28	01-Dec-28
O-BR2-PM-1020	Install 30" SST IMLR Discharge Pipe Bioreactor Basin 2	3	24-Oct-28	26-Oct-28
O-BR2-PM-1040	Install IMLR Pump (Indd Rail) Bioreactor Basin 2	2	03-Nov-28	06-Nov-28
O-BR2-PM-1050	Install Mixer & Mounting Rail Bioreactor Basin 2	3	07-Nov-28	09-Nov-28
O-BR2-PM-1070	Install Diffuser & Piping Supports Bioreactor Basin 2	10	14-Nov-28	29-Nov-28
O-BR2-PM-1080	Install Adjustable Supports Bioreactor Basin 2	2	30-Nov-28	01-Dec-28
Architectural		3	05-Dec-28	07-Dec-28
O-BR2-ARCH-1010	Install Aluminum Covers	3	05-Dec-28	07-Dec-28
Electrical		71	29-Aug-28	08-Dec-28
O-BR2-ELEC-2060	MOPO - Install MCP-410-201 & Install MCP-410-281 in MCC-410-002	1	29-Aug-28	29-Aug-28
O-BR2-ELEC-1060	Install Conduit	10	10-Nov-28	27-Nov-28
O-BR2-ELEC-1070	Install LCP-410-281, LCP-410-201	1	28-Nov-28	28-Nov-28
O-BR2-ELEC-1080	Install Disconnect DSC-410-201, DSC-410-281	1	29-Nov-28	29-Nov-28
O-BR2-ELEC-1090	Wire Pull - Power & Control	5	30-Nov-28	06-Dec-28
O-BR2-ELEC-1100	Test & Term Wire	2	07-Dec-28	08-Dec-28



Activity ID	Activity Name	Orig Dur	Start	Finish
Startup & Commissioning		25	04-Dec-28	09-Jan-29
O-BR2-CX-1030	Level Test Diffuser Piping Bioreactor Basin 2	1	04-Dec-28	04-Dec-28
O-BR2-CX-1040	Vendor Checkout Bioreactor Basin 2	4	11-Dec-28	14-Dec-28
O-BR2-CX-1000	Vendor Checkout IMLR Pump Bioreactor Basin 2	2	11-Dec-28	12-Dec-28
O-BR2-CX-1010	Vendor Checkout Mixer Bioreactor Basin 2	2	11-Dec-28	12-Dec-28
O-BR2-CX-1050	Bubble Test Diffuser Piping Bioreactor Basin 2	1	15-Dec-28	15-Dec-28
O-BR2-CX-1060	Startup / Preformance Run Time IMLR Pump Bioreactor Basin 2	5	18-Dec-28	22-Dec-28
O-BR2-CX-1070	Startup / Preformance Run Time Mixer Bioreactor Basin 2	5	18-Dec-28	22-Dec-28
O-BR2-CX-1080	McC Punchlist & Corrections IMLR Pump Bioreactor Basin 2	5	26-Dec-28	02-Jan-29
O-BR2-CX-1110	McC Punchlist & Corrections Mixer Bioreactor Basin 2	5	26-Dec-28	02-Jan-29
O-BR2-CX-1090	IMLR Pump Bioreactor Basin 2 CX	5	03-Jan-29	09-Jan-29
O-BR2-CX-1100	Mixer Bioreactor Basin 2 CX	5	03-Jan-29	09-Jan-29
Electrical Upgrades MLE Effulent		84	24-May-28	22-Sep-28
O-MLE-1020	Install New EFF-MCC-001/002	10	24-May-28	07-Jun-28
O-MLE-1040	Wire Pull & Term New Feeders to New EFF-MCC-001/002	10	08-Jun-28	21-Jun-28
O-MLE-1030	Electrical Acceptance Testing New EFF-MCC-001/002	5	22-Jun-28	28-Jun-28
O-MLE-1070	MOPO - Shut Down & Re-Feed New EFF-MCC-001/002	5	29-Jun-28	07-Jul-28
O-MLE-1050	Re-Term Existing Loads in New EFF-MCC-001/002	10	10-Jul-28	21-Jul-28
O-MLE-1000	Startup & Commissioning New EFF-MCC-001/002	10	24-Jul-28	04-Aug-28
O-MLE-1010	Demo Existing EFF-MCC-001/002	10	11-Sep-28	22-Sep-28
Electrical Upgrades Blower Building		7	23-Aug-28	31-Aug-28
O-BB-ELEC-1000	MOPO - Demo Existing & Install New Feeders to AER-BLR-MCC-001/002	5	23-Aug-28	29-Aug-28
O-BB-ELEC-1060	MOPO - LOTO / Shut Down Existing AER-BLR-MCC-001/002	1	23-Aug-28	23-Aug-28
O-BB-ELEC-1070	MOPO - Duration for Shut Down Existing AER-BLR-MCC-001/002	7	23-Aug-28	31-Aug-28
O-BB-ELEC-1020	MOPO - Electrical Megger Testing New Feeders AER-BLR-MCC-001/002	1	30-Aug-28	30-Aug-28
O-BB-ELEC-1040	MOPO - Energize & Verify Rotation	1	31-Aug-28	31-Aug-28
Electrical Upgrades MCC-D1/D2		12	12-Jul-28	27-Jul-28
O-D1D2-ELEC-1000	MOPO - Demo Existing & Install New Feeders to MCC-D1/D2	5	12-Jul-28	18-Jul-28
O-D1D2-ELEC-1040	MOPO - LOTO / Shut Down Existing MCC-D1/D2	1	12-Jul-28	12-Jul-28
O-D1D2-ELEC-1050	MOPO - Duration for Shut Down Existing MCC-D1/D2	12	12-Jul-28	27-Jul-28
O-D1D2-ELEC-1070	MOPO - Demo Existing Circuits MCC-D1/D2	10	13-Jul-28	26-Jul-28
O-D1D2-ELEC-1020	MOPO - Electrical Megger Testing New Feeders MCC-D1/D2	1	19-Jul-28	19-Jul-28
O-D1D2-ELEC-1030	MOPO - Energize & Verify Rotation	1	27-Jul-28	27-Jul-28
Electrical Upgrades Transformer T-POC & Panel LP-P1		19	27-Jul-28	22-Aug-28
O-ELEC-1160	MOPO - Demo MCC-POC	2	27-Jul-28	28-Jul-28
O-ELEC-1180	Instal T-POC & LP-P1	2	31-Jul-28	01-Aug-28
O-ELEC-1190	Wire Pull & Term T-POC & LP-P1	5	02-Aug-28	08-Aug-28
O-ELEC-1200	Electrical Acceptance Testing T-POC & LP-P1	2	09-Aug-28	10-Aug-28
O-ELEC-1220	MOPO - Re-Term Existing Loads T-POC & LP-P1	3	11-Aug-28	15-Aug-28
O-ELEC-1210	Startup & Commissioning T-POC & LP-P1	2	16-Aug-28	17-Aug-28
O-ELEC-1230	MOPO - Demo MCC-P	3	18-Aug-28	22-Aug-28
Switchgear 1AA/1AB Building		297	23-Jul-27	22-Sep-28
O-ELEC-5000	Construct Building for SWGR-1AA/1AB	120	23-Jul-27	13-Jan-28
O-ELEC-1040	F/R/P Elect Xfmr & SWGR Pads	10	14-Jan-28	27-Jan-28
O-ELEC-1050	Install Xfmr MVT-1 & MVT-2	2	10-Apr-28	11-Apr-28
O-ELEC-1060	Install SWGR-1AA/1AB	7	03-May-28	11-May-28
O-ELEC-1090	Install Ancillary Equip for SWGR-1AA/1-AB (Lighting Panel, Dry Type Transformers	7	12-May-28	22-May-28
O-ELEC-5030	MOPO - Install MV Buckets in Existing MV Switchgear	5	23-May-28	30-May-28
O-ELEC-1020	MOPO - Wire Pull & Term - 15KV from Existing Switchgear to New Transformers M	12	31-May-28	15-Jun-28
O-ELEC-1080	Wire Pull & Term - MVT-1 & MVT-2 & SWGR-1AA/1AB	10	16-Jun-28	29-Jun-28
O-ELEC-1070	Electrical Acceptance Testing MVT-1 & MVT-2 & SWGR-1AA/1AB	3	30-Jun-28	06-Jul-28
O-ELEC-1140	Startup & Commissioning MVT-1 & MVT-2 & SWGR-1AA/1AB	3	07-Jul-28	11-Jul-28
O-ELEC-1150	*Milestone: Energize MVT-1 & MVT-2 & SWGR-1AA/1AB	0		11-Jul-28
O-ELEC-1030	Demo Existing OWRF SES-1	15	01-Sep-28	22-Sep-28
O-ELEC-1100	MOPO - Make Safe / De-Energize Existing SES-1	5	01-Sep-28	08-Sep-28
O-ELEC-1110	*MOPO Start - Shut Down SES-1 for Electrical Upgrades	0	01-Sep-28	
O-ELEC-1130	MOPO Duration (Calendar Days) - Shut Down SES-1 for Electrical Upgrades	5	01-Sep-28	08-Sep-28
O-ELEC-1120	*MOPO Complete - Shut Down SES-1 for Electrical Upgrades	0		08-Sep-28
Site Plan 4		484	29-Mar-27	22-Feb-29
Fuel Storage Tank		210	29-Mar-27	25-Jan-28
O-FUEL-1000	Grade for Fuel Storage Tank	5	29-Mar-27	02-Apr-27
O-FUEL-1010	Subgrade for SOG - Fuel Storage Tank	1	05-Apr-27	05-Apr-27
O-FUEL-1020	F/R/P/S Sump Pit	4	06-Apr-27	09-Apr-27
O-FUEL-1040	F/R/P SOG - Fuel Storage Tank	5	12-Apr-27	16-Apr-27
O-FUEL-1070	Cure SOG - Fuel Storage Tank	5	19-Apr-27	23-Apr-27
O-FUEL-1080	Set & Anchor Fuel Storage Tank	5	28-Oct-27	03-Nov-27
O-FUEL-1090	Piping & Appernances	20	04-Nov-27	03-Dec-27
O-FUEL-1100	Install Stairs	2	06-Dec-27	07-Dec-27
O-FUEL-1110	Electrical - Power Center	5	08-Dec-27	14-Dec-27
O-FUEL-1180	Electrical - Vendor Control Loop	5	15-Dec-27	21-Dec-27
O-FUEL-1190	Electrical - Fiber Loop Panel	5	22-Dec-27	29-Dec-27
O-FUEL-1120	Install Bollards	10	30-Dec-27	13-Jan-28
O-FUEL-1140	Subgrade Prep for Curb	3	14-Jan-28	18-Jan-28
O-FUEL-1150	F/R/P/S Pour Curb	5	19-Jan-28	25-Jan-28



Activity ID	Activity Name	Orig Dur	Start	Finish
Ductbank (Civil/Electrical)		337	29-Mar-27	25-Jul-28
O-MOB-1010	Utility Locates & Pothole for Ductbanks SWGR - 120 to SWGR 1 AA	10	29-Mar-27	09-Apr-27
O-ELEC-1010	Ductbank from SWGR-120-001/002 to SWGR-1 AA/1 AB (Incld 5 Manholes)	72	12-Apr-27	22-Jul-27
O-MOB-1100	Utility Locates & Pothole for Ductbanks SWGR-1 AA/1 AB to EMH 40	10	23-Jul-27	05-Aug-27
O-ELEC-1310	Ductbank from SWGR-1 AA/1 AB to EMH 40	20	06-Aug-27	02-Sep-27
O-MOB-1090	Utility Locates & Pothole for Ductbanks EMH 40 to EMH 44	10	03-Sep-27	17-Sep-27
O-ELEC-1320	Ductbank from EMH 40 to EMH 44	17	20-Sep-27	12-Oct-27
O-MOB-1080	Utility Locates & Pothole for Ductbanks EMH 44 to EMH-EFF/EFF-BLD (existing)	10	13-Oct-27	26-Oct-27
O-ELEC-1330	Ductbank from EMH 44 to EMH-EFF/EFF-BLD (existing)	32	27-Oct-27	13-Dec-27
O-MOB-1070	Utility Locates & Pothole for Ductbanks EFF BLD to EMH 42	10	14-Dec-27	28-Dec-27
O-ELEC-1340	Ductbank from EFF BLD to EMH 42	5	29-Dec-27	05-Jan-28
O-MOB-1060	Utility Locates & Pothole for Ductbanks EMH 44 to EMH 42	10	06-Jan-28	19-Jan-28
O-ELEC-1350	Ductbank from EMH 44 to EMH 42	32	20-Jan-28	03-Mar-28
O-MOB-1050	Utility Locates & Pothole for Ductbanks EMH 40 to EMH 17	10	06-Mar-28	17-Mar-28
O-ELEC-1360	Ductbank from EMH 40 to EMH 17	20	20-Mar-28	14-Apr-28
O-MOB-1040	Utility Locates & Pothole for Ductbanks EMH 42 to ANX MCC	10	17-Apr-28	28-Apr-28
O-ELEC-1370	Ductbank from EMH 42 to ANX MCC	39	01-May-28	23-Jun-28
O-MOB-1030	Utility Locates & Pothole for Ductbanks ANX MCC to Fuel Station	10	26-Jun-28	11-Jul-28
O-ELEC-1380	Ductbank from ANX MCC to Fuel Station	10	12-Jul-28	25-Jul-28
Civil		256	21-Feb-28	22-Feb-29
O-CVL-1010	Landscape and DG Touch-up - Clarifier 3	5	21-Feb-28	25-Feb-28
O-CVL-1030	Landscape and DG Touch-up - Anoxic Basins	5	15-Sep-28	21-Sep-28
O-CVL-1020	Landscape and DG Touch-up - Bioreactor Basins	5	10-Jan-29	16-Jan-29
O-CVL-1000	Remove & Replace Existing Paving	20	26-Jan-29	22-Feb-29
Project Close Out Wilson Balance of Plant		320	26-Jan-29	29-Apr-30
CO-1000	McCarthy Punchlist & Corrections	20	26-Jan-29	22-Feb-29
CO-1020	A/E Develop Punchlist	1	23-Feb-29	23-Feb-29
CO-1040	A/E Punchlist Corrections	20	26-Feb-29	23-Mar-29
CO-1010	Weather Allowance	12	01-Mar-30	18-Mar-30
CO-1030	Construction Contingency	10	19-Mar-30	01-Apr-30
CO-1050	*Milestone: Substantial Completion	0		01-Apr-30
CO-1070	Project Close Out / Final Clean	20	02-Apr-30	29-Apr-30
CO-1060	De-Mob	10	02-Apr-30	15-Apr-30
CO-1080	*Milestone: Final Completion	0		29-Apr-30





City of Chandler
WRF Improvements Phase 3
Plans and Specifications

Section #	Specification Title	Pages	Date Issued
01010	SUMMARY OF WORK	5	April 2026
01012	PLANT OPERATION DURING CONSTRUCTION	25	April 2026
01013	ENGINEERING SERVICES	2	April 2026
01040	COORDINATION	2	April 2026
01050	FIELD ENGINEERING AND SURVEYING	1	April 2026
01090	REFERENCE STANDARDS AND ABBREVIATIONS	6	April 2026
01202	PROGRESS MEETINGS	2	April 2026
01300	SUBMITTALS	57	April 2026
01310	PROGRESS SCHEDULE	10	April 2026
01380	CONSTRUCTION PHOTOGRAPHS	3	April 2026
01400	QUALITY CONTROL	2	April 2026
01410	TESTING	1	April 2026
01412	STORMWATER POLLUTION PREVENTION PLAN AND PERMIT	3	April 2026
01414	EARTHMOVING AND DUST CONTROL	2	April 2026
01416	SPECIAL INSPECTIONS	10	April 2026
01451	TESTING LABORATORY SERVICES FURNISHED BY OWNER	3	April 2026
01500	CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS	12	April 2026
01600	GENERAL EQUIPMENT PROVISIONS	9	April 2026
01640	MATERIALS AND EQUIPMENT	4	April 2026
01650	STARTING OF SYSTEMS	9	April 2026
01660	FIELD TEST OF EQUIPMENT	3	April 2026
01700	CONTRACT CLOSEOUT	2	April 2026
01710	CLEANING	2	April 2026
01715	TESTING OF HYDRAULIC STRUCTURES	7	April 2026
01720	RECORD DOCUMENTS	4	April 2026
01730	OPERATION AND MAINTENANCE DATA	4	April 2026
01750	SPARE PARTS AND MAINTENANCE MATERIAL	2	April 2026
01800	EQUIPMENT SCHEDULE	12	April 2026
01821	INSTRUCTION OF OPERATIONS AND MAINTENANCE PERSONNEL	8	April 2026
02050	DEMOLITIONS	9	April 2026
02100	SITE PREPARATION	4	April 2026
02150	SHORING	3	April 2026
02315	EARTHWORK, EXCAVATION, AND BACKFILL	21	April 2026
02318	CRUSHED STONE AND GRAVEL	3	April 2026
02319	RIPRAP	3	April 2026
02371	FILTER FABRIC FOR RIPRAP CHANNELS	3	April 2026
02500	ASPHALT PAVEMENT	3	April 2026
02580	PAVEMENT MARKINGS	3	April 2026
02751	PORTLAND CEMENT CONCRETE PAVING	6	April 2026
03100	CONCRETE FORMWORK	8	April 2026
03101	QUAKEWRAP SPIRE PANEL SYSTEM	14	April 2026
03200	CONCRETE REINFORCEMENT	8	April 2026
03251	CONCRETE JOINTS	12	April 2026
03252	ANCHORAGE IN CONCRETE	10	April 2026
03300	CAST-IN-PLACE CONCRETE	33	April 2026
03400	PRECAST CONCRETE	7	April 2026
03600	GROUT	11	April 2026
03930	CONCRETE REPAIR AND REHABILITATION	9	April 2026
04220	SINGLE-WHYTE UNIT MASONRY	4	April 2026
05120	STRUCTURAL STEEL	10	April 2026
05500	METAL FABRICATIONS	3	April 2026
05501	MISCELLANEOUS METAL FABRICATIONS	9	April 2026
05510	METAL STAIRS	8	April 2026
05522	ALUMINUM RAILINGS	15	April 2026
05532	ALUMINUM GRATING AND CHECKER PLATE	5	April 2026
05581	FLOOR ACCESS HATCH COVERS	3	April 2026

Section #	Specification Title	Pages	Date Issued
05600	FLAT PANEL COVERS	5	April 2026
06410	ARCHITECTURAL WOOD CASEWORK	5	April 2026
06611	FIBERGLASS REINFORCED PLASTIC FABRICATIONS	7	April 2026
07210	THERMAL INSULATION	3	April 2026
07620	SHEET METAL FLASHING AND TRIM	3	April 2026
07900	JOINT SEALANTS	5	April 2026
08110	HOLLOW METAL FRAMES	5	April 2026
08113	HOLLOW METAL DOORS AND FRAMES	5	April 2026
08211	FLUSH WOOD DOORS	4	April 2026
08331	OVERHEAD COILING DOORS	4	April 2026
08360	ACCORDION FOLDING DOORS	4	April 2026
08381	FLEXIBLE STRIP DOORS	4	April 2026
08710	DOOR HARDWARE	8	April 2026
08800	GLAZING	4	April 2026
09050	COMMON WORK RESULTS FOR FLOORING PREPARATION	6	April 2026
09260	GYPSUM BOARD ASSEMBLIES	7	April 2026
09300	TILING	6	April 2026
09511	ACOUSTICAL CEILINGS	5	April 2026
09680	TILE CARPETING	3	April 2026
09900	PAINTING	22	April 2026
09900.1	INTERIOR PAITING	8	April 2026
09920	COATING SYSTEMS	8	April 2026
10400	EQUIPMENT IDENTIFICATION PLATES	5	April 2026
10440	FIRE PROTECTION SPECIALTIES	1	April 2026
10811	BIRD CONTROL DEVICES	1	April 2026
11218	MAGNETIC DRIVE SEALLESS END SUCTION PUMPS	10	April 2026
11295	HYDRAULIC VALVES	11	April 2026
11310	VERTICAL TURBINE PUMPS	16	April 2026
11313	LOW-FLOW PROPELLER (IMLR) PUMPS	11	April 2026
11335	SECONDARY CLARIFIER MECHANISM	23	April 2026
11375	AERATION SYSTEMS	11	April 2026
11400	DISC FILTER SYSTEM	21	April 2026
11520	PROJECTION SCREENS	3	April 2026
12360	COUNTERTOPS	4	April 2026
13213	PRECAST POLYMER CONCRETE TRENCH INSERT	5	April 2026
13300	METAL BUILDING SYSTEMS	8	April 2026
13400	ABOVEGROUND FUEL STORAGE TANK	8	April 2026
13447	ELECTRIC MOTOR ACTUATORS	15	April 2026
14610	DAVIT CRANE	5	April 2026
14630	HOISTS, TROLLEYS, AND MONORAILS	6	April 2026
15010	BASIC MECHANICAL REQUIREMENTS	3	April 2026
15050	PIPING SYSTEMS	21	April 2026
15051	BURIED PIPING INSTALLATION	20	April 2026
15052	EXPOSED PIPING INSTALLATION	15	April 2026
15061	DUCTILE IRON PIPE	9	April 2026
15062	STEEL PIPE	8	April 2026
15064	COPPER PIPE	4	April 2026
15065	THERMOPLASTIC PIPE AND ACCESSORIES	10	April 2026
15066	STAINLESS STEEL PIPE	7	April 2026
15067	FIBERGLASS REINFORCED PLASTIC PIPE AND ACCESSORIES	10	April 2026
15068	REINFORCED CONCRETE PIPE	8	April 2026
15120	PIPING SPECIALTIES AND ACCESSORIES	8	April 2026
15140	SUPPORTS AND ANCHORS	5	April 2026
15260	PIPING INSULATION	4	April 2026
15441	SUMP PUMPS	5	April 2026
15700	GENERAL HVAC REQUIEREMENTS	15	April 2026

Section #	Specification Title	Pages	Date Issued
15710	SUMMARY OF WORK FOR HEATING, VENTILATING AND AIR CONDITIONING	3	April 2026
15720	AIR HANDLING AND AIR DISTRIBUTION SPECIALTIES	2	April 2026
15730	CLEANING MECHANICAL SYSTEMS	2	April 2026
15732	PACKAGE HEAT PUMP AIR CONDITIONING UNITS	7	April 2026
15734	SPLIT SYSTEM AIR CONDITIONING UNITS (DUCTLESS)	4	April 2026
15736	VARIABLE REFRIGERANT VOLUME SYSTEMS AND CONTROLS	10	April 2026
15738	DEDICATED OUTDOOR AIR SYSTEM	7	April 2026
15780	CONDENSATE AND EQUIPMENT DRAIN SYSTEMS	2	April 2026
15890	SHEET METAL DUCTWORK	5	April 2026
15910	MECHANICAL SYSTEMS INSULATION	6	April 2026
15950	TESTING MECHANICAL SYSTEMS	3	April 2026
15951	TESTING, ADJUSTING AND BALANCING OF MECHANICAL SYSTEMS	5	April 2026
16000	GENERAL ELECTRICAL REQUIREMENTS	10	April 2026
16001	PACKAGED SYSTEMS AND PACKAGED CONTROL PANELS	4	April 2026
16010	ELECTRICAL: BASIC REQUIREMENTS	8	April 2026
16050	BASIC MATERIALS AND METHODS	3	April 2026
16060	ELECTRICAL DEMOLITION	3	April 2026
16062	LIGHTNING PROTECTION	8	April 2026
16111	CONDUITS	6	April 2026
16117	CONCRETE MANHOLES, HANDHOLES AND PULL BOXES	8	April 2026
16123	600 VOLT CLASS CABLE	5	April 2026
16124	INSTRUMENTATION CLASS CABLE	3	April 2026
16130	OUTLET, PULL, AND JUNCTION BOXES	6	April 2026
16137	UNDERGROUND DUCT BANKS	4	April 2026
16141	WIRING DEVICES	6	April 2026
16142	WEATHERPROOF WHILE IN USE OUTLET ENCLOSURES	3	April 2026
16143	TERMINAL BLOCKS	3	April 2026
16160	ENCLOSURES	2	April 2026
16161	CONTROL PANELS	34	April 2026
16170	GROUNDING AND BONDING	9	April 2026
16190	SUPPORTING DEVICES	5	April 2026
16195	ELECTRICAL IDENTIFICATION	5	April 2026
16225	ELECTRIC MOTORS 250 HORSEPOWER OR LESS	11	April 2026
16282	SURGE PROTECTIVE DEVICE	5	April 2026
16307	15000 VOLT CLASS CABLE	7	April 2026
16321	OIL FILLED SUBSTATION TRANSFORMERS	6	April 2026
16341	MEDIUM VOLTAGE SWITCHES	5	April 2026
16343	MEDIUM VOLTAGE METAL-CLAD SWITCHGEAR	13	April 2026
16430	CUSTOMER POWER METERING SYSTEM	4	April 2026
16431	LOW VOLTAGE DRAW-OUT METAL-ENCLOSED SWITCHGEAR	7	April 2026
16440	DISCONNECT SWITCHES	2	April 2026
16461	TRANSFORMERS - DRY TYPE	3	April 2026
16470	PANELBOARDS	8	April 2026
16474	MOTOR CONTROL EQUIPMENT	7	April 2026
16475	MINI POWER CENTERS	2	April 2026
16476	LOW VOLTAGE CIRCUIT BREAKERS	3	April 2026
16477	600 V FUSES	4	April 2026
16480	MOTOR CONTROLLERS	6	April 2026
16481	MOTOR CONTROL CENTERS (MCC)	12	April 2026
16482	SOLID STATE MOTOR CONTROLLERS	6	April 2026
16485	VARIABLE FREQUENCY DRIVES – LOW VOLTAGE	8	April 2026
16500	LIGHTING	5	April 2026
16611	STATIC UNINTERRUPTIBLE POWER SUPPLY	3	April 2026
16720	FIRE SURVEILLANCE AND ALARM SYSTEM	8	April 2026
16912	ETHERNET NETWORK EQUIPMENT	2	April 2026
16913	SINGLE MODE FIBER OPTIC CABLING	9	April 2026

Section #	Specification Title	Pages	Date Issued
16920	ELECTRICAL ACCEPTANCE TESTING	8	April 2026
16951	SHORT CIRCUIT, COORDINATION AND ARC FLASH HAZARD REPORT	5	April 2026
17000	INSTRUMENTATION	14	April 2026
17111	FLOAT SWITCHES	3	April 2026
17120	PRESSURE TRANSMITTERS	3	April 2026
17121	PRESSURE SWITCHES AND GAUGES	4	April 2026
17124	SUBMERSIBLE LEVEL TRANSMITTER	3	April 2026
17134	FLOW SWITCHES	3	April 2026
17137	MAGNETIC FLOWMETERS	5	April 2026
17150	LIMIT AND POSITION SWITCHES	4	April 2026
17221	ELECTRONIC 4 –20 MA INDICATORS	3	April 2026
17222	SIGNAL CONDITIONERS	3	April 2026
17321	GAS DETECTION SYSTEM	3	April 2026
17325	TURBIDITY AND TSS ANALYZERS	5	April 2026
17452	PROGRAMMABLE LOGIC CONTROLLER SYSTEM SOFTWARE AND ACCESSORIES	7	April 2026
17454	OPERATIONS AND CONTROL DESCRIPTIONS	32	April 2026
17456	PROGRAMMING GENERAL	5	April 2026
17461	PROGRAMMABLE LOGIC CONTROLLER SYSTEM (M340)	7	April 2026

Facility	Sheet #	Sheet Name	Sheet Version	Date of Issuance
OWRF	G-1	COVER	OWRF - For Construction Submittal	April 2026
OWRF	G-2	SHEET INDEX	OWRF - For Construction Submittal	April 2026
OWRF	G-3	GENERAL NOTES - 1	OWRF - For Construction Submittal	April 2026
OWRF	G-4	GENERAL NOTES - 2	OWRF - For Construction Submittal	April 2026
OWRF	G-5	PROCESS AND SITE LEGEND	OWRF - For Construction Submittal	April 2026
OWRF	G-9	OWRF - MBR HYDRAULIC PROFILE	OWRF - For Construction Submittal	April 2026
OWRF	G-10	OWRF - MLE HYDRAULIC PROFILE	OWRF - For Construction Submittal	April 2026
OWRF	G-11	OWRF - MBR PROCESS SCHEMATIC	OWRF - For Construction Submittal	April 2026
OWRF	G-12	OWRF - MLE PROCESS SCHEMATIC	OWRF - For Construction Submittal	April 2026
OWRF	D-20.01	OWRF - OVERALL DEMOLITION PLAN	OWRF - For Construction Submittal	April 2026
OWRF	D-20.02	OWRF - PARTIAL DEMOLITION PLAN - 1	OWRF - For Construction Submittal	April 2026
OWRF	D-20.03	OWRF - PARTIAL DEMOLITION PLAN - 2	OWRF - For Construction Submittal	April 2026
OWRF	D-23.01	OWRF - MBR AERATION BASINS DEMOLITION UPPER PLAN	OWRF - For Construction Submittal	April 2026
OWRF	D-23.02	OWRF - MBR AERATION BASINS DEMOLITION LOWER PLAN	OWRF - For Construction Submittal	April 2026
OWRF	D-27.01	OWRF - MLE SECONDARY CLARIFIER NO. 3 OVERALL DEMOLITION PLAN	OWRF - For Construction Submittal	April 2026
OWRF	D-27.02	OWRF - MLE SECONDARY CLARIFIER NO. 3 DEMOLITION SECTIONS & DETAILS - 1	OWRF - For Construction Submittal	April 2026
OWRF	D-27.03	OWRF - MLE SECONDARY CLARIFIER NO. 3 DEMOLITION SECTIONS & DETAILS - 2	OWRF - For Construction Submittal	April 2026
OWRF	D-28.01	OWRF - EFFLUENT PUMP STATION ELECTRICAL BUILDING DEMO PLAN	OWRF - For Construction Submittal	April 2026
OWRF	C-20.01	OWRF - SURVEY CONTROL SHEET	OWRF - For Construction Submittal	April 2026
OWRF	C-21.01	OWRF - OVERALL SITE PLAN	OWRF - For Construction Submittal	April 2026
OWRF	C-21.02	OWRF - PARTIAL SITE PLAN - 1	OWRF - For Construction Submittal	April 2026
OWRF	C-21.03	OWRF - PARTIAL SITE PLAN - 2	OWRF - For Construction Submittal	April 2026
OWRF	C-22.01	OWRF - OVERALL YARD PIPING PLAN	OWRF - For Construction Submittal	April 2026
OWRF	C-22.02	OWRF - PARTIAL YARD PIPING PLAN - 1	OWRF - For Construction Submittal	April 2026
OWRF	C-23.01	OWRF - GRADING AND DRAINAGE OVERALL SITE PLAN	OWRF - For Construction Submittal	April 2026
OWRF	C-23.02	OWRF - GRADING AND DRAINAGE PARTIAL SITE PLAN 1	OWRF - For Construction Submittal	April 2026
OWRF	C-23.03	OWRF - GRADING AND DRAINAGE PARTIAL SITE PLAN 2	OWRF - For Construction Submittal	April 2026
OWRF	C-23.04	OWRF - GRADING AND DRAINAGE PARTIAL SITE PLAN 3	OWRF - For Construction Submittal	April 2026
OWRF	C-23.05	OWRF - GRADING AND DRAINAGE PARTIAL SITE PLAN 4	OWRF - For Construction Submittal	April 2026
OWRF	C-40.01	OWRF - CIVIL DETAILS - 1	OWRF - For Construction Submittal	April 2026
OWRF	C-40.02	OWRF - CIVIL DETAILS - 2	OWRF - For Construction Submittal	April 2026
OWRF	M-23.01	OWRF - MBR BIOREACTOR BASINS UPPER PLAN	OWRF - For Construction Submittal	April 2026
OWRF	M-23.02	OWRF - MBR BIOREACTOR BASINS LOWER PLAN	OWRF - For Construction Submittal	April 2026
OWRF	M-23.03	OWRF - MBR BIOREACTOR BASINS SECTIONS	OWRF - For Construction Submittal	April 2026
OWRF	M-23.04	OWRF - MBR BIOREACTOR BASINS SECTIONS AND DETAILS - 1	OWRF - For Construction Submittal	April 2026
OWRF	M-27.01	OWRF - MLE SECONDARY CLARIFIER NO. 3 OVERALL PLAN	OWRF - For Construction Submittal	April 2026
OWRF	M-27.02	OWRF - MLE SECONDARY CLARIFIER NO. 3 SECTIONS AND DETAILS	OWRF - For Construction Submittal	April 2026
OWRF	M-27.03	OWRF - MLE SECONDARY CLARIFIER NO. 3 DETAILS - 1	OWRF - For Construction Submittal	April 2026
OWRF	M-27.04	OWRF - MLE SECONDARY CLARIFIER NO. 3 DETAILS - 2	OWRF - For Construction Submittal	April 2026
OWRF	M-33.01	OWRF - EMERGENCY FUEL STORAGE PLAN	OWRF - For Construction Submittal	April 2026
OWRF	M-33.02	OWRF - EMERGENCY FUEL STORAGE SECTIONS	OWRF - For Construction Submittal	April 2026
OWRF	M-40.01	TYPICAL DETAILS - 1	OWRF - For Construction Submittal	April 2026
OWRF	M-40.02	TYPICAL DETAILS - 2	OWRF - For Construction Submittal	April 2026
OWRF	M-40.03	TYPICAL DETAILS - 3	OWRF - For Construction Submittal	April 2026
OWRF	M-40.04	TYPICAL DETAILS - 4	OWRF - For Construction Submittal	April 2026
OWRF	M-40.05	TYPICAL DETAILS - 5	OWRF - For Construction Submittal	April 2026
OWRF	M-40.06	TYPICAL DETAILS - 6	OWRF - For Construction Submittal	April 2026
OWRF	S-20.01	OWRF - GENERAL STRUCTURAL NOTES	OWRF - For Construction Submittal	April 2026
OWRF	S-20.02	OWRF - STANDARD STRUCTURAL DETAILS	OWRF - For Construction Submittal	April 2026
OWRF	S-20.03	OWRF - CONCRETE REPAIR DETAILS	OWRF - For Construction Submittal	April 2026
OWRF	S-23.01	OWRF - MBR AERATION BASINS TOP PLAN AND SECTIONS	OWRF - For Construction Submittal	April 2026
OWRF	S-29.01	OWRF - MLE EFFLUENT PUMP STATION WET WELL TOP PLAN AND SECTIONS	OWRF - For Construction Submittal	April 2026
OWRF	S-33.01	OWRF - FUEL STORAGE TANK FOUNDATION PLAN	OWRF - For Construction Submittal	April 2026
OWRF	S-33.02	OWRF - FUEL STORAGE TANK SECTION AND DETAILS	OWRF - For Construction Submittal	April 2026
OWRF	S-34.01	OWRF - ELECTRICAL BUILDING 01 PLAN AND SECTION	OWRF - For Construction Submittal	April 2026
OWRF	S-34.02	OWRF - ELECTRICAL BUILDING 02 PLAN AND SECTION	OWRF - For Construction Submittal	April 2026
OWRF	A-34.01	OWRF - ELECTRICAL BUILDINGS ARCHITECTURAL CODE SHEET	OWRF - For Construction Submittal	April 2026
OWRF	A-34.02	OWRF - ELECTRICAL BUILDING 01 PLAN VIEWS 01	OWRF - For Construction Submittal	April 2026
OWRF	A-34.03	OWRF - ELECTRICAL BUILDING 01 PLAN VIEWS 02	OWRF - For Construction Submittal	April 2026
OWRF	A-34.04	OWRF - ELECTRICAL BUILDING 01 ELEVATIONS & SECTIONS	OWRF - For Construction Submittal	April 2026
OWRF	A-34.05	OWRF - ELECTRICAL BUILDING 02 PLAN VIEWS	OWRF - For Construction Submittal	April 2026
OWRF	A-34.06	OWRF - ELECTRICAL BUILDING 02 ELEVATIONS & SECTIONS	OWRF - For Construction Submittal	April 2026
OWRF	A-34.07	OWRF - ELECTRICAL BUILDINGS SCHEDULES & DETAILS	OWRF - For Construction Submittal	April 2026
OWRF	H-28.01	EFFLUENT PUMP STATION ELECTRICAL BUILDING MECHANICAL SCHEDULES, GENERAL NOTES, AND COMCHECK	OWRF - For Construction Submittal	April 2026
OWRF	H-28.02	OWRF EFFLUENT PUMP STATION ELECTRICAL BUILDING MECHANICAL HVAC FLOOR PLANS	OWRF - For Construction Submittal	April 2026
OWRF	H-28.03	OWRF EFFLUENT PUMP STATION ELECTRICAL BUILDING MECHANICAL DETAILS	OWRF - For Construction Submittal	April 2026
OWRF	H-34.01	OWRF ELECTRICAL BUILDINGS 1 AND 2 MECHANICAL SCHEDULES, GENERAL NOTES, AND COMCHECK	OWRF - For Construction Submittal	April 2026
OWRF	H-34.02	OWRF ELECTRICAL BUILDINGS 1 AND 2 MECHANICAL HVAC FLOOR PLAN - ELECTRICAL BUILDING 1	OWRF - For Construction Submittal	April 2026
OWRF	H-34.03	OWRF ELECTRICAL BUILDINGS 1 AND 2 MECHANICAL HVAC FLOOR PLAN - ELECTRICAL BUILDING 2	OWRF - For Construction Submittal	April 2026
OWRF	H-34.04	OWRF ELECTRICAL BUILDINGS 1 AND 2 MECHANICAL DETAILS 1	OWRF - For Construction Submittal	April 2026
OWRF	H-34.05	OWRF ELECTRICAL BUILDINGS 1 AND 2 MECHANICAL DETAILS 2	OWRF - For Construction Submittal	April 2026
OWRF	E-00.01	ELECTRICAL SYMBOLS AND LEGEND	OWRF - For Construction Submittal	April 2026
OWRF	E-20.01	OWRF - OVERALL ELECTRICAL SITE PLAN	OWRF - For Construction Submittal	April 2026
OWRF	E-20.02	OWRF - PARTIAL SITE ELECTRICAL PLAN 1	OWRF - For Construction Submittal	April 2026
OWRF	E-20.03	OWRF - PARTIAL SITE ELECTRICAL PLAN 2	OWRF - For Construction Submittal	April 2026
OWRF	E-20.04	OWRF - PARTIAL SITE ELECTRICAL PLAN 3	OWRF - For Construction Submittal	April 2026
OWRF	E-20.05	OWRF - EXISTING SES-1 SINGLE LINE DIAGRAM - DEMOLITION	OWRF - For Construction Submittal	April 2026

Facility	Sheet #	Sheet Name	Sheet Version	Date of Issuance
OWRF	E-20.06	OWRF - HIGH LEVEL FACILITY SINGLE LINE DIAGRAM MODIFICATION	OWRF - For Construction Submittal	April 2026
OWRF	E-20.07	OWRF - SGR-120-001 & SGR-120-002 EXISTING SINGLE LINE DIAGRAM -MODIFICATION	OWRF - For Construction Submittal	April 2026
OWRF	E-20.08	OWRF - SGR-120-001 & SGR-120-002 SWGR-1AA & SWGR-1AB LOAD SUMMARY - MODIFICATION	OWRF - For Construction Submittal	April 2026
OWRF	E-20.09	OWRF - SHORT CIRCUIT CALCULATIONS	OWRF - For Construction Submittal	April 2026
OWRF	E-20.10	OWRF - EXISTING SES-1 ELECTRICAL PLAN - DEMOLITION	OWRF - For Construction Submittal	April 2026
OWRF	E-20.11	OWRF - SGR-120-001 & SGR-120-002 SWGR-1AA & SWGR 1AB ELECTRICAL PLAN - MODIFICATIONS	OWRF - For Construction Submittal	April 2026
OWRF	E-20.12	OWRF - SGR-120-001 & SGR-120-002 SWGR-1AA & SWGR-1AB GROUNDING AND LIGHTING PLAN - MODIFICATIONS	OWRF - For Construction Submittal	April 2026
OWRF	E-20.13	OWRF - SGR-120-001 & SGR-120-002 SWGR-1AA & SWGR-1AB ELECTRICAL POWER CONDUIT BLOCK DIAGRAM	OWRF - For Construction Submittal	April 2026
OWRF	E-23.01	OWRF - BIOREACTOR BASINS EXISTING MCC-410-001 & MCC-410-002 SINGLE LINE DIAGRAM - DEMOLITION	OWRF - For Construction Submittal	April 2026
OWRF	E-23.02	OWRF - BIOREACTOR BASINS EXISTING MCC-410-001 & MCC-410-002 SINGLE LINE DIAGRAM - MODIFICATION	OWRF - For Construction Submittal	April 2026
OWRF	E-23.03	OWRF - BIOREACTOR BASINS EXISTING MCC-410-001 & MCC-410-002 LOAD SUMMARIES - MODIFICATION	OWRF - For Construction Submittal	April 2026
OWRF	E-23.04	OWRF - EXISTING SBD-420-001 & SBD-420-002, & MCC- 410-001 & MCC-410-002 ELECTRICAL PLAN - MODIFICATION	OWRF - For Construction Submittal	April 2026
OWRF	E-23.05	OWRF - AERATION BASINS ELECTRICAL PLAN - MODIFICATIONS	OWRF - For Construction Submittal	April 2026
OWRF	E-23.06	OWRF - BIOREACTOR BASINS IMLR PUMP CONTROL SCHEMATIC	OWRF - For Construction Submittal	April 2026
OWRF	E-23.07	OWRF - BIOREACTOR BASINS MIXER CONTROL SCHEMATIC -MODIFICATION	OWRF - For Construction Submittal	April 2026
OWRF	E-23.08	OWRF - MCC-410-001 & MCC-410-002 CONDUIT BLOCK DIAGRAMS	OWRF - For Construction Submittal	April 2026
OWRF	E-24.01	OWRF - SUBMERGED MEMBRANE FILTERS EXISTING SBD- 420-001 & SBD-420-002 SINGLE LINE DIAGRAM - MODIFICATION	OWRF - For Construction Submittal	April 2026
OWRF	E-25.01	OWRF - EXISTING MCC-T1 & MCC-T2 SINGLE LINE DIAGRAM - DEMOLITION	OWRF - For Construction Submittal	April 2026
OWRF	E-25.02	OWRF - PDP-639-001 PANEL SCHEDULE	OWRF - For Construction Submittal	April 2026
OWRF	E-25.03	OWRF - EXISTING ANX-MCC-001 SINGLE LINE DIAGRAM - DEMOLITION	OWRF - For Construction Submittal	April 2026
OWRF	E-25.04	OWRF - EXISTING ANX-MCC-002 SINGLE LINE DIAGRAM - DEMOLITION	OWRF - For Construction Submittal	April 2026
OWRF	E-25.05	OWRF - ANX-MCC-001 SINGLE LINE DIAGRAM - MODIFICATION	OWRF - For Construction Submittal	April 2026
OWRF	E-25.06	OWRF - ANX-MCC-002 SINGLE LINE DIAGRAM - MODIFICATION	OWRF - For Construction Submittal	April 2026
OWRF	E-25.07	OWRF - ANX-MCC-001 & ANX-MCC-002 LOAD SUMMARIES - DEMOLITION & MODIFICATION	OWRF - For Construction Submittal	April 2026
OWRF	E-25.08	OWRF - LP-419-001 PANEL SCHEDULE	OWRF - For Construction Submittal	April 2026
OWRF	E-25.09	OWRF - EXISTING MCC-T1 & MCC-T2 ELECTRICAL PLAN - DEMOLITION & MODIFICATION	OWRF - For Construction Submittal	April 2026
OWRF	E-25.10	OWRF - ANX-MCC-001 & ANX-MCC-002 ELECTRICAL PLAN -DEMOLITION & MODIFICATION	OWRF - For Construction Submittal	April 2026
OWRF	E-25.11	OWRF - ANOXIC BASIN IMLR PUMP NO. 7 ELECTRICAL PLAN - MODIFICATION	OWRF - For Construction Submittal	April 2026
OWRF	E-25.12	OWRF - ANOXIC BASINS MLR PUMP NO. 7 CONTROL SCHEMATIC I	OWRF - For Construction Submittal	April 2026
OWRF	E-25.13	OWRF - ANOXIC BASINS MLR PUMP NO. 7 CONTROL SCHEMATIC II	OWRF - For Construction Submittal	April 2026
OWRF	E-25.14	OWRF - ANX-MCC-001 (MCC-419-001) (A1) & ANX-MCC- 002 (MCC-419-002) (A2) POWER CONDUIT BLOCK DIAGRAM	OWRF - For Construction Submittal	April 2026
OWRF	E-25.15	OWRF - ANX-MCC-001 (MCC-419-001) (A1) & ANX-MCC- 002 (MCC-419-002) (A2) CONTROL CONDUIT BLOCK DIAGRAM I	OWRF - For Construction Submittal	April 2026
OWRF	E-25.16	OWRF - ANX-MCC-001 (MCC-419-001) (A1) & ANX-MCC- 002 (MCC-419-002) (A2) CONTROL CONDUIT BLOCK DIAGRAM II	OWRF - For Construction Submittal	April 2026
OWRF	E-25.17	OWRF - ANX-MCC-001 (MCC-419-001) (A1) & ANX-MCC- 002 (MCC-419-002) (A2) CONTROL CONDUIT BLOCK DIAGRAM III	OWRF - For Construction Submittal	April 2026
OWRF	E-26.01	OWRF - AER-BLR-MCC-001 (MCC-449-001) (B1) EXISTING SINGLE LINE DIAGRAM - DEMOLITION	OWRF - For Construction Submittal	April 2026
OWRF	E-26.02	OWRF - AER-BLR-MCC-002 (MCC-449-002) (B2) EXISTING SINGLE LINE DIAGRAM - DEMOLITION	OWRF - For Construction Submittal	April 2026
OWRF	E-26.03	OWRF - AER-BLR-MCC-001 (MCC-449-001) (B1) EXISTING SINGLE LINE DIAGRAM -MODIFICATION	OWRF - For Construction Submittal	April 2026
OWRF	E-26.04	OWRF - AER-BLR-MCC-002 (MCC-449-002) (B2) EXISTING SINGLE LINE DIAGRAM -MODIFICATION	OWRF - For Construction Submittal	April 2026
OWRF	E-26.05	OWRF - AER-BLR-MCC-001 (MCC-449-001) (B1) & AER- BLR-MCC-002 (MCC-449-002) (B2) EXISTING LOAD SUMMARIES -DEMOLITION	OWRF - For Construction Submittal	April 2026
OWRF	E-26.06	OWRF - AER-BLR-MCC-001 (MCC-449-001) (B1) & AER- BLR-MCC-002 (MCC-449-002) (B2) EXISTING LOAD SUMMARIES -MODIFICATION	OWRF - For Construction Submittal	April 2026
OWRF	E-26.07	OWRF - AER-BLR-MCC-001 (MCC-449-001) (B1) & AER- BLR-MCC-002 (MCC-449-002) (B2) ELECTRICAL PLAN - DEMOLITION	OWRF - For Construction Submittal	April 2026
OWRF	E-26.08	OWRF - AER-BLR-MCC-001 (MCC-449-001) (B1) & AER- BLR-MCC-002 (MCC-449-002) (B2) POWER CONDUIT BLOCK DIAGRAM	OWRF - For Construction Submittal	April 2026
OWRF	E-27.01	OWRF - SECONDARY CLARIFIER 3 -ELECTRICAL PLAN	OWRF - For Construction Submittal	April 2026
OWRF	E-27.02	OWRF - SECONDARY CLARIFIER NO. 3 CONTROL SCHEMATIC	OWRF - For Construction Submittal	April 2026
OWRF	E-28.01	OWRF - EXISTING MCC-E1 & MCC-E2 SINGLE LINE DIAGRAM - DEMOLITION	OWRF - For Construction Submittal	April 2026
OWRF	E-28.02	OWRF - MCC-E1 & MCC-E2 SINGLE LINE DIAGRAM - MODIFICATION	OWRF - For Construction Submittal	April 2026
OWRF	E-28.03	OWRF - EXISTING MCC-E1 & MCC-E2 LOAD SUMMARIES - DEMOLITION & MODIFICATION	OWRF - For Construction Submittal	April 2026
OWRF	E-28.04	OWRF - EXISTING MCC-E1 & MCC-E2 ELECTRICAL PLAN - DEMOLITION & MODIFICATION	OWRF - For Construction Submittal	April 2026
OWRF	E-28.05	OWRF - DISCONNECT FILTER DSF01 -ELECTRICAL PLAN	OWRF - For Construction Submittal	April 2026
OWRF	E-28.06	OWRF - DISCONNECT FILTER DSF02 & DSF03 -ELECTRICAL PLAN	OWRF - For Construction Submittal	April 2026
OWRF	E-28.07	OWRF - DISCONNECT FILTER DSF04 ELECTRICAL PLAN	OWRF - For Construction Submittal	April 2026
OWRF	E-28.08	OWRF - MCC-E1 & MCC-E2 POWER CONDUIT BLOCK DIAGRAM	OWRF - For Construction Submittal	April 2026
OWRF	E-28.09	OWRF - MCC-E1 & MCC-E2 POWER CONDUIT BLOCK DIAGRAM II	OWRF - For Construction Submittal	April 2026
OWRF	E-30.01	OWRF - EXISTING MCC-P & MCC-POC SINGLE LINE DIAGRAM - DEMOLITION	OWRF - For Construction Submittal	April 2026
OWRF	E-30.02	OWRF - EXISTING MCC-P & MCC-POC ELECTRICAL PLAN - DEMOLITION & MODIFICATION	OWRF - For Construction Submittal	April 2026
OWRF	E-30.03	OWRF - LP-P1 POWER PANEL SCHEDULES -DEMOLITION & MODIFICATION	OWRF - For Construction Submittal	April 2026
OWRF	E-30.04	OWRF - LP-P1 POWER CONDUIT BLOCK DIAGRAM	OWRF - For Construction Submittal	April 2026
OWRF	E-31.01	OWRF - EXISTING MCC-D1 SINGLE LINE DIAGRAM - DEMOLITION	OWRF - For Construction Submittal	April 2026
OWRF	E-31.02	OWRF - EXISTING MCC D1 & MCC-SOC-400A SINGLE LINE DIAGRAM - DEMOLITION	OWRF - For Construction Submittal	April 2026
OWRF	E-31.03	OWRF - EXISTING MCC D2 SINGLE LINE DIAGRAM - DEMOLITION	OWRF - For Construction Submittal	April 2026
OWRF	E-31.04	OWRF - EXISTING MCC D2 SINGLE LINE DIAGRAM - DEMOLITION	OWRF - For Construction Submittal	April 2026
OWRF	E-31.05	OWRF - EXISTING D1 SINGLE LINE DIAGRAM - MODIFICATION	OWRF - For Construction Submittal	April 2026
OWRF	E-31.06	OWRF - EXISTING D1 & MCC-SOC-400A SINGLE LINE DIAGRAM - MODIFICATION	OWRF - For Construction Submittal	April 2026
OWRF	E-31.07	OWRF - EXISTING MCC-D2 SINGLE LINE DIAGRAM - MODIFICATION	OWRF - For Construction Submittal	April 2026
OWRF	E-31.08	OWRF - EXISTING MCC-D2 SINGLE LINE DIAGRAM - MODIFICATION	OWRF - For Construction Submittal	April 2026

Facility	Sheet #	Sheet Name	Sheet Version	Date of Issuance
OWRF	E-31.09	OWRF - EXISTING MCC-D1, MCC-D2 & MCC-SOC-400A ELECTRICAL PLAN - DEMOLITION & MODIFICATIONS	OWRF - For Construction Submittal	April 2026
OWRF	E-31.10	OWRF - MCC-D1 & MCC-D2 POWER CONDUIT BLOCK DIAGRAM	OWRF - For Construction Submittal	April 2026
OWRF	E-32.01	OWRF - MCC-H1 EXISTING SINGLE LINE DIAGRAM - DEMOLITION	OWRF - For Construction Submittal	April 2026
OWRF	E-32.02	OWRF - MCC-H2 EXISTING SINGLE LINE DIAGRAM - DEMOLITION	OWRF - For Construction Submittal	April 2026
OWRF	E-32.03	OWRF - PDP-001 PANEL SCHEDULE	OWRF - For Construction Submittal	April 2026
OWRF	E-32.04	OWRF - EXISTING H1 & H2 ELECTRICAL PLAN - DEMOLITION & MODIFICATIONS	OWRF - For Construction Submittal	April 2026
OWRF	E-32.05	OWRF - PDP-001 CONDUIT BLOCK DIAGRAMS	OWRF - For Construction Submittal	April 2026
OWRF	E-33.01	OWRF - FUEL STORAGE TANK PANEL SCHEDULES & CONDUIT BLOCK DIAGRAM	OWRF - For Construction Submittal	April 2026
OWRF	E-33.02	OWRF - FUEL STORAGE TANK	OWRF - For Construction Submittal	April 2026
OWRF	E-34.01	OWRF - EXISTING RW-SES-1 SINGLE LINE DIAGRAM MODIFICATIONS	OWRF - For Construction Submittal	April 2026
OWRF	E-34.02	OWRF - EXISTING RW-SES-1 ELECTRICAL PLAN - MODIFICATION	OWRF - For Construction Submittal	April 2026
OWRF	E-35.01	OWRF - ELECTRICAL DETAILS I	OWRF - For Construction Submittal	April 2026
OWRF	E-35.02	OWRF - ELECTRICAL DETAILS II	OWRF - For Construction Submittal	April 2026
OWRF	E-35.03	OWRF - ELECTRICAL DETAILS III	OWRF - For Construction Submittal	April 2026
OWRF	E-35.04	OWRF - ELECTRICAL DETAILS IV	OWRF - For Construction Submittal	April 2026
OWRF	I-00.00	OWRF - INSTRUMENTATION STANDARD SYMBOLS AND LEGEND	OWRF - For Construction Submittal	April 2026
OWRF	I-23.01	OWRF - MBR BIOREACTOR BASIN NO. 1 DEMOLITION P&ID	OWRF - For Construction Submittal	April 2026
OWRF	I-23.02	OWRF - MBR BIOREACTOR BASIN NO. 1 MODIFICATION P&ID SHEET 1 OF 2	OWRF - For Construction Submittal	April 2026
OWRF	I-23.03	OWRF - MBR BIOREACTOR BASIN NO. 1 MODIFICATION P&ID SHEET 2 OF 2	OWRF - For Construction Submittal	April 2026
OWRF	I-23.04	OWRF - MBR BIOREACTOR BASIN NO. 2 DEMOLITION P&ID	OWRF - For Construction Submittal	April 2026
OWRF	I-23.05	OWRF - MBR BIOREACTOR BASIN NO. 2 MODIFICATION P&ID SHEET 1 OF 2	OWRF - For Construction Submittal	April 2026
OWRF	I-23.06	OWRF - MBR BIOREACTOR BASIN NO. 2 MODIFICATIONS P&ID SHEET 2 OF 2	OWRF - For Construction Submittal	April 2026
OWRF	I-25.01	OWRF - ANOXIC BASINS MODIFICATIONS P&ID	OWRF - For Construction Submittal	April 2026
OWRF	I-27.01	OWRF - SECONDARY CLARIFIER NO. 3 P&ID	OWRF - For Construction Submittal	April 2026
OWRF	I-33.01	OWRF - FUEL STORAGE TANK P&ID	OWRF - For Construction Submittal	April 2026
AWRF	G-1	COVER	AWRF - For Construction Submittal	April 2026
AWRF	G-2	SHEET INDEX	AWRF - For Construction Submittal	April 2026
AWRF	G-3	GENERAL NOTES - 1	AWRF - For Construction Submittal	April 2026
AWRF	G-4	GENERAL NOTES - 2	AWRF - For Construction Submittal	April 2026
AWRF	G-5	PROCESS AND SITE LEGEND	AWRF - For Construction Submittal	April 2026
AWRF	G-6	AWRF - HYDRAULIC PROFILE	AWRF - For Construction Submittal	April 2026
AWRF	G-7	AWRF - LIQUID STREAM PROCESS FLOW SCHEMATIC	AWRF - For Construction Submittal	April 2026
AWRF	G-8	AWRF - SOLID STREAM PROCESS FLOW SCHEMATIC	AWRF - For Construction Submittal	April 2026
AWRF	D-00.01	AWRF - OVERALL DEMOLITION PLAN	AWRF - For Construction Submittal	April 2026
AWRF	D-00.02	AWRF - PARTIAL DEMOLITION PLAN - 1	AWRF - For Construction Submittal	April 2026
AWRF	D-00.03	AWRF - PARTIAL DEMOLITION PLAN - 2	AWRF - For Construction Submittal	April 2026
AWRF	D-00.04	AWRF - PARTIAL DEMOLITION PLAN - 3	AWRF - For Construction Submittal	April 2026
AWRF	D-00.05	AWRF - PARTIAL DEMOLITION PLAN - 4	AWRF - For Construction Submittal	April 2026
AWRF	D-00.06	AWRF - PARTIAL DEMOLITION PLAN - 5	AWRF - For Construction Submittal	April 2026
AWRF	D-01.01	AWRF - FLOW METERING MANHOLE 10 SECTION AND DETAILS	AWRF - For Construction Submittal	April 2026
AWRF	D-02.01	AWRF - HEADWORKS DEMOLITION OVERALL PLAN	AWRF - For Construction Submittal	April 2026
AWRF	D-03.01	AWRF - AERATION BASINS NO. 5 & NO. 6 DIFFUSERS DEMOLITION OVERALL PLAN	AWRF - For Construction Submittal	April 2026
AWRF	D-03.02	AWRF - AERATION BASINS NO. 5 & NO. 6 DIFFUSERS DEMOLITION SECTIONS AND DETAILS	AWRF - For Construction Submittal	April 2026
AWRF	D-04.01	AWRF - SECONDARY CLARIFIERS NO. 1, NO. 2 & NO. 3 OVERALL DEMOLITION PLAN	AWRF - For Construction Submittal	April 2026
AWRF	D-04.02	AWRF - SECONDARY CLARIFIERS NO. 1, NO. 2 & NO. 3 DEMOLITION SECTION AND DETAILS	AWRF - For Construction Submittal	April 2026
AWRF	D-04.03	AWRF - SECONDARY CLARIFIERS NO. 4 OVERALL DEMOLITION PLAN	AWRF - For Construction Submittal	April 2026
AWRF	D-04.04	AWRF - SECONDARY CLARIFIERS NO. 4 SECTION AND DETAILS	AWRF - For Construction Submittal	April 2026
AWRF	D-11.01	AWRF - CHEMICAL STORAGE FACILITY OVERALL DEMOLITION PLAN AND SECTION	AWRF - For Construction Submittal	April 2026
AWRF	D-11.02	AWRF - HEADWORKS ODOR CONTROL OVERALL DEMOLITION PLAN AND SECTION	AWRF - For Construction Submittal	April 2026
AWRF	D-11.03	AWRF - PRE-STAGE BASIN NO. 1 ODOR CONTROL OVERALL DEMOLITION PLAN AND SECTION	AWRF - For Construction Submittal	April 2026
AWRF	D-11.04	AWRF - PRE-STAGE BASIN NO. 2 ODOR CONTROL OVERALL DEMOLITION PLAN AND SECTION	AWRF - For Construction Submittal	April 2026
AWRF	C-00.01	AWRF - SURVEY CONTROL SHEET	AWRF - For Construction Submittal	April 2026
AWRF	C-01.01	AWRF - OVERALL SITE PLAN	AWRF - For Construction Submittal	April 2026
AWRF	C-01.02	AWRF - PARTIAL SITE PLAN - 1	AWRF - For Construction Submittal	April 2026
AWRF	C-01.03	AWRF - PARTIAL SITE PLAN - 2	AWRF - For Construction Submittal	April 2026
AWRF	C-01.04	AWRF - PARTIAL SITE PLAN - 3	AWRF - For Construction Submittal	April 2026
AWRF	C-01.05	AWRF - PARTIAL SITE PLAN - 4	AWRF - For Construction Submittal	April 2026
AWRF	C-02.01	AWRF - OVERALL YARD PIPING PLAN	AWRF - For Construction Submittal	April 2026
AWRF	C-02.02	AWRF - PARTIAL YARD PIPING PLAN - 1	AWRF - For Construction Submittal	April 2026
AWRF	C-02.03	AWRF - PARTIAL YARD PIPING PLAN - 2	AWRF - For Construction Submittal	April 2026
AWRF	C-02.04	AWRF - PARTIAL YARD PIPING PLAN - 3	AWRF - For Construction Submittal	April 2026
AWRF	C-03.01	AWRF - GRADING AND DRAINAGE OVERALL SITE PLAN	AWRF - For Construction Submittal	April 2026
AWRF	C-03.02	AWRF - GRADING AND DRAINAGE PARTIAL SITE PLAN 1	AWRF - For Construction Submittal	April 2026
AWRF	C-03.03	AWRF - GRADING AND DRAINAGE PARTIAL SITE PLAN 2	AWRF - For Construction Submittal	April 2026
AWRF	C-03.04	AWRF - GRADING AND DRAINAGE PARTIAL SITE PLAN 3	AWRF - For Construction Submittal	April 2026
AWRF	C-03.05	AWRF - GRADING AND DRAINAGE PARTIAL SITE PLAN 4	AWRF - For Construction Submittal	April 2026
AWRF	C-04.01	AWRF - YARD PIPING PROFILES 1	AWRF - For Construction Submittal	April 2026
AWRF	C-40.01	AWRF - CIVIL DETAILS - 1	AWRF - For Construction Submittal	April 2026
AWRF	C-40.02	AWRF - CIVIL DETAILS - 2	AWRF - For Construction Submittal	April 2026
AWRF	C-40.03	AWRF - CIVIL DETAILS - 3	AWRF - For Construction Submittal	April 2026
AWRF	M-01.01	AWRF - FLOW METERING MANHOLE 10 SECTION AND DETAILS	AWRF - For Construction Submittal	April 2026
AWRF	M-01.02	AWRF - INFLUENT PUMP STATION PLAN AND SECTION	AWRF - For Construction Submittal	April 2026
AWRF	M-02.01	AWRF - HEADWORKS BUILDING PLAN	AWRF - For Construction Submittal	April 2026
AWRF	M-02.02	AWRF - HEADWORKS BUILDING SECTIONS AND DETAILS - 1	AWRF - For Construction Submittal	April 2026
AWRF	M-02.03	AWRF - HEADWORKS BUILDING SECTIONS AND DETAILS - 2	AWRF - For Construction Submittal	April 2026
AWRF	M-03.01	AWRF - AERATION BASIN NO. 5 AND NO. 6 OVERALL PLAN	AWRF - For Construction Submittal	April 2026
AWRF	M-03.02	AWRF - AERATION BASIN NO. 5 AND NO. 6 SECTIONS - 1	AWRF - For Construction Submittal	April 2026

Facility	Sheet #	Sheet Name	Sheet Version	Date of Issuance
AWRF	M-03.03	AWRF - AERATION BASIN NO. 5 AND NO. 6 SECTIONS - 2	AWRF - For Construction Submittal	April 2026
AWRF	M-04.01	AWRF - SECONDARY CLARIFIERS NO. 1 AND NO. 3 OVERALL PLAN	AWRF - For Construction Submittal	April 2026
AWRF	M-04.02	AWRF - SECONDARY CLARIFIERS NO. 1, NO. 2, AND NO. 3 SECTION AND DETAILS	AWRF - For Construction Submittal	April 2026
AWRF	M-04.03	AWRF - SECONDARY CLARIFIER NO. 2 OVERALL PLAN	AWRF - For Construction Submittal	April 2026
AWRF	M-04.04	AWRF - SECONDARY CLARIFIER NO. 4 OVERALL PLAN	AWRF - For Construction Submittal	April 2026
AWRF	M-04.05	AWRF - SECONDARY CLARIFIER NO. 4 SECTION AND DETAILS	AWRF - For Construction Submittal	April 2026
AWRF	M-04.06	AWRF - SECONDARY CLARIFIER NO. 1, NO. 2, AND NO. 3 DETAILS - 1	AWRF - For Construction Submittal	April 2026
AWRF	M-04.07	AWRF - SECONDARY CLARIFIER NO. 1, NO. 2, AND NO. 3 DETAILS - 2	AWRF - For Construction Submittal	April 2026
AWRF	M-05.01	AWRF - DISC FILTERS RENDERING	AWRF - For Construction Submittal	April 2026
AWRF	M-05.02	AWRF - DISC FILTERS OVERALL PLAN	AWRF - For Construction Submittal	April 2026
AWRF	M-05.03	AWRF - DISC FILTERS BASIN NO. 6 PLAN	AWRF - For Construction Submittal	April 2026
AWRF	M-05.04	AWRF - DISC FILTERS BASIN NO. 6 SECTION A	AWRF - For Construction Submittal	April 2026
AWRF	M-05.05	AWRF - DISC FILTERS BASIN NO. 6 SECTION B AND C	AWRF - For Construction Submittal	April 2026
AWRF	M-08.01	AWRF - NHLW DISPOSAL STATION SITE PLAN RENDERING - 1	AWRF - For Construction Submittal	April 2026
AWRF	M-08.02	AWRF - NHLW DISPOSAL STATION SITE PLAN RENDERING - 2	AWRF - For Construction Submittal	April 2026
AWRF	M-08.03	AWRF - NHLW DISPOSAL STATION UPPER PLAN	AWRF - For Construction Submittal	April 2026
AWRF	M-08.04	AWRF - NHLW DISPOSAL STATION SECTION VIEWS	AWRF - For Construction Submittal	April 2026
AWRF	M-11.01	AWRF - CHEMICAL STORAGE FACILITY OVERALL PLAN	AWRF - For Construction Submittal	April 2026
AWRF	M-11.02	AWRF - CHEMICAL STORAGE FACILITY SECTIONS AND DETAILS	AWRF - For Construction Submittal	April 2026
AWRF	M-11.03	AWRF - HEADWORKS ODOR CONTROL OVERALL PLAN AND SECTION	AWRF - For Construction Submittal	April 2026
AWRF	M-11.04	AWRF - PRE-STAGE BASIN NO. 1 ODOR CONTROL OVERALL PLAN AND SECTION	AWRF - For Construction Submittal	April 2026
AWRF	M-11.05	AWRF - PRE-STAGE BASIN NO. 2 ODOR CONTROL OVERALL PLAN AND SECTION	AWRF - For Construction Submittal	April 2026
AWRF	M-11.06	AWRF - CHEMICAL LOOP DETAILS	AWRF - For Construction Submittal	April 2026
AWRF	M-13.01	AWRF - EMERGENCY FUEL STORAGE OVERALL PLAN	AWRF - For Construction Submittal	April 2026
AWRF	M-13.02	AWRF - EMERGENCY FUEL STORAGE SECTIONS	AWRF - For Construction Submittal	April 2026
AWRF	M-16.01	AWRF - BLOWER BUILDING OVERALL PLAN AND SECTION	AWRF - For Construction Submittal	April 2026
AWRF	M-40.01	TYPICAL DETAILS - 1	AWRF - For Construction Submittal	April 2026
AWRF	M-40.02	TYPICAL DETAILS - 2	AWRF - For Construction Submittal	April 2026
AWRF	M-40.03	TYPICAL DETAILS - 3	AWRF - For Construction Submittal	April 2026
AWRF	M-40.04	TYPICAL DETAILS - 4	AWRF - For Construction Submittal	April 2026
AWRF	M-40.05	TYPICAL DETAILS - 5	AWRF - For Construction Submittal	April 2026
AWRF	M-40.06	TYPICAL DETAILS - 6	AWRF - For Construction Submittal	April 2026
AWRF	S-00.01	GENERAL STRUCTURAL NOTES	AWRF - For Construction Submittal	April 2026
AWRF	S-00.02	AWRF - STANDARD STRUCTURAL DETAILS 1	AWRF - For Construction Submittal	April 2026
AWRF	S-00.03	AWRF - STANDARD STRUCTURAL DETAILS 2	AWRF - For Construction Submittal	April 2026
AWRF	S-00.04	AWRF - STANDARD STRUCTURAL DETAILS 3	AWRF - For Construction Submittal	April 2026
AWRF	S-01.01	AWRF - PRECAST MANHOLE PLANS, SECTION AND DETAILS	AWRF - For Construction Submittal	April 2026
AWRF	S-03.01	AWRF - METAL BRIDGE AND STAIRS PLAN	AWRF - For Construction Submittal	April 2026
AWRF	S-03.02	AWRF - STRUCTURAL STEEL STAIR SECTIONS	AWRF - For Construction Submittal	April 2026
AWRF	S-03.03	AWRF - STRUCTURAL DETAILS	AWRF - For Construction Submittal	April 2026
AWRF	S-05.01	AWRF - STRUCTURAL STEEL PLATFORM OVERALL PLAN	AWRF - For Construction Submittal	April 2026
AWRF	S-05.02	AWRF - PLATFORM PLAN AND SECTIONS	AWRF - For Construction Submittal	April 2026
AWRF	S-05.03	AWRF - STEEL PLATFORM STRUCTURAL DETAIL	AWRF - For Construction Submittal	April 2026
AWRF	S-08.01	AWRF - NHLW DISPOSAL STATION PLANS	AWRF - For Construction Submittal	April 2026
AWRF	S-08.02	AWRF - NHLW DISPOSAL STATION SECTIONS	AWRF - For Construction Submittal	April 2026
AWRF	S-08.03	AWRF - NHLW DISPOSAL STATION DETAILS	AWRF - For Construction Submittal	April 2026
AWRF	E-00.01	AWRF - ELECTRICAL SYMBOLS AND LEGEND	AWRF - For Construction Submittal	April 2026
AWRF	E-00.02	AWRF - ELECTRICAL OVERALL SITE PLAN	AWRF - For Construction Submittal	April 2026
AWRF	E-01.01	AWRF - PARSHALL FLUME DEMOLITION AND MODIFICATION PANEL SCHEDULE	AWRF - For Construction Submittal	April 2026
AWRF	E-01.02	AWRF - PARSHALL FLUME DEMOLITION AND MODIFICATION ELECTRICAL PLAN	AWRF - For Construction Submittal	April 2026
AWRF	E-04.01	AWRF - MCC-BL2 EXISTING SINGLE LINE DIAGRAM	AWRF - For Construction Submittal	April 2026
AWRF	E-04.02	AWRF - EXISTING CLARIFIERS 480V PANEL SCHEDULES & LIGHTING FIXTURE SCHEDULE MODIFICATIONS	AWRF - For Construction Submittal	April 2026
AWRF	E-04.03	AWRF - EXISTING AERATION BASIN BLOWER BUILDING MODIFICATIONS	AWRF - For Construction Submittal	April 2026
AWRF	E-04.04	AWRF - SECONDARY CLARIFIER NO.1 DEMOLITION AND MODIFICATION ELECTRICAL PLAN	AWRF - For Construction Submittal	April 2026
AWRF	E-04.05	AWRF - SECONDARY CLARIFIER NO.2 DEMOLITION AND MODIFICATION ELECTRICAL PLAN	AWRF - For Construction Submittal	April 2026
AWRF	E-04.06	AWRF - SECONDARY CLARIFIER NO.3 DEMOLITION AND MODIFICATION ELECTRICAL PLAN	AWRF - For Construction Submittal	April 2026
AWRF	E-04.07	AWRF - SECONDARY CLARIFIER NO.4 DEMOLITION AND MODIFICATION ELECTRICAL PLAN	AWRF - For Construction Submittal	April 2026
AWRF	E-04.08	AWRF - SECONDARY CLARIFIERS NO. 1--4 CONTROL SCHEMATICS	AWRF - For Construction Submittal	April 2026
AWRF	E-04.09	AWRF - CLARIFIER MOTORS POWER & CONTROL CONDUIT BLOCK DIAGRAMS	AWRF - For Construction Submittal	April 2026
AWRF	E-05.01	AWRF - MCC-AD EXISTING SINGLE LINE DIAGRAM	AWRF - For Construction Submittal	April 2026
AWRF	E-05.02	AWRF - DSF-LP-400 & DSF-PP-300 PANEL SCHEDULES MODIFICATIONS	AWRF - For Construction Submittal	April 2026
AWRF	E-05.03	AWRF - ENLARGED DISC FILTER DSS ELECTRICAL PLAN	AWRF - For Construction Submittal	April 2026
AWRF	E-05.04	AWRF - DISC FILTER 6 POWER CONDUIT BLOCK DIAGRAM	AWRF - For Construction Submittal	April 2026
AWRF	E-05.05	AWRF - DISC FILTER 6 CONTROL CONDUIT BLOCK DIAGRAM	AWRF - For Construction Submittal	April 2026
AWRF	E-08.01	AWRF - MCC-RW SINGLE LINE DIAGRAM	AWRF - For Construction Submittal	April 2026
AWRF	E-08.02	AWRF - NHLW DISPOSAL STATION 120/240V PANEL SCHEDULE MODIFICATION POWER AND CONTROL CONDUIT BLOCK DIAGRAMS	AWRF - For Construction Submittal	April 2026
AWRF	E-08.03	AWRF - FLT-BLDO1 ELECTRICAL BUILDING ELECTRICAL PLAN	AWRF - For Construction Submittal	April 2026
AWRF	E-08.04	AWRF - NHLW DISPOSAL STATION ELECTRICAL PLAN	AWRF - For Construction Submittal	April 2026
AWRF	E-11.01	AWRF - CHEMICAL FEED PUMPS 120/240V PANEL SCHEDULE MODIFICATION	AWRF - For Construction Submittal	April 2026
AWRF	E-11.02	AWRF - CHEMICAL FEED PUMPS 120/208V PANEL SCHEDULE	AWRF - For Construction Submittal	April 2026
AWRF	E-11.03	AWRF - CHEMICAL STORAGE DEMOLITION AND MODIFICATION ELECTRICAL PLAN	AWRF - For Construction Submittal	April 2026
AWRF	E-11.04	AWRF - CHEMICAL STORAGE DEMOLITION AND MODIFICATION ELECTRICAL PLAN	AWRF - For Construction Submittal	April 2026
AWRF	E-11.05	AWRF - CHEMICAL STORAGE SYSTEM POWER & CONTROL CONDUIT BLOCK DIAGRAMS	AWRF - For Construction Submittal	April 2026
AWRF	E-13.01	AWRF - FUEL STORAGE PANEL SCHEDULES POWER AND CONTROL CONDUIT BLOCK DIAGRAMS	AWRF - For Construction Submittal	April 2026
AWRF	E-13.02	AWRF - FUEL STORAGE ELECTRICAL PLAN	AWRF - For Construction Submittal	April 2026
AWRF	E-34.01	ELECTRICAL DETAILS I	AWRF - For Construction Submittal	April 2026
AWRF	E-34.02	ELECTRICAL DETAILS II	AWRF - For Construction Submittal	April 2026
AWRF	E-34.03	ELECTRICAL DETAILS III	AWRF - For Construction Submittal	April 2026

Facility	Sheet #	Sheet Name	Sheet Version	Date of Issuance
AWRF	I-00.01	AWRF - INSTRUMENTATION STANDARD SYMBOLS AND LEGEND	AWRF - For Construction Submittal	April 2026
AWRF	I-01.01	AWRF - PARSHALL FLUME -INFLUENT PUMP STATION DEMOLITION P&ID 1	AWRF - For Construction Submittal	April 2026
AWRF	I-01.02	AWRF - PARSHALL FLUME -INFLUENT PUMP STATION MODIFICATION P&ID 1	AWRF - For Construction Submittal	April 2026
AWRF	I-04.01	AWRF - SECONDARY CLARIFIERS NO. 1-4 DEMOLITION P&ID	AWRF - For Construction Submittal	April 2026
AWRF	I-04.02	AWRF - SECONDARY CLARIFIERS NO. 1-4 MODIFICATION P&ID	AWRF - For Construction Submittal	April 2026
AWRF	I-05.01	AWRF - DISC FILTER DS6 P&ID SHEET 1 OF 3	AWRF - For Construction Submittal	April 2026
AWRF	I-05.02	AWRF - DISC FILTER DS6 P&ID SHEET 2 OF 3	AWRF - For Construction Submittal	April 2026
AWRF	I-05.03	AWRF - DISC FILTER DS6 P&ID SHEET 3 OF 3	AWRF - For Construction Submittal	April 2026
AWRF	I-05.04	AWRF - DISC FILTER BASINS SUMP P&ID	AWRF - For Construction Submittal	April 2026
AWRF	I-08.01	AWRF - NHLW DISPOSAL STATION SUMP PUMP P&ID	AWRF - For Construction Submittal	April 2026
AWRF	I-11.01	AWRF - CHEMICAL STORAGE FACILITY NaOH AND NaOCl - DEMOLITION P&ID	AWRF - For Construction Submittal	April 2026
AWRF	I-11.02	AWRF - CHEMICAL STORAGE FACILITY SODIUM HYPOCHLORITE (NaOCl) P&ID	AWRF - For Construction Submittal	April 2026
AWRF	I-11.03	AWRF - CHEMICAL STORAGE FACILITY SODIUM HYDROXIDE (NaOH) P&ID	AWRF - For Construction Submittal	April 2026
AWRF	I-11.04	AWRF - HEADWORKS BUILDING ODOR CONTROL - DEMOLITION P&ID	AWRF - For Construction Submittal	April 2026
AWRF	I-11.05	AWRF - HEADWORKS BUILDING ODOR CONTROL - MODIFICATION P&ID	AWRF - For Construction Submittal	April 2026
AWRF	I-11.06	AWRF - PRE-STAGE BASIN NO.2 ODOR CONTROL - DEMOLITION P&ID	AWRF - For Construction Submittal	April 2026
AWRF	I-11.07	AWRF - PRE-STAGE BASIN NO.2 ODOR CONTROL - MODIFICATION P&ID	AWRF - For Construction Submittal	April 2026
AWRF	I-11.08	AWRF - PRE-STAGE BASIN NO.1 ODOR CONTROL - DEMOLITION P&ID	AWRF - For Construction Submittal	April 2026
AWRF	I-11.09	AWRF - PRE-STAGE BASIN NO.1 ODOR CONTROL - MODIFICATION P&ID	AWRF - For Construction Submittal	April 2026
AWRF	I-13.01	AWRF - FUEL STORAGE TANK P&ID	AWRF - For Construction Submittal	April 2026



City of Chandler
WRF Improvements Phase 3
Qualifications and
Assumptions Summary

Qualifications & Assumptions – Chandler Phase 3 Wilson Scope

General

1. Price validity assumes council approval on October 15th, 2026 and a notice to proceed issued by November 15
2. The parties agree that the Qualifications and Assumptions, including Work Category specific Assumptions and Clarifications, set forth herein shall govern and control over any terms or conditions to the contrary in the Contract Documents.
3. Liquidated damages have been assumed to be per MAG section 108.9. Liquidated damages will be in the amount of $1,780 per day. Liquidated damages may be assessed if contractual Substantial completion is not met. No milestones are assumed to be tied to liquidated damages other than Substantial completion.
4. Submittals have been included to be submitted in electronic format only. No hard copies of shop drawings will be submitted.
5. As built documents to be captured using Procore drawing management system. Live access to as built documents will be made available to Engineer C Owner via Procore. Final As Built drawing turnover to occur using Bluebeam session for final review. No hard copies of As built drawings will be maintained. Access to Procore to serve as monthly transmission of As Built documents. Additionally, no updates to Engineer CAD files will be completed with As Built deliverable.
6. Quantity (2) hard copies of OCM manuals to be provided for Final OCMs only. Preliminary OCMs shall be submitted electronically.
7. Daily reports and project photos to be transmitted through Newforma in PDF file format. Quantity of photos required will depend on work performed that month and not in compliance with quantity provided in specification 01380-1.1.B2.
8. The project schedule will be documented in Primavera P6 and not in Microsoft Project as outlined in Section 6.2.1 of the agreement.
9. No trailer rental has been included in this proposal for contractor or engineer/owner's representative. Office space for entire CMAR team shall be provided by the Owner to operate at AWRF and OWRF at the start of mobilization to each site. Proposed office space is subject to McCarthy approval.
10. No considerations have been included in the general requirement for trailer hook-ups, utility usage, set-up, or tear-down. It is assumed all these responsibilities will be managed by the Owner.
11. All maintenance of the trailers will be deferred to the Owner.
12. Fee, bond, and insurance have not been included on the Owner's Allowance value within the GMP. These costs will be added to and applied against the Owner's Allowance as it is used.



City of Chandler
WRF Improvements Phase 3
Question and Answer Log

Comment Log - Wilson Engineers

Chandler Phase 3 Improvements - Lump Sum Proposal

#	Comment	Page #	Section Name	Author	Date	Response
1	OWRF Clarifier Drain Line Plug valve is 8" not 6".	21	11D - Hydraulic Valves	Wesley Terrones	9/1/2026	Confirmed 8". Typo. Please provide spec 11295, it was not included in addendum 3
2	Ensure actuator replacement only, not valve at AWRF Clarifier 4.	21	11D - Hydraulic Valves	Wesley Terrones	9/1/2026	MCC needs to update. Spec 11295 not provided in Addendum No. 3.
3	OWRF Clarifier Plug valve is not Motor operated.	21	11D - Hydraulic Valves	Wesley Terrones	9/1/2026	MCC needs to update. Spec 11295 not provided in Addendum No. 3.
4	Clarify. Detail 132 is not on sheet C-40.01.	23	11H - Secondary Clarifiers	Wesley Terrones	9/1/2026	Per Detail 101 and 104 as applicable. Clarification not applicable and will be removed.
5	Clarify. Not in the assumptions and clarifications table	34	11H - Secondary Clarifiers	Wesley Terrones	9/1/2026	This will be modified to "yes" at not additional cost.
6	What is an alternative purge method? Provide manual and continuous purge.	39	11I - Aeration System	Yago Freire	9/1/2026	Both purge options will be provided
7	Provide SCH40 equivalent (thickness) piping.	39	11I - Aeration System	Yago Freire	9/1/2026	Per Aquarius quote, manifolds suggested to be SDR 18 PVC as it is the same wall thickness as SCH 40
8	Medium Voltage Buckets need to include Protection & Control as required in spec 16343 section 2.2 and indicated on drawings.	51	16A.1 - Electrical Long Lead Equipment	Jaco Kruger	9/1/2026	Included
9	Main Electrical Switchgear needs to include Protection & Control as required in the spec and indicated on drawings.	51	16A.1 - Electrical Long Lead Equipment	Jaco Kruger	9/1/2026	Included
10	Ensure seismic certification per 16343 is included.	52	16A.1 - Electrical Long Lead Equipment	Jaco Kruger	9/1/2026	Included
11	Is the city OK with Contractor including videos only? Include Training session in addition to video?	58	01A - General Requirements	Yago Freire	9/1/2026	One in person training session, and one video are included for each piece of equipment listed.
12	City to confirm if these utility and permitting exclusions are acceptable.	58	01A - General Requirements	Yago Freire	9/1/2026	These items would be covered under the owner allowance if required.
13	IMLR pump #7 not #6	62	01B - MOPO Tie-Ins	Wesley Terrones	9/1/2026	Noted
14	IMLR pump #7 not #6	64	01B - MOPOs Tie-Ins	Wesley Terrones	9/1/2026	Noted
15	IMLR pump #7 not #6	64	01B - MOPOs Tie-Ins	Wesley Terrones	9/1/2026	Noted
16	Per comment log 162 and 164, grout topping at AWRF Clarifiers per manufacturers recommendation during construction.	101	03A - Concrete	Wesley Terrones	9/1/2026	Included
17	Grout is not required in launder decks per Contract Documents. If not required, money shall be credited back to City.	101	03A - Concrete	Yago Freire	9/1/2026	Noted
18	Grout is not required in launder decks per Contract Documents. If not required, money shall be credited back to City.	102	03A - Concrete	Wesley Terrones	9/1/2026	Noted
19	If clarifier weir anchors are reused, contractor shall provide PE stamped letter validating the integrity of the existing anchors.	103	03A - Concrete	Yago Freire	9/1/2026	Noted
20	Per D-27.02 and comment log, full removal of existing grout topping is required at OWRF clarifier 3.	103	03A - Concrete	Wesley Terrones	9/1/2026	Noted
21	Grout is not required in launder decks per Contract Documents. If not required, money shall be credited back to City.	103	03A - Concrete	Wesley Terrones	9/1/2026	Noted
22	Clarify. There are no clarifications regarding the pump speed in the assumptions and clarifications table.	130	11A - Magnetic Drive Sealless End Suction Pumps	Wesley Terrones	9/1/2026	Noted
23	Pump shall be compliant with ANSI per Contract Documents.	132	11A - Magnetic Drive Sealless End Suction Pumps	Wesley Terrones	9/1/2026	Noted
24	Motor shall be suitable for 50 degrees Celsius at a minimum as required by the Contract Documents. 40 C is not acceptable.	132	11A - Magnetic Drive Sealless End Suction Pumps	Wesley Terrones	9/1/2026	Noted
25	These deviations are not acceptable. Deviations do not meet specifications of the Contract Documents including: motor ambient temperature, shutoff head, efficiency.	132	11A - Magnetic Drive Sealless End Suction Pumps	Wesley Terrones	9/1/2026	Noted
26	Pump selected is different from specified.	132	11A - Magnetic Drive Sealless End Suction Pumps	Wesley Terrones	9/1/2026	Noted
27	Contractor shall be responsible for coordinating between IMLR pump manufacturer and aeration basin diffuser manufacturer to ensure minimum distances are met and equipment is not conflicting with each other as required by Contract Documents.	138	11G - Low-Flow Propeller (IMLR) Pumps	Yago Freire	9/1/2026	MCC will ensure installation meetings manufacturer and design installation requirements.
28	Dispenser hose is required to be 75ft long per specification, this distance is required to get to the generators.	146	13C - Fuel Storage Tank System	Yago Freire	9/1/2026	Noted
29	Re-balancing is required per specification. Is it included elsewhere?	163	15A - Process Piping and Equipment Installation	Yago Freire	9/1/2026	MCC will rebalance the system, but performance of the existing blower cannot be guarantee with the new FRP suction pipe design.
30	Contractor to ensure mixers are functional in the same capacity as before relocation.	163	15A - Process Piping and Equipment Installation	Yago Freire	9/1/2026	Noted
31	This conflicts with general assumptions & clarifications later on, where contractor states warranty is for 1 year after substantial completion or beneficial use.	169	15C - HVAC	Yago Freire	9/1/2026	Warranty will be 1 year from final completion.
32	Clarify scope of provided HVAC supports.	169	15C - HVAC	WTerrones	9/1/2026	Supports provided per drawings to support system
33	Fire Surveillance and Alarm are needed at the new electrical buildings.	179	16A - Electrical, Instrumentations & Controls	Jaco Kruger	9/1/2026	Confirm location of fire alarm at OWRF electrical buildings only
34	Fire Surveillance and Alarm are needed at the new electrical buildings.	180	16A - Electrical, Instrumentations & Controls	Jaco Kruger	9/1/2026	Confirm location of fire alarm at OWRF electrical buildings only
35	Ensure that City is OK with Lack of UL inspection or recertification for modifications to existing instrumentation and control panels, and SCADA network cabinets.	183	16A - Electrical, Instrumentations & Controls	Jaco Kruger	9/1/2026	This clarification has been updated following conversation with the City.
36	This clarification about MOPO provisions is not acceptable, major work at 480V and above is excluded by this. Contract documents include major work at 480V and above. Ensure provisions are provided for all MOPOs in Contract Documents. WC 01B does not mention anything about these provisions either.	184	16A - Electrical, Instrumentations & Controls	Jaco Kruger	9/1/2026	Noted
37	Protection & Controls on SWGR-120-001/002 and new SWGR 1AA/1AB is indicated, required and essential. Compliance with specifications 16343, 16430, 16431 required.	185	16A - Electrical, Instrumentations & Controls	Jaco Kruger	9/1/2026	Noted
38.1	1. Protective Relay Commissioning & Programming is not mentioned. This should be included in the scope.	186	16A - Electrical, Instrumentations & Controls	Jaco Kruger	9/1/2026	Noted
38.2	Surge Arresters not mentioned in proposal. Required per spec 16343 Section 2.2.	186	16A - Electrical, Instrumentations & Controls	Jaco Kruger	9/1/2026	Noted
38.3	Provide conduit routing drawings for engineers approval and not for for information only. This includes re-use of existing conduits.	186	16A - Electrical, Instrumentations & Controls	Jaco Kruger	9/1/2026	Noted
38.4	High Risk Items:	186	16A - Electrical, Instrumentations & Controls	Jaco Kruger	9/1/2026	N/A
38.4.1	PLC Programming scope split with WC 16A is unclear and leaves a potentially large gap. Clarify and ensure that all PLC programming required by Contract Documents is included.	186	16A - Electrical, Instrumentations & Controls	Jaco Kruger	9/1/2026	Noted
38.4.2	Duct bank remediation may be needed if ducts cannot be re-used. Explicitly excluded and may lead to large change-orders.	186	16A - Electrical, Instrumentations & Controls	Jaco Kruger	9/1/2026	Noted
38.4.3	Fire Alarm requirements: NFPA 101 may require fire detection in electrical rooms and City Design Standards typically require fire alarm in enclosed electrical/mechanical rooms.	186	16A - Electrical, Instrumentations & Controls	Jaco Kruger	9/1/2026	Addressed above

McCARTHY

100% Agency Review Clarifications Log

(highlighted rows received a response, non-highlighted rows did not)

*Questions without a response will be submitted as an RFI during construction as required.

Item #	Site	Location	Referenced Document	Sheet Number	Scope of Work	MBC Comment	Architect/Engineer Response
1	OWRF		Volume 4 (OWRF) Drawings - 100% Submittal	G-03		Contradicts COC contract. Please confirm final completion is 30d after substantial	No response
2	OWRF		Volume 4 (OWRF) Drawings - 100% Submittal	G-03		Please update to say 'AND'	Noted.
3	OWRF		Volume 4 (OWRF) Drawings - 100% Submittal	G-03		NA, please delete or confirm this is not a requirement	Will be updated in forthcoming submittal.
4	OWRF	O - Effluent Electrical Building	Volume 4 (OWRF) Drawings - 100% Submittal	G-10	MOPO	Condition Assessment Required. Do we need to replace these gates for proper isolation?	No response
5	OWRF	O - Effluent Electrical Building	Volume 4 (OWRF) Drawings - 100% Submittal	G-10	Concrete	Further discussion needed for MOPO to perform concrete repairs. Pump around? What locations? Means of isolation? Can this work be coordinated with electrical shutdown? Pump around would be required if not coordinated with electrical shutdown.	No response
6	OWRF	O - Clarifier #3	Volume 4 (OWRF) Drawings - 100% Submittal	D-20.02	Misc Metals	This may conflict with new stair landing location. Please confirm if box is being relocated or the stair landing is being shifted.	Reuse existing stairs at existing location.
7	OWRF	O - Site	Volume 4 (OWRF) Drawings - 100% Submittal	D-20.03	Demo	Electrical Demo not indicated. Please include extent of demo	No response
8	OWRF	O - Site	Volume 4 (OWRF) Drawings - 100% Submittal	D-20.03	Demo	Do we need to salvage any electrical equipment at silo?	No response
9	OWRF	O - Site	Volume 4 (OWRF) Drawings - 100% Submittal	D-20.03	Demo	Confirm extent of demo at building. Is masonry infill required?	Masonry infill is not requiered. Cover hole with a metal plate.
10	OWRF	O - Site	Volume 4 (OWRF) Drawings - 100% Submittal	D-20.03	Demo	Confirm extents of demo, just above grade or do we need to demo UG concrete	Demo of underground concrete is not necessary.
11	OWRF	O - Site	Volume 4 (OWRF) Drawings - 100% Submittal	D-20.03	Demo	Please update to extend lines to include curb	Noted, will be updated in forthcoming submittal.
12	OWRF	O - MBR Aeration Basin	Volume 4 (OWRF) Drawings - 100% Submittal	D-23.01	Demo	Confirm COC does not want them salvaged?	Zone 8 mixers will be relocated, will be updated in forthcoming submittal.
13	OWRF	O - MBR Aeration Basin	Volume 4 (OWRF) Drawings - 100% Submittal	D-23.02	Demo	Confirm quantity / clarify if zone 7 mixers get demo'ed in drawing and note. Also confirm if mixers are to be removed and not salvaged	Zone 7 mixers are to remain in place, will be updated in forthcoming submittal.
14	OWRF	O - MBR Aeration Basin	Volume 4 (OWRF) Drawings - 100% Submittal	D-23.02	Demo	IMLR Piping is called out as 30" on M sheets but note calls for 24" core. Please clarify.	30" Pipe is correct. Core to be 30". Will be updated on forthcoming submittal
15	OWRF	O - MBR Aeration Basin	Volume 4 (OWRF) Drawings - 100% Submittal	D-23.02	Demo	Confirm we can core through rebar. McC will coordinate best location with Engineer in field	Confirmed. Repair exposed rebar at cut per Detail 5/S-20.03
16	OWRF	O - Clarifier #3	Volume 4 (OWRF) Drawings - 100% Submittal	D-27.01	Demo	Existing walkway location for Clarifier 3. Please update	Noted.
17	OWRF	O - Clarifier #3	Volume 4 (OWRF) Drawings - 100% Submittal	D-27.01	Demo	Confirm if this staircase requires demo or leave in place	Protect in place and reuse
18	OWRF	O - Clarifier #3	Volume 4 (OWRF) Drawings - 100% Submittal	D-27.01	Demo	Confirm this hose bib does not need to be relocated (if bridge location changes as shown on M sheets)	Confirmed.
19	OWRF	O - Clarifier #3	Volume 4 (OWRF) Drawings - 100% Submittal	D-27.01	Demo	Please redraw to depict the actual location.	Noted.
20	OWRF	O - Clarifier #3	Volume 4 (OWRF) Drawings - 100% Submittal	D-27.01	Demo	Update to show demo of Valve in drawing	Noted.
21	OWRF	O - Effluent Electrical Building	Volume 4 (OWRF) Drawings - 100% Submittal	D-28.01	Demo	Please update to include demo lines to detail 1	Contractor to clarify.
22	OWRF	O - Site	Volume 4 (OWRF) Drawings - 100% Submittal	C-21.01	Civil	Update reference to show C-21.02 & C-21.03	Noted.
23	OWRF	O - Site	Volume 4 (OWRF) Drawings - 100% Submittal	C-21.01	Civil	Please insert new Elec building	Will be updated in forthcoming submittal.
24	OWRF	O - Clarifier #3	Volume 4 (OWRF) Drawings - 100% Submittal	C-21.02	Civil	Does new bridge land on the East side of clarifier 3?	New bridge will land at existing stairs.
25	OWRF	O - Clarifier #3	Volume 4 (OWRF) Drawings - 100% Submittal	C-21.02, 22.02	Civil	Update to show Plug Valve replacement	Noted.
26	OWRF	O - Fuel Storage Tank	Volume 4 (OWRF) Drawings - 100% Submittal	C-21.03	Civil	update to 12,000g storage tank? M sheets state 12 Summary states 10 C sheet states 10	Fuel Tank at OWRF is 10,000 gallons. Conflicting information will be fixed in next submittal.
27	OWRF	O - Fuel Storage Tank	Volume 4 (OWRF) Drawings - 100% Submittal	C-21.03	Civil	During page flip, COC requested for the fuel tank to be located closer to the generators so that could be filled using a hose. Please confirm if tank is being located at the proposed location	Pending further design and owner discussion
28	OWRF	O - Fuel Storage Tank	Volume 4 (OWRF) Drawings - 100% Submittal	C-21.03	Civil	Please confirm if McCarthy should provide the millings, or transport millings from stockpile at AWRF.	Contractor shall coordinate with city to request if millings at AWRF can be used.
29	OWRF	O - Clarifier #3	Volume 4 (OWRF) Drawings - 100% Submittal	C-22.01 & C-22.02	Civil	Add details for scum piping & valve replacement	Noted.

100% Agency Review Clarifications Log

(highlighted rows received a response, non-highlted rows did not)

Item #	Site	Location	Referenced Document	Sheet Number	Scope of Work	MBC Comment	Architect/Engineer Response
30	OWRF	O - Site	Volume 4 (OWRF) Drawings - 100% Submittal	C-23.02	Civil	soil is soft, potential leak in this area. Leak is pre existing, McCarthy has not included investigation in GMP	Noted.
31	OWRF	O - Site	Volume 4 (OWRF) Drawings - 100% Submittal	C-23.02	Civil	Please confirm McCarthy to relocate grounding rod in order to pave area, provide location for relocation	No response
32	OWRF	O - Site	Volume 4 (OWRF) Drawings - 100% Submittal	C-23.02	Civil	Curb looks bad, confirm which (if any) curbs need to be replaced. Alternatively, potential to also pave old containment area rather than fixing curb	Noted, will be updated in forthcoming submittal.
33	OWRF	O - Site	Volume 4 (OWRF) Drawings - 100% Submittal	C-23.02	Civil	Please confirm the design intent is for this area to be flat	Will be updated in forthcoming submittal.
34	OWRF	O - Site	Volume 4 (OWRF) Drawings - 100% Submittal	C-23.02	Civil	Update note 60 to include existing electrical manholes/boxes. Or add additional callout for all boxes that require adjustment. (Typ.)	Noted.
35	OWRF	O - Site	Volume 4 (OWRF) Drawings - 100% Submittal	C-23.03	Civil	RFI - Confirm if this is a new sidewalk. Provide detail callout as required.	This is not a new sidewalk, lines will be eliminated in forthcoming submittal.
36	OWRF	O - Site	Volume 4 (OWRF) Drawings - 100% Submittal	C-23.03	Civil	Confirm this geofabric is not new. MCC to install curb next to existing rip rap	No response
37	OWRF	O - MBR Aeration Basin	Volume 4 (OWRF) Drawings - 100% Submittal	M-23.01	Mechanical	Mixer hoist locations not shown. Please update	Noted.
38	OWRF	O - MBR Aeration Basin	Volume 4 (OWRF) Drawings - 100% Submittal	M-23.01	Mechanical	Does this cover need to be modified to accommodate adjacent concrete walkway and prevent tripping hazard between existing cover and new concrete deck?	Cover does not need to be modified. Cover shall sit on new concrete walkway in the same fashion that it is currently supported by the structural steel.
39	OWRF	O - MBR Aeration Basin	Volume 4 (OWRF) Drawings - 100% Submittal	M-23.01	Mechanical	Confirm if fall protection rings need to be provided here?	Confirmed. Fall protection rings need to be provided and will be shown on forthcoming submittal.
40	OWRF	O - MBR Aeration Basin	Volume 4 (OWRF) Drawings - 100% Submittal	M-23.02	Mechanical	VE: Potential to reuse submersible mixers. spec calls for purchase of 3 mixers (2 new & 1 Spare), priced at ~$60k each	Noted. Will consider and update in forthcomming submittal if necessary.
41	OWRF	O - MBR Aeration Basin	Volume 4 (OWRF) Drawings - 100% Submittal	M-23.02	Mechanical	these mixers were shown to be removed in demo drawings. Please clarify intent	Mixers will not be demo'ed.
42	OWRF	O - MBR Aeration Basin	Volume 4 (OWRF) Drawings - 100% Submittal	M-23.02	Mechanical	VE- Duckbill check valve or flap gate instead of swing check valve	Yes, will be included in forthcoming submittal
43	OWRF	O - MBR Aeration Basin	Volume 4 (OWRF) Drawings - 100% Submittal	M-23.02	Mechanical	VE - Confirm if team is open to other material types such as cement lined ductile iron or C900	Cement lined ductile iron or c900 are not acceptable.
44	OWRF	O - MBR Aeration Basin	Volume 4 (OWRF) Drawings - 100% Submittal	M-23.02	Mechanical	Detail 40.01 does not exist. Please update	Noted.
45	OWRF	O - MBR Aeration Basin	Volume 4 (OWRF) Drawings - 100% Submittal	M-23.03	Mechanical	Please Update to provide Keynote #10	Noted.
46	OWRF	O - Anoxic Basin	Volume 4 (OWRF) Drawings - 100% Submittal	M-25.01	Mechanical	Please provide detail and location for tie-in of new seal water line to existing seal water header	Will be updated in forthcoming submittal.
47	OWRF	O - Anoxic Basin	Volume 4 (OWRF) Drawings - 100% Submittal	M-25.02	Mechanical	MISSING KEYED NOTE 10. Please update	Noted.
48	OWRF	O - Anoxic Basin	Volume 4 (OWRF) Drawings - 100% Submittal	M-25.02	Mechanical	update drawings to show core holes for discharge pipe and seal water	Noted.
49	OWRF	O - Anoxic Basin	Volume 4 (OWRF) Drawings - 100% Submittal	M-25.02	Mechanical	GMP 1 Long Lead set shows hydrocone. Please confirm a hydrocone is no longer required.	Hydrocone not required, however, manufacturer anti-vortex device for mixed liqour application is required.
50	OWRF	O - Anoxic Basin	Volume 4 (OWRF) Drawings - 100% Submittal	M-25.02	Mechanical	Pad is hollow in spots, will likely need to be chipped out. Please update drawing to include the removal and replacement of the pad to accomodate the veritical turbine pump.	Noted.
51	OWRF	O - Anoxic Basin	Volume 4 (OWRF) Drawings - 100% Submittal	M-25.02	Mechanical	Seal water supply is in the south chamber, not the pump suction. Please update drawing.	Noted.
52	OWRF	O - Clarifier #3	Volume 4 (OWRF) Drawings - 100% Submittal	M-27.01	Mechanical	existing hatch here to access scum line. Will have to move new walkway landing slightly north to have room. Please Confirm. Proposed new bridge location is shown on drawings	Reuse existing stairs at existing location.
53	OWRF	O - Clarifier #3	Volume 4 (OWRF) Drawings - 100% Submittal	M-27.01	Mechanical	Pad is not existing. Please update and provide detail	Noted.

100% Agency Review Clarifications Log

(highlighted rows received a response, non-highlted rows did not)

Item #	Site	Location	Referenced Document	Sheet Number	Scope of Work	MBC Comment	Architect/Engineer Response
54	OWRF	O - Clarifier #3	Volume 4 (OWRF) Drawings - 100% Submittal	M-27.01	Mechanical	Please confirm if gate in effluent channel works. if not working, plug is needed for work	Contractor to confirm with plant staff.
55	OWRF	O - Clarifier #3	Volume 4 (OWRF) Drawings - 100% Submittal	M-27.01	Mechanical	current bridge location, please update existing staircase location to match	Noted.
56	OWRF	O - Clarifier #3	Volume 4 (OWRF) Drawings - 100% Submittal	M-27.01	Mechanical	Add detail 104 to sheet C-40.01	Noted.
57	OWRF	O - Clarifier #3	Volume 4 (OWRF) Drawings - 100% Submittal	M-27.01	Mechanical	Potential to add gate here instead of filling the gap in with handrail. City could use this location for ladder access into the clarifier (If bridge is moving as shown on M sheets). Please verify	Reuse existing stairs at existing location.
58	OWRF	O - Clarifier #3	Volume 4 (OWRF) Drawings - 100% Submittal	M-27.02	Mechanical	No existing staircase at new walkway location as shown on M-27.01 (east side of clarifier). Please update	Noted.
59	OWRF	O - Clarifier #3	Volume 4 (OWRF) Drawings - 100% Submittal	M-27.02	Mechanical	Existing Mckinny Baffle, update to include McKinny baffle and penetration	Noted.
60	OWRF	O - Clarifier #3	Volume 4 (OWRF) Drawings - 100% Submittal	M-27.02	Mechanical	existing scum box piping goes through deck (mckinny baffle). Please update	Will be updated in forthcoming submittal.
61	OWRF	O - Clarifier #3	Volume 4 (OWRF) Drawings - 100% Submittal	M-27.02	Mechanical	New grout should be shown in bold. Please update	Will be updated in forthcoming submittal.
62	OWRF	O - Clarifier #3	Volume 4 (OWRF) Drawings - 100% Submittal	M-27.02	Mechanical	2 45's instead of a 90? this was brought up in AWRF Page flip. Please confirm if this is wanted here as well	Confirmed.
63	OWRF	O - Clarifier #3	Volume 4 (OWRF) Drawings - 100% Submittal	M-27.02	Mechanical	Update note on scum baffle support bracket assembly to reference sheet M-27.03 instead of 27.04	Will be updated in forthcoming submittal.
64	OWRF	O - Clarifier #3	Volume 4 (OWRF) Drawings - 100% Submittal	M-27.02	Mechanical	this clarifier doesn't have an arm in the pit. Please update drawings to show design intent if this is to be added	Noted.
65	OWRF	O - Clarifier #3	Volume 4 (OWRF) Drawings - 100% Submittal	M-27.02	Mechanical	Does the team anticipate modifications needed to concrete floor to accommodate new center pier? Reference clarifier center pier RFI from Improvements phase 2	No response
66	OWRF	O - Clarifier #3	Volume 4 (OWRF) Drawings - 100% Submittal	M-27.02	Mechanical	New scum baffle bracket should be shown in bold, please update	Noted.
67	OWRF	O - Clarifier #3	Volume 4 (OWRF) Drawings - 100% Submittal	M-27.03	Mechanical	Confirm effluent trough is not to be replaced	Confirmed.
68	OWRF	O - Clarifier #3	Volume 4 (OWRF) Drawings - 100% Submittal	M-27.03	Mechanical	Provide anchor detail for existing concrete	Noted.
69	OWRF	O - Fuel Storage Tank	Volume 4 (OWRF) Drawings - 100% Submittal	M-33.01, M-33.02	Mechanical	Summary of work for OWRF calls for 10,000 Gallon Fuel Tank. Please clarify and update	Confirmed. OWRF shall have 10,000 gallon tank
70	OWRF	O - Site	Volume 4 (OWRF) Drawings - 100% Submittal	M-40.01	Mechanical	What steps should be followed if rebar is in the way? Provide rebar modification detail for typical conflict locations.	No response
71	OWRF	O - Effluent Electrical Building	Volume 4 (OWRF) Drawings - 100% Submittal	S-29.01	Structural	Confirm if beam extent is reflected in yellow or yellow + blue	Beam extent is yellow. See +/-19'-4" dimension note.
72	OWRF	O - Effluent Electrical Building	Volume 4 (OWRF) Drawings - 100% Submittal	S-29.01	Structural	4. add structural detail required to repair beam. Pins and wire required if corrosion is extensive? See concrete repair details used on Improvements 2 at aeration basin walkway if needed	Traditional concrete repair is not acceptable due to extensive spalling and rebar corrosion. Repair per Section A/S-29.01 and referenced Specification Section 03101. SPiRe+ system includes beam repair and strengthening.
73	OWRF	O - Site	Volume 4 (OWRF) Drawings - 100% Submittal	E-20.01	Electrical	RFI 4 - Spare 4" conduits Routing ~1,500' (2 splice points needed, maybe 3) EMH-22 EMH-23 EMH-24 EMH-26 (4 total) Existing Feeds for MCC-610-001/002 MCC-530-001/002 Can we use these to pull wire in? We would need to shut down the MV feeds. Do they want separate manholes for A/B feeds? Recommend shut down to pull in new mule tape and get exact distances needed for wire cuts.	Acknowledged. A/B feeds will be in seperate Manholes. Will be updated in forthcoming submittal.
74	OWRF	O - Site	Volume 4 (OWRF) Drawings - 100% Submittal	E-20.02	Electrical	Scaling of page appears to be misaligned with stated scale. Please update	Acknowledged. It will be updated in the construction package.
75	OWRF	O - Site	Volume 4 (OWRF) Drawings - 100% Submittal	E-20.02	Electrical	GRIC to be refed from SES nearby. Please confirm	Acknowledged. It will be updated in the construction package.

100% Agency Review Clarifications Log

(highlighted rows received a response, non-highlted rows did not)

Item #	Site	Location	Referenced Document	Sheet Number	Scope of Work	MBC Comment	Architect/Engineer Response
76	OWRF	O - Site	Volume 4 (OWRF) Drawings - 100% Submittal	E-20.03	Electrical	Scaling of page appears to be misaligned with stated scale. Please verify	Acknowledged. It will be updated in the construction package.
77	OWRF	O - Site	Volume 4 (OWRF) Drawings - 100% Submittal	E-20.04	Electrical	Fuel Storage Tank location conflicts with revised location shown on C-21.01. Please clarify	Acknowledged. It will be updated in the construction package.
78	OWRF	O - Site	Volume 4 (OWRF) Drawings - 100% Submittal	E-20.04	Electrical	RFI Is this supposed to be MCC-410?	No response
79	OWRF	O - Site	Volume 4 (OWRF) Drawings - 100% Submittal	E-20.04	Electrical	Scaling of page appears to be misaligned with stated scale. known measurement of 70Lf on C23.03 is shown on drawing. Please update	Acknowledged. It will be updated in the construction package.
80	OWRF	O - Electrical	Volume 4 (OWRF) Drawings - 100% Submittal	E-20.06	Electrical	Needs backup power. Lighting, life safety, PLC. Please update	No action required at the scope of this project. coordinate with MOPO if Temp power needed.
81	OWRF	O - Electrical	Volume 4 (OWRF) Drawings - 100% Submittal	E-20.06	Electrical	VE Verify with Plant size of generator needed to temp feed during MOPO. Can save a lot for Gen and Fuel costs.	Contractor to define during MOPO coordination.
82	OWRF	O - Electrical	Volume 4 (OWRF) Drawings - 100% Submittal	E-20.06	Electrical	RFI Loads are not redundant to A/B sides of SGR-120. Will temp power be needed?	PDP-710-001 admin building needs temp power.
83	OWRF	O - Electrical	Volume 4 (OWRF) Drawings - 100% Submittal	E-20.08	Electrical	This Load Summary does not include NEW Loads added on Sheet E-20.07. Please update	Acknowledged. It will be updated in the construction package.
84	OWRF	O - Electrical	Volume 4 (OWRF) Drawings - 100% Submittal	E-20.11	Electrical	Suggested location for NEW ATS-Panel LS. Please confirm	Acknowledged. The equipment will be installed in the new electrical building, adjacent to XFR-PANEL LS.
85	OWRF	O - Electrical	Volume 4 (OWRF) Drawings - 100% Submittal	E-20.11	Electrical	Should this be renamed as XFR-Panel LS?	Acknowledged. The equipment will be re-designated as XFR-PANEL LS, and the construction package will be updated accordingly.
86	OWRF	O - Electrical	Volume 4 (OWRF) Drawings - 100% Submittal	E-20.11	Electrical	RFI Is this equipment to be replaced with new? It is conflicting on various drawings? E 20.06 E 33.01 Equipment to remain per walk with Wilson Engineers	This equipment is existing. It will be updated in the construction package.
87	OWRF	O - Electrical	Volume 4 (OWRF) Drawings - 100% Submittal	E-20.11	Electrical	RFI MV Controls and protection relays have not been called out in the drawings specifically. This information will be needed. Especially for ductbank needs. The settings and programming for these relays need to be call out specifically of who is provide them. No protection relays but A/B manholes maybe needed.	1. Spec will be updated accordingly. No drawing chnages required. 2. Reference response No.79.
88	OWRF	O - Electrical	Volume 4 (OWRF) Drawings - 100% Submittal	E-20.13	Electrical	VE smaller wire for feeds can save $ Check with Engineer to see why this derated? 800amp 3-400MCM 600amp 2 - 500MCM less conduit in ductbank	No response
89	OWRF	O - Electrical	Volume 4 (OWRF) Drawings - 100% Submittal	E-20.13	Electrical	Constructibility Does EMH-23 have existing MV? Might need MOPO to tie in Conduit and also to pull in conductors.	No action required as we are installing new man holes and duct banks.
90	OWRF	O - Electrical	Volume 4 (OWRF) Drawings - 100% Submittal	E-20.13	Electrical	NFPA-70 live work in Manholes? Workplans to avoid MOPOs?	No action required as we are installing new man holes and duct banks.
91	OWRF	O - Electrical	Volume 4 (OWRF) Drawings - 100% Submittal	E-20.13	Electrical	RFI MV Controls and protection relays have not been called out in the drawings specifically. This information will be needed. Especially for ductbank needs. The settings and programming for these relays need to be call out specifically of who is provide them. Wilson Engineers - no need for controls between 15kV to 480V gear.	1. Spec will be updated accordingly. No drawing chnages required. 2. Reference response No.79.
92	OWRF	O - Electrical	Volume 4 (OWRF) Drawings - 100% Submittal	E-20.13	Electrical	VE CMH (no block diagram - but shown on site plan) Controls Man Holes to be Handholes depending on specific needs for controls. No controls but A/B manholes maybe needed. Please verify	Acknowledged. A/B feeds will be in seperate Manholes, control man holes will be chnaged to electrical man holes.It will be updated in the construction package.
93	OWRF	O - Electrical	Volume 4 (OWRF) Drawings - 100% Submittal	E-23.03	Electrical	Should we Demo? Please update	Acknowledged. It will be updated in the construction package.

100% Agency Review Clarifications Log

(highlighted rows received a response, non-highlted rows did not)

Item #	Site	Location	Referenced Document	Sheet Number	Scope of Work	MBC Comment	Architect/Engineer Response
94	OWRF	O - Electrical	Volume 4 (OWRF) Drawings - 100% Submittal	E-23.04	Electrical	RFI Is this supposed to be MCC-410? Site Plan says MCC-610	Acknowledged. It will be updated in the construction package.
95	OWRF	O - Electrical	Volume 4 (OWRF) Drawings - 100% Submittal	E-23.04	Electrical	RFI Is PLC-440 in here? If so, it should be indicated on the drawings. See drawings for potential location	Acknowledged. It will be updated in the construction package.
96	OWRF	O - Electrical	Volume 4 (OWRF) Drawings - 100% Submittal	E-23.08	Electrical	Constructibility Will MOPOs be needed for working in live manholes? How will that affect the plant?	Per site coordination and pre construction walk contractor expressed they can work in live manholes 600V or less, with safety measures as per NFP 70. No MOPO required.
97	OWRF	O - Electrical	Volume 4 (OWRF) Drawings - 100% Submittal	E-23.08	Electrical	RFI Will this Panel need to be modified and UL listed at the site?	No re-listing required.
98	OWRF	O - Electrical	Volume 4 (OWRF) Drawings - 100% Submittal	E-23.08	Electrical	RFI Is this a symbol for a seal off? Is this needed for this area?	Yes, those are seal-off symbols. Yes seal-offs will be required.
99	OWRF	O - Electrical	Volume 4 (OWRF) Drawings - 100% Submittal	E-25.02	Electrical	RFI Not indicated on Panel Schedule. Wilson to review area and possibly refeed this from another SES.	Acknowledged. It will be updated in the construction package.
100	OWRF	O - Electrical	Volume 4 (OWRF) Drawings - 100% Submittal	E-25.02	Electrical	Name conflict with Keynote 9 on E-25.09. PDP-T1-001. Please update	Acknowledged. It will be updated in the construction package.
101	OWRF	O - Electrical	Volume 4 (OWRF) Drawings - 100% Submittal	E-25.06	Electrical	VE Recommend Installing this MCP in the NEW AUX-MCC-001 building for climate controlled environment for longevity of the VFD and maintenance of the panel because no A/C unit will be required. Wilson - This comes as a vendor package. Please confirm	No, it is part of Vendor Control Panel. To be consistent with the exisitng Clarifier.
102	OWRF	O - Electrical	Volume 4 (OWRF) Drawings - 100% Submittal	E-25.06, 25.07	Electrical	RFI Should Clarifiers be on separate sides of the MCC for redundancy?	Acknowledged. It will be updated in the construction package.
103	OWRF	O - Electrical	Volume 4 (OWRF) Drawings - 100% Submittal	E-25.08	Electrical	Panel is not integrated within MCC-001 anymore. Please update	Acknowledged. As indicated on Sheet E-25.10, this panel isnot integrated withing MCC . The panel schedule on Sheet E-25.08 will be revised accordingly in the construction package.
104	OWRF	O - Electrical	Volume 4 (OWRF) Drawings - 100% Submittal	E-25.08	Electrical	Change to 208v/120v 3 phase?	Acknowledged. As indicated on Sheet E-25.10, this panel isnot integrated withing MCC . The panel schedule on Sheet E-25.08 will be revised accordingly in the construction package.
105	OWRF	O - Electrical	Volume 4 (OWRF) Drawings - 100% Submittal	E-25.08	Electrical	Actually fed from ATS-419-001. Please update panel schedule.	Acknowledged. As indicated on Sheet E-25.10, this panel isnot integrated withing MCC . The panel schedule on Sheet E-25.08 will be revised accordingly in the construction package.
106	OWRF	O - Electrical	Volume 4 (OWRF) Drawings - 100% Submittal	E-25.09	Electrical	This name has changed from 60% drawings. Please clarify which name is to be used for this PDP RFI Change name to PDP-639-001	Acknowledged. It will be updated in the construction package.
107	OWRF	O - Electrical	Volume 4 (OWRF) Drawings - 100% Submittal	E-25.10	Electrical	RFI New Location for ATS-419-001	Acknowledged. The equipment will be installed in the new Anoxic electrical building, adjacent to TFR-419-001.
108	OWRF	O - Electrical	Volume 4 (OWRF) Drawings - 100% Submittal	E-25.10	Electrical	Constructibility Use an A and B side termination box for 120V loads. Please confirm	No response
109	OWRF	O - Electrical	Volume 4 (OWRF) Drawings - 100% Submittal	E-25.14	Electrical	Constructibility Utilize existing conduit routing to equipment by routing conduit to existing manholes. Replace all conductors as shown.	Possible. We will update the note to state that the contractor must field verify the existing spare conduits and submit the information to the engineer for approval prior to installation.

100% Agency Review Clarifications Log

(highlighted rows received a response, non-highlted rows did not)

Item #	Site	Location	Referenced Document	Sheet Number	Scope of Work	MBC Comment	Architect/Engineer Response
110	OWRF	O - Electrical	Volume 4 (OWRF) Drawings - 100% Submittal	E-25.15	Electrical	RFI Will this Panel need to be modified and UL listed at the site? Wilson - Possibly add a PCL cabinet	As discussed in the recent meetings, a new PLC will be installed in the Anoxic Electrical Building. All new controls will be connected to this new Anoxic PLC, and it will be connected to the existing Network via 24 strand fiber.
111	OWRF	O - Electrical	Volume 4 (OWRF) Drawings - 100% Submittal	E-25.15,16,17	Electrical	general location not shown on site plan drawings. Please update	As per site walk it's not new. It is a existing manhole. It will be updated in the construction package.
112	OWRF	O - Electrical	Volume 4 (OWRF) Drawings - 100% Submittal	E-26.03	Electrical	Constructibility Can we safely complete a MOPO to swap out the existing feed? Can we isolate half of the MCC to replace the A and B side feeds? Plant to identify if we can shut down half of the MCC and plant can operate?	1. Yes per field investigation. 2. Yes with potential of minimum temporary power provided. 3. Depending MOPO coordination and operation variables.
113	OWRF	O - Electrical	Volume 4 (OWRF) Drawings - 100% Submittal	E-26.04	Electrical	Constructibility Can we safely complete a MOPO to swap out the existing feed? Can we isolate half of the MCC to replace the A and B side feeds? Plant to identify if we can shut down half of the MCC and plant can operate?	1. Yes per field investigation. 2. Yes with potential of minimum temporary power provided. 3. Depending MOPO coordination and operation variables.
114	OWRF	O - Electrical	Volume 4 (OWRF) Drawings - 100% Submittal	E-27.01	Electrical	VE Recommend Installing this MCP in the NEW AUX-MCC-001 building for climate controlled environment for longevity of the VFD and maintenance of the panel because no A/C unit will be required. Install LCP/LCS in the field Wilson - This is a vendor package.	Not acceptable. City wants to match the exisitng clarifiers MCP locations.
115	OWRF	O - Electrical	Volume 4 (OWRF) Drawings - 100% Submittal	E-28.02	Electrical	RFI Load identified as not needed during discussion with City. Please confirm	No response
116	OWRF	O - Electrical	Volume 4 (OWRF) Drawings - 100% Submittal	E-28.04	Electrical	RFI Will this Panel need to be modified and UL listed at the site?	Yes/No coordinate with item 121.
117	OWRF	O - Electrical	Volume 4 (OWRF) Drawings - 100% Submittal	E-28.04	Electrical	Large ITP in place place of existing MCC-E1 has potential to eliminate re-feeds shown on E28.08 & E28.09. Please confirm	No.
118	OWRF	O - Electrical	Volume 4 (OWRF) Drawings - 100% Submittal	E-28.05, 28.06, 28.07	Electrical	RFI Will this MOPO be separate from O-9? Can the equipment be running while we run conduit and wire from new MCC to equipment?	No response
119	OWRF	O - Electrical	Volume 4 (OWRF) Drawings - 100% Submittal	E-28.08	Electrical	VE Wire oversized for 250amps. Please confirm	No response
120	OWRF	O - Electrical	Volume 4 (OWRF) Drawings - 100% Submittal	E-28.08	Electrical	DSF-MTS-100 is within 5' of new MCC-E1; raceway exiting building should not be necessary. Please confirm	Acknowledged. It will be updated in the construction package.
121	OWRF	O - Electrical	Volume 4 (OWRF) Drawings - 100% Submittal	E-28.08, 28.09	Electrical	Facility tag needed; fits general description of multiple valves on disk filter layout drawings. Please confirm	Alex, please confirm the equipment tag naming.
122	OWRF	O - Electrical	Volume 4 (OWRF) Drawings - 100% Submittal	E-28.08, 28.09	Electrical	NEW ATS-E is within 10' of new MCC-E1; raceway exiting building should not be necessary. Please confirm	Acknowledged. It will be updated in the construction package.
124	OWRF	O - Electrical	Volume 4 (OWRF) Drawings - 100% Submittal	E-30.04	Electrical	RFI Where is this existing equipment? Is there a plan view?	See notes 5 & 6
125	OWRF	O - Electrical	Volume 4 (OWRF) Drawings - 100% Submittal	E-31.05	Electrical	Constructibility Can we safely complete a MOPO to swap out the existing feed? Can we isolate half of the MCC to replace the A and B side feeds? Plant to identify if we can shut down half of the MCC and plant can operate?	1. Yes per field investigation. 2. Yes with potential of minimum temporary power provided.
126	OWRF	O - Electrical	Volume 4 (OWRF) Drawings - 100% Submittal	E-31.07	Electrical	Constructibility Can we safely complete a MOPO to swap out the existing feed? Can we isolate half of the MCC to replace the A and B side feeds? Plant to identify if we can shut down half of the MCC and plant can operate?	1. Yes per field investigation. 2. Yes with potential of minimum temporary power provided.
127	OWRF	O - Electrical	Volume 4 (OWRF) Drawings - 100% Submittal	E-32.04	Electrical	RFI What is the sequencing for this equipment to be removed? Where will the communication be tied for the existing RTU panel?	No response
128	OWRF	O - Electrical	Volume 4 (OWRF) Drawings - 100% Submittal	E-33.01	Electrical	MOPO O-6 equipment to remain on during the MOPO. Please confirm	coordinate with switchgear MOPO.

100% Agency Review Clarifications Log

(highlighted rows received a response, non-highlted rows did not)

Item #	Site	Location	Referenced Document	Sheet Number	Scope of Work	MBC Comment	Architect/Engineer Response
129	OWRF	O - Electrical	Volume 4 (OWRF) Drawings - 100% Submittal	E-33.01	Electrical	RFI DP-120-001 indicated as both existing and new on this page. Which is it? Wilson - confirmed existing equipment to remain.	This equipment is existing. It will be updated in the construction package.
130	OWRF	O - Electrical	Volume 4 (OWRF) Drawings - 100% Submittal	E-33.01	Electrical	RFI Is this a classified zone? Do seal offs need to be indicated? What about for vendor control panel?	Yes, seal off's needed. It will be updated in the construction package.
131	OWRF	O - MBR Aeration Basin	Volume 4 (OWRF) Drawings - 100% Submittal	I-23.02	Instrumentation	Please update to show demo of diffusers in zone 8	No response
132	OWRF	O - MBR Aeration Basin	Volume 4 (OWRF) Drawings - 100% Submittal	I-23.02, 23.03, 23.05, 23	Instrumentation	Please clarify if mixers in zone 7 are demo'd or if existing is to remain. D Sheets show demo of Mixers in zone 7.	No response
133	OWRF	O - MBR Aeration Basin	Volume 4 (OWRF) Drawings - 100% Submittal	I-23.02, 23.05	Instrumentation	D sheets do not show demo of diffusers in zone 7. Please clarify	No response
134	OWRF	O - MBR Aeration Basin	Volume 4 (OWRF) Drawings - 100% Submittal	I-23.03	Instrumentation	please update to Show new diffusers in zone 8	No response
135	OWRF	O - MBR Aeration Basin	Volume 4 (OWRF) Drawings - 100% Submittal	I-23.03, 23.06	Instrumentation	M sheets do not show new diffusers in zone 7. Please clarify	No response
136	OWRF	O - Electrical	Volume 4 (OWRF) Drawings - 100% Submittal	I-25.01	Instrumentation	These Starters and the VFD appear to be integral to the MCC. Please confirm	No action required. refer the tag on VFD and Starters.
137	OWRF	O - Electrical	Volume 4 (OWRF) Drawings - 100% Submittal	I-25.01	Instrumentation	Per previous discussions only 1 new set of pump with accessories/pipe should be required. Please confirm	Yes confirmed.
138	OWRF	O - Electrical	Volume 4 (OWRF) Drawings - 100% Submittal	I-27.01	Instrumentation	VE Recommend Installing this MCP in the NEW AUX-MCC-001 building for climate controlled environment for longevity of the . Please confirmVFD and maintenance of the panel because no A/C unit will be required. Install LCP/LCS in the field	Not acceptable. City wants to match the exisitng clarifiers MCP.
139	OWRF	O - Clarifier #3	Volume 4 (OWRF) Drawings - 100% Submittal	I-27.01	Instrumentation	Valve shown as new on M sheets but shown to keep existing here. Please clarify	No response
140	OWRF	O - Electrical	Volume 4 (OWRF) Drawings - 100% Submittal	I-33.01	Instrumentation	Constructibility Conduit routing to tie in this VCP to the network via fiber connection. Need fiber work to be clearly indicated.	Acknowledged. It will be updated in the construction package.
141	OWRF	O - Electrical	Volume 4 (OWRF) Drawings - 100% Submittal	I-33.01	Instrumentation	RFI Is this a classified zone?	Yes confirmed.
142	AWRF		Volume 3 (AWRF) Drawings - 100% Submittal	G-2		Errors found in sheet index. replacement provided on sheet. Please update	Noted.
143	AWRF		Volume 3 (AWRF) Drawings - 100% Submittal	G-3		RFI - Specs Section 02315-8 Notes 3-5 call for 2-Sack CLSM only within/underneath 18" of footings. Please confirm if CLSM backfill is required and if so to what extent for piping outside of the 18" footing perimeter.	No response
144	AWRF		Volume 3 (AWRF) Drawings - 100% Submittal	G-3		Please confirm submittal review timeline for engineer, and resubmittal review timeline for contractor. McCarthy is requesting 3 weeks (calendar days) for resubmittal review.	See specification section 01300. Submittal review timeframe is 21 days.
145	AWRF		Volume 3 (AWRF) Drawings - 100% Submittal	G-6		Include high, low, and operating water levels for Clarifiers. Please update	Will be updated in forthcomming submittal.
146	AWRF	A - Secondary Clarifiers	Volume 3 (AWRF) Drawings - 100% Submittal	D-00.01	Demo	Please identify clarifier no. 4 demo on plan sheets.	Will be updated in forthcomming submittal.
147	AWRF	A - Site	Volume 3 (AWRF) Drawings - 100% Submittal	D-00.02	Demo	Sheet S-2.00 not found. Update to Sheet S-3.01 & 3.02.	Noted.
148	AWRF	A - Chemical Facilities	Volume 3 (AWRF) Drawings - 100% Submittal	D-00.02	Demo	This is the new pump layout. does not show demo of old layout. Please update	Noted.
149	AWRF	A - Secondary Clarifiers	Volume 3 (AWRF) Drawings - 100% Submittal	D-00.03	Demo	Page flip: no longer replacing valve on #4, only the actuator. Please update	Will be updated in forthcomming submittal.
150	AWRF	A- NHLW	Volume 3 (AWRF) Drawings - 100% Submittal	D-00.04	Demo	Please provide clarity for light relocation and identify. Confirm if new light goes in this location or if a light is being relocated. Called out as existing on electrical sheets and it is not existing, or would need to be relocated.	One existing light pole that is currently where the new road will be built shall be relocated. Other lightpoles are new and shall be provided by contractor.
151	AWRF	A- NHLW	Volume 3 (AWRF) Drawings - 100% Submittal	D-00.04	Demo	Lightpole Location shown as existing on electrical sheets, Existing light pole is this approx. location (see drawing annotation). Please update	Will be updated in forthcomming submittal.
152	AWRF	A - Parshall Flume	Volume 3 (AWRF) Drawings - 100% Submittal	D-01.01	Demo	Confirm extent of slab demo. entire slab or only the section under MH?	Demo section of slab under MH.

McCARTHY

100% Agency Review Clarifications Log

(highlighted rows received a response, non-highlted rows did not)

Item #	Site	Location	Referenced Document	Sheet Number	Scope of Work	MBC Comment	Architect/Engineer Response
153	AWRF	A - Headworks	Volume 3 (AWRF) Drawings - 100% Submittal	D-02.01	Demo	Need to add angle iron at this location	Noted.
154	AWRF	A - Headworks	Volume 3 (AWRF) Drawings - 100% Submittal	D-02.01	Demo	Handrail shown as new in M sheets but not shown to be demo'd here. Please clarify	Handrail is exisiting. Will be updated to be gray.
155	AWRF	A - Aeration Basins	Volume 3 (AWRF) Drawings - 100% Submittal	D-03.01	Demo	Confirm all supports shall be removed.	Supports shall be kept if possible. If contractor determines it is better for total cost or schedule of project they may be demo'ed. Provide cost savings.
156	AWRF	A - Aeration Basins	Volume 3 (AWRF) Drawings - 100% Submittal	D-03.02	Demo	Update drawings to include demo of supports	Supports shall be kept if possible. If contractor determines it is better for total cost or schedule of project they may be demo'ed. Provide cost savings.
157	AWRF	A - Secondary Clarifiers	Volume 3 (AWRF) Drawings - 100% Submittal	D-04.01	Demo	Please clarify what this bold line is.	Will be updated in forthcoming submittal.
158	AWRF	A - Secondary Clarifiers	Volume 3 (AWRF) Drawings - 100% Submittal	D-04.02	Demo	Demo of Grout not called out but appears to be demoed here. Per conditions assessment, team decided to reuse grout in #2 & #3. Please clarify with a callout that grout shall be demo'd.	Grout shall not be demoed.
159	AWRF	A - Secondary Clarifiers	Volume 3 (AWRF) Drawings - 100% Submittal	D-04.02	Demo	Are stairs being removed or staying? Key note removed wording from 60% to 100% but drawing still showing removal. Please clarify.	Stairs to remain.
160	AWRF	A - Secondary Clarifiers	Volume 3 (AWRF) Drawings - 100% Submittal	D-04.02	Demo	60% calls for 30" center riser column. Please confirm dimension	Existing influent pipe is 30". Field verify size of existing center riser.
161	AWRF	A - Secondary Clarifiers	Volume 3 (AWRF) Drawings - 100% Submittal	D-04.04	Demo	These are mislabeled, red number in drawing show what they should be labeled as. Please update	Will be updated in forthcoming submittal.
162	AWRF	A - Secondary Clarifiers	Volume 3 (AWRF) Drawings - 100% Submittal	D-04.04	Demo	Per Alex G. in Big room, there would be no demo of Grout, but new 2" topping would go on top of existing grout. Please clarify in drawings and callouts.	Grout replacement is not specifically required at AWRF, coordinate with manufacturer.
163	AWRF	A - Secondary Clarifiers	Volume 3 (AWRF) Drawings - 100% Submittal	D-04.04	Demo	Please confirm that scum draining piping needs to be removed on clarifier no. 4. Not shown on plan view for this to be removed.	Confirmed.
164	AWRF	A - Secondary Clarifiers	Volume 3 (AWRF) Drawings - 100% Submittal	D-04.04	Demo	Please confirm if old grout is being demo'd. Update new grout drawing to show old grout if not being demo'd.	Grout replacement is not specifically required at AWRF, coordinate with manufacturer.
165	AWRF	A - Chemical Facilities	Volume 3 (AWRF) Drawings - 100% Submittal	D-11.03	Demo	Recommend replacing concrete pad. Current condition is not great. Please confirm if this concrete needs to be replaced. McCarthy is currently not carrying cost in the GMP for this item, unless directed otherwise.	Per discussions with City, concrete pad rehab is not included in this project scope.
166	AWRF	A - Admin	Volume 3 (AWRF) Drawings - 100% Submittal	D-12.01	Demo	Add ADMINISTRATION BUILDING Label to this page	Noted.
167	AWRF	A - Secondary Clarifiers	Volume 3 (AWRF) Drawings - 100% Submittal	C-01.02	Civil	Page flip: Only replacing actuator for valve on #4. please update	Will be updated in forthcoming submittal.
168	AWRF	A - Site	Volume 3 (AWRF) Drawings - 100% Submittal	C-01.03	Civil	Include new proposed bridge location on plan sheet.	Will be updated in forthcomming submittal.
169	AWRF	A - Site	Volume 3 (AWRF) Drawings - 100% Submittal	C-01.03	Civil	Move location of new stairs to west side of existing stairs per Seet S-3.01	Will be updated in forthcomming submittal.
170	AWRF	A - Site	Volume 3 (AWRF) Drawings - 100% Submittal	C-01.03	Civil	VE: Bridge is being added because of limited access to existing bridge because of lightpole here. Instead of installing new bridge, relocate this lightpole	Lightpole is not the only item limiting access. New bridge to stay as part of design.
171	AWRF	A - Site	Volume 3 (AWRF) Drawings - 100% Submittal	C-01.03	Civil	Please confirm if this handrail is to be new or keep existing	Keep existing.
173	AWRF	A - Secondary Clarifiers	Volume 3 (AWRF) Drawings - 100% Submittal	C-02.02	Civil	Update to Include actuator of #4	Noted.
174	AWRF	A - Secondary Clarifiers	Volume 3 (AWRF) Drawings - 100% Submittal	C-02.02	Civil	Identify underground water line connection points for scum box sprayers	Will be updated in forthcoming submittal.
175	AWRF	A- NHLW	Volume 3 (AWRF) Drawings - 100% Submittal	C-02.03	Civil	RFI - Please Confirm Size of proposed MH. 63	MH shall be 5ft diameter.
176	AWRF	A- NHLW	Volume 3 (AWRF) Drawings - 100% Submittal	C-02.03	Civil	Provide detail for curb around manhole. Curb requested during AWRF page flip.	Will be updated in forthcomming submittal.

100% Agency Review Clarifications Log

(highlighted rows received a response, non-highlted rows did not)

Item #	Site	Location	Referenced Document	Sheet Number	Scope of Work	MBC Comment	Architect/Engineer Response
177	AWRF	A- NHLW	Volume 3 (AWRF) Drawings - 100% Submittal	C-02.03	Civil	Confirm coating preference for MH penetration patching	No response
178	AWRF	A- NHLW	Volume 3 (AWRF) Drawings - 100% Submittal	C-02.03	Civil	Please include height of light pole in light pole details or specs	Will be included in forthcomming submittal.
179	AWRF	A - Chemical Facilities	Volume 3 (AWRF) Drawings - 100% Submittal	C-02.04	Civil	RFI - Please Confirm that the scale for this sheet is correct.	Scale is not correct. Will be updated in forthcomming submittal.
180	AWRF	A - Site	Volume 3 (AWRF) Drawings - 100% Submittal	C-02.04	Civil	Confirm if handrail is new or existing, also reference in earlier Civil sheet	Handrail is exising.
181	AWRF	A - Site	Volume 3 (AWRF) Drawings - 100% Submittal	C-02.04	Civil	Please confirm location of new staircase	See structural sheets.
182	AWRF	A - Admin	Volume 3 (AWRF) Drawings - 100% Submittal	C-03.03	Civil	RFI - Please confirm that existing surface material is concrete pavement	Existing material is not concrete pavement.
183	AWRF	A - Fuel Storage Tank	Volume 3 (AWRF) Drawings - 100% Submittal	C-03.04	Civil	Show increased tank size per summary of work a M-13.01	Will be updated in forthcomming submittal.
184	AWRF	A - Fuel Storage Tank	Volume 3 (AWRF) Drawings - 100% Submittal	C-03.05	Civil	RFI - Please Confirm if the sitework on this page needs to be demo and replaced.	Scope only includes fixing rip rap drainage channel, not demoing and replacing sitework.
185	AWRF	A - Site	Volume 3 (AWRF) Drawings - 100% Submittal	C-03.05	Civil	Confirm only scope on this page is to adjust rip rap. Update all bold lines to be gray for existing curbs, sidewalks, landscaping etc to remain in place	Confirmed. Will be updated in forthcomming submittal.
186	AWRF	A - Parshall Flume	Volume 3 (AWRF) Drawings - 100% Submittal	C-40.03	Civil	Suggest using HOBAS Pipe instead of RCP (HOBAS does not need t-lock. Duration of pump around will be shortened because T-lock repairs will not be required during pump around). Will require a coupling between HOBAS and existing RCP. Please confirm	HOBAS is acceptable.
187	AWRF	A - Parshall Flume	Volume 3 (AWRF) Drawings - 100% Submittal	C-40.03	Civil	Alternate option from Wilson Page flip: purchase laser flow meter that can be mounted on a rail and raised out of MH for service. Please confirm	Proposed laser flow meter has this capability. Mounting bracket detail will be modified in next submittal.
188	AWRF	A - Parshall Flume	Volume 3 (AWRF) Drawings - 100% Submittal	C-40.03	Civil	No specification provided for lase flow-meter. Please provide. McCarthy wants to confirm whether the laser flow meter design will need to accommodate confined space entry for retrieval.	See Teledyne LaserFlow® Ex Velocity Sensor for Hazardous Areas. No approved equal. Mounting bracket can be adjusted to allow for outside retrieval.
189	AWRF	A - Parshall Flume	Volume 3 (AWRF) Drawings - 100% Submittal	C-40.03	Civil	MCC is not familiar with this style of coupling for RCP Pipe. Please provide a manufacturer. RCP pipe is typically coupled with a poured collar. MarMac MacWrap?	No response
190	AWRF	A - Parshall Flume	Volume 3 (AWRF) Drawings - 100% Submittal	C-40.03	Civil	According to I-01.01 and I-01.02, this laser velocity sensor calls to be demolished and NOT replaced. confirm design intent.	Currently, only level element and parshall flume exists. Laser flow meter to be added.
191	AWRF	A - Chemical Facilities	Volume 3 (AWRF) Drawings - 100% Submittal	C-40.04	Civil	meant to be 2', not 2". Please update	Not applicable. Trench design detail has been altered.
192	AWRF	A - Chemical Facilities	Volume 3 (AWRF) Drawings - 100% Submittal	C-40.04	Civil	Add detail to show a chamfered edge per AWRF page flip comments.	Noted in new trench design detail.
193	AWRF	A - Chemical Facilities	Volume 3 (AWRF) Drawings - 100% Submittal	C-40.04	Civil	Operations staff noted that covers from Membrane Project are corroding. Ductile Iron Class E was confirmed in the old submittal. Please confirm the specified grate material will not corrode in the same manner. Please update material specified as required to prevent corrosion.	Noted.
194	AWRF	A - Chemical Facilities	Volume 3 (AWRF) Drawings - 100% Submittal	C-40.04	Civil	Wilson Page flip: Update grating drawing to not have slits. and be solid to match existing	Noted in new trench design detail.
195	AWRF	A - Headworks	Volume 3 (AWRF) Drawings - 100% Submittal	M-02.01	Mechanical	This tie in may be too close to head level when standing on platform below. Potential to relocate penetration slightly to the north to avoid this problem. Please confirm	There is ~6'6" of space between proposed pipe and platform.
196	AWRF	A - Headworks	Volume 3 (AWRF) Drawings - 100% Submittal	M-02.01	Mechanical	There is an existing ladder and roof access here, suggest moving penetration slightly north or south. Please confirm	Confirmed. Penetration will be adjusted slightly north.

100% Agency Review Clarifications Log

(highlighted rows received a response, non-highlted rows did not)

Item #	Site	Location	Referenced Document	Sheet Number	Scope of Work	MBC Comment	Architect/Engineer Response
197	AWRF	A - Headworks	Volume 3 (AWRF) Drawings - 100% Submittal	M-02.01	Mechanical	Suggest moving penetration to be 36" from north wall (Centerline) to avoid relocating existing conduit and other utilities. Please confirm	Not acceptable. Plant needs access to mud valve south of pipe.
198	AWRF	A - Headworks	Volume 3 (AWRF) Drawings - 100% Submittal	M-02.01	Mechanical	Valve stems and instrumentation sticking up above grating in various locations. What should be done with these?	Stems and instrumentation shall be protected in place. See keyed notes for information on openings on the FRP Panels.
199	AWRF	A - Headworks	Volume 3 (AWRF) Drawings - 100% Submittal	M-02.01	Mechanical	This is Detail B. Please Update	Noted.
200	AWRF	A - Headworks	Volume 3 (AWRF) Drawings - 100% Submittal	M-02.01	Mechanical	This is Detail C. Please update	Noted.
201	AWRF	A - Headworks	Volume 3 (AWRF) Drawings - 100% Submittal	M-02.01	Mechanical	Provide clarify whether stainless steel supports need to be provided for all FRP piping (typ.) Request during AWRF page flip.	Confirmed. Provide stainless steel supports per page flip.
202	AWRF	A - Headworks	Volume 3 (AWRF) Drawings - 100% Submittal	M-02.01	Mechanical	Add mixer to channel for grit build-up? Request during AWRF page flip. Please confirm/clarify on scope.	Not at this time.
203	AWRF	A - Headworks	Volume 3 (AWRF) Drawings - 100% Submittal	M-02.01	Mechanical	Should this join be updated to a flexible coupling for less downtime during final tie in? Please confirm support locations can accommodate new coupling	Confirmed. Will be updated in forthcomming submittal.
204	AWRF	A - Headworks	Volume 3 (AWRF) Drawings - 100% Submittal	M-02.01	Mechanical	Handrail shown to be new in section view. Please confirm if new or existing to remain	Handrail is existing and shall not be replaced.
205	AWRF	A - Headworks	Volume 3 (AWRF) Drawings - 100% Submittal	M-02.02	Mechanical	Handrail shown in bold, confirm if new or existing to remain. Not called to be demo'd in D sheets	Handrail is existing and shall not be replaced.
206	AWRF	A - Headworks	Volume 3 (AWRF) Drawings - 100% Submittal	M-02.02	Mechanical	Suggest having pipe be a plane end rather than flange	Suggestion is acceptable.
207	AWRF	A - Headworks	Volume 3 (AWRF) Drawings - 100% Submittal	M-02.02	Mechanical	Per page flip, this will be a plane end, not flange, please update	Confirmed.
208	AWRF	A - Aeration Basins	Volume 3 (AWRF) Drawings - 100% Submittal	M-03.01	Mechanical	Update to say removing all concrete supports	Concrete supports shall be kept if possible. If contractor determines it is better for total cost or schedule of project they may be demo'ed. Provide cost savings.
209	AWRF	A - Aeration Basins	Volume 3 (AWRF) Drawings - 100% Submittal	M-03.03	Mechanical	Update Keynote 12 to be 10	Noted.
210	AWRF	A - Secondary Clarifiers	Volume 3 (AWRF) Drawings - 100% Submittal	M-04.01	Mechanical	Provide a separate drawing for Clarifier No. 3 to show walkway to the South.	Shown on the left hand side of the drawing.
211	AWRF	A - Secondary Clarifiers	Volume 3 (AWRF) Drawings - 100% Submittal	M-04.01	Mechanical	Clarify if spray bar is on leading side, middle, or lagging side	Will be updated in forthcoming submittal.
212	AWRF	A - Secondary Clarifiers	Volume 3 (AWRF) Drawings - 100% Submittal	M-04.01, 4.03, 4.04	Mechanical	Reuse existing concrete pad at landing? Please clarify	Yes, reuse concrete pad.
213	AWRF	A - Secondary Clarifiers	Volume 3 (AWRF) Drawings - 100% Submittal	M-04.02	Mechanical	Grout appears to be demoed in Demo sheets but not called out to be replaced here. Please clarify grout scope	Grout demo not required at AWRF
214	AWRF	A - Secondary Clarifiers	Volume 3 (AWRF) Drawings - 100% Submittal	M-04.02	Mechanical	Update to remove arm mechanism from drawings.	Will be updated in forthcoming submittal.
215	AWRF	A - Secondary Clarifiers	Volume 3 (AWRF) Drawings - 100% Submittal	M-04.02	Mechanical	Need details for where this tie-ins into. Please provide	Will be updated in forthcoming submittal.
216	AWRF	A - Secondary Clarifiers	Volume 3 (AWRF) Drawings - 100% Submittal	M-04.02	Mechanical	Provide direction on angle of spray bar nozzles toward scum box.	Will be updated in forthcoming submittal.
217	AWRF	A - Secondary Clarifiers	Volume 3 (AWRF) Drawings - 100% Submittal	M-04.02, 4.05	Mechanical	Wilson Page flip: 2 45's instead of a 90? Please update	Will be updated in forthcoming submittal.
218	AWRF	A - Secondary Clarifiers	Volume 3 (AWRF) Drawings - 100% Submittal	M-04.03	Mechanical	Update to Call out to remain in place.	Noted.
219	AWRF	A - Secondary Clarifiers	Volume 3 (AWRF) Drawings - 100% Submittal	M-04.03	Mechanical	Confirm for all spray bar nozzles to aim toward the scum box	Confirmed.
220	AWRF	A - Secondary Clarifiers	Volume 3 (AWRF) Drawings - 100% Submittal	M-04.05	Mechanical	Shown in gray, should be bold. Please update	Will be updated in forthcoming submittal.
221	AWRF	A - Secondary Clarifiers	Volume 3 (AWRF) Drawings - 100% Submittal	M-04.06	Mechanical	Please confirm that existing concrete launder shall remain. Please also confirm that grout at the existing concrete launder shall be poured on top of the existing grout	Launder to remain. Grout demo not required.
222	AWRF	A - Secondary Clarifiers	Volume 3 (AWRF) Drawings - 100% Submittal	M-04.06	Mechanical	Confirm design intent is to reuse existing anchor system to accomodate new weir bracket supports.MCC will need to validate that existing anchors are reusable. Update detail for unsuitable anchor support locations.	MCC to validate existing anchors are reusable. If not, additional detail will be provided
223	AWRF	A - Secondary Clarifiers	Volume 3 (AWRF) Drawings - 100% Submittal	M-04.07	Mechanical	modify with a tee and three valves to be in-line with the pump discharge line. Please confirm	Confirmed.
224	AWRF	A - Secondary Clarifiers	Volume 3 (AWRF) Drawings - 100% Submittal	M-04.07	Mechanical	Increase line size to be 6" diameter. Please confirm	Confirmed.

100% Agency Review Clarifications Log

(highlighted rows received a response, non-highlted rows did not)

Item #	Site	Location	Referenced Document	Sheet Number	Scope of Work	MBC Comment	Architect/Engineer Response
225	AWRF	A - Secondary Clarifiers	Volume 3 (AWRF) Drawings - 100% Submittal	M-04.07	Mechanical	Provide double 90 for discharge male connection to operations staff trash pump. Please confirm	Confirmed.
226	AWRF	A - Secondary Clarifiers	Volume 3 (AWRF) Drawings - 100% Submittal	M-04.07	Mechanical	All modifications are typical at all clairifier locations. Please verify	Please clarify.
227	AWRF	A - Secondary Clarifiers	Volume 3 (AWRF) Drawings - 100% Submittal	M-04.07	Mechanical	All mark-ups were comments made in the page flip. Wilson to review suggestions and draw final design routing.	Confirmed.
228	AWRF	A - Disc Filters	Volume 3 (AWRF) Drawings - 100% Submittal	M-05.02	Mechanical	Panel layout does not match electrical drawings. Coordinate mechanical and electrical drawings in final design. Existing space does not permit depicted layout.	Electrical installation to match existing basins.
229	AWRF	A - Disc Filters	Volume 3 (AWRF) Drawings - 100% Submittal	M-05.03	Mechanical	Wilson Page Flip: Need to create room for easier access for service	Will be updated in forthcoming submittal.
230	AWRF	A - Disc Filters	Volume 3 (AWRF) Drawings - 100% Submittal	M-05.03	Mechanical	Handrail will need to be modified for Drive install. Please update design	Noted.
231	AWRF	A - Disc Filters	Volume 3 (AWRF) Drawings - 100% Submittal	M-05.03	Mechanical	Wilson Page Flip: Add spigot. Please confirm	Confirmed.
232	AWRF	A - Disc Filters	Volume 3 (AWRF) Drawings - 100% Submittal	M-05.03	Mechanical	VE/Constructability: McCarthy is requesting to core drill a hole in lieu of pouring a wall sleeve.	Acceptable.
233	AWRF	A - Disc Filters	Volume 3 (AWRF) Drawings - 100% Submittal	M-05.03	Mechanical	Update to Relocate turbidity meter for access.	Noted.
234	AWRF	A - Disc Filters	Volume 3 (AWRF) Drawings - 100% Submittal	M-05.04	Mechanical	Callout removed. Confirm no work required at this location.	Confirmed.
235	AWRF	A - Disc Filters	Volume 3 (AWRF) Drawings - 100% Submittal	M-05.04	Mechanical	Added scope. Grout does not exist. Show as new. Provide details for sloping elevation toward mud valve.	Will be updated in forthcoming submittal.
236	AWRF	A - Disc Filters	Volume 3 (AWRF) Drawings - 100% Submittal	M-05.04	Mechanical	Existing installations for disc filters have pull boxes mounted on the wall in the pit. Please confirm design intent is to mirror the existing locations/installations.	Mirror exisiting pullbox installation locations.
237	AWRF	A - Disc Filters	Volume 3 (AWRF) Drawings - 100% Submittal	M-05.05	Mechanical	Strut supports needed here. Please update	Noted.
238	AWRF	A- NHLW	Volume 3 (AWRF) Drawings - 100% Submittal	M-08.01	Mechanical	Wilson Page Flip: Add camera to dump spot? and eye wash station?	Camera and eye wash station will not be a part of the scope.
239	AWRF	A- NHLW	Volume 3 (AWRF) Drawings - 100% Submittal	M-08.02	Mechanical	is this enough room for the truck to load and unload the dumpster? The truck will probably be a dump trailer so the dumpster will be at an angle when loaded and unloaded	Dumpster will likely need to be pulled out of room before being loaded into the truck.
240	AWRF	A- NHLW	Volume 3 (AWRF) Drawings - 100% Submittal	M-08.03	Mechanical	Wilson Page Flip: Add trench drain?	Confirmed. Will be updated in forthcomming submittal.
241	AWRF	A- NHLW	Volume 3 (AWRF) Drawings - 100% Submittal	M-08.03	Mechanical	Add two spigots for washdown: one at top and one at bottom. Top shown, but need to add bottom. Please update	Spigot will be added at bottom.
242	AWRF	A- NHLW	Volume 3 (AWRF) Drawings - 100% Submittal	M-08.03	Mechanical	Add Eyewash Shower in truck bay. Requested during the page flip. Please confirm	Eyewash shower will not be included in scope.
243	AWRF	A- NHLW	Volume 3 (AWRF) Drawings - 100% Submittal	M-08.03	Mechanical	Coating / Cover needed at drain?	No response
244	AWRF	A- NHLW	Volume 3 (AWRF) Drawings - 100% Submittal	M-08.03	Mechanical	Confirm these are bollards. Call out in keynotes.	Confirmed.
245	AWRF	A- NHLW	Volume 3 (AWRF) Drawings - 100% Submittal	M-08.04	Mechanical	Please confirm keynote 15 should point to this line	No response
246	AWRF	A- NHLW	Volume 3 (AWRF) Drawings - 100% Submittal	M-08.04	Mechanical	Please confirm appropriate penetration detail to be used for FA and DR lines at NHLW station from sheet M-40.01	No response
247	AWRF	A- NHLW	Volume 3 (AWRF) Drawings - 100% Submittal	M-08.04	Mechanical	Comment from page flip: make the chutes a different material than 316 SS. Go with aluminum, FRP, PVC for future replacements as items corrode.	Chutes shall be neoprene.
248	AWRF	A- NHLW	Volume 3 (AWRF) Drawings - 100% Submittal	M-08.04	Mechanical	Called out as 10" on previous page. Please confirm required size.	Foul Air pipe shall be 10" DIA.
249	AWRF	A- NHLW	Volume 3 (AWRF) Drawings - 100% Submittal	M-08.04	Mechanical	Provide detail for metal chutes. Are they anchored to the concrete or embedded?	Chutes shall be anchored to concrete.
250	AWRF	A- NHLW	Volume 3 (AWRF) Drawings - 100% Submittal	M-08.04	Mechanical	Curtain requested around dumpster to mitigate splash. Detail required for curtain or chute extension. Please provide	Will be provided in forthcomming submittal.

100% Agency Review Clarifications Log

(highlighted rows received a response, non-highlted rows did not)

Item #	Site	Location	Referenced Document	Sheet Number	Scope of Work	MBC Comment	Architect/Engineer Response
251	AWRF	A- NHLW	Volume 3 (AWRF) Drawings - 100% Submittal	M-08.04	Mechanical	Updated dimension. Called out as 6" on previous page. Please confirm required size.	Sanitary sewer pipe shall be 8" DIA. Keyed note in previous page was pointing to drain pipe from trench drains and will be updated to 4" DIA.
252	AWRF	A- NHLW	Volume 3 (AWRF) Drawings - 100% Submittal	M-08.04	Mechanical	Incorrect detail callout. Please specify permanent or removable.	Permanent.
253	AWRF	A - Chemical Facilities	Volume 3 (AWRF) Drawings - 100% Submittal	M-11.01	Mechanical	existing sight glass/over flow valves should be replaced on both tanks. Please confirm	Will not be replaced.
254	AWRF	A - Chemical Facilities	Volume 3 (AWRF) Drawings - 100% Submittal	M-11.01	Mechanical	Update NAOCL to say NAOH	Noted.
255	AWRF	A - Chemical Facilities	Volume 3 (AWRF) Drawings - 100% Submittal	M-11.01	Mechanical	MOV here but not on NAOH tank? Please clarify	No response
256	AWRF	A - Chemical Facilities	Volume 3 (AWRF) Drawings - 100% Submittal	M-11.01	Mechanical	Comment during page flip to tie into suction line instead of fill line. Please confirm	Confirmed. Will be provided in forthcomming submittal.
257	AWRF	A - Chemical Facilities	Volume 3 (AWRF) Drawings - 100% Submittal	M-11.01	Mechanical	Update to reuse existing penetrations	No response
258	AWRF	A - Chemical Facilities	Volume 3 (AWRF) Drawings - 100% Submittal	M-11.02	Mechanical	Discussion during page flip: How to protect the system if a line blows and we need to identify chemical leak? - Low pressure alarm and leak detection in trench - Add details for leak detection system in trench	Confirmed. Will be provided in forthcomming submittal.
259	AWRF	A - Chemical Facilities	Volume 3 (AWRF) Drawings - 100% Submittal	M-11.04	Mechanical	Concrete is spalling here. Please confirm if concrete repair is needed. McCarthy has not included in GMP. Additional effort will be required to remove tank before repairing concrete. Concrete repair details are requested if scope is desired.	Per discussions with City, concrete pad rehab is not included in this project scope.
260	AWRF	A - Chemical Facilities	Volume 3 (AWRF) Drawings - 100% Submittal	M-11.04	Mechanical	concrete is spalling here. Suggest repairing. Please confirm	Per discussions with City, concrete pad rehab is not included in this project scope.
261	AWRF	A - Chemical Facilities	Volume 3 (AWRF) Drawings - 100% Submittal	M-11.06	Mechanical	Wilson Page flip: Remove strainer. Please confirm	Strainer removed.
262	AWRF	A - Chemical Facilities	Volume 3 (AWRF) Drawings - 100% Submittal	M-11.06	Mechanical	Sheet M-40.07 not provided. Please provide	Noted. Will be provided in forthcomming submittal.
263	AWRF	A - Chemical Facilities	Volume 3 (AWRF) Drawings - 100% Submittal	M-11.06	Mechanical	Does this need to be a needle valve? Comment during page flip. By-pass required for when needle valve is being maintained?	Confirmed. Will be provided in forthcomming submittal.
264	AWRF	A - Chemical Facilities	Volume 3 (AWRF) Drawings - 100% Submittal	M-11.06	Mechanical	Add programming for daily actuation. Please confirm	Confirmed. Will be provided in forthcomming submittal.
265	AWRF	A - Fuel Storage Tank	Volume 3 (AWRF) Drawings - 100% Submittal	M-13.01	Mechanical	This sheet is details for the Parshall Flume. Please provide a more specific reference in the structural drawings.	Noted. Will be provided in forthcomming submittal.
266	AWRF	A - Fuel Storage Tank	Volume 3 (AWRF) Drawings - 100% Submittal	M-13.01	Mechanical	Confirm if we need a hose rack next to dispensing system. Confirm if hose needs to be provided as well. Specify length required.	Dispensing system shall include hose. Length shall be detailed in specification 13400 in forthcomming submittal.
267	AWRF	A - Fuel Storage Tank	Volume 3 (AWRF) Drawings - 100% Submittal	M-13.01	Mechanical	Please confirm what this port is and what size it needs to be.	No response
268	AWRF	A - Fuel Storage Tank	Volume 3 (AWRF) Drawings - 100% Submittal	M-13.01	Mechanical	Incorrect detail callout. Please specify permanent or removable.	Permanent.
269	AWRF	A - Fuel Storage Tank	Volume 3 (AWRF) Drawings - 100% Submittal	M-13.02	Mechanical	incorrect callout, Update to say 16	Noted.
270	AWRF	A - Fuel Storage Tank	Volume 3 (AWRF) Drawings - 100% Submittal	M-13.02	Mechanical	Update to a correct detail reference.	Noted.
271	AWRF	A - Site	Volume 3 (AWRF) Drawings - 100% Submittal	M-16.01	Mechanical	Per Wilson Page flip, changes to trash pump in clarifiers 1,2, & 3 should solve this problem. Please confirm	Confirmed.
272	AWRF	A - Headworks	Volume 3 (AWRF) Drawings - 100% Submittal	M-40.02	Mechanical	Wilson Page Flip: Make HW pipe supports Stainless steel due to H2S pressence. Please confirm	Confirmed.
273	AWRF	A - Site	Volume 3 (AWRF) Drawings - 100% Submittal	M-40.02	Mechanical	Constructibility: Please update strut clamps to be the "T" style that slides into strut and is tightened with a single nut and bolt.	No response
274	AWRF	A - Site	Volume 3 (AWRF) Drawings - 100% Submittal	M-40.03	Mechanical	Recommend adding isolation ball valves on each branch. Please confirm	No response
275	AWRF	A - Site	Volume 3 (AWRF) Drawings - 100% Submittal	M-40.03	Mechanical	Recommend adding a relief port. Utilize tee in lieu of 90 with a plug for future testing. Please confirm	No response

100% Agency Review Clarifications Log

(highlighted rows received a response, non-highlted rows did not)

Item #	Site	Location	Referenced Document	Sheet Number	Scope of Work	MBC Comment	Architect/Engineer Response
276	AWRF	A - Site	Volume 3 (AWRF) Drawings - 100% Submittal	M-40.04	Mechanical	Need anchor and attachment details for disc filter installation. Please provide	Noted.
277	AWRF	A - Site	Volume 3 (AWRF) Drawings - 100% Submittal	M-40.04	Mechanical	Please provide details specific for steel fuel tank.	See specification section 13400.
278	AWRF	A - Site	Volume 3 (AWRF) Drawings - 100% Submittal	S-00.03	Structural	Detail only goes down to size 6". Please confirm this detail should be used for all aeration lateral supports.	This detail may be used for all applications where concrete saddle-type support is required. Notify engineer of additional pipe sizes not shown.
279	AWRF	A- NHLW	Volume 3 (AWRF) Drawings - 100% Submittal	S-00.03	Structural	Is this required? NHLW is not a waterbearing structure. Please clarify	Yes. WS required for below-grade structures.
280	AWRF	A - Site	Volume 3 (AWRF) Drawings - 100% Submittal	S-01.01	Structural	Does shroud need lifting points? Please specify locations and sizing.	No response
281	AWRF	A - Site	Volume 3 (AWRF) Drawings - 100% Submittal	S-03.01	Structural	Please provide location of new bridge. suggest including on plan view of pre-stage basins.	Bridge is located 6'-0" west of existing concrete wall and 16'-0" south of new stair platform. Overall location to be shown on overall site plan.
282	AWRF	A- NHLW	Volume 3 (AWRF) Drawings - 100% Submittal	S-08.01	Structural	Sloping concrete through flat metal tracks will create standing water. Suggest sloping directly south beyond tracks, then into sump	Trench drain to be provided between tracks to allow uniform slope across tracks.
283	AWRF	A- NHLW	Volume 3 (AWRF) Drawings - 100% Submittal	S-08.02	Structural	Constructability / RFI - Please confirm that these openings may be squared off. There is potential for air bubbles forming during the pour. Constructability - Consider structural steel plate system to funnel, in lieu of sloped openings. This eliminates potential of future concrete spalling. Understand design intent.	No response
284	AWRF	A- NHLW	Volume 3 (AWRF) Drawings - 100% Submittal	S-08.02	Structural	Is this needed? Not a water bearing structure.	Yes. WS required for below-grade structures.
285	AWRF	A- NHLW	Volume 3 (AWRF) Drawings - 100% Submittal	S-08.02	Structural	Provide sloping requirements for grout at the bottom or trench drain.	See Top Plan/S-08.01 for fill slope elevations
286	AWRF	A - Electrical	Volume 3 (AWRF) Drawings - 100% Submittal	E-01.01	Electrical	Is this supposed to be FE-001?	Acknowledged. It will be updated in the construction package.
287	AWRF	A - Electrical	Volume 3 (AWRF) Drawings - 100% Submittal	E-01.01	Electrical	RFI Reuse existing conduit to the I/O HW or is new ductbank needed?	Possible. We will update the note to state that the contractor must field verify the existing spare conduits and submit the information to the engineer for approval prior to installation.
288	AWRF	A - Electrical	Volume 3 (AWRF) Drawings - 100% Submittal	E-01.02	Electrical	SC 4500 not recommended during page flip. Please confirm	No response
289	AWRF	A - Electrical	Volume 3 (AWRF) Drawings - 100% Submittal	E-01.02, C-40.03	Electrical	Please confirm whether the existing transmitter is being removed and replaced, or whether the existing transmitter is being modified as mentioned during the AWRF page flip. Tim mentioned that it could be modified with a card. If so, please provide additional details and specs on what the modification would be.	No response
290	AWRF	A - Electrical	Volume 3 (AWRF) Drawings - 100% Submittal	E-04.03	Electrical	CHANGE TO EXISTING SECONDARY CLARIFIERS MODIFICATION ELECTRICAL PLAN	Acknowledged. It will be updated in the construction package.
291	AWRF	A - Electrical	Volume 3 (AWRF) Drawings - 100% Submittal	E-04.04	Electrical	Remove or protect in place ductbanks to extent required for RAS Valve replacement. Reuse existing ductbank as much as feasible. Exposed conduits will be replaced. (typical for all clarifiers). Please confirm	Possible. We will update the note to state that the contractor must field verify the existing spare conduits and submit the information to the engineer for approval prior to installation.
292	AWRF	A - Electrical	Volume 3 (AWRF) Drawings - 100% Submittal	E-04.07	Electrical	Verify if SC-004-ACE is SHT-004-ACE.	Make sure the tags are consistent with P&ID's and Process tags.
293	AWRF	A - Electrical	Volume 3 (AWRF) Drawings - 100% Submittal	E-04.07	Electrical	Local disconnect exist at clarifiers 1-3, existing clarifier no. 4 has a toggle switch. Please confirm that disconnect is desired at this location as well. Include additional callout.	Yes, we need disconnect switch. It will be updated in the construction package.

100% Agency Review Clarifications Log

(highlighted rows received a response, non-highlted rows did not)

Item #	Site	Location	Referenced Document	Sheet Number	Scope of Work	MBC Comment	Architect/Engineer Response
294	AWRF	A - Electrical	Volume 3 (AWRF) Drawings - 100% Submittal	E-04.09	Electrical	Verify if Single Pole Switch should be here, indicated on E-04.06	Yes Single Pole Switch is required. It will be updated in the construction package.
295	AWRF	A - Electrical	Volume 3 (AWRF) Drawings - 100% Submittal	E-04.09	Electrical	Verify location. SHT-004-ACE not on any Schedule. Is this supposed to be SC-004-ACE	Make sure the tags are consistent with P&ID's and Process tags.
296	AWRF	A - Electrical	Volume 3 (AWRF) Drawings - 100% Submittal	E-05.02	Electrical	Sheet Name does not match Sheet Index. Please update	Acknowledged. It will be updated in the construction package.
297	AWRF	A - Electrical	Volume 3 (AWRF) Drawings - 100% Submittal	E-05.03	Electrical	RFI Review Actual Location of Existing or intended new equipment.	No response
298	AWRF	A - Electrical	Volume 3 (AWRF) Drawings - 100% Submittal	E-05.03	Electrical	RFI Wilson - Verify circuit called out. DSF-PP-300 - CKT #4,7	Acknowledged. It will be updated in the construction package.
299	AWRF	A - Electrical	Volume 3 (AWRF) Drawings - 100% Submittal	E-05.03	Electrical	McCarthy to install pull boxes to mirror existing installations are disc filter 1-5. Providing in locations as shown on Sheet M-05.04. Please confirm	No response
300	AWRF	A - Electrical	Volume 3 (AWRF) Drawings - 100% Submittal	E-05.05	Electrical	CONTROL not POWER. Please Update	Acknowledged. It will be updated in the construction package.
301	AWRF	A - Electrical	Volume 3 (AWRF) Drawings - 100% Submittal	E-08.01	Electrical	Load for Overhead Coiling Door is missing. Please include on Panel.	No response
302	AWRF	A - Electrical	Volume 3 (AWRF) Drawings - 100% Submittal	E-08.02	Electrical	Additional light requested for dumping area during page flip. Please update	Acknowledged. It will be updated in the construction package.
303	AWRF	A - Electrical	Volume 3 (AWRF) Drawings - 100% Submittal	E-08.02	Electrical	RFI Existing vs Relocated lights? Verify	Acknowledged. It will be updated in the construction package.
304	AWRF	A - Electrical	Volume 3 (AWRF) Drawings - 100% Submittal	E-08.02	Electrical	Existing, does this have to be relocated or can it stay where it is?	Acknowledged. It will be updated in the construction package.
305	AWRF	A - Electrical	Volume 3 (AWRF) Drawings - 100% Submittal	E-08.02	Electrical	Manhole indicated on E-0.02 - Suggestion: Switch to handhole with addition of pull box to save cost	Acknowledged. It will be updated in the construction package.
307	AWRF	A - Electrical	Volume 3 (AWRF) Drawings - 100% Submittal	E-11.01	Electrical	RFI Panel not current PP-GD - 2 pole 60amp - ckts 10,12 FIT - 1 pole 20amp - ckt 14 FS - 1 pole 20amp - ckt 16 FS - 1 pole 20amp - ckt 18 Check added Panel Schedule in the panel.	No response
308	AWRF	A - Electrical	Volume 3 (AWRF) Drawings - 100% Submittal	E-11.02	Electrical	Constructibility Leave Pullboxes in place as these conduits already route under ground between the chem pumps and the respective chem feed LCPs Reuse the conduits already in the pad to keep the area clean from new conduit installation. Plan to replace new from conduit stub up.	Possible for existing pull boxes. For conduits we will update the note to state that the contractor must field verify the existing spare conduits and submit the information to the engineer for approval prior to installation.
309	AWRF	A - Electrical	Volume 3 (AWRF) Drawings - 100% Submittal	E-11.02	Electrical	New ductbank and pull box needed from I/O panels to PITs. Please indicate routing on drawings.	See sheet E-0.02 for conduit routing.
310	AWRF	A - Electrical	Volume 3 (AWRF) Drawings - 100% Submittal	E-11.03	Electrical	RFI Panel Schedule not current - need to verify adding the load called out on drawings.	No response
311	AWRF	A - Electrical	Volume 3 (AWRF) Drawings - 100% Submittal	E-11.03	Electrical	Constructibility Civil work required. Can we utilize existing or is worthing finding conduit routing that could remove having to saw cut and run new ductbank?	Possible. We will update the note to state that the contractor must field verify the existing spare conduits and submit the information to the engineer for approval prior to installation.
312	AWRF	A - Electrical	Volume 3 (AWRF) Drawings - 100% Submittal	E-11.03	Electrical	RFI Seal off installed in some of the areas. Please clarify classification requirements	Yes.We will update the note to state that seal off are required.
313	AWRF	A - Electrical	Volume 3 (AWRF) Drawings - 100% Submittal	E-11.04	Electrical	Verify # of PMP, PSH, PIT. Quantity does not match Key Notes on E-11.02.	Acknowledged. It will be updated in the construction package.
314	AWRF	A - Electrical	Volume 3 (AWRF) Drawings - 100% Submittal	E-11.04	Electrical	RFI Missing NaOCL-PIT-003	Acknowledged. It will be updated in the construction package.
315	AWRF	A - Electrical	Volume 3 (AWRF) Drawings - 100% Submittal	E-11.04, 11.05	Electrical	RFI Ethernet or Controls. See E-11.05	It is hard wire to CFS-LCP-001
316	AWRF	A - Electrical	Volume 3 (AWRF) Drawings - 100% Submittal	E-11.05	Electrical	Where? Relevance to this section? Controls. Where is VCP located?	VCP is for fuel storage system.
317	AWRF	A - Electrical	Volume 3 (AWRF) Drawings - 100% Submittal	E-11.05	Electrical	RFI Is this to be panel CFS-LCP-001?	No it's VCP for fuel storage system.

100% Agency Review Clarifications Log

(highlighted rows received a response, non-highlted rows did not)

Item #	Site	Location	Referenced Document	Sheet Number	Scope of Work	MBC Comment	Architect/Engineer Response
318	AWRF	A - Electrical	Volume 3 (AWRF) Drawings - 100% Submittal	E-11.05	Electrical	Constructibility MOPO coordination and sequencing. How are these panels to be completed as we can only do 1 valve at a time after the chem feed pump is removed. Does this panel need to be operational as the work is completed? See P&ID I-11.04-11.09	No response
319	AWRF	A - Electrical	Volume 3 (AWRF) Drawings - 100% Submittal	E-13.01	Electrical	Constructibility Is there another panel closer to feed this from?	No response
320	AWRF	A - Electrical	Volume 3 (AWRF) Drawings - 100% Submittal	E-13.01	Electrical	Add details for various devices coming back to vendor control panel.	No response
321	AWRF	A - Electrical	Volume 3 (AWRF) Drawings - 100% Submittal	E-13.01	Electrical	Verify Name Name conflict with Note 4 on E-13.02 - FS-MPS-001	Acknowledged. It will be updated in the construction package.
322	AWRF	A - Electrical	Volume 3 (AWRF) Drawings - 100% Submittal	E-13.02	Electrical	RFI Need ethernet connection for VCP communication. Where does this raceway need to be installed and completed for the scope?	No response
323	AWRF	A - Electrical	Volume 3 (AWRF) Drawings - 100% Submittal	E-13.02	Electrical	Verify Name Name conflict with E-13.01 - FS-MPS-100	Yes.We will update the note to state that seal off are required.
324	AWRF	A - Electrical	Volume 3 (AWRF) Drawings - 100% Submittal	E-13.02	Electrical	Should fuel storage area be considered C1D1 per NEC500?	No response
325	AWRF	A - Electrical	Volume 3 (AWRF) Drawings - 100% Submittal	E-13.02	Electrical	Level sensor called out on mechanical drawings at this location. Please include details for installation in the electrical drawings and block diagrams.	No response
326	AWRF	A - Electrical	Volume 3 (AWRF) Drawings - 100% Submittal	E-13.02	Electrical	Locate MCP outside of classified zone. Please show new location based on clearance requirements.	Acknowledged. It will be updated in the construction package.
327	AWRF	A - Electrical	Volume 3 (AWRF) Drawings - 100% Submittal	E-13.02	Electrical	Add electrical details for leak detection mechanism as required.	No response
328	AWRF	A - Electrical	Volume 3 (AWRF) Drawings - 100% Submittal	E-13.02	Electrical	Add electrical details for overfill high level switch/alarm	No response
329	AWRF	A - Electrical	Volume 3 (AWRF) Drawings - 100% Submittal	E-13.02	Electrical	All electrical devices associated with fuel control panel require details for EIC to install vendor furnished fuel system. Please provide	No response
330	AWRF	A - Chemical Facilities	Volume 3 (AWRF) Drawings - 100% Submittal	I-5.01	Instrumentation	RFI Need ethernet connection for VCP communication. Where does this raceway need to be installed and completed for the scope? Where is AWF-DSF-ECOM-001?	No response
331	AWRF	A - Chemical Facilities	Volume 3 (AWRF) Drawings - 100% Submittal	I-11.02, 11.03	Instrumentation	Continuation notes reference old 60% sheet #'s. Please update	Acknowledged. It will be updated in the construction package.
332	AWRF	A - Electrical	Volume 3 (AWRF) Drawings - 100% Submittal	I-11.04, 11.05, 11.06, 11.07, 11.08, 11.09	Instrumentation	Constructibility MOPO coordination and sequencing. How are these panels to be completed as we can only do 1 valve at a time after the chem feed pump is removed. Does this panel need to be operational as the work is completed? See P&ID I-11.04-11.09	No response
333	AWRF	A - Electrical	Volume 3 (AWRF) Drawings - 100% Submittal	I-13.01	Instrumentation	Where does this go to?	No response
334	SPEC	A - Admin	Volume 2 Specifications - 100% Submittal	TOC-3	Spec	Will specifications be added for various trades within the admin building? Gypsum Board, acoustical ceiling tile, floor tile, accordion partition, metal stud framing, etc.	Yes.
335	SPEC	A - Secondary Clarifiers	Volume 2 Specifications - 100% Submittal	01010-1	Spec	Remove no. 4 if not required.	Will be updated in forthcoming submittal.

100% Agency Review Clarifications Log

(highlighted rows received a response, non-highlted rows did not)

Item #	Site	Location	Referenced Document	Sheet Number	Scope of Work	MBC Comment	Architect/Engineer Response
336	SPEC	A - Secondary Clarifiers	Volume 2 Specifications - 100% Submittal	01010-1	Spec	Spec 11335 states carbon steel for Bridge, cage, influent well, and arms. Also 304 SS for center column, RAS adapter, LA EDI Well, and Skimmer/Scum box. Confirm if these should be 316 stainless steel	See spec 11335 for correct materials.
337	SPEC	A - Secondary Clarifiers	Volume 2 Specifications - 100% Submittal	01012-11	Spec	Single lines indicate that MCC buckets will not be new, please clarify if buckets are new or existing	No response
338	SPEC	O - Effluent Electrical Building	Volume 2 Specifications - 100% Submittal	01012-15	Spec	Suggest replacing gate on CCB or install coffer dam over gate location. Please verify	No response
339	SPEC	O - Effluent Electrical Building	Volume 2 Specifications - 100% Submittal	01012-15	Spec	Recommend doing during electrical shutdown Shutdown filters for 10 working days to perform repair (requires shutting down entire MLE side) Block CCB pipe with valve Note: if entire MLE side is being shutdown, core for the VTP at anoxic basin could happen at the same time Alternative to shutting down MLE side: Pump around from Disc filters to CCB. Place gate at effluent of disc filters. use valve to block pipe too CCB Filters flow: 8-10 MGD	No response
340	SPEC	O - Site	Volume 2 Specifications - 100% Submittal	01010-2	Spec	Please confirm if the Northwest entrance may be utilized for construction activities.	No response
341	SPEC	O - Fuel Storage Tank	Volume 2 Specifications - 100% Submittal	01010-2	Spec	M sheets in OWRF Drawings call for 12,000 gal. tank. Please clarify	OWRF shall have 10,000 gallon tank. Will be corrected in forthcomming submittal.
342	SPEC		Volume 2 Specifications - 100% Submittal	01300-1	Spec	No submittal review timeline established in drawings, specs, or contract documents for engineer. 21 days (calendar) for shop drawings is the assumed time line for submittal review. Please confirm	No response
343	SPEC		Volume 2 Specifications - 100% Submittal	02315-1	Spec	Copy of report is requested by McCarthy and trade partners.	Will be provided.
344	SPEC		Volume 2 Specifications - 100% Submittal	11218-4	Spec	All 3 listed manufacturers have stated side discharge is not standard. 2 indicated a side discharge is not possible, the 3rd stated side discharge would be a custom modification. Please confirm if deviation would be acceptable or if custom pump discharge will be required.	No response
345	SPEC		Volume 2 Specifications - 100% Submittal	11218-4	Spec	In accordance with ANSI/ASME B73.1, please confirm top centerline discharge shall be acceptable in lieu of side discharge.	No response
346	SPEC		Volume 2 Specifications - 100% Submittal	11218-5	Spec	Multiple manufacturer's proposing close coupled design. Please confirm this shall be acceptable	No response
347	SPEC		Volume 2 Specifications - 100% Submittal	11295-1	Spec	RFI - Request to Add Plug Valves Specification Section for RAS Plug Valves	To be included in next submittal.
348	SPEC		Volume 2 Specifications - 100% Submittal	11295-5	Spec	is this possible for the swing check valves on the IMRL piping at OWRF?	No response
349	SPEC		Volume 2 Specifications - 100% Submittal	11310-1	Spec	Spec 09920 Not provided. Please provide	Specification will be updated for next submittal.
350	SPEC		Volume 2 Specifications - 100% Submittal	11310-12	Spec	Specification 05051 not provided. Please provide	Should be referencing specificaiton 03252
351	SPEC		Volume 2 Specifications - 100% Submittal	11310-15	Spec	Please confirm Pump Performance Testing is intended to be part of factory testing, not field quality control testing.	Pump performance testing is required both at factory and field
352	SPEC		Volume 2 Specifications - 100% Submittal	11310-4	Spec	Per manufacturer, AWWA E101 is obsolete. Pumps shall be per H.I 14.6. Please confirm	H.I. 14.6 is acceptable for hydraulic testing methodology. Also see AWWA E103

100% Agency Review Clarifications Log

(highlighted rows received a response, non-highlted rows did not)

Item #	Site	Location	Referenced Document	Sheet Number	Scope of Work	MBC Comment	Architect/Engineer Response
353	SPEC		Volume 2 Specifications - 100% Submittal	11310-7	Spec	Per manufacturer feedback: Anti-vortex device is not the same as a strainer. Please clarify spec requirements for anti-vortex device.	Specification will be updated for next submittal.
354	SPEC		Volume 2 Specifications - 100% Submittal	11310-8	Spec	Manufacturer standard is to perform and submit a lateral analysis report in lieu of field vibration testing. Please confirm this is acceptable.	Vibration testing is required.
355	SPEC		Volume 2 Specifications - 100% Submittal	11313-4	Spec	Please confirm Sulzer shall be an acceptable manufacturer for the Low-Flow Propeller (IMLR) Pumps. Pump data available upon request.	Please provide spec review and product data sheets to determine if it is an acceptable equal.
356	SPEC		Volume 2 Specifications - 100% Submittal	11313-4	Spec	Sulzer XRCP 8031 submitted as or equal. Deviations include: minimum shutoff head is 4.4'; shaft material; seal material; water tight to 65'; seal system; utilizes planetary gear box *Spec review provided for more detail (Grundfos and Sulzer rep'd by same supplier)	Please provide spec review and product data sheets to determine if it is an acceptable equal.
357	SPEC		Volume 2 Specifications - 100% Submittal	11335-1	Spec	Weirs, baffles, and stamford baffles shall be existing per drawings. Please confirm new weirs, baffles, and stamford baffles shall not be included in this scope.	Confirmed.
358	SPEC		Volume 2 Specifications - 100% Submittal	11335-10	Spec	Per specifications, torque requirements differ for 75-ft and 100-ft units. Some drive requirements could be adjusted for lower torques on 75-ft units. Please confirm the same drive unit is required for both 75-ft and 100-ft clarifier units.	No, same drive unit is not required.
359	SPEC		Volume 2 Specifications - 100% Submittal	11335-11	Spec	VE proposal to remove VFD requirement. Please confirm VFD's are required for clarifiers	OWRF requires VFD.
360	SPEC		Volume 2 Specifications - 100% Submittal	11335-12	Spec	The lower torque requirement for the 75-ft clarifiers can be met with a 40" main gear. Please confirm a 40" main gear shall be acceptable for 75-ft clarifiers.	Acceptable.
361	SPEC		Volume 2 Specifications - 100% Submittal	11335-14	Spec	Torque of the worm shaft can be measured without a load cell. Please confirm a standard drive control overload protection would be acceptable without load cell.	Provide cost savings and clarify proposed method for torque measurement.
362	SPEC		Volume 2 Specifications - 100% Submittal	11335-15	Spec	Clarifier manufacturers do not usually include stairs (not included at 60%). Please change verbiage to allow Contractor to provide. Also cheaper to buy direct from misc metals	Noted.
363	SPEC		Volume 2 Specifications - 100% Submittal	11335-15	Spec	Confirm stairs also required for OWRF Clarifier #3	Reuse existing stairs
364	SPEC		Volume 2 Specifications - 100% Submittal	11335-15	Spec	live load requirement of 50 lbs/sq ft instead of 100 to meet manufacturer standards. Adjust as permissible for design.	Not acceptable.
365	SPEC		Volume 2 Specifications - 100% Submittal	11335-21	Spec	Per 01010 Summary of Work, clarifiers are to be 316 SS which is not typically coated. Please remove this spec section or confirm which components are steel and should be painted.	Noted.
366	SPEC		Volume 2 Specifications - 100% Submittal	11335-6	Spec	Please modify to say we can take 2 down at a time	No response
367	SPEC		Volume 2 Specifications - 100% Submittal	11335-6	Spec	Manufacturer proposes standard torques which would lower overall mechanism costs: 75 ft - 25,000 ft lb continuous torque and 50,000 ft lb peak torque 100 ft- 45,500 ft lb continuous torque and 91,000 ft lbs peak torque. Please confirm if acceptable.	Not acceptable.
368	SPEC		Volume 2 Specifications - 100% Submittal	11335-8	Spec	No mention in spec which clarifiers are getting new grout, drawings show all 5 clarifiers having existing grout be demoed, but only new grout in #4 (AWRF) & #3 (OWRF) Please clarify	Clarifier #3 (OWRF) will be only clarifier with demoed grout
369	SPEC		Volume 2 Specifications - 100% Submittal	11375-10	Spec	Per manufacturer, permeability is typically considered for ceramic media rather than membrane diffusers. DWP measurements and graphs provided instead. Please update	No response

100% Agency Review Clarifications Log

(highlighted rows received a response, non-highlted rows did not)

Item #	Site	Location	Referenced Document	Sheet Number	Scope of Work	MBC Comment	Architect/Engineer Response
370	SPEC		Volume 2 Specifications - 100% Submittal	11375-4	Spec	Please confirm peak-day airflow requirements correspond to 33 MGD and average-day airflows correspond to 27 MGD. It is assumed there is no peak-day loading associated with 27 MGD or average-day loading at 33 MGD	No response
371	SPEC		Volume 2 Specifications - 100% Submittal	11375-5	Spec	Please provide blower discharge pressure and discharge temperature data.	Pressure: Average operating: 8.7 psi Peak: 9.5 psi Temperature: Average operating: 155-175 F Peak: 195 F Contractor shall confirm with Plant Staff
372	SPEC		Volume 2 Specifications - 100% Submittal	11375-6	Spec	Per manufacturer, their standard diffuser holder is only designed for Sch 40 or SDR 33.5. Please confirm Sch 40 PVC shall be acceptable for the aeration laterals in lieu of Sch 80.	Sch. 40 is acceptable
373	SPEC		Volume 2 Specifications - 100% Submittal	11375-6	Spec	Please confirm 304 SS or 316 SS shall be acceptable for lateral supports.	Both are acceptable.
374	SPEC		Volume 2 Specifications - 100% Submittal	11375-7	Spec	Missing zone 3 dropleg 2 (drawing M-3.01). Drawing M-3.01 calls out 14", but drawing M-3.03 shows 12". Please provide diffuser information for zone 3 dropleg 2 and confirm correct size.	Contractor shall field verify size of droplegs.
375	SPEC		Volume 2 Specifications - 100% Submittal	11375-8	Spec	Per drawing M-3.01, Zone 2 dropleg 2 is 14" while drawing M-3.03 notes zone 2 dropleg 2 as 10". Please confirm correct size of zone 2 dropleg 2	Contractor shall field verify size of droplegs.
376	SPEC		Volume 2 Specifications - 100% Submittal	11375-8	Spec	If the aeration system has 3,048 diffuser holders per basin, the total for two basins should be 6,096 diffuser holders. Please confirm the Grand Total of New Diffuser Holders required	Confirmed, 6096 is correct.
377	SPEC		Volume 2 Specifications - 100% Submittal	11375-9	Spec	Please confirm glass filled polypropylene diffuser holders with carbon black for UV protection and a mechanical saddle mount to the air header would be acceptable in lieu of PVC diffuser holders with Ti02 and solvent welded to the air header.	Based on product data sheets provided, glass filled polypropylene diffuser holders with mechanical saddle mount would be acceptable if all relevant specifications are met and if cost savings are provided.
378	SPEC		Volume 2 Specifications - 100% Submittal	11400-11	Spec	Per P&IDs these shall be 3". Please confirm correct size is 3" for the manufacturer provided manual ball valves.	Motorized ball valves to be 2". Manual valves to be 3"
379	SPEC		Volume 2 Specifications - 100% Submittal	11400-13	Spec	Existing disc filters have a Micrologix 1400. Please confirm Micrologix shall be an acceptable PLC.	Match Existing.
380	SPEC		Volume 2 Specifications - 100% Submittal	11400-14	Spec	Existing disc filters have a PanelView Plus 700. Please confirm PanelView Plus shall be an acceptable OIT.	Match Existing.
381	SPEC		Volume 2 Specifications - 100% Submittal	15140-1	Spec	Please confirm where SST vs Galvanized supports are required	No response
382	SPEC		Volume 2 Specifications - 100% Submittal	15260-1	Spec	Please provide insulation schedule confirming which systems require insulation. If no insulation required, please state in response.	No response
383	SPEC		Volume 2 Specifications - 100% Submittal	15700	Spec	Section and Page number missing (Typ 15700)	Noted.
384	SPEC		Volume 2 Specifications - 100% Submittal	15710-1	Spec	Update per the HVAC drawings	Noted.
385	SPEC		Volume 2 Specifications - 100% Submittal	16225-2	Spec	Please confirm a complete initial test of job motor shall be acceptable in lieu of Prototype test	Acceptable.
386	SPEC		Volume 2 Specifications - 100% Submittal	16225-3	Spec	Per manufacturer, guaranteed efficiency is at full load only. Typical values at 3/4 and 1/2 load shall be provided. Please confirm	No response
387	SPEC		Volume 2 Specifications - 100% Submittal	16720-1	Spec	Clarify what the fire alarm scope is for this project.	No response
388	OWRF	O - Anoxic Basin	Volume 4 (OWRF) Drawings - 100% Submittal	M-25.02	Anoxic - Vertical turbine pump	Provide specification for seal water assembly strainer, ball valves, globe valve, and solenoid valve.	No response

100% Agency Review Clarifications Log

(highlighted rows received a response, non-highlted rows did not)

Item #	Site	Location	Referenced Document	Sheet Number	Scope of Work	MBC Comment	Architect/Engineer Response
389	AWRF	A - Headworks	Volume 3 (AWRF) Drawings - 100% Submittal	M-2.01		Arrow in wrong place. Please update	No response
390	AWRF	A - Headworks	Volume 3 (AWRF) Drawings - 100% Submittal	M-2.01		Should be keynote 5 for support bracket	No response
391	AWRF	A - Disc Filters	Volume 3 (AWRF) Drawings - 100% Submittal	M-5.05		Detail 703/M-40.07 not provided. Please provide	No response
392	AWRF	A - Headworks	Volume 3 (AWRF) Drawings - 100% Submittal	M-2.01		Please provide elevation of existing FA line.	No response
393	AWRF	A- NHLW	Volume 3 (AWRF) Drawings - 100% Submittal	M-8.03		Add detail showing location of 4" drain line at ground level	No response
394	SPEC		Volume 2 Specifications - 100% Submittal	15050-12	Piping	Per the AWRF and OWRF pipe tables (specification 15050 pages 12 and 13), Scum (SCM) lines shall be SST, but the AWRF Exposed Pipe and Fittings table (page 14) calls for epoxy lined ductile iron while the OWRF Exposed Pipe and Fittings table (page 15) calls for glass lined ductile iron. Please confirm the desired material for scum lines is glass lined ductile iron.	No response
395	SPEC		Volume 2 Specifications - 100% Submittal	11218-7	Suction Pumps	Specifications 17051, 17052, 17053, 17226, 17260, and 17454 have not been provided. Please provide.	No response
396	SPEC		Volume 2 Specifications - 100% Submittal	15066-3	Stainless steel pipe	Provide smallbore stainless steel specification for new clarifier spray header.	No response
397	SPEC		Volume 2 Specifications - 100% Submittal	15051-17	Buried pipe	Per drawings, new FA line is 10-inch. Please update	No response
398	SPEC		Volume 2 Specifications - 100% Submittal	15051-17	Piping systems	Please confirm 30" submerged WW line at aeration basins shall be stainless steel and 20" WW line at anoxic basin for the vertical turbine pump discharge shall be ductile iron.	No response
399	SPEC		Volume 2 Specifications - 100% Submittal	15052-15	Exposed piping installation	Aeration basin WW SS Submerged line is 30-inch per drawings. Missing 20" VTP pump discharge	No response
400	SPEC		Volume 2 Specifications - 100% Submittal	15067-3	FRP Pipe	Dampers only required to be rated 12.5 inches w.c. Please confirm the required design pressure for the FRP pipe.	No response



City of Chandler

WRF Improvements Phase 3

Rate Sheets

* Rates are provided as context for future change order requests adding scope to the project. Any changes to scope on the lump sum proposal will need to be reevaluated within the context of the lump sum proposal. Rates for credits on scope reductions may deviate from the supporting back-up rates.*

City of Chandler WRF Improvements Phase 3

Project No. WW2401.251

8/27/2026

McCarthy Staff Unit Rates

Hourly

Project Director	$201.93
Senior Project Manager	$190.14
Project Manager	$178.15
Assistant Project Manager	$150.11
Project Safety Manager	$170.74
General Superintendent	$189.63
Project Superintendent	$174.78
Assistant Project Superintendent	$150.11
Project Engineer	$126.61
Project Administrator	$89.62

Rates are valid through 2028 and include salary and burden, vehicle, fuel, oil, parts, cell phone, computer, software & maintenance, subsistence, travel, training. Sick and Vacation are included in the rates; holidays have been included as cost of the work.

City of Chandler WRF Improvements Phase 3

Project No. WW2401.251

8/27/2026

McCarthy Non-Staff Unit Rates

Hourly

General Foreman	$107.26
Foreman	$101.11
Carpenter	$96.39
Finisher	$94.95
Laborer	$80.25
Operator - Crane / Heavy EQ	$103.81
Operator - Forklift	$95.65
Millwright	$99.46
Pipefitter / Pipe Layer	$91.59
Welder	$102.52

Rates are valid through 2028 and include wages plus burden, cell phone, travel, safety incentive, and training.

McCarthy Equipment Rates

EQUIPMENT – with fuel and maintenance

Equipment rates are based on the Blue Book monthly hourly rate for Arizona. Rates include cost of ownership and all operating costs. The monthly hourly rate is based on 176 hours per month.

Equipment	Type	Monthly (M) or Hourly (H) Charge
CAT 140M3 AWD Blade	MO	$ 26,275
CAT 320F Excavator	MO	$ 24,349
CAT 349E L Excavator	MO	$ 47,654
CAT 950 Loader w/fork	MO	$ 22,009
CAT CP56B Compactor Roller	MO	$ 14,946
MQ RX1575 Rmt trch rlr	MO	$ 14,028
Pickup Truck	MO	$ 4,701
2K Water Truck	MO	$ 9,525

EQUIPMENT – bare rental

Equipment	Type	Monthly (M) or Hourly (H) Charge
CRANE - 65 TON	MO	$ 23,584
CRANE – 90 TON	MO	$ 29,867
FORKLIFT - 10000#	MO	$ 6,125
SCISSOR LIFT - SJM 3219	MO	$ 1,791
LIGHT PLANT / TOWER	MO	$ 1,156
COMPRESSOR - 185 CFM	MO	$ 1,375
BOOM LIFT	MO	$ 4,045
CONCRETE SCABBLER	MO	$ 1,502
WATER BUFFALO TRUCK	MO	$ 1,173

EXHIBIT E

SUBCONTRACTOR DOCUMENTS WITH CM@RISK

Any subcontractor assumptions, clarifications, exclusions, terms & conditions, signature blocks, etc. included are strictly between the CM@RISK and their subcontractors, and do not apply to the Agreement between the CM@RISK and the City.

SUBCONTRACTOR'S LIST FORM

If CM@Risk intends to subcontract any portion of this Agreement, the CM@Risk must submit the name, address, and contractor's license number (if applicable) of each subcontractor, including the work component of such subcontracting. Include the form with the bid submittal documents. CM@Risk may make multiple copies of this form as needed.

Company Name:	Ceterra
Contact Name:	Ron Kaiser
Contact Email:	rkaiser@certerra.com
Contact Phone:	(602) 437-3737
Work Component:	01C – Quality Control Testing
Percentage of Total Work Performed:	0.474%

Company Name:	L&L Ashphalt
Contact Name:	Rita Lawrence
Contact Email:	Rita@llasp.com
Contact Phone:	(623) 434-1200
Work Component:	02C – AC Paving
Percentage of Total Work Performed:	0.442%

Company Name:	Alta E&I
Contact Name:	Jeff Fields
Contact Email:	jeff.fields@altaei.com
Contact Phone:	(480) 656-1517
Work Component:	01D – Surveying
Percentage of Total Work Performed:	0.383%

Company Name:	Buesing
Contact Name:	Bill Gordon
Contact Email:	bgordon@buesingcorp.com
Contact Phone:	(602) 233-3339
Work Component:	02D – Site Concrete
Percentage of Total Work Performed:	0.469%

Company Name:	Dickens Quality Demo
Contact Name:	Craig Snider
Contact Email:	csnider@dickensquality.com
Contact Phone:	(602) 361-5173
Work Component:	02A - Demolition
Percentage of Total Work Performed:	0.145%

Company Name:	OCM
Contact Name:	Conny Lindeman
Contact Email:	conny@ocmcompany.com
Contact Phone:	(623) 242-4024
Work Component:	02E – Landscaping
Percentage of Total Work Performed:	0.281%

EXHIBIT E

Company Name:	Nucor
Contact Name:	Michael Johnson
Contact Email:	Michael.Johnston@nucor.com
Contact Phone:	(623) 826-7924
Work Component:	03B – Concrete Reinforcement
Percentage of Total Work Performed:	0.337%

Company Name:	Resolute
Contact Name:	David Mahalovich
Contact Email:	dmahalovich@resolutepc.com
Contact Phone:	(480) 406-8602
Work Component:	05A - Misc. Metals
Percentage of Total Work Performed:	0.991%

Company Name:	CST
Contact Name:	Lisa Snyders
Contact Email:	lisa@chcwater.com
Contact Phone:	(602) 339-8070
Work Component:	05C – Extruded Flat Panel Covers
Percentage of Total Work Performed:	0.773

Company Name:	Grating Pacific
Contact Name:	Brendan DeBerry
Contact Email:	bdeberry@gratingpacific.com
Contact Phone:	(562) 598-4314
Work Component:	06B – FRP
Percentage of Total Work Performed:	0.516%

Company Name:	PPS
Contact Name:	Tony Bodzioney
Contact Email:	tbodz@ppsphx.com
Contact Phone:	(602) 497-4997
Work Component:	09C – Painting/Coating Industrial
Percentage of Total Work Performed:	0.688%

Company Name:	GMC
Contact Name:	Seth Resler
Contact Email:	estimatinggmcllc@gmail.com
Contact Phone:	(480) 244-3400
Work Component:	13A – Metal Canopies
Percentage of Total Work Performed:	0.469%

EXHIBIT E

Company Name:	AZ Fuel Systems
Contact Name:	Perry Keilman
Contact Email:	perry@arizonafuelmanagement.com
Contact Phone:	(480) 650-6978
Work Component:	13C – Fuel Storage Tank System
Percentage of Total Work Performed:	1.463%

Company Name:	PPS
Contact Name:	Sujith Prakash
Contact Email:	sprakash@ppsphx.com
Contact Phone:	(602) 497-4997
Work Component:	15C – HVAC
Percentage of Total Work Performed:	0.799%

Company Name:	AZ Corp. Builders
Contact Name:	Dave Manarin
Contact Email:	dave@azcorporatebuilders.com
Contact Phone:	(602) 488-6079
Work Component:	13D – Pre-Engineered Structures
Percentage of Total Work Performed:	0.967%

Company Name:	Loenbro
Contact Name:	Joseph Nasert
Contact Email:	jnasert@revolutionindustrial.com
Contact Phone:	(917) 560-0356
Work Component:	16A – Electrical, Instrumentation, and Controls
Percentage of Total Work Performed:	25.557%

Company Name:	MMI
Contact Name:	Jeff Sanuik
Contact Email:	jeff@mmihoist.com
Contact Phone:	(480) 719-3994
Work Component:	14A – Monorail Festoon Replacement
Percentage of Total Work Performed:	0.046%

Company Name:	McCarthy Self Perform
Contact Name:	Jennifer Lee
Contact Email:	JKLee@mccarthy.com
Contact Phone:	(323) 693-4202
Work Component:	15A - Process Piping and Equipment Installation
Percentage of Total Work Performed:	20.957%

EXHIBIT E

Company Name:	McCarthy Self Perform
Contact Name:	David Gonzalez
Contact Email:	DAGonzalez@mccarthy.com
Contact Phone:	(945) 210-3568
Work Component:	03A - Concrete
Percentage of Total Work Performed:	5.719%

Company Name:	McCarthy Self Perform
Contact Name:	Peyton Tucker
Contact Email:	PTTucker@mccarthy.com
Contact Phone:	(913) 608-6982
Work Component:	02B – Earthwork & Yard Piping
Percentage of Total Work Performed:	6.897%

EXHIBIT F

GIS / GPS DATA DELIVERY REQUIREMENTS
N/A

EXHIBIT G

SUBCONTRACTOR DOCUMENTS WITH CM@RISK

Any subcontractor assumptions, clarifications, exclusions, terms & conditions, signature blocks, etc. included are strictly between the CM@Risk and their subcontractors, and do not apply to the Agreement between the CM@Risk and the City.



City of Chandler

WRF Improvements Phase 3

WC 11D - Hydraulic Valves

Solicitation Summary
Chandler Improvements Phase 3
Long Lead Procurement and Wilson Balance of Plant Proposal

Work Category: **11D - Hydraulic Valves**

Subcontractor/Supplier Name	***Status***
Fortiline	*Recommended*
Winwater	*Proposed*
Core and Main	*Declined*

Chandler Improvements Phase 3

Work Category: 11D - Hydraulic Valves

WC Lead: Peyton Tucker

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		**$148,867**
MCCARTHY SUBCONTRACT & FRONT END TERMS		
1	Compliant with McCarthy Front Ends	Yes
2	Bid Submitted on McCarthy Bid Form	No
3	Bid Bond Included with Bid	No
4	Surety Company	NA
5	Surety AM Best Rating (Must be A- or Better)	NA
6	Bond/CDI Cost	Yes
7	Insurance Requirements Per Matrix	NA
8	GL Insurance Company Name	NA
9	GL Insurance Carrier AM Best Rating (Must be A- or Better)	NA
10	E&O Insurance (If Required by Front Ends)	NA
11	Pollution Insurance (If Required by Front Ends)	NA
12	Tier 1 Approved	Draft
13	Tier 2 Approved	Draft
14	OSHA Recordable Incident Rate (Current)	NA
15	Includes Hoisting for Sub's Own Work Scope	NA
16	Acknowledges Soils Report	NA
17	Acknowledges Addenda	NA
18	Hold Bid for 150 Days	Yes
Scope of Work:		
20	**Per Plans & Specifications:**	Yes
21	Provide all labor, materials, tools, equipment and appurtenances as required to perform the Work Category - 11D Hydraulic Valves, in accordance with and reasonably inferable from the Contract Documents, complete and without exception unless otherwise noted below, including, but not limited to the following:	Yes
22	Per Plans & Specifications:	Yes
23	Division 1 General Requirements	Yes
24	11295 - Hydraulic Valves	Yes
25	13447 - Electric Motor Actuators	Yes
26	Shipping shall be FOB jobsite	Yes
27	Lead time (wks):	18-22 wks
28	**Scope per Specs Drawings Including:**	Yes
29	Furnish 16" RAS Direct Buried Motor Operated Hydraulic Actuator	Yes
30	Furnish 12" RAS Direct Buried Motor Operated Hydraulic Actuator	Yes
31	Furnish 08" DL Direct Buried Plug Valve	Yes

Chandler Improvements Phase 3

Work Category: 11D - Hydraulic Valves

WC Lead: Peyton Tucker

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		**$148,867**
32	**Field Services (section 3.4)**	Yes
33	Startup Services: 1 Trip	Yes
34	In person operator training services	Yes
37	Bond/CDI Cost	Yes

Chandler Improvements Phase 3

Work Category: 11D - Hydraulic Valves

WC Lead: Peyton Tucker

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE	$148,867

	ASSUMPTIONS & CLARIFICATIONS:
1	Valve purchases have been included per Detail 104 on page C-40.01.
2	All plug valves quoted as Henry Pratt FIG 600 Full Round Port Plug Valve, 175 PSI, Mechanical Joints ends, Cast Iron Body, Cast Iron Cap, Nickel seat, Ductile Iron Plug coated in Buna.



City of Chandler

WRF Improvements Phase 3

WC11E – Vertical Turbine Pumps

Solicitation Summary

Chandler Improvements Phase 3

Long Lead Procurement and Wilson Balance of Plant Proposal

Work Category: **11E - Vertical Turbine Pumps**

Subcontractor/Supplier Name	***Status***
JCH (Cascade)	*Recommended*
Arrowhead (Sulzer)	*Proposed*
Hennesy Mechanical (Fairbanks)	*Declined*
Hennesy Mechanical (Peerless)	*Declined*
Phoenix Pumps (Floway)	*Declined*

Chandler Improvements Phase 3

Work Category: 11E - Vertical Turbine Pumps

WC Lead: Jennifer Lee

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		**$263,124**
MCCARTHY SUBCONTRACT & FRONT END TERMS		
1	Compliant with McCarthy Front Ends	Yes
2	Bid Submitted on McCarthy Bid Form	Yes
3	Bid Bond Included with Bid	N/A
4	Surety Company	N/A
5	Surety AM Best Rating (Must be A- or Better)	N/A
6	Bond/CDI Cost	Yes
7	Insurance Requirements Per Matrix	Yes
8	GL Insurance Company Name	Travelers
9	GL Insurance Carrier AM Best Rating (Must be A- or Better)	A++
10	E&O Insurance (If Required by Front Ends)	NA
11	Pollution Insurance (If Required by Front Ends)	NA
12	Tier 1 Approved	No
13	Tier 2 Approved	No
14	OSHA Recordable Incident Rate (Current)	N/A
15	Includes Hoisting for Sub's Own Work Scope	N/A
16	Acknowledges Soils Report	N/A
17	Acknowledges Addenda	N/A
18	Hold Bid for 150 Days	Yes
Scope of Work:		
19	**Per Plans & Specifications:**	Yes
20	Provide all labor, materials, tools, equipment and appurtenances as required to perform the **Work Category - 11E Vertical Turbine Pumps**, in accordance with and reasonably inferable from the Contract Documents, complete and without exception unless otherwise noted below, including, but not limited to the following:	Yes
21	Per Plans & Specifications:	Yes
22	Division 1 General Requirements	Yes
23	01300 – Submittals	Yes
24	01640 – Materials and Equipment	Yes
25	01650 – Starting of Systems	Yes
26	01660 – Field Tests of Equipment	Yes
27	03252 - Anchorage in Concrete	Yes
28	09900 – Painting	Yes
29	11310 - Vertical Turbine Pumps	Yes
30	16225 – Electric Motors 250 Horsepower or Less	Yes
31	Check to Spec completed and submitted to McCarthy	Yes
32	Includes all requirements from McCarthy Exhibits (as applicable)	Yes
33	Warranty Adder - 1 year from Project Final Completion	Yes

Chandler Improvements Phase 3

Work Category: 11E - Vertical Turbine Pumps

WC Lead: Jennifer Lee

Bid Date: August 21, 2026

	TOTAL WORK CATEGORY PACKAGE VALUE	**$263,124**
34	Shipping shall be FOB jobsite	Yes
35	Lead time (wks):	
36	Submittals	4-6 weeks
37	Fabrication	22-24 weeks
38	Anchors and epoxy required for installation	Yes
39	**Scope per Specs Drawings Including:**	Yes
40	Furnish (1) vertical turbine pump with axial impeller, motor drivers, and anti-vortex device	Yes
41	**Submittals per section 1.6**	Yes
42	Calculations: Anchorage	Yes
43	**Quality Assurance per section 1.7**	Yes
44	Pump and equipment for pump from single pump manufacturer	Yes
45	Shop Testing: Hydrostatic, Performance, Motor	Yes
46	Shop testing witnesses by Registered Professional Engineer	Yes
47	**Manufacturers (section 2.1)**	
48	Cascade, Fairbanks Morse, or Approved Equal	Yes
49	Minimum 5 years of experience producing similar equipment	Yes
50	5 reference installations for a period of at least 3 years	Yes
51	**Service Conditions per section 2.2**	Yes
52	Vertical line-shaft type suitable for MLSS up to 3300 mg/L at water temperature 50° F to 85° F	Yes
53	**Materials (section 2.3)**	Yes
54	Cast Iron: ASTM A 48, Class 30 minimum	Yes
55	Nickle Cast Iron: ASTM A 48, Class 30 minimum, 3% nickle	Yes
56	Gray Iron Casting: ASTM A 278, Class 30	Yes
57	Iron-Chromium Alloy: ASTM A 743, Grade CA40, Brinell Hardness 350 to 380	Yes
58	Leaded Tin Bronze: ASTM B 584, Alloy C90300, Leaded red brass	Yes
59	416 SS: ASTM A 582, Type 416 SS	Yes
60	Neoprene: Polychloroprene rubber	Yes
61	Steel: ASTM A 283, Grade D or ASTM A36	Yes
62	Steel Pipe: ASTM 53, Grade B	Yes
63	Aluminum Bronze: ASTM B 148	Yes
64	**Pump Construction per section 2.4-A**	Yes
65	Industrial, heavy duty, vertical turbine type pumps	Yes
66	Discharge Flange: ASME B16.1 or B16.5 drilled, rated for 1.2 times pump shutoff head	Yes
67	Discharge Nozzle: 1/2 in NPT taps for pressure gauges	Yes
68	Bearings: Support line shaft assembly and rated ABMA L10 life of 40,000 hours	Yes
69	Fasteners: Type 316 SS	Yes
70	**Pump Suction Assembly per section 2.4-B**	Yes
71	Include Anti-vortex device	Yes
72	**Pump Impeller Bowl Assembly per section 2.4-C**	Yes
73	**Line Shafts per section 2.4-D**	Yes
74	Include Adjustable Spacer Coupling	Yes
75	**Pump Column Pipe per section 2.4-E**	Yes
76	**Pump Discharge Head Assembly per section 2.4-F**	Yes

Chandler Improvements Phase 3

Work Category: 11E - Vertical Turbine Pumps

WC Lead: Jennifer Lee

Bid Date: August 21, 2026

	TOTAL WORK CATEGORY PACKAGE VALUE	**$263,124**
77	**Equipment Guards per section 2.4-G**	Yes
78	**Driver per section 2.4-H**	Yes
79	**Motor per section 2.4-I and specification 16225**	See Clarifications
80	Acceptable Products (16225 2.7): General Electric, Emerson US Motors, Siemens, WEG)	Yes
81	Temperature Sensor	Yes
82	**Supports per section 2.4-J**	Yes
83	**Design Criteria (section 2.5)**	Yes
84	General Characteristics:	Yes
85	Maximum Noise @ 3 ft: 85 dBA	Yes
86	Pumped Fluid Temperature Range: 50° F to 85° F	Yes
87	Pump Characteristics:	Yes
88	Impeller Type: Axial Flow	Yes
89	Pass Minimum Sphere Size: 3.5"	Yes
90	Pump Impeller Bowl Bearing and Suction Bowl Bearing Lubrication: Water Flush	Yes
91	Suction Cone: Required	Yes
92	Line Shaft Type: Enclosed	Yes
93	Maximum Line Shaft Bearing Spacing: 10 ft	Yes
94	Line Shaft Lubrication: Water Flush	Yes
95	Discharge Shaft Seal Type: Single Mechanical	Yes
96	Column Connection Type: Flanged	Yes
97	Column Diameter: 20"	Yes
98	Max Column Section Length: 10 ft	Yes
99	Discharge Arrangement: Above Base	Yes
100	Coupling Type: Spacer	Yes
101	Speed Control: VFD	Yes
102	Maximum Pump RPM: 1200	Yes
103	Rated Design Point (@ Max Revolutions per Minute):	Yes
104	Flow: 8,500 gpm	Yes
105	Head: 18 ft	Yes
106	Pump Discharge Centerline Elevation: 1199.4	Yes
107	Minimum Pump Efficiency: 79%	Yes
108	Pump Materials:	Yes
109	Suction Bell: Cast Iron	Yes
110	Suction Bell Bearing: High Lead Tin Bronze	Yes
111	Impeller Cases: Cast Iron	Yes
112	Impeller: Aluminum Bronze	Yes
113	Impeller Bearing: Bronze	Yes
114	Impeller Shaft Key: 416 SS	Yes
115	Line Shaft and Coupling: 416 SS	Yes
116	Line Shaft Bearings: Bronze	Yes
117	Shaft Enclosing Tube: Steel Pipe 3/8"/0.01x Pipe ID/Schedule 80	Yes
118	Column Material and Thickness: Steel Pipe 3/8"	Yes
119	Discharge Head/Driver Stand: Fabricated Steel	Yes
120	Discharge Head Bearing: Bismuth Bronze	Yes
121	Discharge Stuffing Box: Cast Iron	Yes

Chandler Improvements Phase 3

Work Category: 11E - Vertical Turbine Pumps

WC Lead: Jennifer Lee

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		**$263,124**
122	Driver Characteristics:	Yes
123	Driver Type: Motor	Yes
124	Driver Arrangement: Vertical, coupled	Yes
125	Non-reverse Ratchets: Required	Yes
126	Max Drive Horsepower: 60 HP	Yes
127	Max Driver RPM: 1,200	Yes
128	Inverter Duty Rated: Yes	Yes
129	Motor Voltage/Phase/Hertz: 460/3/60	Yes
130	Enclosure Type: TEFC	Yes
131	**Source Quality Control Testing (section 2.6)**	Yes
132	Pump Performance Testing	Yes
133	Noise Test	Yes
134	**Surface Prep and Coating per section 2.8**	Yes
135	**Spare Equipment (section 2.9)**	Yes
136	(1) set line shaft bronze bearings for each type of pump	Yes
137	(1) of each type of complete mechanical seal	Yes
138	(1) motor/gear thrust bearing set for each type of pump	Yes
139	(1) motor radial bearing set (if applicable)	Yes
140	**Factory Performance Test per section 3.2**	Yes
141	**Field Services (section 3.4)**	Yes
142	Installation/Startup Services: 2 trips, total time of four (eight hour) days	Yes
143	In person operator training services: 4 hours	Yes
144	Textura Included (Total Under $2.2M add 0.22%, if total is Equal or More than $2.2M add $5,000)	Yes
145	Bond/CDI Cost	Yes

	ASSUMPTIONS & CLARIFICATIONS:
1	PO Execution will lock-in pricing for the equipment.
2	11310 – 2.4.C.1.3. [Clarification]: Impeller will be secured by Thrust Collar Halves and Key.
3	16225 – 1.3.A.4. [Clarification]: Guaranteed efficiency is at full load only. Motor manufacturer will supply typical values at ¾ & ½ load.
4	16225 – 2.2.A.12. [Exception]: Copper rotor is not available on the requested rating. Rotor material is cast aluminum.
5	16225 – 2.4.D.2. [Clarification]: Motor is offered with insulated bearing on upper end. Shaft Grounding Ring is not offered on motors rated for Hazardous Areas (as specified in 1.2.B.10 of this specification). Note: this is the same insulation design provided on previously supplied motor for Cascade SO# 19500 (existing pumps).



City of Chandler

WRF Improvements Phase 3

WC11H – Secondary Clarifier Replacements

Solicitation Summary

Chandler Improvements Phase 3

Long Lead Procurement and Wilson Balance of Plant Proposal

Work Category: **11H - Secondary Clarifier Replacement**

Subcontractor/Supplier Name	***Status***
Goble Sampson (Westech)	*Recommended*
Coombs Hopkins (Ovivo)	*Proposed*
IES Southwest (Walker)	*Proposed*
JBI (Clearstream)	*Declined*

Chandler Improvements Phase 3

Work Category: 11H - Secondary Clarifiers

WC Lead: Jennifer Lee

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		**$3,319,296**
MCCARTHY SUBCONTRACT & FRONT END TERMS		
1	Compliant with McCarthy Front Ends	Yes
2	Bid Submitted on McCarthy Bid Form	Yes
3	Bid Bond Included with Bid	Yes
4	Surety Company	Fidelity and Deposit Company of Maryland
5	Surety AM Best Rating (Must be A- or Better)	A+
6	Bond/CDI Cost	Yes
7	Insurance Requirements Per Matrix	Yes
8	GL Insurance Company Name	Zurich American Ins Co
9	GL Insurance Carrier AM Best Rating (Must be A- or Better)	A+
10	E&O Insurance (If Required by Front Ends)	NA
11	Pollution Insurance (If Required by Front Ends)	NA
12	Tier 1 Approved	No
13	Tier 2 Approved	No
14	OSHA Recordable Incident Rate (Current)	N/A
15	Includes Hoisting for Sub's Own Work Scope	N/A
16	Acknowledges Soils Report	N/A
17	Acknowledges Addenda	N/A
18	Hold Bid for 120 Days	Yes
Scope of Work:		
19	Provide all labor, materials, tools, equipment and appurtenances as required to perform the **Work Category - 11H Secondary Clarifiers**, in accordance with and reasonably inferable from the Contract Documents, complete and without exception unless otherwise noted below, including, but not limited to the following:	Yes
20	Per Plans & Specifications:	Yes
21	Division 1 General Requirements	Yes
22	01300 – Submittals	Yes
23	01640 – Materials and Equipment	Yes
24	01650 – Starting of Systems	Yes
25	01660 – Field Tests of Equipment	Yes
26	03252 - Anchorage in Concrete	Yes
27	05522 – Aluminum Handrails and Railings	Yes
28	09900 – Painting	Yes
29	15064 – Copper Pipe	Yes
30	11335 – Secondary Clarifier Mechanism	Yes
31	16161 – Control Panels	Yes
32	16225 – Electric Motors 250 Horsepower or Less	Yes
33	17000 – Instrumentation	Yes

Chandler Improvements Phase 3

Work Category: 11H - Secondary Clarifiers

WC Lead: Jennifer Lee

Bid Date: August 21, 2026

	TOTAL WORK CATEGORY PACKAGE VALUE	**$3,319,296**
34	17454 – Operations and Control Descriptions	Yes
35	Check to Spec completed and submitted to McCarthy	Yes
36	Includes all requirements from McCarthy Exhibits (as applicable)	Yes
37	Shipping shall be FOB jobsite	Yes
38	Lead time (wks):	
39	Submittals	10-12 weeks
40	Fabrication	26-28 weeks
41	Anchors and epoxy required for installation	Yes
42	**Scope per Specs and Drawings Including:**	Yes
43	Furnish 5 secondary clarifiers w/appurtenances: -(1) 100 ft and (3) 75 ft at AWRF -(1) 100 ft at OWRF	Yes
44	Center-drive type, supported on stationary effluent column, with flow entering from bottom of influent column into inner EDI. Scraper blades designed to move sludge uniformly to center of tank (section 2.4)	Yes
45	**Submittals per section 1.5**	Yes
46	Engineering Calculations: Structural, Output Torque and Overload Torque, Bearing, Gear	Yes
47	**AWRF Design Requirements (section 1.6)**	Yes
48	Secondary Clarifiers 1-3:	Yes
49	Clarifier Effluent, Average: 3.5 MGD	Yes
50	Clarifier Effluent, Peak: 6.11 MGD	Yes
51	RAS Flow, Average: 1.05 MGD	Yes
52	RAS Flow, Peak: 1.8 MGD	Yes
53	MLSS Concentration: 3,400 mg/L	Yes
54	Continuous Operating Torque: 35,000 ft-lb AGMA	Yes
55	Momentary Peak Torque: 70,000 ft-lb	Yes
56	Sludge Collector Rotation Speed: 4-10 fpm	Yes
57	Internal Tank Diameter: 75 ft	Yes
58	Nominal Side Water Depth: 13 ft	Yes
59	Bottom Floor Slope: 1:4	Yes
60	Double Bridge	Yes
61	Secondary Clarifier 4:	Yes
62	Clarifier Effluent, Average: 6.21 MGD	Yes
63	Clarifier Effluent, Peak: 10.74 MGD	Yes
64	RAS Flow, Average: 1.85 MGD	Yes
65	RAS Flow, Peak: 3.2 MGD	Yes
66	MLSS Concentration: 3,400 mg/L	Yes
67	Continuous Operating Torque: 66,000 ft-lb AGMA	Yes
68	Momentary Peak Torque: 132,000 ft-lb	Yes
69	Sludge Collector Rotation Speed: 4-10 fpm	Yes
70	Internal Tank Diameter: 100 ft	Yes
71	Nominal Side Water Depth: 14 ft	Yes
72	Bottom Floor Slope: 1:4	Yes
73	**OWRF Design Requirements (section 1.7)**	Yes
74	Secondary Clarifier 3:	Yes
75	Clarifier Effluent, Average: 5 MGD	Yes
76	Clarifier Effluent, Peak: 10 MGD	Yes

Chandler Improvements Phase 3

Work Category: 11H - Secondary Clarifiers

WC Lead: Jennifer Lee

Bid Date: August 21, 2026

	TOTAL WORK CATEGORY PACKAGE VALUE	**$3,319,296**
77	RAS Flow, Average: 1.9 MGD	Yes
78	RAS Flow, Peak: 3.3 MGD	Yes
79	MLSS Concentration: 3,300 mg/L	Yes
80	Continuous Operating Torque: 66,000 ft-lb AGMA	Yes
81	Momentary Peak Torque: 132,000 ft-lb	Yes
82	Sludge Collector Rotation Speed: 4-10 fpm	Yes
83	Internal Tank Diameter: 100 ft	Yes
84	Nominal Side Water Depth: 14 ft	Yes
85	Bottom Floor Slope: 1:12	Yes
86	**Quality Assurance per section 1.8**	Yes
87	Reference installation of similar design operating at least 5 years	Yes
88	**Manufacturers (section 2.1)**	Yes
89	Clarifiers: Ovivo, Walker Process Equipment, Westech, or Approved Equal	Yes
90	Density Current(Stamford) Baffle: Nefco, or Approved Equal	Yes
91	Launder Brushes: Ford Hall Company, or Approved Equal	Yes
92	Energy Dissipating Inlet (EDI): CPE Type II LA-EDI (No Approved Equal)	Yes
93	**Materials per section 2.3**	Yes
94	Structural Steel: 304 SS	Yes
95	Center Feedwell Minimum Thickness: 3/16 inch	Yes
96	Stainless Steel Minimum Thickness: 1/4 inch	Yes
97	Welding: AWS D1.1	Yes
98	Hardware: 316 SS	Yes
99	Minimum Bolt Diameter: 5/8 inch	Yes
100	Spur and Pinion Gears: AGMA 908-B89, AGMA 240.01, AGMA 2001-C95	Yes
101	Worm Gears: AGMA 6034-A87	Yes
102	Iron Castings: ASTM A48	Yes
103	Anti-friction Bearing Minimum B-10 Life Rating: 200,000 hours	Yes
104	**Center Assembly per section 2.5**	Yes
105	**Control Panels per section 2.6**	Yes
106	VFD: (1) for Ocotillo 100 ft Clarifier	Yes
107	**Overload Protection per section 2.7**	See Clarifications
108	**Walkway and Drive Platform per section 2.8**	Yes
109	Double Walkway	Yes
110	**Center Cage per section 2.9**	Yes
111	**Center Column per section 2.10**	Yes
112	**RAS Adapter per section 2.11**	See Clarifications
113	**Influent Feedwell per section 2.12**	Yes
114	**Energy Dissipating Inlet (EDI) per section 2.13**	Yes
115	**Scum Baffle Supports Brackets per section 2.14**	Yes
116	**Rotating Rake Arms and Scrapers per section 2.15**	Yes
117	**Skimmers and Scum Boxes per section 2.16**	Yes
118	**Lauder Brushes per section 2.17**	Yes
119	**Peripheral Density Current (Stamford) Baffle per section 2.18**	Yes
120	**Surface Preparation per section 2.19**	Yes
121	**Spare Parts (section 2.20)**	Yes
122	Sight glasses and oil gauges	Yes

Chandler Improvements Phase 3

Work Category: 11H - Secondary Clarifiers

WC Lead: Jennifer Lee

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		$3,319,296
123	(1) set seals per clarifier	Yes
124	(1) set overload control device switches	Yes
125	(1) set squeegees per clarifier	Yes
126	10% of the total number of each type of fastener	Yes
127	(1) drive main bearing (Incl liners, balls, drive seals)	Yes
128	(1) set seals for each wash water flocculation arm drive unit	Yes
129	Additional manufacturer recommended spare parts	NA
130	**Field Services (section 3.3)**	Yes
131	Installation/Startup Services: 2 trips, total time of three (eight hour) days per clarifier	Yes
132	In person operator training services: 8 hours	Yes
133	Textura Included (Total Under $2.2M add 0.22%, if total is Equal or More than $2.2M add $5,000)	Yes
134	Bond/CDI Cost	Yes

	ASSUMPTIONS & CLARIFICATIONS:
1	11335 – 2.7-A: This proposal excludes a clutch or load cell for overload protection. Westech utilizes electro-mechanical switches that can transmit alarm data to plant SCADA.
2	11335 – 2.11: In lieu of a sludge drum, Westech proposes a sludge withdrawal ring for OWRF clarifier.



City of Chandler

WRF Improvements Phase 3

WC11I – Aeration Systems

Solicitation Summary

Chandler Improvements Phase 3

Long Lead Procurement and Wilson Balance of Plant Proposal

Work Category: **11I - Aeration System**

Subcontractor/Supplier Name	***Status***
JCH (Aquarius)	*Recommended*
Coombs Hopkins (Sanitaire)	*Proposed*
Goble Sampson (SSI)	*Proposed*
Misco (EDI)	*Proposed*
JBI (OTT)	*Declined*

Chandler Improvements Phase 3

Work Category: 11I - Aeration System

WC Lead: Jennifer Lee

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		**$574,857**
MCCARTHY SUBCONTRACT & FRONT END TERMS		
1	Compliant with McCarthy Front Ends	Yes
2	Bid Submitted on McCarthy Bid Form	No
3	Bid Bond Included with Bid	No
4	Surety Company	NA
5	Surety AM Best Rating (Must be A- or Better)	NA
6	Bond/CDI Cost	Yes
7	Insurance Requirements Per Matrix	Yes
8	GL Insurance Company Name	Travelers
9	GL Insurance Carrier AM Best Rating (Must be A- or Better)	A++
10	E&O Insurance (If Required by Front Ends)	NA
11	Pollution Insurance (If Required by Front Ends)	NA
12	Tier 1 Approved	No
13	Tier 2 Approved	No
14	OSHA Recordable Incident Rate (Current)	N/A
15	Includes Hoisting for Sub's Own Work Scope	N/A
16	Acknowledges Soils Report	N/A
17	Acknowledges Addenda	N/A
18	Hold Bid for 150 Days	Yes
Scope of Work:		
19	Provide all labor, materials, tools, equipment and appurtenances as required to perform the **Work Category - 11I Aeration System**, in accordance with and reasonably inferable from the Contract Documents, complete and without exception unless otherwise noted below, including, but not limited to the following:	Yes
20	Per Plans & Specifications:	Yes
21	Division 1 General Requirements	Yes
22	01300 – Submittals	Yes
23	01640 – Materials and Equipment	Yes
24	01650 – Starting of Systems	Yes
25	11375 – Aeration Systems	Yes
26	Check to Spec completed and submitted to McCarthy	Yes
27	Includes all requirements from McCarthy Exhibits (as applicable)	Yes
30	Shipping shall be FOB jobsite	Yes
31	Lead time (wks):	
32	Submittals	4-6 weeks
33	Fabrication	10-12 weeks
34	Anchors and epoxy required for installation	Yes
35	**Scope per Specs and Drawings Including**	Yes

Chandler Improvements Phase 3

Work Category: 11I - Aeration System

WC Lead: Jennifer Lee

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		**$574,857**
36	Furnish Fine Bubble Aeration Systems for: -Airport Aeration Basins 5 and 6 -Ocotillo Zone 8 or MBR Bioreactor Basins 1 & 2	Yes
37	Including purge header on laterals (Alternative purge methods deviate from drawing design per manufacturer) Include Manual and continuous purge	Yes
38	**Submittals per section 1.4**	Yes
39	Engineering Calculations: Headloss calculations, Seismic	Yes
40	**Quality Assurance (section 1.6)**	Yes
41	5 reference installations operating at least 5 years	Yes
42	Fine Bubble Membrane Disc Diffuser Minimum Oxygen Transfer Rate at 2 scfm Air Flow Rate Per Diffuser: 32%	Yes
43	**Manufacturers (section 2.1)**	Yes
44	Aquarius, Sanitaire, Stamford Scientific International (SSI), Environmental Dynamics International (EDI)	Yes
45	**Design Criteria (section 2.2)**	Yes
46	Average Expected Water Temperature: 60° F - 90° F	Yes
47	Expected Ambient Air Temperature Range: 20° F - 120° F	Yes
48	Lateral Spacing per Drawings	Yes
49	Airport:	Yes
50	27 MGD Conditions	Yes
51	Total Basins: 2	Yes
52	Air Requirement per Basin: 5640 scfm	Yes
53	Max Anticipated Water Depth: 20'9"	Yes
54	Depth of Water from Top of Diffuser Plate: 19'6"	Yes
55	Elevation: 1,209	Yes
56	Ocotillo:	Yes
57	8.2 MGD Conditions	Yes
58	Total Basins: 2	Yes
59	Max Anticipated Water Depth: 17.3'	Yes
60	Depth of Water from Top of Diffuser Plate: 16.38'	Yes
61	Elevation: 1,174.5	Yes
62	**Materials per section 2.3**	Yes
63	**Components (section 2.4)**	Yes
64	Air Distribution Manifold: Sch 80 PVC	Yes
65	Air Distribution Lateral: SDR 18 Sch40 Equivilant	Yes
66	Metal supports included for laterals	Yes
67	Manifold Support Straps (Detail 5/S-003)	Yes
68	Diffusers per section 2.4-D: 9", EPDM membrane diffuser w/integral O-ring	Yes
69	Diffuser Baseplate per section 2.4-F: PVC	Yes
70	Elastomeric gaskets per section 2.4-G: Neoprene rubber, 4.5-inches I.D, durometer of 40 ±5	Yes
71	**Spare Equipment (section 2.5)**	Yes
72	10% of the total number of installed diffusers (Incl retainer rings and diffuser support plates)	Yes
73	1% of the total number of pipe supports (Incl anchor bolts)	Yes
74	1% of each type of diffuser lateral	Yes
75	50% of the total number of installed plugs for blank baseplates (Incl gaskets and accessory equipment)	Yes
76	**Field Services (section 3.2)**	Yes

Chandler Improvements Phase 3

Work Category: 11I - Aeration System

WC Lead: Jennifer Lee

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		**$574,857**
77	Installation/Startup Services for each basin: 4 trips, minimum 1 eight hour day per trip	Yes
78	In person operator training services: 4 hours	Yes
79	**Factory Certified Tests per section 3.3**	Yes
80	Textura Included (Total Under $2.2M add 0.22%, if total is Equal or More than $2.2M add $5,000)	Yes
81	Bond/CDI Cost	Yes



City of Chandler

WRF Improvements Phase 3

WC11J – Disc Filters

Solicitation Summary

Chandler Improvements Phase 3

Long Lead Procurement and Wilson Balance of Plant Proposal

Work Category: **11J - Disc Filter**

Subcontractor/Supplier Name	***Status***
IES Southwest (Aqua-Aerobics)	*Recommended*
Coombs Hopkins (Five Star Filtration)	*Declined*

Chandler Improvements Phase 3

Work Category: 11J - Disc Filter

WC Lead: Jennifer Lee

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		**$730,170**
MCCARTHY SUBCONTRACT & FRONT END TERMS		
1	Compliant with McCarthy Front Ends	Yes
2	Bid Submitted on McCarthy Bid Form	Yes
3	Bid Bond Included with Bid	N/A
4	Surety Company	Fidelity and Deposit Company of Maryland
5	Surety AM Best Rating (Must be A- or Better)	A+
6	Bond/CDI Cost	Yes
7	Insurance Requirements Per Matrix	Yes
8	GL Insurance Company Name	Colony
9	GL Insurance Carrier AM Best Rating (Must be A- or Better)	A-
10	E&O Insurance (If Required by Front Ends)	NA
11	Pollution Insurance (If Required by Front Ends)	NA
12	Tier 1 Approved	Yes
13	Tier 2 Approved	No
14	OSHA Recordable Incident Rate (Current)	N/A
15	Includes Hoisting for Sub's Own Work Scope	N/A
16	Acknowledges Soils Report	N/A
17	Acknowledges Addenda	N/A
18	Hold Bid for 150 Days	Yes
Scope of Work:		
19	Provide all labor, materials, tools, equipment and appurtenances as required to perform the **Work Category - 11J Disc Filter**, in accordance with and reasonably inferable from the Contract Documents, complete and without exception unless otherwise noted below, including, but not limited to the following:	Yes
20	**Per Plans & Specifications:**	Yes
21	Division 1 General Requirements	Yes
22	01300 – Submittals	Yes
23	01640 – Materials and Equipment	Yes
24	01650 – Starting of Systems	Yes
25	01660 – Field Tests of Equipment	Yes
26	03252 - Anchorage in Concrete	Yes
27	05501 - Miscellaneous Metal Fabrications	Yes
28	11295 - Hydraulic Valves	Yes
29	11400 - Disc Filter System	Yes
30	13447 - Electric Motor Actuators	Yes
31	16161 - Control Panels	Yes
32	16225 - Electric Motors 250 Horsepower or Less	Yes
33	17454 - Operation and Control Description	Yes

Chandler Improvements Phase 3

Work Category: 11J - Disc Filter

WC Lead: Jennifer Lee

Bid Date: August 21, 2026

	TOTAL WORK CATEGORY PACKAGE VALUE	**$730,170**
34	Check to Spec completed and submitted to McCarthy	Yes
35	Includes all requirements from McCarthy Exhibits (as applicable)	Yes
36	Shipping shall be FOB jobsite	Yes
37	Lead time (wks):	
38	Submittals	8-10 weeks
39	Fabrication	16-22 weeks
40	Anchors and epoxy required for installation	Yes
41	**Scope per Specs and Drawings Including**	Yes
42	Furnish (1) Disc Filter System with Filter Backwash and Solids Wasting Assembly	Yes
43	Centertube Assembly with Cloth Media Discs, Drive Assembly, Influent Weir, Basin Mounting Brackets and Hardware, Electrical Controls and Internal Components	Yes
44	Backwash/Solids Waste Pump Assembly, Valves, Pressure Gauges, Float Switch, Vacuum Gauges and Transmitter, Vendor Control Panel	Yes
45	**Submittals per section 1.5**	Yes
46	Engineering Calculations: Seismic Structural, Anchor Bolt, VPP and VCP Enclosure Heat Loads	Yes
47	**Quality Assurance per section 1.6**	Yes
48	Minimum 5 years of documented experience	Yes
49	Minimum 15 similar sized reference installations in service	Yes
50	Anchor Bolts: 316 SS	Yes
51	Wetted Parts: 316 SS, FRP, or Polypropylene	Yes
52	Parts Above Water Line (support steel, platforms, handrails): Aluminum	Yes
53	**Manufacturers (section 2.2)**	Yes
54	Aqua-Aerobic, Five Star Filtration, or Approved Equal	Yes
55	**Design Criteria per section 2.3**	Yes
56	Capacity:	Yes
57	Average Daily Flow: 5.4 MGD	Yes
58	Peak Hourly Flow: 6.6 MGD	Yes
59	Filter Loading Rate:	Yes
60	Average Hydraulic Loading: 4.98 gpm/ft^2	Yes
61	Peak Hydraulic Loading: 6.1 gpm/ft^2	Yes
62	Maximum Headloss through Filter: 18 in	Yes
63	Maximum Total Suspended Solids: 20 mg/l	Yes
64	Average Total Suspended Solids: 10 mg/l	Yes
65	Effluent Characteristics Meeting Average Daily Limit Under:	Yes
66	State of Arizona Class A+ Reclaimed Water	Yes
67	24-Hour Composite Average Turbidity: 2 NTU or Less	Yes
68	Anytime Maximum Turbidity: 5 NTU	Yes
69	Total Suspended Solids: 5 milligrams per liter or less	Yes
70	**Design Requirements per section 2.3-B**	Yes
71	**Components of Cloth Media Filter per section 2.4**	Yes
72	Material	Yes
73	Stainless Steel: 316 SS	Yes
74	Welded Stainless Steel: 316L SS	Yes
75	Passivated after Welding (spec 05501)	Yes
76	Drive Assembly	Yes

Chandler Improvements Phase 3

Work Category: 11J - Disc Filter

WC Lead: Jennifer Lee

Bid Date: August 21, 2026

	TOTAL WORK CATEGORY PACKAGE VALUE	**$730,170**
77	Gearbox: Parallel in-line helical-type, AGMA Class I drive motor, 460/3/60	Yes
78	Power: 1 HP	Yes
79	Output Speed: 4.4 RPM	Yes
80	Drive Sprocket: Nylon	Yes
81	Chain: Acctal with 316 SS link pins	Yes
82	Chain Guard: 316L SS	Yes
83	Centertube Assembly	Yes
84	Center Tube Weldment: 316L, minimum 3/16" thick	No
85	Drive Sprocket: Nylon	No
86	Wheel Assemblies	Yes
87	Frame and Cloth Assemblies	Yes
88	Mounting Brackets and Hardware: 316 SS	Yes
89	Filter Cloth Disc Assemblies: 14	Yes
90	Effective Submerged Filtration Area (per cloth disc assembly): 53.8 ft^2	Yes
91	Cloths: Chlorine-resistant polyester (PES) fiber pile with polyester backing	Yes
92	Cloth Filtration Rating: 10 microns	Yes
93	Cloth Media Active Filter Depth: 3-5 millimeters	Yes
94	Influent Weir Box: 316 SS	Yes
95	Backwash/Solids Wasting Assembly	Yes
96	Backwash System Assembly	Yes
97	External Piping Assembly: Pressure Gauges, Vacuum Gauges and Transducers, Throttling Gate Valves, 3" Manual Ball Valves	Yes
98	(3) Backwash Pumps: Gorman Rupp G-R 12B20-B, or Approved Equal	Yes
99	2HP/460 V/3 Phase/ 60 Hz	Yes
100	RPM: 1,740 RPM	Yes
101	130 GPM at 23 ft total dynamic head	Yes
102	Backwash Valves and Sludge Valves: TCI/RCI, Nibco, or Equal	Yes
103	2" electric ball (backwash/Solids) Valves: 2 piece, flanged, ASTM A351 Grade CF8M SS, 115V/1 phase/60 Hz	Yes
104	Actuator: Include compartment heater and limit switch feedback to microprocessor	Yes
105	Throttling Gate Valves:Nibco T-113 Threaded, or Approved Equal	Yes
106	MSS SP-80, class 125, screw in bonnet, non-rising stem, solid wedge	Yes
107	Body/Bonnet/Wedge: Bronze ASTM B-62	Yes
108	Stem: Silicon Bronze ASTM B-371 Alloy C6940 or ASTM B99 Alloy C65100	Yes
109	Packing: Aramid Fibers with Graphite	Yes
110	Anchor Bolts: 316 SS	Yes
111	Piping (section 2.4-K)	Yes
112	Finishes (section 2.4-L)	Yes
113	**Vendor Power Panel (VPP) and Vendor Control Panel (VCP) per section 2.5**	Yes
114	VPP: 480 V/3 Phase/60 Hz, NEMA 4X SS Enclosure	Yes
115	Control Power Transformer (CPT): 480 V/120 V, 1 Phase	Yes
116	VCP: NEMA 4X SS Enclosure	Yes
117	Minimum Short Circuit Current: 10 kA	Yes
118	Programmable Logic Controller (PLC): Modicon M340, or Approved Equal	Yes

Chandler Improvements Phase 3

Work Category: 11J - Disc Filter

WC Lead: Jennifer Lee

Bid Date: August 21, 2026

	TOTAL WORK CATEGORY PACKAGE VALUE	**$730,170**
119	Operator Interface Terminal (OIT): Modicon Magelix HMIGTO5310, or Approved Equal	Yes
120	**Instrumentation per section 2.6**	Yes
121	(1) Pressure Based Level Transducer	Yes
122	(1) High Level Float	Yes
123	(2) Pressure Gauges	Yes
124	(2) Vacuum Gauge and Transducers	Yes
125	**Controls per section 2.7**	Yes
126	(6) Additional Spare Dry Contacts	Yes
127	Main Breaker, Disconnect, Fuse, Fuse Block, Starter	Yes
128	Engraved Nameplates	Yes
129	**Delivery and Storage per section 2.8**	Yes
130	**Spare Parts (section 2.9)**	Yes
131	(2) Filter Frame and Cloth Assemblies	Yes
132	(1) Backwash/Solids Waste Valve and Actuator	Yes
133	(1) Backwash Pump	Yes
134	(1) Viton V-ring Effluent Port/Center Tube Seal	Yes
135	(1) Each PLC I/O Module	Yes
136	(1) Each Fuse, Control Relay, Indicating Light Replacement Bulb	Yes
137	(1) Cloth Repair Kit	No
138	(1) Set Special Tools, if required	NA
139	**Fields Tests per section 3.2**	Yes
140	Conducted under Supervision of Manufacturer's Representative	Yes
141	**Manufacturer's Field Services (section 3.3)**	Yes
142	Sampling/Testing and Classifying Filter Effluent: 1 day, total time of eight hours	Yes
143	Installation: 2 days, total time of 16 hours (eight hours per day)	Yes
144	Startup Services/Operator Training/Testing and Sampling Filter Effluent: 3 days, total time of 24 hours (eight hours per day)	Yes
145	Textura Included (Total Under $2.2M add 0.22%, if total is Equal or More than $2.2M add $5,000)	Yes
146	Bond/CDI Cost	Yes



City of Chandler
WRF Improvements Phase 3
WC16A.1 – Electrical Long Lead Equipment

Solicitation Summary

Chandler Improvements Phase 3

Long Lead Procurement and Wilson Balance of Plant Proposal

Work Category: 16A.1 Electrical Long Lead Equipment

Subcontractor/Supplier Name	***Status***
Eaton	*Recommended*
Schneider Electric	*Bid Received*
ABB	*No Bid*
Seimens	*Declined*

Chandler Improvements Phase 3

Work Category: **16A.1 - Electrical Long Lead Equipment**

WC Lead: **Kyle Roman**

Bid Date: **August 21, 2026**

TOTAL WORK CATEGORY PACKAGE VALUE		**$3,683,275**
MCCARTHY SUBCONTRACT & FRONT END TERMS		
1	Compliant with McCarthy Front Ends	NA
2	Bid Submitted on McCarthy Bid Form	NA
3	Bid Bond Included with Bid	NA
4	Surety Company	NA
5	Surety AM Best Rating (Must be A- or Better)	NA
6	Bond/CDI Cost	Yes
7	Insurance Requirements Per Matrix	NA
8	GL Insurance Company Name	NA
9	GL Insurance Carrier AM Best Rating (Must be A- or Better)	NA
10	GL Insurance (GL - $10MM)	NA
11	E&O Network Security and Privacy Liability Insurance (CYB - $5MM)	NA
12	Pollution Insurance (POL - $10MM)	NA
13	Automobile Liability Insurance (AUTO - $1MM)	NA
14	Tier 1 Approved	NA
15	Tier 2 Approved	
16	Hold Bid for 150 Days	No
17	Estimated Tax Exempt Value of Total Bid	Approx. 60%
18		
Scope of Work:		
21	Provide all materials, equipment and appurtenances as required to perform the **Work Category 16A - Electrical Long Lead Equipment** in accordance with and reasonably inferable from the Contract Documents, complete and without exception unless otherwise noted below including, but not limited to, the following:	
22	Division 1 General Requirements	
23	Section 01300 - Submittals	Yes
24	Section 01640 - Materials and Equipment	Yes
25	Section 01650 - Starting of Systems	Yes
26	Section 01660 - Field Tests of Equipment	Yes
27	Section 01720 - Record Documents	Yes
28	Section 01821 - Instruction of Operations and Maintenance Personnel	Yes
29	Section 13300 - Metal Building Systems	No

Chandler Improvements Phase 3

Work Category: 16A.1 - Electrical Long Lead Equipment

WC Lead: Kyle Roman

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		$3,683,275
30	Section 16001 - Packaged Systems And Packaged Control Panels	Yes
31	Section 16010 - Electrical - Basic Requirements	Yes
32	Section 16050 - Basic Materials And Methods	Yes
33	Section 16123 - 600 Volt Class Cable	Yes
34	Section 16124 - Instrumentation Class Cable	Yes
35	Section 16160 - Enclosures	Yes
36	Section 16161 - Control Panels	Yes
37	Section 16195 - Electrical Identification	Yes
38	Section 16282 - Surge Protective Device	Yes
39	Section 16321 - Oil Filled Substation Transformers	Yes
40	Section 16341 - Medium Voltage Switches	Yes
41	Section 16343 - Medium Voltage Metal Clad Switchgear	Yes
42	Section 16430 - Customer Power Metering System	Yes
43	Section 16431 - Low Voltage Drawout Switchgear	Yes
44	Section 16440 - Disconnect Switches	Yes
45	Section 16461 - Transformers - Dry Type	Yes
46	Section 16470 - Panelboards	Yes
47	Section 16474 - Motor Control Equipment (Separately Mounted)	Yes
48	Section 16475 - Mini Power Centers	Yes
49	Section 16476 - Low Voltage Circuit Breakers	Yes
50	Section 16477 - 600 V Fuses	Yes
51	Section 16480 - Motor Controllers	Yes
52	Section 16481 - Motor Control Centers (MCC)	Yes
53	Section 16482 - Solid State Motor Controllers	Yes
54	Section 16485 - Variable Frequency Drives – Low Voltage	Yes
55	Section 16611 - Static Uninterruptible Power Supply	Yes
56	Section 16920 - Electrical Acceptance Testing	Yes
57	Section 16951 - Short Circuit, Coordination And Arc Flash Hazard Report	Yes

Chandler Improvements Phase 3

Work Category: 16A.1 - Electrical Long Lead Equipment

WC Lead: Kyle Roman

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		**$3,683,275**
58	**Scope Items:**	
59	**Medium Voltage Bucket - OWRF** (New Buss attachment hardware, all associated provisions and new circuit breaker bucket) 1200AF/150AT in existing SGR-120-001 as required in 16343 section 2.2 and indicated on the drawings	Yes
60	**Medium Voltage Bucket - OWRF** (New Circuit Breaker installed in existing spare bucket) 1200AF/150AT in existing SGR-120-002 as required in 16343 section 2.2 and indicated on the drawings	Yes
61	**Medium Voltage Fused Disconnect - OWRF** DSC-1AA-001 - 600A, 150E, 12,470V DSC-1AB-002 - 600A, 150E, 12,470V	Yes
62	**Main Electrical Switchgear - OWRF** 480V Main Switchgear SWGR-1AA & SWGR-1AB - 3000AT/3200AF(1AA), 4000AF/4000AT(tie), 3000AT/3200AF(1AB) as required in 16343 section 2.2 and indicated on the drawings	Yes
63	**Prefabricated Electrical Building - OWRF** SWGR-1AA & SWGR-1AB Electrical Building	No
64	**Prefabricated Electrical Building - OWRF** Anoxic MCC Electrical Building	No
65	**MCC's - OWRF** 600A, 480v, EFF-MCC-001/002 600A, 480v, ANX-MCC-001/002	Yes
66	**PDP's and Panelboards - OWRF** 225A, 480V, Panelboard PDP-001 225A, 480V, Panelboard PDP-639-001 150A, 208V/120V, Panelboard Panel LS 150A, 208V/120V Panelboard LP-P1 100A, 208v/120v 3ph, 4w, Panelboard LP-419-001	Yes
67	**Mini Power Center - OWRF** 100A, 208V/120V 3ph, 4w NEMA 4X - FS-MPC-100 30KVA 480V-208V/120V Transformer XMFR FS-MPC-100	Yes

Chandler Improvements Phase 3

Work Category: **16A.1 - Electrical Long Lead Equipment**

WC Lead: **Kyle Roman**

Bid Date: **August 21, 2026**

TOTAL WORK CATEGORY PACKAGE VALUE		**$3,683,275**
68	**XMFR's - OWRF** 45kVA 480V-208V/120V Transformer XFR-Panel LS 30kVA 480V-208V/120V Transformer XFMR T-POC 15KVA 480v-208V/120V Transformer XMFR TRF-419-001 2.5MVA 12.47KV-277/480 Transformer XMFR TRF-1AA-001 2.5MVA 12.47KV-277/480 Transformer XMFR TRF-1AB-002	Yes
69	**ATS - OWRF** 70a, 4w, 480v, NEMA 3R - ATS-PANEL LS 25a, 4w, 480v, NEMA 3R - ATS-E 40a, 4w, 480v, NEMA 3R - ATS-419-001	Yes
70	**Stand Alone VFD's - OWRF** SEC-MTR-VFD-300 (CLARIFIER 3 MCP), NEMA 4X Enclosure	Yes
71	**Bucket Retrofit VFD's - OWRF** IMLP-410-101-VFD (MCC-410-001) IMLP-410-201-VFD (MCC-410-001)	Yes
72	**Disconnects - OWRF** ACU-DSC-102 - 60A, 480V, NEMA 4X ACU-DSC-101 - 60A, 480V, NEMA 4X DSC-410-181 - 30A, 480v, NEMA 4X DSC-410-281 - 30A, 480v, NEMA 4X DSC-410-101 - 60A, 480V, NEMA 4X DSC-410-201 - 60A, 480V, NEMA 4X ANX-MLR-PMP-DSC-007 - 100A, 480v, NEMA 4X	Yes
73	**Bucket Retrofit Motor Starters - OWRF** MIX-410-181 (MCC-410-001) MIX-410-281 in (MCC-410-002)	Yes
74	**Disconnects - AWRF** DSF06-MTR-DSC-600 - 30A, 480v, NEMA 4X DSF06-BWP-DSC-601 - 30A, 480v, NEMA 4X DSF06-BWP-DSC-602 - 30A, 480v, NEMA 4X	Yes
75	**Mini Power Center - AWRF** 100A, 208V/120V 3ph, 4w NEMA 4X - FS-MPC-100 30KVA 480V-208V/120V Transformer XMFR FS-MPC-100	Yes
76	Arc Flash/Power Coordination Studies	Yes
77	FAT Test, Startup and Training	Yes
78	FOB Jobsite included	Yes
79	Extended Warantees (through 6/30/2030)	Yes

Chandler Improvements Phase 3

Work Category: **16A.1 - Electrical Long Lead Equipment**

WC Lead: **Kyle Roman**

Bid Date: **August 21, 2026**

TOTAL WORK CATEGORY PACKAGE VALUE		**$3,683,275**
80	Textura Included (Total Under $2.2M add 0.22%, if total is Equal or More than $2.2M add $5,000)	Yes
81	Bond/CDI Cost	Yes
82	Travel for Witness Testing & Production Verification(10 Trips)	Yes

	ASSUMPTIONS & CLARIFICATIONS:
1	Electrical gear procurement is by McCarthy. McCarthy requires two collaborative submittal review sessions with Engineer and Vendor to ensure expedited review cycles.
2	Damages associated with the direct electrical procurement scope will not be assessed assuming that McCarthy has not been negligent in the management of the scope
3	Pricing is based upon Eaton's suggestions discussed with Wilson Engineers on 06/10/2026 Teams call. Discussed in this meeting was Definition of Services to be provided by Eaton Field Services, Requirements and Proposed Arrangement of SWGR-1AA & 1-AB, Size of Tie Breakers throughout SLD, and Medium Voltage Transformers and Switches. Reference Document: [City of Chandler SWGR 1AA 1AB with Provisions.pdf] provided to Wilson Engineers via email on 6/16/26
4	Due to the nature of electrical long-lead equipment procurement, once orders are released to production they are non-cancelable and non-returnable, and all costs associated with such equipment shall remain the Owner’s responsibility. In addition, any major changes or additions to the electrical single line after initial design development may require revised equipment procurement, which can result in additional costs and extended lead times.
5	The Contractor's (McCarthy's) liability for damages arising out of the Direct Electrical Procurement Scope shall be limited to those damages resulting from the Contractor's negligence or other culpable acts or omissions in the management of such scope. The Limitations of Liability applicable to vendor delays associated with Work Categories 11E, 11H, 11I, 11J, and 16A.1 are contingent upon the extent of the Contractor's (McCarthy's) responsibility for the delay. For delays attributable to the Vendor, the Contractors liability shall be limited to 30% of the equipment value.
6	The pricing included in proposal is based upon the assumption that mutually acceptable contract terms will be reached with the selected electrical supplier. If the final negotiated terms materially differ from those assumed in establishing the proposal pricing, the Contractor (McCarthy) may, upon completion of such negotiations, submit a timely proposal for an adjustment to the proposal pricing. Any adjustment shall be subject to the Owner's review and written approval prior to becoming effective.
7	Cost for Programming or configuration of PLC and Electrical MLE and ANX Buildings is not included. Progamming cost covered under WC 16A in the Wilson Plant of Balance Scope.



City of Chandler
WRF Improvements Phase 3
Balance of Plant Work
Categories



City of Chandler
WRF Improvements Phase 3
WC 01A – General Requirements

Solicitation Summary
City of Chandler WRF Improvements Phase 3
Long Lead Procurement and Wilson Balance of Plant Proposal
Work Category: **01A.1 - General Requirements**

Subcontractor/Supplier Name	***Status***
McCarthy	*Recommended*

Chandler Phase 3

Work Category: 01A - General Requirements

WC Lead: Dominic McCarver

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		$1,366,558
Description		
1	Drinking Water/Cups/Hydration/Ice	Yes
2	Debris and Clean Up Both Sites	Yes
3	Owner Engineer Requirements	Yes
4	General Safety Support Requirements	Yes
5	CPM Schedule Progress Updates	Yes
6	Project Documentation and Photograph Requirements	Yes
7	Dust Control and SWPPP Requirements	Yes
8	Temporary Construction Access and Support	Yes
9	Temporary Construction Facilities	Yes

Chandler Phase 3

Work Category: 01A - General Requirements

WC Lead: Dominic McCarver

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE	**$1,366,558**

	ASSUMPTIONS & CLARIFICATIONS:
1	Monthly photos will be transmitted monthly via Procore using daily reports, and will not comply with specification 01380-1.1.B2. Quantity of photos required will depend on work performed that month and not in compliance with quantity provided in specification 01380-1.1.B.2.
2	As built documents to be captured using Procore drawing management system. Live access to as built documents will be made available to Engineer & Owner via Procore. Final As Built drawing turnover using Bluebeam session for final review. No hard copies of as built drawings will be maintained. Access to Procore to serve as monthly transmission of As Built documents. Additionally, no updates to Engineer CAD files will be completed with As Built deliverable.
3	For each unique piece of equipment, only one of the training sessions will be recorded.
4	Owner Engineer Requirements will include the following: office supplies, printer, appliances, desks, chairs, conference table, office furniture, TV, first-aid, and kitchen consummables. Engineer's trailer is NOT included. Owner to provide engineer's trailer and all associated hook-ups/maintenance or trailer.
5	The following are City of Chandler project costs and have not been included:
A.	Temporary/construction/startup use and permanent utility hookup and usage costs including power, sewer, reuse water, and chemicals.
B.	Building and Environmental Permits, MCDES and ADEQ permitting fees, plan review fees and impact costs.
C.	Special Inspection Fees.
D.	Furnishings, Fixtures, and Equipment (FFE) and design of FFE.
6	No costs have been carried for background checks for CMAR or trade partners as outlined in article 9 of the agreement. Based on previous projects no costs had been assessed for background checks.



City of Chandler

WRF Improvements Phase 3

WC 01B – MOPO Tie-Ins

Solicitation Summary

City of Chandler WRF Improvements Phase 3

Long Lead Procurement and Wilson Balance of Plant Proposal

Work Category: **01B - MOPOs Tie-Ins**

Subcontractor/Supplier Name	***Status***
McCarthy	*Recommended*

Chandler Phase 3

Work Category: 01B - MOPOs Tie-Ins

WC Lead: Dominic McCarver

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		**$720,296**
MCCARTHY SUBCONTRACT & FRONT END TERMS		
1	Compliant with McCarthy Front Ends	Yes
2	Bid Submitted on McCarthy Bid Form	NA
3	Bid Bond Included with Bid	NA
4	Surety Company	Traveler's Casualty
5	Surety AM Best Rating (Must be A- or Better)	A++
6	Bond/CDI Cost	No
7	Insurance Requirements Per Matrix	Yes
8	GL Insurance Company Name	Old Republic Insurance
9	GL Insurance Carrier AM Best Rating (Must be A- or Better)	A+
10	E&O Insurance (If Required by Front Ends)	Yes
11	Pollution Insurance (If Required by Front Ends)	Yes
12	Tier 1 Approved	Yes
13	Tier 2 Approved	Yes
14	OSHA Recordable Incident Rate (Current)	0.22
15	Includes Hoisting for Sub's Own Work Scope	Yes
16	Acknowledges Soils Report	Yes
17	Acknowledges Addenda	Yes
18	Hold Bid for 150 Days	Yes
Scope of Work:		
19	Per Plans & Specifications	
20	Division 1 as it relates to this scope of work	Yes
21	01012 Plant Operations During Construction	Yes
22	Provide all labor, materials, tools, equipment, and appurtenances as required to perform the Work Category 01B - Maintenance of Plant Operations, in accordance with and reasonably inferable from the Contract Documents, complete and without exception unless otherwise noted below, including, but not limited to the following:	Yes
23	**CMAR MOPO**	Yes
24	A-01 Influent Pump Station T-Lock Repair	Yes
25	Temporary ventilation	Yes
26	Hanging scaffolding	Yes
27	A-2 Parshall Flume Rehabilitation	Yes
28	Bypass pumping (with pump watch)	Yes
29	High pressure sewer plug rental	Yes

Chandler Phase 3

Work Category: 01B - MOPOs Tie-Ins

WC Lead: Dominic McCarver

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		$720,296
30	Road barricades	Yes
31	Light Plant	Yes
32	Temporary Ventilation	Yes
33	A-03 Installation of new FRP foul air piping in Headworks building	Yes
34	Temporary ventilation	Yes
35	A-04 Aeration Basins No. 5 & 6 new diffuser and piping installation	Yes
36	Hydrovacing services	Yes
37	Skid steer rental	Yes
38	Waste disposal after cleaning Basins 5 & 6	Yes
39	Labor & supplies to clean Basins 5 & 6	Yes
40	Temporary access & lighting for work	Yes
41	A-5 Secondary Clarifiers No. 1 - No. 4 mechanism Replacement	Yes
42	Hydrovacing services	Yes
43	Waste disposal after cleaning Secondary Clarifiers 1 - 4	Yes
44	Labor & supplies to clean Secondary Clarifiers 1 - 4	Yes
45	Labor and materials for temporary access into Secondary Clarifiers 1 - 4	Yes
46	A-6 Secondary Clarifiers No. 1 and No. 3 12-inch drain plug valve replacement	Yes
47	Inflatable plug rental to block flow to perform work	Yes
48	Diver to install plug for Secondary Clarifiers 1 & 3	Yes
49	A-8 Chemical feed loop	Yes
50	Bypass pumping (with pump watch)	Yes
51	Temporary piping materials	Yes
52	Labor to install temporary piping	Yes
53	Light Plant	Yes
54	O-1 MBR IMLR pump installation	Yes
55	Hydrovacing services	Yes
56	Waste disposal after cleaning Basins	Yes
57	Labor & supplies to clean Basins	Yes
58	Temporary access for work	Yes
59	Temporary ventilation	Yes
60	O-2 MLE IMLR pump No. 6	Yes
61	Hydrovacing services	Yes
62	Labor & supplies to clean Anoxic pit	Yes
63	Temporary access for work	Yes

Chandler Phase 3

Work Category: 01B - MOPOs Tie-Ins

WC Lead: Dominic McCarver

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		$720,296
64	Unistrut to aid in removal of core	Yes
65	O-3 Secondary Clarifier No. 3 mechanism replacement	Yes
66	Hydrovacing services	Yes
67	Inflatable plug rental to block flow to perform work	Yes
68	Labor & supplies to clean Secondary Clarifier 3	Yes
69	Labor to install inflatable plug	Yes
70	Labor and materials for temporary access into Secondary Clarifier 3	Yes
71	O-4 Effluent Pump Station beam repair	Yes
72	Coffer dam procurement	Yes
73	Labor to install coffer dam in wet well	Yes
74	anchor bolts to secure coffer dam in place	Yes
75	Crane rental to fly coffer dam in and out of wet well	Yes
76	Rolling scaffold to aid in performing work	Yes
77	Labor and materials for temporary access into wet well	Yes
78	AWRF/OWRF ELECTRICAL MOPOS	In WC 16A
79	Safety and Access equipment for work	Yes
80	Mobilization / demobilization included	Yes
81	Textura Included (Total Under $2.2M add 0.22%, if total is Equal or More than $2.2M add $5,000)	NA
82	Bond/CDI Cost	NA

Chandler Phase 3

Work Category: 01B - MOPOs Tie-Ins

WC Lead: Dominic McCarver

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE	$720,296

	ASSUMPTIONS & CLARIFICATIONS:
1	Costs carried in 01B are strictly costs that are needed to allow for isolation and work to safely take place. Performance of the work is carried in its respective WC.
2	A-02 - Parshall Flume Rehabilitation: Assuming 10MGD flow.
3	A-04 Aeration Basins: Both aeration basins will be down for the entire duration of work (10 months).
4	A-05 Secondary Clarifiers No. 1 - No. 4 mechanism replacement: it is assumed that any 2 of the clarifiers can be down at a time (no matter the time of year).
5	A-05 Secondary Clarifiers No. 1 - No. 4 mechanism replacement: Splitter box gates are assumed to be operational. No considerations made for back-up plugs.
6	A-05 Secondary Clarifiers No. 1 - No. 4 mechanism replacement: Existing RAS Valves for Clarifiers 2 &4 are assumed operational to prevent back flow. No considerations made for back-up plugs.
7	A-08 Chemical Feed Loop: Assuming shut-off valves on feed tanks are operational and will not leak.
8	O-01 MBR IMLR Pump Installation: Inlet gates are operational and will isolate the basin. No considerations for back-up plugs are included.
9	O-02 MLE IMLR Pump No. 7: All valves at headworks are assumed to be operation and will hold flow. Effluent gates at anoxic are operational and will hold flow. No considerations for back-up plugs are included.
10	O-02 MLE IMLR Pump No. 7: RAS Valves in the RAS Pump Station and the Anoxic gates are operational and will isolate the IMLR discharge basin. No considerations for back-up plugs are included.
11	O-03 – Secondary Clarifier Mechanism Replacement: Demoing Mechanism 2 months before installing mechanism for procurement scheduling reasons and to optimize craft labor on the project. Therefore clarifier will be unusable for six months.
12	O-04 Effluent Pump Station Beam Repairs: All valves at headworks are assumed to be operational and will hold flow. Effluent gates at anoxic are operational and will hold flow. No considerations for back-up plugs are included.
13	Seasonal Restrictions Assumed: None.



City of Chandler
WRF Improvements Phase 3
WC 01C – Quality Control Testing

Solicitation Summary
City of Chandler WRF Improvements Phase 3
Long Lead Procurement and Wilson Balance of Plant Proposal
Work Category: **01C - Quality Control**

Subcontractor/Supplier Name	***Status***
Ceterra Southwest LLC	*Recommended*
US Inspection and Consulting LLC	*Proposed*
Alpha Geotechnical and Materials Inc	*Proposed*
CMT Technical Services	*Declined*
QTO Solutions	*Declined*
Statewide Disinfection Services	*Declined*
Western Technologies	*Declined*
Field Verified Inc	*Declined*
Phoenix Testing & Inspection LLC	*Declined*

Chandler Phase 3

Work Category: 01C - Quality Control Testing

WC Lead: Dominic McCarver

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		$178,118
MCCARTHY SUBCONTRACT & FRONT END TERMS		
1	Compliant with McCarthy Front Ends	Yes
2	Bid Submitted on McCarthy Bid Form	Yes
3	Bid Bond Included with Bid	N/A
4	Surety Company	N/A
5	Surety AM Best Rating (Must be A- or Better)	N/A
6	Bond/CDI Cost	Yes
7	Insurance Requirements Per Matrix	Yes
8	GL Insurance Company Name	Travelers Property Casualty Co. of AZ
9	GL Insurance Carrier AM Best Rating (Must be A- or Better)	A++
10	E&O Insurance (If Required by Front Ends)	Admiral Insurance Company
11	Pollution Insurance (If Required by Front Ends)	Admiral Insurance Company
12	Tier 1 Approved	No
13	Tier 2 Approved	No
14	OSHA Recordable Incident Rate (Current)	1.01
15	Includes Hoisting for Sub's Own Work Scope	N/A
16	Acknowledges Soils Report	N/A
17	Acknowledges Addenda	Yes
18	Hold Bid for 150 Days	Yes
Scope of Work:		
20	Startup/testing records and reporting package	Yes
21	Cast in Place Concrete Testing	Yes
22	Soils Verification and Inspection	Yes
23	Structural Steel Special Inspections. (NOTE: 2 buildings)	Yes
24	Welding Inspection (Clarifier Mechanism QC)	Yes
25	Leak Testing existing Hydraulic Structures	No
26	Aeration basin field test (4 zones)	Yes
27	Bond/CDI Cost	Yes

ASSUMPTIONS & CLARIFICATIONS:	
1	McCarthy has removed the requirement to hydro-leak testing existing basins as a cost saving measure.



City of Chandler

WRF Improvements Phase 3

WC 01D – Surveying

Solicitation Summary
City of Chandler WRF Improvements Phase 3
Long Lead Procurement and Wilson Balance of Plant Proposal
Work Category: **01D - Surveying**

Subcontractor/Supplier Name	***Status***
Alta E&I Estimating	*Recommended*
Southwest Survey Solutions / S3 Arizona	*Proposed*
EPS Group	*Declined*
QTO Solutions	*Declined*
Vigilantex	*Declined*
D2 Surveying LLC	*Declined*
Holigraph VDC LLC	*Declined*
RNL Consultant	*Declined*

Chandler Phase 3

Work Category: 01D - Surveying

WC Lead: Dominic McCarver

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		$143,939
MCCARTHY SUBCONTRACT & FRONT END TERMS		
1	Compliant with McCarthy Front Ends	Yes
2	Bid Submitted on McCarthy Bid Form	NA
3	Bid Bond Included with Bid	No
4	Surety Company	CDI
5	Surety AM Best Rating (Must be A- or Better)	NA
6	Bond/CDI Cost	Yes
7	Insurance Requirements Per Matrix	Yes
8	GL Insurance Company Name	Travelers Indemnity Co of America
9	GL Insurance Carrier AM Best Rating (Must be A- or Better)	A++
10	E&O Insurance (If Required by Front Ends)	Yes
11	Pollution Insurance (If Required by Front Ends)	NA
12	Tier 1 Approved	NA
13	Tier 2 Approved	NA
14	OSHA Recordable Incident Rate (Current)	0.00
15	Includes Hoisting for Sub's Own Work Scope	NA
16	Acknowledges Soils Report	Yes
17	Acknowledges Addenda	Yes
18	Hold Bid for 150 Days	Yes
Scope of Work:		
19	**Per Plans & Specifications:**	
20	Division 1 General Requirements	Yes
21	Section 01050 Field Engineering, Surveying	Yes
22	AWRF - Layout control, horizontal / vertical control and staking (67 HRs)	Yes
23	AWRF - Existing conditions verification and tie-in verification (76 HRs)	Yes
24	AWRF - As-built survey, record data and closeout support (119 HRs)	Yes
25	AWRF - Removal of NHLW (-32 HRs)	Yes
26	OWRF - Layout control, horizontal / vertical control and staking (57 HRs)	Yes
27	OWRF - Existing conditions verification and tie-in verification (20 HRs)	Yes
28	OWRF - As-built survey, record data and closeout support (132 HRs)	Yes
29	OWRF - Survey for new SWGR electrical building (8 HRs)	Yes
30	OWRF - Survey for new ANX electrical building (8 HRs)	Yes
31	OWRF - Survey for new Duct banks	In WC 16A
32	AWRF - Survey for new Chemical trench location	In WC 02B

Chandler Phase 3

Work Category: 01D - Surveying

WC Lead: Dominic McCarver

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		$143,939
33	Both Sites - Any & all other new underground Civil structures	In WC 02B
34	Both Sites - Any & all other new underground Electrical structures	Yes
35	Textura Included (Total Under $2.2M add 0.22%, if total is Equal or More than $2.2M add $5,000)	Yes
36	Bond/CDI Cost	Yes

ASSUMPTIONS & CLARIFICATIONS:	
1	No as-builting of existing underground utilities is included in our survey cost. Surveying only covers as-builting new installations per the contract scope.



City of Chandler
WRF Improvements Phase 3
WC01F – Start-Up and Commissioning

Solicitation Summary

City of Chandler WRF Improvements Phase 3

Long Lead Procurement and Wilson Balance of Plant Proposal

Work Category: **01F - Start-Up and Commissioning**

Subcontractor/Supplier Name	***Status***
McCarthy	*Recommended*

Chandler Phase 3

Work Category: 01F - Start-Up & Commissioni

WC Lead: Dominic McCarver

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		$216,947
Description		
1	General start up and commissioning Plans and documentation	Yes
2	Training and Operation & Maintenance Validation	Yes
3	Clean Water Commisioning and Start up	Yes
4	HVAC start up and commissioning	Yes
5	Wilson Engineering Electrical Scope Start Up and Commissioning	Yes



City of Chandler

WRF Improvement Phase 3

WC 02A - Demolition

Solicitation Summary

Chandler Improvements Phase 3

Long Lead Procurement and Wilson Balance of Plant Proposal

Work Category: **02A - Demolition**

Subcontractor/Supplier Name	***Status***
Dickens Quality Demo	*Recommended*
EZARC Inc.	*Proposed*
Arizona Specialty Demo	*Declined*
August Building	*Declined*
Arrowmark LLC	*Declined*
ENG Systems	*Declined*
Freddy's Drywall LLC	*Declined*
OCM LLC	*Declined*

Chandler Improvements Phase 3

Work Category: 02A - Demolition

WC Lead: Dominic McCarver

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		$54,427
MCCARTHY SUBCONTRACT & FRONT END TERMS		
1	Compliant with McCarthy Front Ends	Yes
2	Bid Submitted on McCarthy Bid Form	Yes
3	Bid Bond Included with Bid	NA
4	Surety Company	Merchants Bonding
5	Surety AM Best Rating (Must be A- or Better)	A
6	Bond/CDI Cost	Yes
7	Insurance Requirements Per Matrix	Yes
8	GL Insurance Company Name	Homesite Insurance Company of Florida
9	GL Insurance Carrier AM Best Rating (Must be A- or Better)	A
10	E&O Insurance (If Required by Front Ends)	NA
11	Pollution Insurance (If Required by Front Ends)	Yes
12	Tier 1 Approved	Yes
13	Tier 2 Approved	NA
14	OSHA Recordable Incident Rate (Current)	1.00
15	Includes Hoisting for Sub's Own Work Scope	Yes
16	Acknowledges Soils Report	NA
17	Acknowledges Addenda	Yes
18	Hold Bid for 150 Days	Yes
Scope of Work:		
19	Provide all labor, materials, tools, equipment and appurtenances as required to perform the Work Category in accordance with and reasonably inferable from the Contract Documents, complete and without exception unless otherwise noted below, including, but not limited to the following:	Yes
20	**Per Plans & Specifications:**	
21	Division 1 General Requirements	Yes
22	Section 02050: Demolitions	Yes
23	Dispose of all removed materials and equipment per owners request	Yes
24	Items listed to be demolished shall be removed including all but not limited to:	Yes
25	OWRF - Demo of Housekeeping pad where VTP will sit	In WC 03A
26	OWRF - Demo of concrete pad in EFF Electrical Bldg	In WC 03A
27	OWRF - Demo of Electrical gear in EFF Electrical Bldg	In WC 16A
28	OWRF - Demo of HVAC system in EFF Electrical Bldg	In WC 15C
29	OWRF - Demo of Asphalt road near conveyor system	In WC 02B
30	OWRF - Demo of Conveyor system	Yes

Chandler Improvements Phase 3

Work Category: 02A - Demolition

WC Lead: Dominic McCarver

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		$54,427
31	OWRF - Demo of MBR Basin Diffusers, mixers and mixer rails	In WC 15A
32	OWRF - Demo of metal covers over MBR Basins	In WC 15A
33	AWRF - Demo of chemical trench	In WC 02B
34	AWRF - Demo of all chemical feed and return lines	In WC 15A
35	AWRF - Demo of chemical feed pumps	In WC 15A
36	AWRF - Demo of Clarifiers 1-3 and scum piping	In WC 15A
37	AWRF - Demo of Clarifier #4 and scum piping	In WC 15A
38	OWRF - Demo of Clarifier #3 and scum piping	In WC 15A
39	AWRF - Demo of A-Basin Diffuser system	In WC 15A
40	AWRF - Demo of Headworks grating	In WC 05A
41	AWRF - Demo of Headworks FRP pipe	In WC 15A
42	AWRF - Demo of curb at Fuel Storage Tank	In WC 02B
43	AWRF - Demo of Parshall Flume	In WC 02B
44	AWRF/OWRF - Demo of Clarifier Basin grout with scabbler	In WC 03A
45	AWRF/OWRF - Demo of Clarifier Trough grout with scabbler	In WC 03A
63	Both sites - Demo of stairs to clairifer (5 total, not including concrete landing)	Yes
64	AWRF - Demo of stairs at prestage basin #2.	Yes
46	Holding bid for 150 days	Yes
47	Haul off debris.	Yes
48	Provide dust control for building demolition scope of work	Yes
49	File NESHAP permit as needed for City & County requirements.	Yes
50	Protect existing owner property to remain, from demo as required.	Yes
51	Complete all demo work per drawings	Yes
52	Extra materials as required	Yes
53	Unloading and hoisting of own work	Yes
54	Subcontractor will perform work in phases in accordance with Exhibit E in the Front-End Documents	Yes
55	Shipping shall be FOB jobsite	Yes
56	Unloading & storage	Yes
57	Temporary protection & enclosure for the duration of the Scope Only	Yes
58	Textura Included (Total Under $2.2M add 0.22%, if total is Equal or More than $2.2M add $5,000)	Yes
59	Hazardous Materials Testing	Yes
60	Additional Mobilization	Yes
61	Bond/CDI Cost	Yes

Chandler Improvements Phase 3

Work Category: 02A - Demolition

WC Lead: Dominic McCarver

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE	$54,427

	ASSUMPTIONS & CLARIFICATIONS:
1	Hazardous waste removal including but not limited to asbestos, lead based products, substation demo materials, or plant waste is not included in this proposal.
2	This proposal includes trucking and disposal to a non-hazardous legally licensed landfill.



City of Chandler

WRF Improvements Phase 3

WC 02B – Earthwork & Yard Piping

Solicitation Summary

Chandler Improvements Phase 3

Long Lead Procurement and Wilson Balance of Plant Proposal

Work Category: **02B - Earthwork & Yard Piping**

Subcontractor/Supplier Name	***Status***
McCarthy Building Companies	*Recommended*

Chandler Phase 3

Work Category: 02B - Earthwork & Yard Pipe

WC Lead: Peyton Tucker

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		**$2,592,465**
MCCARTHY SUBCONTRACT & FRONT END TERMS		
1	Compliant with McCarthy Front Ends	Yes
2	Bid Submitted on McCarthy Bid Form	NA
3	Bid Bond Included with Bid	NA
4	Surety Company	NA
5	Surety AM Best Rating (Must be A- or Better)	NA
6	Bond/CDI Cost	Yes
7	Insurance Requirements Per Matrix	NA
8	GL Insurance Company Name	NA
9	GL Insurance Carrier AM Best Rating (Must be A- or Better)	NA
10	E&O Insurance (If Required by Front Ends)	NA
11	Pollution Insurance (If Required by Front Ends)	NA
12	Tier 1 Approved	NA
13	Tier 2 Approved	NA
14	OSHA Recordable Incident Rate (Current)	0.22
15	Includes Hoisting for Sub's Own Work Scope	Yes
16	Acknowledges Soils Report	Yes
17	Acknowledges Addenda	Yes
18	Hold Bid for 150 Days	Yes
19	Sales Tax Excluded for Non-Permanent Materials	Yes
Scope of Work:		
20	**Per Plans & Specifications:**	
21	Provide all labor, materials, tools, equipment and appurtenances as required to perform the Work Category in accordance with and reasonably inferable from the Contract Documents, complete and without exception unless otherwise noted below, including, but not limited to the following:	Yes
22	Division 1 General Requirements	Yes
23	Section 01414 - Earthmoving and Dust Control	Yes
24	Section 02050 - Demolitions	Yes
25	Section 02150 - Site Preperation	Yes
26	Section 02150 - Shoring	Yes
27	Section 02315 - Earthwork Excavation and Backfill	Yes

Chandler Phase 3

Work Category: 02B - Earthwork & Yard Pipe

WC Lead: Peyton Tucker

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		$2,592,465
28	Section 02319 - Rip Rap	Yes
29	Section 02371 - Filter Fabric for Rip Rap Channels	Yes
30	Section 15050 - Piping Systems	Yes
31	Section 15051 - Buried Piping	Yes
32	Section 15052 - Copper Pipe	Yes
33	Section 15053 - Thermoplastic Pipe and Accessories	Yes
34	Site Demo for Airport and Ocotillo Site	Yes
35	Subgrade Preperation and Placement of Aggregate for all Sitework at Airport and Ocotillo Site	Yes
36	General earthwork, excavation, backfill, subgrade prep, and localized exterior grading per civil/architectural/structural drawings. including, but not limited to the following:	Yes
37	Airport - Fuel Storage Tank	Yes
38	Airport - Site Pavement Excavations	Yes
39	Airport - Site Grading	Yes
40	Airport - Engineered Shoring for proposed Manhole 10	Yes
41	Ocotillo - Fuel Storage Tank	Yes
42	Ocotillo - Electrical Buildings	Yes
43	Ocotillo - Site Pavement Excavations	Yes
44	Ocotillo - Site Grading	Yes
45	General Yard Pipe, excavation, lay, bedding, and backfill per civil/architectural/structural drawings. including, but not limited to the following:	Yes
46	Drain Line (Excavate / Bed / Backfill)	Yes
47	Non-Potable Water Sprayer Line (Excavate / Bed / Backfill)	Yes
48	Non-Potable Water Sprayer Line (Excavate / Bed / Backfill)	Yes
49	Return Activated Sludge (Excavate / Bed / Backfill)	Yes
50	Scum (Excavate / Backfill)	Yes
51	Tank Drain (Excavate / Bed / Backfill)	Yes
52	Vent (Excavate / Backfill)	Yes
53	Precast Structures, excavation, set, and backfill per civil/architectural/structural drawings. including, but not limited to the following:	Yes
54	Manhole 10	Yes
55	Chemical Trench Sump Boxes	Yes
56	Miscellaneous items, including, but not limited to the following:	Yes
57	Open excavation protection around excavation	Yes
58	Dewatering of excavations for rain events	Yes

Chandler Phase 3

Work Category: 02B - Earthwork & Yard Pipe

WC Lead: Peyton Tucker

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		**$2,592,465**
59	Survey of own work	Yes
60	Haul off spoils	Yes
61	Extra materials as required	Yes
63	Textura Included	Yes
65	Bond/CDI Cost	Yes

Chandler Phase 3

Work Category: 02B - Earthwork & Yard Pipe

WC Lead: Peyton Tucker

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE	$2,592,465

	ASSUMPTIONS & CLARIFICATIONS:
1	Removal and Replacement of the existing rip rap east of the MLE Anoxic Basins has been included to match the existing limits for the area disturbed by the proposed Electrical Building earthwork.
2	Proposal includes beam & shotcrete shoring required for the Parshall Flume Demo/ MH 10. The north, east, and west sides of the shoring will be abandoned in-place 5' below finish grade. The south side of the shoring will be abandoned in-place full depth as it is adjacent to the Electrical Building and within the zone of influence.
3	Parshall Flume manhole base removal calls out an existing base slab for demo. Team is unable to verify the existing conditions. Demolition is priced as shown on the drawings. Any additional demolition will be at the owner's expense.
4	Replacement of Trees being removed at Electrical building on sheet C-23.05 of OWRF Drawing Set and at Manhole 10, has not been included.
5	Hard dig/rock excavation has not been included. Hard dig scenarios will be addressed with the project team to determine when the hard dig is established and begin to impact the project.
6	Pipe backfill material has been included per specification 02315-8. Full depth CLSM backfill as noted in General Notes on the plan sheets has not been included.
7	Civil detail 302 does not provide termination distance for trench drain lines. Bid includes 14 LF per location with a sump box.



City of Chandler

WRF Improvements Phase 3

WC 02C – Asphalt Paving

Solicitation Summary
Chandler Improvements Phase 3
Long Lead Procurement and Wilson Balance of Plant Proposal

Work Category: **02C - Asphalt Paving**

Subcontractor/Supplier Name	***Status***
L&L Asphalt	*Recommended*
Copper State Paving	*Proposed*
Alk Asphalt	*Proposed*
Cactus Asphalt	*Proposed*
Viasun	*Proposed*

Chandler Improvements Phase 3

Work Category: 02C - Asphalt Paving

WC Lead: Peyton Tucker

Bid Date: 8/21/2026

TOTAL WORK CATEGORY PACKAGE VALUE		**$166,249**
MCCARTHY SUBCONTRACT & FRONT END TERMS		
1	Compliant with McCarthy Front Ends	Yes
2	Bid Submitted on McCarthy Bid Form	Yes
3	Bid Bond Included with Bid	Yes
4	Surety Company	Paffenbarger & Walden
5	Surety AM Best Rating (Must be A- or Better)	A
6	Bond/CDI Cost	Yes
7	Insurance Requirements Per Matrix	Yes
8	GL Insurance Company Name	United Fire & Casualty
9	GL Insurance Carrier AM Best Rating (Must be A- or Better)	A-
10	E&O Insurance (If Required by Front Ends)	NA
11	Pollution Insurance (If Required by Front Ends)	NA
12	Tier 1 Approved	Yes
13	Tier 2 Approved	No
14	OSHA Recordable Incident Rate (Current)	0.84
15	Includes Hoisting for Sub's Own Work Scope	Yes
16	Acknowledges Soils Report	Yes
17	Acknowledges Addenda	Yes
18	Hold Bid for 150 Days	Yes
Scope of Work:		
20	Provide all labor, materials, tools, equipment and appurtenances as required to perform the Work Category 02C - Asphalt Paving, in accordance with and reasonably inferable from the Contract Documents, complete and without exception unless otherwise noted below, including, but not limited to the following:	Yes
21	**Per Plans & Specifications:**	Yes
22	Division 1 General Requirements	Yes
23	Section 02500: Asphalt Pavement	Yes
24	Section 02580: Pavement Markings	Yes
25	Check to Spec completed and submitted to McCarthy	Yes
26	Airport - 4" Asphalt Road Paving	Yes
27	Airport - 4" Asphalt Trench Patching	Yes
28	Airport - 4" Asphalt Road Paving	Yes
29	Slurry Seal	Yes
30	Additional Mobilizations	Yes
31	Placement of Aggregate Base Course	Yes

Chandler Improvements Phase 3

Work Category: 02C - Asphalt Paving

WC Lead: Peyton Tucker

Bid Date: 8/21/2026

TOTAL WORK CATEGORY PACKAGE VALUE		**$166,249**
32	Fine grading of surface coarse	Yes
33	Verification of subbase coarse	Yes
34	Textura Included (Total Under $2.2M add 0.22%, if total is Equal or More than $2.2M add $5,000)	Yes
35	Survey and Layout	Yes
36	Traffic Control	Yes
37	General Foreman Supervision	Yes
38	Bond/CDI Cost	Yes



City of Chandler

WRF Improvements Phase 3

WC 02D – Site Concrete

Solicitation Summary
Chandler Improvements Phase 3
Long Lead Procurement and Wilson Balance of Plant Proposal

Work Category: **02D - Site Concrete**

Subcontractor/Supplier Name	***Status***
Buesing Corp	*Recommended*
Alk Asphalt	*Proposed*
Keystone	*Proposed*
Viasun	*Proposed*

Chandler Improvements Phase 3

Work Category: 02D - Site Concrete

WC Lead: Peyton Tucker

Bid Date: 8/21/2026

TOTAL WORK CATEGORY PACKAGE VALUE		**$176,169**
MCCARTHY SUBCONTRACT & FRONT END TERMS		
1	Compliant with McCarthy Front Ends	Yes
2	Bid Submitted on McCarthy Bid Form	Yes
3	Bid Bond Included with Bid	Yes
4	Surety Company	Holmes Murphy
5	Surety AM Best Rating (Must be A- or Better)	A
6	Bond/CDI Cost	Yes
7	Insurance Requirements Per Matrix	Yes
8	GL Insurance Company Name	Navigators Insurance Company
9	GL Insurance Carrier AM Best Rating (Must be A- or Better)	A+
10	E&O Insurance (If Required by Front Ends)	NA
11	Pollution Insurance (If Required by Front Ends)	NA
12	Tier 1 Approved	Yes
13	Tier 2 Approved	No
14	OSHA Recordable Incident Rate (Current)	0.57
15	Includes Hoisting for Sub's Own Work Scope	Yes
16	Acknowledges Soils Report	Yes
17	Acknowledges Addenda	Yes
18	Hold Bid for 150 Days	Yes
Scope of Work:		
20	Provide all labor, materials, tools, equipment and appurtenances as required to perform the Work Category 02D - Site Concrete, in accordance with and reasonably inferable from the Contract Documents, complete and without exception unless otherwise noted below, including, but not limited to the following:	Yes
21	**Per Plans & Specifications:**	Yes
22	Division 1 General Requirements	Yes
23	Section 02751: Portland Cement Concrete Paving	Yes
24	Check to Spec completed and submitted to McCarthy	Yes
25	Airport - Curb & Gutter	Yes
26	Ocotillo - Curb & Gutter Replacement	Yes
27	Airport - Valley Gutter	Yes
28	Ocotillo - Sidewalk	Yes
29	Airport - Manhole/Valve Box Adjustment Collars	Yes
30	Ocotillo - Manhole/Valve Box Adjustment Collars	Yes
31	Airport - Bollard Bases	Yes

Chandler Improvements Phase 3

Work Category: 02D - Site Concrete

WC Lead: Peyton Tucker

Bid Date: 8/21/2026

TOTAL WORK CATEGORY PACKAGE VALUE		**$176,169**
32	Ocotillo - Bollard Bases	Yes
33	All ready-mix per structural Notes and Spec including all applicable admixtures as part of each mix	Yes
34	Reinforcment as required	Yes
35	Additional Mobilizations	Yes
36	Verification of subbase coarse	Yes
37	Textura Included (Total Under $2.2M add 0.22%, if total is Equal or More than $2.2M add $5,000)	Yes
38	Survey and Layout	Yes
39	Traffic Control	Yes
40	General Foreman Supervision	Yes
41	Bond/CDI Cost	Yes



City of Chandler

WRF Improvements Phase 3

WC 02E – Landscaping

Solicitation Summary
Chandler Improvements Phase 3
Long Lead Procurement and Wilson Balance of Plant Proposal

Work Category: **02E - Landscaping**

Subcontractor/Supplier Name	***Status***
OCM	*Recommended*
Gothic Landscape	*Proposed*
Sunburst Landscaping	*Proposed*
Brightview	*Proposed*

Chandler Improvements Phase 3

Work Category: 02E - Landscaping

WC Lead: Peyton Tucker

Bid Date: 8/21/2026

TOTAL WORK CATEGORY PACKAGE VALUE		**$105,751**
MCCARTHY SUBCONTRACT & FRONT END TERMS		
1	Compliant with McCarthy Front Ends	Yes
2	Bid Submitted on McCarthy Bid Form	Yes
3	Bid Bond Included with Bid	No
4	Surety Company	CDI
5	Surety AM Best Rating (Must be A- or Better)	NA
6	Bond/CDI Cost	Yes
7	Insurance Requirements Per Matrix	Yes
8	GL Insurance Company Name	Upland Specialty Insurance Company
9	GL Insurance Carrier AM Best Rating (Must be A- or Better)	A-
10	E&O Insurance (If Required by Front Ends)	NA
11	Pollution Insurance (If Required by Front Ends)	NA
12	Tier 1 Approved	Yes
13	Tier 2 Approved	No
14	OSHA Recordable Incident Rate (Current)	0.70
15	Includes Hoisting for Sub's Own Work Scope	Yes
16	Acknowledges Soils Report	Yes
17	Acknowledges Addenda	Yes
18	Hold Bid for 150 Days	Yes
Scope of Work:		
20	Provide all labor, materials, tools, equipment and appurtenances as required to perform the Work Category 02E - Landscaping, in accordance with and reasonably inferable from the Contract Documents, complete and without exception unless otherwise noted below, including, but not limited to the following:	Yes
21	**Per Plans & Specifications:**	Yes
22	Division 1 General Requirements	Yes
23	Section 02315: Earthwork Excavation and Backfill	Yes
24	Section 02318: Crushed Stone, Gravel and Decomposed Granite	Yes
25	Check to Spec completed and submitted to McCarthy	Yes
26	Airport - Decomposed Granite	Yes
27	Ocotillo - Decomposed Granite	Yes
28	Ocotillo - Retaining Wall	Yes
29	Samples of material	Yes
30	Cleanup of spilled material on asphalt and concrete a. Include sweeping of the asphalt, concrete, sidewalks, etc. Upon completion of this scope of work	Yes
31	Mobilizations	Yes

Chandler Improvements Phase 3

Work Category: 02E - Landscaping

WC Lead: Peyton Tucker

Bid Date: 8/21/2026

TOTAL WORK CATEGORY PACKAGE VALUE		$105,751
32	Cost to hold bid	Yes
33	Textura Included (Total Under $2.2M add 0.22%, if total is Equal or More than $2.2M add $5,000)	Yes
36	General Foreman Supervision	Yes
37	Bond/CDI Cost	Yes



City of Chandler

WRF Improvements Phase 3

WC 03A - Concrete

Solicitation Summary

Chandler Improvements Phase 3

Long Lead Procurement and Wilson Balance of Plant Proposal

Work Category: **03A - Concrete**

Subcontractor/Supplier Name	***Status***
McCarthy Building Companies	*Recommended*

Chandler Improvements Phase 3

Work Category: 03A - Concrete
WC Lead: David Gonzalez
Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		**$2,148,774**
MCCARTHY SUBCONTRACT & FRONT END TERMS		
1	Compliant with McCarthy Front Ends	Yes
2	Bid Submitted on McCarthy Bid Form	NA
3	Bid Bond Included with Bid	NA
4	Surety Company	NA
5	Surety AM Best Rating (Must be A- or Better)	NA
6	Bond/CDI Cost	Yes
7	Insurance Requirements Per Matrix	NA
8	GL Insurance Company Name	NA
9	GL Insurance Carrier AM Best Rating (Must be A- or Better)	NA
10	E&O Insurance (If Required by Front Ends)	NA
11	Pollution Insurance (If Required by Front Ends)	NA
12	Tier 1 Approved	NA
13	Tier 2 Approved	NA
14	OSHA Recordable Incident Rate (Current)	0.22
15	Includes Hoisting for Sub's Own Work Scope	Yes
16	Acknowledges Soils Report	Yes
17	Acknowledges Addenda	Yes
18	Hold Bid for 150 Days	Yes
Scope of Work:		
19	**Per Plans & Specifications:**	Yes
20	Division 1 General Requirements	Yes
21	03100 - Concrete Formwork	Yes
22	03200 - Concrete Reinforcement	Yes
23	03251 - Concrete Joints	Yes
24	03252 - Anchorage in Concrete	Yes
25	0300 - Cast-in-Place Concrete	Yes
26	03600 - Grout	Yes
27	Provide all labor, materials, tools, equipment and appurtenances as required to perform the Work Category - 03A Concrete, in accordance with and reasonably inferable from the Contract Documents, complete and without exception unless otherwise noted below, but not limited to the following:	Yes
28	Airport WRF	Yes
29	Aeration Basins	Yes
30	Form, place and finish 2'-10" x 1'-0" x 1'-6", and 3'-6" x 1'-0" x 7'-0" concrete pipe supports	Yes
31	Roughen existing bonding surface	Yes
32	Drill and epoxy #5 reinforcing bars at existing slab	Yes
33	Blower Building	Yes
34	Sawcut 1'-0" x 1'-0" x 1'-0" opening at existing slab	Yes

Chandler Improvements Phase 3

Work Category: 03A - Concrete
WC Lead: David Gonzalez
Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		$2,148,774
35	Prepare surface and pourback opening using structural grout	Yes
36	Chemical Improvements	Yes
37	Concrete and reinforcement repairs at existing Scrubber pad	Yes
38	Furnish and install precast polymer	Yes
39	Form, place and finish chemical trench	Yes
40	Disc Filters	Yes
41	Roughen existing bonding surfaces for Disc Filter No. 6 pad, and pump pads	Yes
42	Form, place and finish equipment pads	Yes
43	Fuel Storage Tank	Yes
44	Form, place and finish 1'-4" slab on grade with 10" x 6" curbs	Yes
45	Furnish and install 6" PVC waterstop at curbs	Yes
46	Furnish, place, and grout fill pipe bollards originating in the structural slab	Yes
47	Headworks	Yes
48	Grouting at all new penetrations	Yes
49	IPS	Yes
50	Set up working platform for safe and proper access	Yes
51	Concrete surface and reinforcement repairs at all openings that require T-Lock repairs	Yes
52	Furnish and install T-Lock at all openings	Yes
53	Overall Site	Yes
54	Form, place and finish slabs and concrete pipe supports at all buried RAS plugs	Yes
55	Form, place and finish slab and grout at Parshall Flume	Yes
56	Secondary Clarifiers	Yes
57	Roughen existing slab using scabbler, and removal of debris	Yes
58	Form, place, and finish new 2" grout topping at slabs at Secondary Clarifier No. 1, and 4	Yes
59	Roughen existing launder deck using scabbler, and removal of debris	Yes
60	Not used	N/A
61	Grout at scum line penetrations	Yes
62	Ocotillo	Yes
63	MBR Aeration Basins	Yes
64	Chip and sawcut beam pockets at existing walls	Yes
65	Drill and epoxy #4 dowels bars at existing walls	Yes
66	Set up 21'-0" tall shoring system for (2) elevated walkways	Yes
67	Form, place and finish elevated walkways	Yes
68	Roughen existing bonding surface for new concrete pipe supports	Yes
69	Drill and epoxy #5 dowels at existing slab	Yes
70	Form, place and finish (8) concrete pipe supports	Yes
71	Anoxic Basins	Yes
72	Roughen existing bonding surface	Yes
73	Drill and epoxy #5 dowels at existing elevated slab	Yes
74	Form, place and finish pipe support and equipment pad	Yes
75	Effluent Pump Station	Yes
76	Remove existing electrical pad	Yes
77	Fill and abandon existing conduit	Yes
78	Form, place and finish concrete pad at existing conduit	Yes
79	Chip, sawcut, and surface preparation at bottom of existing beam	Yes

Chandler Improvements Phase 3

Work Category: 03A - Concrete
WC Lead: David Gonzalez
Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		$2,148,774
80	Drill and epoxy #3 dowels at existing beam	Yes
81	Concrete and reinforcement repairs	Yes
82	Furnish and install QuakeWrap FRP	Yes
83	Switchgear and Anoxic Electrical Buildings	Yes
84	Form, place and finish slabs on grade and pads on grade	Yes
85	Form, place and finish housekeeping pads	Yes
86	Fuel Storage Tank	Yes
87	Form, place and finish 12" pit slab, 1'-4" slab on grade, and 10" x 6" curbs	Yes
88	Furnish and install 6" TPV waterstop at curbs	Yes
89	Furnish, place, and grout fill pipe bollards originating in the structural slab	Yes
90	Secondary Clarifiers	Yes
91	Form, place and finish 6" stair landing	Yes
92	Roughen existing slab using scabbler, and removal of debris	Yes
93	Form, place, and finish new 2" grout topping at slabs at Secondary Clarifier No. 3	Yes
94	Roughen existing launder deck using scabbler, and removal of debris	Yes
95	Not used	N/A
96	Grout at scum line penetration	Yes
97	Textura Included for T-Lock and SPiRe+ vendors	Yes
98	Bond/CDI Cost for T-Lock and SPiRe+ vendors	Yes

Chandler Improvements Phase 3

Work Category: 03A - Concrete
WC Lead: David Gonzalez
Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE	$2,148,774

	ASSUMPTIONS & CLARIFICATIONS:
1	All concrete mix designs include retarding admixture as necessary. Any changes to design will be additional cost.
2	Membrane cure at all non water bearing structures using spray can in lieu of power spray
3	SF 1.0, class D finish for non exposed wall surfaces and SF 2.0, class C finish for exposed wall surfaces (Reference ACI 301 & 317)
4	The bottom of elevated concrete deck surfaces will be SF 2.0. Class finishes do not apply.
5	Roughening of existing slab grout topping to achieve an 1/8” amplitude using a scabbler, and new 2” thick grout topping at Airport WRF Secondary Clarifier No.1, and 4
6	Not used
7	Rebar corrosion repairs at elevated beam at Ocotillo WRF EFF Electrical Building and access hatch openings at Airport WRF Influent Pump Station, including the application of one coat of Sika FerroGard 903, and two coats of Sikatop Seal 107-
8	Concrete repairs at elevated beam at Ocotillo WRF EFF Electrical Building and access hatch openings at Airport WRF Influent Pump Station, including the application of 1” of SikaTop 123 Plus
9	Repairs to existing manholes and any existing structures not called out on the drawings are not included in the project scope.
10	Not used



City of Chandler

WRF Improvements Phase 3

WC 03B – Concrete Reinforcement

Solicitation Summary

Chandler Improvements Phase 3

Long Lead Procurement and Wilson Balance of Plant Proposal

Work Category: **03B - Concrete Reinforcement**

Subcontractor/Supplier Name	***Status***
Nucor	*Recommended*
CMC	*Proposed*
Tyler Reinforcing	*Declined*
Endo Steel	*Declined*
Paradise Steel	*Declined*

Chandler Improvements Phase 3

Work Category: 03B - Concrete Reinforcement

WC Lead: David Gonzalez

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		**$126,436**
MCCARTHY SUBCONTRACT & FRONT END TERMS		
1	Compliant with McCarthy Front Ends	Yes
2	Bid Submitted on McCarthy Bid Form	Yes
3	Bid Bond Included with Bid	NA
4	Surety Company	CDI
5	Surety AM Best Rating (Must be A- or Better)	NA
6	Bond/CDI Cost	Yes
7	Insurance Requirements Per Matrix	Yes
8	GL Insurance Company Name	Zurich
9	GL Insurance Carrier AM Best Rating (Must be A- or Better)	A++
10	E&O Insurance (If Required by Front Ends)	NA
11	Pollution Insurance (If Required by Front Ends)	NA
12	Tier 1 Approved	Yes
13	Tier 2 Approved	No
14	OSHA Recordable Incident Rate (Current)	0.00
15	Includes Hoisting for Sub's Own Work Scope	NA
16	Acknowledges Soils Report	NA
17	Acknowledges Addenda	Yes
18	Hold Bid for 150 Days	Yes
Scope of Work:		
19	Per Plans & Specifications:	Yes
20	**Division 1 General Requirements**	Yes
21	03200 - Concrete Reinforcement	Yes
22	03251 - Concrete Joints	Yes
23	0300 - Cast-in-Place Concrete	Yes
24	Provide all labor, materials, tools, equipment and appurtenances as required to provide all Concrete Reinforcement, in accordance with and reasonably inferable from the Contract Documents, complete and without exception unless otherwise noted below, but not limited to the following:	Yes
25	Airport WRF	Yes
26	Aeration Basins	Yes
27	Concrete Pipe Supports	Yes
28	Large Concrete Pipe Supports	Yes
29	Chemical Improvements	Yes
30	271 LF of Chemical Trench per C-02.04 and Detail 5 in S-00.04	Yes

Chandler Improvements Phase 3

Work Category: 03B - Concrete Reinforcement

WC Lead: David Gonzalez

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		$126,436
31	RWF Blower Building	Yes
32	12" x 12" x 12" Pourback	Yes
33	Disc Filter No. 6	Yes
34	10" Concrete Pads	Yes
35	Fuel Storage Tanks	Yes
36	18" Slab on Grade per Addendum #1 C-01.05 & S-33.02	Yes
37	10" x 6" Curb per Addendum #1 C-01.05 & S-33.02	Yes
38	Overall Site	Yes
39	5' x 5' x 12" Thick Transmitter Concrete Pad - Assuming #5@12 EW T&B	Yes
40	12" Slab @ Parshall Flume per S-01.01	Yes
41	8" Slab @ Buried RAS Plug per Detail 104 in C-40.01	Yes
42	Concrete Pipe Support @ Buried RAS Plug	Yes
43	Grout @ Parshall Flume	Yes
44	Secondary Clarifier No. 2	Yes
45	4' x 4' x 8" Stair support pad per Vol 3 Detail 3 in S-00.04	Yes
46	Ocotillo WRF	Yes
47	A-Basins	Yes
48	24" Elevated Walkway	Yes
49	Concrete Pipe Supports	Yes
50	Anoxic Basins	Yes
51	2'-9" x 3'-0" x 1'-0" Pipe Support per Addendum #1, Detail 6 in S-20.02	Yes
52	4' x 4' x 6" Concrete Pad per Addendum #1 Detail 7 in S-20.02	Yes
53	Electrical	Yes
54	8" Slab @ Switchgear Building	Yes
55	Concrete Pads on Grade @ Switchgear Bldg	Yes
56	6" Housekeeping Pad @ Switchgear Bldg	Yes
57	8" Slab on Grade @ Anoxic MCC Bldg	Yes
58	Concrete Pads on Grade @ Anoxic MCC Bldg	Yes
59	6" Housekeeping Pad @ Anoxic MCC Bldg	Yes
60	Fuel Storage Tank	Yes
61	12" Pit Slab per Addendum #1 S-33.01 & S-33.02	Yes
62	18" Slab on Grade per Addendum #1 S-33.01 & S-33.02	Yes
63	10" x 6" Curb per Addendum #1 S-33.01 & S-33.02	Yes
64	Secondary Clarifiers	Yes

Chandler Improvements Phase 3

Work Category: 03B - Concrete Reinforcement

WC Lead: David Gonzalez

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		**$126,436**
65	6" Stair Landing	Yes
66	Hoisting & Handling of Steel Reinforcement Material	In WC03A
67	Supply and installation of acceptable spacers, standees, and chairs to meet required spacing	Yes
68	Textura Included (Total Under $2.2M add 0.22%, if total is Equal or More than $2.2M add $5,000)	Yes
69	Bond/CDI Cost	Yes



City of Chandler

WRF Improvements Phase 3

WC 05A – Misc Metals

Solicitation Summary

Chandler Improvements Phase 3

Long Lead Procurement and Wilson Balance of Plant Proposal

Work Category: **05A - Misc Metals**

Subcontractor/Supplier Name	***Status***
Resolute Performance Iron Inc.	*Recommended*
Loenbro LLC	*Proposed*
EZARC	*Proposed*
Southwest Metalsmiths, Inc.	*Declined*
Professional Piping Systems	*Declined*

Chandler Improvements Phase 3

Work Category: 05A - Misc Metals

WC Lead: Patrick Conlon

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE	**$372,427**

MCCARTHY SUBCONTRACT & FRONT END TERMS		
1	Compliant with McCarthy Front Ends	Yes
2	Bid Submitted on McCarthy Bid Form	Yes
3	Bid Bond Included with Bid	NA
4	Surety Company	Travelers Insurance
5	Surety AM Best Rating (Must be A- or Better)	A++
6	Bond/CDI Cost	0.520%
7	Insurance Requirements Per Matrix	Yes
8	GL Insurance Company Name	The Phoenix
9	GL Insurance Carrier AM Best Rating (Must be A- or Better)	A++
10	E&O Insurance (If Required by Front Ends)	NA
11	Pollution Insurance (If Required by Front Ends)	Yes
12	Tier 1 Approved	Yes
13	Tier 2 Approved	NA
14	OSHA Recordable Incident Rate (Current)	0.00
15	Includes Hoisting for Sub's Own Work Scope	Yes
16	Acknowledges Soils Report	NA
17	Acknowledges Addenda	Yes
18	Hold Bid for 150 Days	Yes
Scope of Work:		
19	Provide all labor, materials, tools, equipment and appurtenances as required to perform the Work Category in accordance with and reasonably inferable from the Contract Documents, complete and without exception unless otherwise noted below, including, but not limited to the following:	Yes
20	**Per Plans & Specifications:**	
21	Division 1 General Requirements	Yes
22	05120 Structural Steel	Yes
23	05500 Metal Fabrications	Yes
24	05501 Miscellaneous Metal Fabrications	Yes
25	05510 Metal Stairs	Yes
26	05522 Aluminum Railings	Yes
27	05532 Aluminum Grating and Checker Plate	Yes
28	**Miscellaneous Metal**	
29	**AWRF**	

Chandler Improvements Phase 3

Work Category: 05A - Misc Metals

WC Lead: Patrick Conlon

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		**$372,427**
30	Parshall Flume Manhole	
31	Supply equipment supports, hardware, and anchors for laser flowmeter	Yes
32	Installation (by McCarthy Craft)	Yes
33	Secondary Clarifiers #1,2,3,& 4:	
34	Supply access stairs associated with basin/clarifier work areas where shown	Yes
35	Supply aluminum guardrail needed for clarifier modifications	Yes
36	Installation	Yes
37	Disc Filter Basin #6:	
38	Furnish and install stainless steel maintenance access platform with stainless steel ladder and aluminum handrail system	Yes
39	Stainless steel hardware	Yes
40	316 Stainless steel weir plate	Yes
41	Installation (by McCarthy Craft)	Yes
42	Pre-Stage Basin No. 2:	
43	Metal access bridge with aluminum grating and guardrail	Yes
44	Metal access stairs with aluminum grating and guardrail	Yes
45	Installation	Yes
46	Headworks:	
47	Supply aluminum flush mounted angle (2"x2.5"x1/4")	Yes
48	Plant Sitework:	
49	Supply all Sch. 40 black steel bollards at fuel storage tank areas (Install in 03A)	Yes
50	**OWRF**	
51	MBR Bioreactor Basins:	
52	D-Ring anchor plates with appropriate embeds to allow fall protection attachment adjacent to each access hatch (x6)	Yes
53	Hoist socket for davit crane attachment with appropriate embeds(x2)	Yes
54	Installation (by McCarthy Craft)	Yes
55	Supply aluminum guardrail needed for clarifier modifications	Yes
56	Installation	Yes
57	All anchors, embeds, epoxy anchors, bolts, fasteners, plates, clips, shims, weld tabs, and incidental metals required for complete installation	Yes
58	Include all bolted and welded connections required to complete the scope.	Yes
59	Field verify dimensions, elevations, attachment points, and existing conditions prior to fabrication.	Yes
60	Steel primer to accommodate finish painting systems manufacturers' requirements.	Yes
61	3rd Party Welding Inspector	Yes
62	Adjacent areas protection as required when welding.	Yes

Chandler Improvements Phase 3

Work Category: 05A - Misc Metals

WC Lead: Patrick Conlon

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		$372,427
63	Hoisting and rigging for own scope of work.	Yes
64	Textura Included (Total Under $2.2M add 0.22%, if total is Equal or More than $2.2M add $5,000)	Yes
65	Bond/CDI Cost	Yes
66	McCarthy SP Install of Vendor Supplied Items	
67	Laser Flow Meter Supports Installation	Yes
68	Disc Filter Basin #6 Weir Installation	Yes
69	MBR D-Rings and Davit Sockets Installation	Yes
70	Rotate Influent Pump Station Hatches	Yes

ASSUMPTIONS & CLARIFICATIONS:	
1	Shop primed coatings carried under 05A as required.
2	Specialty coatings carried under 09C.
3	Per spec section 14610, 1.1B & 2.2A state to provide portable davit crane systems as shown on the drawings at the AWRF Disc Filter Basins. No items are shown on the drawings. Proposal only includes davit crane socket embedded into concrete.



City of Chandler

WRF Improvements Phase 3

WC 05C – Extruded Flat Panel Covers

Solicitation Summary

Chandler Improvements Phase 3

Long Lead Procurement and Wilson Balance of Plant Proposal

Work Category: **05C - Extruded Flat Panel Covers**

Subcontractor/Supplier Name	***Status***
Coombs Hopkins (CST) *CST purchased Conservatek	*Recommended*

Chandler Improvements Phase 3

Work Category: 05C - Extruded Flat Panel Covers

WC Lead: Jennifer Lee

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		**$290,506**
MCCARTHY SUBCONTRACT & FRONT END TERMS		
1	Compliant with McCarthy Front Ends	No
2	Bid Submitted on McCarthy Bid Form	Yes
3	Bid Bond Included with Bid	N/A
4	Surety Company	N/A
5	Surety AM Best Rating (Must be A- or Better)	N/A
6	Bond/CDI Cost	1.925%
7	Insurance Requirements Per Matrix	N/A
8	GL Insurance Company Name	N/A
9	GL Insurance Carrier AM Best Rating (Must be A- or Better)	N/A
10	E&O Insurance (If Required by Front Ends)	N/A
11	Pollution Insurance (If Required by Front Ends)	N/A
12	Tier 1 Approved	No
13	Tier 2 Approved	No
14	OSHA Recordable Incident Rate (Current)	0.00
15	Includes Hoisting for Sub's Own Work Scope	N/A
16	Acknowledges Soils Report	N/A
17	Acknowledges Addenda	N/A
18	Hold Bid for 150 Days	Yes
Scope of Work:		
19	**Per Plans & Specifications:**	
20	Provide all labor, materials, tools, equipment and appurtenances as required to perform the **Work Category - 05C Extruded Flat Panel Covers**, in accordance with and reasonably inferable from the Contract Documents, complete and without exception unless otherwise noted below, including, but not limited to the following:	Yes
21	Reflect Construction Schedule	Yes
22	Warranty - 1 year from Final Completion	Yes
23	**Scope per Specs Drawings Including:**	Yes
24	Furnish and install (4) flush mounted flat cover structures for MBR Basins 1 and 2, zone 8	Yes
25	**Submittals per section 1.2**	Yes
26	Calculations: Stamped by AZ PE	Yes
27	**Manufacturers (section 2.1)**	Yes
28	CST Industries, Conservatek Industries, or Approved Equal	Yes
29	**Construction per section 2.2**	Yes
30	Maximum weight: 150 lbs	Yes
31	Metal Components: Aluminum or 300 series stainless steel	Yes
32	**Manufacturer Experience per section 2.3**	Yes
33	**Materials (section 2.4)**	Yes

Chandler Improvements Phase 3

Work Category: 05C - Extruded Flat Panel Covers

WC Lead: Jennifer Lee

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		**$290,506**
34	Bolts and Fasteners: 2024-T4 or 7075-T73 aluminum, or series 300 stainless steel	Yes
35	Structural and Miscellaneous Shapes: Alloy 6061-T6, 6005A-T6, or 6063-T6	Yes
36	Gaskets: Neoprene (ASTM C864-90, resistant to ozone and shielded from UV light)	Yes
37	Sealant: Ozone/UV light resistant, Federal Specification TT-S-00230C	Yes
38	**Design Loads per section 2.5**	Yes
39	Deflections: L/240	Yes
40	Maximum Weight Access Hatches: 50 lbs	Yes
41	**Connections per section 2.6**	Yes
42	Allowable Shear Stress:	Yes
43	Series 300 Stainless Steel Fasteners: 20% of minimum tensile strength	Yes
44	6061-T6 Aluminum Fasteners: 11 ksi	Yes
45	7075-T73 Fasteners: 18 ksi	Yes
46	Subcontractor Site Visit	Yes
47	Mob/Demob: 2	Yes
48	Textura Included (Total Under $2.2M add 0.22%, if total is Equal or More than $2.2M add $5,000)	Yes
49	Bond/CDI Cost	Yes



City of Chandler

WRF Improvements Phase 3

WC 06B – FRP

Solicitation Summary

Chandler Improvements Phase 3

Long Lead Procurement and Wilson Balance of Plant Proposal

Work Category: **06B - FRP**

Subcontractor/Supplier Name	***Status***
Grating Pacific, Inc.	*Recommended*
Fibergrate Composite Structures	*Proposed*
American Grating, LLC	*Proposed*
Brown-Campbell Co.	*Declined*
Loenbro LLC	*Declined*

Chandler Improvements Phase 3

Work Category: 06B - FRP

WC Lead: Patrick Conlon

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		**$193,972**
MCCARTHY SUBCONTRACT & FRONT END TERMS		
1	Compliant with McCarthy Front Ends	Yes
2	Bid Submitted on McCarthy Bid Form	Yes
3	Bid Bond Included with Bid	NA
4	Surety Company	CDI
5	Surety AM Best Rating (Must be A- or Better)	NA
6	Bond/CDI Cost	Yes
7	Insurance Requirements Per Matrix	Yes
8	GL Insurance Company Name	Travelers
9	GL Insurance Carrier AM Best Rating (Must be A- or Better)	A++
10	E&O Insurance (If Required by Front Ends)	NA
11	Pollution Insurance (If Required by Front Ends)	Yes
12	Tier 1 Approved	Yes
13	Tier 2 Approved	NA
14	OSHA Recordable Incident Rate (Current)	NA
15	Includes Hoisting for Sub's Own Work Scope	NA
16	Acknowledges Soils Report	NA
17	Acknowledges Addenda	Yes
18	Hold Bid for 150 Days	Yes
Scope of Work:		
19	**Per Plans & Specifications:**	
20	Division 1 General Requirements	Yes
21	06611 - Fiberglass Reinforced Plastic Fabrications	Yes
22	FRP Grating systems at AWRF:	
23	Headworks Building Platform	Yes
24	Disc Filter No. 6 Maintenance Access Platform	Yes
25	Aluminum cover side plates for valve openings	Yes
26	Furnish all FRP grating and related accessories, including clips, bolts, washers, hold-downs, anchors, embeds, epoxy, and FRP-to-concrete fasteners.	Yes
27	Verification of bearing seat dimensions and hold-down clip requirements	Yes
28	Domestic fabrication	Yes
29	Shipping shall be FOB jobsite	Yes
30	Spare resin and repair materials	Yes

Chandler Improvements Phase 3

Work Category: 06B - FRP

WC Lead: Patrick Conlon

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		**$193,972**
31	Lead time	12-14 weeks
32	Samples	Yes
33	Textura Included (Total Under $2.2M add 0.22%, if total is Equal or More than $2.2M add $5,000)	Yes
34	Bond/CDI Cost	Yes
35	Installation of FRP grating by McCarthy Craft	Yes

	ASSUMPTIONS & CLARIFICATIONS:
1	Existing Headworks grating beams and columns are assumed to be adequate to support the new grating; no structural rehabilitation is included.



City of Chandler

WRF Improvements Phase 3

WC 09C – Paintings/Coatings Industrial

Solicitation Summary

Chandler Improvements Phase 3

Long Lead Procurement and Wilson Balance of Plant Proposal

Work Category: **09C - Painting/Coatings Industrial**

Subcontractor/Supplier Name	***Status***
Professional Piping Systems, LLC	*Recommended*
Loenbro LLC	*Proposed*
Penington Painting Company	*Proposed*
L&M Painting	*Proposed*
Envision Painting & Roofing	*Declined*

Chandler Improvements Phase 3

Work Category: 09C - Paintings/Coatings Ind

WC Lead: Patrick Conlon

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE	**$258,615**

MCCARTHY SUBCONTRACT & FRONT END TERMS		
1	Compliant with McCarthy Front Ends	Yes
2	Bid Submitted on McCarthy Bid Form	Yes
3	Bid Bond Included with Bid	NA
4	Surety Company	CDI
5	Surety AM Best Rating (Must be A- or Better)	A
6	Bond/CDI Cost	Yes
7	Insurance Requirements Per Matrix	Yes
8	GL Insurance Company Name	Zurich American
9	GL Insurance Carrier AM Best Rating (Must be A- or Better)	A+
10	E&O Insurance (If Required by Front Ends)	Yes
11	Pollution Insurance (If Required by Front Ends)	Yes
12	Tier 1 Approved	Yes
13	Tier 2 Approved	NA
14	OSHA Recordable Incident Rate (Current)	0.68
15	Includes Hoisting for Sub's Own Work Scope	Yes
16	Acknowledges Soils Report	NA
17	Acknowledges Addenda	Yes
18	Hold Bid for 150 Days	Yes
Scope of Work:		
19	Provide all labor, materials, tools, equipment and appurtenances as required to perform the Work Category - 09 Paintings / Coatings Industrial, in accordance with and reasonably inferable from the Contract Documents, complete and without exception unless otherwise noted below, including, but not limited to the following:	Yes
20	**Per Plans & Specifications:**	
21	Division 1 General Requirements	Yes
22	09900 - Painting	Yes
23	09920 - Coating Systems	Yes
24	Furnish and install of a fully functional painting & coating system. Scope shall be complete and without exception unless noted below.	Yes
25	Protect adjacent surfaces from paint and damage. Repair damage resulting from inadequate or unsuitable protection.	Yes
26	Painting/coating materials shall be formulated for environments encountered in water and wastewater treatment processes	Yes
27	Provide cleaning solvents for surface preparation	Yes

Chandler Improvements Phase 3

Work Category: 09C - Paintings/Coatings Ind

WC Lead: Patrick Conlon

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		**$258,615**
28	Material and equipment handling for large area coatings required for clarifier walkways/platforms	Yes
29	3rd Party NACE Inspection	Yes
30	Provide painting for all new exposed and/or submerged piping with corrosion resistant labeling including but not limited to:	
31	Air Piping	Yes
32	Non-potable water lines	Yes
33	Potable water lines	Yes
34	Sample Piping	Yes
35	IMLR Piping	Yes
36	Odor Control	Yes
37	Backwash Washwater	Yes
38	Tank Drain / Sump Drain	Yes
39	Sodium Hypochlorite	Yes
40	Sodium Hydroxide	Yes
41	Provide painting for factory primed equipment items including but not limited to:	
42	All New Secondary Clarifier Walkways with associated handrail at AWRF & OWRF	Yes
43	All New Secondary Clarifier Drive Platforms at AWRF & OWRF	Yes
44	Provide painting for all new site bollards on AWRF & OWRF	Yes
45	Paint new hollow metal doors & frames	Yes
46	High-Performance Coatings:	
47	**AWRF**	Yes
48	Parshall Flume Manhole	
49	Provide coating to exposed concrete fill surface w/ polymer modified resin w/ non-slip finish	Yes
50	Spark testing	Yes
51	**OWRF**	
52	Anoxic MCC Eletrical Room	
53	Furnish and install concrete sealer flooring system	Yes
54	Provide final coating to primed exposed structural steel	Yes
55	Switchgear Electrical Room	
56	Furnish and install concrete sealer flooring system	Yes
57	Provide final coating to primed exposed structural steel	Yes
58	Include final touch up for painting and coatings	Yes
59	Unloading and storage	Yes
60	Mock ups for scope of work	Yes

Chandler Improvements Phase 3

Work Category: 09C - Paintings/Coatings Ind

WC Lead: Patrick Conlon

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		$258,615
61	Spare touch-up materials	Yes
62	Hoisting and rigging for your scope of work	Yes
63	Subcontractor responsible for access to work area	Yes
64	AWRF Emergency Fuel Storage Painting scope removal	Yes
65	OWRF Emergency Fuel Storage Painting scope removal	Yes
66	Textura Included (Total Under $2.2M add 0.22%, if total is Equal or More than $2.2M add $5,000)	Yes
67	Bond/CDI Cost	Yes

ASSUMPTIONS & CLARIFICATIONS:	
1	Excludes coating of factory-finished equipment, process pumps, process equipment motors, hydraulic valves, fuel storage tanks, and appurtenances; proposal includes touch-up only unless noted otherwise.



City of Chandler

WRF Improvements Phase 3

WC 11A – Chemical Feed Pumps

Solicitation Summary

Chandler Improvements Phase 3

Long Lead Procurement and Wilson Balance of Plant Proposal

Work Category: **11A - Magnetic Drive Sealless End Suction Pumps**

Subcontractor/Supplier Name	***Status***
Harrington (Finish Thompson)	*Recommended*
Pheonix Pumps (March)	*Proposed*
Misco (Lutz Jesco)	*Proposed*
Pioneer Equipment (Flowserve)	*Proposed*
JCH (ANSIMAG)	*No Bid*

Chandler Improvements Phase 3

Work Category: 11A - Magnetic Drive Sealless End Suction Pumps

WC Lead: Jennifer Lee

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		**$149,253**
MCCARTHY SUBCONTRACT & FRONT END TERMS		
1	Compliant with McCarthy Front Ends	Yes
2	Bid Submitted on McCarthy Bid Form	Yes
3	Bid Bond Included with Bid	N/A
4	Surety Company	N/A
5	Surety AM Best Rating (Must be A- or Better)	N/A
6	Bond/CDI Cost	1.925%
7	Insurance Requirements Per Matrix	N/A
8	GL Insurance Company Name	N/A
9	GL Insurance Carrier AM Best Rating (Must be A- or Better)	N/A
10	E&O Insurance (If Required by Front Ends)	N/A
11	Pollution Insurance (If Required by Front Ends)	N/A
12	Tier 1 Approved	No
13	Tier 2 Approved	No
14	OSHA Recordable Incident Rate (Current)	N/A
15	Includes Hoisting for Sub's Own Work Scope	N/A
16	Acknowledges Soils Report	N/A
17	Acknowledges Addenda	Yes
18	Hold Bid for 150 Days	Yes
Scope of Work:		
19	**Per Plans & Specifications:**	
20	Provide all labor, materials, tools, equipment and appurtenances as required to perform the **Work Category - 11A Magnetic Drive Sealless End Suction Pumps**, in accordance with and reasonably inferable from the Contract Documents, complete and without exception unless otherwise noted below, including, but not limited to the following:	Yes
21	Division 1 General Requirements	Yes
22	11218 - Magnetic Drive Sealless End Suction Pumps and Appurtenances	Yes
23	Check to Spec completed and submitted to McCarthy	Yes
24	Warranty - 1 year from final completion	Yes
25	Shipping shall be FOB jobsite	Yes
26	Lead time (wks):	
27	Submittals	1 week
28	Fabrication	3 weeks
29	Anchors and epoxy required for installation	Yes
30	**Scope per Specs Drawings Including:**	
31	Furnish (6) magnetic drive sealless end suction pumps with separate motor	Yes
32	Include any required grease and oil for initial installation	Yes
33	**Quality Assurance per section 1.2**	Yes

Chandler Improvements Phase 3

Work Category: 11A - Magnetic Drive Sealless End Suction Pumps

WC Lead: Jennifer Lee

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		**$149,253**
34	Manufacturer's Qualifications: Minimum 5 years experience producing similar equipment	Yes
35	Shop testing witnessed by Registered Professional Engineer	Yes
36	Provide Certificate of Unit Responsibility	Yes
37	**Submittals per section 1.3**	Yes
38	Calculations: Anchorage	Yes
39	**Ambient Conditions per section 1.4**	Yes
40	**Service Conditions per section 2.1**	
41	Close coupled, end suction, side discharge (rotated 90 degrees) back pullout design	See Clarifications
42	NaOH Service: Quantity 3	Yes
43	Chemical Concentration: 25%	Yes
44	Specific Gravity (68° F): 1.25	Yes
45	NaOCL Service: Quantity 3	Yes
46	Chemical Concentration: 15%	Yes
47	Specific Gravity (68° F): 1.2	Yes
48	Liquid Temperature Range: 40-120° F	See Clarifications
49	Design Flow: 20 gpm	Yes
50	Design Discharge Head: 38 ft	Yes
51	Minimum Flow at Second Design Point: 25 gpm	Yes
52	Minimum Head at Second Design Point: 36 ft	Yes
53	Shutoff Head: 45 ft	See Clarifications
54	Maximum Pump Speed: 3450 RPM	See Clarifications
55	Efficiency at Design: 55%	See Clarifications
56	Motor Horsepower: 0.3 HP	See Clarifications
57	Motor Volts/Phase/Hertz: 208v/3/60Hz	Yes
58	Seal Type: NaOH-EPDM; NaOCL-FKM	See Clarifications
59	Chemical Feed Pump System Curves per section 2.1-B	See Clarifications
60	Backpressure for Loop: 10-15 psi +/-5	Yes
61	**Manufacturers (section 2.1 C)**	
62	Finish Thompson, March, or Approved Equal	Yes
63	**Details of Construction per section 2.2**	Yes
64	Dimension Standards: ASME Specification B 73.3	Yes
65	Dimensionally interchangeable with standard sealed ASME pump of the same size designation	Yes
66	Pump Materials of Construction (Section 2.2 B)	
67	Outer Magnet Carrier: Carbon steel	Yes
68	Magnet Attachment to Outer Magnet Carrier: High temperature epoxy	Yes
69	Magnet Cover: Stainless steel cup	See Clarifications
70	Magnets: Rare earth, made of Neodymium Iron Boron, designed for zero slippage for full range of operation	Yes
71	Containment Shell: Nonmetallic material, maximum operating pressure 75 psi	Yes
72	Liquid Gap: Minimum 0.045 inch side or 0.09 inch diametral clearance	Yes
73	Containment Shell Attachment to Rear Casing Cover: SS cap screws	Yes
74	Inner Bearings: Product lubricated	Yes
75	Impeller: Enclosed design	Yes

Chandler Improvements Phase 3

Work Category: 11A - Magnetic Drive Sealless End Suction Pumps

WC Lead: Jennifer Lee

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		**$149,253**
76	Construction: Non-rotating, minimum 1-1/4 inch diameter, minimum 1/16 inch groove along length of shaft or bypass channels for passage of solids	Yes
77	Material: Non-metallic, suitable for intended service	Yes
78	Mouth Ring: Silicon carbide fiber reinforced, removable and replaceable	Yes
79	Casing: Minimum 150 lb ANSI flanges, casing and lining material suitable for intended service	Yes
80	Includes drain and removable silicon carbide thrust ring pressfit into casing	Yes
81	Bedplate: FRP composite or Type 316 SS	Yes
82	Hardware: Molded-in 316 stainless steel	Yes
83	Motors per section 2.2 C and specification 16225	Yes
84	NEMA frame, TEFC, severe duty, horizontal	Yes
85	Minimum Service Factor: 1.15	Yes
86	Insulation: Class B	Yes
87	Windings: Coppers	Yes
88	Rating: NEMA standard MG 1, paragraph 10.35	Yes
89	Enclosures: Totally enclosed fan cooled or totally enclosed non-ventilated	Yes
90	**Tools, Spare Parts, and Maintenance Materials (section 2.5)**	
91	Sparts Parts furnished for Each Pump:	Yes
92	(1) recommended spare parts kit	Yes
93	(1) set of special tools for maintenance or operations	N/A
94	**Surface Preparation and Shop Painting per section 2.6**	See Clarifications
95	**Field Services (section 3.4)**	
96	Installation/Startup/Training Services: Total 3 trips	Yes
97	Textura Included (Total Under $2.2M add 0.22%, if total is Equal or More than $2.2M add $5,000)	Yes
98	Bond/CDI Cost	Yes

Chandler Improvements Phase 3

Work Category: 11A - Magnetic Drive Sealless End Suction Pumps

WC Lead: Jennifer Lee

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE	$149,253

	ASSUMPTIONS & CLARIFICATIONS:
1	Deviations from specifications and provide a pump not compliant with ANSI.
2	Specification 11218 1.4 Motors are suitable for operation in a 40°C ambient temperature.
3	Specification 11218 2.1-B Pumps shall have a vertical discharge.
4	Specification 11218 2.1-B Pumps are suitable for a liquid temperature range of 40-104 °F.
5	Specification 11218 2.1-B Shutoff Head is 41 ft.
6	Specification 11218 2.1-B Efficiency is 37%.
7	Specification 11218 2.1-B Motors are 1 HP with FEP seals.
8	Specification 11218 2.1-B Finish Thompson takes exception to the Fluid Level System Curve and proposes their standard UCR1516 which operates per the flow curve provided.
9	Specification 11218 2.2-B-4 Outer drive magnets shall be nickel plated and do not utilize a stainless steel cup to cover them.
10	Specification 11218 2.6 Pumps include manufacturers standard PPG epoxy primer and polyurethane coating.



City of Chandler

WRF Improvements Phase 3

WC 11G – Low Flow Propeller (IMLR) Pumps

Solicitation Summary

Chandler Improvements Phase 3

Long Lead Procurement and Wilson Balance of Plant Proposal

Work Category: **11G - Low Flow Propeller (IMLR) Pumps**

Subcontractor/Supplier Name	***Status***
JCH (Flygt)	*Recommended*
Phoenix Pumps (Grundfos)	*Not Compliant*

Chandler Improvements Phase 3

Work Category: 11G - Low-Flow Propeller (IMLR) Pumps

WC Lead: Jennifer Lee

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		**$401,101**
MCCARTHY SUBCONTRACT & FRONT END TERMS		
1	Compliant with McCarthy Front Ends	Yes
2	Bid Submitted on McCarthy Bid Form	Yes
3	Bid Bond Included with Bid	NA
4	Surety Company	NA
5	Surety AM Best Rating (Must be A- or Better)	NA
6	Bond/CDI Cost	1.925%
7	Insurance Requirements Per Matrix	NA
8	GL Insurance Company Name	NA
9	GL Insurance Carrier AM Best Rating (Must be A- or Better)	NA
10	E&O Insurance (If Required by Front Ends)	NA
11	Pollution Insurance (If Required by Front Ends)	NA
12	Tier 1 Approved	No
13	Tier 2 Approved	No
14	OSHA Recordable Incident Rate (Current)	NA
15	Includes Hoisting for Sub's Own Work Scope	NA
16	Acknowledges Soils Report	NA
17	Acknowledges Addenda	NA
18	Hold Bid for 150 Days	Yes
Scope of Work:		
19	**Per Plans & Specifications:**	Yes
20	Provide all labor, materials, tools, equipment and appurtenances as required to perform the **Work Category - 15A Low-Flow Propeller (IMLR) Pumps**, in accordance with and reasonably inferable from the Contract Documents, complete and without exception unless otherwise noted below, including, but not limited to the following:	Yes
21	Division 1 General Requirements	Yes
22	01300 – Submittals	Yes
23	01640 – Materials and Equipment	Yes
24	01650 – Starting of Systems	Yes
25	11313 - Low-Flow Propeller (IMLR) Pumps	Yes
26	Check to Spec completed and submitted to McCarthy	Yes
27	Includes all requirements from McCarthy Exhibits (as applicable)	Yes
28	Warranty - 1 year from Final Completion	Yes
29	Shipping shall be FOB jobsite	Yes
30	Lead time (wks):	
31	Submittals	1-2 weeks
32	Fabrication	12-14 weeks
33	Anchors and epoxy required for installation	N/A

Chandler Improvements Phase 3

Work Category: 11G - Low-Flow Propeller (IMLR) Pumps

WC Lead: Jennifer Lee

Bid Date: August 21, 2026

	TOTAL WORK CATEGORY PACKAGE VALUE	**$401,101**
34	**Scope per Specs Drawings Including:**	Yes
35	Furnish (3) low flow propeller (IMLR) pumps (2 duty, 1 spare) with appurtenances	Yes
36	**Submittals per section 1.4**	Yes
37	AZ PE Stamped: Certified Drawings and Calculations	Yes
38	**Manufacturers (section 2.2)**	Yes
39	ITT Flygt, Grundfos, or Approved Equal	Yes
40	**Design Criteria (section 2.3)**	Yes
41	Flow: 11,389 gpm	Yes
42	Total Dynamic Head: 3.4 ft	Yes
43	Pump Curve Operating Points (Flow at Head):	Yes
44	5,700 gpm at 1.0 ft	Yes
45	11,389 gpm at 3.4 ft	Yes
46	Minimum Overall Pump Efficiency @ Rated Design Point: 44%	Yes
47	Motor Efficiency: 82%	Yes
48	Pump Efficiency @ Rated Design Point: 50%	Yes
49	Minimum Shutoff Head: 10 ft	Yes
50	Maximum Motor HP: 30 HP	Yes
51	Maximum Speed: 440 rpm	Yes
52	Voltage: 460 V	Yes
53	Power Phase: 3	Yes
54	Power Frequency: 60 Hz	Yes
55	Minimum Power Cable Length: 60 ft	Yes
56	Pipe Mount Discharge Connection Size: 30 in	Yes
57	**Materials (section 2.4)**	Yes
58	Major Pump Components: 316 SS	Yes
59	Propeller: 316 SS (ASTM A276)	Yes
60	Stationary Pump Mounting Flange: 30" 316 SS (ASTM A276)	Yes
61	Pump Casing Ring and Supports: 316 SS (ASTM A276)	Yes
62	Propeller Drive Shaft: 420 SS (ASTM A286)	Yes
63	Motor Shaft: 420 SS (ASTM A286)	Yes
64	O-Rings: Fluorinated Rubber (Viton)	Yes
65	Fasteners: 316T SS (ASTM A276)	Yes
66	Outer Seal Faces: Tungsten Carbide/Tungsten Carbide (WCCR)	Yes
67	Inner Seal Faces: Tungsten Carbide/Tungsten Carbide (WCCR)	Yes
68	Guide Rail and Upper Support Brackets: 2" 316 SS Sch 40	Yes
69	Lifting Chain or Cable: 40 ft 316 SS (ASTM A276)	Yes
70	Oil (Seal Lubrication): Ecologically safe, mineral base	Yes
71	Power/Control Cable Jacket: Chloroprene Rubber Jacketed	Yes
72	Lighting Handler: 1 per pump	Yes
73	**Design per section 2.5**	Yes
74	Exposed Nuts and Bolts: Stainless Steel	Yes
75	Capable of Continuous Submergence to a Depth of: 130 ft	Yes
76	Non-Stainless Steel Surfaces in Contact w/Pumped Media: Factory Applied Acrylic Dispersion Zinc Phosphate Primer w/Plaster Resin Paint Finish	Yes
77	Mounting Clips: Integral to Casing	Yes
78	**Propeller per section 2.6**	Yes

Chandler Improvements Phase 3

Work Category: 11G - Low-Flow Propeller (IMLR) Pumps

WC Lead: Jennifer Lee

Bid Date: August 21, 2026

	TOTAL WORK CATEGORY PACKAGE VALUE	$401,101
79	**Shaft per section 2.7**	Yes
80	Maximum Deflection: 0.002 in	Yes
81	**Shaft Seal per section 2.8**	Yes
82	(2) mechanical shaft seals w/independent spring system	Yes
83	**Bearings per section 2.9**	Yes
84	Minimum B-10 Rated Life: 100,000 hours	Yes
85	**Thermal Sensors per section 2.10**	Yes
86	(3) thermal switches embedded in end coils of stator winding	Yes
87	**Shroud Assembly per section 2.11**	Yes
88	Bell Shaped, 360 degrees around the propeller	Yes
89	**Lubricant Housing per section 2.12**	Yes
90	Two compartments with four ports	Yes
91	Lubricant: FDA Approved Non-Toxic	Yes
92	**Mechanical Seals per section 2.13**	Yes
93	2 set of Lapped End Face Type Mechanical Seals	Yes
94	**Motor per section 2.14**	Yes
95	Maximum Propeller Speed: 440 rpm	Yes
96	Stator Winding Insulation: Class F	Yes
97	Pump Rating: 40° C	Yes
98	Pump Service Factor:1.15	Yes
99	Stator Varnish: Dipped and Baked 3 times in Class H Varnish	Yes
100	Starts per Hour: 10	Yes
101	Leakage and Over-Temperature Protection System	Yes
102	Control Module: Flygt Mini-CASII, or equal	Flygt
103	**Elastomers per section 2.15**	Yes
104	O-Rings: Nitrile Rubber or Viton	Viton
105	**Cable Entry per section 2.16**	Yes
106	Integral to Back Plate	Yes
107	Double set of Elastomer Grommets	Yes
108	**IMLR Pump Mount Assembly per section 2.17**	Yes
109	**Factory Pump Test per section 3.1**	
110	Field Verification of Performance	No
111	**Manufacturer Field Services (section 3.3)**	Yes
112	Installation/Startup Services	Yes
113	In person operator training services: 8 hours	Yes
114	Textura Included (Total Under $2.2M add 0.22%, if total is Equal or More than $2.2M add $5,000)	Yes
115	Bond/CDI Cost	Yes

ASSUMPTIONS & CLARIFICATIONS:

Chandler Improvements Phase 3

Work Category: 11G - Low-Flow Propeller (IMLR) Pumps

WC Lead: Jennifer Lee

Bid Date: August 21, 2026

	TOTAL WORK CATEGORY PACKAGE VALUE	**$401,101**
1	Contractor is not responsible for coordination between the low-flow propeller pump operations and aeration system operations. Low-flow propeller pumps are provided per the specification 11313 pump schedule operating conditions.	
2	Specification 11313 3.1 Field testing of low-flow propeller (IMLR) pumps is not included. Per Flygt, it is not possible to isolate and test output flow, power use, discharge pressure, vibration, etc. in the field as these operate in a submerged application. Performance shall be verified through factory inspections and testing in accordance with ANSI/HI 14.6 Test Grade 1U.	

City of Chandler

WRF Improvements Phase 3

WC 13A – Metal Canopies

Solicitation Summary

City of Chandler WRF Improvements Phase 3

Long Lead Procurement and Wilson Balance of Plant Proposal

Work Category: **13A - Metal Canopies**

Subcontractor/Supplier Name	***Status***
General Metal Construction	*Recommended*
Conwear	*Proposed*
Loenbro LLC	*Proposed*
EZARC	*Proposed*
Agate Steel	*Declined*
KDM Steelwork	*Declined*
Blast Resource Group	*Declined*
Hart Carport Solutions	*Declined*

Chandler Phase 3

Work Category: 13A - Metal Canopies

WC Lead: Dominic McCarver

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		**$176,368**
MCCARTHY SUBCONTRACT & FRONT END TERMS		
1	Compliant with McCarthy Front Ends	Yes
2	Bid Submitted on McCarthy Bid Form	Yes
3	Bid Bond Included with Bid	No
4	Surety Company	CDI
5	Surety AM Best Rating (Must be A- or Better)	NA
6	Bond/CDI Cost	Yes
7	Insurance Requirements Per Matrix	Yes
8	GL Insurance Company Name	American Builders Insurance Company
9	GL Insurance Carrier AM Best Rating (Must be A- or Better)	A
10	E&O Insurance (If Required by Front Ends)	NA
11	Pollution Insurance (If Required by Front Ends)	Yes
12	Tier 1 Approved	No
13	Tier 2 Approved	No
14	OSHA Recordable Incident Rate (Current)	0.00
15	Acknowledges Soils Report	NA
16	Acknowledges Addenda	Yes
17	Hold Bid for 150 Days	Yes
Scope of Work:		
19	**Per Plans & Specifications:**	Yes
20	Division 1 General Requirements	Yes
21	Volume 2 – Technical Specification	Yes
22	01012 – PLANT OPERATION DURING CONSTRUCTION	Yes
23	01416 – SPECIAL INSPECTIONS	Yes
24	01500 – CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS	Yes
25	01700 – CONTRACT CLOSEOUT	Yes
26	01710 – CLEANING	Yes
27	09900 – PAINTING	Yes
28	11335 – SECONDARY CLARIFIER MECHANISM	Yes
29	11375 – AERATION SYSTEMS	Yes
30	Volume 3 – AWRF Drawings	Yes
31	Scope includes, but is not limited to:	
32	AWRF - Removal of canopies over Secondary Clarifiers 1-3	Yes
33	AWRF - Reinstallation of canopies over Secondary Clarifiers 1-3	Yes

Chandler Phase 3

Work Category: 13A - Metal Canopies

WC Lead: Dominic McCarver

Bid Date: August 21, 2026

	TOTAL WORK CATEGORY PACKAGE VALUE	$176,368
34	AWRF - Removal of canopy over Secondary Clarifier 4	Yes
35	AWRF - Removal of structural beam over Clarifier 4	Yes
36	AWRF - Reinstallation of canopy over Secondary Clarifier 4	Yes
37	AWRF - Renstallation of structural beam over Clarifier 4	Yes
38	AWRF - Removal of canopies over A-Basins 5 & 6	Yes
39	AWRF - Reinstallation of canopies over A-Basins 5 & 6	Yes
40	Paint Touch ups	Yes
41	Plug & Redrill Anchor Holes if necessary	Yes
42	Hold Bid for 150 Days	Yes
43	Provide all labor, material, equipment, rigging, hoisting, lifts, scaffolding, and temporary bracing required for complete work	Yes
44	Field verify existing canopy conditions, dimensions, supports, and connections prior to removal	Yes
45	Protect, label, store, and maintain removed canopy components for reinstallation	Yes
46	Include incidental replacement hardware, fasteners, anchors, clips, shims, and sealants required for complete reinstallation	Yes
47	Maintain alignment, fit-up, and complete functioning/finish of canopy assemblies after reinstall	Yes
48	Coordinate removal/reinstallation sequencing with Secondary Clarifier 1-4 mechanism replacement activities	Yes
49	Coordinate removal/reinstallation sequencing with Aeration Basin 5 & 6 diffuser/piping work	Yes
50	Flagging / Safety Protection	Yes
51	Coordinate required access restrictions, shutdowns, and MOPO requirements with McCarthy / Owner / Engineer	Yes
52	Maintain plant operations and protect adjacent operating facilities during work	Yes
53	Prevent debris from entering basins and process areas; keep work areas clean	Yes
54	Provide required submittals / shop drawings for removal / reinstallation procedures and materials	Yes
55	General Warranty – 1 year past Final Completion	Yes
56	Mobilization / demobilization included (include cost per MOB)	Yes
57	McCarthy: Crane & Operator	In WC 15A
58	Textura Included (Total Under $2.2M add 0.22%, if total is Equal or More than $2.2M add $5,000)	Yes
59	Bond/CDI Cost	Yes

Chandler Phase 3

Work Category: 13A - Metal Canopies

WC Lead: Dominic McCarver

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE	$176,368

	ASSUMPTIONS & CLARIFICATIONS:
1	Clarifiers must be fully drained during canopy removal, clarifier mechanism replacement, and installation.
2	Canopies will be laid down in the lot south of the aeration basin and north of the reservoir. Area will be flagged off for protection.



City of Chandler

WRF Improvements Phase 3

WC 13C – Fuel Storage Tank System

Solicitation Summary
City of Chandler WRF Improvements Phase 3
Long Lead Procurement and Wilson Balance of Plant Proposal
Work Category: **13C - Fuel Storage Tank System**

Subcontractor/Supplier Name	***Status***
Arizona Fuel Systems	*Recommended*
Western Pumps	*Proposed*
Eagle Environmental	*Non-Responsive*
ASR Construction Group	*Declined*
MMI Tank & Industrial Services	*Declined*
Professional Piping Services	*Declined*

Chandler Phase 3

Work Category: 13C - Fuel Storage Tank System

WC Lead: Jenna Soltwedel

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		**$549,866**
MCCARTHY SUBCONTRACT & FRONT END TERMS		
1	Compliant with McCarthy Front Ends	Yes
2	Bid Submitted on McCarthy Bid Form	Yes
3	Bid Bond Included with Bid	NA
4	Surety Company	CDI
5	Surety AM Best Rating (Must be A- or Better)	NA
6	Bond/CDI Cost	Yes
7	Insurance Requirements Per Matrix	Yes
8	GL Insurance Company Name	AXIS Surplus Insurance Company
9	GL Insurance Carrier AM Best Rating (Must be A- or Better)	A
10	E&O Insurance (If Required by Front Ends)	Yes
11	Pollution Insurance (If Required by Front Ends)	Yes
12	Tier 1 Approved	Yes
13	Tier 2 Approved	NA
14	OSHA Recordable Incident Rate (Current)	0
15	Includes Material Management for Sub's Own Work Scope	Yes
16	Acknowledges Soils Report	Yes
17	Acknowledges Addenda	Yes
18	Hold Bid for 150 Days	Yes
Scope of Work:		
19	**Per Plans & Specifications:**	Yes
20	Division 1 General Requirements	Yes
21	Volume 2 – Technical Specification	Yes
22	01800 – EQUIPMENT SCHEUDLE	Yes
23	13400 – ABOVE GROUND FUEL STORAGE TANK	Yes
24	01650 - STARTING OF SYSTEMS	Yes
25	01750 – SPARE PARTS AND MAINTENANCE MATERIALS	Yes
26	17454 - OPERATIONS AND CONTROL DESCRIPTIONS	Yes
27	Volume 3 – AWRF Drawings	Yes
28	Volume 4 – OWRF Drawings	Yes
29	Supply and install material which includes but not limited to:	Yes
30	Fuel dispenser	Yes
31	1-Hose Fleet Fueling Dispensers w/ 50' hose reels	Yes
32	Include 30 manufacture year warrenty (per spec)	Yes

Chandler Phase 3

Work Category: 13C - Fuel Storage Tank System

WC Lead: Jenna Soltwedel

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		**$549,866**
33	10,000 Gallon UL-2085 Tank and its accessories	Yes
34	12,000 Gallon UL-2085 Tank and its accessories	Yes
35	Off-Load Crane	Yes
36	Tank Ladder	Yes
37	Ground Level Remote Fill	Yes
38	Overfill Stop Valve	Yes
39	In-Tank Turbin Pump	Yes
40	Shear/Fire Valve	Yes
41	Dispensing Hardware	Yes
42	Fuel Polisher & Required FOR & FOS Piping & Valves	Yes
43	All anchors and bolts needed for securing tank into concrete pad	Yes
44	Furnish and Install equipment	Yes
45	Startup/commissioning of systems Fuel storage tank system	Yes
46	Involvement in all fire/life safety inspections and meetings	Yes
47	Ensure all items in “Volume 2,3, & 4 Drawings” are captures in proposal	Yes
48	General Warranty – 1 year past Final Completion	Yes
49	Owner training	Yes
50	Textura Included (Total Under $2.2M add 0.22%, if total is Equal or More than $2.2M add $5,000)	Yes
51	Preventative maintenance	Yes
52	Extended Warranty	Yes
53	Bond/CDI Cost	Yes
54	Crane for Setting Tank	Yes
55	General Foreman Coordination	Yes

	ASSUMPTIONS & CLARIFICATIONS:
1	City of Chandler is responsible for filling the storage tank at both AWRF & OWRF locations. No initial fill for start-up and testing will be provided.
2	Fuel Tank will be turned over to City of Chandler for Beneficial Use. Fuel system warranty is for 1 year after final acceptance.



City of Chandler
WRF Improvements Phase 3
WC 13D – Pre-Engineered Structures

Solicitation Summary
City of Chandler WRF Improvements Phase 3
Long Lead Procurement and Wilson Balance of Plant Proposal
Work Category: **13D - Pre-Engineered Structures**

Subcontractor/Supplier Name	***Status***
Arizona Corporate Builders	*Recommended*
August Building	*Proposed*
Resolute Performance Iron	*Declined*
ASR Construction Group	*Declined*
Loenbro LLC	*Declined*
Blox	*Declined*
Bunger Steel Inc	*Declined*
Metal Building Industries	*Declined*

Chandler Phase 3

Work Category: 13D Pre-engineered Structures

WC Lead: Dominic McCarver

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		$363,432
MCCARTHY SUBCONTRACT & FRONT END TERMS		
1	Compliant with McCarthy Front Ends	Yes
2	Bid Submitted on McCarthy Bid Form	Yes
3	Bid Bond Included with Bid	Yes
4	Surety Company	Travelers Insurance
5	Surety AM Best Rating (Must be A- or Better)	A++
6	Bond/CDI Cost	Yes
7	Insurance Requirements Per Matrix	Yes
8	GL Insurance Company Name	Palomar Specialty Insurance Company
9	GL Insurance Carrier AM Best Rating (Must be A- or Better)	A-
10	E&O Insurance (If Required by Front Ends)	NA
11	Pollution Insurance (If Required by Front Ends)	Yes
12	Tier 1 Approved	Yes
13	Tier 2 Approved	NA
14	OSHA Recordable Incident Rate (Current)	No
15	Includes Hoisting for Sub's Own Work Scope	Yes
16	Acknowledges Soils Report	Yes
17	Acknowledges Addenda	Yes
18	Hold Bid for 150 Days	Yes
Scope of Work:		
19	**Per Plans & Specifications:**	Yes
20	Division 1 General Requirements	Yes
21	Volume 2 – Technical Specification	Yes
22	01300 – SUBMITTALS	Yes
23	01416 – SPECIAL INSPECTIONS	Yes
24	01500 – CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS	Yes
25	01700 – CONTRACT CLOSEOUT	Yes
26	01710 – CLEANING	Yes
27	01800 – EQUIPMENT SCHEDULE	Yes
28	05120 – STRUCTURAL STEEL	Yes
29	05500 – METAL FABRICATIONS	Yes
30	09900 – PAINTING	Yes
31	13300 – METAL BUILDING SYSTEMS	Yes

Chandler Phase 3

Work Category: 13D Pre-engineered Structures

WC Lead: Dominic McCarver

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		**$363,432**
32	Volume 4 – OWRF Drawings	Yes
33	Scope includes, but is not limited to:	Yes
34	OWRF - Procurement / fabrication of Switchgear Building materials	Yes
35	OWRF - Construction of Switchgear Building (HVAC not included)	Yes
36	OWRF - Procurement / fabrication of Anoxic Basin Electrical Building materials	Yes
37	OWRF - Construction of Anoxic Basin Electrical Building (HVAC not included)	Yes
38	Labor and materials to clean and protect concrete	Yes
39	GF Supervision (GF for 80 hrs)	Yes
40	Provide option for including HVAC	In WC 15C
41	Furnish all labor, materials, equipment, tools, fasteners, anchors, embeds, and incidentals required for complete pre-engineered structures scope	Yes
42	Provide complete pre-engineered metal building systems and associated structural components required by plans and specifications	Yes
43	Include structural steel, framing, girts, purlins, wall and roof panels, trim, flashing, closures, sealants, doors / framed openings, and accessories required for complete building shells	Yes
44	Include shop fabrication, shop priming / coatings, delivery, unloading, staging, erection, field assembly, alignment, and temporary bracing	Yes
45	Coordinate all required openings, embeds, anchor bolts, attachments, and interfaces with concrete, structural, electrical, and other adjacent trades	Yes
46	Provide setting templates and required information for items to be cast into concrete or otherwise embedded	Yes
47	Field verify dimensions and conditions prior to fabrication and installation	Yes
48	Coordinate erection sequencing with McCarthy and other trades to maintain project schedule and site access	Yes
49	Provide hoisting, rigging, cranes, lifts, scaffolding, and access required for subcontractor's own work scope	Yes
50	Include all required submittals / shop drawings / erection drawings / product data for materials and assemblies in this scope	Yes
51	Coordinate special inspections, testing, and quality-control requirements applicable to structural steel / metal building work	In WC 01C
52	Touch up / repair damaged primer, galvanizing, and coatings caused by this scope; protect installed work and stored materials from moisture and weather exposure	Yes
53	Provide complete weather-tight exterior building envelope for scope items included in plans / specifications	Yes
54	Final cleaning and punchlist completion for this scope	Yes
55	General Warranty – 1 year past Final Completion	Yes
56	McCarthy WC Support: Layout, electrical coordination, inspection coordination, HVAC	Yes

Chandler Phase 3

Work Category: 13D Pre-engineered Structures

WC Lead: Dominic McCarver

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		**$363,432**
57	35 year manufacturer warranty for high performance coatings	Yes
58	Gutters & downspouts	Yes
59	Sealants, gaps, & Caulking	Yes
60	Mobilization / demobilization included	Yes
61	Textura Included (Total Under $2.2M add 0.22%, if total is Equal or More than $2.2M add $5,000)	Yes
62	Bond Carried in Base Bid	Yes
63	Bond/CDI Cost	Yes



City of Chandler

WRF Improvements Phase 3

WC 14A – Monorail Festoon Replacement

Solicitation Summary
City of Chandler WRF Improvements Phase 3
Long Lead Procurement and Wilson Balance of Plant Proposal
Work Category: **14A - Monorail Festoon Replacement**

Subcontractor/Supplier Name	***Status***
MMI Hoist Systems	*Recommended*
Brand Safway LLC	*Declined*
Crane & Hoist of Arizona Inc	*Declined*

Chandler Phase 3

Work Category: 14A Monorail Festoon Replacement

WC Lead: Dominic McCarver

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		$17,112
MCCARTHY SUBCONTRACT & FRONT END TERMS		
1	Compliant with McCarthy Front Ends	Yes
2	Bid Submitted on McCarthy Bid Form	Yes
3	Bid Bond Included with Bid	No
4	Surety Company	CDI
5	Surety AM Best Rating (Must be A- or Better)	NA
6	Bond/CDI Cost	Yes
7	Insurance Requirements Per Matrix	Yes
8	GL Insurance Company Name	Middlesex Insurance Company
9	GL Insurance Carrier AM Best Rating (Must be A- or Better)	A+
10	E&O Insurance (If Required by Front Ends)	No
11	Pollution Insurance (If Required by Front Ends)	Yes
12	Tier 1 Approved	No
13	Tier 2 Approved	No
14	OSHA Recordable Incident Rate (Current)	1.64
15	Includes Hoisting for Sub's Own Work Scope	Yes
16	Acknowledges Soils Report	No
17	Acknowledges Addenda	Yes
18	Hold Bid for 150 Days	Yes
Scope of Work:		
21	**Per Plans & Specifications:**	Yes
21	Division 1 General Requirements	Yes
22	Volume 2 – Technical Specification	Yes
23	01300 – Submittals	Yes
24	14630 - Hoists, Trolleys and Monorails	Yes
25	Scope includes, but is not limited to:	
26	Furnish all labor, materials, equipment, tools, fasteners, anchors, embeds, and incidentals required for complete Monorail Hoist System	Yes
27	Field verify dimensions and conditions prior to fabrication and installation	Yes
28	Coordinate erection sequencing with McCarthy and other trades to maintain project schedule and site access	Yes
29	Provide hoisting, rigging, cranes, lifts, scaffolding, and access required for subcontractor's own work scope	Yes
30	Include all required submittals / shop drawings / product data for materials and assemblies in this scope	Yes

Chandler Phase 3

Work Category: 14A Monorail Festoon Replacement

WC Lead: Dominic McCarver

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		**$17,112**
31	Coordinate special inspections, testing, and quality-control requirements applicable to scope of work	Yes
32	General Warranty – 1 year past Final Completion	Yes
33	Mobilization / demobilization included	Yes
34	Textura Included (Total Under $2.2M add 0.22%, if total is Equal or More than $2.2M add $5,000)	Yes
35	End of Scope (Add New Rows Above This Line)	Yes
36	Bond/CDI Cost	Yes



City of Chandler

WRF Improvements Phase 3

WC15A – Process Piping and Equipment Installation

Solicitation Summary

Chandler Improvements Phase 3

Long Lead Procurement and Wilson Balance of Plant Proposal

Work Category: **15A - Process Piping and Equipment Installation**

Subcontractor/Supplier Name	***Status***
McCarthy Building Companies	*Recommended*

Chandler Improvements Phase 3

Work Category: 15A - Process Piping and Equipment Installation

WC Lead: Jennifer Lee

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		**$7,874,238**
MCCARTHY SUBCONTRACT & FRONT END TERMS		
1	Compliant with McCarthy Front Ends	Yes
2	Bid Submitted on McCarthy Bid Form	N/A
3	Bid Bond Included with Bid	N/A
4	Surety Company	N/A
5	Surety AM Best Rating (Must be A- or Better)	N/A
6	Bond/CDI Cost	Yes
7	Insurance Requirements Per Matrix	N/A
8	GL Insurance Company Name	N/A
9	GL Insurance Carrier AM Best Rating (Must be A- or Better)	N/A
10	E&O Insurance (If Required by Front Ends)	N/A
11	Pollution Insurance (If Required by Front Ends)	N/A
12	Tier 1 Approved	N/A
13	Tier 2 Approved	N/A
14	OSHA Recordable Incident Rate (Current)	0.22
15	Includes Hoisting for Sub's Own Work Scope	Yes
16	Acknowledges Soils Report	Yes
17	Acknowledges Addenda	Yes
18	Hold Bid for 150 Days	Yes
Scope of Work:		
19	**Per Plans & Specifications:**	
20	Provide all labor, materials, tools, equipment and appurtenances as required to perform the **Work Category - 15A Process Piping and Equipment**, in accordance with and reasonably inferable from the Contract Documents, complete and without exception unless otherwise noted below, including, but not limited to the following:	Yes
21	Division 1 General Requirements	Yes
22	01013 – Engineering Services	Yes
23	01300 – Submittals	Yes
24	01640 – Material and Equipment	Yes
25	01650 – Stating of Systems	Yes
26	01730 –Operation and Maintenance Data	Yes
27	01750 – Spare Parts and Maintenance Materials	Yes
28	01800 – Equipment Schedule	Yes
29	02050 – Demolitions	Yes
30	03252 – Anchorage in Concrete	Yes
31	05501 – Miscellaneous Metal Fabrication	Yes
32	09900 – Painting	Yes
33	11218 – Magnetic Drive Sealless End Suction Pumps	Yes

Chandler Improvements Phase 3

Work Category: 15A - Process Piping and Equipment Installation

WC Lead: Jennifer Lee

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		**$7,874,238**
34	11221 – Submersible Mixers and Accessories	Yes
35	11295 – Hydraulic Valves	Yes
36	11310 – Vertical Turbine Pumps	Yes
37	11313 – Low-Flow Propelled (IMLR) Pumps	Yes
38	11335 – Secondary Clarifier Mechanism	Yes
39	11375 – Aeration Systems	Yes
40	11400 – Disc Filter System	Yes
41	13447 – Electric Motor Actuators	Yes
42	15050 – Piping Systems	Yes
43	15052 – Exposed Piping	Yes
44	15061 – Ductile Iron Pipe	Yes
45	15064 – Copper Pipe	Yes
46	15065 – Thermoplastic Pipe and Accessories	Yes
47	15066 – Stainless Steel Pipe	Yes
48	15067 – Fiberglass Reinforced Plastic Pipe and Accessories	Yes
49	15120 – Piping Specialties and Accessories	Yes
50	15140 – Supports and Anchors	Yes
51	15950 – Testing Mechanical Systems	Yes
52	16000 – General Electrical Requirements	Yes
53	16161 – Control Panels	Yes
54	16225 – Electric Motors 250 Horsepower and Less	Yes
55	17000 – Instrumentation	Yes
56	17111 – Float Switches	Yes
57	17120 – Pressure Transmitters	Yes
58	17121 – Pressure Switches and Gauges	Yes
59	17124 – Submersible Level Transmitter	Yes
60	17134 – Flow Switches	Yes
61	17137 – Magnetic Flow Meters	Yes
62	17150 – Limit and Position Switches	Yes
63	Warranty - 1 year from Project Final Completion	Yes
64	Core Drilling and Penetrations as required.	Yes
65	**AWRF - Headworks**	
66	Demolish existing FA line per plans	Yes
67	Furnish & install exposed FA line(s) complete, including but not limited to pipe and fitting (s), valve(s), hangers/supports, penetration (s), etc.	Yes
68	**AWRF - Aeration Basin**	
69	Demolish existing aeration system per plans.	Yes
70	Installation, and start-up per the specifications and manufacturer's recommendations, for WC 11I – Aeration Systems per Specification 11375	Yes
71	**AWRF - Secondary Clarifiers**	
72	Demolish existing clarifiers 1-4.	Yes
73	Demolish existing DR, SCUM, and spray system lines per plans.	Yes
74	Furnish & install exposed DR line(s) complete, including but not limited to pipe and fitting (s), valve(s), hangers/supports, penetration (s), etc.	Yes
75	Furnish & install exposed SCUM line(s) complete, including but not limited to pipe and fitting (s), valve(s), hangers/supports, penetration (s), etc.	Yes

Chandler Improvements Phase 3

Work Category: 15A - Process Piping and Equipment Installation

WC Lead: Jennifer Lee

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		**$7,874,238**
76	Furnish & install exposed NPW spray system line(s) complete, including but not limited to pipe and fitting (s), valve(s), hangers/supports, penetration (s), etc.	Yes
77	Installation, and start-up per the specifications and manufacturer's recommendations, for WC 11H – Secondary Clarifier per Specification 11335	Yes
78	**AWRF - Disc Filter**	
79	Furnish & install exposed D line(s) complete, including but not limited to pipe and fitting (s), valve(s), hangers/supports, penetration (s), etc.	Yes
80	Furnish & install exposed BWW line(s) complete, including but not limited to pipe and fitting (s), valve(s), hangers/supports, penetration (s), etc.	Yes
81	Furnish & install exposed SW line(s) complete, including but not limited to pipe and fitting (s), valve(s), hangers/supports, penetration (s), etc.	Yes
82	Install instrumentation as required per drawings and P&IDs for all pipelines and as indicated on the P&ID Responsibility Matrix.	Yes
83	Installation, and start-up per the specifications and manufacturer's recommendations, for WC 11J – Disc Filter per Specification 11400	Yes
84	**AWRF - Chemical Storage Facility**	
85	Demolish six (6) existing chemical metering pumps and associated piping connections.	Yes
86	Demolish existing chemical pipe, fitting(s), valve(s), hangers/supports, penetrations, etc. per plans.	Yes
87	Furnish & install exposed NaOCL line(s) complete, including but not limited to pipe and fitting (s), valve(s), hangers/supports, penetration (s), etc.	Yes
88	Furnish & install exposed NaOH line(s) complete, including but not limited to pipe and fitting (s), valve(s), hangers/supports, penetration (s), etc.	Yes
89	Install instrumentation as required per drawings and P&IDs for all pipelines and as indicated on the P&ID Responsibility Matrix.	Yes
90	Installation, and start-up per the specifications and manufacturer's recommendations, for WC 11A – Magnetic Drive Sealless End Suction Pumps per specification 11218	Yes
91	**AWRF - RWIF Blower Building**	
92	Demolish existing vent line per plans.	Yes
93	Furnish & install exposed vent line(s) complete, including but not limited to pipe and fitting (s), valve(s), hangers/supports, penetration (s), etc.	Yes
94	**AWRF - Overall Site**	
95	Demolish existing chemical pipe, fitting(s), valve(s), hangers/supports, penetrations, etc. per plans.	Yes
96	Furnish & install NaOCL line(s) complete, including but not limited to pipe and fitting (s), valve(s), hangers/supports, penetration (s), etc.	Yes
97	Furnish & install NaOH line(s) complete, including but not limited to pipe and fitting (s), valve(s), hangers/supports, penetration (s), etc.	Yes
98	**OWRF - MBR Aeration Basins**	
99	Relocate existing submersible mixers per plans.	Yes
100	Demolish existing MBR Bioreactor Basin covers per plans.	Yes
101	Demolish existing aeration system per plans.	Yes
102	Furnish & install submerged MLR line(s) complete, including but not limited to pipe and fitting (s), valve(s), hangers/supports, penetration (s), etc.	Yes
103	Installation, and start-up per the specifications and manufacturer's recommendations, for WC 11I – Aeration Systems per Specification 11375	Yes
104	Installation, and start-up per the specifications and manufacturer's recommendations, for WC 11I – Low-flow Propeller (IMLR) Pumps per specification 11313	Yes
105	**OWRF - Anoxic Basins**	
106	Furnish & install exposed seal water line(s) complete, including but not limited to pipe and fitting (s), valve(s), hangers/supports, penetration (s), etc.	Yes

Chandler Improvements Phase 3

Work Category: 15A - Process Piping and Equipment Installation

WC Lead: Jennifer Lee

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		**$7,874,238**
107	Furnish & install exposed MLR line(s) complete, including but not limited to pipe and fitting (s), valve(s), hangers/supports, penetration (s), etc.	Yes
108	Install instrumentation as required per drawings and P&IDs for all pipelines and as indicated on the P&ID Responsibility Matrix.	Yes
109	Installation, and start-up per the specifications and manufacturer's recommendations, for WC 11E – Vertical Turbine Pump per Specification 11310	Yes
110	**OWRF - Secondary Clarifiers**	
111	Demolish existing clarifier 3	Yes
112	Demolish existing DR, SCUM, and spray system per plans	Yes
113	Furnish & install exposed DR line(s) complete, including but not limited to pipe and fitting (s), valve(s), hangers/supports, penetration (s), etc.	Yes
114	Furnish & install exposed SCUM line(s) complete, including but not limited to pipe and fitting (s), valve(s), hangers/supports, penetration (s), etc.	Yes
115	Furnish & install exposed NPW spray system line(s) complete, including but not limited to pipe and fitting (s), valve(s), hangers/supports, penetration (s), etc.	Yes
116	Installation, and start-up per the specifications and manufacturer's recommendations, for WC 11H – Secondary Clarifier per Specification 11335	Yes
117	All tie-ins to process equipment	Yes
118	Testing of new and re-used exiting piping	Yes
119	Coordination with CMAR for exposed piping MOPOs	Yes
120	Scope coordination between all other work categories	Yes
121	All equipment for hoisting, lifting, and setting materials	Yes
122	Purchase of all process mechanical piping materials	Yes
123	Shipping shall be FOB jobsite	Yes
124	Unloading & storage including CMAR supplied equipment	Yes
125	Temporary protection & enclosure including CMAR supplied equipment	Yes
126	Training: per the Spec	Yes
127	Manufactures Services	Yes

Chandler Improvements Phase 3

Work Category: 15A - Process Piping and Equipment Installation

WC Lead: Jennifer Lee

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE	$7,874,238

ASSUMPTIONS & CLARIFICATIONS:

1. Proposal assumes that all existing pipes that new piping connects to will pass leak testing. Cost of testing or repairing existing piping has not been included.
2. The re-balancing of existing Foul Air lines is not included in direct costs of project.
3. Existing pipe support anchorage in aeration basins shall be burned and grouted.
4. Engineering for pipe supports has not been included. Pipe supports shall be supplied per details referenced in the Contract Drawings.
5. Proposed valves per table below:

System	Diameter	Valve	Manufacturer
D	3”	Mud Valve	Trumbull
NPW	2”	SS Globe Valve	Sharpe
NPW	½”	Bronze Globe Valve	Apollo
NPW	½”	Solenoid Valve	ASCO
NPW	½”	Bronze Ball Valve	Matco Norca
WW – Pressure Gauge	½”	SS Ball Valve	Matco Norca

6. Manufacturer Warranties on existing equipment that will be relocated are not provided. This is applicable to the mixers at the MBR Basins. Standard workmanship warranty for one year after final completion is included.



City of Chandler

WRF Improvements Phase 3

WC 15C - HVAC

Solicitation Summary
City of Chandler WRF Improvements Phase 3
Long Lead Procurement and Wilson Balance of Plant Proposal
Work Category: **15C - HVAC**

Subcontractor/Supplier Name	***Status***
Professional Piping Systems	*Recommended*
Pueblo Mechanical and Controls	*Proposed*
Tempe Mechanical	*Proposed*
Karber Corporation	*Declined*
Comfort Systems	*Declined*

Chandler Improvements Phase 3

Work Category: 15C - HVAC

WC Lead: Jenna Soltwedel

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		**$262,492**
MCCARTHY SUBCONTRACT & FRONT END TERMS		
1	Compliant with McCarthy Front Ends	Yes
2	Bid Submitted on McCarthy Bid Form	Yes
3	Bid Bond Included with Bid	NA
4	Surety Company	Ascot Surety & Casualty Company
5	Surety AM Best Rating (Must be A- or Better)	A
6	Bond/CDI Cost	Yes
7	Insurance Requirements Per Matrix	Yes
8	GL Insurance Company Name	Continental Casualty
9	GL Insurance Carrier AM Best Rating (Must be A- or Better)	A+
10	E&O Insurance (If Required by Front Ends)	Yes
11	Pollution Insurance (If Required by Front Ends)	Yes
12	Tier 1 Approved	Yes
13	Tier 2 Approved	NA
14	OSHA Recordable Incident Rate (Current)	0.26
15	Includes Hoisting for Sub's Own Work Scope	Yes
16	Acknowledges Soils Report	NA
17	Acknowledges Addenda	Yes
18	Hold Bid for 150 Days	Yes
Scope of Work:		
19	Provide all labor, materials, tools, equipment and appurtenances as required to perform the Work Category in accordance with and reasonably inferable from the Contract Documents, complete and without exception unless otherwise noted below, including, but not limited to the following:	Yes
20	**General Conditions/General Requirements**	
21	MOPO/Shutdown - The site-wide HVAC distribution and equipment shall be operational during this Project. The contractor will participate in the MOPO process as described in Section 01 of the specifications and obtain approval prior to disconnecting any HVAC services that are currently in operations at the plant.	Yes
22	Working Hours - Assume that tie-ins and shutdowns will be performed after hours or on weekends	Yes
23	Protect in Place/ Salvage - Remove, protect, relocate, re-install, and adjust Site HVAC including but not limited to HVAC Structures, Equipment, fittings, etc. as required to support the work of others	Yes
24	Signage/Labelling - Equipment and instrument tags, and signage as required and specified in the contract documents	Yes

Chandler Improvements Phase 3

Work Category: 15C - HVAC

WC Lead: Jenna Soltwedel

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		**$262,492**
25	Testing/Commissioning - Startup and Commissioning for new equipment & equipment modified by this scope of work	Yes
26	Final acceptance filter replacemement	Yes
27	3rd Party testing as required and specified in the contract documents	Yes
28	Verify space requirements of materials and equipment before ordering	Yes
29	Dispose of all removed materials and equipment	Yes
30	Coordinate connection of mechanical systems with exterior underground and overhead utilities and services.	Yes
31	Balancing contractor to conduct "pre-reads" to document the current air balance of the building prior to construction.	Yes
32	Temperature control requirements are included in this scope of work.	Yes
33	**Per Plans & Specifications**	Yes
34	**Division 16 - General Electrical Requirements - as it relates to this scope of work, including, but not limited to the following:**	Yes
35	Section 16001 - PACKAGED SYSTEMS AND PACKAGED CONTROL PANELS	Yes
36	Section 16010 - ELECTRICAL: BASIC REQUIREMENTS	Yes
37	**Division 15 General Requirements - as it relates to this scope of work, including, but not limited to the following:**	Yes
38	Spec Section 15700 - GENERAL HVAC REQUIREMENTS	Yes
39	Spec Section 15710 - SUMMARY OF WORK FOR HEATING, VENTILATING AND AIR CONDITIONING	Yes
40	Spec Section 15720 - AIR HANDLING AND AIR DISTRIBUTION SPECIALTIES	Yes
41	Spec Section 15730 - CLEANING MECHANICAL SYSTEMS	Yes
42	Spec Section 15732 - PACKAGE HEAT PUMP AIR CONDITIONING UNITS	Yes
43	Spec Section 15734 - SPLIT SYSTEM AIR CONDITIONING UNITS (DUCTLESS)	Yes
44	Spec Section 15736 - VARIABLE REFRIGERANT VOLUME SYSTEMS AND CONTROLS	Yes
45	Spec Section 15738 - DEDICATED OUTDOOR AIR SYSTEM	Yes
46	Spec Section 15780 - CONDENSATE AND EQUIPMENT DRAIN SYSTEMS	Yes
47	Spec Section 15890 - SHEET METAL DUCTWORK	Yes
48	Spec Section 15910 - MECHANICAL SYSTEMS INSULATION	Yes
49	Spec Section 15950 - TESTING MECHANICAL SYSTEMS	Yes
50	Spec Section 15951 - TESTING, ADJUSTING AND BALANCING OF MECHANICAL SYSTEMS	Yes

Chandler Improvements Phase 3

Work Category: 15C - HVAC

WC Lead: Jenna Soltwedel

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		**$262,492**
51	The following items should be included into proposal, including but not limited to:	Yes
52	All necessary core drilling/demolition and means to route piping is included in this scope.	Yes
53	Supply all access panels/doors required for this scope of work.	Yes
54	Temperature control requirements are included in this scope of work.	Yes
55	Provide blocking/backing for this scope of work.	Yes
56	Furnish, install, and replace construction filters as needed. Final filters to be installed after final clean	Yes
57	Temporary sealing/protection of existing supply and return vents during construction activities.	Yes
58	Tie-Up Existing Equipment in each space that is not to be removed during demo.	Yes
59	Make-Safe and cutting ductwork at point of demolition lower to the ground. Demo and haul off by others.	Yes
60	Hoisting and rigging for your own scope of work.	Yes
61	Involvement in all fire/life safety inspections and meetings.	Yes
62	Startup/commissioning of mechanical systems.	Yes
63	Furnish/install all units as indicated on contract documents and drawings, Mechanical Schedules and General Notes, including but not limited to:	Yes
64	Air Handling Unit	Yes
65	Grilles	Yes
66	Registers	Yes
67	New Condensing Units	Yes
68	Refrigerant Piping	Yes
69	Equipment Supports	Yes
70	Condensate Drain Piping	Yes
71	Wall mounted Thermostat	Yes
72	Air Conditioning Unit	Yes
73	Full size copper condensate drain piping	Yes
74	Hub Drain assembly	Yes
75	Air ductwork	Yes
76	Outside air economizer assembly	Yes
77	Ductwork supports	Yes
78	PVC drain line	Yes
79	Duct Smoke detector (Detail 8 H-34.04)	Yes
80	All other equipment, attacments, items needed to place HVAC equipment listed in HVAC schedule	Yes

Chandler Improvements Phase 3

Work Category: 15C - HVAC

WC Lead: Jenna Soltwedel

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		**$262,492**
81	Install and size the refrigerant piping from the outdoor condensing unit to the indoor d/x cooling coil	Yes
82	Air Balance report	Yes
83	All ductwork to be Class 0 or 1	Yes
84	Demo all existing HVAC equipment that is stated in all mechanical HVAC floor plans/Schedules	Yes
85	Warranty - 1 year from final completion	Yes
86	Owner training	Yes
87	Holding Bid	Yes
88	Textura Included (Total Under $2.2M add 0.22%, if total is Equal or More than $2.2M add $5,000)	Yes
89	Preventative maintenance	Yes
90	Cross Disipline Work	Yes
91	Bond/CDI Cost	Yes

	ASSUMPTIONS & CLARIFICATIONS:
1	Standard warranty carried 1 year after installation.
2	Refrigerant piping per plans.
3	This proposal excludes supplemental structural supports. Only supports considered are those provided in details.
4	Pricing only includes local unit controls, not full system integration implied by specs and scope matrix.
5	HVAC to only cover the buildings at OWRF. AWRF Administration Building upgrades are not included.



City of Chandler
WRF Improvements Phase 3
WC16A – Electrical, Instrumentation, and Controls

Solicitation Summary

Chandler Improvements Phase 3

Long Lead Procurement and Wilson Balance of Plant Proposal

Work Category: **16A Electrical, Instrumentation & Controls**

Subcontractor/Supplier Name	***Status***
Loenbro	*Recommended*
Industrial Power Solutions	*Bid Received*
Skyline Electric	*Bid Received*
Bombard Electric	*No Bid*

Chandler Improvements Phase 3

Work Category: 16A Electrical, Instrumentations & Controls

WC Lead: Kyle Roman

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		$9,602,875
MCCARTHY SUBCONTRACT & FRONT END TERMS		
1	Compliant with McCarthy Front Ends	Yes
2	Bid Submitted on McCarthy Bid Form	Yes
3	Bid Bond Included with Bid	Yes
4	Surety Company	West Bend
5	Surety AM Best Rating (Must be A- or Better)	A+
6	Bond/CDI Cost	Yes
7	Insurance Requirements Per Matrix	Yes
8	GL Insurance Company Name	Zurich American
9	GL Insurance Carrier AM Best Rating (Must be A- or Better)	A+
10	GL Insurance (GL - $10MM)	Yes
11	E&O Network Security and Privacy Liability Insurance (CYB - $5MM)	Yes
12	Pollution Insurance (POL - $10MM)	Yes
13	Automobile Liability Insurance (AUTO - $1MM)	Yes
14	Tier 1 Approved	Yes
15	Tier 2 Approved	
16	Safety Items:	
17	OSHA Recordable Incident Rate (2025)	0.50
18	Agrees to comply with PPE requirements including 100% glove policy	Yes
19	Acknowledges updated ladder policy (platform ladders)	Yes
20	Task Hazard Analysis included for all tasks	Yes
21	Tie-off above 6' required	Yes
22	New Helmet Policy	Yes
23	Participate in weekly safety meeting.	Yes
24	Includes Hoisting for Sub's Own Work Scope	Yes
25	Acknowledges Soils Report	N/A
26	Acknowledges Addenda (#1 & #2, and Answers to Pre-bid RFI's)	Yes
27	Hold Bid for 150 Days	Yes
28	Estimated Tax Exempt Value of Total Bid	Approx. 20%
29		
Scope of Work:		

Chandler Improvements Phase 3

Work Category: **16A Electrical, Instrumentations & Controls**

WC Lead: **Kyle Roman**

Bid Date: **August 21, 2026**

	TOTAL WORK CATEGORY PACKAGE VALUE	**$9,602,875**
32	Provide all labor, materials, tools, equipment and appurtenances as required to perform the **Work Category 16A - Electrical, Instrumentation & Controls**, in accordance with and reasonably inferable from the Contract Documents, complete and without exception unless otherwise noted below including, but not limited to, the following:	Yes
33	**General Conditions/General Requirements**	
34	Temporary Construction Power - provide power outlets for construction operations, with branch wiring and distribution boxes located as required and provide flexible power cords as required. Coordinate use the existing electric utility service at the site at the discretion and acceptance of the CoC Field Operations Staff.	Yes
35	MOPO/Shutdowns - The site-wide electrical distribution, instrumentation and communication system shall be operational during this Project. Any shutdowns related to electrical connections shall be coordinated with the plant shutdown schedule. Include temporary electrical and communication conduits, wiring and temporary setup during longer periods of outages	Yes
36	Working Hours - Assume that tie-ins and shutdowns will be performed after hours or on weekends	Yes
37	Protect in Place/ Salvage - Remove, protect, relocate, re-install, and adjust Site Electrical including but not limited to Electrical Structures, Equipment, Duct Banks, UGE Lines, Branch Circuits, Light Poles, etc. as required to support the work of others	Yes
38	Selective Demolition - Disconnect and disassemble distribution inside electrical rooms and other enclosures and move to exterior of buildings for removal and disposal by others	Yes
39	**Trenching for Electrical and Fiber Duct Banks -** Duct bank civil work including excavation, spoils removal and backfill. *(Refer to Electrical Duct Bank Excluded Items Estimate for further detail)*	Yes
40	Underground - Duct bank work including rebar and spacers as per plan drawings and specifications. All manholes and handholes to be furnished and installed as part of this scope of work with all damp proofing and grounding required.	Yes
41	General earthwork, excavation, backfill, subgrade prep, and localized exterior grading per civil/architectural/structural drawings. including, but not limited to the following:	Yes
42	Demo/Replacment of all Asphalt due to Electrical Trenching	Yes
43	Demo/Replacment of all Site Concrete due to Electrical Trenching	Yes
44	Demo/Replacment of all Landscaping due to Electrical Trenching	Yes
45	Open excavation protection around excavations	Yes
46	Dewatering of excavations for rain events	Yes
47	Potholing per McCarthy Policies and Procedures	Yes
48	Soft Digging and Hydroexcavation around existing known utilities	Yes
49	Undermining, Bracing, Reshoring, and Grouting where Ductbanks pass below existing Utilities	Yes
50	Equipment and Operator idle time, for redesign of layout	Yes
51	Ductbank Concrete Material (Fiber Reinforced Red Dyed Concrete)	Yes
52	Ocotillo - CLSM around and under New Electrical Buildings	Yes
53	Miscellaneous Civil Scope items, including, but not limited to the following:	

Chandler Improvements Phase 3

Work Category: **16A Electrical, Instrumentations & Controls**

WC Lead: **Kyle Roman**

Bid Date: **August 21, 2026**

TOTAL WORK CATEGORY PACKAGE VALUE		**$9,602,875**
54	Daily Dust control	Yes
55	Survey and Layout (300 hours @ $175.00/hr.)	Yes
56	Road Plates	Yes
57	Site Clean up	Yes
58	Spoils Haul Away & Disposal	Yes
59	Dedicated Onsite Civil Scope Supervision	Yes
60	Coordination & Ancillary work - Provide necessary block-outs, sleeves, coring, etc. for instrument installation as necessary for complete instrument installation, coordinate with Process Mechanical contractor for locations & mechanical equipment vendors, for a fully integrated electrical and instrumentation system. Furnish and install all electrical & instrumentation racks, termination of all electrical equipment, layout of electrical equipment, control panels, and PLC's equipment pads.	Yes
61	Electrical Equipment - Coordinate and Install Long Lead Electrical Equipment all the requirements for Electrical, Instrumentation and Controls including but not limited to, receiving, storing, O&M related (pre-installation) maintenance, and start-up per the specifications and manufacturer's recommendations	Yes
62	Instrumentation & Controls - included but are not limited to: a) Installation of instruments and control devices furnished by others as shown and specified. Refer to P&ID Matrix. Provide and install all supports and hardware for a complete installation. b) Furnish and install all raceways, including supports and wire for instruments and control devices, label wire at both ends per termination schedules. c) Terminate wire at field device after testing. Terminate the wire at PLC's and control panels. Create and maintain testing and termination logs	Yes
63	Signage/Labelling - Equipment and instrument tags, and signage as required and specified in the contract documents	Yes
64	Testing/Commissioning - Startup and Commisioning for new equipment & equipment modified by this scope of work	Yes
65	3rd Party testing - Arc Flash Coordination, Harmonic Studies, Power Studies, Ground Grid, Lighting Protection and Acceptance Testing for new equipment as required and specified in the contract documents	Yes
66	**Per Plans & Specifications (Wilson 100% IFC Submittal)**	Yes
67	**Division 01 - General Requirements - as it relates to this scope of work**	Yes
68	**Division 02 - Site Construction & Demolition - as it relates to this scope of work**	Yes
69	**Division 03 - Concrete - as it relates to this scope of work**	Yes
70	**Division 05 - Metals - as it relates to this scope of work**	Yes
71	**Division 10 - Specialties - as it relates to this scope of work**	Yes
72	**Division 11 - Equipment - as it relates to this scope of work**	Yes
73	**Division 13 - Special Construction - as it relates to this scope of work**	Yes
74	**Division 14 - Hoisting and Conveying - as it relates to this scope of work**	Yes
75	**Division 15 - Mechanical - as it relates to this scope of work**	Yes
76	**Division 16 - Electrical - as it relates to this scope of work**	Yes

Chandler Improvements Phase 3

Work Category: **16A Electrical, Instrumentations & Controls**

WC Lead: **Kyle Roman**

Bid Date: **August 21, 2026**

	TOTAL WORK CATEGORY PACKAGE VALUE	**$9,602,875**
77	**Division 17 - Instrumentation - as it relates to this scope of work**	Yes
78	**Wilson Engineers - 100% Drawings**	
79	**AWRF Summary of General EI&C Work -** as it relates to this scope of work, including, but not limited to the following:	
80	Overall Site - EI&C Demolition, Modification, Installation and wiring of devices, Instruments, circuits, PLC I/O, etc.	Yes
81	Parshall Flume - EI&C Demolition, Modification, Installation and wiring of devices, Instruments, circuits, PLC I/O, etc.	Yes
82	Secondary Clarifiers No.1& No.3 - Replace the underground RAS control/isolation valve - EI&C Demolition, Modification, Installation and wiring of devices, Instruments, circuits, PLC I/O, etc.	Yes
83	Secondary Clarifiers No.1 through No.4 - EI&C Demolition, Modification, Installation and wiring of devices, Instruments, circuits, PLC I/O, etc.	Yes
84	Disk Filter Area - EI&C Demolition, Modification, Installation and wiring of devices, Instruments, circuits, PLC I/O, etc.	Yes
85	NHLW Disposal Station - EI&C Demolition, Modification, Installation and wiring of devices, Instruments, circuits, PLC I/O, etc.	**No**
86	Headworks - EI&C Demolition, Modification, Installation and wiring of devices, Instruments, circuits, PLC I/O, etc.	Yes
87	Odor Control - EI&C Demolition, Modification, Installation and wiring of devices, Instruments, circuits, PLC I/O, etc.	Yes
88	Pre-Stage Basins - EI&C Demolition, Modification, Installation and wiring of devices, Instruments, circuits, PLC I/O, etc.	Yes
89	Chemical Storage Area - EI&C Demolition, Modification, Installation and wiring of devices, Instruments, circuits, PLC I/O, etc.	Yes
90	Fuel Storage Station - EI&C Demolition, Modification, Installation and wiring of devices, Instruments, circuits, PLC I/O, etc.	Yes
91	**AWRF Summary of Instrumentation, Controls, & Programming Work -** as it relates to this scope of work, including, but not limited to the following:	
92	**Furnish, Install, Program, Calibrate, Activate & Test all new wired Instruments and Local Control Panels as indicated within project documents at the following locations:**	Yes
93	Parshall Flume, Secondary Clarifiers(#1-#4), Disk Filter #6, NHLW Station, Headworks, Odor Control, Pre-Stage Basins, Chemical Storage, Chemical Feed, Fuel Storage Tank	Yes
94	**AWRF Summary of Hoisting and Conveying Work -** as it relates to this scope of work, including, but not limited to the following:	
95	Disc Filter Monorail Electrification - (14630-2.3) Replace existing festoon system for the existing monorail Trolley and hoists with a new Conductor Bar System. Furnish and install by Division 14. Disconnect & Reconnect by EI&C	Yes
96	**AWRF Summary of Network & Fiber Work -** as it relates to this scope of work, including, but not limited to the following:	
97	Fuel Storage Station - Installation and wiring of Network capability & Ethernet switch w/ Fiber Connection	Yes
98	Disk Filter 6 VCP - Installation and wiring of Network capability & Ethernet switch w/ Fiber Connection	Yes
99	Network communication extension to Maintenance Building Fire Alarm	**No**
100	**AWRF Summary of Fire Alarm Work -** as it relates to this scope of work, including, but not limited to the following:	

Chandler Improvements Phase 3

Work Category: **16A Electrical, Instrumentations & Controls**

WC Lead: **Kyle Roman**

Bid Date: **August 21, 2026**

	TOTAL WORK CATEGORY PACKAGE VALUE	**$9,602,875**
101	Fire Alarm System - (16720) Complete Fire Surveillance and alarm system at Maintenance Building. Interface with exisiting (Simplex) system at Thickening Building	**No**
102	**Instrumentation List - AWRF -** Furnish Process instruments and Control Panels as indicated in the contract documents resulting in a complete instrumentation and control system including, but not limited to the following:	
103	**Parshall Flume - Influent Pump Station - AWRF (I-01.02)**	
104	Flow Indicator Transmitter - FIT-001	Yes
105	Flow Element - FE-001	Yes
106	Laser Flow Sensor - IPS-001-SLM	Yes
107	**Disc Filter DS6 - AWRF (I-05.03)**	
108	Analyzer Element - AE-600	Yes
109	Analyzer Indicator/Transmitter - DSF06-AIT-600	Yes
110	**NHLW Disposal Station - AWRF (I-08.01) - (ALTERNATE #1)**	
111	Level Switch High-High - LSHH-100 - (ALTERNATE #1)	**No**
112	H2S Control Panel & Alarm - (Refer to 17321) - (ALTERNATE #1)	**No**
113	H2S Sensor - (Refer to 17321) - (ALTERNATE #1)	**No**
114	**Chemical Storage Facility (NaOCL) - AWRF (I-11.02)**	
115	Local Control Panel - CFS-LCP-001	Yes
116	Emergency Stop Hand Switch - NaOCL-HS-001	Yes
117	Level Switch High - NaOH-LSH-775 (See detail C-40.03)	Yes
118	Pressure Switch High - NaOCL-PSH-001	Yes
119	Pressure Switch Low - NaOCL-PSL-001	Yes
120	Pressure Indicator/Transmitter - NaOCL-PIT-001	Yes
121	Pressure Indicator - NaOCL-PI-001	Yes
122	Pressure Switch High - NaOCL-PSH-002	Yes
123	Pressure Indicator - NaOCL-PI-002	Yes
124	Pressure Switch High - NaOCL-PSH-003	Yes
125	Pressure Indicator - NaOCL-PI-003	Yes
126	**Chemical Storage Facility (NaOH) - AWRF (I-11.03)**	
127	Emergency Stop Hand Switch - NaOH-HS-001	Yes
128	Level Switch High - NaOH-LSH-776 (See detail C-40.03)	Yes
129	Pressure Switch High - NaOH-PSH-001	Yes
130	Pressure Switch Low - NaOH-PSL-001	Yes
131	Pressure Indicator/Transmitter - NaOH-PIT-001	Yes
132	Pressure Indicator - NaOH-PI-001	Yes
133	Pressure Switch High - NaOH-PSH-002	Yes
134	Pressure Indicator - NaOH-PI-002	Yes

Chandler Improvements Phase 3

Work Category: **16A Electrical, Instrumentations & Controls**

WC Lead: **Kyle Roman**

Bid Date: **August 21, 2026**

	TOTAL WORK CATEGORY PACKAGE VALUE	**$9,602,875**
135	Pressure Switch High - NaOH-PSH-003	Yes
136	Pressure Indicator - NaOH-PI-003	Yes
137	**Pre-Stage Basin No. 2 Odor Control Modification - AWRF (I-11.07)**	
138	Level Switch High - NaOH-LSH-### (See detail C-40.03)	Yes
139	**Pre-Stage Basin No. 1 Odor Control Modification - AWRF (I-11.09)**	
140	Level Switch High - NaOH-LSH-### (See detail C-40.03)	Yes
141	**AWRF MOPO's -** Actively participate in the MOPO process including, but not limited to, creating step by step plans, hosting/attending meetings, coordination, identifying and furnishing temporary power and controls and direct execution of means and measures nessesary to accomplish each MOPO successfully as provided in the Specifications and confirmed by Plant Operations.	
142	A-2 Parshall Flume Rehabilitation(60 days) - Laser flow meter replacement & support temp EI&C measures as needed for IPS process	Yes
143	A-5 Secondary Clarifiers Mechanism Replacement(93 days) - Support Temp EI&C measures as needed to maintain 2 Clarifiers operable. Assume temporary power connections to be made via SO cord and connections at Clarifier Junction Boxes for minimum 2 Clarifiers at a time	Yes
144	A-6 Secondary Clarifiers drain 12" plug valve replacement(6 days) - De-term, replace disconnect and electrical wiring, re-term and support temp EI&C measures as needed to maintain minimum 2 Clarifiers operable	Yes
145	A-7 Secondary Clarifiers drain 16" plug valve replacement(3 days) - Determ, replace disconnect and electrical wiring, retern and support temp EI&C measures as needed to maintain min.Clarifiers operable	Yes
146	A-8 Chemical Feed Loop(180 days) - Chem panels interact with multiple pumps each. This MOPO will likely contain as many as 9 separate shutdowns (1 pump at a time, 1 panel at a time) provide temporary connections of power and controls as needed to maintain min chemical process	Yes
147	A-8.1 Chemical Feed Loop(1/2 day) - Shutdown and electrical Tie-ins for PP-HW2. Provide temporary connections of power and controls as needed to maintain min chemical process	Yes
148	A-9.1 Disk Filter #6 Installation(1/2 day) - Shutdown and electrical Tie-ins for DSF-LP-400. provide temporary connections of power and controls as needed to maintain min disk filter process	Yes
149	A-9.2 Disk Filter #6 Installation(1/2 day) - Shutdown and electrical Tie-ins for DSF-PP-300. provide temporary connections of power and controls as needed to maintain min disk filter process	Yes
150	A-12 NHLW Station - Shutdown and electrical Tie-ins at PP-DW3. Provide temporary connections of 120v power for PLC and/or Network controls to maintain min process in affected area	Yes
151	A-13 Fuel Storage Station - Shutdown and electrical Tie-ins for MPC feeding Fuel Storage Station. Provide temporary connections of 120v power for PLC and/or Network controls to maintain min process in affected area	Yes
152	**Ocotillo WRF Summary of General EI&C Work -** as it relates to this scope of work, including, but not limited to the following:	
153	Overall Site - EI&C Demolition, Modification, Installation and wiring of devices, Instruments, circuits, PLC I/O, etc.	Yes

Chandler Improvements Phase 3

Work Category: 16A Electrical, Instrumentations & Controls

WC Lead: Kyle Roman

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		**$9,602,875**
154	New Duct banks - New Concrete encased pathways for electrical distribution as follows: SGR-120-001&002 to SWGR-1AA&1AB - MV to MLE SWGR-1AA&1AB to PDP-639-001 - Sludge Building SWGR-1AA&1AB to EFF-MCC-001&002 - Effluent Pump Station SWGR-1AA&1AB to ANX-MCC-001&002 - Anoxic Basin SWGR-1AA&1AB to EMH-17 - Refeed MCC AER-BLR-001&002 (Aeration Blower Building) SWGR-1AA&1AB to EMH-17 - Refeed MCC D1&D2 (Old Dewatering Building) SWGR-1AA&1AB to EMH-17 - Feed to PDP-001 (Old Headworks) EMH-19 to T-POC - LP-P1 conduit block diagram	Yes
155	**Duct bank Reuse - Reuse of existing infrastructure of Duct bank and Manholes as follows:**	
156	EMH-17 to EMH-19 - Refeed MCC D1&D2	Yes
157	EMH-17 to EMH-31 - Refeed MCC AER-BLR-001&002	Yes
158	EMH-28 to EMH-10 - MCC EFF-001&002 conduit block diagram	Yes
159	EMH&CMH(ANX) to EPB's&CPB's(1-3) - ANX-MCC-001&002 conduit block diagram	Yes
160	EMH&CMH-03 to EMH&CMH-04 - MCC-410-001&002 conduit block diagram	Yes
161	MV Switchgear Bucket Tie-ins (SGR-120-001&002) - EI&C Modification, Installation and wiring of devices, Instruments, circuits, etc. (Switchgear modifications by Eaton, FBO)	Yes
162	New MV Switches (DSC-1AA-001& DSC-1AB-002) & Liquid Filled Substation XMFR's (TRF-1AA-0011&TRF-1AB-002) - EI&C Installation of equipment and wiring of devices, Instruments, circuits, etc. (Equipment by Eaton, FBO)	Yes
163	New Main Electrical Building, Switchgear(SWGR-1AA & SWGR1-AB), Panel(LS), XMFR(XFR-Panel LS), ATS(LS) - EI&C Installation of equipment and wiring of devices, Instruments, circuits, etc. (Building by TBD, Equipment by Eaton, all FBO)	Yes
164	Bioreactor Basins MCC Upgrades, Aeration Mixers & IMLR Pumps - EI&C Demolition, Modification, Remove/Replace of Buckets & install of Disconnects and wiring of devices, Instruments, circuits, PLC I/O, etc. (MCC Buckets and Disconnects by Eaton, FBO)	Yes
165	South Sludge Holding - Demolish MCC-639-001&002, EI&C Modification, Installation of new PDP(639-001) Refeed, Rewiring of equipment, devices, Instruments, circuits, PLC I/O, etc. (Equipment by Eaton, FBO)	Yes
166	Anoxic Aeration Basin - New Electrical Building, MCC(ANX-001&002), Panel(419-001), XMFR(TRF-419-001), ATS(419-001) IMLR Pump 7 - EI&C Demolition, Modification, Installation, Refeed, and Rewiring of equipment, devices, Instruments, circuits, PLC I/O, etc. (Electrical Building by TBD, Equipment by Eaton, all FBO)	Yes
167	Secondary Clarifiers No.3 - EI&C Demolition, Modification, Installation of MCP(SEC-MTR-MCP-300) and Fixtures, wiring of devices, Instruments, circuits, PLC I/O, etc. (Equipment by Eaton, FBO)	Yes

Chandler Improvements Phase 3

Work Category: **16A Electrical, Instrumentations & Controls**

WC Lead: **Kyle Roman**

Bid Date: **August 21, 2026**

	TOTAL WORK CATEGORY PACKAGE VALUE	**$9,602,875**
168	Effluent Pump Station - MCC(EFF-001&002) Replacement, EI&C Demolition, Modification, Remove/replace of ATS(E), intallation and Refeed from SWGR-1AA&1AB, Rewiring of equipment, devices, Instruments, circuits, PLC I/O, etc. (Equipment by Eaton, FBO)	Yes
169	Aeration Blower MCC's(AER-BLR-MCC-001&002) - Disconnect, Demolition and Refeed from new SWGR-1AA&1AB	Yes
170	Old Dewatering Building MCC's(MCC-D1 & MCC-D2) - Disconnect and Demolition of existing Circuits, feeders, etc. back to MCC. Install, Rewire, & Refeed MCC from SWGR-1AA&1AB	Yes
171	MCC-SOC-400A - Disconnection, Demolition of Existing Circuits, feeders, etc. back to MCC-SOC-400A	Yes
172	MCC-P & MCC-POC - Demolish MCC-P & MCC-POC. Install new XMFR (T-POC), Panel (LP-P1). Feed from MCC-D1. Refeed, Rewiring of equipment, devices, Instruments, circuits, PLC I/O, etc. (Equipment by Eaton, FBO)	Yes
173	Old Headworks MCC Replacement - Demolish MCC-H1&H2. EI&C Modification, Installation of new PDP(001) Refeed from SWGR-1AA&1AB, Rewiring of equipment, devices, Instruments, circuits, PLC I/O, etc. (Equipment by Eaton, FBO)	Yes
174	Fuel Storage Station - New MPC(FS-MPC-100) Feed from DP-120-001. Installation and wiring of equipment, VCP, devices, Instruments, circuits, PLC I/O, etc. (Equipment by Eaton, FBO)	Yes
175	Demo Existing SES-1- Remove SES-1 Entirely, Including Existing Panel LS, PCP-129-001, 750kw Gen No.1, 750kw Gen No.2, Existing SES Substation. Move all ro exterior of SES yard for removal and disposal by others	Yes
176	**OWRF Summary of Instrumentation, Controls, & Programming Work -** as it relates to this scope of work, including, but not limited to the following:	
177	Furnish, Install, Program, Calibrate, Activate & Test all new wired Instruments as shown on Instrumentation drawings at the following locations:	Yes
178	Bioreactor Basins, Anoxic Basins, Secondary Clarifier No. 3, Fuel Storage Tank	Yes
179	**OWRF Summary of Grounding and Lighting Protection Work -** as it relates to this scope of work, including, but not limited to the following:	
180	New Electrical Equipment and New Buildings - Furnish, install, Modify and test Ground Grid	Yes
181	New Electrical Equipment and New Buildings - Furnish, install, Modify and test External Building Lighting Protection	**No**
182	**OWRF Summary of Network & Fiber Work -** as it relates to this scope of work, including, but not limited to the following:	
183	Fuel Storage Station - Installation and wiring of Network capability & Ethernet switch w/ Fiber Connection	Yes
184	New ANX PLC - Installation and wiring of Network capability & Ethernet switch w/ Fiber Connection	Yes
185	Extend Network to Fire Alarm Panels at Anoxic Electrial Building and New Electrical Building	Yes
186	Network communication extension to Sludge Building Fire Alarm	**No**

Chandler Improvements Phase 3

Work Category: **16A Electrical, Instrumentations & Controls**

WC Lead: **Kyle Roman**

Bid Date: **August 21, 2026**

	TOTAL WORK CATEGORY PACKAGE VALUE	**$9,602,875**
187	**OWRF Summary of Fire Alarm Work -** as it relates to this scope of work, including, but not limited to the following:	
188	Sludge Building - (16720) Complete Fire Surveillance and alarm system for Sludge Holding Tank Blower Building No.2 Interface with existing (simplex) system at South Admin Building. New System to communicate with all existing zones in south plant	**No**
189	New Electrical Buildings - (16720) Fire Surveillance and alarm system for New Electrical Interface with existing (simplex) system. New System to communicate with all existing zones in south plant	Yes
190	**Instrumentation List - OWRF -** Furnish Process instruments and Control Panels as indicated in the contract documents resulting in a complete instrumentation and control system including, but not limited to the following:	
191	**MBR Aeration Basin No. 1 Modification - OWRF (I-23.03)**	
192	Local Control Panel - LCP-410-101	Yes
193	**MBR Aeration Basin No. 2 Modification - OWRF (I-23.06)**	
194	Local Control Panel - LCP-410-201	Yes
195	**Anoxic Basins Modifications - OWRF (I-25.01)**	
196	Local Control Panel - ANX-MLR-PMP-LCP-007	Yes
197	Flow Switch Low - ANX-MLR-FSL-007	Yes
198	Pressure Indicator - PI-007	Yes
199	Flush Water Flow Switch - FSL-701A	Yes
200	Seal Water Flow Switch - FSL-701B	Yes
201	Pressure Indicator - PI-701	Yes
202	**Secondary Clarifiers No. 3 - OWRF (I-27.01)**	
203	Torque Indicator - OT-300	Yes
204	Torque Element - OE-300	Yes
205	**OWRF MOPO's -** Actively participate in the MOPO process including, but not limited to, creating step by step plans, hosting/attending meetings, coordination, identifying and furnishing temporary power and controls and direct execution of means and measures nessesary to accomplish each MOPO successfully as provided in the Specifications and confirmed by Plant Operations.	
206	O-1.1 MBR IMLR Pump Installation - Shutdown and electrical Tie-ins at MCC-410-001/002. Replace existing NEMA 1 Starter Buckets with NEMA 2 Starter Buckets. Install new VFD Bucket for IMLR Pumps. Buckets and provisions furnished by Eaton, to be installed by EC. Only 1 side of MCC-410-001/002 can be down at a time. Coordinate with installation of new diffusers while basin is drained.	Yes
207	O-2 Anoxic Basin IMLR Pump No.7 - Shutdown and electrical Tie-ins at MCC-ANX-002. Coordination with O-10 required. Connect IMLR Pump No. 7 to new MCC-ANX-002 and complete startup prior to proceeding with O-10	Yes
208	O-3 Secondary Clarifier No.3 Mechanism Replacement - Support Temp EI&C measures as needed to maintain 2 Clarifiers operable. Only 1 side of each Clarifier MCC can be shut down at a time for installation of new equipment. Coordianation with O-8 required to determine if this MOPO must be completed prior to MCC re-feed in O-8	Yes

Chandler Improvements Phase 3

Work Category: 16A Electrical, Instrumentations & Controls

WC Lead: Kyle Roman

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE		**$9,602,875**
209	O-5 SGR-120-001 A side energization(3 days) - This MOPO will contain multiple phases Temporary power provisions. A.) Conduit and Wire into MV switchgear. B.) Eaton Field Services to install new modifications to add new MV bucket and breaker in SGR-120-001 C.) DP-710-001 feeds the current Administration building, which is in use continually and houses critical network infrastructure which must remain energized for the duration. Temporary Generator will need to be connected and ready for min.72 hours use prior to this outage. Coordinate this MOPO with O-6. O-5 and O-6 cannot occur at the same time. Duration of time between these os subject to coordination with and approval by the plant	Yes
210	O-6 SGR-120-002 B side energization(1 day) - This MOPO will contain multiple phases Temporary power provisions. A.) Conduit and Wire into MV switchgear. B.) Eaton Field Services to install new MV breaker and calibrate CT's in SGR-120-002 C.) DP-120-001 can only be deenergized for a short window (1 hour) This DP will require temp power as it serves PLC's and Network power that must remain energized for the duration. Coordinate with DP-120-001 shutdown to connect FS-MPC-100 conduit and wire during 1 hour window D.) DP-720-001 feeds the current Maintenance building, which can be interupted for up to 10 hours without the need for a temporary generator. Coordinate this MOPO with O-5. O-6 and O-5 cannot occur at the same time. Duration of time between these os subject to coordination with and approval by the plant	Yes
211	O-7 MCC D1/D2 Energization - (2 days A side, 2 days B side) - Provide temporary connections of 120v power for PLC and/or Network controls as needed to maintain power to plant communications and controls during the outage	Yes
212	O-8 AER-BLR-MCC 001/002 Energization - (2 days A side, 2 days B side) - Provide temporary connections of 120v power for PLC and/or Network controls as needed to maintain power to plant communications and controls during the outage. Support Temp EI&C measures as needed to maintain 2 Clarifiers operable.	Yes
213	O-9.1 EFF-MCC-001/002 Energization (2-3 weeks A side, 2-3 weeks B side) - This MOPO requires new MCC equipment and raceways for connecting to existing to be installed prior to first side outage. A side of new MCC to be connected to new SWGR, while B side of existing is still connected to SES-1. de-energize and transfer loads 1 at a time from existing A side to new A side until all loads are terminated on A side of new MCC. Repeat for New B side, energizing the new feed from SWGR, and then transfering over 1 load at a time from existing MCC- side B to new MCC side B. Provide temporary connections of 120v power for PLC and/or Network controls as needed to maintain power to plant communications and controls during the outage	Yes
214	O-9.2 EFF-MCC-001/002 New ATS-E (1 day) de-energize and replace ATS-E. Provide temporary connections of 120v power for PLC and/or Network controls fed from Panel LPE as needed to maintain power to plant communications and controls during the outage Coordinate with O-9.1 to determine when to execute this MOPO within the duration of O-9.1	Yes
215	O-9.3 EFF-MCC-001/002 LP-519-001 (1/2 day) Move load over to New MCC. Coordinate with O-9.1 to determine when to execute this MOPO within the duration of O-9.1	Yes
216	O-9.4 EFF-MCC-001/002 Maintenance BLDG A (1 day) Move load over to New MCC. Coordinate with O-9.1 to determine when to execute this MOPO within the duration of O-9.1. Provide temporary connections of 120v power for PLC and/or Network controls as needed to maintain power to plant communications and controls during the outage	Yes
217	O-9.5 EFF-MCC-001/002 DSF-LP-100 (1/2 day) Move load over to New MCC. Coordinate with O-9.1 to determine when to execute this MOPO within the duration of O-9.2	Yes

Chandler Improvements Phase 3

Work Category: **16A Electrical, Instrumentations & Controls**

WC Lead: **Kyle Roman**

Bid Date: **August 21, 2026**

TOTAL WORK CATEGORY PACKAGE VALUE		**$9,602,875**
218	O-10 ANX-MCC-001/002 Energization (2-3 weeks A side, 2-3 weeks B side) - This MOPO requires new MCC equipment to be fully installed and conduits for loads to be connected to existing Manholes prior to first side outage. B side of new MCC to be connected to new SWGR, while A side of existing is still connected to SES-1. De-energize and transfer loads 1 at a time from existing B side to new B side until all loads are terminated on B side of new MCC. Repeat for New A side, energizing the new feed from SWGR, and then transfering over 1 load at a time from existing MCC- side A to new MCC side A. Coordinate with MOPO O-2 (Anoxic IMLR Pump installation) This MOPO may have to wait until O-2 is complete depending on needed capacity in ANX basin Provide temporary connections of 120v power for PLC and/or Network controls as needed to maintain power to plant communications and controls during the outage and other measures as needed to maintain 2 Clarifiers operable.	Yes
219	O-11 PDP-639-001 -MCC T1 & T2 removal & LPT Refeed (1 day) - 4 feeds total. Important loads include power roof vent and GRIC. This MOPO requires new PDP and raceways for connection to existing loads to be installed prior to outage. Provide temporary connections of 120v power for PLC and/or Network controls as needed to maintain power to plant communications and controls during the outage. MOPO O-10 and MOPO O-14 to re-feed PP-GRIC must be complete prior to this MOPO	Yes
220	O-12 PDP-001 - H1 & H2 removal & LPH Refeed (2 days) - 4 feeds total. Important loads include Headworks roll up door, Air conditioner, and air fans 229-001, 229-002. This MOPO requires new PDP and raceways for connection to existing loads to be installed prior to outage. Provide temporary connections of 120v power for PLC and/or Network controls as needed to maintain power to plant communications and controls during the outage.	Yes
221	O-13 T-POC and LP-P1 (MCC-P & MCC-POC Removal and refeed) (5 days) - POC currently fed from MCC-P to be removed and refed by existing MCC-D1. Important loads include LIT's (LIT-210-909-27 & LIT-210-910-31), & camera. Provide temporary connections of 120v power for PLC, LIT, camera and network controls as needed to maintain power to plant communications and controls during the outage.	Yes
222	O-14 PP-GRIC Refeed from local SES (1 day) - GRIC currently fed from MCC-T2. To be refed from local SES board next to GRIC Building. Provide temporary connections of 120v power for PLC and/or Network controls as needed to maintain power to plant communications and controls during the outage. Coordinate with MOPO O-11. May need to be completed before or during O-11	Yes
223	Textura Included	Yes
224	End of Scope (Add New Rows Above This Line)	
225	Bond/CDI Cost	Yes

Chandler Improvements Phase 3

Work Category: 16A Electrical, Instrumentations & Controls

WC Lead: Kyle Roman

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE	$9,602,875

	ASSUMPTIONS & CLARIFICATIONS:
1	Electrical instrumentation and Controls scope included per Wilson For Construction submittal as indicated below:
2	Includes all labor, materials, equipment, supervision, coordination, testing, and programming required for this work category in accordance with the contract documents.
3	Wire and Cable pricing is based upon the June 12th, 2026 $6.43/lb. Copper Index.
4	Includes instrumentation devices, control wiring, raceways, panels, terminations, programming, integration, testing, and calibration. Integration is limited to the defined electrical and I&C scope.
5	Mechanical, process piping, and nonelectrical instrumentation installation is by others, unless specifically noted.
6	It is assumed that all existing electrical single-line equipment designated in the Contract Documents for modification and reuse has been verified by the City of Chandler as operational and suitable for continued service. We further assume that all manufacturer-recommended maintenance and service requirements have been performed throughout the equipment's service life up to the point at which McCarthy begins work on the equipment.
7	Our scope includes only the modifications and connections required by the Contract Documents. If functional testing, energization, startup, or commissioning reveals damaged, worn, failed, or otherwise defective internal components or conditions not caused by McCarthy's or its subcontractors' negligence, such repair or replacement work is excluded.
8	It is understood that per site coordination and preconstruction walk between Wilson, CoC and McCarthy that work may be performed in live existing manholes containing systems 600V or less, with appropriate safety measures as per NFPA 70 with no formal MOPO required.
9	Contractor will UL certify any modiciations that are completed as a part of this GMP. If previous work completed on the panels will not allow for the panel to be UL certified then recertification will not be required or change order will be provided by the City to the contractor to further modify the compnents that are not compliant.
10	Electrical and Communications Duct Banks Include furnishing, layout, survey, coordination, demolition, modification and installation of Raceways, Handholes and Manholes as shown in contract documents unless existing sections of duct bank are specifically identified for reuse, as indicated herein.
11	According to Section 16137. Underground conduits grouped together (3) or fewer will be PVC Coated GRC and buried at required minimum depth without rebar reinforcement or concrete encasement. Conduits grouped together (4) or more will include reinforcement and encasement according to detail 188 on E-35.01
12	Some existing underground duct bank conduits have been investigated and found to be intact, of adequate size for new wiring, and routing is practical to refeed or serve new loads as required in the project documents. These conduits are planned for reuse. A formal submittal map and conduit block diagram will be submitted to engineer for information prior to installation in each process area.
13	Conduit Seal offs will be furnished and installed in locations as indicated and implied within the contract documents, and as required by applicable NEC.
14	Handling, removal and disposal of hazardous materials associated with existing transformers, generators and substations is not included in the project scope.

Chandler Improvements Phase 3

Work Category: **16A Electrical, Instrumentations & Controls**

WC Lead: **Kyle Roman**

Bid Date: **August 21, 2026**

TOTAL WORK CATEGORY PACKAGE VALUE	**$9,602,875**

15	
16	AWRF Airport Water Reclamation Facility
17	Secondary Clarifiers: Disconnect Switches are not shown on Clarifier Motors power conduit block diagrams. Based on Response from Wilson on Agency Review log, we will assume to reuse existing disconnect switches at clarifier 1-3 and replace toggle switch at Clarifier 4 with a disconnect of matching rating and type.
18	Disc Filter No. 6: Regarding Power and Control pull boxes; New pull boxes for Disc Filter No. 6 will be furnished and installed to mirror placement and routing of existing filters 1-5. Deviation from drawings; to be confirmed in submittal drawing during construction.
19	Fuel Storage Station: Includes terminations and connections for Network, Electrical, and Controls from field panels to the Vendor Control Panel under 16A.
20	Parshall Flume: Replace as indicated in the contract documents.
21	MOPO Provisions: Included are temporary provisions for instrumentation and controls and temp power connections extending from existing nearby 120v sources, 20A and smaller, as needed to maintain plant process operations.
22	
23	Excluded from AWRF Pricing:
24	Fire Alarm System upgrades at Maintenance building. We believe this summary of work in specification 16720 is unintended carryover from a previous phase of work and is not required to be part of this project. Therefore, any work related to or associated with fire alarm is excluded.
25	Disc Filter Monorail Power System will be furnished and installed under WC 14A. Only electrical make safe and reconnect to existing circuitry is included under 16A
26	Not used
27	All work supporting Jacobs EI&C, I/O Panel replacement and SCADA Network upgrades are not included.
28	All work supporting Volume 5 (Administration Building Remodel) is not included.

Chandler Improvements Phase 3

Work Category: **16A Electrical, Instrumentations & Controls**

WC Lead: **Kyle Roman**

Bid Date: **August 21, 2026**

TOTAL WORK CATEGORY PACKAGE VALUE	**$9,602,875**

29	
30	OWRF Ocotillo Water Reclamation Facility
31	Effluent Pump Station: DSF-MTS-100 and ATS-E are located within the electrical room. Raceways for this equipment will not leave the building and route through existing manholes as indicated on the Conduit Block Diagrams
32	SGR-120-001/002 to SWGR 1AA/1AB: A Side and B Side duct banks will occupy the same trench and encasement for the full distance between existing buildings and new switchgear building. A side and B side conduits will be separated at manholes only.
33	Lightning Protection System: It is assumed that the extent of Lightning Protection is limited to the counterpoise and pigtail tie-ins to interior equipment only as detailed in the E drawings. No further exterior building mounted system is included. Additional cost alternate provided in Work Category Description.
34	Typical MOPO Provisions: Included are temporary provisions for instrumentation and controls and temp power connections extending from existing nearby 120v sources, 20A and smaller, as needed to maintain plant process operations.
35	MOPO Sequence: It is assumed that electrical service cutovers to existing and new replacement equipment (MCC's and SWGR's) can be performed by isolating and deenergizing 1 side of each associated main-tie-main at a time. It is assumed that no additional 3 phase temp power generation or provisions will be required unless specifically noted under 'Expanded MOPO Provisions'.
36	Expanded MOPO Provisions: DP-710-001 feeds the current Administration building, which is in use continually and houses critical network infrastructure which must remain energized for the MOPO O-5 duration (3 Days) Temp Generator or equal provision will be provided.
37	
38	Excluded from OWRF Pricing:
39	Fire Alarm system upgrades at the Sludge Holding Building. We interpret that the provided summary of work in specification 16720 is unintended carryover from a previous phase of work and is not required to be part of this project. Therefore, any work related to or associated with fire alarm is excluded.
40	Fire Surveillance and Alarm Systems at new Electrical Buildings: There is insufficient information to determine if new Fire Surveillance and Alarm system is required inside of the 2 new electrical buildings (Anoxic MCC) & (SWGR-1AA/1AB) Therefore, any work related to or associated with fire alarm is excluded.
41	Not used
42	Ductbank Clarifications

Chandler Improvements Phase 3

Work Category: 16A Electrical, Instrumentations & Controls

WC Lead: Kyle Roman

Bid Date: August 21, 2026

TOTAL WORK CATEGORY PACKAGE VALUE	**$9,602,875**

43	Duct bank sections will be reused as defined by the attached Utility Exhibit. Utility Exhibit was developed in conjunction with design engineer through field walks, and confirmed over the course of several meetings. Official submittal with duct bank routing will define the conduit runs and wire pulls utilizing existing for final confirmation.
44	Minor field adjustments within the intended corridor are covered under the WC cost. Major relocation outside of the intended corridor, redesign due to unforeseen obstruction, or added length/structure beyond the current basis.
45	Existing duct bank identified for reuse are assumed to be accessible, structurally serviceable, reasonably clean, and capable of accommodating the planned conductors/raceways after normal verification. Remediation for collapsed, blocked, flooded, undersized, inaccessible, structurally deficient, or otherwise unusable is not included in the project costs. New conduit needed for areas identified as reuse conduit per the attached Utility Exhibit are not included in the project costs. Any investigation/verification of the existing conduits beyond a mandrel is not included.
46	Demolition of Existing duct bank will be limited to locations where new duct bank must be installed in the same civil elevation of existing duct bank underground. All other existing underground duct bank, handholes and manholes will be marked as spare, conduit ends sealed and abandoned in place .
47	Utility relocation or replacement are not planned to accommodate any duct banks. Duct banks will need to be adjusted around existing utilities.
48	Dewatering includes ordinary rainwater, surface water, and localized ground water management necessary to install the work. Persistent groundwater, perched water, contaminated water, high-volume pumping, treatment, discharge permitting, offsite disposal, well points, or dewatering that materially extends the work duration is not included in the projects costs.
49	Soil report for the project was not available upon request from Engineers. Soil conditions have been assumed to be typical for Chandler construction projects based on previous job experience. Trenching operations that encounter unsuitable soil that requires over excavation/engineered fill, hard dig conditions, shoring beyond typical measures, or contamination disposal are not included in the projects costs.

GENERAL NOTES:

1. This plan was prepared in conformance with ASCE standard CI/ASCE 38-22 "American Society of Civil Engineers Standard Guideline for Investigating and Documenting Existing Utilities".
2. WE will only warrant the three dimensional location of utility lines based on quality level A information. QL "A" information is only valid within the visible limits of the test hole.
3. WE will advance a vacuum test hole until a condition of practical refusal for vacuum excavation is reached. Practical refusal is defined as any of the following conditions occurring: bedrock, water table or reaching a depth of 12'.
4. Below ground structures, unless dimensioned, are symbolic only.
5. Prior to excavation utility owners shall review and approve this drawing.
6. This drawing is prepared in color. Reproduction may alter the information contained herein. WE do not warrant the information contained herein in the event of reproduction.
7. Base mapping/survey control is shown for information only and is not warranted.
8. WE recommend that all existing utilities critical to proposed construction activities be located by vacuum excavation (quality level A) prior to any excavation (if not already located by vacuum excavation).
9. Utility Lines shown on the plans labeled as Quality Level B have been traced and surveyed using various geophysical instruments. Unless noted as Quality Level B it should be assumed that lines are shown as approximate only.
10. Utility Lines depicted on the plan as ASCE Quality Level D are from various plans and records from public or private stakeholders. WE requested that all available plans and records be provided from all of the known stakeholders.
11. WE obtained numerous One Call design tickets for this project and the locations of all markouts have been surveyed and documented.
12. Electrical lines shown on the plans were traced using hand held locators by indirect induction methods. The lines traced are depicted as ASCE 38-22 Quality Level B.
13. Telephone and communication lines shown on the plans were traced using direct and indirect connections through building basements, vaults, and hand holes. The lines traced are depicted as ASCE 38-22 Quality Level B.
14. Water lines were traced using direct and indirect induction methods. The lines traced are depicted as ASCE 38-22 Quality Level B.
15. Underground structural elements such as tie backs, sheeting, shoring, framing, piles or pile caps have not been plotted within this set. The respective public and private plans should be reviewed prior to demolition and construction in order to identify underground structural elements.
16. Utilities located within fenced in electrical sub-stations are not accessible by field personnel, therefore can not be field located.
17. Utility vault structures are shown using best available information collected at the time of the survey/investigation. However, data may be limited by accessibility and measurement accuracies. All below grade utility vaults structures shown hereon should be considered approximate and are depicted as ASCE 38-22 Quality Level C.
18. Any and all depth of utilities depicted at a QL-B standard of care hereon shall be considered approximate as of the date of the investigation an[illegible]e used as a basis of design, construc[illegible], or construction methodology without further investigation to expose the utility in question and obtain a hard measurement. It is the responsibility of the contractor to utilize soft digging best practices to expose all utilities having a potential for conflict within the area of excavation prior to any hard digging excavation. McCarthy shall not be held liable for any decisions of incidents that result from the reliance upon any of the QL-B provided depth information.
19. All easement lines depicted hereon are shown per provided record documents and approximately plotted per available GIS parcel information or survey by others. These lines are approximate and should be considered for reference only. The purpose of this depiction is to show the possibility of the existence of utilities that may or may not exist within said easements and should not be relied upon for any other purpose. A title report has not been procured as a part of this scope and therefore additional easements may exist beyond what has been depicted.

conventional excavation

potholing & hydro excavation

duct bank identified for reuse

UTILITY COMPANY STAKEHOLDERS:

ELECTRIC
City of Chandler
175 S ARIZONA AVE,
CHANDLER, AZ 85225
420-782-2000

SALT RIVER PROJECT - MARICOPA COUNTY
1500 N. MILL AVE,
TEMPE, AZ 85288
602-236-8888

TELEPHONE
City of Chandler
175 S ARIZONA AVE,
CHANDLER, AZ 85225
420-782-2000

SALT RIVER PROJECT - MARICOPA COUNTY
1500 N. MILL AVE,
TEMPE, AZ 85288
602-236-8888

FIBER OPTIC
City of Chandler TRAFFIC SIGNALS
175 S ARIZONA AVE,
CHANDLER, AZ 85225
420-782-2000

SALT RIVER PROJECT - MARICOPA COUNTY
1500 N. MILL AVE,
TEMPE, AZ 85288
602-236-8888

CENTURYLINK
2942 M HARTFORD ST.
CHANDLER, AZ 85225
833-660-1244

STORM & SANITARY SEWER
City of Chandler
175 S ARIZONA AVE,
CHANDLER, AZ 85225
420-782-2000

We have contacted the listed utility stakeholders and have requested and and all available utility records. The provided records have be depicted hereon at the appropriate quality level.

ARIZONA811 BLUE STAKE, INC.
Know what's below. Call before you dig.

ARIZONA LAW REQUIRES THAT A UTILITY LOCATE REQUEST BE PLACED 2 WORKING DAYS BEFORE BEGINNING ANY EXCAVATION. CALL (602) 659-7500 OR 811 OR PLACE A REQUEST ONLINE BY CLICKING AT WWW.AZBLUESTAKE.COM.

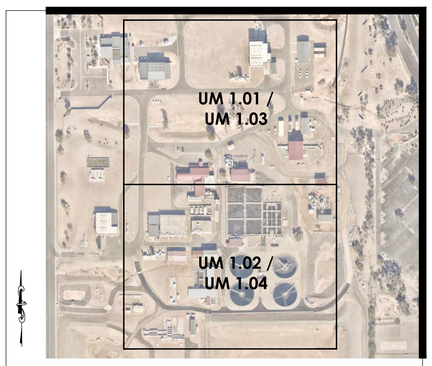
Chandler • Arizona
Where Values Make The Difference

CHANDLER WTP OWRF
2737 S OLD PRINCE RD., CHANDLER AZ, 85248
EXISTING SUBSURFACE UTILITY EXHIBIT

MAPPING NUMBER:
004006.SUM

PROJECT DIRECTORY

PROJECT MANAGER CONTACT
McCARTHY MAPPING
Elijah Enos
PHONE: 480-851-3722
WEBSITE: http://www.mapping.mccarthy.com
Email: eenos@mccarthy.com



KEY PLAN
NOT TO SCALE

DRAWING INDEX

SHEET #	SHEET NAME
UM 1.00	COVER SHEET
UM 1.01 - UM 1.02	EXISTING COMPOSITE UTILITY PLAN - QL-B
UM 1.03 - UM 1.04	PROPOSED COMPOSITE UTILITY PLAN - QL-B

LEGEND:

CURB/AREA INLET
GRATED INLET/GRATED INLET w/SIDE INTAKE
GRATED MANHOLE
ROUND GRATED INLET
YARD DRAIN
SEWER CLEANOUT
ROOF DRAIN (PIPED)
ROOF DRAIN (SPLASH TO GRADE)
STORM SEWER MANHOLE
SUMP PIT
SANITARY SEWER MANHOLE
QL-A TESTHOLE LOCATION
WATER VALVE, WATER METER
WATER MAINTENANCE HOLE
FIRE HYDRANT, WATER SPIGOT
POST INDICATOR VALVE
SIAMESE FIRE DEPT. CONNECTION
MONITORING WELL
FIRE DEPT. CONNECTION - WALL MOUNTED
WATER BACKFLOW PREVENTER
RECLAIMED WATER BACKFLOW PREVENTER
IRRIGATION CONTROL VALVE
RECLAIMED WATER VALVE
RECLAIMED WATER MANHOLE
FUEL MANHOLE/FUEL TANK LID
STEAM MANHOLE
WASTE WATER / PROCESS PIPING MANHOLE
HYDRONIC MANHOLE
TUNNEL ACCESS LID / MANHOLE
COMMUNICATION CELLULAR TOWER
COMMUNICATION MANHOLE
COMMUNICATION VAULT
COMMUNICATION PEDESTAL
COMMUNICATION HANDHOLE
COMMUNICATION WALL BOX/JUNCTION BOX
EMERGENCY CALL BOX
GAS VALVE, GAS METER, GAS DRIP
TRACER WIRE BOX
ELECTRIC MANHOLE
ELECTRIC TRANSFORMER BOX
ELECTRIC SWITCHGEAR
UTILITY POLE
ELECTRIC PEDESTAL
ELECTRIC METER
ELECTRIC HANDHOLE
ELECTRIC PULLBOX
ELECTRIC GROUND ROD BOX
ELECTRIC WALL BOX/JUNCTION BOX
ELECTRIC VEHICLE CHARGING STATION
ELECTRIC OUTLET
STREET LIGHT
STADIUM LIGHTS
LIGHT STANDARD/LIGHT STANDARD w/CAMERA
YARD LIGHT
LIGHTED BOLLARD
TRANSMISSION POWER POLE
TRAFFIC SIGNAL/TRAFFIC SIGNAL w/MAST ARM
TRAFFIC SIGNAL BOX
TRAFFIC CROSSWALK PUSH BUTTON

PROJECT LIMITS
STORM SEWER LINE (UNDER 12")
STORM SEWER LINE (OVER 12")
SANITARY FORCEMAIN
SANITARY SEWER LINE (UNDER 12")
SANITARY SEWER LINE (OVER 12")
PROCESS PIPING LINE (UNDER 12")
PROCESS PIPING LINE (OVER 12")
WATER LINE (UNDER 12")
FIRE WATER LINE (UNDER 12")
WATER LINE (OVER 12")
CHILLED WATER LINE (UNDER 12")
CHILLED WATER LINE (OVER 12")
HEATING HOT WATER LINE (UNDER 12")
HEATING HOT WATER LINE (OVER 12")
RECLAIMED WATER LINE (UNDER 12")
RECLAIMED WATER LINE (OVER 12")
TELEPHONE LINE
TELEPHONE DUCT
COAX TV LINE
COMMUNICATION LINE
COMMUNICATION DUCT
FIBER OPTIC LINE
OVERHEAD COMM. LINE
FIBER OPTIC DUCT
GAS LINE (UNDER 12")
GAS LINE (OVER 12")
STEAM LINE (UNDER 12")
STEAM LINE (OVER 12")
CONDENSATE RETURN
VENT PIPE LINE
TRAFFIC SIGNAL LINE
SITE LIGHTING ELECTRIC LINE
ELECTRIC LINE
ELECTRIC DUCTBANK
OVERHEAD ELECTRIC LINE
"END OF INFORMATION (PIPE OR DUCTBANK)
"END OF INFORMATION (UTILITY LINE OR LATERAL)
CAPPED UTILITY
UTILITY CONTINUES ABOVE GROUND AT THIS POINT
OXYGEN LINE
NITROUS OXIDE LINE
MEDICAL AIR LINE
COMPRESSED AIR LINE
NITROGEN LINE
CARBON DIOXIDE LINE
MEDICAL BRINE / SALINE
COMPRESSED AIR LINE
PROCESS PIPING/WASTE WATER
ACID WASTE
WASTE SLUDGE
DEWATERED SLUDGE
CHLORINE SOLUTION
PLANT AIR
RAW SEWAGE INFLUENT
RETURN ACTIVATED SLUDGE
MIXED LIQUOR
EFFLUENT
FILTERED EFFLUENT
CENTRATE
FUEL / DIESEL LINE
OIL PIPELINE
HYDRAULIC LINE
INDUSTRIAL WASTE LINE
TRAFFIC SIGNAL LINE
SEWER LATERAL
SEWER LATERAL (CAPPED)
QUALITY LEVEL D
UTILITY CROSSING (NO CONNECTION)
EXISTING EASEMENT LINE
LIMITS OF TESTHOLE EXCAV.
TUNNEL

RCP –	REINFORCED CONCRETE PIPE	CMP –	CORRUGATED METAL PIPE	OP/FE –	OUTLET PIPE/FLARED END
ACP –	ASBESTOS CONCRETE PIPE	FRP –	FIBERGLASS REINFORCED PIPE	TCB –	COMMUNICATION PULL BOX
VCP –	VITRIFIED CLAY PIPE	STMH –	STORM MANHOLE	TCP –	COMMUNICATION PEDESTAL
PVC –	POLYVINYL CHLORIDE PIPE	CB –	CATCH BASIN	EMH –	ELECTRIC MANHOLE
CIP –	CAST IRON PIPE	CO –	CLEANOUT	EHH –	ELECTRIC HAND HOLE
HDPE –	HIGH DENSITY POLYETHYLENE PIPE	TS –	TRAFFIC SIGNAL	EPB –	ELECTRIC PULL BOX
DIP –	DUCTILE IRON PIPE	SAMH –	SANITARY MANHOLE	EPD –	ELECTRIC PEDESTAL
CPP –	CORRUGATED PLASTIC PIPE	CMH –	COMMUNICATION MANHOLE	TRF –	TRANSFORMER
PE –	POLYETHYLENE PIPE	OGS –	OIL/GREASE SEPARATOR	SGR –	SWITCHGEAR

* NOTE: END OF INFORMATION INDICATES THAT EITHER THE LINE COULD NOT BE LOCATED BEYOND THIS POINT USING ANY GEOPHYSICAL UTILITY PROSPECTING TOOL OR THAT THE QL-D INFORMATION ENDED AT THIS POINT AND THE CONTINUATION OF THE UTILITY COULD NOT BE DETERMINED. IT SHOULD NOT BE ASSUMED THAT THE UTILITY IS CAPPED AT THIS POINT

TYPICAL UTILITY CALLOUT:

QUALITY LEVEL
8"PVC WATERMAIN (QL-B)
UTILITY TYPE
UTILITY MATERIAL TYPE
UTILITY SIZE

TYPICAL SHEET CALLOUT:

UM 1.00
SHEET ORDER
SHEET TYPE
DISCIPLINE

UTILITY QUALITY LEVEL INFORMATION INDEX:

QUALITY LEVEL D: "QL D": Records Search: This level of service provides information that has been obtained from existing records, which includes utilizing existing plans, contacting utility companies, verbal recollections, obtaining as-built plans and researching prior rights (i.e. easements) issues.

QUALITY LEVEL C: "QL C": This level adds field surveys of visible above-ground utility systems such as maintenance holes, valve boxes, fire hydrants, etc., and reconciles this information to existing utility records (Quality Level D)

QUALITY LEVEL B: "QL B": Designating Underground Utility Systems: This level includes using surface geophysical prospecting techniques, including electromagnetic, magnetic, sonic, or other energy fields to determine the existence, horizontal position of underground utility systems, approximate vertical positions of subsurface utilities can be identified depending on the specific subsurface prospecting technique utilized.

QUALITY LEVEL A: "QL A": Locating Underground Utility Systems: This level is the highest level of accuracy, which includes obtaining precise horizontal and vertical position of the utility line by excavating a test hole. The test holes shall be done using vacuum excavation or comparable nondestructive equipment in a manner as to cause no damage to the utility line. After excavating a test hole, a field survey was performed to determine the exact location and position of the utility line, type, size, condition, material, and other characteristics of underground utility system.



LOCATOR MAP
NOT TO SCALE

3737
S OLD PRICE RD.

CHANDLER,AZ
MARICOPA CO.

PREPARED FOR:

McCARTHY

McCARTHY BUILDING COMPANIES, INC
6225 N. 24th St., Suite 200,
Phoenix, AZ 85061

PREPARED BY:

McCARTHY

McCARTHY MAPPING
20401 SW Birch St.
Newport Beach, California 92660
p: 949-851-8383
http://www.mccarthy.com

SIGNATURE

DATE

THE SEAL AND SIGNATURE APPLY ONLY TO THE DOCUMENT TO WHICH THEY ARE AFFIXED. THE SIGNER OF THIS DOCUMENT EXPRESSLY DISCLAIMS ANY AND ALL RESPONSIBILITY FOR DOCUMENTS THAT DO NOT BEAR HIS SEAL AND SIGNATURE INCLUDING, BUT NOT NECESSARILY LIMITED TO, DRAWINGS, SPECIFICATIONS, ESTIMATES, REPORTS, AND SIMILAR SIMILAR INSTRUMENTS OF SERVICES INTENDED TO BE USED FOR THIS PROJECT.

DRAWING ISSUE

NO.	DATE
NO.	DATE
NO.	DATE
NO.	DATE
NO.	DATE
NO.	DATE
NO.	DATE
NO.	DATE
NO.	DATE
NO.	DATE
NO.	DATE
NO.	DATE
NO.	DATE
NO.	DATE
NO.	DATE
NO.	DATE
NO.	DATE
NO.	DATE
NO.	DATE
NO.	DATE
NO.	DATE

DRAWN BY	JMF & ERJ
CHECKED BY	CLM
MAPPING NO.	-
PROJECT NO.	004006.SUM
MSD BASE MAP	-
PARCEL NO.	-
ZIP CODE	85248

SHEET TITLE
COVER SHEET

SHEET
UM 1.00

© McCarthy Building Companies, Inc. 2025

MATCHLINE THIS PAGE

MATCHLINE THIS PAGE

MATCHLINE UM 1.02

MATCHLINE UM 1.02

GRAPHIC SCALE 1"=20'
0 20 40

conventional excavation

potholing & hydro excavation

duct bank identified for reuse

NOTE: ANY AND ALL DEPTH OF UTILITY'S DEPICTED AT A QL-B STANDARD OF CARE HEREON SHALL BE CONSIDERED APPROXIMATE AS OF THE DATE OF THE INVESTIGATION. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO UTILIZE SOFT DIGGING BEST PRACTICES TO EXPOSE ALL UTILITIES HAVING A POTENTIAL FOR CONFLICT WITHIN THE AREA OF EXCAVATION PRIOR TO ANY HARD DIGGING EXCAVATION.

EXISTING COMPOSITE UTILITY PLAN - QL-B

3737
OLD PRICE RD.

CHANDLER,AZ
MARICOPA CO.

PREPARED FOR:

McCARTHY BUILDING COMPANIES, INC
6225 N. 24th St., Suite 200,
Phoenix, AZ 85061

PREPARED BY:

McCARTHY MAPPING
20401 SW Birch St.
Newport Beach, California 92660
p: 949-851-8383
http://www.mccarthy.com

SIGNATURE

DATE

THE SEAL AND SIGNATURE APPLY ONLY TO THE DOCUMENT TO WHICH THEY ARE AFFIXED. THE SIGNER OF THIS DOCUMENT EXPRESSLY DISCLAIMS ANY AND ALL RESPONSIBILITY FOR DOCUMENTS THAT DO NOT BEAR HIS SEAL AND SIGNATURE INCLUDING, BUT NOT NECESSARILY LIMITED TO, DRAWINGS, SPECIFICATIONS, ESTIMATES, REPORTS, AND SIMILAR SIMILAR INSTRUMENTS OF SERVICES INTENDED TO BE USED FOR THIS PROJECT.

DRAWING ISSUE

NO.	DATE
NO.	DATE
NO.	DATE
NO.	DATE

MATCHLINE UM 1.01

MATCHLINE UM 1.01

PROJECT LIMITS

PROJ. LMT.

GRAPHIC SCALE 1"=20'
0 20 40

conventional excavation

potholing & hydro excavation

duct bank identified for reuse

NOTE: ANY AND ALL DEPTH OF UTILITY'S DEPICTED AT A QL-B STANDARD OF CARE HEREON SHALL BE CONSIDERED APPROXIMATE AS OF THE DATE OF THE INVESTIGATION. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO UTILIZE SOFT DIGGING BEST PRACTICES TO EXPOSE ALL UTILITIES HAVING A POTENTIAL FOR CONFLICT WITHIN THE AREA OF EXCAVATION PRIOR TO ANY HARD DIGGING EXCAVATION.

EXISTING COMPOSITE UTILITY PLAN - QL-B

3737
OLD PRICE RD.

CHANDLER,AZ
MARICOPA CO.

PREPARED FOR:

McCARTHY BUILDING COMPANIES, INC
6225 N. 24th St., Suite 200,
Phoenix, AZ 85061

PREPARED BY:

McCARTHY MAPPING
20401 SW Birch St.
Newport Beach, California 92660
p: 949-851-8383
http://www.mccarthy.com

SIGNATURE

DATE

THE SEAL AND SIGNATURE APPLY ONLY TO THE DOCUMENT TO WHICH THEY ARE AFFIXED. THE SIGNER OF THIS DOCUMENT EXPRESSLY DISCLAIMS ANY AND ALL RESPONSIBILITY FOR DOCUMENTS THAT DO NOT BEAR HIS SEAL AND SIGNATURE INCLUDING, BUT NOT NECESSARILY LIMITED TO, DRAWINGS, SPECIFICATIONS, ESTIMATES, REPORTS, AND SIMILAR SIMILAR INSTRUMENTS OF SERVICES INTENDED TO BE USED FOR THIS PROJECT.

DRAWING ISSUE

NO.	DATE
NO.	DATE
NO.	DATE
NO.	DATE
NO.	DATE
NO.	DATE
NO.	DATE
NO.	DATE
NO.	DATE
NO.	DATE
NO.	DATE
NO.	DATE
NO.	DATE
NO.	DATE
NO.	DATE
NO.	DATE
NO.	DATE
NO.	DATE
NO.	DATE
NO.	DATE
NO.	DATE
NO.	DATE

DRAWN BY	JMF & ERJ
CHECKED BY	CLM
MAPPING NO.	-
PROJECT NO.	004006.MAP
MSD BASE MAP	-
PARCEL NO.	-
ZIP CODE	85248

SHEET TITLE

EXISTING COMPOSITE UTILITY PLAN - QL-B

SHEET
UM 1.02

© McCarthy Building Companies, Inc. 2025

MATCHLINE THIS PAGE

MATCHLINE THIS PAGE

MATCHLINE UM 1.04

MATCHLINE UM 1.04

NOTE: ANY AND ALL DEPTH OF UTILITY'S DEPICTED AT A QL-B STANDARD OF CARE HEREON SHALL BE CONSIDERED APPROXIMATE AS OF THE DATE OF THE INVESTIGATION. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO UTILIZE SOFT DIGGING BEST PRACTICES TO EXPOSE ALL UTILITIES HAVING A POTENTIAL FOR CONFLICT WITHIN THE AREA OF EXCAVATION PRIOR TO ANY HARD DIGGING EXCAVATION.

PROPOSED COMPOSITE UTILITY PLAN - QL-B

conventional excavation

potholing & hydro excavation

duct bank identified for reuse

3737
OLD PRICE RD.

CHANDLER,AZ
MARICOPA CO.

PREPARED FOR:

McCARTHY

McCARTHY BUILDING COMPANIES, INC
6225 N. 24th St., Suite 200.
Phoenix, AZ 85061

PREPARED BY:

McCARTHY

McCARTHY MAPPING
20401 SW Birch St.
Newport Beach, California 92660
p: 949-851-8383
http://www.mccarthy.com

SIGNATURE

DATE

THE SEAL AND SIGNATURE APPLY ONLY TO THE DOCUMENT TO WHICH THEY ARE AFFIXED. THE SIGNER OF THIS DOCUMENT EXPRESSLY DISCLAIMS ANY AND ALL RESPONSIBILITY FOR DOCUMENTS THAT DO NOT BEAR HIS SEAL AND SIGNATURE INCLUDING, BUT NOT NECESSARILY LIMITED TO, DRAWINGS, SPECIFICATIONS, ESTIMATES, REPORTS, AND SIMILAR SIMILAR INSTRUMENTS OF SERVICES INTENDED TO BE USED FOR THIS PROJECT.

DRAWING ISSUE

NO.	DATE
NO.	DATE
NO.	DATE
NO.	DATE

DRAWN BY	JMF & ERJ
CHECKED BY	CLM
MAPPING NO.	-
PROJECT NO.	004006.SUM
MSD BASE MAP	-
PARCEL NO.	-
ZIP CODE	85248

SHEET TITLE

PROPOSED COMPOSITE UTILITY PLAN - QL-B

SHEET

UM 1.03

© McCarthy Building Companies, Inc. 2025

MATCHLINE UM 1.03

MATCHLINE UM 1.03

SWGR EMH 005

SWGR-EMH -010

PROJECT LIMITS

ELECTRIC LINE (QL-B)

12" WATERMAIN (QL-B)

12"PVC NON-POTABLE WATER (QL-B)

188 E-35.01 TYPICAL

151 E-35.01

366 E-35.03

TYPICAL

EXISTING SES-1. REFER TO SHEET E-20.10 FOR ENLARGED PLAN

NEW EMH 40

EXISTING MCC-639-201 & MCC-639-202. REFER TO SHEET E-25.09 FOR ENLARGED PLAN

EXISTING EMH 17

EXISTING MCC-H1 & MCC-H2. SEE SHEET E-32.04 FOR ENLARGED PLAN

EXISTING AER-BLR-MCC-001 & AER-BLR-MCC-002. SEE SHEET E-26.07 FOR ENLARGED PLAN

EXISTING ANOXIC BASIN. SEE SHEET E-27.11 FOR ENLARGED PLAN

NEW AUX-MCC-001 & AUX-MCC-002. SEE SHEET E-25.10 FOR ENLARGED PLAN

EXISTING MH

EXISTING FIBER

EXISTING EMH 06

EXISTING EMH 07

NEW EMH 42

EXISTING MH 16

EXISTING ANX-MCC-001 & ANX-MCC-002. SEE SHEET E-25.10 FOR ENLARGED PLAN

NEW EMH 43

EXISTING MH 18

NEW FIBER

EXISTING DISC FILTERS DSF03 & DSF02. REFER TO SHEET E-28.06 FOR ENLARGED PLAN

EXISTING DISC FILTERS DSF01. REFER TO SHEET E-28.05 FOR ENLARGED PLAN

NEW EMH 41

EXISTING EMH 31

EXISTING EMH 32

EXISTING EMH 33

EXISTING EMH 10

EXISTING DISCONNECT FILTER DSF04. REFER TO SHEET E-28.07 FOR ENLARGED PLAN

EXISTING EMH

EXISTING EFF-MCC-001 & EFF-MCC-002. REFER TO SHEET E-28.04 FOR ENLARGED PLAN

EXISTING HH

EXISTING EMH 28

EXISTING ANOXIC BASIN. SEE SHEET E-27.01 FOR ENLARGED PLAN

EXISTING MH

END OF PIPE DRP2-TF-1 INVERT=1170.00

FO

conventional excavation

potholing & hydro excavation

duct bank identified for reuse

NOTE: ANY AND ALL DEPTH OF UTILITY'S DEPICTED AT A QL-B STANDARD OF CARE HEREON SHALL BE CONSIDERED APPROXIMATE AS OF THE DATE OF THE INVESTIGATION. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO UTILIZE SOFT DIGGING BEST PRACTICES TO EXPOSE ALL UTILITIES HAVING A POTENTIAL FOR CONFLICT WITHIN THE AREA OF EXCAVATION PRIOR TO ANY HARD DIGGING EXCAVATION.

PROPOSED COMPOSITE UTILITY PLAN - QL-B

3737
OLD PRICE RD.

CHANDLER,AZ
MARICOPA CO.

GRAPHIC SCALE 1"=20'
0 20 40

PREPARED FOR:

McCARTHY

McCARTHY BUILDING COMPANIES, INC
6225 N. 24th St., Suite 200,
Phoenix, AZ 85061

PREPARED BY:

McCARTHY

McCARTHY MAPPING
20401 SW Birch St.
Newport Beach, California 92660
p: 949-851-8383
http://www.mccarthy.com

SIGNATURE

DATE

THE SEAL AND SIGNATURE APPLY ONLY TO THE DOCUMENT TO WHICH THEY ARE AFFIXED. THE SIGNER OF THIS DOCUMENT EXPRESSLY DISCLAIMS ANY AND ALL RESPONSIBILITY FOR DOCUMENTS THAT DO NOT BEAR HIS SEAL AND SIGNATURE INCLUDING, BUT NOT NECESSARILY LIMITED TO, DRAWINGS, SPECIFICATIONS, ESTIMATES, REPORTS, AND SIMILAR SIMILAR INSTRUMENTS OF SERVICES INTENDED TO BE USED ON THIS PROJECT.

DRAWING ISSUE

NO.	DATE
NO.	DATE
NO.	DATE
NO.	DATE