



CITY OF CHANDLER, ARIZONA

WATER RECLAMATION FACILITY IMPROVEMENTS – GMP 1

CITY PROJECT NO. WW1901.401

CONSTRUCTION SERVICES CONTRACT (CONSTRUCTION MANAGER AT RISK)

**Andrew Goh, P.E.
CIP City Engineer**

CITY OF CHANDLER, ARIZONA

**WATER RECLAMATION FACILITY IMPROVEMENTS – GMP 1
CITY PROJECT NO.: WW1901.401**

TABLE OF CONTENTS

ARTICLE 1 - PARTICIPANTS AND PROJECT	1
ARTICLE 2 - CONTRACT DOCUMENTS	2
ARTICLE 3 - PRE-CONSTRUCTION SERVICES	2
ARTICLE 4 - CONSTRUCTION SERVICES.....	2
ARTICLE 5 - CITY RESPONSIBILITIES.....	4
ARTICLE 6 - CONTRACT TIME	5
ARTICLE 7 - CONTRACT PRICE.....	7
EXHIBIT A – PROJECT SPECIFIC SPECIAL PROVISIONS	SP-1
EXHIBIT B – GENERAL CONDITIONS	GC-1
EXHIBIT C – TECHNICAL SPECIFICATIONS	TS-1
EXHIBIT D – ACCEPTED GMP/PRICE PROPOSAL	GMP-1
EXHIBIT E – SUBCONTRACTOR’S LIST FORM.....	SUB-1
EXHIBIT F – GIS / GPS DATA DELIVERY REQUIREMENTS (IF APPLICABLE)	GIS-1

**CONSTRUCTION MANAGER AT RISK
CONSTRUCTION SERVICES CONTRACT
PROJECT NO.: WW1901.401**

THIS CONTRACT is made and entered into on the ____ day of _____, 2021, ("Effective Date") by and between City of Chandler, an Arizona municipal corporation, hereinafter called "City" and 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: **City of Chandler**
CIP City Engineer: Andrew Goh
Public Works & Utilities Department
P.O. Box 4008, Mail Stop 407
Chandler, AZ 85244-4008
Phone: 480-782-3343
Email: andrew.goh@chandleraz.gov

CM@Risk: **McCarthy Building Companies, Inc.**
6225 N. 24th St., Ste. 200, Phoenix, AZ 85016
Business Organization: **Corporation**
State Where Organized: **Missouri**
CM@Risk Representative: **Mr. Shane Banks**
Phone: 480-389-7612
Email: sbanks@mccarthy.com

PROJECT DESCRIPTION:

Procurement of disc filters and stainless steel gates, demolition and concrete work.

PROJECT LOCATION:

Ocotillo Water Reclamation Facility (OWRF) is located at 3333 South Old Price Road, and Airport Water Reclamation Facility (AWRF) is located at 905 East Queen Creek Road.

ARTICLE 2 - CONTRACT DOCUMENTS

2.1 CONTRACT DOCUMENTS

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

1. This Construction Services Contract 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 Contract Documents, the Contract 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 Contract Documents, including this Agreement. Additional definitions or defined terms applicable to all the Contract Documents for this Project, if any, include the following:

N/A

ARTICLE 3 - PRE-CONSTRUCTION SERVICES

Although CM@Risk has performed Pre-Construction Services pursuant to a separate Contract 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 Contract. 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 Contract and are incorporated herein. Any breach of any of CM@Risk's duties, obligations, or warranties under the Pre-Construction Services Contract will likewise be considered a breach of this Contract.

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 Contract 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 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 a contract 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 contract 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 Contract 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 Contract, including, without limitation, those set forth on attached **Exhibit A**.
- 4.1.6 CM@Risk must perform the Work under this Contract using only those firms, team members and individuals designated by CM@Risk consistent with the Statement of Qualifications dated December 12, 2019, 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 Contract and the General Conditions or an exhibit hereto or appendix thereto, the terms of this Contract will control.
- 4.1.9 Ownership of Work Product. Notwithstanding anything to the contrary in this Contract, all Work Product prepared or otherwise created in connection with the performance of this Contract, 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-CONTRACT AND PRE-WORK DELIVERABLES

- 4.2.1 The CM@Risk must provide the Deliverables in accordance with Section 4.2 of the General Conditions. Any additional items which CM@Risk must deliver to City prior to commencing the Work on this Project, if any, include the following:

N/A

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.

5.2 Additional services to be provided or responsibilities assumed, by City, if any, are listed below:

N/A

5.3 Additional information to be provided by City, if any, is listed below:

N/A

ARTICLE 6 - CONTRACT TIME

6.1 GENERAL

6.1.1 The Contract Duration is **250** Calendar Days.

6.1.2 The Contract 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 Contract 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 Contract Time.

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

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 Contract 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 Contract by City.

6.2.3 Work must be completed to meet the following milestones after the Notice to Proceed:

	<u>Milestone</u>	<u>Time</u>	<u>Liquidated damages for delay</u>
1.	N/A	within [REDACTED] days	\$ [REDACTED] per calendar day

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 Contract 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 Contract 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 Contract 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 Contract.

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.

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 Contract. 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 Contract. 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 Contract 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 - CONTRACT PRICE

7.1 CONTRACT PRICE

- 7.1.1 In exchange for CM@Risk's full, timely, and acceptable performances and construction of the Work under this Contract, and subject to all of the terms of this Contract, City will pay CM@Risk the "Contract 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 **\$5,842,737**. Costs which would cause the GMP to be exceeded must be paid by CM@Risk without reimbursement from City.

- 7.1.2 The Contract 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 **COSTS**

For any portion of the Work which, either through this Contract, Change Order or otherwise, is performed and paid for on a cost, or time and materials basis, the costs which may be reimbursed to CM@Risk and chargeable against the Contract Price will be determined as set forth in MAG § 109.5.

SIGNATURE PAGE TO FOLLOW

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

"CITY"

CITY OF CHANDLER

MAYOR Date

Recommended By:

Andrew Goh

Andrew Goh, P.E. Date
CIP City Engineer

APPROVED AS TO FORM:

City Attorney
ATTEST:

WW3

City Clerk Seal

"CM@RISK"

McCarthy Building Companies, Inc.

Signature

Date

Name

Title

ATTEST: If Corporation

Secretary

STATE OF ARIZONA

County of Maricopa

SUBSCRIBED AND SWORN TO before me, the undersigned notary public, by *Joseph Brunsmann* who was identified as *Sr. VP* of *McCarthy* on this *17th* day of *February*, 20*21*

My commission expires:

4/28/22

Notary Public

Joseph Brunsmann
Stacy Parks

City of Chandler Construction Manager at Risk Construction Services
Public Works & Utilities Department, Capital Projects Division
Project Name: WATER RECLAMATION FACILITY IMPROVEMENTS
Project No.: WW1901.401
Rev.12/1/2020

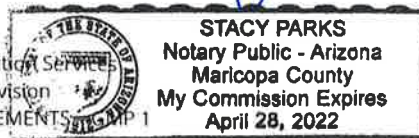


EXHIBIT A

**PROJECT SPECIFIC
SPECIAL PROVISIONS**

N/A

EXHIBIT B

GENERAL CONDITIONS



GENERAL CONDITIONS

Approved date: January 22, 2021

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 - CONTRACT TIME.....	29
SECTION 7 - CONTRACT PRICE	35
SECTION 8 - PAYMENT	35
SECTION 9 - CHANGES TO THE CONTRACT	40
SECTION 10 - SUSPENSION AND TERMINATION	43
SECTION 11 - INSURANCE AND BONDS	44
SECTION 12 - INDEMNIFICATION	49
SECTION 13 - DISPUTE RESOLUTION.....	49
SECTION 14 - MISCELLANEOUS PROVISIONS.....	49
SECTION 15 - PROVISIONS APPLICABLE SOLELY TO GMP AND COST-BASED CONTRACTS, CHANGE ORDERS, AND JOB ORDERS	57
SECTION 16 - PROVISIONS APPLICABLE SOLELY TO JOB ORDER CONTRACTS (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 Contracts

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 contracts entered into by the City of Chandler, unless otherwise specifically excluded in the executed Contract.

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 Contract 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 Contract 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 Contract Price, the extent of the adjustment to the Contract Time, or modifications of other contract terms. The Contract Price and the Contract 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 Contract and for whom the Work or Services are to be provided pursuant to the Contract(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.

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

Contract Documents: The documents which together form the Contract between City and Contractor, as identified in Article 2 of the Contract, or are otherwise incorporated into the Contract, including the Contract, 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 Contract.

Contract 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 Contract.

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

to Proceed (NTP) and ends with Final Acceptance. The Contract Time is set forth in the Contract 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 Contract 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 Contract by this reference. All amendments and modifications to the Construction Documents must be approved in writing by City prior to incorporation into the Contract.

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 Contract Documents.

Design Professional: The qualified, licensed person, firm or corporation who furnishes design and construction administration services required under the Contract 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 contract 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 Contract 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 contract requirements. Final Acceptance results in a Letter of Acceptance (LOA).

Fixed Price: A fixed price or amount for a Contract Price, Scope of Work, materials, or other item under a Contract, 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 Contract 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 Contract.

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

Project Manager: The Project Manager designated in Article 1 of the Contract, 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 Contract 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 Contract.

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 Contract 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 Contract, and to be completed or corrected by Contractor after Substantial Completion and before Final Acceptance in accordance with the Contract 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 Contract Documents.

Quality Control (QC) Testing: Testing performed to assure that the materials installed comply with the requirements in the Contract 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 Contract. 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 Contract Price into pay items, such that the sum of all pay items equals the Contract Price for the construction phase Work, or for any portion of the Work having a separate specified Contract Price.

Scope of Work: The scope of work agreed to or required by City and incorporated into the Contract 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 Contract 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 a Contract 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 Contract with Contractor or any other individual or firm having a Contract 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 Contract Documents, if any.

Substantial Completion: The date when the City determines that the Work (or separable units of Phases as provided in the Contract Documents) is essentially and satisfactorily complete in accordance with the Contract 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 Contract 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 Contract 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 Contract 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 in the 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 Contract 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 Contract Documents and as outlined in Exhibit A of the Contract 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 Contract 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 insure 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 Contract 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 Contract 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 Contract Documents;
 - b. Design Professional construction phase services rendered on the project during the time the project remains incomplete after the Contract 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 Contract 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-CONTRACT AND PRE-WORK DELIVERABLES**

4.2.1 Prior to award of the Contract, Contractor must execute Contract and deliver to City. Failure to do so may delay Contract 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 Contract, Contract must be fully executed by City.

4.2.3 After Contract 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 Contract 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 Contract 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 Contract 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 Contract 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 shut downs 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 Contract 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 Contract 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 Contract 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 Contract is taking place. Contractor's Superintendent or designee must be present at the Site at all times any other Work under this Contract 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 Contract 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 Contract 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 Contract 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 Contract 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 Contract 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 Contract 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 Contract 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 Contract 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 Contract 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 Contract 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 Contract 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 Contract 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 a Contract 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 Contract.

- 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 Contract 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, underpinning, and trench support will be included in the appropriate items listed in the Contract 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 Contract 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 contract 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 Contract 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 Contract 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 Contract and work under other Contracts.
 - 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 Contract Documents.
 - j. Contractor's stamp, initialed or signed, dated and certifying the review of submittal, certification of field measurements and compliance with Contract.
 - 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 timetable 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 Contract 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 Contract. 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 Contract 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 Contract 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 Contract 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 Contract 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 Contract 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 Contract. 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 Contract. 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 Contract 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 Contract Documents and a reduction in the Contract 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 Contract 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 Contract Documents, or by any specific provision of the Contract 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 Contract 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 Contract 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 Contract Documents, including appropriate reduction in the Contract 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 Contract Documents are intended to limit any manufacturer's warranty which provides City with greater warranty rights than set forth in this Section or the Contract 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 Contract Documents during the warranty periods set forth in this Section, or during any longer periods to the extent required by the Contract 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 Contract 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 Contract 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 Contract 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 Contract Documents.
- 4.9.14 Without limiting the foregoing or anything in these General Conditions or the Contract 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 Contract 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 Contract 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 Contract, 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 Contract 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 Contract 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 Contract 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 - CONTRACT TIME

6.1 CONTRACT TIME

- 6.1.1 The Contract 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 Contract. 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 contract insurance, bonds, and schedules are submitted to and accepted by the City.
- 6.1.3 The Contract 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 Contract Time.
- 6.1.4 Time is of the essence of this Contract, 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 Contract Documents within the time periods specified herein, will constitute a material breach of this Contract entitling City to terminate the Contract unless Contractor applies for and receives an extension of time, in accordance with the procedures set forth in the Contract 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 Contract 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 Contract 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 Contract 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 Contract 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 Contract Documents and completion of the Project within the Contract 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 Contract Time remains the obligation of Contractor. City’s review does not relieve Contractor from compliance with the requirements of the Contract 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 Contract Time, as adjusted in accordance with the Contract Documents. No modification to the Contract Documents or the Contract 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 Contract 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 Contract 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 Contract, 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 contract 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, etc. No time extensions will be granted nor delay damages paid until a delay occurs which extends the Work beyond the Contract 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 Contract, 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 Contract 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 Contract 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 Contract 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.

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 Contract 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 Contract 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 Contract Documents) is essentially and satisfactorily complete in accordance with the Contract 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 Contract 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 contracts) after the date of Substantial Completion. Failure to timely obtain Final Acceptance will be a material breach of the Contract.
- 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 Contract Documents, law or equity.
- 6.6.2 Furthermore, the timely completion of the Work being of the utmost importance under this Contract, notwithstanding the existence of one or more disputes between the parties concerning the scope of the Work, the Project Schedule, Contract 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 Contract 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 - CONTRACT PRICE

7.1 UNIT PRICE CONTRACTS

- 7.1.1 The Contract Price for all Unit Price Contracts will be the amount set forth in the Contract or Change Order multiplied by the verified quantity provided.
- 7.1.2 Measurements of quantities to determine the total Contract 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 Contract 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. No adjustments in any Unit Prices will be allowed. Sections 109.4.1(A) and (B) and 109.4.2(A) are deleted in their entirety.

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 Contract 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 Contract 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 The Contracting Agency will retain 10 percent of all estimates as a guarantee for complete performance of the Contract in accordance with Arizona Revised Statutes Section 34-221 or 34-607, unless the Contractor elects to deposit securities in accordance with Arizona Revised Statutes Section 34-221, Paragraph C.5. or 34-607, Paragraph B.5.

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 Contract.

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 Contract 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 contracts, and notices of its provision must be given to all persons furnishing materials for the Work when no formal contract 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

Contract, 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 Contract Documents) have been delivered to City, as specified in this Section 8.4;
- 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 Contract Price;
- e. Damage to City or another Contractor;
- f. Reasonable evidence that the Work will not be completed within the Contract 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 Contract Documents; or
- h. Contractor is in default of any of its other obligations under the Contract 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. .

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 Contract 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 Contract, 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 Contracts 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 Contract 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 Contract 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 Contract requirements for deliverables;
 - b. Compliance with approved Plans and Specifications;
 - c. Compliance with § 14.9 below;
 - d. Compliance with Contract 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 Contract Agreement between Contractor and payee. Contractor will ensure that all payees (including those entering into lump sum contracts) have the same right to audit provisions contained in this contract included in their contracts 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 contract 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 CONTRACT

9.1 FIELD ORDERS

City may authorize minor changes in the Work not involving an adjustment in the Contract Price or the Contract Times, which are consistent with the overall intent of the Contract 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 Contract Price or Contract 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 Contract 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 Contract 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 Contract 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 Contract 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 Contract 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 Contract Documents;
 - c. When the City determines that a Unit Price Book Job Order associated with a Job Order Contract 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 Contract, 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 Contract 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 Contract (including Change Orders) will be approved in writing by the Project Manager. Once properly executed by both parties, these modifications to the Contract will have the same effect as if they had been included in the original Contract.
- 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 or other modification of the Contract 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 Contract Price adjustments under the Contract. 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 Contract 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 Contract period and up to three years after final payment is made on the Contract) 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 Contract regarding pricing of Change Orders, an appropriate Contract Price adjustment will be made. Such post-approval Contract 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 Contract Price or Contract 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 Contract 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 Contract 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 Contract 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 Contract 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 Contract.

10.2.2 City may also terminate the Contract 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 Contract Documents or any other contract between City and Contractor.

10.2.3 When any of the above reasons exist, City may terminate the Contract, 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 Contract 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 Contract 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 Contract 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 Contract.

10.3 **TERMINATION BY CITY FOR CONVENIENCE**

City may also terminate the Contract 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 Contract, no further payments will be due from City to Contractor.

10.4 **A.R.S. § 38-511**

The Contract 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 Contract 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 Contract are satisfied, the insurances set forth below.

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

11.1.4 The City in no way warrants that the minimum insurance limits contained in this Contract are sufficient to protect Contractor from liabilities that might arise out of the performance of the Contract services under this Contract 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 Contract 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 Contract.

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 Contract.

The Contractor is responsible for executing the Contract 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 Contract. 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 Contract 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 contract 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 Contract/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 Contract/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 Contract.

- 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 Contract 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 Contract 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.

11.3 **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 Contract.
- 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 Contract 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 Contract 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 Contract.

11.3.9 Insurance Cancellation During Contract Term.

11.3.9.1 If any of the required policies expire during the life of this Contract, 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 Contract 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 required 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 Contract.

11.4 **BONDS AND OTHER PERFORMANCE SECURITY**

11.4.1 After Contract award, Contractor must provide a Performance Bond and a Payment Bond, each in an amount equal to the full amount of the Contract 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 Contract 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 "Indemnitor") must indemnify, save, and hold harmless the City and its officers, officials, agents, and employees (collectively "Indemnatee") 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 Indemnatee from and against any and all Claims, except those arising solely from Indemnatee'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 Indemnatee 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 Contract, 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 Contract until such dispute is resolved.
- 13.3 Notwithstanding any other provision in this Contract, 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 Contract, to obtain specific performance of any provision of the Contract, to advance the completion of the Project, or to protect health, welfare and safety.

SECTION 14 - MISCELLANEOUS PROVISIONS

14.1 **CONTRACT DOCUMENTS**

- 14.1.1 The Contract Documents are intended to permit the parties to complete the Work and all obligations required by the Contract Documents within the Contract Times for the Contract Price. The Contract 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 Contract Documents to describe a functionally complete Project (or part thereof) to be constructed in accordance with the Contract Documents. Any labor, documentation, services, materials, or equipment that may reasonably be inferred from the Contract 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 Contract Documents establish the rights and obligations of the parties and include the Contract, Addenda (which pertain to the Contract Documents), Contractor's Bid or Proposal (including documentation accompanying the Bid and any post-Bid documentation submitted prior to Contract award) when attached as an exhibit to the Contract, 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, Contract Drawings, as the same may be more specifically identified in the Contract, 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 Contract. Approved Shop Drawings and the reports and drawings of subsurface and physical conditions are not Contract Documents.
- 14.1.4 In the event of any inconsistency, conflict, or ambiguity between or among the Contract Documents, the Contract Documents will take precedence as follows from highest to lowest: Change Orders, Addenda, Contract, 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 Contract, 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 Contract Documents will be issued by the Design Professional through the City.
- 14.1.7 The headings used in this Agreement or any other Contract 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 Contract 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 Contract Documents.
- 14.1.9 The Contract 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 Contract if there were no Bids), except as may be otherwise specifically stated in the Contract 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 Contract 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 Contract 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 Contract and subject to penalties up to and including termination of this Contract.
- 14.3.3 The City retains the legal right to inspect the papers of any Contractor or Subcontractor employee who works on this Contract 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 contract the Contractor enters into with any and all of its subcontractors who provide services under this Contract 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 Contract 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 Contract. 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 Contract 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 Contract Documents, any such assignment will be void, will transfer no rights to the purported assignee, and would be a material breach of the Contract.

14.7 **SUCCESSORS**

Contractor and City intend that the provisions of the Contract 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 a contract 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 contract 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 Contract, Contractor certifies under A.R.S. § 35-393.01 that Contractor is not currently engaged in and for the duration of this Contract will not engage in a boycott of Israel.

14.10 **NO THIRD PARTY BENEFICIARY**

Nothing under the Contract Documents will be construed to give any rights or benefits in the Contract Documents to anyone other than City and Contractor, and all duties and responsibilities undertaken pursuant to the Contract 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 Contract Documents.

14.11 **GOVERNING LAW AND VENUE**

The Agreement and all Contract 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 Contract 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 Contract 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 Contract 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 Contract 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 Contract, including, without limitation, those set forth on Exhibit C of the Contract.

14.14 **PARTIAL INVALIDITY**

If any provision of the Contract 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 Contract bring an action to enforce any provision of the Contract, 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 Contract. 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 Contract. If Contractor gains financial or economic interest in the Project during the course of this Contract, this may be grounds for terminating this Contract. Any decision to terminate the Contract must be at the sole discretion of City.
- 14.16.2 Contractor will not engage the services on this Contract 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 Contract Modifications for this Contract.
- 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 Contract.
- 14.17 **INDEPENDENT CONTRACTOR**
Contractor is and must be an independent contractor. Any provisions in the Contract 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 Contract, "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 Contract.
- 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 Contract is confidential and proprietary information belonging to City.

- 14.20.3 Except as specifically provided in this Contract, 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 Contract. 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 Contract 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 Contract 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 contract 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 Contract.
- 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 Contract 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 Contract without liability or at its discretion to deduct from the Contract 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 Contract 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 Contract 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 Contract 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 Contract. 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 Contract or the Scope of Work, or effectuate any change that requires a written Change Order.

14.25.3 When any provisions of the Contract 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 to the person designated in the Contract Documents as Project Manager, or if delivered at or sent by registered or certified mail, postage prepaid, to the City Engineer addressed as follows:

To City:	City of Chandler Public Works & Utilities Department Attn: City Engineer P.O. Box 4008, Mail Stop 407 Chandler, AZ 85244-4008
With a Copy to:	Project Manager City of Chandler Public Works & Utilities Department P.O. Box 4008, Mail Stop 407 Chandler, AZ 85244-4008
With a Copy to:	Paul Ahlas, Construction Project Manager City of Chandler Public Works & Utilities Department P.O. Box 4008, Mail Stop 407 Chandler, AZ 85244-4008

To Contractor:	Mr. Shane Banks McCarthy Building Companies, Inc. 6225 N. 24th St., Ste. 200 Phoenix, AZ 85016
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14.25.4 When any provisions of the Contract 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 Contract 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 Contract 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 Contract. Specifically, all employees of Contractor who are working under a Contract 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 Contract and possible debarment from bidding on future City projects.

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

15.1 **ADDITIONAL DEFINITIONS**

The definitions set forth in Section 2 apply to GMP and Cost-Based Contracts, 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 Contract with City. In these General Conditions, the term "Contractor" includes CM@Risk under both Pre-Construction and Construction Services Contracts.

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.

Contract Documents –

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

Contract Price –

Where compensation under the Contract based upon a GMP accepted by City, the term “Contract Price” refers to the GMP.

Cost-Based Contract, Change Order, or Job Order –

A Contract, Change Order, or Job Order where the Contract Price is based upon the actual cost of performing the Work, subject to the terms of the Contract 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 Contract. 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 Contract or required by the Project Team.

Pre-Construction Services Contract –

The Contract 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 Contract is entered into between City and CM@Risk, the duties, obligations and warranties of the CM@Risk under the Pre-Construction Services Contract survive and are incorporated into the resulting Construction Contract.

Pre-Construction Services –

The services to be provided under the Pre-Construction Services Contract, 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 Contract, Change Order, or Job Order if applicable.

15.2 **CONTRACT PRICE**

15.2.1 The Contract Price for all Contracts, 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 Contract, Change Order, or Job Order, all Cost Based pricing will be subject to and limited to GMP.

15.2.2 The Contract 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 Contract Price. All other costs will not be paid by City and will not be chargeable against the Contract Price.

15.2.4 Cost-Based Contracts. For Contracts, 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 Contract Price all Allowances stated in the Contract 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 Contract 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 Contract Sum and not in the Allowance; and

15.3.2.3 Whenever the cost is more or less than the Allowance, the Contract 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) contract 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 Contract 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 Contract.

15.6 **FINAL PAYMENT**

If the Contract 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 Contract, 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 CONTRACTS (JOC)

16.1 **ADDITIONAL DEFINITIONS**

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

Contract –

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 on 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 Contract 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 Contract 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 Contract 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 Contracts, 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 Contract, 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 Contract 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 Contract 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 Contract 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 Contract 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 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 Contracts.

17.2 **GENERAL**

17.2.1 CM@Risk must perform the Services required by, and in accordance with the Contract Documents and as outlined in Exhibit A of the Contract 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 Contract 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 Contract 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 Contract, 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

- Contract 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 Supplier(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 from 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 Contract Price until acceptance of ALL Pre-Construction Services and award of the final approved Construction Services Contract 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 Contract 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 Contract. 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 CONTRACT, DUTIES, OBLIGATIONS AND WARRANTIES**

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

General Conditions Appendices

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 Contracts
- 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

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 Contractor Documents, and will be the Contract 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 Contract 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 Contract Completion Time set forth in the Contract Document will be considered for issues relating to Contract 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. Contract 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 Contract 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 Contract at or prior to the time of execution of the Contract. Since the Contractor presumably has no control over the events causing the delay, he may be entitled to both contract 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 Contract; 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 Contract Submittals in accordance with the Contract; 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 Contract 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 Contract Specifications. Again, this list is not necessarily all inclusive.

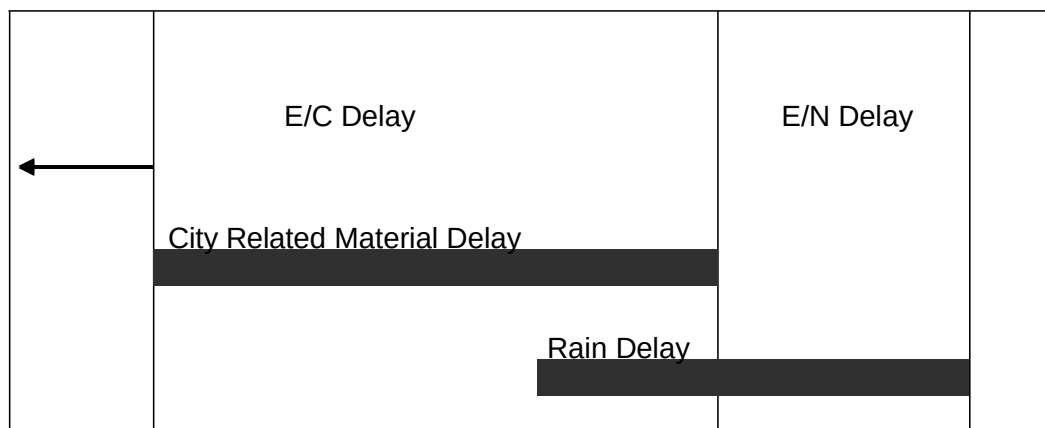
D. Concurrent:

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 contract completion time are considered as delays. The concurrent delay is considered an additional delay only to the extent it prolongs the delay to the Contract 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 Contract 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 Contract 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 Contract 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 Contract. 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 CONTRACTS

The Contractor may submit to the Engineer proposals for modifying the Plans, Specifications, or other requirements of the Contract 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 Contract 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 Contract 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 Contract and under the proposed changes, including the cost of developing and implementing the changes.
6. The Contract 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.

General Conditions

Appendix 2

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 Contract.

If the Contractor's Proposal is accepted in whole or in part, the necessary Contract Modifications and Contract 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 Contract 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 Contract 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 Contract 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 Contract 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 Contract prices. Contract 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

General Conditions Appendix 2

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 – GMP 1

PROJECT NUMBER: WW1901.401

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 Contract 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 – GMP 1
City Project No.: WW1901.401

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 consideration of \$_____, as set out in the final pay estimate, as full and complete payment under the terms of the contract, 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 Contract 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 contract with the Obligee, dated the _____ day of _____, 20__ for construction of **WATER RECLAMATION FACILITY IMPROVEMENTS – GMP 1, WW1901.401** which contract 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, conditions and agreements of the contract during the original term of the contract and any extension of the contract, with or without notice of the Surety, and during the life of any guaranty required under the contract, and also performs and fulfills all the undertakings, covenants, terms, conditions, and agreements of all duly authorized modifications of the contract 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 Contract.

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__.

AGENT OF RECORD

PRINCIPAL SEAL

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 Contract 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 contract with the Obligee, dated the _____ day of _____, 20__ for construction of **WATER RECLAMATION FACILITY IMPROVEMENTS – GMP 1, WW1901.401** which contract 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 contract, 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 Contract.

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 Contract agree that time is of the essence in relation to performance of the Contract and completion of the Project, therefore any and all disputes in relation to the Contract 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 Contract 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 contract provisions in the Contract 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 Contract 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 Contract Documents, the Contract 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 Contract 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 Contract, except Claims relating to aesthetic effect and except those claims waived as provided for in the Contract 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 - GMP 1		
CITY PROJECT NO.:	WW1901.401		
If Federally Funded:			
FEDERAL NO.:	WW1901.401	TRACS NO:	WW1901.401

(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 CONTRACT DOCUMENTS AND BID SPECIFICATIONS AND ALL ACTIVITIES REQUIRED BY THE CONTRACTOR UNDER THE CONTRACT HAVE BEEN COMPLETED AS OF THE COMPLETION DATE LISTED HERE:

<u>COMPLETION DATE:</u>	
--------------------------------	--

PRIME

FIRM NAME:			
PRINCIPAL:			
TITLE:			
SIGNATURE:		DATE:	

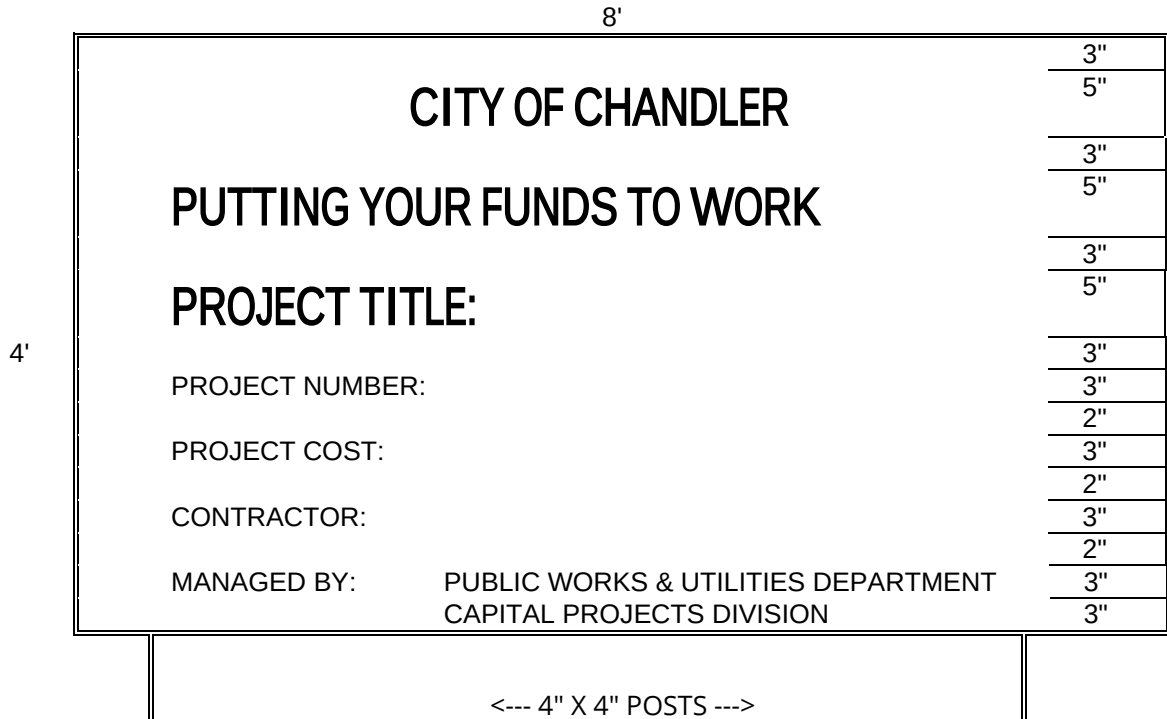
CERTIFIED BY ENGINEER/CONSULTANT:

FIRM NAME:			
SIGNATURE:		DATE:	

PROJECT ACCEPTED BY CITY OF CHANDLER:

FIRM 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 Contract 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 contract 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 owing 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 Contract 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 Contract.

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 contract 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 Contract. The City will reimburse Contractor for contractually required bond at time of first pay application for GMP and Cost-Based contracts upon receipt of proof of payment from the Contractor. If the Contractor completes Work for less than the Contract 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 Contract 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 Contract 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 contracts. 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 contracts 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 Contract Documents to pay.
- 1.6.4 Fees of laboratories for tests required by the Contract 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 Contract Documents; the cost of defending suites or claims for infringement of patent rights arising from such requirement of the Contract 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 Contract 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 Contract 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 Contract Price or on a lump/stipulate sum basis as set forth in the Contract. 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 Granite 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:

<u>Original Size</u>	<u>Replacement Size</u>
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:

<u>Existing Plant Material Sizes</u>	<u>Replacement Size</u>
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.

EXHIBIT C
TECHNICAL SPECIFICATIONS



CITY OF CHANDLER

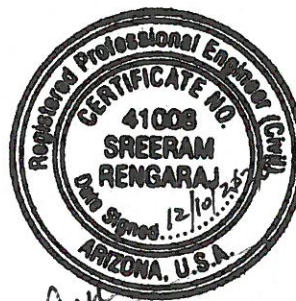
PUBLIC WORKS & UTILITIES

Water Reclamation Facility Improvements

Project No. WW1901.201

GUARANTEED MAXIMUM PRICE (GMP) 1

December 10, 2020



Sreeram Rengaraj

**SPECIFICATIONS
FOR
WRF IMPROVEMENTS PROJECT
GUARANTEED MAXIMUM PRICE (GMP) 1
CITY OF CHANDLER PUBLIC WORKS AND UTILITIES
DEPARTMENT
DECEMBER 10, 2020**

The attention of the contractor submitting GMP for the above referenced project is called to the following plans & specifications. The items set forth herein, whether of omission, addition, substitution, or clarification, are all to be included as a procurement package as part of the proposed work. Along with the specifications, preliminary drawings and Process/Instrumentation Diagrams (P&IDs) of the filtration system are included for vendor review. The vendor shall review the attached information and acknowledge/confirm conformance of their proposal to the P&IDs and the layout of the equipment. Any modifications required for the proper functioning of the proposed equipment shall be included along with the proposal. If no information is provided in the bid package, it is assumed that the proposed equipment will operate as specified within the reference layout and P&IDs provided with this GMP. The vendor shall also include the duration required for shop drawing preparation and the duration from the time of approved shop drawings to delivery of equipment on-site with the bid package. In addition, the vendor shall provide expedited durations for shop drawing preparation and equipment delivery from time of approved shop drawings along with associated costs in the bid package as a separate line item.

Include the following Specification Sections and Figures in the Contract Documents.

I. CONTRACT AND SPECIFICATIONS

SECTION 01010 – Summary of Work

Include Section 01010 – Summary of Work attached as Attachment One of this Procurement Package.

SECTION 01300 – Submittals

Include Section 01300 – Submittals attached as Attachment One of this Procurement Package.

SECTION 01640 – Materials and Equipment

Include Section 01640 – Materials and Equipment attached as Attachment One of this Procurement Package.

SECTION 01650 – Starting of Systems

Include Section 01650 – Starting of Systems attached as Attachment One of this Procurement Package.

SECTION 01660 – Field Tests of Equipment

Include Section 01660 – Field Tests of Equipment attached as Attachment One of this Procurement Package.

SECTION 01730 – Operation and Maintenance Data

Include Section 01730 – Operation and Maintenance Data attached as Attachment One of this Procurement Package.

SECTION 01750 – Spare Parts and Maintenance Materials

Include Section 01750 – Spare Parts and Maintenance Materials attached as Attachment One of this Procurement Package.

SECTION 01821 – Instruction of Operations and Maintenance Personnel

Include Section 01821 – Instruction of Operations and Maintenance Personnel attached as Attachment One of this Procurement Package.

SECTION 03300 – Cast-In-Place Concrete

Include Section 03300 – Cast-In-Place Concrete attached as Attachment One of this Procurement Package.

SECTION 09900 – Painting

Include Section 09900 – Painting attached as Attachment One of this Procurement Package.

SECTION 11285 – Hydraulic Gates and Stop Logs

Include Section 11285 – Hydraulic Gates and Stop Logs attached as Attachment One of this Procurement Package.

SECTION 11400 – Disc Filters

Include Section 11400 – Disc Filters attached as Attachment One of this Procurement Package.

SECTION 13447 – Electric Motor Actuators

Include Section 13447 – Electric Motor Actuators attached as Attachment One of this Procurement Package.

SECTION 16160 – Enclosures

Include Section 16160 – Enclosures attached as Attachment One of this Procurement Package.

SECTION 16161 – Control Panels

Include Section 16161 – Control Panels attached as Attachment One of this Procurement Package.

SECTION 16170 – Grounding and Bonding

Include Section 16170 – Grounding and Bonding attached as Attachment One of this Procurement Package.

SECTION 16225 – Electric Motors 250 HP or Less

Include Section 16225 – Electric Motors 250 HP or Less attached as Attachment One of this Procurement Package.

SECTION 16474 – Motor Control Equipment

Include Section 16474 – Motor Control Equipment attached as Attachment One of this Procurement Package.

SECTION 16476 – Low Voltage Circuit Breakers

Include Section 16476 – Low Voltage Circuit Breakers attached as Attachment One of this Procurement Package.

SECTION 16482 – Solid State Motor Controllers

Include Section 16482 – Solid State Motor Controllers attached as Attachment One of this Procurement Package.

SECTION 16951 – Short Circuit, Coordination, and Arc-Flash Hazard Report

Include Section 16951 – Short Circuit, Coordination, and Arc-Flash Hazard Report attached as Attachment One of this Procurement Package.

SECTION 17325 – Turbidity and TSS Analyzer

Include Section 17325 – Turbidity and TSS Analyzer attached as Attachment One of this Procurement Package.

SECTION 17454 – Operations and Control Description

Include Section 17454 – Operations and Control Description attached as Attachment One of this Procurement Package.

II. FIGURES (PRELIMINARY – FOR REFERENCE ONLY)

FIGURE 1 – Airport WRF Filters Overall Plan

Figure 1 – Airport WRF Filters Overall Plan attached as Attachment Two of this Procurement Package.

FIGURE 2 – Airport WRF Filter Basin 5 Plan

Figure 2 – Airport WRF Filter Basin 5 Plan attached as Attachment Two of this Procurement Package.

FIGURE 3 – Airport WRF Filter Pump Gallery

Figure 3 – Airport WRF Filter Pump Gallery Plan attached as Attachment Two of this Procurement Package.

FIGURE 4 – Airport WRF Filter Section 1

Figure 4 – Airport WRF Filter Section 1 attached as Attachment Two of this Procurement Package.

FIGURE 5 – Airport WRF Filter DS1 P&ID – Sheet 1 of 3

Figure 5 – Airport WRF Filter Section 1 attached as Attachment Two of this Procurement Package.

FIGURE 6 – Airport WRF Filter DS1 P&ID – Sheet 2 of 3

Figure 6 – Airport WRF Filter Section 1 attached as Attachment Two of this Procurement Package.

FIGURE 7 – Airport WRF Filter DS1 P&ID – Sheet 3 of 3

Figure 7 – Airport WRF Filter Section 1 attached as Attachment Two of this Procurement Package.

FIGURE 8 – Ocotillo WRF Filters Overall Plan

Figure 8 – Ocotillo WRF Filters Overall Plan attached as Attachment Two of this Procurement Package.

FIGURE 9 – Ocotillo WRF Filter Basin 4 Plan

Figure 9 – Ocotillo WRF Filter Basin 4 Plan attached as Attachment Two of this Procurement Package.

FIGURE 10 – Ocotillo WRF Filter Pump Gallery

Figure 10 – Ocotillo WRF Filter Pump Gallery Plan attached as Attachment Two of this Procurement Package.

FIGURE 11 – Ocotillo WRF Filter Section 1

Figure 11 – Ocotillo WRF Filter Section 1 attached as Attachment Two of this Procurement Package.

FIGURE 12 – Ocotillo WRF Filter DS1 P&ID – Sheet 1 of 3

Figure 12 – Ocotillo WRF Filter Section 1 attached as Attachment Two of this Procurement Package.

FIGURE 13 – Ocotillo WRF Filter DS1 P&ID – Sheet 2 of 3

Figure 13 – Ocotillo WRF Filter Section 1 attached as Attachment Two of this Procurement Package.

FIGURE 14 – Ocotillo WRF Filter DS1 P&ID – Sheet 3 of 3

Figure 14 – Ocotillo WRF Filter Section 1 attached as Attachment Two of this Procurement Package.

ATTACHMENT ONE

GMP 1 - Specifications

SECTION 01010

SUMMARY OF WORK

PART 1 - GENERAL

1.1 SUMMARY

- A. The Work to be accomplished under the Pre-Procurement Package Contract Documents consists of procuring the equipment required to install:
 - 1. Six Disc Filters and all accessories at the Airport WRF.
 - 2. Four Disc Filters and all accessories at the Ocotillo WRF.
 - 3. Gates and actuators for the Chandler WRF improvements Project.
- B. The following work/notes pertain to both Airport WRF and Ocotillo WRF:
 - a. Provide minimum of one year warranty on all warranted materials and labor.
 - b. Provide one year warranty on start-up assistance.
 - c. Provide on-site, hands-on operator training.
 - d. All other miscellaneous work as specified in the Contract Documents.
- C. A subsequent package of Contract Documents will include the remainder of the Work for the Chandler WRF Improvements Project including installation of equipment procured as part of this package.

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.

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. Submittals shall be sent to the ENGINEER. CONTRACTOR shall deliver and pick up submittals from ENGINEER'S office located at 1620 W. Fountainhead Pkwy, Suite 501, Tempe, AZ 85282, between the hours of 7:00 a.m. and 4:00 p.m. All submittals shall be addressed to Sreeram Rengaraj.

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 minimum of 1 hard copy of Shop Drawings is required for each submittal. Each submittal shall also include one electronic copy in the latest version of Adobe Acrobat (PDF Extension). Hard copies will not be returned. Disposition of the Shop Drawings will be in accordance with the following schedule:

Action by ENGINEER	Retained by ENGINEER	Returned to CONTRACTOR	No. Required for Resubmittal
Approved	1	0	0
Approved as Corrected	1	0	0
Approved as Corrected, Resubmit	1	0	1
Revise and Resubmit	0	1	1
Rejected	0	1	1
No Action Taken	1	0	0

- B. The ENGINEER shall return Shop Drawings to the CONTRACTOR within 35 days of receipt by the ENGINEER.

- C. One copy of returned Shop Drawings shall be marked with red line comments.
- D. Only one copy of "Revise and Resubmit", "Rejected", and "No Action Taken" Shop Drawings will be stamped.
- E. If the CONTRACTOR requires additional copies of "No Exceptions Noted", "Exceptions Noted", or "No Action Taken" Shop Drawings, additional copies shall be included in original submittal.
- F. 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.
- G. 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.
- H. Do not execute Work required by Shop Drawings until accepted Shop Drawings are received from the ENGINEER.
- I. 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.
- J. 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.
- K. 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.
- L. 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.
 - M. 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.
 - N. 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.
 - O. 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.
 - P. 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.
 - Q. 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.

- R. 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.
- S. Action taken by ENGINEER shall apply to entire submittal. ENGINEER shall not approve portions of a submittal while disapproving other portions.
- T. Resubmitted submittal shall contain entirety of information to review.
- U. 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 – PROCUREMENT SUBMITTAL LISTING		
ITEM NO.	SPEC SECT	DESCRIPTION OF SUBMITTAL
1	01650	STARTING OF SYSTEMS
2	01730	OPERATION AND MAINTENANCE MANUALS
3	01750	SPARE PARTS AND MAINTENANCE MATERIALS
4	01821	INSTRUCTION OF O & M PERSONNEL
5	03300	CONCRETE MIX DESIGN
6	09900	PAINTING
7	11285	HYDRAULIC GATES
8	11295	HYDRAULIC VALVES
9	11400	DISC FILTERS
10	13447	ELECTRIC MOTOR ACTUATORS
11	16160	ENCLOSURES
12	16161	CONTROL PANELS
13	16170	GROUNDING AND BONDING
14	16225	ELECTRIC MOTORS 250 HORSEPOWER OR LESS
15	16474	MOTOR CONTROL EQUIPMENT
16	16476	LOW VOLTAGE CIRCUIT BREAKERS
17	16482	SOLID STATE MOTOR CONTROLLERS
18	16951	SHORT CIRCUIT, COORDINATION, AND ARC-FLASH HAZARD REPORT
19	17325	TURBIDITY AND TSS ANALYZER
20	17454	OPERATIONS AND CONTROL DESCRIPTION

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 Project
 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.
- F. 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 Project

CONTRACTOR'S Name: _____

Date: _____

-----Reference-----

Item: _____

Specifications:

Section: _____

Page No.: _____

Para. No.: _____

Drawing No.: _____ of _____

Location: _____

Submittal No.: _____

Approved By: _____

- G. 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 11285, Hydraulic Gates, 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. Three copies 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.

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.
- I. 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. One hard copy and one electronic copy 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. Additional data to be included in the manual shall be as required in these Specifications.
 - 10. Temporary storage recommendations.
 - 11. Warranty information.

- 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.
- 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 (i.e., IMLR Pumps and Submersible Mixers) 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 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.

<u>Form Designation</u>	<u>Title</u>
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, 3-ring binders with tabs for each process area 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 five copies of all 3-ring binders 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

Name of Corporation

Commission expiration date

Address

Seal:

By: _____
Duly Authorized Official

Legal Title of Official

Date: _____

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 plate 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.

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. 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.

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.
- b. Factory performance tests.
- c. Accelerometer recordings made during shipment.
- d. Field calibration tests¹.
- e. Field pressure tests¹.
- f. Field performance tests¹.
- g. Field operational tests¹.

(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 10400, Equipment Identification Plates.
 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. 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)
Disc Filter System	2 (1 day at each plant)
Hydraulic Gates	1 (½ day at each plant)
Actuators	1 (½ day at each plant)
Turbidity Instrument	1 (½ day at each plant)

- 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.

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. Six 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 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 in CD format 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)

(The remainder of this page left intentionally blank).

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 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 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. Credentials of their designated operations and maintenance instructor. Credentials 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.
3. Training Request Form: CONTRACTOR shall submit the Training Request Form to the ENGINEER 28 days prior to the requested training date.
4. There shall be separate "Operations" and "Maintenance" staff training.

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. Identify equipment's mechanical, electrical and electronic components and features.
 - d. Identify all support equipment associated with the operation of subject equipment (e.g., air intake filters, valve actuators, motors).
 - e. 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.
 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 SCHEDULE

- A. Each manufacturer shall provide as a minimum the following hours of training. Travel time and expenses are responsibility of manufacturer and are not included in training schedule time.
- B. The CONTRACTOR shall provide experienced, competent manufacturers' representatives 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 video tape the manufacturers' training sessions and provide OWNER with DVD format professional quality discs 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 hours as specified below:

Equipment	Additional Training Days (Day = 8 hrs minimum)
Disc Filter System	2 (1 day at each plant)
Hydraulic Gates	1 (½ day at each plant)
Actuators	1 (½ day at each plant)
Turbidity Instrument	1 (½ day at each plant)

- C. 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 three shifts and staff flex time.
- D. 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 PROJECT

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 03300

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, 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. Classes of Concrete:

1. 6,000 psi (at 28 days) concrete shall be steel reinforced and shall be used for the Ocotillo Wastewater Reclamation Facility – Reservoir.
2. 5,000 psi (at 28 days) concrete shall be steel reinforced and shall be used for the following pre-cast applications:
 - a. Manholes and vaults.
3. Class "A" (5,000 psi at 28 days) concrete shall be steel reinforced and shall be used for the following applications:
 - a. All concrete, unless indicated otherwise.
4. Class "B" concrete (3,000 psi at 28 days) shall be placed without forms or with simple forms, with little or no reinforcing, and includes the following:
 - a. Duct banks.
 - b. Unreinforced encasements.
 - c. Curbs and gutters.
 - d. Sidewalks.
 - e. Thrust blocks.
5. Class "C" (2,000 psi at 28 days) concrete shall be placed without forms or with simple forms, with little or no reinforcing.

D. Related Sections:

1. Section 02315, Earthwork, Excavation, and Backfill.
2. Section 03100, Concrete Formwork.
3. Section 03200, Concrete Reinforcement.

4. Section 03251, Concrete Joints.

1.2 QUALITY ASSURANCE

- A. Reference Standards: Comply with the applicable provisions and recommendations of the following, except as otherwise shown or specified.
1. ACI 211.1, Standard Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete.
 2. ACI 214, Recommended Practice for Evaluation of Strength Test Results of Concrete.
 3. ACI 301, Specifications for Structural Concrete for Buildings, (includes ASTM Standards referred to herein).
 4. ACI 304, Guide for Measuring, Mixing, Transporting, and Placing Concrete.
 5. ACI 305, Hot Weather Concreting.
 6. ACI 309, Guide for Consolidation of Concrete.
 7. ACI 311, Guide for Concrete Inspection.
 8. ACI 318, Building Code Requirements for Reinforced Concrete.
 9. ACI 350R, Environmental Engineering Concrete Structures.
 10. AASHTO M182, Burlap Cloth Made From Jute or Kenaf.
- B. Concrete Testing Service:
1. CONTRACTOR shall employ, at his own expense, a testing laboratory experienced in design and testing of concrete materials and mixes to perform material evaluation tests and to design concrete mixes.
 - a. Testing agency shall meet the requirements of ASTM E329.
 - 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 which 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.
- C. Qualifications of Water-Reducing Admixture Manufacturer:
1. Water-reducing admixtures shall be manufactured under strict quality control in facilities operated under a quality assurance program. CONTRACTOR shall furnish copy of manufacturer's quality assurance handbook to document the existence of the program. Manufacturer shall maintain a concrete testing laboratory which 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 job site conditions.

D. Tests for Concrete Materials:

1. Submit written reports to ENGINEER, for each material sampled and tested, prior to the start of Work.
2. Provide the Project identification name and number, date of report, name of CONTRACTOR, name of concrete testing service, source of concrete aggregates, material manufacturer and brand name for manufactured materials, values specified in the referenced specification for each material, and test results. Indicate whether or not material is acceptable for intended use.

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. Manufacturer's specifications with application and installation instructions for proprietary materials and items, including admixtures and bonding agents.
 2. 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.
 3. The following information, if ready-mixed concrete is used.
 - a. Physical capacity of mixing plant.
 - b. Trucking facilities available.
 - c. Estimated average amount which 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. 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 C94, Section 16.
1. Provide batch tickets for each batch of job site mixed concrete, as specified.
- F. The CONTRACTOR shall submit Portland cement submittals to the ENGINEER by a well known manufacturer and supplied by one plant.
- G. CONTRACTOR may provide Portland cement from a second plant to be used in emergency situations only. CONTRACTOR must provide second submittal within 30 days of receipt of first submittal.

- H. 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.
- I. 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 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 insure that segregation of the coarse and fine aggregate particles does not occur and the grading is not affected.

1.5 CONCRETE COORDINATION MEETING

- 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.

PART 2 - PRODUCTS

2.1 CONCRETE MATERIALS

- A. Cement:
1. Portland cement, ASTM C150, Type II.
 2. Use Portland cement made by a well-known acceptable manufacturer and produced by not more than one plant.
 3. Do not use cement which has deteriorated because of improper storage or handling.
- B. Aggregates: ASTM C33 and as herein specified.
1. 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.
 2. Fine Aggregate: Clean, sharp, natural sand free from loam, clay, lumps, or other deleterious substances.
 - a. Dune sand, bank run sand, and manufactured sand are not acceptable.
 3. Coarse Aggregate: Clean, uncoated, processed aggregate containing no clay, mud, loam, or foreign matter as follows:
 - a. Crushed stone, processed from natural rock or stone.
 - b. Washed gravel, either natural or crushed. Use of slag and pit or bank run gravel is not permitted.
 - c. Coarse Aggregate Size: Size to be ASTM C33, Nos. 57 or 67, except that No. 467 may be used for footings, foundation mats, and walls 16-inches or greater in thickness.
- C. Water: Clean, free from injurious amounts of oils, acids, alkalis, organic materials, or other substances that may be deleterious to concrete or steel.

2.2 CONCRETE ADMIXTURES

- A. Provide admixtures produced by established reputable manufacturers and use in compliance with the manufacturer's printed instruction. Do not use admixtures which have not been incorporated and tested in the accepted mixes, unless otherwise authorized in writing by ENGINEER.
- B. Air-Entraining Admixtures: ASTM C 260.
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 Master Builders, Inc.
 - c. Daravair, as manufactured by W.R. Grace & Company.
 - d. Or approved equal.
- C. Water-Reducing Admixture: ASTM C494, Type A.
 - 1. Proportion all Class "A" and Class "B" 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 WR-75, as manufactured by The Euclid Chemical Company.
 - b. Pozzolith, as manufactured by Master Builders, Inc.
 - c. WRDA-15, as manufactured by W.R. Grace & Conn.
 - d. Or approved equal.
- D. Pozzolanic Admixtures:
 - 1. Mineral admixtures, when used, shall meet the requirements of ASTM C618, Class F, except as follows:
 - a. The loss on ignition shall be a maximum of 4%.
 - b. The maximum percent of sulfur trioxide (SO₃) shall be 4.0.
 - 2. A substitution by weight, of the Portland cement, by pozzolan, so that the total tricalcium aluminate content of the resulting cement plus pozzolan is not greater than 8%, will be considered. However, the pozzolan shall not exceed 20% by weight of the cement, plus pozzolan.
- E. Set-Control Admixtures: ASTM C494, as follows:
 - 1. Type B, Retarding.
 - 2. Type C, Accelerating.
 - 3. Type D, Water-reducing and Retarding.
 - 4. Type E, Water-reducing and Accelerating.
- F. Calcium Chloride: Do not use calcium chloride in concrete, unless otherwise authorized in writing by ENGINEER. Do not use admixtures containing calcium chloride where concrete is placed against galvanized steel.

2.3 PROPORTIONING AND DESIGN OF MIXES

- A. Prepare concrete design mixes subject to the following limitations:

Class	Coarse Aggregate ¹ Size A Size B	Minimum Cementitious (lbs/cu yd)	Maximum W/C	Slump ²	Air %	Min. Comp Strength ³ (psi)
6000 psi	#57 or #67	846	0.40	4" Max.		6000
5000 psi	#57 or #67	705	0.40	4" Max.	3 max	5000
Class "A"	#57 or #67	564	0.45	4" Max.	4+/-1	4000
Class "B"	#57 or #67	517	0.55	4" Max.	4+/-1	3000
Class "C"	Any ASTM C33	← No requirements →				2000

1. Coarse aggregate size numbers refer to ASTM C33. Where a size A and B are listed, it is intended that the smaller size B aggregate is to be added, replacing a portion of the coarse and /or fine aggregate, in the minimum amount necessary to make a workable and pumpable mix with a sand content not exceeding 41% of total aggregate.
 2. The slumps listed are prior to the addition of high range water reducer (super plasticizer).
 3. Mix designs shall be made for all but Class "C", which does not require a trial batch, so that the compressive strength achieved for the laboratory trial batches will be no less than 125% of the specified design strength. This is to assure meeting the design strength for all concrete batched during the Project.
 4. 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.
- 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. Proportion mixes by either laboratory trial batch or field experience methods, using materials to be employed on the Project for concrete required. Comply with ACI 211.1 and report to ENGINEER the following data:
1. Complete identification of aggregate source of supply.
 2. Tests of aggregates for compliance with specified requirements.
 3. Scale weight of each aggregate.
 4. Absorbed water in each aggregate.
 5. Brand, type, and composition of cement.
 6. Brand, type, and amount of each admixture.
 7. Amounts of water used in trial mixes.
 8. Proportions of each material per cubic yard.
 9. Gross weight and yield per cubic yard of trial mixtures.
 10. Measured slump.
 11. Compressive strength developed at 7 days and 28 days, from not less than three test cylinders cast for each 7 day and 28 day test, and for each design mix.
- D. Submit written reports to ENGINEER of proposed mix of concrete at least 15 days prior to start of Work.
- E. Laboratory Trial Batches: When laboratory trial batches are used to select concrete proportions, prepare test specimens and conduct strength tests as specified in ACI 301, Section 4 - Proportioning.



- F. Field Experience Method: When field experience methods are used to select concrete proportions, establish proportions as specified in ACI 301, Section 4.
- G. 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.
- H. Admixtures:
 - 1. 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.
- I. Slump Limits:
 - 1. A slump of up to 5-inches will be allowed for Class "C" concrete. See the General Structural Notes in the Drawings for allowable slumps for other mixes.
 - 2. Slump tolerances for all concrete shall meet the requirements of ACI 301 and ACI 117.
- J. Red Dye:
 - 1. Add red dye to all concrete used for electrical duct bank encasement.

2.4 EPOXY BONDING AGENT

- A. Provide an epoxy-resin bonding agent, two-component type.
- B. Product and Manufacturer: Provide one of the following:
 - 1. Sikadur 32 Hi-Mod LPL, as manufactured by Sika Corporation.
 - 2. Eucopoxy LPL, as manufactured by the Euclid Chemical Company.
 - 3. Or approved equal.

2.5 CONCRETE CURING MATERIALS

- A. Absorptive Cover: Burlap cloth made from jute or kenaf, weighing approximately 10 ounces per square yard and complying with AASHTO M182, Class 3.
- B. Moisture-Retaining Cover: Comply with ASTM C171.
 - 1. Transguard 4000 or approved equal.
- C. Curing Compound: ASTM C309 Type 1-D (water retention requirements):
 - 1. Product and Manufacturer: Provide one of the following:
 - 2. Super Aqua Cure VOX, as manufactured by The Euclid Chemical Company.
 - 3. Sealtight 1100, as manufactured by W.R. Meadows, Incorporated.
 - 4. MasterKure, as manufactured by Master Builders, Inc.

5. Or approved equal.
6. Provide fugitive dye when requested by ENGINEER.

2.6 EMBEDDED ITEMS

- A. Items such as plates, angles, inserts, bolts, and similar items not specified elsewhere shall be provided and installed under this Section. All embedded items shall be hot-dip galvanized after fabrication. After galvanizing, coat with zinc chromate paint. Stainless steel items shall not be galvanized.

2.7 CRACK INJECTION MATERIALS

- A. Epoxy:
 1. Epoxy for injection shall be a low viscosity, high modulus moisture insensitive type.
 2. Products and Manufacturers: Provide one of the following:
 - a. Sikadur 35, Hi-Mod L.V. and Sikadur 31, Hi-Mod Gel, as manufactured by Sika Corporation.
 - b. Eucopoxy Injection Resin, as manufactured by The Euclid Chemical Company.
 - c. Or approved equal.

PART 3 - EXECUTION

3.1 INSPECTION

- A. CONTRACTOR and his installer shall 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.
 2. Mixing:
 - a. Mix concrete with an approved rotating type batch machine, except where hand mixing of very small quantities may be permitted.
 - b. Remove hardened accumulations of cement and concrete frequently from drum and blades to assure acceptable mixing action.
 - c. Replace mixer blades when they have lost 10% of their original height.

- d. Use quantities such that a whole number of bags of cement is required, unless otherwise permitted.
- 3. Job Site Mixing: Is not permitted.
- B. Ready-Mix Concrete:
 - 1. Comply with the requirements of ASTM C94 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 which 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. Mix at proper speed until concrete is discharged.
 - f. Maintain adequate facilities at the job site for continuous delivery of concrete at the required rates.
 - g. Provide access to the mixing plant for ENGINEER at all times.
 - 2. Provide a batch ticket for each batch discharged and used in the Work, indicating the Project identification name and number, date, mix type, mix time, quantity, and amount of water introduced.
- 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 CONCRETE PLACEMENT

- A. General: Place concrete continuously so that no concrete will be placed on concrete which 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 3.4.E of these Specifications only as approved by ENGINEER. 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 which 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 48 hours before placing concrete against a slab or wall already in place.

B. 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 which 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, snow, 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.

C. 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 which is being integrated with fresh concrete is still plastic.
2. Do not permit concrete to free-fall within the form from a distance exceeding 6 feet. Use "elephant trunks" to prevent free fall and excessive splashing on forms and reinforcement.
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. 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.
6. Do not place concrete in beam and slab forms until the concrete previously placed in columns and walls is no longer plastic.
7. Force concrete under pipes, sleeves, openings, and inserts from one side until visible from the other side to prevent voids.

D. 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.

E. Bonding for Next Concrete Pour: Roughen surfaces of set concrete at all joints, except where bonding is obtained by use of a concrete bonding agent.

Construction joints shown on the Drawings are specified in Section 03251, Concrete Joints, of these Specifications. Clean surfaces of laitance, coatings, loose particles, and foreign matter. Roughen surfaces in a manner to expose bonded aggregate uniformly and to not leave laitance, loose particles of aggregate, or damaged concrete at the surface.

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 freestanding water.
 - b. For horizontal surfaces, place a 2-inch layer of mortar, one part sand and one part cement with water, over the hardened concrete surface.
 - c. Place fresh concrete before the mortar has attained its initial set.
2. Bonding of fresh concrete to fully-cured hardened concrete or existing concrete and horizontal surfaces which will receive a topping shall be

accomplished by using an epoxy-resin bonding agent as specified in Section 03251, Concrete Joints, of these Specifications.

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 ordered 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 will not be acceptable.
4. All leaks through concrete 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 ordered by ENGINEER shall be at no additional cost to OWNER.

G. 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. Cool ingredients before mixing to maintain concrete temperature at time of placement below 80° F when the temperature is rising and below 85° F when the temperature is falling. Mixing water may be chilled or chopped ice or liquid nitrogen may be used to control the concrete temperature provided the water equivalent of the ice is calculated in the total amount of mixing water.
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.

3.5 FINISH OF FORMED SURFACES

A. Rough Form Finish:

1. Standard rough form finish shall be the concrete surface having the texture imparted by the form material used, with tie holes and defective areas repaired and patched with mortar of one part cement to 1-1/2 parts sand and all fins and other projections exceeding 1/4-inch in height rubbed down or chipped off.
2. Use rough form finish for the following:

- a. Exterior vertical surfaces up to 1 foot below grade.
- b. Interior exposed vertical surfaces of liquid containers up to 1 foot below liquid level.
- c. Interior and exterior exposed beams and undersides of slabs.
- d. Other areas shown.

B. Smooth Form Finish:

1. Produce smooth form finish by selecting form materials which 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 above with all fins or other projections completely removed and smoothed.
2. Use smooth form finish for 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, damp proofing, painting or other similar system.

C. Smooth Rubbed Finish:

1. Provide smooth rubbed finish to concrete surfaces which have received smooth form finish 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 rubbed finish as follows:
 - a. Repair all defects and patch all tie holes prior to rubbed finish.
 - b. Grind all form finish and joint lines, smooth. Remove all curing compound and form oil.
 - c. Combine one part Portland cement to 1-1/2 parts fine sand by volume and mix with water to a consistency of thick paint. Blend standard Portland cement with white Portland cement in amounts determined by trial patches. Final color of dried grout to match color of adjacent concrete surfaces.
 - d. Thoroughly wet concrete surface with bonding agent and water mix. Apply grout uniformly by rubber or cork float. Fill all surface holes. Remove excess grout by rubbing with clean wet burlap to remove any visible grout film.
 - e. Provide sample panel for approval, prior to start of Work.

D. 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.

3.6 MONOLITHIC 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 10 feet when tested with a 10 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 10 feet when tested with a 10 foot straightedge. 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 fiber bristle broom unless otherwise directed. 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.

3.7 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 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. Final Curing Methods:

1. Perform curing of concrete by moist curing, or by moisture-retaining cover curing, or curing compound.
 - a. For curing, use water that is free of impurities which 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 the specified absorptive cover, thoroughly saturating the cover with water, and keeping the absorptive cover continuously wet with sprinklers or porous hoses. Cover shall be Transguard 4000 or approved equal.
 - d. Place absorptive cover so as to provide coverage of the concrete surfaces and edges, with a 4-inch lap over adjacent absorptive covers.
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 which 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 which will be in contact with raw or potable water, the manufacturer shall certify that the curing compound used is EPA approved.

C. Curing Formed Surfaces:

1. Cure formed concrete surfaces, including the undersides of girders, beams, supported slabs, and other similar surfaces with the forms in place for the full curing period. If forms are removed earlier, continue curing by methods specified above, as applicable.
- D. Curing Unformed Surfaces:
1. Final cure unformed surfaces, such as slabs, floor topping, and other flat surfaces by using the appropriate method specified above.
- 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.

3.8 FIELD QUALITY CONTROL

- A. CONTRACTOR shall employ a testing laboratory to perform field quality control testing. ENGINEER will make slump tests and will direct the number of tests and cylinders required. CONTRACTOR shall make standard compression test cylinders and entrained air tests as specified below, under the direct inspection by ENGINEER. CONTRACTOR shall furnish all necessary assistance required by ENGINEER. CONTRACTOR shall also furnish all labor, material, and equipment required, including 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. CONTRACTOR shall furnish all necessary storage, 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 C172.
 - b. Slump: ASTM C143; one test for each concrete load at point of discharge; and one for each set of compressive strength test specimens.
 - c. Air Content: ASTM C231; one for every other concrete load at point of discharge, or when required by an indication of change.
 - d. Compressive Strength Tests: ASTM C39; one set of compression cylinders for each 50 cubic yards or fraction thereof, of each mix design placed in any one day or for each 2,500 square feet of surface area placed; one specimen tested at seven days, and two specimens tested at 28 days.
 - 1) Adjust mix if test results are unsatisfactory and resubmit for ENGINEER'S approval.
 - 2) Concrete which 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 C31; 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 C31.
 - f. 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. 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% 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% 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 the OWNER employed testing laboratory results indicate that the strength of the in-place concrete does not meet Specification requirements, CONTRACTOR shall employ, at his expense, the services of a concrete testing service to take cores drilled from hardened concrete for compressive strength determination. Tests shall comply with ASTM C42 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% and no single core is less than 75% of the 28 day required compressive strength.
 - c. Report test results in writing to ENGINEER 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 ACI 318 if the results of the core tests are unsatisfactory, or if core tests are impractical to obtain, as directed by ENGINEER.
4. OWNER, at his own expense, may also conduct the same tests using the laboratory of OWNER'S choice when the test results show that the concrete

does not meet the specifications. The CONTRACTOR shall coordinate with the OWNER and ENGINEER prior to taking any representative samples and beginning the testing process.

3.9 MISCELLANEOUS CONCRETE ITEMS

A. Filling-In:

1. Fill-in holes and openings left in concrete structures for the passage of work by other contractors, unless otherwise shown or directed, after the work of other contractors is in place. Mix, place and cure concrete as herein specified, to blend with in-place construction. Provide all other miscellaneous concrete filling shown or required to complete the Work.

B. 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.

C. Equipment Bases:

1. Unless specifically shown otherwise, provide concrete bases for all pumps and other equipment. Construct bases to the dimensions shown, or as required to meet manufacturer's 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 to 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 or other contracts.
3. In general, place bases up to 1-1/2-inches below the metal base. Properly shim equipment to grade and fill 1-1/2-inch void with non-shrink grout, as specified in Section 03600, Grout.

3.10 CONCRETE ENCASEMENT OF ELECTRICAL DUCT BANKS

- A. Mix red dye into concrete to be used for encasement.
- B. Provide a minimum covering of 3-inches of concrete over the top and sides of the conduit and conduit supports.
- C. Conduit shall be firmly fixed in place before pouring concrete. Vibrate the concrete to ensure filling of all spaces between conduits.
- D. Where duct banks pass under paved or unpaved roadways, concrete encasement shall be reinforced with No. 4 longitudinal steel bars placed at each "corner" and at 18-inches o.c. along the top and sides of the duct bank. Place No. 3 tie-bars

- placed transversely at 18-inches o.c. Maintain a minimum cover of 2-inches of concrete over the reinforcing bars.
- E. Install a bare stranded copper duct bank ground in each duct bank. Make the ground electrically continuous throughout the entire duct bank system and connect to switchgear and motor control center ground busses and to steel conduit extension of the underground duct system.

3.11 CONCRETE REPAIRS

- A. Repair of Formed Surfaces:
1. Repair exposed-to-view formed concrete surfaces, that contain defects which adversely affect the appearance of the finish. Surface defects that require repair include color and texture irregularities, cracks, spalls, air bubbles, honeycomb, rock pockets, and holes left by the rods and bolts; fins and other projections on the surface; and stains and other discolorations that cannot be removed by cleaning.
 2. Repair concealed formed concrete surfaces that may contain defects that adversely affect the durability of the concrete. Surface defects that require repair include cracks in excess of 0.01-inch wide, cracks of any width and other surface deficiencies which penetrate to the reinforcement or completely through non-reinforced sections, honeycomb, rock pockets, holes left by tie rods and bolts, and spalls except minor breakage at corner.
- B. Repair structural cracks and cracks in water-holding structures. Method of Repair of Formed Surfaces:
1. Repair and patch defective areas with cement mortar immediately after removal of forms and as directed by ENGINEER.
 2. Cut out honeycomb, rock pockets, voids over 1/2-inch diameter, and holes left by tie rods and bolts, down to solid concrete but, in no case, to a depth of less than 1-inch. Make edges of cuts perpendicular to the concrete surface. Before placing the cement mortar, thoroughly clean, dampen with water, and brush-coat the area to be patched with the specified bonding agent.
 - a. For exposed-to-view surfaces, blend white Portland cement and standard Portland cement so that, when dry, the patching mortar color will match the color of the surrounding concrete. CONTRACTOR shall 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. Cracks which require repair shall be pressure grouted using one of the following. Apply in accordance with the manufacturer's directions and recommendations.
 - a. Sikadur 35, Hi-Mod L.V., and Sikadur 31, Hi-Mod Gel, as manufactured by Sika Corporation Company.

- b. Euco Epoxy #452 Epoxy System, as manufactured by The Euclid Chemical Company.
 - c. Or approved equal.
 - 4. 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.
 - 5. Sandblast 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 which adversely affect the durability of the concrete. Surface defects as such, include crazing, cracks in excess of 0.01-inch wide or which penetrate to the reinforcement or completely through non-reinforced sections regardless of width, spalling, popouts, honeycomb, rock pockets, and other objectionable conditions.
 - 4. Repair structural cracks and cracks in water-holding structures.
- 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. Use one of the following. Apply in accordance with the manufacturer's directions and recommendations.
 - a. Euco Poly-Patch, as manufactured by The Euclid Chemical Company.
 - b. Sikatop 122, as manufactured by Sika Corporation.
 - c. Or approved equal.
 - 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. Dampen all concrete surfaces in contact with patching concrete and brush with the specified bonding agent. Place patching concrete before grout takes its initial set. Mix patching concrete of the same materials and proportions to provide concrete of the same type or class 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 cracks 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. Cracks which require repair shall be pressure grouted using one of the following. Apply in accordance with the manufacturer's directions and recommendations.
 - a. Sikadur 35, Hi-Mod L.V., and Sikadur 31, Hi-Mod Gel, as manufactured by Sika Corporation.
 - b. Euco Epoxy #452 Epoxy System, as manufactured by The Euclid Chemical Company.
 - c. Or approved equal.
 6. 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 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. 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.
- C. 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 meter.
 - 5. Full gloss refers to high-sheen finish with a gloss range more than 65 when measured at a 60 degree meter.
 - 6. Buried refers to covered with earth.
 - 7. 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.
 - 8. 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. 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.

1.7 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 45° F (7° 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 50° F and 120° F (10° C and 48.9° C).
- B. Apply solvent-thinned paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 45° F and 120° F (7.2° C and 48.9° 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 5° F (3° 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 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 (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. Masonry:
 1. Interior Exposed CMU:
 - a. Surface Preparation: Clean, dry, and free of contaminants.
 - b. Block Filler: Series 130 Envirofill; one coat; 60-80 square foot per gallon.
 - c. Finish Coats: Series 69 H.B. Epoxoline II; two coats; 4-6 mils DFT per coat.
- F. 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.
- G. 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 ARCHITECTURAL PAINT SYSTEMS

- A. Concrete Gloss Epoxy:
 1. Surface Preparation: All surfaces to be clean and free of contaminants prior to application of the coating system.
 2. Prime Coat: Series 104 H.S. Epoxy; one coat; 4-5 mils DFT.
 3. Finish Coat: Series 104 H.S. Epoxy; one coat; 4-5 mils DFT.
- B. Interior Gypsum Wallboard and Plaster: Ducts/Pipes:
 1. Surface Preparation: Clean dry and free of contaminants prior to application of coating system.
 2. Prime Coat: Series 51-792 PVA Sealer; one coat; 1-2 mils DFT.
 3. Finish Coats: Series 113 Tufcoat; two coats; 4-5 mils DFT per coat.
- C. Insulated Ducts/Pipes:

1. Surface Preparation: All surfaces to be clean and free of contaminants prior to application of the coating system.
 2. Prime Coats: Series 6 Tneme-Cryl; one coat; 2-3 mils DFT.
- D. Concrete Semi-Gloss Latex:
1. Surface Preparation: All surfaces to be clean and free of contaminants prior to application of the coating system.
 2. Prime Coat: Series 7 Tneme-Cryl; one coat; 2-3 mils DFT.
 3. Finish Coat: Series 7 Tneme-Cryl; one coat; 2-3 mils DFT.

2.5 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's 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, hollow 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 Razor 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:

Exposed Pipe Labels	Background Colors	Color of Letters
Air Piping:	John Deere Green (AWRF)	Black (AWRF)
Water Lines: Water - Potable Water - Non-Potable	Light Blue Tan (AWRF) Purple (OWRF)	Black Black (AWRF) White (OWRF)
Exposed Electrical Conduits: 120 V / 480 V / 4,160 V (no label)	Match Background Color	None
Fire Quenching Materials: Water, Foam, CO2, Halon, Fire Hydrants, including sections of potable water for Fire Dept. access (no label)	Red	None
HVAC Duct Work:	Match Background Color	None
Sample Lines Piping:	Dark Blue	Black
Piping: IMLR Return Activated Sludge Odor Control Piping Backwash Washwater Tank Drain / Sump Drain	Tan (OWRF) Dark Brown (OWRF) White (OWRF) Dark Brown Black (AWRF) Grey (OWRF)	Black (OWRF) White (OWRF) Black (OWRF) White White (AWRF) White (OWRF)
Chemical Piping: Sodium Hypochlorite	Yellow	Black

- 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 <u>(inches)</u>	Height of Letters <u>(inches)</u>
3/4 - 1-1/4	1/2
1-1/2 - 2	3/4
2-1/2 - 6	1-1/4
8 - 10	2-1/2
Over 10	3-1/2

END OF SECTION

SECTION 11285

HYDRAULIC GATES AND STOP LOGS

PART 1 - GENERAL

1.1 SUMMARY

- A. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install stainless steel gates, and appurtenances.
- B. Gate mountings shall be supplied by the gate manufacturer and all other appurtenances shall be provided by the CONTRACTOR.

1.2 SECTION INCLUDES

- A. Slide Gates.
- B. Sluice Gates
- C. Stop Logs.

1.3 REFERENCES

- A. American Society of Mechanical Engineers (ASME)
 - 1. Section IX - Boiler and Pressure Vessel Code - Welding and Brazing Qualifications.
- B. American Water Works Association (AWWA)
 - 1. AWWA C 561 - Fabricated Stainless Steel Gates.
- C. American Welding Society (AWS)
 - 1. D1.6 - Structural Welding Code-Stainless Steel.
- D. American Society for Testing Materials (ASTM)
 - 1. A 276 - Stainless and Heat-Resisting Steel Bars and Shapes, Type 304 and Type 316.
 - 2. B 584 - Copper Alloy Sand Castings for General Application.
 - 3. D 1248 - Standard Specification for Polyurethane Plastics Extrusion Materials for Wire and Cable.
 - 4. D 2000 - Standard Classification for Rubber Products in Automotive Applications.
 - 5. D 4020 - Standard Specification for Ultra-High Molecular-Weight Polyethylene Molding and Extrusion Materials.

1.4 RELATED SECTIONS

- A. Section 01300, Submittals.
- B. Section 01640, Materials and Equipment.
- C. Section 01650, Starting of Systems.
- D. Section 03300, Cast-in-Place Concrete.
- E. Section 03600, Grout.
- F. Section 09900, Painting (Specifications for surface preparation and shop priming required under Section 11285, Hydraulic Gates, are to be done in conformance with Section 09900, Painting).
- G. Section 13447, Electric Motor Actuators.
- H. Division 16, Electrical.
- I. Division 17, Instrumentation.

1.5 QUALITY ASSURANCE

- A. Manufacturer's Qualifications:
 - 1. Manufacturer shall have a minimum of five years of experience in the production of substantially similar equipment and shall show evidence of satisfactory operation in at least five installations.
 - 2. All gates shall be the product of one manufacturer.
- B. Shop Tests:
 - 1. Test each gate fully assembled in the vertical position for proper seating.
 - 2. Fully open and close gate disc in its guide system to ensure that it operates freely.
 - 3. Operate and test floor stands, bench stands, and motor operators to ensure proper assembly and operation. Motor operators shall be tested by the operator manufacturer prior to shipment.

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. Shop Detail Drawings showing individual sub-assemblies and fabricated pieces with material specifications and other applicable data.
 - d. 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.
 - e. General bulletins and catalog cuts describing complete apparatus, including operating principles and fundamentals.
 - f. Materials of construction of all components.
 - g. 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.
 - h. Stuffing box sizes; packing sizes; specifications and arrangement; and mechanical seal details, specifications, etc., if furnished in equipment.
 - i. Deviations from the Contract Documents.
2. O&M Manuals:
- a. Final Certified Drawings showing outline dimensions, foundation layout or mounting information, and other pertinent dimensions.
 - b. Shop Detail Drawings showing individual sub- assemblies and fabricated pieces with material specifications and other applicable data.
 - c. 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.
 - d. General bulletins and catalog cuts describing complete apparatus, including operating principles and fundamentals.
 - e. Materials of construction of all components.
 - f. 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.
 - g. Stuffing box sizes; packing sizes; specifications and arrangement; and mechanical seal details, specifications, etc., if furnished in equipment.
 - h. Test reports, maintenance data and schedules, description of operation, and spare parts information.
 - i. Furnish Operation and Maintenance Manuals in conformance with the requirements of Section 01300, Submittals.
- B. Field Test Results:
- 1. Submit a written report giving the results of the field tests required.
- C. Lubricant Specification: Furnish a lubricant specification for the type and grade necessary to meet the requirements of the equipment.

- 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.**

1.7 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to the site to insure uninterrupted progress of the Work.
 - 1. Deliver anchor bolts and anchorage devices which are to be embedded in cast-in-place concrete in ample time to maintain the construction schedule.
- B. Handle all gates and appurtenances properly, in accordance with manufacturer's recommendations. Gates which are distorted or otherwise damaged will not be acceptable. Protect all steam threads, bolt threads and ends from damage.
- C. Store materials to permit easy access for inspection and identification.
- D. Store all mechanical equipment in covered storage off the ground and prevent condensation.

1.8 GATE SCHEDULE

- A. The Gate Schedule is included at the end of this Section. This schedule is provided for general information on specific gates. In the event of discrepancies between this schedule and the Plans and Specifications, the information on the Plans shall govern.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Whipps, Inc., Athol, MA
- B. Fontaine
- C. Golden Harvest, Inc., Burlington, WA.
- D. Waterman Industries
- E. Or, Approved Equal.
- F. 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 MATERIALS

- A. All materials used in the manufacturing of the gates shall be of the best quality used for the purpose of commercial production.
- B. General: Design equipment to be suitable for the process and service conditions described below and in the Gate & Stop Log Schedule.
 - 1. Design gates to safely withstand conditions listed in the Gate and Stop Log Schedule.
 - 2. Gates and stop logs shall be substantially watertight with leakage less than 0.5 gpm per foot of seating perimeter at design head.
 - 3. Manual operators shall turn right to close, unless otherwise specified. Operators shall indicate the direction of operation.
 - 4. Bolts, studs, cap screws, and adjusting screws shall be of ample section to withstand the force created by operation of the gate under a full head of water.
 - 5. Downward opening gates and stop logs shall be capable of being lowered to an elevation below the invert of the channel or opening.
 - 6. Gates and stop logs shall open to not less than 6-inches above the maximum water level in the channel in which they are installed.
- C. Materials of Construction for Gates:
 - 1. Stainless Steel: For frame, slide, slide stiffeners, rail, yoke, pedestals, wall brackets, and wall thimbles ASTM A276, Type 316 stainless steel. All metal for gate and wall thimble parts shall have a minimum thickness of 1/4-inch.
 - 2. Frame, top stiffener, vertical stiffener, center stiffener, seal landing, seal retainer, and stop log lifter shall be made of stainless steel consistent with ASTM A240.
 - 3. Bronze Casting: For operating nut, thrust nut and lift nut; ASTM B 584 Alloy

4. Bronze Casting: For operating nut, thrust nut, and lift nut, ASTM B584 Alloy 865.
5. All bolts, studs, cap screws, and adjusting screws shall be of Type 316 stainless steel.
6. Bolts and nuts shall have hexagon heads.
7. Gasket material and installation shall conform to manufacturer's recommendations.
8. Disc:
 - a. Stainless Steel: Fabricate the slide or disc of ASTM A276, Type 316L stainless steel plate reinforced with structural shapes attached by welding.
 - b. Provide reinforcing to limit deflection under full head to not more than 1/360 of the span, or 1/16-inch maximum at seal points, whichever is less.
 - c. Extend reinforcing ribs into the guides overlapping the seating surface of the guide.
 - d. Disc shall be sized to engage into the guides a minimum of 1-inch on each side.
 - e. Weld stem mounting guides to the disc.
9. Disc Guides:
 - a. Stainless Steel: Guides shall be of Type 316L stainless steel formed and welded to create a one-piece type construction. using formed plate. Gussets shall be provided to accommodate the load on the frame in unseating head conditions.
 - b. Guides shall be designed for maximum rigidity in accordance with the latest revision of AWWA C561 to take the load developed at maximum design head and the thrust developed during gate operation, including the stall torque of the electric actuator, under maximum head.
 - c. Guides shall extend beneath the opening a sufficient amount to completely support the disc in the fully open or closed position.
10. Stop Log Guides:
 - a. Guides shall be of stainless steel and incorporating a sandwich type construction using plates and structural angles.
 - b. Guides shall be designed for maximum rigidity as columns to take the thrust developed during gate operation under maximum head.
 - c. Frame design shall allow for embedded mounting with stainless steel anchor bolts and grout. Mounting style shall be as shown on the Contract Drawings.
 - d. The gussets shall be provided as necessary to support the guide members in an unseating head condition. The gussets shall extend to support the outer portion of the frame guides and shall be positioned to ensure that the load is transferred to the anchor bolts.
 - e. An invert member shall be provided across the bottom of the guides. The invert member shall be of the flushbottom type. Frame mounted seals are not acceptable.
11. Stem:

- a. Operating stems shall be of Type 316 stainless steel and designed as specified below. Stems shall have a minimum diameter of 1-1/2 inches.
 - b. Design stem to transmit in compression at least 2-1/2 times the rated output of the operating mechanism with an 80 lb effort on the crank or handwheel.
 - c. Determine the critical buckling load using the Euler column formula, using $C = 2$. Where hydraulic cylinder lifts are used, the stem design force shall not be less than 1.25 times the output thrust of the hydraulic cylinder with a pressure equal to the maximum working pressure of the hydraulic fluid supply. Where electric motor driven lifts are used, the stem design force shall not be less than 1.25 times the output thrust of the unit in the stalled motor condition.
 - d. Stems shall have a slenderness ratio (L/R) less than 200.
 - e. Threaded portion of the stem shall have machined cut or machine rolled threads of the Acme type, having a surface roughness finish of 16 micro-inches or less. Join stems of more than one section by stainless steel couplings threaded and keyed, or bored and pinned, to the stems. All threaded and keyed couplings of the same size shall be interchangeable. Provide rising stems with an adjustable stop collar on the stem on manually operated gates.
 - f. Connect the stem to the disc by means of a bolted connection with a minimum of two attachment bolts.
12. Yoke (For Self Contained Type Gates):
- a. Furnish tops of the extended guides with a yoke for mounting of the lifting device.
 - b. Construct the yoke of structural shapes of sufficient strength to take the full thrust created by operating the gate under the maximum specified head.
 - c. Attach the yoke to the framework by bolting or welding so as to permit removal of the gate slide and stem.
13. Lower Seals:
- a. Mount a specially shaped resilient neoprene seal on the bottom of the disc or guide frame to provide flush-bottom closure for gates.
 - b. Shape of the seal shall produce a seating surface having a minimum width of 3/4-inch, and the seal will extend beyond the seating surface of the gate frame.
 - c. Vertical face of the seal shall be in contact with the seating surface of the guide to provide a proper seal at the corners.
14. Side and Upper Seals:
- a. Side and upper seals shall be self-adjusting seals with compression cord fabricated from ultra high molecular weight (UHMW) polyethylene or UHMW polymer. Weir gates to have the self-adjust seal on the bottom versus top for slide gates. UHMW bearing strips shall be mechanically retained to lock seat in place. Elastomeric seals such as J-Seals and Crown seals or adjust seal designs are not acceptable.
15. Stop Log Seals:

- a. Each stop log shall be outfitted with a continuous resilient lip seal along the bottom and both sides to restrict leakage in accordance with the requirements listed in this specification.
 - b. Vertical face of the seal shall be in contact with the seating surface of the guide to provide a proper seal at the corners.
 - c. The continuous lip seal shall be constructed of urethane or rubber and shall mechanically retained to the stop log.
 - d. The lip seal shall be activated by a combination of the weight of the stop log and the differential water pressure, which pushes the seal against the inside the groove assembly.
 - e. Stop logs that utilize rubber “J” seals or “P” seals are not acceptable.
 - f. Seals shall be place at the invert of each stop log providing a leak proof barrier. Seal retainers shall be made of 316 stainless steel.
16. Lifters:
- a. One stop log lifter shall be provided for each different guide frame width
 - b. the lifter shall be constructed of stainless steel and shall be outfitted with UHMW guide bars and stainless steel fasteners.
 - c. The lifter shall be provided with lifting hooks designed to engage the slots in the top of the stop logs. A lanyard release will be incorporated into the design.
 - d. The lifter shall be capable of installing and removing all stop logs of the same width whether they are installed or at the operating floor level.

2.3 APPURTENANCES

A. Stem Guides:

- 1. Guides shall be adjustable in two directions and shall be spaced so that stems have a maximum unsupported length of 84-inches.
- 2. Anchor bolts for stem guides shall be Type 316 stainless steel.

B. Anchor Bolts:

- 1. Provide Type 316 stainless steel anchor bolts as required for stem guides, floorstands, and all equipment or appurtenances which must be secured to concrete walls or floors. Anchor bolts shall be of ample size and strength for the purpose intended, and shall be furnished by the manufacturer. Anchor bolts shall be hooked, and provided for direct embedment during placement of concrete. Anchor bolts shall conform to the requirements of Section 05051, Anchor Bolts, Toggle Bolts and Concrete Inserts.

C. Stem Cover:

- 1. Furnish all stems with a clear polycarbonate or butyrate plastic pipe stem cover. Covers shall be furnished with a cast aluminum adaptor for mounting covers to floor stands. Stem covers shall be designed and furnished with gasketing and breathers to eliminate water intrusion into operators and condensation within the covers.

2. Stem covers shall have with legible markings showing as a minimum the gate position at 1/4 open, 1/2 open, 3/4 open and full open.
- D. Electric Operators:
 1. Electric motor operators shall be furnished as shown on the Slide Gate Schedule, in accordance with the requirements of Section 11200, 480 Volt Motor-Operated Valve and Gate Actuators.
- E. Identification: Identify each gate with a stainless steel manufacturer's nameplate stamped with the approved designation as shown in the Gate Schedule, below. Manufacturer's nameplate shall be permanently fastened to the gate at the factory.

2.4 SURFACE PREPARATION AND PAINTING

- A. Clean, prime coat, and finish coat ferrous metal surfaces of equipment in the shop in accordance with the requirements of Section 01600, General Equipment Provisions, and Section 09900, Painting.
- B. Coat machined, polished and non-ferrous surfaces bearing surfaces and similar unpainted surfaces with corrosion prevention compound which shall be maintained during storage and until equipment begins operation.
- C. Surface preparation and painting shall conform to Section 09900, Painting.
- D. Certify, in writing, that the shop primer and coating system conforms to the requirements of Section 09900, Painting.

2.5 SPECIAL TOOLS

- A. Furnish two sets of any special tools required for normal operation and maintenance.

2.6 LUBRICANTS

- A. Furnish Food grade oil and grease meeting NSF 61 for water applications as required for initial operation. Use products recommended by the manufacturer.

2.7 GATE AND STOP LOG SCHEDULE

- A. Schedule 11285 is the Gate and Stop Log Schedule. Conform to type, size, operation and other data specified, unless otherwise approved by ENGINEER.
- B. Provide all gates as shown on the Drawings and listed in the Gate Schedule.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Gates shall be installed in accordance with manufacturer's recommendations.
- B. Gates shall be installed at the respective location as shown on the Plans.
- C. Gate stems shall be plumb and vertical. Each gate shall be adjusted for smooth and easy operation.
- D. Brace guides and frames during placement of concrete.
- E. Set anchor bolts in accord with approved manufacturers drawings.
- F. Provide minimum of 1-inch of non-shrink grout below all floor stands and between gate frame and wall on wall mounted gates.
- G. Adjust all parts and components as required to provide correct operation.

3.2 FIELD TESTS

- A. After CONTRACTOR and ENGINEER have mutually agreed that the equipment installation is complete and ready for continuous operation, CONTRACTOR and a qualified field service representative of the manufacturer shall conduct a functional field test and a leakage test of each gate in the presence of ENGINEER to demonstrate that each gate furnished will function correctly and that maximum permissible leakage is not exceeded.
 - 1. Functional Tests:
 - a. Each gate with appurtenances shall be field tested. Tests 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. OWNER will furnish all power, and incidental material and labor required for the tests.
 - 2. Leakage Tests:
 - a. Maximum permissible leakage shall be in accordance with the requirements of Paragraph 2.2.B.2. Excess leakage shall be reduced to meet specified requirements by adjusting the gate or replacement will be required.
 - 3. In the event that the manufacturer is unable to demonstrate to ENGINEER that his equipment meets the requirements of the tests, the deficient equipment will be rejected and CONTRACTOR shall adjust and/or modify and retest the equipment as often as necessary to meet the specified requirements. No separate payments shall be made for adjustments and/or modifications.

3.3 MANUFACTURER'S FIELD SERVICE

- A. A factory employed and trained representative of the manufacturer shall visit the site and provide installation and start-up services, as specified in Section 01650, Starting of Systems. The factory employed representative shall make six visits to the site. The six visits will be split as needed between installation assistance and supervision, checking the completed installation and start-up of the system, and for training on the operation and maintenance of the gates. Trips to include:
 - 1. Installation supervision: 2 trips, 1 day per plant (AWRF and OWRF).
 - 2. Dry wall installation inspection and operation: 2 trips, 4 days per plant (AWRF and OWRF).
 - 3. Wet wall functional and leakage testing: 2 trips, 4 days per plant (AWRF and OWRF).
 - 4. Training and remaining startup: 2 trips, ½ day per plant (AWRF and OWRF).
- B. 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.
- C. Training: A factory employed and trained 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 one day of training and of training will be required.
- D. All costs, including travel, lodging, meals, and incidentals, shall be considered as included in the CONTRACTOR'S lump sum bid price.

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GATE / STOP LOGS SCHEDULE

WM = WALL MOUNTED; SC = SELF CONTAINED; NSC = NON-SELF CONTAINED; FB = FLUSH BOTTOM; STD = STANDARD; DO = DOWNWARD; EO = ELECTRIC OPERATOR; MO = MANUALLY OPERATOR

Equipment Number	Gate / Stop Logs Location	Mounting Style / Frame Type	Shape of Wall Opening / Top Seal (Y/N)	Invert (ft) / Operating Floor Elevation (ft)	Size (WxH, in)	Gate Opening Direction	Min Gate Travel (ft)	Seating / Unseating (ft)	Type of Closure	Operator
AIRPORT WRF										
FIT-XXX-SLG	DISC FILTER NO.1 INFLUENT SLIDE GATE	WM / NSC	RECTANGULAR / Y	1218.08 / 1224.58	48 x 24	UPWARD	2	4 / 4	STD	EO
FIT-XXX-SLG	DISC FILTER NO.2 INFLUENT SLIDE GATE	WM / NSC	RECTANGULAR / Y	1218.08 / 1224.58	48 x 24	UPWARD	2	4 / 4	STD	EO
FIT-XXX-SLG	DISC FILTER NO.3 INFLUENT SLIDE GATE	WM / NSC	RECTANGULAR / Y	1218.08 / 1224.58	48 x 24	UPWARD	2	4 / 4	STD	EO
FIT-XXX-SLG	DISC FILTER NO.4 INFLUENT SLIDE GATE	WM / NSC	RECTANGULAR / Y	1218.08 / 1224.58	48 x 24	UPWARD	2	4 / 4	STD	EO
FIT-XXX-SLG	DISC FILTER NO.5 INFLUENT SLIDE GATE	WM / NSC	RECTANGULAR / Y	1218.08 / 1224.58	48 x 24	UPWARD	2	4 / 4	STD	EO
FIT-XXX-SLG	DISC FILTER NO.6 INFLUENT SLIDE GATE	WM / NSC	RECTANGULAR / Y	1218.08 / 1224.58	48 x 24	UPWARD	2	4 / 4	STD	EO

GATE / STOP LOGS SCHEDULE

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Equipment Number	Gate / Stop Logs Location	Mounting Style / Frame Type	Shape of Wall Opening / Top Seal (Y/N)	Invert (ft) / Operating Floor Elevation (ft)	Size (WxH, in)	Gate Opening Direction	Min Gate Travel (ft)	Seating / Unseating (ft)	Type of Closure	Operator
FIT-XXX-SLG	DISC FILTER EFFLUENT SLIDE GATE	WM / NSC	RECTANGULAR / Y	1212.33 / 1224.58	60 x 48	UPWARD	4	10 / 10	STD	EO
OCOTILLO WRF										
AB-XXX-SLG	IMLR DISCHARGE CHANNEL GATE 1	WM / SC	RECTANGULAR / Y	1189.60 / 1196.60	30 X 36	UPWARD	3	5 / 5	STD	MO
AB-XXX-SLG	IMLR DISCHARGE CHANNEL GATE 2	WM / SC	RECTANGULAR / Y	1189.60 / 1196.60	30 X 36	UPWARD	3	5 / 5	STD	MO
AB-XXX-SUG	ANOXIC INFLUENT CHANNEL GATE 1	WM (on existing thimble) / NSC	RECTANGULAR / Y	1174.85 / 1196.60	36 X 36	UPWARD	3	20 / 20	STD	MO
AB-XXX-SUG	ANOXIC INFLUENT CHANNEL GATE 2	WM (on existing thimble) / NSC	RECTANGULAR / Y	1174.85 / 1196.60	36 X 36	UPWARD	3	20 / 20	STD	MO
AB-XXX-SLG	IMLR DISCHARGE CHANNEL EXPANSION GATE 1	WM / SC	RECTANGULAR / Y	1189.10 / 1196.60	60 X 72	UPWARD	6	6 / 6	STD	MO

GATE / STOP LOGS SCHEDULE

WM = WALL MOUNTED; SC = SELF CONTAINED; NSC = NON-SELF CONTAINED; FB = FLUSH BOTTOM; STD = STANDARD; DO = DOWNWARD; EO = ELECTRIC OPERATOR; MO = MANUALLY OPERATOR

Equipment Number	Gate / Stop Logs Location	Mounting Style / Frame Type	Shape of Wall Opening / Top Seal (Y/N)	Invert (ft) / Operating Floor Elevation (ft)	Size (WxH, in)	Gate Opening Direction	Min Gate Travel (ft)	Seating / Unseating (ft)	Type of Closure	Operator
AB-XXX-SLG	IMLR DISCHARGE CHANNEL EXPANSION GATE 2	WM / SC	RECTANGULAR / Y	1189.10 / 1196.60	60 X 72	UPWARD	6	6 / 6	STD	MO
AB-XXX-SUG	48" DIA MLR INFLUENT PIPE	WM (on existing thimble) / SC	ROUND / Y	1182.60 / 1196.60	48 X 48	UPWARD	4	12 / 12	STD	MO
AB-XXX-SUG	PROPOSED IMLR PUMP FEED CHANNEL	WM (on existing thimble) / SC	RECTANGULAR / Y	1181.10 / 1196.60	42 X 42	UPWARD	3.5	13 / 13	STD	MO
AB-XXX-SUG	PROPOSED MLR FROM FUTURE OXIC BASINS	WM (on existing thimble) / SC	RECTANGULAR / Y	1174.60 / 1196.60	42 X 42	UPWARD	3.5	19 / 19	STD	MO
AB-XXX-SUG	ANOXIC NORTH EFFLUENT TRAIN 1 GATE 1	WM (on existing thimble) / NSC	RECTANGULAR / Y	1188.85 / 1196.60	60X 72	DOWNWARD	6	6 / 6	STD	MO
AB-XXX-SUG	ANOXIC EFFLUENT TRAIN 2 GATE 1	WM (on existing thimble) / NSC	RECTANGULAR / Y	1188.85 / 1196.60	60X 72	DOWNWARD	6	6 / 6	STD	MO

GATE / STOP LOGS SCHEDULE

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Equipment Number	Gate / Stop Logs Location	Mounting Style / Frame Type	Shape of Wall Opening / Top Seal (Y/N)	Invert (ft) / Operating Floor Elevation (ft)	Size (WxH, in)	Gate Opening Direction	Min Gate Travel (ft)	Seating / Unseating (ft)	Type of Closure	Operator
AB-XXX-SUG	OWRF - ANOXIC EFFLUENT TRAIN 1 GATE 2	WM (on existing thimble) / NSC	RECTANGULAR / Y	1174.10 / 1196.60	60 X 72	UPWARD	6	18 / 18	STD	MO
AB-XXX-SUG	OWRF - ANOXIC EFFLUENT TRAIN 2 GATE 2	WM (on existing thimble) / NSC	RECTANGULAR / Y	1174.10 / 1196.60	60 X 72	UPWARD	6	18 / 18	STD	MO
AB-XXX-XXX	OWRF - ANOXIC EFFLUENT CHANNEL STOP LOG 1	WM (in channel)	RECTANGULAR / N	1188.10 / 1196.60	84 X 96 (12" x7; 6" x2)	N/A	N/A	6 / 6	N/A	N/A
AB-XXX-XXX	OWRF - ANOXIC EFFLUENT CHANNEL STOP LOG 2	WM (in channel)	RECTANGULAR / N	1188.10 / 1196.60	84 X 96 (12" x7; 6" x2)	N/A	N/A	6 / 6	N/A	N/A
SC-XXX-SLG	SPLITTER BOX INVERTED WEIR GATE 1	WM / SC	RECTANGULAR / N	1190.89 / 1194.60	60 X 30	DOWNWARD	2.5	2.5 / 2.5	STD	MO
SC-XXX-SLG	SPLITTER BOX INVERTED WEIR GATE 2	WM / SC	RECTANGULAR / N	1190.89 / 1194.60	60 X 30	DOWNWARD	2.5	2.5 / 2.5	STD	MO

GATE / STOP LOGS SCHEDULE

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Equipment Number	Gate / Stop Logs Location	Mounting Style / Frame Type	Shape of Wall Opening / Top Seal (Y/N)	Invert (ft) / Operating Floor Elevation (ft)	Size (WxH, in)	Gate Opening Direction	Min Gate Travel (ft)	Seating / Unseating (ft)	Type of Closure	Operator
SC-XXX-SLG	SPLITTER BOX INVERTED WEIR GATE 3	WM / SC	RECTANGULAR / N	1190.89 / 1194.60	60 X 30	DOWNWARD	2.5	2.5 / 2.5	STD	MO
SC-XXX-SLG	SPLITTER BOX INVERTED WEIR GATE 3	WM / SC	RECTANGULAR / N	1190.89 / 1194.60	60 X 30	DOWNWARD	2.5	2.5 / 2.5	STD	MO
SC-XXX-SLG	SPLITTER BOX	WM / NSC	RECTANGULAR / Y	1184.60 / 1194.60	24 X 24	UPWARD	2	8 / 8	STD	MO
FIT-XXX-SLG	DISC FILTER NO. 1 INFLUENT CHANNEL	WM / NSC	RECTANGULAR / Y	1183.20 / 1188.41	48 X 24	UPWARD	2	4 / 4	STD	EO
FIT-XXX-SLG	DISC FILTER NO. 2 INFLUENT CHANNEL	WM / NSC	RECTANGULAR / Y	1183.20 / 1188.41	48 X 24	UPWARD	2	4 / 4	STD	EO
FIT-XXX-SLG	DISC FILTER NO. 3 INFLUENT CHANNEL	WM / NSC	RECTANGULAR / Y	1183.20 / 1188.41	48 X 24	UPWARD	2	4 / 4	STD	EO
FIT-XXX-SLG	DISC FILTER NO. 4 INFLUENT CHANNEL	WM / NSC	RECTANGULAR / Y	1183.20 / 1188.41	48 X 24	UPWARD	2	4 / 4	STD	EO

GATE / STOP LOGS SCHEDULE

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Equipment Number	Gate / Stop Logs Location	Mounting Style / Frame Type	Shape of Wall Opening / Top Seal (Y/N)	Invert (ft) / Operating Floor Elevation (ft)	Size (WxH, in)	Gate Opening Direction	Min Gate Travel (ft)	Seating / Unseating (ft)	Type of Closure	Operator
FIT-XXX-SLG	COMMON FILTER INFLUENT CHANNEL 1	WM / SC	RECTANGULAR / N	1179.10 / 1188.41	48 X 84	UPWARD	7	7 / 7	FB	MO
FIT-XXX-SLG	COMMON FILTER INFLUENT CHANNEL 2	WM / SC	RECTANGULAR / N	1179.10 / 1188.41	48 X 84	UPWARD	7	7 / 7	FB	MO
FIT-XXX-SLG	FILTER BYPASS CHANNEL GATE	WM / SC	RECTANGULAR / N	1179.10 / 1188.41	48 X 60	UPWARD	5	5 / 5	FB	MO
FIT-XXX-SLG	FILTER BYPASS STOP LOGS	WM (in channel)	RECTANGULAR / N	1184.00 / 1188.41	48 X 48 (12" x3; 6" x2)	N/A	N/A	4 / 4	N/A	N/A
FIT-XXX-SLG	COMMON FILTER EFFLUENT CHANNEL STOP LOGS	WM (in channel)	RECTANGULAR / N	1172.92 / 1188.41	48 X 120 (12" x9; 6" x2)	N/A	N/A	10 / 10	N/A	N/A

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 the Disc Filter System as indicated on the Contract Drawings and specified herein to provide a fully operational Disc Filter System. The Disc Filter System shall be rated for an average flow of 27 MGD with a peak flow of 33 MGD at the Airport WRF and an average flow of 11.4 MGD with a peak flow of 18 MGD at the Ocotillo WRF.
- B. Filter units to be installed in 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 Transducer Assembly.
 - d. Float Switch.
 - e. Vacuum Transmitter.
 - 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 11285, Hydraulic Gates.

- G. Section 11295 – Hydraulic valves.
- H. Section 13447, Electric Motor Actuators.
- I. Division 16, Electrical.
- 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. Each filter unit shall be capable of performing the backwash cycle without interrupting the filtration process. Each 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 (one copy per plant – AWRP and OWRP):
 - 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 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. 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. Wiring and control schematics and control logic diagrams for all electrical and control components furnished.
7. A complete process description detailing all process parameters.
8. Documentation that the manufacturer has produced, supplied, and placed into satisfactory service, equipment similar to that specified herein.
9. Recommended list of spare parts and safety equipment, along with price and ordering information.
10. Complete data sheet (ISA data sheet) for each instrument supplied.
11. Process and instrumentation diagrams (P&IDs) of the cloth media disc filter system.
12. CONTRACTOR shall submit specification section with check marks next to each section denoting submittal complies with section, or an "X" next to the section denoting a deviation from the specification. Justification for any deviations must also be included.

B. Seismic structural calculations:

1. Submit seismic structural calculations in conformance with the following requirements:
 - a. Design spectral acceleration at short periods. $S_{DS} = 0.19$.
 - b. Design spectral acceleration at period of 1-second, $S_{D1} = 0.09$.
 - c. Risk Category: III
 - d. Component amplification factor, a_p = in accordance with ASCE 7, Tables 13.5-1 and 13.6-1.
 - e. Component response modification factor, R_p = in accordance with ASCE 7, Tables 13.5-1 and 13.6-1.
 - f. Component importance factor, I_p = 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.
- J. 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.
- K. 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 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 05530 Aluminum Grating and 05532 Aluminum Checkered Plate, Respectively.

2.2 MANUFACTURERS

- A. Acceptable Manufacturers:
 - 1. Aqua-Aerobic Systems,
 - 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	AWRF	OWRF
Number of Units	(5+1)	(3+1)
Total Average Daily Flow (MGD)	27	11.4
Total Peak Hourly Flow (MGD)	33	18
Rated Peak Flow for Each Unit (MGD)	6.6	6.0
Capacity per Filter:		

a) Average Daily Flow (MGD)	5.4	3.8
b) Peak Hourly Flow (MGD)	6.6	6.0
Filter Loading Rate:		
a) Average Daily Flow (gpm/ft ²)	4.98	4.09
b) Peak Hourly Flow (gpm/ft ²)	6.1	6.5
Maximum Headloss through Filter (in.)	18	18

2. Influent Characteristics:

Parameter	AWRF	OWRF
Maximum Total Suspended Solids (mg/l)	20	20
Average Total Suspended Solids (mg/l)	10	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	AWRF	OWRF
Center Tube Assemblies	6	4
Drive System Assemblies	6	4
Cloth Filter Media Assemblies	6	4
Influent Weir Boxes	6	4
Backwash Pumps (2 per Filter), vacuum gauge and transducer, pressure gauge, 3-inch ball valves	12	8
Backwash System Assemblies	6	4
External Piping Assembly Kits	6	4
Pressure Transducer Assemblies	6	4
Float Switch and Brackets	6	4
Backwash Valves with Electric Actuators	7 per filter (total of 42 backwash valves)	6 per filter (total of 24 backwash valves)
Solids Valves with Electric Actuators	2 per filter (total of 12 solids valves)	1 per filter (total of 4 solids valves)
Vendor Control Panels	6	4
Vendor Power Panels	6	4

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 05500, 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	AWRF	OWRF
Power (HP)	1	0.75
Output Speed (RPM)	4.4	4.8

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 wedge 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. AWRP:
 - 1) Each of the 6 concrete filter basins shall include 14 disc assemblies.
 - b. OWRP:
 - 1) Each of the 4 concrete filter basins shall include 12 disc assemblies.
 - c. 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.
 - d. 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. AWRP:
 - 1) 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. OWRP:
 - 1) Each cloth disc assembly at shall have a minimum of 53.8 square feet of effective submerged filtration area. Each filter unit shall have a total of 645.6 square feet of minimum effective submerged filtration area.
 - d. 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.
 - e. 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. Influent Gates:

1. Each filter shall include 1 influent gate to be provided by CONTRACTOR. Refer to Section 11285 for gate specification and schedule.
2. Each gate shall include a gate stem extension to raise the actuator approximately 42 inches above the top of the wall. The extension shall be constructed of painted steel. CONTRACTOR shall provide intermediate support bracket and hardware required for mounting of the extension.

H. 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) PVC 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).
 - 3) Throttling gate valve(s).
 - 4) 2-inch manual ball valve(s).
4. Backwash Pumps:
- a. Manufacturer: Gorman Rupp, model G-R 12B20-B, or equal.
 - b. Type: Externally mounted centrifugal pump.
 - c. Number: 2 per filter.
 - d. Tag Numbers:
 - 1) AWRF:
 - a) Disc Filter No. 1 – BWP-DS1-A
 - b) Disc Filter No. 1 – BWP-DS1-B
 - c) Disc Filter No. 2 – BWP-DS2-A
 - d) Disc Filter No. 2 – BWP-DS2-B
 - e) Disc Filter No. 3 – BWP-DS3-A
 - f) Disc Filter No. 3 – BWP-DS3-B
 - g) Disc Filter No. 4 – BWP-DS4-A
 - h) Disc Filter No. 4 – BWP-DS4-B
 - i) Disc Filter No. 5 – BWP-DS5-A
 - j) Disc Filter No. 5 – BWP-DS5-B
 - k) Disc Filter No. 6 – BWP-DS6-A
 - l) Disc Filter No. 6 – BWP-DS6-B
 - 2) OWRF:
 - a) Disc Filter No. 1 – BWP-539-130
 - b) Disc Filter No. 1 – BWP-539-140
 - c) Disc Filter No. 2 – BWP-539-230
 - d) Disc Filter No. 2 – BWP-539-240
 - e) Disc Filter No. 3 – BWP-539-330
 - f) Disc Filter No. 3 – BWP-539-340
 - g) Disc Filter No. 4 – BWP-539-430
 - h) Disc Filter No. 4 – BWP-539-440
 - e. 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.
 - f. Pump shall be rated for 130 gallons per minute at 23 feet total dynamic head.
- I. 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.

J. Anchor Bolts:

1. The CONTRACTOR shall provide anchor bolt calculations per Section 05051, Anchor Bolts, Toggle Bolts, and Concrete Inserts.
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 05051, Anchor Bolts, Toggle Bolts, and Concrete Inserts.

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.

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.
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. 2. 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 an Allen-Bradley MicroLogix 1400 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.
 - c. 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 6.5-inch Allen Bradley PanelView Plus 7 700, 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.
- 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 (or 1-5 VDC) 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 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.

- b. Utilize the border and title block as provided in the Drawing Templates referenced in Section 3.03.A.1

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 Viton V-ring effluent port/center tube seal, or equal.
 - 4. One of each PLC I/O module.
 - a. One of each:
 - 1) Fuse.
 - 2) Control Relay.
 - 3) Indicating Light Replacement Bulb.
 - 5. One cloth repair kit.
- 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 two copies 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 per plant (AWRF and OWRF). 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 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 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 11285 - Hydraulic Gates.
 - b. Section 11295 - Hydraulic Valves.
 - c. Section 11400 - Disc Filters.
 - d. Section 16225 - Electric Motors 250 Horsepower or Less.
 - e. Section 09900 - Painting.

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. RCI:
 - a. RCEL-005L, with Receptacle (quarter-turn)
 - 2. Hayward:
 - a. Series EJM (quarter-turn).
 - 3. Rotork:
 - a. ROM Series (quarter turn).
 - 4. Rotork:
 - a. CVA Series (multi- turn).
- 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 Automatic 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. Power supply:
 - a. 120 VAC.
 - b. Valve motion independent of power supply phase rotation.
 - 3. 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.
 - 4. Control inputs:
 - 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) OPEN.
 - 2) CLOSE.
 - 5. Status outputs:
 - 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.
 - 6. Analog input:
 - a. Provide a 4-20 milliamp analog input 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.
 - 7. Analog output:
 - a. Provide an isolated 4-20 milliamp analog output when indicated on the Drawings.
 - 8. Materials:
 - a. Construct motorized actuators of materials suitable for the environment in which the valve or gate is to be installed.
 - 9. 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.
 - b) NEMA Type 7 certified by FM for Class I, Division 1, Groups C, D, E, F and G, for actuators installed in Class I, Division 1 and 2 areas.
 - c. Manual Override:
 - 1) Allen key operation.
 - 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-Remote:
 - i. Motor actuator operation is prevented with the switch in OFF.
 - b) Open-Close:
 - i. Controls the valve when Local-OFF-Remote is in LOCAL.
 - 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 or 24 VDC inputs.
 - 2) Controls the valve when local-stop-remote is in REMOTE.
 - 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) OPEN.
 - b) CLOSE.
 - c) OFF.
 - d) 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) Valve or gate position.
 - e) Operating torque.

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.
 1. 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 of 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. The schedule does not include all number and types of actuators required for the Project.
- 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.
- 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	Type	Size	Actuator Type	NE MA Rating	Voltage	Open Time	Controls
AWRF									
EDR-DS1	DISC FILTER NO.1 INFLUENT SLIDE GATE	M-1.64	SLG	48"W X 24"H	O/C	4	480/3 /60	TBD	A
EDR-DS2	DISC FILTER NO.2 INFLUENT SLIDE GATE	M-1.64	SLG	48"W X 24"H	O/C	4	480/3 /60	TBD	A
EDR-DS3	DISC FILTER NO.3 INFLUENT SLIDE GATE	M-1.64	SLG	48"W X 24"H	O/C	4	480/3 /60	TBD	A
EDR-DS4	DISC FILTER NO.4 INFLUENT SLIDE GATE	M-1.64	SLG	48"W X 24"H	O/C	4	480/3 /60	TBD	A
EDR-DS5	DISC FILTER NO.5 INFLUENT SLIDE GATE	M-1.64	SLG	48"W X 24"H	O/C	4	480/3 /60	TBD	A
EDR-DS6	DISC FILTER NO.6 INFLUENT SLIDE GATE	M-1.64	SLG	48"W X 24"H	O/C	4	480/3 /60	TBD	A
TBD	DISC FILTER COMMON EFFLUENT CHANNEL SLIDE GATE	M-1.64	SLG	48"W X 60"H	O/C	4	480/3 /60	TBD	A
MOV-DS1-BW1	DISC FILTER NO. 1 BACKWASH VALVE 1	M-1.64	BAV	2-IN	O/C	TBD	120/1 /60	TBD	TBD

MOV-DS1-BW2	DISC FILTER NO. 1 BACKWASH VALVE 2	M-1.64	BAV	2-IN	O/C	TBD	120/1 /60	TBD	TBD
MOV-DS1-BW3	DISC FILTER NO. 1 BACKWASH VALVE 3	M-1.64	BAV	2-IN	O/C	TBD	120/1 /60	TBD	TBD
MOV-DS1-BW4	DISC FILTER NO. 1 BACKWASH VALVE 4	M-1.64	BAV	2-IN	O/C	TBD	120/1 /60	TBD	TBD
MOV-DS1-BW5	DISC FILTER NO. 1 BACKWASH VALVE 5	M-1.64	BAV	2-IN	O/C	TBD	120/1 /60	TBD	TBD
MOV-DS1-BW6	DISC FILTER NO. 1 BACKWASH VALVE 6	M-1.64	BAV	2-IN	O/C	TBD	120/1 /60	TBD	TBD
MOV-DS1-BW7	DISC FILTER NO. 1 BACKWASH VALVE 7	M-1.64	BAV	2-IN	O/C	TBD	120/1 /60	TBD	TBD
MOV-DS1-SW2	DISC FILTER NO. 1 SOLIDS WASTE VALVE 1	M-1.64	MUV	2-IN	O/C	TBD	120/1 /60	TBD	TBD
MOV-DS1-SW2	DISC FILTER NO. 1 SOLIDS WASTE VALVE 2	M-1.64	MUV	2-IN	O/C	TBD	120/1 /60	TBD	TBD
MOV-DS2-SW1	DISC FILTER NO. 2 BACKWASH VALVE 1	M-1.64	BAV	2-IN	O/C	TBD	120/1 /60	TBD	TBD
MOV-DS2-BW1	DISC FILTER NO. 2 BACKWASH VALVE 2	M-1.64	BAV	2-IN	O/C	TBD	120/1 /60	TBD	TBD
MOV-DS2-BW2	DISC FILTER NO. 2 BACKWASH VALVE 3	M-1.64	BAV	2-IN	O/C	TBD	120/1 /60	TBD	TBD
MOV-DS2-BW3	DISC FILTER NO. 2 BACKWASH VALVE 4	M-1.64	BAV	2-IN	O/C	TBD	120/1 /60	TBD	TBD

MOV-DS2-BW4	DISC FILTER NO. 2 BACKWASH VALVE 5	M-1.64	BAV	2-IN	O/C	TBD	120/1 /60	TBD	TBD
MOV-DS2-BW5	DISC FILTER NO. 2 BACKWASH VALVE 6	M-1.64	BAV	2-IN	O/C	TBD	120/1 /60	TBD	TBD
MOV-DS2-BW6	DISC FILTER NO. 2 BACKWASH VALVE 7	M-1.64	BAV	2-IN	O/C	TBD	120/1 /60	TBD	TBD
MOV-DS2-BW7	DISC FILTER NO. 2 SOLIDS WASTE VALVE 1	M-1.64	MUV	2-IN	O/C	TBD	120/1 /60	TBD	TBD
MOV-DS2-SW2	DISC FILTER NO. 2 SOLIDS WASTE VALVE 2	M-1.64	MUV	2-IN	O/C	TBD	120/1 /60	TBD	TBD
MOV-DS3-BW1	DISC FILTER NO. 3 BACKWASH VALVE 1	M-1.64	BAV	2-IN	O/C	TBD	120/1 /60	TBD	TBD
MOV-DS3-BW2	DISC FILTER NO. 3 BACKWASH VALVE 2	M-1.64	BAV	2-IN	O/C	TBD	120/1 /60	TBD	TBD
MOV-DS3-BW3	DISC FILTER NO. 3 BACKWASH VALVE 3	M-1.64	BAV	2-IN	O/C	TBD	120/1 /60	TBD	TBD
MOV-DS3-BW4	DISC FILTER NO. 3 BACKWASH VALVE 4	M-1.64	BAV	2-IN	O/C	TBD	120/1 /60	TBD	TBD
MOV-DS3-BW5	DISC FILTER NO. 3 BACKWASH VALVE 5	M-1.64	BAV	2-IN	O/C	TBD	120/1 /60	TBD	TBD
MOV-DS3-BW6	DISC FILTER NO. 3 BACKWASH VALVE 6	M-1.64	BAV	2-IN	O/C	TBD	120/1 /60	TBD	TBD
MOV-DS3-BW7	DISC FILTER NO. 3 BACKWASH VALVE 7	M-1.64	BAV	2-IN	O/C	TBD	120/1 /60	TBD	TBD

MOV-DS3-SW1	DISC FILTER NO. 3 SOLIDS WASTE VALVE 1	M-1.64	MUV	2-IN	O/C	TBD	120/1 /60	TBD	TBD
MOV-DS3-SW2	DISC FILTER NO. 3 SOLIDS WASTE VALVE 2	M-1.64	MUV	2-IN	O/C	TBD	120/1 /60	TBD	TBD
MOV-DS4-BW1	DISC FILTER NO. 4 BACKWASH VALVE 1	M-1.64	BAV	2-IN	O/C	TBD	120/1 /60	TBD	TBD
MOV-DS4-BW2	DISC FILTER NO. 4 BACKWASH VALVE 2	M-1.64	BAV	2-IN	O/C	TBD	120/1 /60	TBD	TBD
MOV-DS4-BW3	DISC FILTER NO. 4 BACKWASH VALVE 3	M-1.64	BAV	2-IN	O/C	TBD	120/1 /60	TBD	TBD
MOV-DS4-BW4	DISC FILTER NO. 4 BACKWASH VALVE 4	M-1.64	BAV	2-IN	O/C	TBD	120/1 /60	TBD	TBD
MOV-DS4-BW5	DISC FILTER NO. 4 BACKWASH VALVE 5	M-1.64	BAV	2-IN	O/C	TBD	120/1 /60	TBD	TBD
MOV-DS4-BW6	DISC FILTER NO. 4 BACKWASH VALVE 6	M-1.64	BAV	2-IN	O/C	TBD	120/1 /60	TBD	TBD
MOV-DS4-BW7	DISC FILTER NO. 4 BACKWASH VALVE 7	M-1.64	BAV	2-IN	O/C	TBD	120/1 /60	TBD	TBD
MOV-DS4-SW1	DISC FILTER NO. 4 SOLIDS WASTE VALVE 1	M-1.64	MUV	2-IN	O/C	TBD	120/1 /60	TBD	TBD
MOV-DS4-SW2	DISC FILTER NO. 4 SOLIDS WASTE VALVE 2	M-1.64	MUV	2-IN	O/C	TBD	120/1 /60	TBD	TBD
MOV-DS5-BW1	DISC FILTER NO. 5 BACKWASH VALVE 1	M-1.64	BAV	2-IN	O/C	TBD	120/1 /60	TBD	TBD

MOV-DS5-BW2	DISC FILTER NO. 5 BACKWASH VALVE 2	M-1.64	BAV	2-IN	O/C	TBD	120/1 /60	TBD	TBD
MOV-DS5-BW3	DISC FILTER NO. 5 BACKWASH VALVE 3	M-1.64	BAV	2-IN	O/C	TBD	120/1 /60	TBD	TBD
MOV-DS5-BW4	DISC FILTER NO. 5 BACKWASH VALVE 4	M-1.64	BAV	2-IN	O/C	TBD	120/1 /60	TBD	TBD
MOV-DS5-BW5	DISC FILTER NO. 5 BACKWASH VALVE 5	M-1.64	BAV	2-IN	O/C	TBD	120/1 /60	TBD	TBD
MOV-DS5-BW6	DISC FILTER NO. 5 BACKWASH VALVE 6	M-1.64	BAV	2-IN	O/C	TBD	120/1 /60	TBD	TBD
MOV-DS5-BW7	DISC FILTER NO. 5 BACKWASH VALVE 7	M-1.64	BAV	2-IN	O/C	TBD	120/1 /60	TBD	TBD
MOV-DS5-SW1	DISC FILTER NO. 5 SOLIDS WASTE VALVE 1	M-1.64	MUV	2-IN	O/C	TBD	120/1 /60	TBD	TBD
MOV-DS5-SW2	DISC FILTER NO. 5 SOLIDS WASTE VALVE 2	M-1.64	MUV	2-IN	O/C	TBD	120/1 /60	TBD	TBD
MOV-DS6-BW1	DISC FILTER NO. 6 BACKWASH VALVE 1	M-1.64	BAV	2-IN	O/C	TBD	120/1 /60	TBD	TBD
MOV-DS6-BW2	DISC FILTER NO. 6 BACKWASH VALVE 2	M-1.64	BAV	2-IN	O/C	TBD	120/1 /60	TBD	TBD
MOV-DS6-BW3	DISC FILTER NO. 6 BACKWASH VALVE 3	M-1.64	BAV	2-IN	O/C	TBD	120/1 /60	TBD	TBD
MOV-DS6-BW4	DISC FILTER NO. 6 BACKWASH VALVE 4	M-1.64	BAV	2-IN	O/C	TBD	120/1 /60	TBD	TBD

MOV-DS6-BW5	DISC FILTER NO. 6 BACKWASH VALVE 5	M-1.64	BAV	2-IN	O/C	TBD	120/1 /60	TBD	TBD
MOV-DS6-BW6	DISC FILTER NO. 6 BACKWASH VALVE 6	M-1.64	BAV	2-IN	O/C	TBD	120/1 /60	TBD	TBD
MOV-DS6-BW7	DISC FILTER NO. 6 BACKWASH VALVE 7	M-1.64	BAV	2-IN	O/C	TBD	120/1 /60	TBD	TBD
MOV-DS6-SW1	DISC FILTER NO. 6 SOLIDS WASTE VALVE 1	M-1.64	MUV	2-IN	O/C	TBD	120/1 /60	TBD	TBD
MOV-DS6-SW2	DISC FILTER NO. 6 SOLIDS WASTE VALVE 2	M-1.64	MUV	2-IN	O/C	TBD	120/1 /60	TBD	TBD
OCOTILLO WRF									
EDR-539-101	DISC FILTER NO.1 INFLUENT SLIDE GATE	M-3.44	SLG	48"W X 24"H	O/C	4	480/3 /60	TBD	A
EDR-539-201	DISC FILTER NO.2 INFLUENT SLIDE GATE	M-3.44	SLG	48"W X 24"H	O/C	4	480/3 /60	TBD	A
EDR-539-301	DISC FILTER NO.3 INFLUENT SLIDE GATE	M-3.44	SLG	48"W X 24"H	O/C	4	480/3 /60	TBD	A
EDR-539-401	DISC FILTER NO.4 INFLUENT SLIDE GATE	M-3.44	SLG	48"W X 24"H	O/C	4	480/3 /60	TBD	A
MOV-539-121	DISC FILTER NO. 1 BACKWASH VALVE 1	M-3.44	BAV	2-IN	O/C	TBD	120/1 /60	TBD	
MOV-539-122	DISC FILTER NO. 1 BACKWASH VALVE 2	M-3.44	BAV	2-IN	O/C	TBD	120/1 /60	TBD	

MOV-539-123	DISC FILTER NO. 1 BACKWASH VALVE 3	M-3.44	BAV	2-IN	O/C	TBD	120/1 /60	TBD	
MOV-539-124	DISC FILTER NO. 1 BACKWASH VALVE 4	M-3.44	BAV	2-IN	O/C	TBD	120/1 /60	TBD	
MOV-539-125	DISC FILTER NO. 1 BACKWASH VALVE 5	M-3.44	BAV	2-IN	O/C	TBD	120/1 /60	TBD	
MOV-539-126	DISC FILTER NO. 1 BACKWASH VALVE 6	M-3.44	BAV	2-IN	O/C	TBD	120/1 /60	TBD	
MOV-539-111	DISC FILTER NO. 1 SOLIDS WASTE VALVE 1	M-3.44	MUV	2-IN	O/C	TBD	120/1 /60	TBD	
MOV-539-221	DISC FILTER NO. 2 BACKWASH VALVE 1	M-3.44	BAV	2-IN	O/C	TBD	120/1 /60	TBD	
MOV-539-222	DISC FILTER NO. 2 BACKWASH VALVE 2	M-3.44	BAV	2-IN	O/C	TBD	120/1 /60	TBD	
MOV-539-223	DISC FILTER NO. 2 BACKWASH VALVE 3	M-3.44	BAV	2-IN	O/C	TBD	120/1 /60	TBD	
MOV-539-224	DISC FILTER NO. 2 BACKWASH VALVE 4	M-3.44	BAV	2-IN	O/C	TBD	120/1 /60	TBD	
MOV-539-225	DISC FILTER NO. 2 BACKWASH VALVE 5	M-3.44	BAV	2-IN	O/C	TBD	120/1 /60	TBD	
MOV-539-226	DISC FILTER NO. 2 BACKWASH VALVE 6	M-3.44	BAV	2-IN	O/C	TBD	120/1 /60	TBD	
MOV-539-211	DISC FILTER NO. 2 SOLIDS WASTE VALVE 1	M-3.44	MUV	2-IN	O/C	TBD	120/1 /60	TBD	

MOV-539-321	DISC FILTER NO. 3 BACKWASH VALVE 1	M-3.44	BAV	2-IN	O/C	TBD	120/1 /60	TBD	
MOV-539-322	DISC FILTER NO. 3 BACKWASH VALVE 2	M-3.44	BAV	2-IN	O/C	TBD	120/1 /60	TBD	
MOV-539-323	DISC FILTER NO. 3 BACKWASH VALVE 3	M-3.44	BAV	2-IN	O/C	TBD	120/1 /60	TBD	
MOV-539-324	DISC FILTER NO. 3 BACKWASH VALVE 4	M-3.44	BAV	2-IN	O/C	TBD	120/1 /60	TBD	
MOV-539-325	DISC FILTER NO. 3 BACKWASH VALVE 5	M-3.44	BAV	2-IN	O/C	TBD	120/1 /60	TBD	
MOV-539-326	DISC FILTER NO. 3 BACKWASH VALVE 6	M-3.44	BAV	2-IN	O/C	TBD	120/1 /60	TBD	
MOV-539-311	DISC FILTER NO. 3 SOLIDS WASTE VALVE 1	M-3.44	MUV	2-IN	O/C	TBD	120/1 /60	TBD	
MOV-539-421	DISC FILTER NO. 4 BACKWASH VALVE 1	M-3.44	BAV	2-IN	O/C	TBD	120/1 /60	TBD	
MOV-539-422	DISC FILTER NO. 4 BACKWASH VALVE 2	M-3.44	BAV	2-IN	O/C	TBD	120/1 /60	TBD	
MOV-539-423	DISC FILTER NO. 4 BACKWASH VALVE 3	M-3.44	BAV	2-IN	O/C	TBD	120/1 /60	TBD	
MOV-539-424	DISC FILTER NO. 4 BACKWASH VALVE 4	M-3.44	BAV	2-IN	O/C	TBD	120/1 /60	TBD	
MOV-539-425	DISC FILTER NO. 4 BACKWASH VALVE 5	M-3.44	BAV	2-IN	O/C	TBD	120/1 /60	TBD	

MOV-539-426	DISC FILTER NO. 4 BACKWASH VALVE 6	M-3.44	BAV	2-IN	O/C	TBD	120/1 /60	TBD	
MOV-539-411	DISC FILTER NO.4 SOLIDS WASTE VALVE 1	M-3.44	MUV	2-IN	O/C	TBD	120/1 /60	TBD	

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.

1.3 MANUFACTURERS

- A. Enclosures shall be manufactured by Hammond, Hoffman, Rittal, or 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 COPE

- 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 17000, 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. Zak Controls, 4970 East Beverly Rd., Phoenix AZ 85044 – (602) 267-0100.
 2. RDC Electrical, 3411 South 44th St., Phoenix, AZ 85308 – (602) 437-0760.
 3. Keller Electrical Industries, Inc., 1881 East University Dr., Phoenix AZ 85034 (602) 437-3015.
 4. Vertech Industrial Systems, 4409 East Baseline Rd., Phoenix, AZ 85042, Tel: (480) 756-2300.

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 2004 through 2008. If utilizing a newer AutoCAD version, submit files saved at version 2008.

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. Clearly 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 Hoffman Temperature Calculation tool at:
11. http://www.hoffmanonline.com/product_catalog/tools/index.aspx?cat_1=34&cat_2=375&SelectCatID=375&CatId=375.
12. Submit location and tube routing details for air conditioner drain line. Coordinate drain location with ENGINEER.

1.6 O&M MANUALS

- A. Comply with the requirements of Section 01782, 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) 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 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 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 (McClean).
- 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 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 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 1/4" stainless steel screws by APM Hexseal.
 - c. Glue Product and Manufacturer:
 - 1) Gorilla Glue.
 - 2) Or 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 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 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 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, boot 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 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 a Brady LS2000 Labeling System, or 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.

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 – Cliqueline.
 - 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 WSU 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 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 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 870-EX, or 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 371L or 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 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 151XST, Edwards Model 92EX, or 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 MTL Inc., Ronan Engineering Co., R. Stahl Inc., A.T.C., or 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 Durant, Automatic Timing and Controls, a Division of Sycon Corp., or 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 Tork, Paragon Electric Company, or equal.

V. Motor Starters and Overload Relays:

1. Refer to Specification Section 16480, Motor Controllers.

PART 3 - PEEXECUTION:

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.

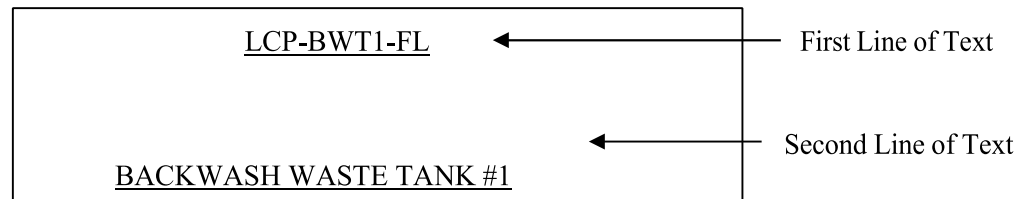


Figure 3.1.B.3

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.

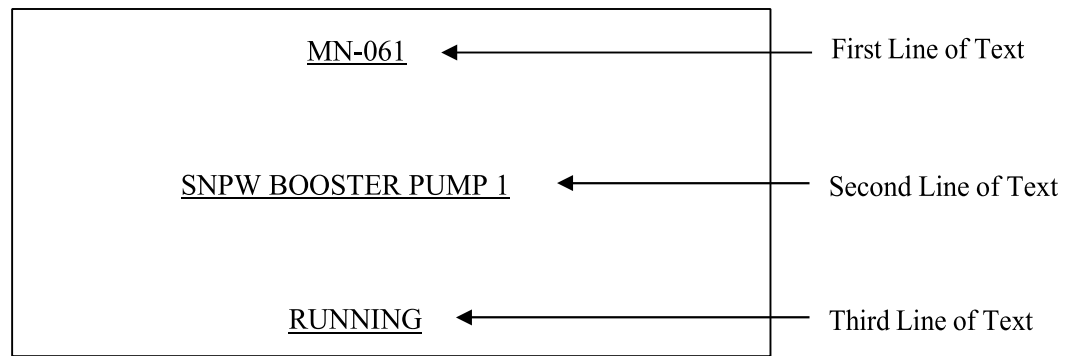


Figure 3.1.B.4
Panel Component Nameplates

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.

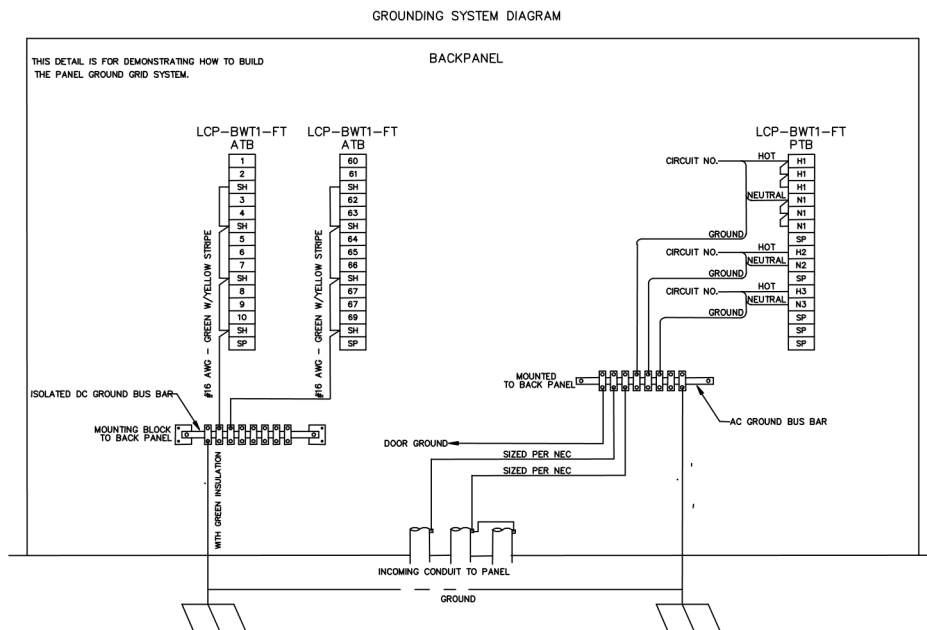


Figure 3.2 Typical Grounding Systems

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 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.
 - 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.
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.
 - e. Provide air conditioning heating and cooling information as provided by the Hoffman Temperature Calculation tool at:
http://www.hoffmanonline.com/product_catalog/tools/index.aspx?cat_1=34&cat_2=375&SelectCatID=375&CatId=375.
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
 - 7. 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 Paragraph 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.

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 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. UL674: 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. 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 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. 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 to be used.
11. Disassembly and repair documentation.

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 MG1-10.40.1.
- 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 equipped 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 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 overtemperature device is required, provide a response curve for the temperature device.
 4. Applicable operation and maintenance information specified in Section 01782, 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.

PART 3 - EXECUTION 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.

4.2 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 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.

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 Section16000, General Electrical Requirements.
 - 2. 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. General Electric.
 - b. Square D.
 - c. Cutler Hammer/Westinghouse.
 - d. Siemens.
 2. Control Relays:
 - a. General Electric.
 - b. Square D.
 - c. Cutler Hammer/Westinghouse.
 - d. Siemens.
 3. Electronic Timers:
 - a. Allen-Bradley 700-HR Dial Multifunction Timer.
 4. Timing Relays:
 - a. Agastat.
 - b. General Electric.
 - c. Square D.
 - d. Cutler Hammer/Westinghouse.
 - e. Siemens.
 5. Enclosures:
 - a. Hoffman.
 - b. Hammond.
 - c. Rittal.
 6. Manual Motor Starters:
 - a. General Electric.
 - b. Square D.
 - c. Cutler Hammer/Westinghouse.
 - d. Siemens.
 7. Separately Mounted Circuit Breakers:
 - a. 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 in MCC and Separately Mounted:
 - 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.
- B. Provide ambient compensated devices.
- C. 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.).
- D. 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.
- E. 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 $\pm 10\%$, unless specified otherwise.
3. Provide contacts for all required control, plus two spares.

F. 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 $\pm 10\%$.
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 $+50^{\circ}\text{C}$.
6. Repeat accuracy: $\pm 3\%$ plus $\pm 10\text{ms}$ 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.

G. 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 aAmps, 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.

H. 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 (8/20 μ s pulse waveform).
 3. SPBs shall be UL 94 V-2 listed.
- I. 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 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.

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 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.
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.

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 MANUFACTURERS

- A. Square D Company
- B. Eaton.
- C. Allen-Bradley.

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 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 copy, on CD-Rom, 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.

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 where the Project is located.
- 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 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.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. Hach Company, Loveland, CO.
 1. Model SOLITAX ts-line sc Turbidity and Suspended Solids 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 17454

OPERATIONS AND CONTROL DESCRIPTIONS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Operation and control descriptions.
- B. New SCADA programming and graphic screens shall follow the conventions of the existing SCADA application.
- C. CONTRACTOR shall coordinate with the ENGINEER during SCADA 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 SCADA programming logic shall be approved by the ENGINEER before programming.
- D. See additional OIT screen development under Operator Interface Terminal Software and Hardware specification 17455.

1.2 RELATED SECTIONS

- A. Section 17000, Instrumentation.
- B. Section 11400, Disc Filtration System.
- C. Section 11221, Mixers and Accessories.

1.3 COMMON CONTROL FUNCTIONS

- A. Alarms:
 - 1. Discrepancy Alarms: Each device capable of being controlled by SCADA in REMOTE mode shall have a discrepancy alarm, which shall be displayed at the SCADA workstations. The discrepancy alarms shall be derived as follows:
 - a. Device is commanded to start, and the starter auxiliary contact or VFD does not echo the command after an operator-adjustable time delay.
 - b. Device is commanded to stop, and the starter auxiliary contact or VFD does not echo the command after an operator-adjustable time delay.
 - c. 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.
 - d. 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.

- e. 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.
 - f. The discrepancy alarms shall only be active if the LOCAL/REMOTE selector switch at the device is in REMOTE mode.
 - g. Once a discrepancy alarm occurs, the SCADA 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 SCADA workstation.
2. Alarms Based on Analog Measurements shall be derived by the SCADA workstation as follows:
 - a. The SCADA workstation shall derive alarms by comparing the process measurement to an operator-adjustable set point.
 3. Within SCADA 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 SCADA, whether from analog measurements, discrete inputs, or discrepancy alarms, shall have a proving timer to limit nuisance alarms. The SCADA 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 SCADA shall have a flow total calculated by the SCADA as follows:
 6. The current day's total flow shall be calculated by the SCADA and displayed at the SCADA 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 DCS 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:
 18. The SCADA workstation graphic screens shall accept manually entered set point data only if it is within valid process range.
 19. The SCADA 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.

1.5 DISC FILTER SYSTEM (AWRF)

A. Summary:

1. The Airport WRF will be updated with a Disc Filter System upstream of the Chlorine Contact Basins (CCB's). Refer to Specification Section 11400, Disc Filter System.
 - a. 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 to 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.
 - b. The cloth media filters are designed to continuously remove particulates from the flow stream. 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.
 - c. 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. 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
 - d. 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/waste pump.
 - e. Backwash and solids wastewater are transported back to the IPS.
 - f. The filter manufacturer shall be responsible for implementing all the detailed control strategies for each filter in each vendor supplied LCP/PLC.

P&ID: See Sheets I-1.61 to I-1.79.

B. Components:

1. Equipment:

Associated Disc Filter Unit(s)	Item Description	Item Tag
DS1	Control Panel	VCP-DS1
DS1	Power Panel	VPP-DS1
DS1	Drive Unit	FDU-DS1
DS1	Drive Unit Disconnect Switch	DSC-FDU-DS1
DS1	Motorized Inlet Gate	EDR-DS1
DS1	Solids Waste Valve 1	MOV-DS1-SW1
DS1	Backwash Valve 1	MOV-DS1-BW1
DS1	Backwash Valve 2	MOV-DS1-BW2
DS1	Backwash Valve 3	MOV-DS1-BW3
DS1	Backwash Valve 4	MOV-DS1-BW4
DS1	Backwash Valve 5	MOV-DS1-BW5
DS1	Backwash Valve 6	MOV-DS1-BW6
DS1	Backwash Valve 7	MOV-DS1-BW7
DS1	Solids Waste Valve 2	MOV-DS1-SW2
DS1	Backwash Pump A	BWP-DS1-A
DS1	Backwash Pump A Disconnect Switch	DSC-BWP-DS1A
DS1	Backwash Pump B	BWP-DS1-B
DS1	Backwash Pump B Disconnect Switch	DSC-BWP-DS1B
DS2	Control Panel	VCP-DS2
DS2	Power Panel	VPP-DS2
DS2	Drive Unit	FDU-DS2
DS2	Drive Unit Disconnect Switch	DSC-FDU-DS2
DS2	Motorized Inlet Gate	EDR-DS2

DS2	Solids Waste Valve 1	MOV-DS2-SW1
DS2	Backwash Valve 1	MOV-DS2-BW1
DS2	Backwash Valve 2	MOV-DS2-BW2
DS2	Backwash Valve 3	MOV-DS2-BW3
DS2	Backwash Valve 4	MOV-DS2-BW4
DS2	Backwash Valve 5	MOV-DS2-BW5
DS2	Backwash Valve 6	MOV-DS2-BW6
DS2	Backwash Valve 7	MOV-DS2-BW7
DS2	Solids Waste Valve 2	MOV-DS2-SW2
DS2	Backwash Pump A	BWP-DS2-A
DS2	Backwash Pump A Disconnect Switch	DSC-BWP-DS2A
DS2	Backwash Pump B	BWP-DS2-B
DS2	Backwash Pump B Disconnect Switch	DSC-BWP-DS2B
DS3	Control Panel	VCP-DS3
DS3	Power Panel	VPP-DS3
DS3	Drive Unit	FDU-DS3
DS3	Drive Unit Disconnect Switch	DSC-FDU-DS3
DS3	Motorized Inlet Gate	EDR-DS3
DS3	Solids Waste Valve 1	MOV-DS3-SW1
DS3	Backwash Valve 1	MOV-DS3-BW1
DS3	Backwash Valve 2	MOV-DS3-BW2
DS3	Backwash Valve 3	MOV-DS3-BW3
DS3	Backwash Valve 4	MOV-DS3-BW4
DS3	Backwash Valve 5	MOV-DS3-BW5
DS3	Backwash Valve 6	MOV-DS3-BW6

DS3	Backwash Valve 7	MOV-DS3-BW7
DS3	Solids Waste Valve 2	MOV-DS3-SW2
DS3	Backwash Pump A	BWP-DS3-A
DS3	Backwash Pump A Disconnect Switch	DSC-BWP-DS3A
DS3	Backwash Pump B	BWP-DS3-B
DS3	Backwash Pump B Disconnect Switch	DSC-BWP-DS3B
DS4	Control Panel	VCP-DS4
DS4	Power Panel	VPP-DS4
DS4	Drive Unit	FDU-DS4
DS4	Drive Unit Disconnect Switch	DSC-FDU-DS4
DS4	Motorized Inlet Gate	EDR-DS4
DS4	Solids Waste Valve 1	MOV-DS4-SW1
DS4	Backwash Valve 1	MOV-DS4-BW1
DS4	Backwash Valve 2	MOV-DS4-BW2
DS4	Backwash Valve 3	MOV-DS4-BW3
DS4	Backwash Valve 4	MOV-DS4-BW4
DS4	Backwash Valve 5	MOV-DS4-BW5
DS4	Backwash Valve 6	MOV-DS4-BW6
DS4	Backwash Valve 7	MOV-DS4-BW7
DS4	Solids Waste Valve 2	MOV-DS4-SW2
DS4	Backwash Pump A	BWP-DS4-A
DS4	Backwash Pump A Disconnect Switch	DSC-BWP-DS4A
DS4	Backwash Pump B	BWP-DS4-B
DS4	Backwash Pump B Disconnect Switch	DSC-BWP-DS4B
DS5	Control Panel	VCP-DS5

DS5	Power Panel	VPP-DS5
DS5	Drive Unit	FDU-DS5
DS5	Drive Unit Disconnect Switch	DSC-FDU-DS5
DS5	Motorized Inlet Gate	EDR-DS5
DS5	Solids Waste Valve 1	MOV-DS5-SW1
DS5	Backwash Valve 1	MOV-DS5-BW1
DS5	Backwash Valve 2	MOV-DS5-BW2
DS5	Backwash Valve 3	MOV-DS5-BW3
DS5	Backwash Valve 4	MOV-DS5-BW4
DS5	Backwash Valve 5	MOV-DS5-BW5
DS5	Backwash Valve 6	MOV-DS5-BW6
DS5	Backwash Valve 7	MOV-DS5-BW7
DS5	Solids Waste Valve 2	MOV-DS5-SW2
DS5	Backwash Pump A	BWP-DS5-A
DS5	Backwash Pump A Disconnect Switch	DSC-BWP-DS5A
DS5	Backwash Pump B	BWP-DS5-B
DS5	Backwash Pump B Disconnect Switch	DSC-BWP-DS5B
DS6	Control Panel	VCP-DS6
DS6	Power Panel	VPP-DS6
DS6	Drive Unit	FDU-DS6
DS6	Drive Unit Disconnect Switch	DSC-FDU-DS6
DS6	Motorized Inlet Gate	EDR-DS6
DS6	Solids Waste Valve 1	MOV-DS6-SW1
DS6	Backwash Valve 1	MOV-DS6-BW1
DS6	Backwash Valve 2	MOV-DS6-BW2

DS6	Backwash Valve 3	MOV-DS6-BW3
DS6	Backwash Valve 4	MOV-DS6-BW4
DS6	Backwash Valve 5	MOV-DS6-BW5
DS6	Backwash Valve 6	MOV-DS6-BW6
DS6	Backwash Valve 7	MOV-DS6-BW7
DS6	Solids Waste Valve 2	MOV-DS6-SW2
DS6	Backwash Pump A	BWP-DS6-A
DS6	Backwash Pump A Disconnect Switch	DSC-BWP-DS6A
DS6	Backwash Pump B	BWP-DS6-B
DS6	Backwash Pump B Disconnect Switch	DSC-BWP-DS6B
NA	Monorail Hoist Disconnect Switch	DSC-CRN-500
NA	Monorail Hoist E-Stop	ES-CRN-500
DS1/DS2	Sump Pump Motor Control Panel No. 1	MCP-SP-1
DS1/DS2	Sump Pump No. 1	PMP-SP-1
DS1/DS2	Sump 1 Low Level Switch	LSL-710
DS1/DS2	Sump 1 High Level Switch	LSH-710
DS1/DS2	Sump 1 High High Level Switch	LSHH-710
DS3/DS4	Sump Pump Motor Control Panel No. 2	MCP-SP-2
DS3/DS4	Sump Pump No. 2	PMP-SP-2
DS3/DS4	Sump 2 Low Level Switch	LSL-720
DS3/DS4	Sump 2 High Level Switch	LSH-720
DS3/DS4	Sump 2 High High Level Switch	LSHH-720
DS5/DS6	Sump Pump Motor Control Panel No. 3	MCP-SP-3
DS5/DS6	Sump Pump No. 3	PMP-SP-3
DS5/DS6	Sump 3 Low Level Switch	LSL-730

DS5/DS6	Sump 3 High Level Switch	LSH-730
DS5/DS6	Sump 3 High High Level Switch	LSHH-730

2. Instruments:

Associated Disc Filter Unit(s)	Item Description	Item Tag
DS1	Pressure Transducer	LIT-DS1-100
DS1	High Level Float Switch	LSH-DS1-100
DS1	Effluent Chamber Turbidity Probe	AE-DS1-100
DS1	Vacuum Transmitter No. 1	VT-DS1-101
DS1	Vacuum Transmitter No. 2	VT-DS1-102
DS1	Vacuum Indicator No. 1	VT-DS1-101
DS1	Pressure Indicator No. 1	PI-DS1-133
DS1	Vacuum Indicator No. 2	VT-DS1-102
DS1	Pressure Indicator No. 2	PI-DS1-143
DS1	Effluent Chamber Turbidity Analyzer	AIT-DS1-100
DS2	Pressure Transducer	LIT-DS2-200
DS2	High Level Float Switch	LSH-DS2-200
DS2	Effluent Chamber Turbidity Probe	AE-DS2-200
DS2	Vacuum Transmitter No. 1	VT-DS2-201
DS2	Vacuum Transmitter No. 2	VT-DS2-202
DS2	Vacuum Indicator No. 1	VI-DS2-232
DS2	Pressure Indicator No. 1	PI-DS2-233
DS2	Vacuum Indicator No. 2	VI-DS2-242
DS2	Pressure Indicator No. 2	PI-DS2-243

DS2	Effluent Chamber Turbidity Analyzer	AIT-DS2-200
DS3	Pressure Transducer	LIT-DS3-300
DS3	High Level Float Switch	LSH-DS3-300
DS3	Effluent Chamber Turbidity Probe	AE-DS3-300
DS3	Vacuum Transmitter No. 1	VT-DS3-301
DS3	Vacuum Transmitter No. 2	VT-DS3-302
DS3	Vacuum Indicator No. 1	VI-DS3-332
DS3	Pressure Indicator No. 1	PI-DS3-333
DS3	Vacuum Indicator No. 2	VI-DS3-342
DS3	Pressure Indicator No. 2	PI-DS3-343
DS3	Effluent Chamber Turbidity Analyzer	AIT-DS3-300
DS4	Pressure Transducer	LIT-DS4-100
DS4	High Level Float Switch	LSH-DS4-400
DS4	Effluent Chamber Turbidity Probe	AE-DS4-400
DS4	Vacuum Transmitter No. 1	VT-DS4-401
DS4	Vacuum Transmitter No. 2	VT-DS4-402
DS4	Vacuum Indicator No. 1	VI-DS4-432
DS4	Pressure Indicator No. 1	PI-DS4-433
DS4	Vacuum Indicator No. 2	VI-DS4-442
DS4	Pressure Indicator No. 2	PI-DS4-443
DS4	Effluent Chamber Turbidity Analyzer	AIT-DS4-400
DS5	Pressure Transducer	LIT-DS5-500
DS5	High Level Float Switch	LSH-DS5-500
DS5	Effluent Chamber Turbidity Probe	AE-DS5-500
DS5	Vacuum Transmitter No. 1	VT-DS5-501

DS5	Vacuum Transmitter No. 2	VT-DS5-502
DS5	Vacuum Indicator No. 1	VI-DS5-532
DS5	Pressure Indicator No. 1	PI-DS5-533
DS5	Vacuum Indicator No. 2	VI-DS5-542
DS5	Pressure Indicator No. 2	PI-DS5-543
DS5	Effluent Chamber Turbidity Analyzer	AIT-DS5-500
DS6	Pressure Transducer	LIT-DS6-600
DS6	High Level Float Switch	LSH-DS6-600
DS6	Effluent Chamber Turbidity Probe	AE-DS6-600
DS6	Vacuum Transmitter No. 1	VT-DS6-601
DS6	Vacuum Transmitter No. 2	VT-DS6-602
DS6	Vacuum Indicator No. 1	VI-DS6-632
DS6	Pressure Indicator No. 1	PI-DS6-633
DS6	Vacuum Indicator No. 2	VI-DS6-642
DS6	Pressure Indicator No. 2	PI-DS6-643
DS6	Effluent Chamber Turbidity Analyzer	AIT-DS6-600

C. Hard-Wired Safety Interlocks:

1. The Filter Drive will automatically stop on motor overload.
2. The Backwash/Solids Waste Pump will automatically stop on low-level alarm.
3. The Backwash/Solids Waste Pump will automatically stop on motor overload.
4. The Backwash high water level set elevation will not go above 1220.68’.

D. Control Modes:

1. Remote Auto (DCS):
 - a. Disc Filter Influent Gate:
 - 1) Place all disc filter influent gates in the REMOTE position at the respective gate LCP.
 - 2) The disc filter inlet gate will open by pressing the OPEN button from individual filter control page at DCS.

- 3) The disc filter influent gate will close by pressing the CLOSE button from individual filter control page at DCS.
- b. Backwash/Solids Waste Cycle
 - 1) Place all vendor control panels, VCP-DS1, VCP-DS2, VCP-DS3, VCP-DS4, VCP-DS5 and VCP-DS6, H-O-A switches in the AUTO position. Place the LEVEL or TIMED selector switch, at the vendor control panels, VCP-DS1, VCP-DS2, VCP-DS3, VCP-DS4, VCP-DS5 and VCP-DS6 in the proper position dependent on operations.
 - 2) Place all backwash valves/solids waste valve(s) in the REMOTE position.
 - 3) Place all backwash/solids wasting pump(s) in the REMOTE position.
 - 4) Place the filter drive unit in the REMOTE position.
 - 5) The disc filter system will start operation in normal filtration mode when set to ENABLE.
 - 6) The backwash/solids waste pump(s) will start automatically when a backwash is initiated by either LEVEL or TIME, dependent on operations.
 - 7) The backwash/solids waste valve(s) will operate automatically during backwash/solids wasting.
 - 8) Backwash interval is set on the Individual Filter Control page from DCS.
 - 9) Backwash high water level for automatic backwash is set on the Individual Filter Control page from DCS.
 - 10) Backwash count to initiate sludge wasting is set on the Individual Filter Control page from DCS.
 - 11) Solids wasting interval (time) is set on the Individual Filter Control page from DCS.
 - 12) The disc filter system will stop operation when set to DISABLE.
2. Remote Hand
 - a. Disc Filter Influent Gate:
 - 1) Place all disc filter influent gates in the REMOTE position at the respective gate LCP.
 - 2) The disc filter inlet gate will open by pressing the OPEN button from individual filter control page at DCS.
 - 3) The disc filter influent gate will close by pressing the CLOSE button from individual filter control page at DCS.
 - b. Backwash/Solids Waste Cycle:
 - 1) Place all vendor control panels, VCP-539-100, VCP-539-200, VCP-539-300, and VCP-539-400, LOCAL-OFF-REMOTE switches in the REMOTE position.
 - 2) Place all backwash/solids wasting pump(s) in the REMOTE position.
 - 3) The Backwash/Solids Waste Pump(s) will start by pressing the START BACKWASH button from individual filter control page at SCADA.
 - 4) The Backwash/Solids Waste Pump(s) will stop when the backwash/solids waste cycle is complete.
 - 5) Place all backwash valves/solids waste valve(s) in the AUTO position.

- 6) The Backwash/Solids Waste Valves(s) will open automatically during a backwash/solids waste cycle.
 - 7) The Backwash/Solids Waste Valve(s) will close automatically during a backwash/solids waste cycle.
 - 8) Place the filter drive unit in the AUTO position.
 - 9) The Filter Drive Motor will start by pressing the START BACKWASH button from individual filter control page at SCADA.
 - 10) The Filter Drive Motor will stop when the backwash/solids waste cycle is complete.
 - 11) Backwash interval is set on the Individual Filter Control page from SCADA.
 - 12) Backwash high water level for automatic backwash is set on the Individual Filter Control page from SCADA.
 - 13) Backwash count to initiate sludge wasting is set on the Individual Filter Control page from SCADA.
 - 14) Solids wasting interval (time) is set on the Individual Filter Control page from SCADA.
3. Local Auto:
- a. Disc Filter Influent Gate:
 - 1) Place all disc filter influent gates in the LOCAL position at the respective gate LCP.
 - 2) The disc filter inlet gate will open by pressing the OPEN button from the gate LCP.
 - 3) The disc filter influent gate will close by pressing the CLOSE button from the gate LCP.
 - b. Backwash/Solids Waste Cycle:
 - 1) Place all vendor control panels, VCP-DS1, VCP-DS2, VCP-DS3, VCP-DS4, VCP-DS5 and VCP-DS6, H-O-A switches in the AUTO position. Place the LEVEL or TIMED selector switch, at the vendor control panels VCP-DS1, VCP-DS2, VCP-DS3, VCP-DS4, VCP-DS5 and VCP-DS6 in the proper position dependent on operations.
 - 2) Place all backwash valves/solids waste valve(s) in the LOCAL position.
 - 3) Place all backwash/solids wasting pump(s) in the LOCAL position.
 - 4) Place the filter drive unit in the LOCAL position.
 - 5) The disc filter system will start operation in normal filtration mode when the disc filter influent gate is open.
 - 6) The backwash/solids waste pump(s) will start automatically when a backwash is initiated by either LEVEL or TIME, dependent on operations.
 - 7) The backwash/solids waste valve(s) will operate automatically during backwash/solids wasting.
 - 8) Backwash interval is set locally at the vendor control panels, VCP-DS1, VCP-DS2, VCP-DS3, VCP-DS4, VCP-DS5 and VCP-DS6.
 - 9) Backwash high water level for automatic backwash is set locally at the vendor control panels, VCP-DS1, VCP-DS2, VCP-DS3, VCP-DS4, VCP-DS5 and VCP-DS6.

- 10) Backwash count to initiate sludge wasting is set locally at the vendor control panels, VCP-DS1, VCP-DS2, VCP-DS3, VCP-DS4, VCP-DS5 and VCP-DS6.
 - 11) Solids wasting interval (time) is set locally at the vendor control panels, VCP-DS1, VCP-DS2, VCP-DS3, VCP-DS4, VCP-DS5 and VCP-DS6.
 - 12) The disc filter system will stop operation when the disc filter influent gate is closed.
4. Local Hand
- a. Disc Filter Influent Gate:
 - 1) Place all disc filter influent gates in the LOCAL position.
 - 2) The disc filter influent gates will open by placing the panel L-O-R switch in the LOCAL position and pressing the OPEN pushbutton.
 - 3) The disc filter influent gates will close by placing the panel L-O-R switch in the HAND position and pressing the CLOSE pushbutton.
 - b. Backwash/Solids Waste Pump(s):
 - 1) The backwash/solids waste pump(s) is controlled locally at the vendor control panel, VCP-DS1, VCP-DS2, VCP-DS3, VCP-DS4, VCP-DS5 and VCP-DS6.
 - 2) The Backwash/Solids Waste Pump(s) START/STOP button is located at the vendor control panel, VCP-DS1, VCP-DS2, VCP-DS3, VCP-DS4, VCP-DS5 and VCP-DS6.
 - 3) 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.
 - 4) The Backwash/Solids Waste Pump(s) will stop by placing the panel H-O-A switch in the HAND position and pressing the STOP pushbutton.
 - c. Backwash/Solids Waste Valve(s):
 - 1) The backwash/solids waste valve(s) is controlled locally at the vendor control panel, VCP-DS1, VCP-DS2, VCP-DS3, VCP-DS4, VCP-DS5 and VCP-DS6.
 - 2) The Backwash/Solids Waste Valve(s) OPEN/CLOSE button is located at the vendor control panel, VCP-DS1, VCP-DS2, VCP-DS3, VCP-DS4, VCP-DS5 and VCP-DS6.
 - 3) The Backwash/Solids Waste valve(s) actuator will open and close the valve using the OPEN/STOP/CLOSE controls at the valve actuator when the LOCAL-OFF-REMOTE switch is set to LOCAL.
 - d. Filter Drive Unit
 - 1) The Filter Drive Motor is controlled locally at the vendor control panel, VCP-DS1, VCP-DS2, VCP-DS3, VCP-DS4, VCP-DS5 and VCP-DS6.
 - 2) The Filter Drive Motor is started by placing the panel H-O-A switch in the HAND position and pressing the START pushbutton.
 - 3) The Filter Drive Motor is stopped by placing the panel H-O-A switch in the HAND position and pressing the STOP pushbutton.

- E. Monitor: The following data will be monitored by DCS:
1. Disc Filter System No. 1 High Level Status
 2. Disc Filter System No. 1 Filter Drive Unit (FDU) in AUTO/HAND status
 3. Disc Filter System No. 1 Filter Drive Unit (FDU) in OFF status
 4. Disc Filter System No. 1 Filter Drive Unit (FDU) RUN status
 5. Disc Filter System No. 1 Backwash Duration (time) status
 6. Disc Filter System No. 1 Solids Wasting Duration (time) status
 7. Disc Filter System No. 1 Backwash/Solids Waste Pump 1 in AUTO/HAND status.
 8. Disc Filter System No. 1 Backwash/Solids Waste Pump 1 in OFF status
 9. Disc Filter System No. 1 Backwash/Solids Waste Pump 1 RUN status
 10. Disc Filter System No. 1 Backwash/Solids Waste Pump 2 in OFF status
 11. Disc Filter System No. 1 Backwash/Solids Waste Pump 2 RUN status
 12. Disc Filter System No. 1 Backwash Valve 1 Open Status
 13. Disc Filter System No. 1 Backwash Valve 1 Closed Status
 14. Disc Filter System No. 1 Backwash Valve 2 Open Status
 15. Disc Filter System No. 1 Backwash Valve 2 Closed Status
 16. Disc Filter System No. 1 Backwash Valve 3 Open Status
 17. Disc Filter System No. 1 Backwash Valve 3 Closed Status
 18. Disc Filter System No. 1 Backwash Valve 4 Open Status
 19. Disc Filter System No. 1 Backwash Valve 4 Closed Status
 20. Disc Filter System No. 1 Backwash Valve 5 Open Status
 21. Disc Filter System No. 1 Backwash Valve 5 Closed Status
 22. Disc Filter System No. 1 Backwash Valve 6 Open Status
 23. Disc Filter System No. 1 Backwash Valve 6 Closed Status
 24. Disc Filter System No. 1 Backwash Valve 7 Open Status
 25. Disc Filter System No. 1 Backwash Valve 7 Closed Status
 26. Disc Filter System No. 1 Solids Waste Valve 1 Open Status
 27. Disc Filter System No. 1 Solids Waste Valve 1 Closed Status
 28. Disc Filter System No. 1 Solids Waste Valve 2 Open Status
 29. Disc Filter System No. 1 Solids Waste Valve 2 Closed Status
 30. Disc Filter System No. 2 Disc Filter Influent Gate Open Status
 31. Disc Filter System No. 2 High Level Status
 32. Disc Filter System No. 2 Filter Drive Unit (FDU) in AUTO/HAND status
 33. Disc Filter System No. 2 Filter Drive Unit (FDU) in OFF status
 34. Disc Filter System No. 2 Filter Drive Unit (FDU) RUN status
 35. Disc Filter System No. 2 Backwash Duration (time) status
 36. Disc Filter System No. 2 Solids Wasting Duration (time) status
 37. Disc Filter System No. 2 Backwash/Solids Waste Pump 1 in AUTO/HAND status.
 38. Disc Filter System No. 2 Backwash/Solids Waste Pump 1 in OFF status
 39. Disc Filter System No. 2 Backwash/Solids Waste Pump 1 RUN status
 40. Disc Filter System No. 2 Backwash/Solids Waste Pump 2 in OFF status
 41. Disc Filter System No. 2 Backwash/Solids Waste Pump 2 RUN status
 42. Disc Filter System No. 2 Backwash Valve 1 Open Status
 43. Disc Filter System No. 2 Backwash Valve 1 Closed Status

44. Disc Filter System No. 2 Backwash Valve 2 Open Status
45. Disc Filter System No. 2 Backwash Valve 2 Closed Status
46. Disc Filter System No. 2 Backwash Valve 3 Open Status
47. Disc Filter System No. 2 Backwash Valve 3 Closed Status
48. Disc Filter System No. 2 Backwash Valve 4 Open Status
49. Disc Filter System No. 2 Backwash Valve 4 Closed Status
50. Disc Filter System No. 2 Backwash Valve 5 Open Status
51. Disc Filter System No. 2 Backwash Valve 5 Closed Status
52. Disc Filter System No. 2 Backwash Valve 6 Open Status
53. Disc Filter System No. 2 Backwash Valve 6 Closed Status
54. Disc Filter System No. 2 Backwash Valve 7 Open Status
55. Disc Filter System No. 2 Backwash Valve 7 Closed Status
56. Disc Filter System No. 2 Solids Waste Valve 1 Open Status
57. Disc Filter System No. 2 Solids Waste Valve 1 Closed Status
58. Disc Filter System No. 2 Solids Waste Valve 2 Open Status
59. Disc Filter System No. 2 Solids Waste Valve 2 Closed Status
60. Disc Filter System No. 3 Disc Filter Influent Gate Open Status
61. Disc Filter System No. 3 High Level Status
62. Disc Filter System No. 3 Filter Drive Unit (FDU) in AUTO/HAND status
63. Disc Filter System No. 3 Filter Drive Unit (FDU) in OFF status
64. Disc Filter System No. 3 Filter Drive Unit (FDU) RUN status
65. Disc Filter System No. 3 Backwash Duration (time) status
66. Disc Filter System No. 3 Solids Wasting Duration (time) status
67. Disc Filter System No. 3 Backwash/Solids Waste Pump 1 in AUTO/HAND status.
68. Disc Filter System No. 3 Backwash/Solids Waste Pump 1 in OFF status
69. Disc Filter System No. 3 Backwash/Solids Waste Pump 1 RUN status
70. Disc Filter System No. 3 Backwash/Solids Waste Pump 2 in OFF status
71. Disc Filter System No. 3 Backwash/Solids Waste Pump 2 RUN status
72. Disc Filter System No. 3 Backwash Valve 1 Open Status
73. Disc Filter System No. 3 Backwash Valve 1 Closed Status
74. Disc Filter System No. 3 Backwash Valve 2 Open Status
75. Disc Filter System No. 3 Backwash Valve 2 Closed Status
76. Disc Filter System No. 3 Backwash Valve 3 Open Status
77. Disc Filter System No. 3 Backwash Valve 3 Closed Status
78. Disc Filter System No. 3 Backwash Valve 4 Open Status
79. Disc Filter System No. 3 Backwash Valve 4 Closed Status
80. Disc Filter System No. 3 Backwash Valve 5 Open Status
81. Disc Filter System No. 3 Backwash Valve 5 Closed Status
82. Disc Filter System No. 3 Backwash Valve 6 Open Status
83. Disc Filter System No. 3 Backwash Valve 6 Closed Status
84. Disc Filter System No. 3 Backwash Valve 7 Open Status
85. Disc Filter System No. 3 Backwash Valve 7 Closed Status
86. Disc Filter System No. 3 Solids Waste Valve 1 Open Status
87. Disc Filter System No. 3 Solids Waste Valve 1 Closed Status
88. Disc Filter System No. 3 Solids Waste Valve 2 Open Status

89. Disc Filter System No. 3 Solids Waste Valve 2 Closed Status
90. Disc Filter System No. 4 Disc Filter Influent Gate Open Status
91. Disc Filter System No. 4 High Level Status
92. Disc Filter System No. 4 Filter Drive Unit (FDU) in AUTO/HAND status
93. Disc Filter System No. 4 Filter Drive Unit (FDU) in OFF status
94. Disc Filter System No. 4 Filter Drive Unit (FDU) RUN status
95. Disc Filter System No. 4 Backwash Duration (time) status
96. Disc Filter System No. 4 Solids Wasting Duration (time) status
97. Disc Filter System No. 4 Backwash/Solids Waste Pump 1 in AUTO/HAND status.
98. Disc Filter System No. 4 Backwash/Solids Waste Pump 1 in OFF status
99. Disc Filter System No. 4 Backwash/Solids Waste Pump 1 RUN status
100. Disc Filter System No. 4 Backwash/Solids Waste Pump 2 in OFF status
101. Disc Filter System No. 4 Backwash/Solids Waste Pump 2 RUN status
102. Disc Filter System No. 4 Backwash Valve 1 Open Status
103. Disc Filter System No. 4 Backwash Valve 1 Closed Status
104. Disc Filter System No. 4 Backwash Valve 2 Open Status
105. Disc Filter System No. 4 Backwash Valve 2 Closed Status
106. Disc Filter System No. 4 Backwash Valve 3 Open Status
107. Disc Filter System No. 4 Backwash Valve 3 Closed Status
108. Disc Filter System No. 4 Backwash Valve 4 Open Status
109. Disc Filter System No. 4 Backwash Valve 4 Closed Status
110. Disc Filter System No. 4 Backwash Valve 5 Open Status
111. Disc Filter System No. 4 Backwash Valve 5 Closed Status
112. Disc Filter System No. 4 Backwash Valve 6 Open Status
113. Disc Filter System No. 4 Backwash Valve 6 Closed Status
114. Disc Filter System No. 4 Backwash Valve 7 Open Status
115. Disc Filter System No. 4 Backwash Valve 7 Closed Status
116. Disc Filter System No. 4 Solids Waste Valve 1 Open Status
117. Disc Filter System No. 4 Solids Waste Valve 1 Closed Status
118. Disc Filter System No. 4 Solids Waste Valve 2 Open Status
119. Disc Filter System No. 4 Solids Waste Valve 2 Closed Status
120. Disc Filter System No. 5 Disc Filter Influent Gate Open Status
121. Disc Filter System No. 5 High Level Status
122. Disc Filter System No. 5 Filter Drive Unit (FDU) in AUTO/HAND status
123. Disc Filter System No. 5 Filter Drive Unit (FDU) in OFF status
124. Disc Filter System No. 5 Filter Drive Unit (FDU) RUN status
125. Disc Filter System No. 5 Backwash Duration (time) status
126. Disc Filter System No. 5 Solids Wasting Duration (time) status
127. Disc Filter System No. 5 Backwash/Solids Waste Pump 1 in AUTO/HAND status.
128. Disc Filter System No. 5 Backwash/Solids Waste Pump 1 in OFF status
129. Disc Filter System No. 5 Backwash/Solids Waste Pump 1 RUN status
130. Disc Filter System No. 5 Backwash/Solids Waste Pump 2 in OFF status
131. Disc Filter System No. 5 Backwash/Solids Waste Pump 2 RUN status
132. Disc Filter System No. 5 Backwash Valve 1 Open Status

- 133.Disc Filter System No. 5 Backwash Valve 1 Closed Status
- 134.Disc Filter System No. 5 Backwash Valve 2 Open Status
- 135.Disc Filter System No. 5 Backwash Valve 2 Closed Status
- 136.Disc Filter System No. 5 Backwash Valve 3 Open Status
- 137.Disc Filter System No. 5 Backwash Valve 3 Closed Status
- 138.Disc Filter System No. 5 Backwash Valve 4 Open Status
- 139.Disc Filter System No. 5 Backwash Valve 4 Closed Status
- 140.Disc Filter System No. 5 Backwash Valve 5 Open Status
- 141.Disc Filter System No. 5 Backwash Valve 5 Closed Status
- 142.Disc Filter System No. 5 Backwash Valve 6 Open Status
- 143.Disc Filter System No. 5 Backwash Valve 6 Closed Status
- 144.Disc Filter System No. 5 Backwash Valve 7 Open Status
- 145.Disc Filter System No. 5 Backwash Valve 7 Closed Status
- 146.Disc Filter System No. 5 Solids Waste Valve 1 Open Status
- 147.Disc Filter System No. 5 Solids Waste Valve 1 Closed Status
- 148.Disc Filter System No. 5 Solids Waste Valve 2 Open Status
- 149.Disc Filter System No. 5 Solids Waste Valve 2 Closed Status
- 150.Disc Filter System No. 6 Disc Filter Influent Gate Open Status
- 151.Disc Filter System No. 6 High Level Status
- 152.Disc Filter System No. 6 Filter Drive Unit (FDU) in AUTO/HAND status
- 153.Disc Filter System No. 6 Filter Drive Unit (FDU) in OFF status
- 154.Disc Filter System No. 6 Filter Drive Unit (FDU) RUN status
- 155.Disc Filter System No. 6 Backwash Duration (time) status
- 156.Disc Filter System No. 6 Solids Wasting Duration (time) status
- 157.Disc Filter System No. 6 Backwash/Solids Waste Pump 1 in AUTO/HAND status.
- 158.Disc Filter System No. 6 Backwash/Solids Waste Pump 1 in OFF status
- 159.Disc Filter System No. 6 Backwash/Solids Waste Pump 1 RUN status
- 160.Disc Filter System No. 6 Backwash/Solids Waste Pump 2 in OFF status
- 161.Disc Filter System No. 6 Backwash/Solids Waste Pump 2 RUN status
- 162.Disc Filter System No. 6 Backwash Valve 1 Open Status
- 163.Disc Filter System No. 6 Backwash Valve 1 Closed Status
- 164.Disc Filter System No. 6 Backwash Valve 2 Open Status
- 165.Disc Filter System No. 6 Backwash Valve 2 Closed Status
- 166.Disc Filter System No. 6 Backwash Valve 3 Open Status
- 167.Disc Filter System No. 6 Backwash Valve 3 Closed Status
- 168.Disc Filter System No. 6 Backwash Valve 4 Open Status
- 169.Disc Filter System No. 6 Backwash Valve 4 Closed Status
- 170.Disc Filter System No. 6 Backwash Valve 5 Open Status
- 171.Disc Filter System No. 6 Backwash Valve 5 Closed Status
- 172.Disc Filter System No. 6 Backwash Valve 6 Open Status
- 173.Disc Filter System No. 6 Backwash Valve 6 Closed Status
- 174.Disc Filter System No. 6 Backwash Valve 7 Open Status
- 175.Disc Filter System No. 6 Backwash Valve 7 Closed Status
- 176.Disc Filter System No. 6 Solids Waste Valve 1 Open Status
- 177.Disc Filter System No. 6 Solids Waste Valve 1 Closed Status

- 178. Disc Filter System No. 6 Solids Waste Valve 2 Open Status
- 179. Disc Filter System No. 6 Solids Waste Valve 2 Closed Status

F. Alarms: The following alarms and indications are available in all control modes:

- 1. Disc Filter System No. 1 Filter Drive Unit (FDU) FAIL
- 2. Disc Filter System No. 1 Backwash/Solids Waste Pump 1 FAIL
- 3. Disc Filter System No. 1 Backwash/Solids Waste Pump 2 FAIL
- 4. Disc Filter System No. 1 Backwash Valve 1 FAIL
- 5. Disc Filter System No. 1 Backwash Valve 2 FAIL
- 6. Disc Filter System No. 1 Backwash Valve 3 FAIL
- 7. Disc Filter System No. 1 Backwash Valve 4 FAIL
- 8. Disc Filter System No. 1 Backwash Valve 5 FAIL
- 9. Disc Filter System No. 1 Backwash Valve 6 FAIL
- 10. Disc Filter System No. 1 Backwash Valve 7 FAIL
- 11. Disc Filter System No. 1 Solids Waste Valve 1 FAIL
- 12. Disc Filter System No. 1 Solids Waste Valve 2 FAIL
- 13. Disc Filter System No. 1 Level alarm high
- 14. Disc Filter System No. 1 Emergency Stop Activated
- 15. Disc Filter System No. 1 High turbidity alarm
- 16. Disc Filter System No. 2 Filter Drive Unit (FDU) FAIL
- 17. Disc Filter System No. 2 Backwash/Solids Waste Pump 1 FAIL
- 18. Disc Filter System No. 2 Backwash/Solids Waste Pump 2 FAIL
- 19. Disc Filter System No. 2 Backwash Valve 1 FAIL
- 20. Disc Filter System No. 2 Backwash Valve 2 FAIL
- 21. Disc Filter System No. 2 Backwash Valve 3 FAIL
- 22. Disc Filter System No. 2 Backwash Valve 4 FAIL
- 23. Disc Filter System No. 2 Backwash Valve 5 FAIL
- 24. Disc Filter System No. 2 Backwash Valve 6 FAIL
- 25. Disc Filter System No. 2 Backwash Valve 7 FAIL
- 26. Disc Filter System No. 2 Solids Waste Valve 1 FAIL
- 27. Disc Filter System No. 2 Solids Waste Valve 2 FAIL
- 28. Disc Filter System No. 2 Level alarm high
- 29. Disc Filter System No. 2 Emergency Stop Activated
- 30. Disc Filter System No. 2 High turbidity alarm
- 31. Disc Filter System No. 3 Filter Drive Unit (FDU) FAIL
- 32. Disc Filter System No. 3 Backwash/Solids Waste Pump 1 FAIL
- 33. Disc Filter System No. 3 Backwash/Solids Waste Pump 2 FAIL
- 34. Disc Filter System No. 3 Backwash Valve 1 FAIL
- 35. Disc Filter System No. 3 Backwash Valve 2 FAIL
- 36. Disc Filter System No. 3 Backwash Valve 3 FAIL
- 37. Disc Filter System No. 3 Backwash Valve 4 FAIL
- 38. Disc Filter System No. 3 Backwash Valve 5 FAIL
- 39. Disc Filter System No. 3 Backwash Valve 6 FAIL
- 40. Disc Filter System No. 3 Backwash Valve 7 FAIL
- 41. Disc Filter System No. 3 Solids Waste Valve 1 FAIL
- 42. Disc Filter System No. 3 Solids Waste Valve 2 FAIL

43. Disc Filter System No. 3 Level alarm high
44. Disc Filter System No. 3 Emergency Stop Activated
45. Disc Filter System No. 3 High turbidity alarm
46. Disc Filter System No. 4 Filter Drive Unit (FDU) FAIL
47. Disc Filter System No. 4 Backwash/Solids Waste Pump 1 FAIL
48. Disc Filter System No. 4 Backwash/Solids Waste Pump 2 FAIL
49. Disc Filter System No. 4 Backwash Valve 1 FAIL
50. Disc Filter System No. 4 Backwash Valve 2 FAIL
51. Disc Filter System No. 4 Backwash Valve 3 FAIL
52. Disc Filter System No. 4 Backwash Valve 4 FAIL
53. Disc Filter System No. 4 Backwash Valve 5 FAIL
54. Disc Filter System No. 4 Backwash Valve 6 FAIL
55. Disc Filter System No. 4 Backwash Valve 7 FAIL
56. Disc Filter System No. 4 Solids Waste Valve 1 FAIL
57. Disc Filter System No. 4 Solids Waste Valve 2 FAIL
58. Disc Filter System No. 4 Level alarm high
59. Disc Filter System No. 4 Emergency Stop Activated
60. Disc Filter System No. 4 High turbidity alarm
61. Disc Filter System No. 5 Filter Drive Unit (FDU) FAIL
62. Disc Filter System No. 5 Backwash/Solids Waste Pump 1 FAIL
63. Disc Filter System No. 5 Backwash/Solids Waste Pump 2 FAIL
64. Disc Filter System No. 5 Backwash Valve 1 FAIL
65. Disc Filter System No. 5 Backwash Valve 2 FAIL
66. Disc Filter System No. 5 Backwash Valve 3 FAIL
67. Disc Filter System No. 5 Backwash Valve 4 FAIL
68. Disc Filter System No. 5 Backwash Valve 5 FAIL
69. Disc Filter System No. 5 Backwash Valve 6 FAIL
70. Disc Filter System No. 5 Backwash Valve 7 FAIL
71. Disc Filter System No. 5 Solids Waste Valve 1 FAIL
72. Disc Filter System No. 5 Solids Waste Valve 2 FAIL
73. Disc Filter System No. 5 Level alarm high
74. Disc Filter System No. 5 Emergency Stop Activated
75. Disc Filter System No. 5 High turbidity alarm
76. Disc Filter System No. 6 Filter Drive Unit (FDU) FAIL
77. Disc Filter System No. 6 Backwash/Solids Waste Pump 1 FAIL
78. Disc Filter System No. 6 Backwash/Solids Waste Pump 2 FAIL
79. Disc Filter System No. 6 Backwash Valve 1 FAIL
80. Disc Filter System No. 6 Backwash Valve 2 FAIL
81. Disc Filter System No. 6 Backwash Valve 3 FAIL
82. Disc Filter System No. 6 Backwash Valve 4 FAIL
83. Disc Filter System No. 6 Backwash Valve 5 FAIL
84. Disc Filter System No. 6 Backwash Valve 6 FAIL
85. Disc Filter System No. 6 Backwash Valve 7 FAIL
86. Disc Filter System No. 6 Solids Waste Valve 1 FAIL
87. Disc Filter System No. 6 Solids Waste Valve 2 FAIL
88. Disc Filter System No. 6 Level alarm high

- 89. Disc Filter System No. 6 Emergency Stop Activated
- 90. Disc Filter System No. 6 High turbidity alarm

END OF AWRP FILTER SECTION

1.6 DISC FILTER SYSTEM (OWRF)

A. Summary:

- 1. The Ocotillo WRF will be updated with a Disc Filtration System upstream of the Chlorine Contact Basins (CCB's). Refer to Specification Section 11400, Disc Filtration System.
 - a. Effluent from the secondary clarifiers upstream flows via gravity through a 42" pipe to the common influent channel. Flow is then distributed between the four filter units (three in operation, one standby) and the filter influent enters the filter basins by flowing over an influent weir and submerging the discs. Under normal operation, the discs are stationary.
 - b. The cloth media filters are designed to continuously remove particulates from the flow stream. 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 collected in the center tube and flows through to an effluent chamber and over an effluent weir, into the effluent channel. The filter effluent is then conveyed to the chlorine contact basin.
 - c. 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. 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
 - d. 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/waste pump.
 - e. Backwash and solids wastewater are transported back to the IPS.
 - f. The filter manufacturer shall be responsible for implementing all the detailed control strategies for each filter in each vendor supplied LCP/PLC.
 - g. Each LCP will be equipped with an OIT.

B. P&ID: See Sheets I-3.41 to I-3.53.

C. Components:

- 1. Equipment

Associated Disc Filter Unit(s)	Item Description	Item Tag
DS1	Control Panel	VCP-539-100
DS1	Power Panel	VPP-539-100
DS1	Drive Unit	FDU-539-100
DS1	Drive Unit Disconnect Switch	DSC-539-100
DS1	Motorized Inlet Gate	EDR-539-101
DS1	Solids Waste Valve 1	MOV-539-111
DS1	Backwash Valve 1	MOV-539-121
DS1	Backwash Valve 2	MOV-539-122
DS1	Backwash Valve 3	MOV-539-123
DS1	Backwash Valve 4	MOV-539-124
DS1	Backwash Valve 5	MOV-539-125
DS1	Backwash Valve 6	MOV-539-126
DS1	Backwash Pump A	BWP-539-130
DS1	Backwash Pump A Disconnect Switch	DSC-539-130
DS1	Backwash Pump B	BWP-539-140
DS1	Backwash Pump B Disconnect Switch	DSC-539-140
DS1	Power Pullbox	PPB-539-100
DS1	Control Pullbox	CPB-539-100
DS1	Analog Pullbox	APB-539-100
DS2	Control Panel	VCP-539-200
DS2	Power Panel	VPP-539-200
DS2	Drive Unit	FDU-539-200

DS2	Drive Unit Disconnect Switch	DSC-539-200
DS2	Motorized Inlet Gate	EDR-539-201
DS2	Solids Waste Valve 1	MOV-539-211
DS2	Backwash Valve 1	MOV-539-221
DS2	Backwash Valve 2	MOV-539-222
DS2	Backwash Valve 3	MOV-539-223
DS2	Backwash Valve 4	MOV-539-224
DS2	Backwash Valve 5	MOV-539-225
DS2	Backwash Valve 6	MOV-539-226
DS2	Backwash Pump A	BWP-539-230
DS2	Backwash Pump A Disconnect Switch	DSC-539-230
DS2	Backwash Pump B	BWP-539-240
DS2	Backwash Pump B Disconnect Switch	DSC-539-240
DS2	Power Pullbox	PPB-539-200
DS2	Control Pullbox	CPB-539-200
DS2	Analog Pullbox	APB-539-200
DS3	Control Panel	VCP-539-300
DS3	Power Panel	VPP-539-300
DS3	Drive Unit	FDU-539-300
DS3	Drive Unit Disconnect Switch	DSC-539-300
DS3	Motorized Inlet Gate	EDR-539-301
DS3	Solids Waste Valve 1	MOV-539-311
DS3	Backwash Valve 1	MOV-539-321
DS3	Backwash Valve 2	MOV-539-322

DS3	Backwash Valve 3	MOV-539-323
DS3	Backwash Valve 4	MOV-539-324
DS3	Backwash Valve 5	MOV-539-325
DS3	Backwash Valve 6	MOV-539-326
DS3	Backwash Pump A	BWP-539-330
DS3	Backwash Pump A Disconnect Switch	DSC-539-330
DS3	Backwash Pump B	BWP-539-340
DS3	Backwash Pump B Disconnect Switch	DSC-539-340
DS3	Power Pullbox	PPB-539-300
DS3	Control Pullbox	CPB-539-300
DS3	Analog Pullbox	APB-539-300
DS4	Control Panel	VCP-539-400
DS4	Power Panel	VPP-539-400
DS4	Drive Unit	FDU-539-400
DS4	Drive Unit Disconnect Switch	DSC-539-400
DS4	Motorized Inlet Gate	EDR-539-401
DS4	Solids Waste Valve 1	MOV-539-411
DS4	Backwash Valve 1	MOV-539-421
DS4	Backwash Valve 2	MOV-539-422
DS4	Backwash Valve 3	MOV-539-423
DS4	Backwash Valve 4	MOV-539-424
DS4	Backwash Valve 5	MOV-539-425
DS4	Backwash Valve 6	MOV-539-426
DS4	Backwash Pump A	BWP-539-430

DS4	Backwash Pump A Disconnect Switch	DSC-539-430
DS4	Backwash Pump B	BWP-539-440
DS4	Backwash Pump B Disconnect Switch	DSC-539-440
DS4	Power Pullbox	PPB-539-400
DS4	Control Pullbox	CPB-539-400
DS4	Analog Pullbox	APB-539-400
NA	Monorail Hoist Disconnect Switch	DSC-539-300
NA	Monorail Hoist E-Stop	ES-539-300
DS1/DS2	Sump Pump Motor Control Panel No. 1	MCP-539-150
DS1/DS2	Sump Pump No. 1	PMP-539-151
DS1/DS2	Sump 1 Low Level Switch	LSL-539-153
DS1/DS2	Sump 1 High Level Switch	LSH-539-154
DS1/DS2	Sump 1 High High Level Switch	LSHH-539-155
DS3/DS4	Sump Pump Motor Control Panel No. 2	MCP-539-250
DS3/DS4	Sump Pump No. 2	PMP-539-251
DS3/DS4	Sump 2 Low Level Switch	LSL-539-253
DS3/DS4	Sump 2 High Level Switch	LSH-539-254
DS3/DS4	Sump 2 High High Level Switch	LSHH-539-255

2. Instruments:

Associated Disc Filter Unit(s)	Item Description	Item Tag
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DS1	Pressure Transducer	LIT-539-103
DS1	High Level Float Switch	LSH-539-102
DS1	Effluent Chamber Turbidity Probe	AE-539-104
DS1	Vacuum Transmitter No. 1	VT-539-131
DS1	Vacuum Transmitter No. 2	VT-539-141
DS1	Vacuum Indicator No. 1	VI-539-132
DS1	Pressure Indicator No. 1	PI-539-133
DS1	Vacuum Indicator No. 2	VI-539-142
DS1	Pressure Indicator No. 2	PI-539-143
DS1	Effluent Chamber Turbidity Analyzer	AIT-539-104
DS2	Pressure Transducer	LIT-539-203
DS2	High Level Float Switch	LSH-539-202
DS2	Effluent Chamber Turbidity Probe	AE-539-204
DS2	Vacuum Transmitter No. 1	VT-539-231
DS2	Vacuum Transmitter No. 2	VT-539-241
DS2	Vacuum Indicator No. 1	VI-539-232
DS2	Pressure Indicator No. 1	PI-539-233
DS2	Vacuum Indicator No. 2	VI-539-242
DS2	Pressure Indicator No. 2	PI-539-243
DS2	Effluent Chamber Turbidity Analyzer	AIT-539-204
DS3	Pressure Transducer	LIT-539-303
DS3	High Level Float Switch	LSH-539-302
DS3	Effluent Chamber Turbidity Probe	AE-539-304
DS3	Vacuum Transmitter No. 1	VT-539-331

DS3	Vacuum Transmitter No. 2	VT-539-341
DS3	Vacuum Indicator No. 1	VI-539-332
DS3	Pressure Indicator No. 1	PI-539-333
DS3	Vacuum Indicator No. 2	VI-539-342
DS3	Pressure Indicator No. 2	PI-539-343
DS3	Effluent Chamber Turbidity Analyzer	AIT-539-304
DS4	Pressure Transducer	LIT-539-403
DS4	High Level Float Switch	LSH-539-402
DS4	Effluent Chamber Turbidity Probe	AE-539-404
DS4	Vacuum Transmitter No. 1	VT-539-431
DS4	Vacuum Transmitter No. 2	VT-539-441
DS4	Vacuum Indicator No. 1	VI-539-432
DS4	Pressure Indicator No. 1	PI-539-433
DS4	Vacuum Indicator No. 2	VI-539-442
DS4	Pressure Indicator No. 2	PI-539-443
DS4	Effluent Chamber Turbidity Analyzer	AIT-539-404

D. Hard-Wired Safety Interlocks:

1. The Filter Drive will automatically stop on motor overload.
2. The Backwash/Solids Waste Pump will automatically STOP on low-level alarm.
3. The Backwash/Solids Waste Pump will automatically STOP on motor overload.
4. The Backwash high water level set elevation will not go above 1184.95'.

E. Control Modes:

1. Remote Auto (SCADA):
 - a. Disc Filter Influent Gate:
 - 1) Place all disc filter influent gates in the REMOTE position at the respective gate LCP.
 - 2) The disc filter inlet gate will open by pressing the OPEN button from individual filter control page at DCS.

- 3) The disc filter influent gate will close by pressing the CLOSE button from individual filter control page at DCS.
- b. Backwash/Solids Waste Cycle
 - 1) Place all vendor control panels, VCP-539-100, VCP-539-200, VCP-539-300, and VCP-539-400, H-O-A switches in the AUTO position. Place the LEVEL or TIMED selector switch, at the vendor control panels, VCP-539-100, VCP-539-200, VCP-539-300, and VCP-539-400 in the proper position dependent on operations.
 - 2) Place all backwash valves/solids waste valve(s) in the REMOTE position.
 - 3) Place all backwash/solids wasting pump(s) in the REMOTE position.
 - 4) Place the filter drive unit in the REMOTE position.
 - 5) The disc filter system will start operation in normal filtration mode when set to ENABLE.
 - 6) The backwash/solids waste pump(s) will start automatically when a backwash is initiated by either LEVEL or TIME, dependent on operations.
 - 7) The backwash/solids waste valve(s) will operate automatically during backwash/solids wasting.
 - 8) Backwash interval is set on the Individual Filter Control page from SCADA.
 - 9) Backwash high water level for automatic backwash is set on the Individual Filter Control page from SCADA.
 - 10) Backwash count to initiate sludge wasting is set on the Individual Filter Control page from SCADA.
 - 11) Solids wasting interval (time) is set on the Individual Filter Control page from SCADA.
 - 12) The disc filter system will stop operation when set to DISABLE.
2. Remote Hand
 - a. Disc Filter Influent Gate:
 - 1) Place all disc filter influent gates in the REMOTE position at the respective gate LCP.
 - 2) The disc filter inlet gate will open by pressing the OPEN button from individual filter control page at SCADA.
 - 3) The disc filter influent gate will close by pressing the CLOSE button from individual filter control page at SCADA.
 - b. Backwash/Solids Waste Cycle:
 - 1) Place all vendor control panels, VCP-539-100, VCP-539-200, VCP-539-300, and VCP-539-400, LOCAL-OFF-REMOTE switches in the REMOTE position.
 - 2) Place all backwash/solids wasting pump(s) in the REMOTE position.
 - 3) The Backwash/Solids Waste Pump(s) will start by pressing the START BACKWASH button from individual filter control page at SCADA.
 - 4) The Backwash/Solids Waste Pump(s) will stop when the backwash/solids waste cycle is complete.

- 5) Place all backwash valves/solids waste valve(s) in the AUTO position.
 - 6) The Backwash/Solids Waste Valves(s) will open automatically during a backwash/solids waste cycle.
 - 7) The Backwash/Solids Waste Valve(s) will close automatically during a backwash/solids waste cycle.
 - 8) Place the filter drive unit in the AUTO position.
 - 9) The Filter Drive Motor will start by pressing the START BACKWASH button from individual filter control page at SCADA.
 - 10) The Filter Drive Motor will stop when the backwash/solids waste cycle is complete.
 - 11) Backwash interval is set on the Individual Filter Control page from SCADA.
 - 12) Backwash high water level for automatic backwash is set on the Individual Filter Control page from SCADA.
 - 13) Backwash count to initiate sludge wasting is set on the Individual Filter Control page from SCADA.
 - 14) Solids wasting interval (time) is set on the Individual Filter Control page from SCADA.
3. Local Auto:
- a. Disc Filter Influent Gate:
 - 1) Place all disc filter influent gates in the LOCAL position at the respective gate LCP.
 - 2) The disc filter inlet gate will open by pressing the OPEN button from the gate LCP.
 - 3) The disc filter influent gate will close by pressing the CLOSE button from the gate LCP.
 - b. Backwash/Solids Waste Cycle:
 - 1) Place all vendor control panels, VCP-539-100, VCP-539-200, VCP-539-300, and VCP-539-400, H-O-A switches in the AUTO position. Place the LEVEL or TIMED selector switch, at the vendor control panels, VCP-539-100, VCP-539-200, VCP-539-300, and VCP-539-400 in the proper position dependent on operations.
 - 2) Place all backwash valves/solids waste valve(s) in the LOCAL position.
 - 3) Place all backwash/solids wasting pump(s) in the LOCAL position.
 - 4) Place the filter drive unit in the LOCAL position.
 - 5) The disc filter system will start operation in normal filtration mode when the disc filter influent gate is open.
 - 6) The backwash/solids waste pump(s) will start automatically when a backwash is initiated by either LEVEL or TIME, dependent on operations.
 - 7) The backwash/solids waste valve(s) will operate automatically during backwash/solids wasting.
 - 8) Backwash interval is set locally at the vendor control panels, VCP-539-100, VCP-539-200, VCP-539-300, and VCP-539-400.

- 9) Backwash high water level for automatic backwash is set locally at the vendor control panels, VCP-539-100, VCP-539-200, VCP-539-300, and VCP-539-400.
 - 10) Backwash count to initiate sludge wasting is set locally at the vendor control panels, VCP-539-100, VCP-539-200, VCP-539-300, and VCP-539-400.
 - 11) Solids wasting interval (time) is set locally at the vendor control panels, VCP-539-100, VCP-539-200, VCP-539-300, and VCP-539-400.
 - 12) The disc filter system will stop operation when the disc filter influent gate is closed.
4. Local Hand
- a. Disc Filter Influent Gate:
 - 1) Place all disc filter influent gates in the LOCAL position.
 - 2) The disc filter influent gates will open by placing the panel L-O-R switch in the LOCAL position and pressing the OPEN pushbutton.
 - 3) The disc filter influent gates will close by placing the panel L-O-R switch in the LOCAL position and pressing the CLOSE pushbutton.
 - b. Backwash/Solids Waste Pump(s):
 - 1) The backwash/solids waste pump(s) is controlled locally at the vendor control panel, VCP-539-100, VCP-539-200, VCP-539-300, and VCP-539-400.
 - 2) The Backwash/Solids Waste Pump(s) START/STOP button is located at the vendor control panel, VCP-539-100, VCP-539-200, VCP-539-300, and VCP-539-400.
 - 3) 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.
 - 4) The Backwash/Solids Waste Pump(s) will stop by placing the panel H-O-A switch in the HAND position and pressing the STOP pushbutton.
 - c. Backwash/Solids Waste Valve(s):
 - 1) The backwash/solids waste valve(s) is controlled locally at the vendor control panel, VCP-539-100, VCP-539-200, VCP-539-300, and VCP-539-400.
 - 2) The Backwash/Solids Waste Valve(s) OPEN/CLOSE button is located at the vendor control panel, VCP-539-100, VCP-539-200, VCP-539-300, and VCP-539-400.
 - 3) The Backwash/Solids Waste valve(s) actuator will open and close the valve using the OPEN/STOP/CLOSE controls at the valve actuator when the LOCAL-OFF-REMOTE switch is set to LOCAL.
 - d. Filter Drive Unit
 - 1) The Filter Drive Motor is controlled locally at the vendor control panel, VCP-539-100, VCP-539-200, VCP-539-300, and VCP-539-400.

- 2) The Filter Drive Motor is started by placing the panel H-O-A switch in the HAND position and pressing the START pushbutton.
- 3) The Filter Drive Motor is stopped by placing the panel H-O-A switch in the HAND position and pressing the STOP pushbutton.

F. Monitor: The following data will be monitored by SCADA

1. Disc Filter System No. 1 High Level Status
2. Disc Filter System No. 1 Filter Drive Unit (FDU) in AUTO/HAND status
3. Disc Filter System No. 1 Filter Drive Unit (FDU) in OFF status
4. Disc Filter System No. 1 Filter Drive Unit (FDU) RUN status
5. Disc Filter System No. 1 Backwash Duration (time) status
6. Disc Filter System No. 1 Solids Wasting Duration (time) status
7. Disc Filter System No. 1 Backwash/Solids Waste Pump 1 in AUTO/HAND status.
8. Disc Filter System No. 1 Backwash/Solids Waste Pump 1 in OFF status
9. Disc Filter System No. 1 Backwash/Solids Waste Pump 1 RUN status
10. Disc Filter System No. 1 Backwash/Solids Waste Pump 2 in OFF status
11. Disc Filter System No. 1 Backwash/Solids Waste Pump 2 RUN status
12. Disc Filter System No. 1 Backwash Valve 1 Open Status
13. Disc Filter System No. 1 Backwash Valve 1 Closed Status
14. Disc Filter System No. 1 Backwash Valve 2 Open Status
15. Disc Filter System No. 1 Backwash Valve 2 Closed Status
16. Disc Filter System No. 1 Backwash Valve 3 Open Status
17. Disc Filter System No. 1 Backwash Valve 3 Closed Status
18. Disc Filter System No. 1 Backwash Valve 4 Open Status
19. Disc Filter System No. 1 Backwash Valve 4 Closed Status
20. Disc Filter System No. 1 Backwash Valve 5 Open Status
21. Disc Filter System No. 1 Backwash Valve 5 Closed Status
22. Disc Filter System No. 1 Backwash Valve 6 Open Status
23. Disc Filter System No. 1 Backwash Valve 6 Closed Status
24. Disc Filter System No. 1 Solids Waste Valve 1 Open Status
25. Disc Filter System No. 1 Solids Waste Valve 1 Closed Status
26. Disc Filter System No. 2 Disc Filter Influent Gate Open Status
27. Disc Filter System No. 2 High Level Status
28. Disc Filter System No. 2 Filter Drive Unit (FDU) in AUTO/HAND status
29. Disc Filter System No. 2 Filter Drive Unit (FDU) in OFF status
30. Disc Filter System No. 2 Filter Drive Unit (FDU) RUN status
31. Disc Filter System No. 2 Backwash Duration (time) status
32. Disc Filter System No. 2 Solids Wasting Duration (time) status
33. Disc Filter System No. 2 Backwash/Solids Waste Pump 1 in AUTO/HAND status.
34. Disc Filter System No. 2 Backwash/Solids Waste Pump 1 in OFF status
35. Disc Filter System No. 2 Backwash/Solids Waste Pump 1 RUN status
36. Disc Filter System No. 2 Backwash/Solids Waste Pump 2 in OFF status
37. Disc Filter System No. 2 Backwash/Solids Waste Pump 2 RUN status
38. Disc Filter System No. 2 Backwash Valve 1 Open Status

39. Disc Filter System No. 2 Backwash Valve 1 Closed Status
40. Disc Filter System No. 2 Backwash Valve 2 Open Status
41. Disc Filter System No. 2 Backwash Valve 2 Closed Status
42. Disc Filter System No. 2 Backwash Valve 3 Open Status
43. Disc Filter System No. 2 Backwash Valve 3 Closed Status
44. Disc Filter System No. 2 Backwash Valve 4 Open Status
45. Disc Filter System No. 2 Backwash Valve 4 Closed Status
46. Disc Filter System No. 2 Backwash Valve 5 Open Status
47. Disc Filter System No. 2 Backwash Valve 5 Closed Status
48. Disc Filter System No. 2 Backwash Valve 6 Open Status
49. Disc Filter System No. 2 Backwash Valve 6 Closed Status
50. Disc Filter System No. 2 Solids Waste Valve 1 Open Status
51. Disc Filter System No. 2 Solids Waste Valve 1 Closed Status
52. Disc Filter System No. 3 Disc Filter Influent Gate Open Status
53. Disc Filter System No. 3 High Level Status
54. Disc Filter System No. 3 Filter Drive Unit (FDU) in AUTO/HAND status
55. Disc Filter System No. 3 Filter Drive Unit (FDU) in OFF status
56. Disc Filter System No. 3 Filter Drive Unit (FDU) RUN status
57. Disc Filter System No. 3 Backwash Duration (time) status
58. Disc Filter System No. 3 Solids Wasting Duration (time) status
59. Disc Filter System No. 3 Backwash/Solids Waste Pump 1 in AUTO/HAND status.
60. Disc Filter System No. 3 Backwash/Solids Waste Pump 1 in OFF status
61. Disc Filter System No. 3 Backwash/Solids Waste Pump 1 RUN status
62. Disc Filter System No. 3 Backwash/Solids Waste Pump 2 in OFF status
63. Disc Filter System No. 3 Backwash/Solids Waste Pump 2 RUN status
64. Disc Filter System No. 3 Backwash Valve 1 Open Status
65. Disc Filter System No. 3 Backwash Valve 1 Closed Status
66. Disc Filter System No. 3 Backwash Valve 2 Open Status
67. Disc Filter System No. 3 Backwash Valve 2 Closed Status
68. Disc Filter System No. 3 Backwash Valve 3 Open Status
69. Disc Filter System No. 3 Backwash Valve 3 Closed Status
70. Disc Filter System No. 3 Backwash Valve 4 Open Status
71. Disc Filter System No. 3 Backwash Valve 4 Closed Status
72. Disc Filter System No. 3 Backwash Valve 5 Open Status
73. Disc Filter System No. 3 Backwash Valve 5 Closed Status
74. Disc Filter System No. 3 Backwash Valve 6 Open Status
75. Disc Filter System No. 3 Backwash Valve 6 Closed Status
76. Disc Filter System No. 3 Solids Waste Valve 1 Open Status
77. Disc Filter System No. 3 Solids Waste Valve 1 Closed Status
78. Disc Filter System No. 4 Disc Filter Influent Gate Open Status
79. Disc Filter System No. 4 High Level Status
80. Disc Filter System No. 4 Filter Drive Unit (FDU) in AUTO/HAND status
81. Disc Filter System No. 4 Filter Drive Unit (FDU) in OFF status
82. Disc Filter System No. 4 Filter Drive Unit (FDU) RUN status
83. Disc Filter System No. 4 Backwash Duration (time) status

84. Disc Filter System No. 4 Solids Wasting Duration (time) status
85. Disc Filter System No. 4 Backwash/Solids Waste Pump 1 in AUTO/HAND status.
86. Disc Filter System No. 4 Backwash/Solids Waste Pump 1 in OFF status
87. Disc Filter System No. 4 Backwash/Solids Waste Pump 1 RUN status
88. Disc Filter System No. 4 Backwash/Solids Waste Pump 2 in OFF status
89. Disc Filter System No. 4 Backwash/Solids Waste Pump 2 RUN status
90. Disc Filter System No. 4 Backwash Valve 1 Open Status
91. Disc Filter System No. 4 Backwash Valve 1 Closed Status
92. Disc Filter System No. 4 Backwash Valve 2 Open Status
93. Disc Filter System No. 4 Backwash Valve 2 Closed Status
94. Disc Filter System No. 4 Backwash Valve 3 Open Status
95. Disc Filter System No. 4 Backwash Valve 3 Closed Status
96. Disc Filter System No. 4 Backwash Valve 4 Open Status
97. Disc Filter System No. 4 Backwash Valve 4 Closed Status
98. Disc Filter System No. 4 Backwash Valve 5 Open Status
99. Disc Filter System No. 4 Backwash Valve 5 Closed Status
100. Disc Filter System No. 4 Backwash Valve 6 Open Status
101. Disc Filter System No. 4 Backwash Valve 6 Closed Status
102. Disc Filter System No. 4 Solids Waste Valve 1 Open Status
103. Disc Filter System No. 4 Solids Waste Valve 1 Closed Status

G. Alarms: The following alarms and indications are available in all control modes:

1. Disc Filter System No. 1 Filter Drive Unit (FDU) FAIL
2. Disc Filter System No. 1 Backwash/Solids Waste Pump 1 FAIL
3. Disc Filter System No. 1 Backwash/Solids Waste Pump 2 FAIL
4. Disc Filter System No. 1 Backwash Valve 1 FAIL
5. Disc Filter System No. 1 Backwash Valve 2 FAIL
6. Disc Filter System No. 1 Backwash Valve 3 FAIL
7. Disc Filter System No. 1 Backwash Valve 4 FAIL
8. Disc Filter System No. 1 Backwash Valve 5 FAIL
9. Disc Filter System No. 1 Backwash Valve 6 FAIL
10. Disc Filter System No. 1 Solids Waste Valve 1 FAIL
11. Disc Filter System No. 1 Level alarm high
12. Disc Filter System No. 1 Emergency Stop Activated
13. Disc Filter System No. 1 High turbidity alarm
14. Disc Filter System No. 2 Filter Drive Unit (FDU) FAIL
15. Disc Filter System No. 2 Backwash/Solids Waste Pump 1 FAIL
16. Disc Filter System No. 2 Backwash/Solids Waste Pump 2 FAIL
17. Disc Filter System No. 2 Backwash Valve 1 FAIL
18. Disc Filter System No. 2 Backwash Valve 2 FAIL
19. Disc Filter System No. 2 Backwash Valve 3 FAIL
20. Disc Filter System No. 2 Backwash Valve 4 FAIL
21. Disc Filter System No. 2 Backwash Valve 5 FAIL
22. Disc Filter System No. 2 Backwash Valve 6 FAIL
23. Disc Filter System No. 2 Solids Waste Valve 1 FAIL

24. Disc Filter System No. 2 Level alarm high
25. Disc Filter System No. 2 Emergency Stop Activated
26. Disc Filter System No. 2 High turbidity alarm
27. Disc Filter System No. 3 Filter Drive Unit (FDU) FAIL
28. Disc Filter System No. 3 Backwash/Solids Waste Pump 1 FAIL
29. Disc Filter System No. 3 Backwash/Solids Waste Pump 2 FAIL
30. Disc Filter System No. 3 Backwash Valve 1 FAIL
31. Disc Filter System No. 3 Backwash Valve 2 FAIL
32. Disc Filter System No. 3 Backwash Valve 3 FAIL
33. Disc Filter System No. 3 Backwash Valve 4 FAIL
34. Disc Filter System No. 3 Backwash Valve 5 FAIL
35. Disc Filter System No. 3 Backwash Valve 6 FAIL
36. Disc Filter System No. 3 Solids Waste Valve 1 FAIL
37. Disc Filter System No. 3 Level alarm high
38. Disc Filter System No. 3 Emergency Stop Activated
39. Disc Filter System No. 3 High turbidity alarm
40. Disc Filter System No. 4 Filter Drive Unit (FDU) FAIL
41. Disc Filter System No. 4 Backwash/Solids Waste Pump 1 FAIL
42. Disc Filter System No. 4 Backwash/Solids Waste Pump 2 FAIL
43. Disc Filter System No. 4 Backwash Valve 1 FAIL
44. Disc Filter System No. 4 Backwash Valve 2 FAIL
45. Disc Filter System No. 4 Backwash Valve 3 FAIL
46. Disc Filter System No. 4 Backwash Valve 4 FAIL
47. Disc Filter System No. 4 Backwash Valve 5 FAIL
48. Disc Filter System No. 4 Backwash Valve 6 FAIL
49. Disc Filter System No. 4 Solids Waste Valve 1 FAIL
50. Disc Filter System No. 4 Level alarm high
51. Disc Filter System No. 4 Emergency Stop Activated
52. Disc Filter System No. 4 High turbidity alarm

PART 2 -

PART 2 -

PART 2 -

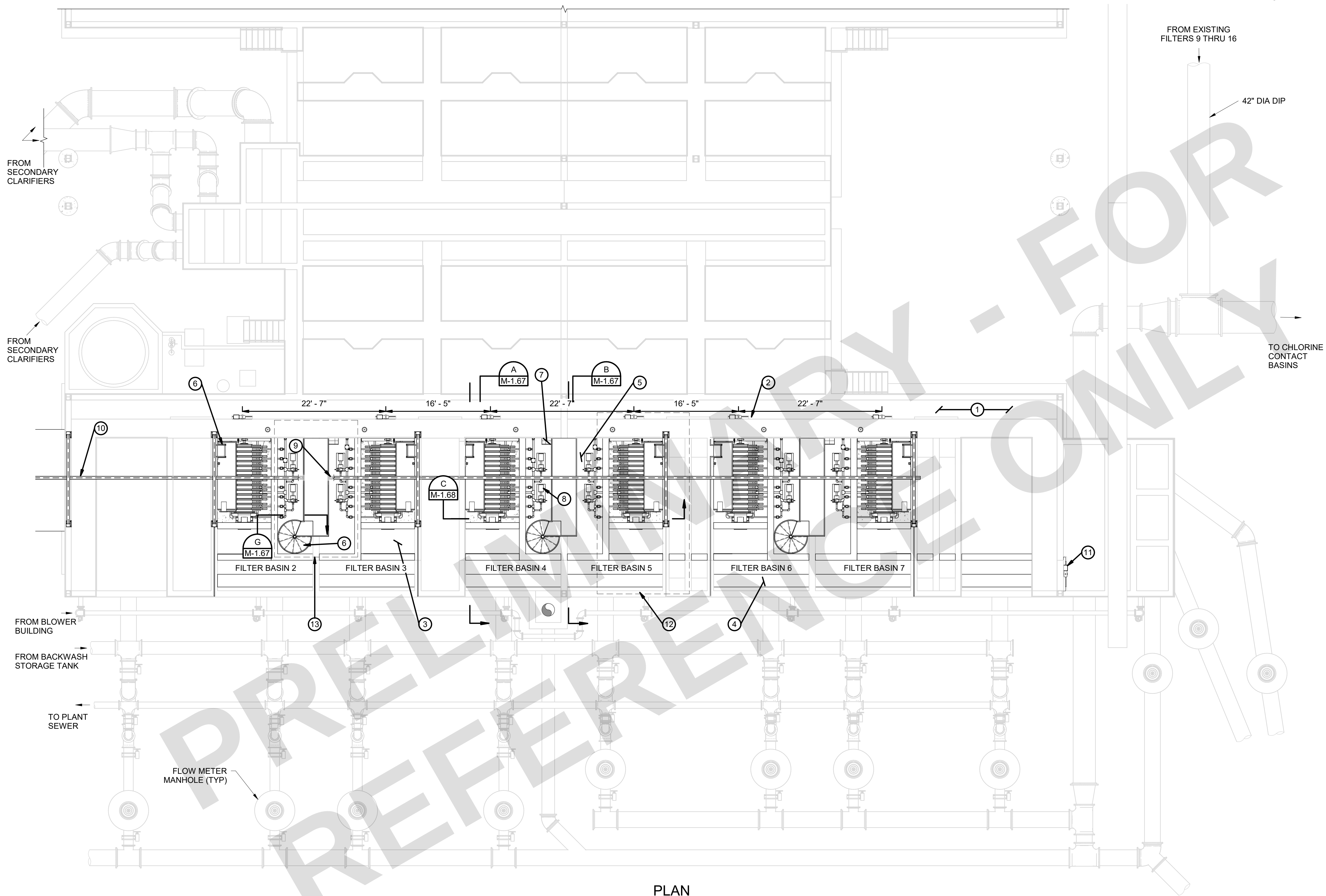
PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

ATTACHMENT TWO

GMP 1 – Figures (Preliminary – Not for Construction)



PLAN
1/8" = 1'-0"

- NOTES**
- 1. PORTIONS OF UPPER WALKWAY AND HANDRAILING NOT SHOWN FOR CLARITY.
 - 2. FILTER CANOPY NOT SHOWN FOR CLARITY.

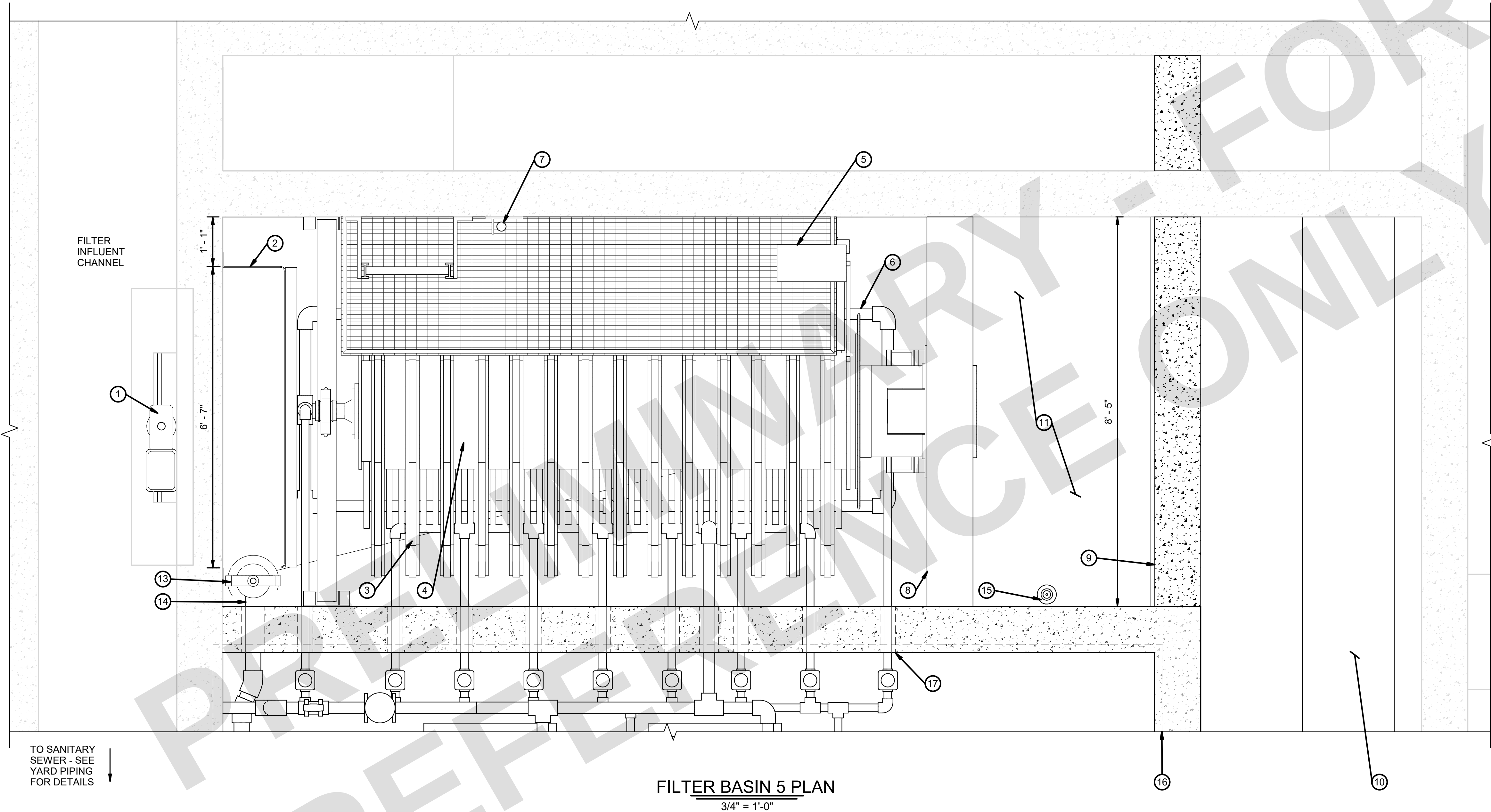
KEYED NOTES

- 1 INFLUENT CHANNEL
- 2 2'x4' INFLUENT SLIDE GATE (TYP)
- 3 EFFLUENT CHAMBER (TYP)
- 4 COMMON FILTER EFFLUENT CHANNEL (TYP)
- 5 BACKWASH/SOLIDS PUMP GALLERY (TYP)
- 6 PUMP GALLERY ACCESS SPIRAL STAIRCASE
- 7 PUMP GALLERY SUMP (TYP)
- 8 BACKSWASH/SOLIDS WASTE PUMP (TYP)
- 9 DAVIT CRANE SOCKET (TYP) SEE DETAIL 408, SHEET M-7.04
- 10 1 TON MONORAIL HOIST ASSEMBLY, SEE STRUCTURAL SHEETS FOR DETAILS
- 11 4'x5' MOTOR ACTUATED FILTER EFFLUENT SLIDE GATE
- 12 SEE SHEET M-1.65 FOR DISC FILTER DETAILS
- 13 SEE SHEET M-1.66 FOR PUMP GALLERY DETAILS

CITY OF CHANDLER
WATER RECLAMATION FACILITY
IMPROVEMENTS
AWRF - FILTERS OVERALL PLAN
CITY PROJECT NO. WW1901201
WILSON PROJECT NO. 19038

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Revision	Date	By

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FILTER BASIN 5 PLAN
3/4" = 1'-0"

KEYED NOTES

- 1 2'x4' MOTOR ACTUATED FILTER INFLUENT SLIDE GATE
- 2 FILTER INFLUENT WEIR
- 3 CLOTH MEDIA FILTER DISC (TYP)
- 4 FILTER EFFLUENT CENTERTUBE
- 5 FILTER DRIVE ASSEMBLY
- 6 3" DIA PVC SOLIDS COLLECTION MANIFOLD
- 7 LEVEL SENSING PRESSURE TRANSDUCER AND FLOAT SWITCH
- 8 EFFLUENT WALL AND OVERFLOW WEIR
- 9 EFFLUENT WEIR
- 10 COMMON EFFLUENT CHANNEL
- 11 FILTER EFFLUENT CHAMBER
- 12 FILTER BACKWASH SHOE ASSEMBLY
- 13 4" DIA MUD VALVE, SEE DETAIL 401, SHEET M-7.04
- 14 4" DIA PVC DRAIN TO SUMP
- 15 TURBIDITY METER
- 16 SEE SHEET M-1.66 FOR DETAILS
- 17 PIPE PENETRATION (TYP), SEE DETAIL 103, SHEET M-7.01

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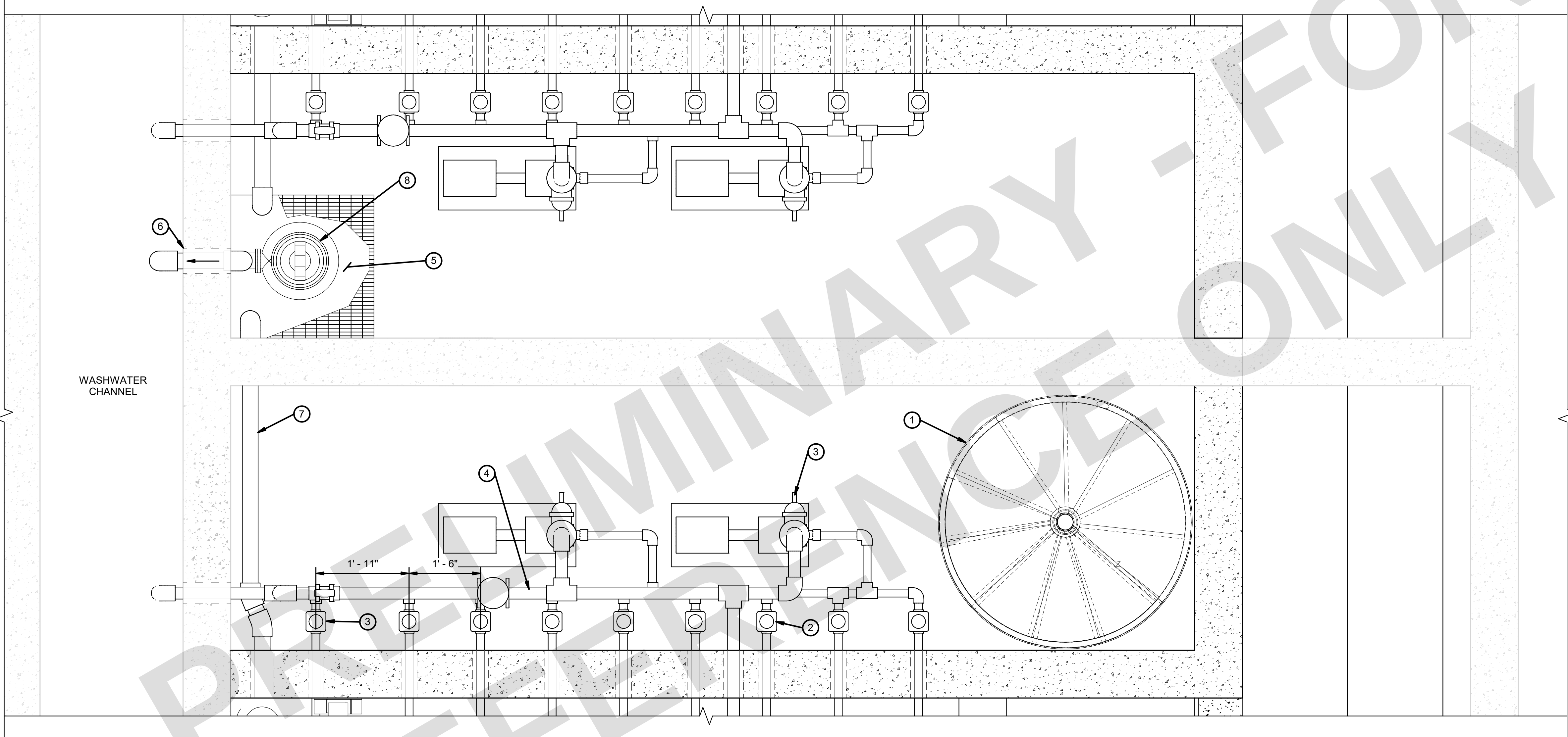
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AWRF - FILTER BASIN 5 PLAN
CITY PROJECT NO. WW1901201
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FIGURE 2



FILTER DRY PIT 1
3/4" = 1'-0"
ELEVATION = 1222

KEYED NOTES

- 1 BACKWASH/SOLIDS WASTE PUMP (TYP)
- 2 3" DIA MOTOR ACTUATED BACKWASH BALL VALVE (TYP)
- 3 3" DIA MOTOR ACTUATED SOLIDS WASTE BALL VALVE (TYP)
- 4 3" DIA PVC PIPING (TYP)
- 5 PUMP GALLERY SUMP
- 6 PIPE PENETRATION, SEE DETAIL 103, SHEET M-7.01 (TYP)
- 7 4" PVC PIPING FROM FILTER CHAMBER MUD VALVE (TYP)
- 8 SUBMERSIBLE SUMP PUMP (TYP)
- 8 PUMP GALLERY ACCESS SPIRAL STAIRCASE, SEE STRUCTURAL SHEETS FOR DETAILS

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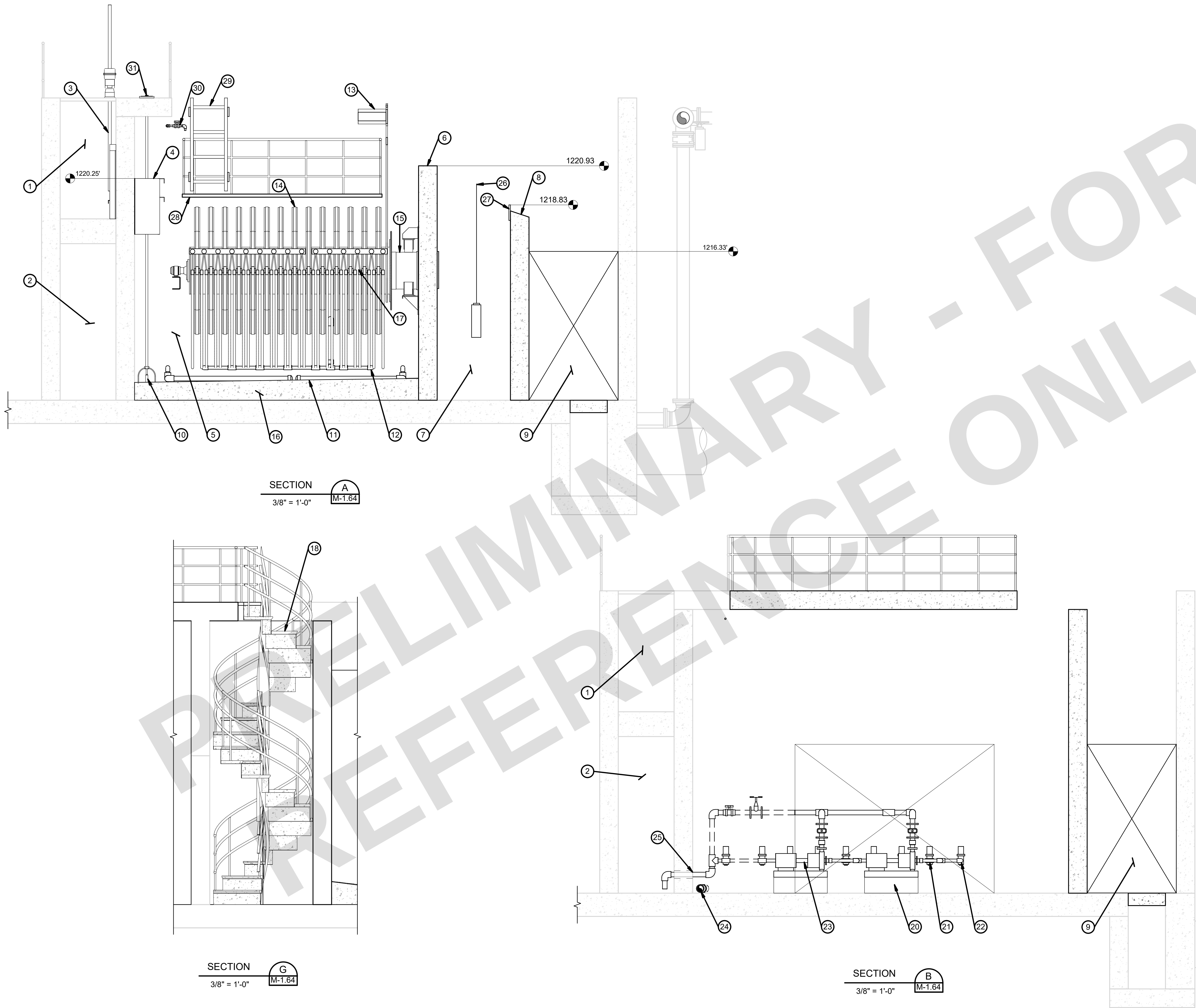
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WATER RECLAMATION FACILITY
IMPROVEMENTS
AWRF - FILTER PUMP GALLERY
CITY PROJECT NO. WW1901201
WILSON PROJECT NO. 19038

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NOTES:
1. WALKWAY NOT SHOWN FOR CLARITY.

FIGURE 3



KEYED NOTES

- 1 FILTER INFLUENT CHANNEL
- 2 WASHWATER CHANNEL
- 3 2'x4' MOTOR ACTUATED FILTER INFLUENT SLIDE GATE
- 4 FILTER INFLUENT WEIR BOX
- 5 FILTER BASIN
- 6 FILTER EFFLUENT OVERFLOW WEIR WALL
- 7 FILTER EFFLUENT CHAMBER
- 8 FILTER EFFLUENT WEIR
- 9 COMMON FILTER EFFLUENT CHANNEL
- 10 FILTER BASIN MUD VALVE, SEE DETAIL 401, SHEET M-7.04
- 11 3" DIA PVC SOLIDS COLLECTION MANIFOLD
- 12 3" DIA PVC BACKWASH MANIFOLD
- 13 DRIVE ASSEMBLY
- 14 CLOTH MEDIA DISC FILTER (TYP)
- 15 FILTER EFFLUENT CENTERTUBE
- 16 FILTER BASIN GROUT, SEE STRUCTURAL SHEETS FOR DETAILS
- 17 BACKWASH SHOE (TYP)
- 18 PUMP GALLERY ACCESS STAIRS
- 19 FILTER BACKWASH/SOLIDS WASTE PUMP (TYP)
- 20 CONCRETE PUMP PAD (TYP), SEE STRUCTURAL SHEETS FOR DETAILS
- 21 3" DIA MOTOR ACTUATED BACKWASH BALL VALVE (TYP)
- 22 3" DIA MOTOR ACTUATED SOLIDS WASTE BALL VALVE (TYP)
- 23 3" DIA PVC BACKWASH WATER/SOLIDS WASTE MANIFOLD
- 24 4" DIA PVC FROM FILTER BASIN MUD VALVE DRAIN TO SUMP
- 25 PIPE PENETRATION (TYP), SEE DETAIL 103, SHEET M-7.01
- 26 TURBIDITY METER
- 27 EFFLUENT WEIR PLATE, SEE DETAIL 407, SHEET M-7.04
- 28 FILTER PLATFORM
- 29 FILTER ACCESS LADDER SEE DETAIL 406, SHEET M-7.04
- 30 1" DIA CPVC SODIUM HYPOCHLORITE DOSING POINT
- 31 MUD VALVE OPERATING NUT FLOOR BOX SEE DETAIL 401, SHEET M-7.04

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AWRF - FILTERS SECTION 1
CITY PROJECT NO. WW1901201
WILSON PROJECT NO. 19038

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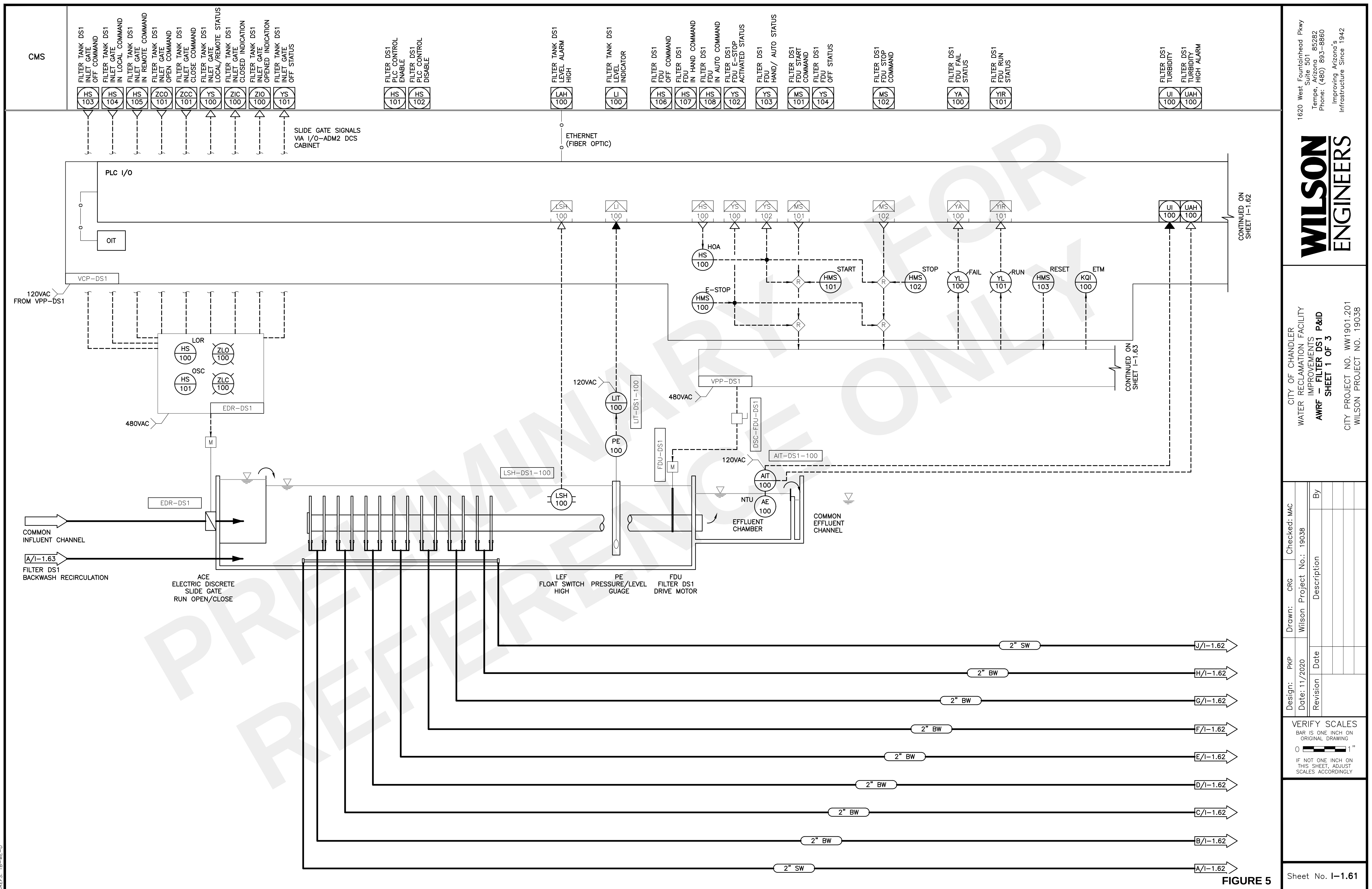
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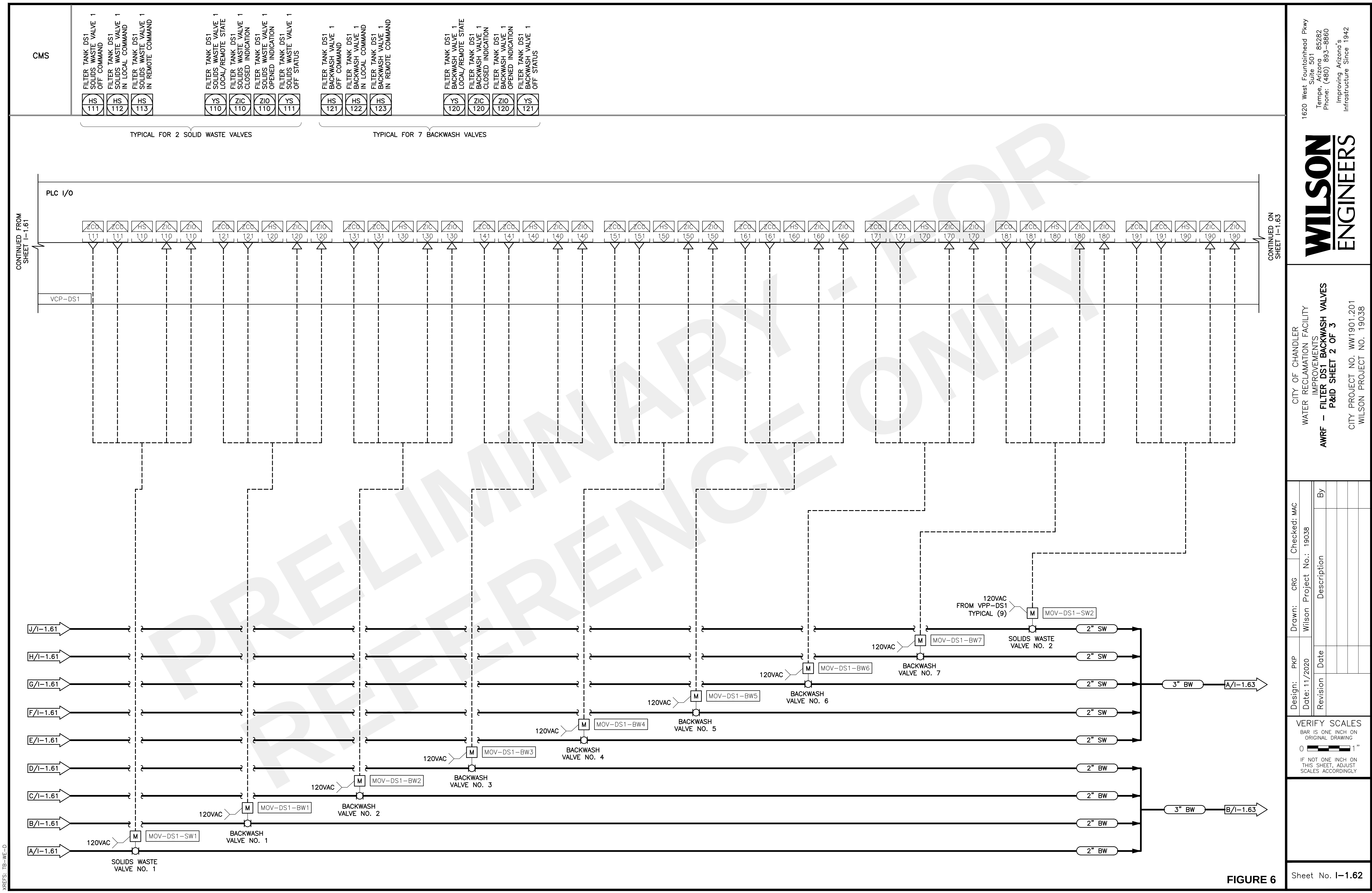
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Sheet No. M-167

FIGURE 4





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AWRF - FILTER DS1 BACKWASH VALVES
P&ID SHEET 2 OF 3
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WILSON PROJECT NO. 19038

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FIGURE 6

XREFS: TB-WE-D

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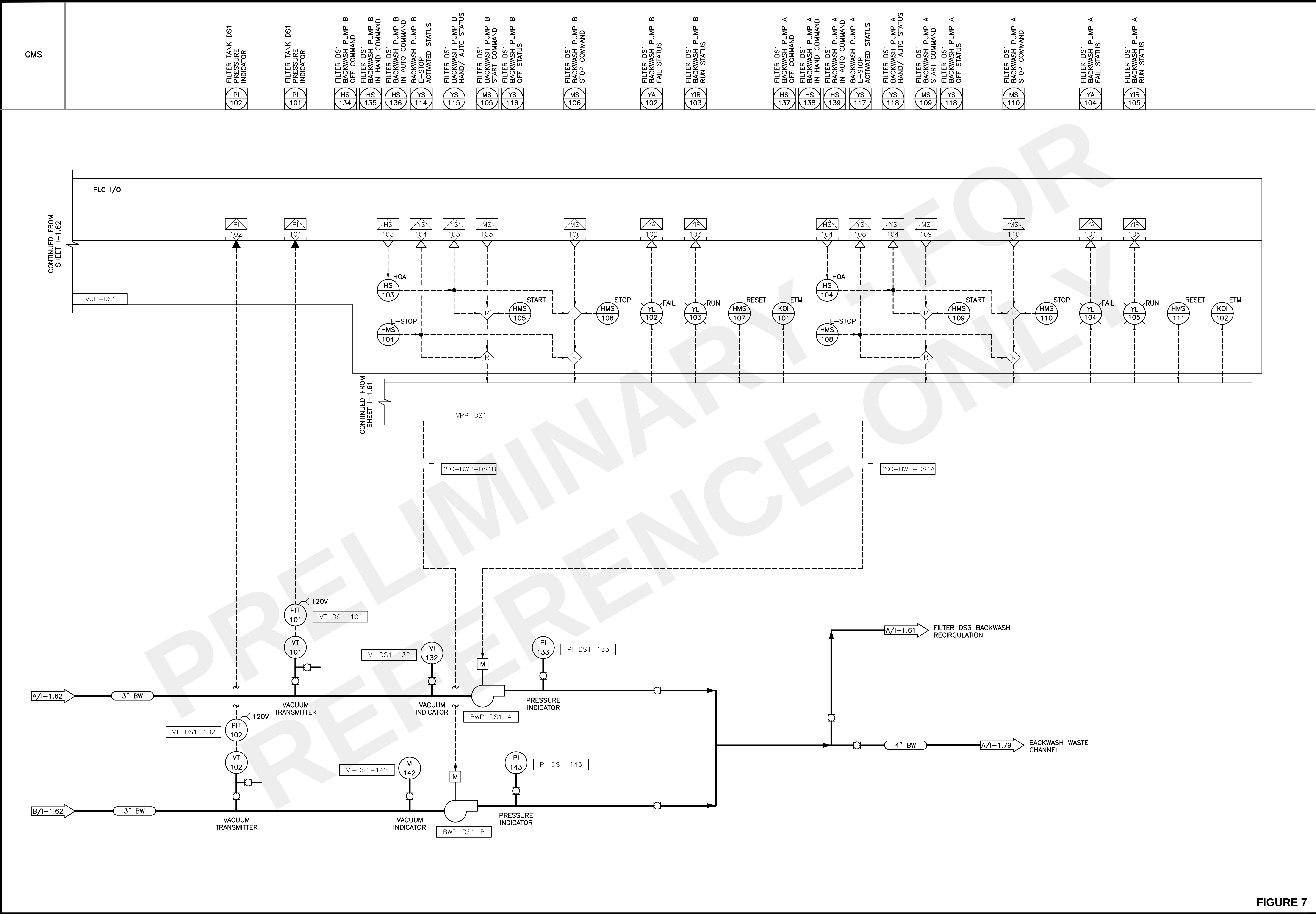


FIGURE 7

Sheet No. I-1.63

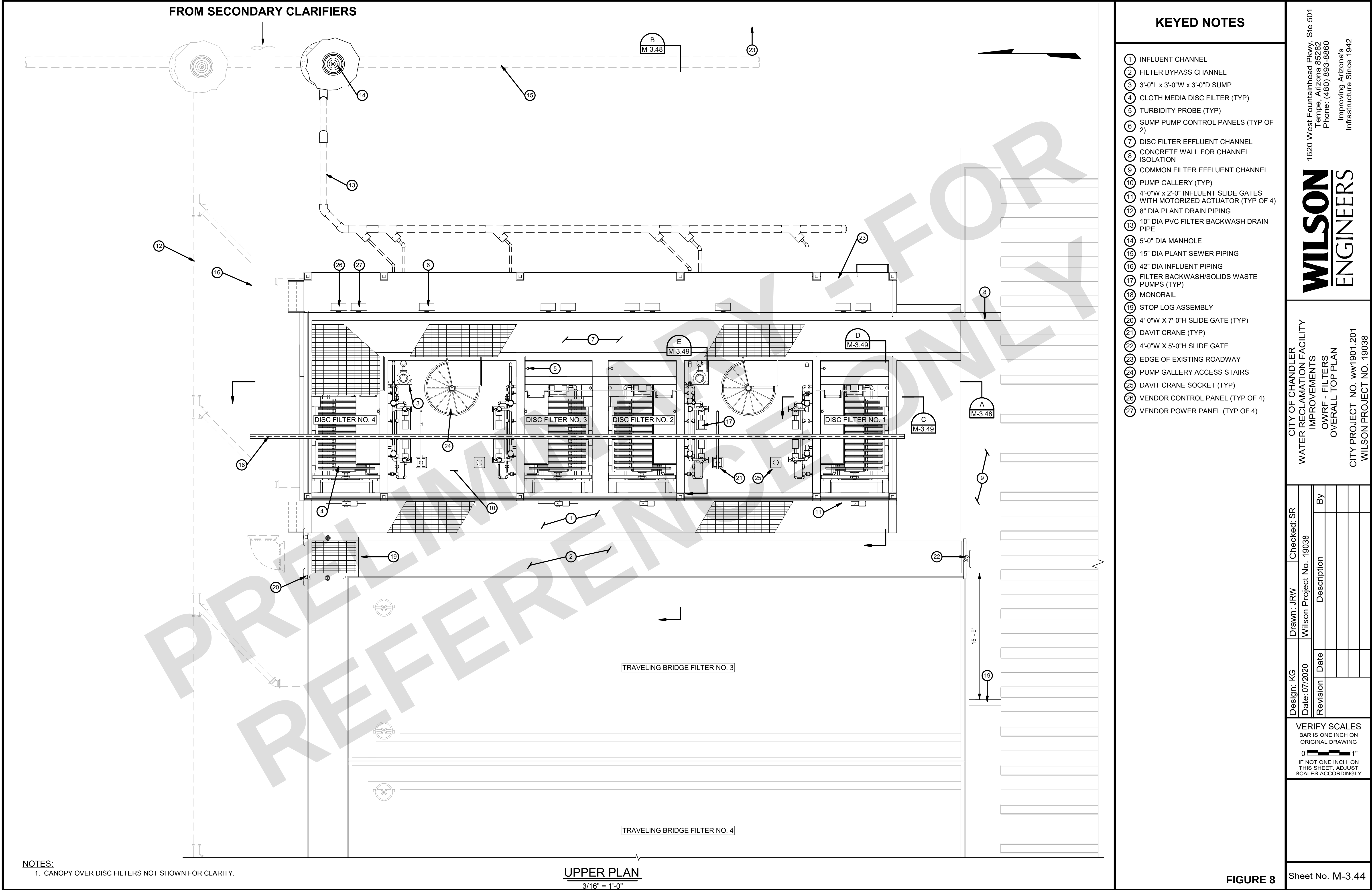
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WATER RECLAMATION FACILITY
IMPROVEMENTS
AWRF - FILTER DS1 BACKWASH
PUMPS P&ID - SHEET 3 OF 3
CITY PROJECT NO. WW1901.201
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KEYED NOTES

- 1 4'-0"W x 2'-0"H INFLUENT SLIDE GATE WITH MOTORIZED ACTUATOR
- 2 INFLUENT WEIR BOX
- 3 CLOTH MEDIA DISC FILTER
- 4 DISC FILTER CENTERTUBE
- 5 FILTER DRIVE ASSEMBLY
- 6 WASTE SOLIDS COLLECTION MANIFOLD
- 7 PRESSURE TRANSDUCER
- 8 OVERFLOW WEIR WALL
- 9 EFFLUENT WEIR
- 10 FILTER EFFLUENT CHAMBER
- 11 FILTER BACKWASH SHOE ASSEMBLY
- 12 4" DIA MUD VALVE
- 13 TURBIDITY PROBE
- 14 DISK FILTER MAINTENANCE ACCESS PLATFORM
- 15 REMOVABLE SECTION OF GUARDRAIL FOR FILTER DRIVE MAINTENANCE
- 16 FLOAT SWITCH

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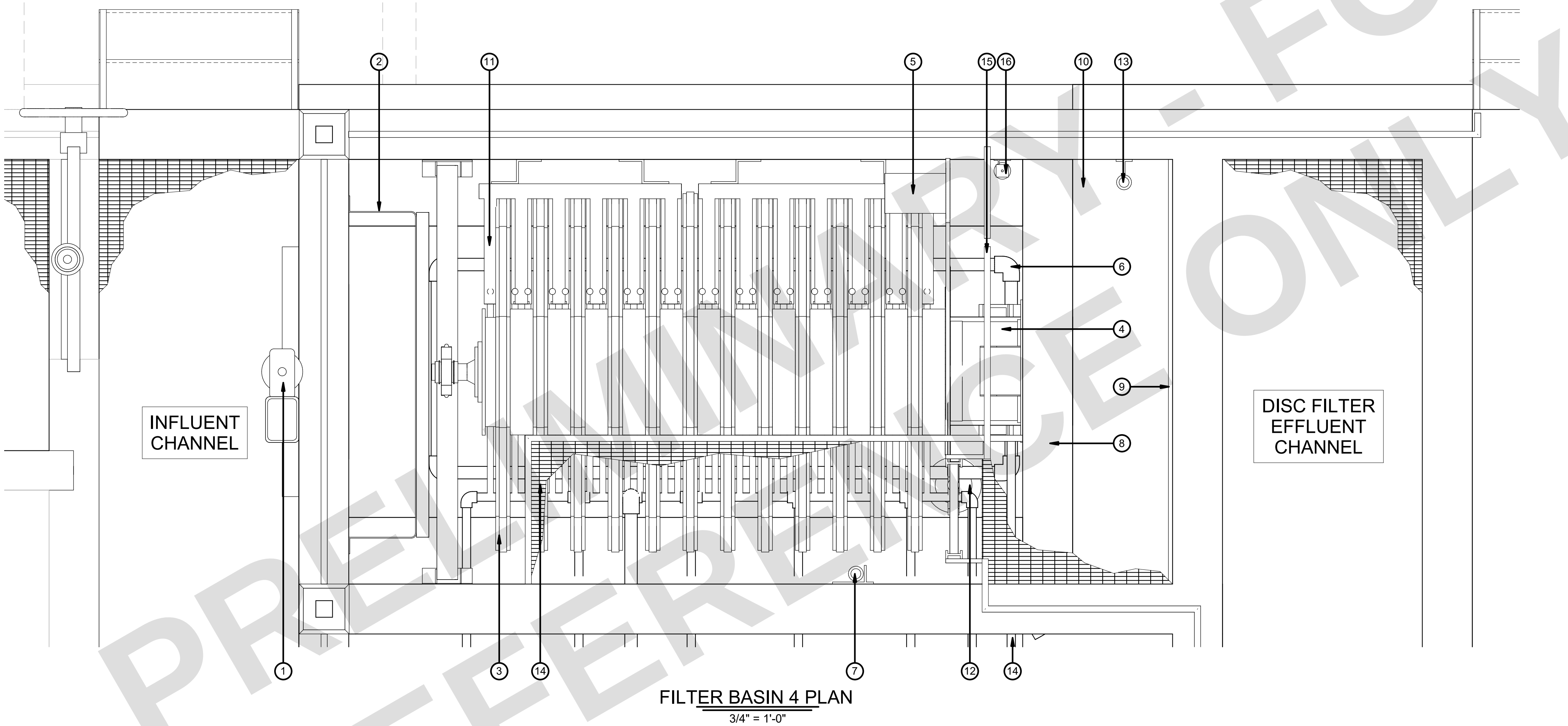
CITY OF CHANDLER
WATER RECLAMATION FACILITY
IMPROVEMENTS
OWRF - FILTERS
FILTER BASIN 1 PLAN
CITY PROJECT NO. ww1901.201
WILSON PROJECT NO. 19036

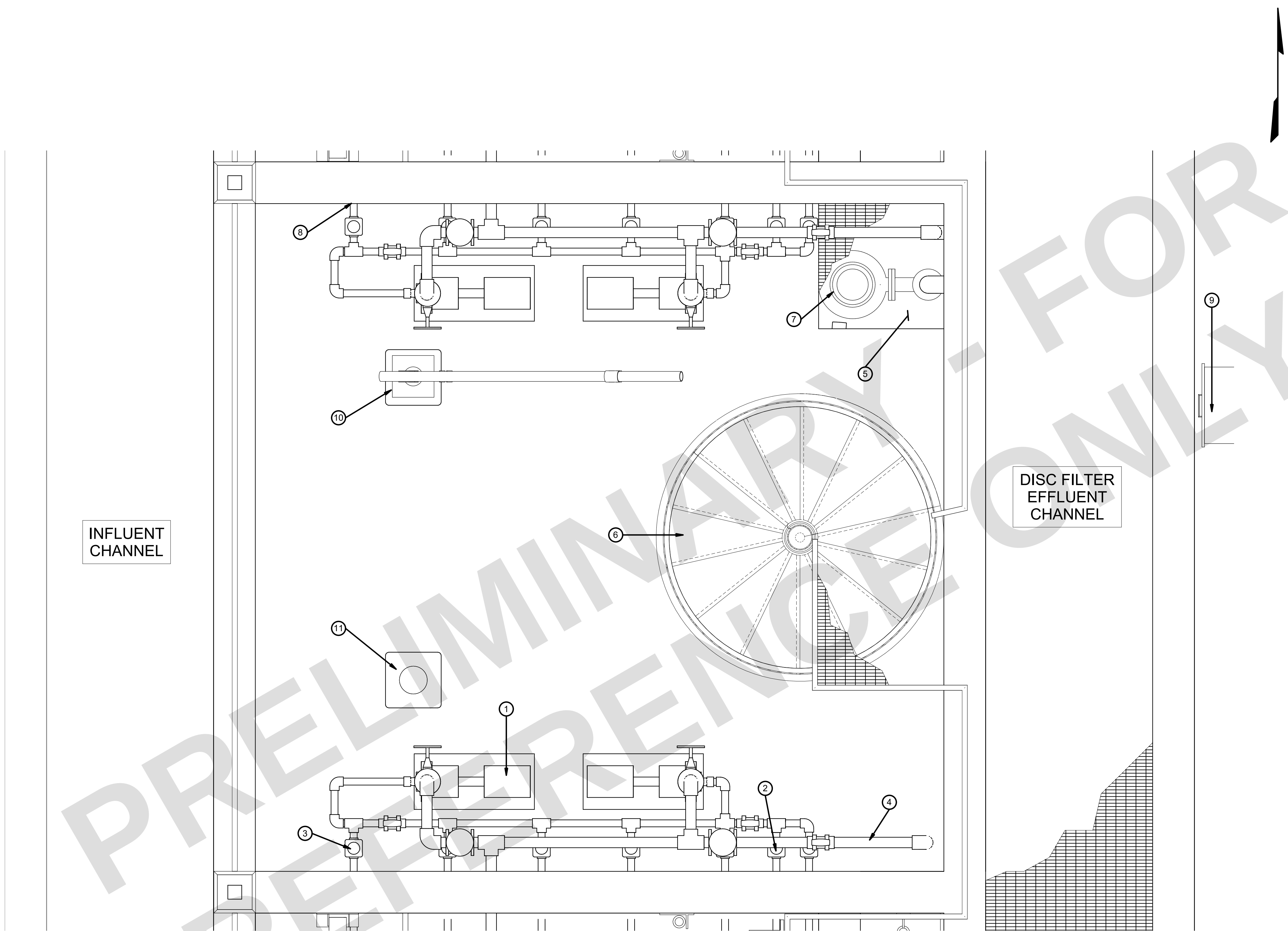
Design: KG	Drawn: AJC	Checked: SR
Date: 07/2020	Wilson Project No. 19036	
Revision	Date	Description
		By

VERIFY SCALES
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0 1"
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FIGURE 9

Sheet No. M-3.46





INFLUENT
CHANNEL

DISC FILTER
EFFLUENT
CHANNEL

PUMP GALLERY
3/4" = 1'-0"

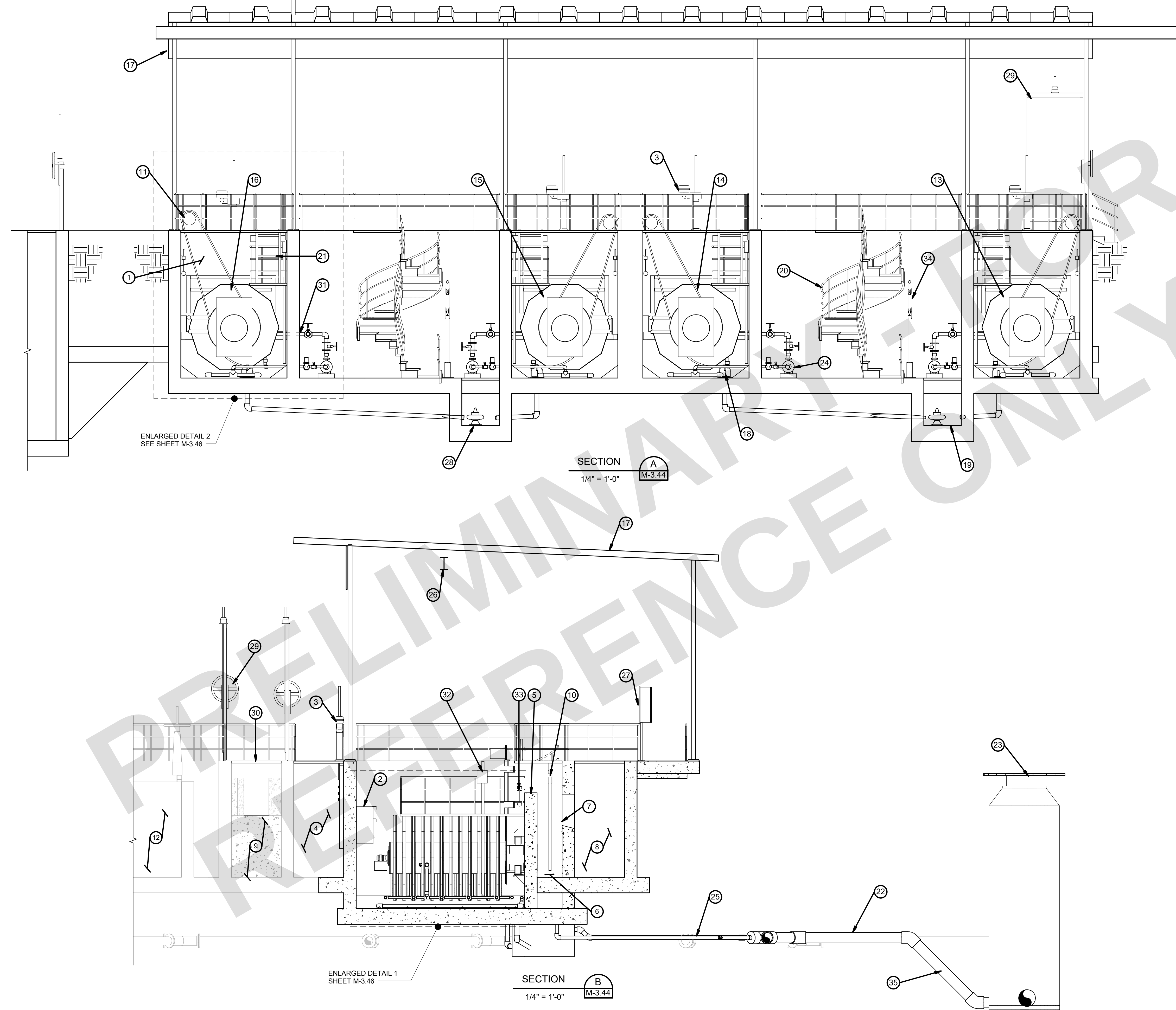
KEYED NOTES

- 1 BACKWASH / SOLIDS WASTE PUMP (TYP)
- 2 2" DIA MOTOR ACTUATED BACKWASH BALL VALVE (TYP)
- 3 2" DIA MOTOR ACTUATED SOLIDS WASTE BALL VALVE (TYP)
- 4 3" DIA PVC PIPING (TYP)
- 5 PUMP GALLERY SUMP
- 6 PUMP GALLERY ACCESS STAIRS
- 7 SUBMERSIBLE SUMP PUMP
- 8 SLEEVE WITH LINK SEAL (TYP) SEE DETAIL 103, SHEET M-7.01
- 9 SUMP PUMP CONTROL PANEL
- 10 DAVIT CRANE
- 11 DAVIT CRANE SOCKET, SEE DETAIL 408, SHEET M-7.04

CITY OF CHANDLER
WATER RECLAMATION FACILITY
IMPROVEMENTS
OWRF - FILTERS
PUMP GALLERY
CITY PROJECT NO. ww1901.201
WILSON PROJECT NO. 19036

Design: KG	Drawn: AJC	Checked: SR
Date: 07/2020	Wilson Project No. 19036	
Revision	Date	Description
		By

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KEYED NOTES

- 1 CLOTH MEDIA DISC FILTER BASIN
- 2 INFLUENT WEIR BOX
- 3 4'-0"W x 2'-0"H INFLUENT SLIDE GATE WITH MOTORIZED ACTUATOR (TYP)
- 4 INFLUENT CHANNEL
- 5 OVERFLOW WEIR WALL
- 6 FILTER EFFLUENT CHAMBER
- 7 EFFLUENT WEIR
- 8 DISC FILTER EFFLUENT CHANNEL
- 9 FILTER BYPASS CHANNEL
- 10 TURBIDITY PROBE
- 11 FILTER DRIVE ASSEMBLY
- 12 TRAVELING BRIDGE FILTER BASIN NO. 3
- 13 DISC FILTER NO. 4
- 14 DISC FILTER NO. 3
- 15 DISC FILTER NO. 2
- 16 DISC FILTER NO. 1
- 17 FILTER CANOPY, SEE STRUCTURAL, SHEET S-3.44
- 18 4" DIA MUD VALVE (TYP) SEE DETAIL 401, SHEET M-7.04
- 19 3'-0"L X 3'-0"W X 3'-0"D SUMP
- 20 PUMP GALLERY ACCESS STAIRS
- 21 FILTER BASINS ACCESS LADDER
- 22 10" DIA PVC FILTER BACKWASH PIPING
- 23 5'-0" DIA MANHOLE
- 24 BACKWASH/SOLIDS WASTE PUMPS (TYP)
- 25 3" DIA PVC FILTER BACKWASH PIPING
- 26 MONORAIL
- 27 ELECTRICAL PANELS
- 28 SUMP PUMP
- 29 4'-0"W x 7'-0"H SLIDE GATE
- 30 STOP LOG ASSEMBLY
- 31 3" DIA PVC RECIRCULATION
- 32 PRESSURE TRANSDUCER
- 33 FLOAT SWITCH
- 34 DAVIT CRANE (TYP)
- 35 SEE MAG DETAIL 426, TYPE A

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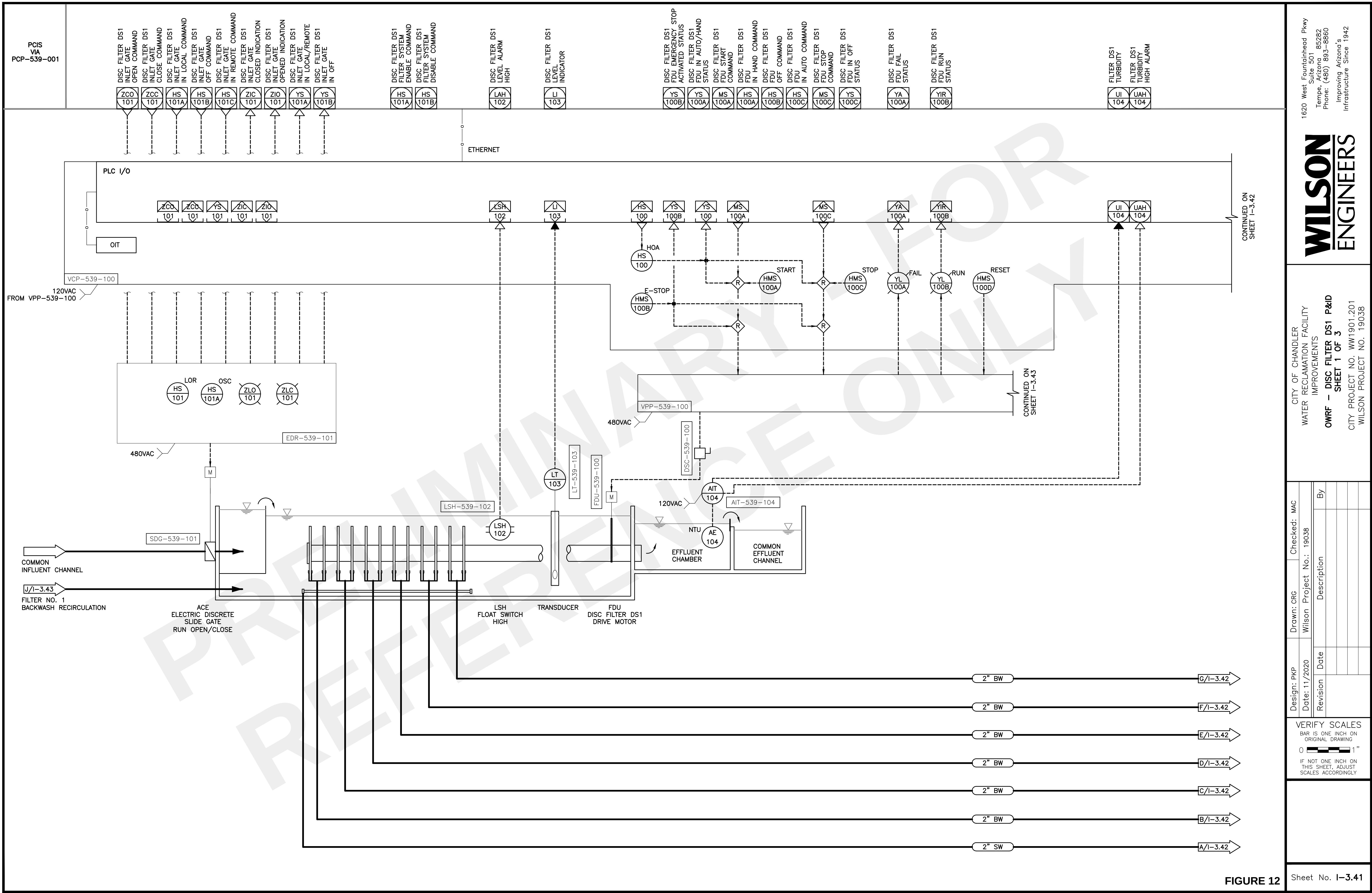
CITY OF CHANDLER
WATER RECLAMATION FACILITY
IMPROVEMENTS
OWRF - FILTERS
SECTIONS AND DETAILS 1
CITY PROJECT NO. ww1901.201
WILSON PROJECT NO. 19038

Design: KG	Drawn: JRW	Checked: SR
Date: 07/2020	Wilson Project No. 19038	
Revision	Date	Description
		By

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FIGURE 11

Sheet No. M-3.48



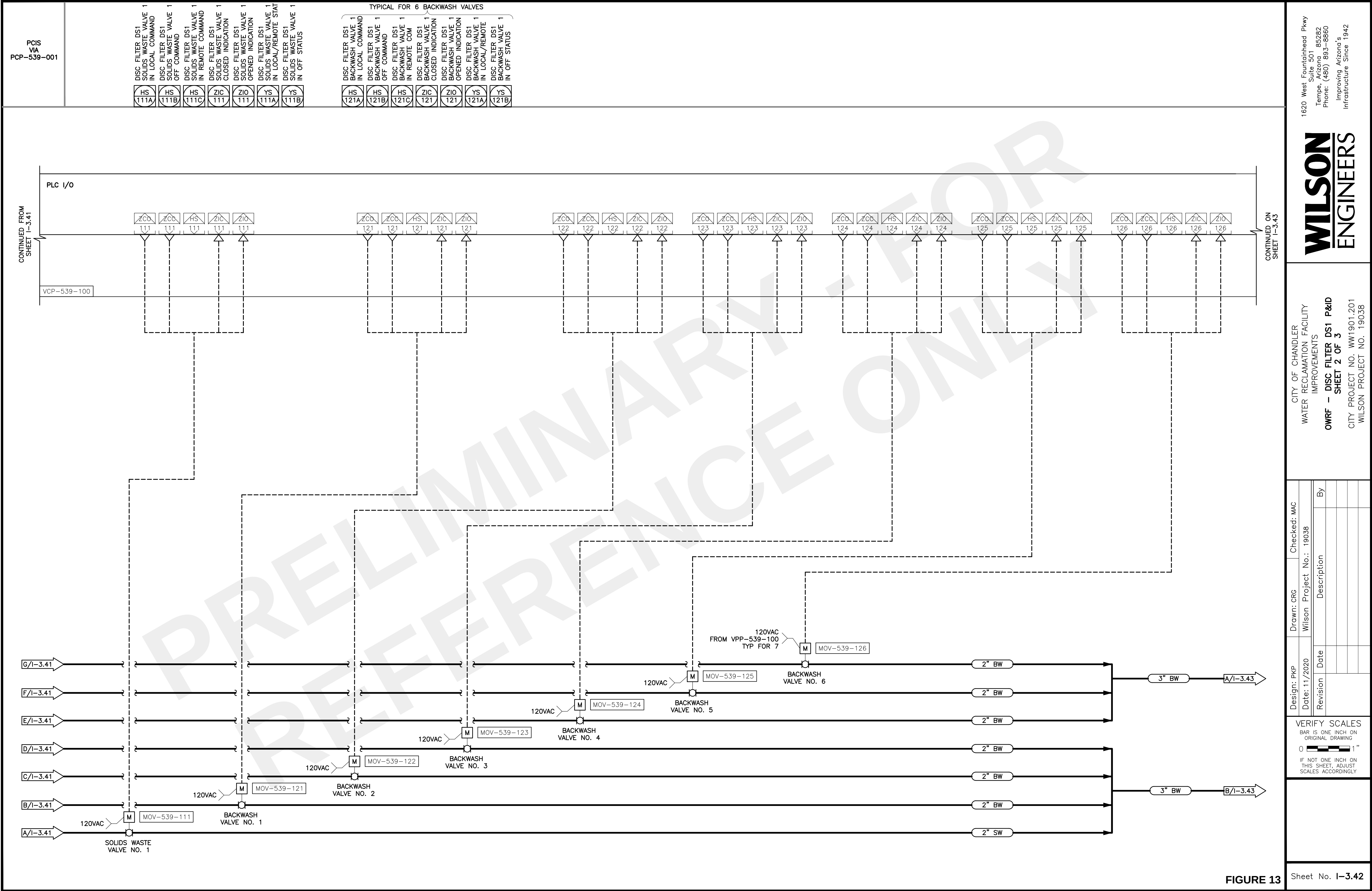
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CITY OF CHANDLER
WATER RECLAMATION FACILITY
IMPROVEMENTS
OWRF - DISC FILTER DS1 P&ID
SHEET 1 OF 3
CITY PROJECT NO. WW1901.201
WILSON PROJECT NO. 19038

Design: PKP	Drawn: CRG	Checked: MAC
Date: 11/2020	Wilson Project No.: 19038	
Revision	Date	Description
		By

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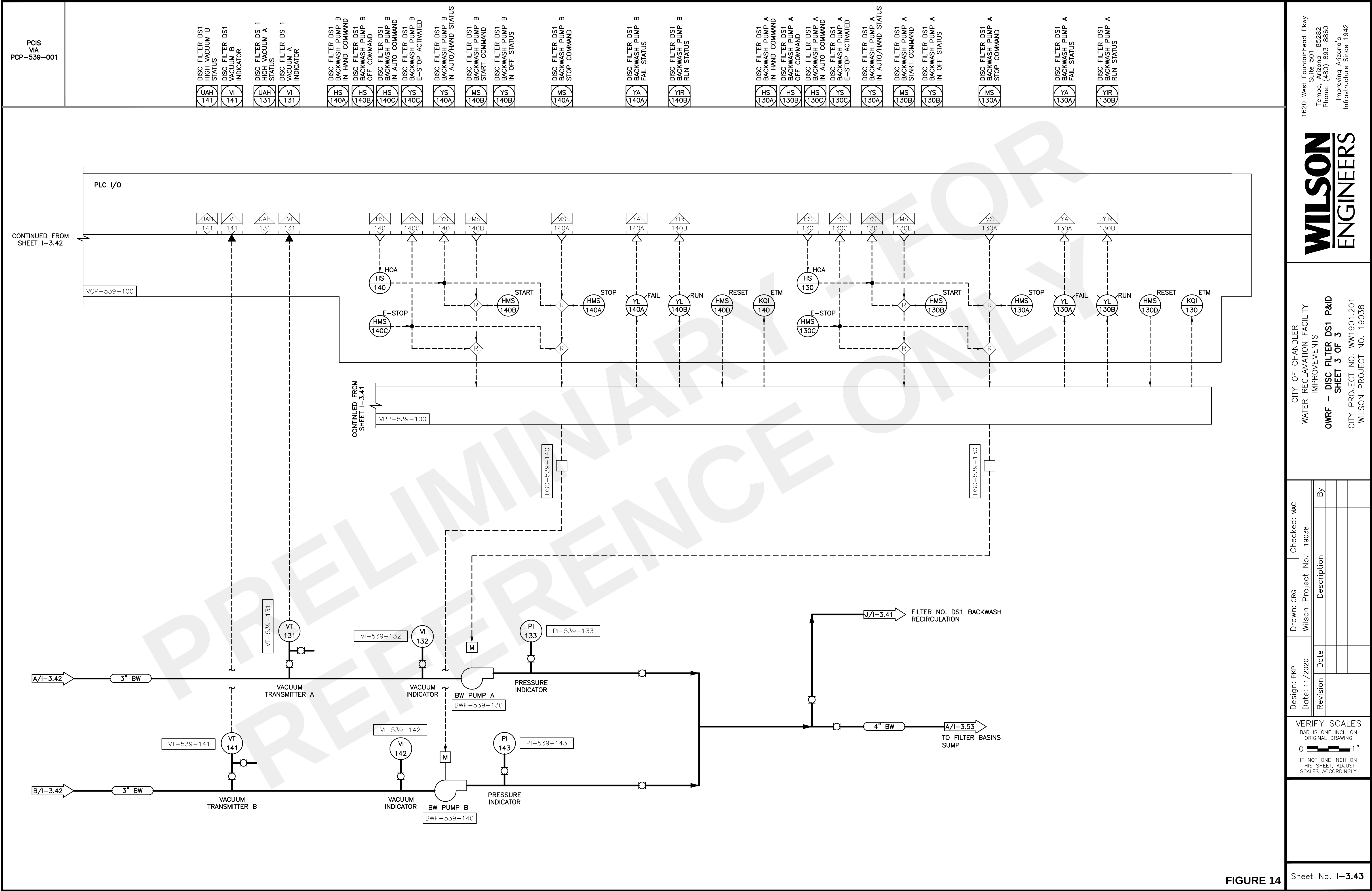


EXHIBIT D
ACCEPTED GMP/PRICE PROPOSAL



**City of Chandler Water Reclamation Facility
Improvements Project**

Project No. WW1901.401

GMP #1 Proposal

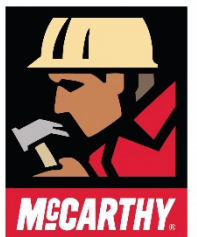
January 8, 2021 Rev. February 16, 2021

City of Chandler Water Reclamation Facility Improvements Project

January 8, 2021 Rev. February 16, 2021

TABLE OF CONTENTS

SECTION 1	PROJECT DESCRIPTION
SECTION 2	GMP PROPOSAL SUMMARY - PROJECT COST SUMMARY - TAX EXEMPT SUMMARY - LIST OF SUBCONTRACTORS AND SUPPLIERS
SECTION 3	WORK CATEGORY SCHEDULE OF VALUES (“SOV”)
SECTION 4	GMP CLARIFICATIONS AND ASSUMPTIONS
SECTION 5	PRELIMINARY PROJECT SCHEDULE
SECTION 6	LIST OF GMP PLANS AND SPECIFICATIONS
SECTION 7	GENERAL CONDITIONS AND RATES



City of Chandler Water Reclamation Facility Improvements Project

PROJECT DESCRIPTION

January 8, 2021 Rev. February 16, 2021

Project Description

The overall project consists of improvements to the Airport Water Reclamation Facility (AWRF) and the Ocotillo Water Reclamation Facility (OWRF). This GMP only includes select early work for the project as follows:

The following Work Packages include procurement only. Installation has not been included as it will be part of a future GMP.

- Disc Filters
- Stainless Steel Gates

PROJECT COST SUMMARY

January 8, 2021 Rev. February 16, 2021

Project: Chandler Water Reclamation Facility Improvements Project
GMP #1 Proposal

Client: City of Chandler

Location: Chandler, AZ

City Project # WW1901.401

		Percentage	Amount
A. Direct Costs			
A1	Direct Cost		\$4,165,419
A2	Construction Contingency	4.0%	\$166,617
TOTAL DIRECT COSTS:			\$4,332,036
B. General Conditions on Direct Costs only			
B	General Conditions	2.7%	\$118,313
<i>SUBTOTAL 1 (Cost of the Work):</i>			\$4,450,349
C. CM@Risks's Fee on Cost of Work only			
	CMAR Construction Fee	7.0%	\$311,524
<i>SUBTOTAL 2</i>			\$4,761,873
D. Bonds and Insurance			
D1	Performance and Payment Bonds	0.7%	\$33,333
D2	Insurance (PL/PD, Builders Risk)	1.2%	\$59,047
<i>Bonds & Insurance Allowance Total</i>			\$92,380
<i>SUBTOTAL 3</i>			\$4,854,253
E. Sales Tax			
E1	Sales Tax (65% of 7.8%)	5.07%	\$246,111
E2	Tax Credits		(\$196,724)
TOTAL SALES TAX			\$49,387
F. Allowances			
F1	COVID/Force Majeure Allowance		\$200,000
F2	Owner Allowance		\$739,097
TOTAL GMP #1 PROPOSAL			\$5,842,737

TAX EXEMPT SUMMARY

January 8, 2021 Rev. February 16, 2021

Project: **Chandler Water Reclamation Facility Improvements Project**

GMP #1 Proposal

Client: **City of Chandler**

Location: **Chandler, AZ**

City Job # **WW1901.401**

DESCRIPTION		Total Tax Exempt Value
01A	General Requirements	\$0
11A	Disc Filters	\$3,430,560
11B	Stainless Steel Slide Gates	\$449,600
Total Tax Exempt Amount		\$3,880,160
Gross Receipts Tax Credit, 65% * 7.8%		5.07% \$ (196,724)

LIST OF SUBCONTRACTORS AND SUPPLIERS

January 8, 2021 Rev. February 16, 2021

Project: Chandler Water Reclamation Facility Improvements Project
GMP #1 Proposal

Client: City of Chandler

Location: Chandler, AZ

City Project # WW1901.401

Work Category	DESCRIPTION	Subcontractor / Supplier
<i>Recommended Subcontractors / Suppliers</i>		
11A	Disc Filters	IES Southwest (Aqua Aerobics)
11B	Stainless Steel Slide Gates	Coombs (Whipps/Auma)

WORK CATEGORY SCHEDULE OF VALUES ("SOV")

January 8, 2021 Rev. February 16, 2021

Project: Chandler Water Reclamation Facility Improvements Project

GMP #1 Proposal

Client: City of Chandler

Location: Chandler, AZ

City Project # **WW1901.401**

Work Category	Description	Total
A. DIRECT COSTS		
01A	General Requirements	\$43,023
11A	Disc Filters	\$3,598,173
11B	Stainless Steel Slide Gates	\$524,223
Direct Cost Subtotal		\$4,165,419

City of Chandler Water Reclamation Facility Improvements Project

GMP #1 CLARIFICATIONS AND ASSUMPTIONS

January 8, 2021 Rev. February 16, 2021

General

1. Liquidated damages have been assumed to be per MAG section 108.9.
2. The cost of reuse water, sewer, power, and chemical usage during construction and start-up is not included.
3. Transaction Privilege Tax has been included at 7.8% based on the projects being in the City of Chandler. Tax exemptions have also been included.
4. No cost has been included for security guards.
5. The following are City of Chandler project costs and have not been included in the cost model:
 - a. Temporary/construction/startup use and permanent utility hookup and usage costs including power, sewer, reuse water
 - b. Building and Environmental Permits, MCDES and ADEQ permitting fees, plan review fees and impact costs
 - c. Special Inspection Fees
 - d. Asbestos testing and Hazardous Waste removal
 - e. Furnishings, Fixtures, and Equipment (FFE) and design of FFE
6. Submittals have been included to be submitted in electronic format only. No hard copies of shop drawings will be submitted.
7. Section 4.1.4 of the Construction Services Contract (Construction Manager at Risk) is rewritten as follows:

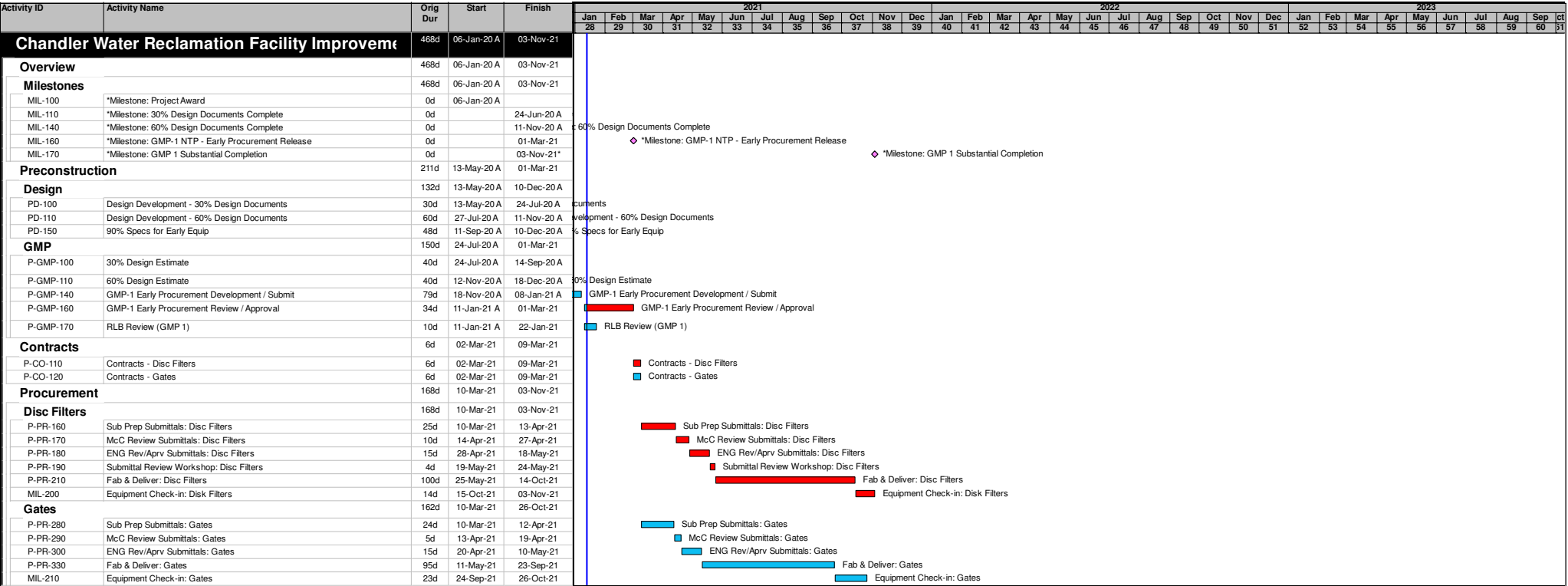
“4.1.4 CM@RISK is responsible for undertaking all necessary action contemplated under the contract documents to construct the Project and ensure timely and quality completion of the Project at a cost within the Guaranteed Maximum Price (GMP).”
8. General Conditions have been included for GMP 1 only through the equipment check-in period.
9. COVID-19/Force Majeure Allowance: This allowance to be used only under authorization by the City. This allowance is available if the parties agree conditions that directly arise out of or directly result from the COVID19 pandemic or other force majeure event as defined in General Conditions Article 6.2.14, which may excuse a party's performance under this clause. The party who seeks to invoke this clause must give the other party written notice 30 days after the occurrence of the event giving rise to such condition and the parties must agree in writing to the length of excused or suspended performance. An allowance has been established to cover increases in costs incurred by Contractor resulting from the COVID19 pandemic or force majeure event, which allowance may be used by Contractor subject to the prior written approval of the City, which approval shall not be unreasonably withheld.

Work Category 11A – Disc Filters

1. This Work Category includes 5 filters at the Airport Plant, and 4 filters at the Ocotillo plant.
2. The backwash and solid waste valves have been included as 2” as shown on the P&ID drawings.

Work Category 11B – Stainless Steel Slide Gates

1. The gate quantities and sizes are based on the 60% gate schedule dated November 2020.
2. Guides are to be a single piece construction.
3. A 6P NEMA box has been included in lieu of a 4X.



City of Chandler Water Reclamation Facility Improvements Project

List of GMP Plans and Specifications

January 8, 2021 Rev. February 16, 2021

GMP 1 Specifications

<i>Specification Section</i>	<i># Pages</i>	<i>Date Issued</i>
Section 01010- Summary of Work	3	December 2020
Section 01300- Submittals	15	December 2020
Section 01640- Materials and Equipment	5	December 2020
Section 01650- Starting of Systems	9	December 2020
Section 01660- Field Tests of Equipment	3	December 2020
Section 01730- Operation and Maintenance Data	4	December 2020
Section 01750- Spare Parts and Maintenance Materials	3	December 2020
Section 01821- Instruction of Operations and Maintenance Personnel	5	December 2020
Section 03300- Cast in Place Concrete	23	December 2020
Section 09900- Painting	22	December 2020
Section 11285- Hydraulic Gates and Stop Logs	11	December 2020
Gate/Stop Log Schedule (60% Submittal)	Pg 12- 20	November 2020
Section 11400- Disc Filters	21	December 2020
Section 13447- Electric Motor Actuators	21	December 2020
Section 16160- Enclosures	2	December 2020
Section 16161- Control Panels	34	December 2020
Section 16170- Grounding and Bonding	8	December 2020
Section 16225- Electric Motors	10	December 2020
Section 16474- Motor Control Equipment	6	December 2020
Section 16476- Low Voltage Circuit Breakers	2	December 2020
Section 16482- Solid State Motor Controllers	6	December 2020
Section 16951- Short Circuit, Coordination, and Arc-Flash Hazard Report	5	December 2020
Section 17325- Turbidity and TSS Analyzer	5	December 2020
Section 17454- Operations and Control Descriptions	34	December 2020

*This GMP only includes the procurement of the items described in Section 1 and the directly associated specification sections. All other specification sections are supporting documents.

GMP 1 Plans

<i>Sheet #</i>	<i>Sheet Name</i>	<i>Sheet Version</i>	<i>Date of Print</i>	<i>Date of Issuance</i>
M – 1.64	AWRF – Filters Overall Plan	60% Submittal	11/11/2020 @5:22:06 PM	12/10/2020
M – 1.65	AWRF – Filter Basin 5 Plan	60% Submittal	11/11/2020 @5:22:07 PM	12/10/2020
M – 1.66	AWRF – Filter Pump Gallery	60% Submittal	11/12/2020 @8:14:53 AM	12/10/2020
M – 1.67	AWRF – Filters Section 1	60% Submittal	11/11/2020 @5:22:11 PM	12/10/2020
I – 1.61	AWRF – Filter DS1 P&ID Sheet 1 of 3	60% Submittal	12/8/2020 @1:44:36 PM	12/10/2020
I – 1.62	AWRF – Filter DS1 Backwash Valves P&ID Sheet 2 of 3	60% Submittal	12/8/2020 @1:44:38 PM	12/10/2020
I – 1.63	AWRF – Filter DS1 Backwash Valves P&ID Sheet 3 of 3	60% Submittal	12/8/2020 @1:44:40 PM	12/10/2020
M – 3.44	OWRF – Filters Overall Top Plan	60% Submittal	11/11/2020 @1:25:37 PM	12/10/2020
M – 3.46	OWRF – Filters Filter Basin 1 Plan	60% Submittal	11/11/2020 @1:25:38 PM	12/10/2020
M – 3.47	OWRF – Filters Filter Pump Gallery	60% Submittal	11/11/2020 @1:25:39 PM	12/10/2020
M – 3.48	OWRF – Filters Sections and Details 1	60% Submittal	11/11/2020 @1:25:41 PM	12/10/2020
I – 3.41	OWRF – Disc Filter DS1 P&ID Sheet 1 of 3	60% Submittal	12/8/2020 @1:45:20 PM	12/10/2020
I – 3.42	OWRF – Disc Filter DS1 P&ID Sheet 2 of 3	60% Submittal	12/8/2020 @1:45:22 PM	12/10/2020
I – 3.43	AWRF – Disc Filter DS1 P&ID Sheet 3 of 3	60% Submittal	12/8/2020 @1:45:24 PM	12/10/2020

City of Chandler Water Reclamation Facility Improvements Project

Project No. WW1901.401

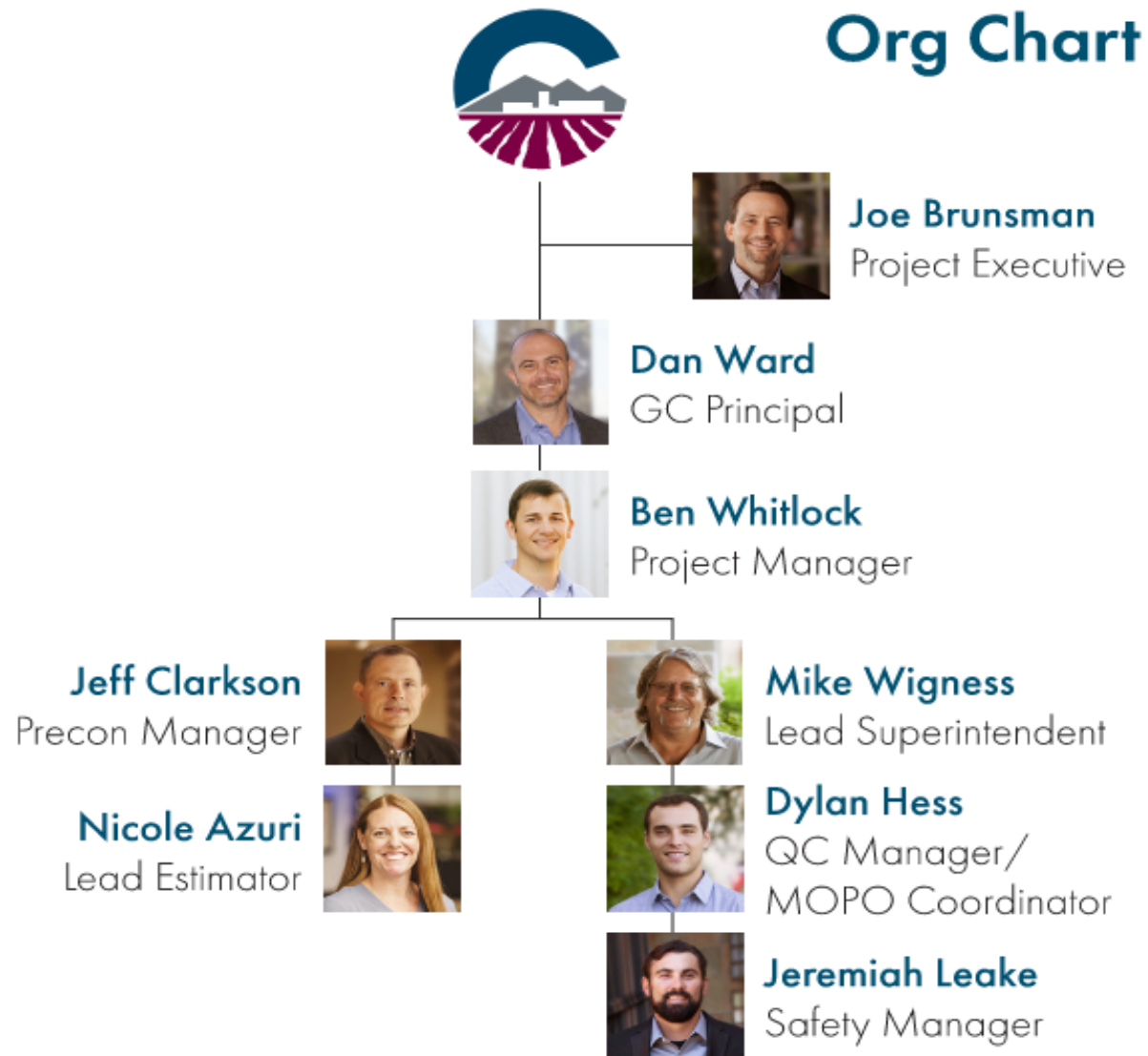
January 8, 2021 Rev. February 16, 2021

GENERAL CONDITIONS

Early Procurement

							TOTALS		
POSITION	QTY	UNIT	PRICE	TOTAL	Start	End	Hours	Wks	Months
Project Director	0.75	WKS	\$ 5,858	\$ 4,394	3/1/2021	11/3/2021	30	0.75	0.2
Project Manager	10.0	WKS	\$ 5,168	\$ 51,680	3/1/2021	11/3/2021	400	10.00	2.3
General Superintendent	5.5	WKS	\$ 5,501	\$ 30,256	3/1/2021	11/3/2021	220	5.50	1.3
Project Engineer	8.0	WKS	\$ 3,673	\$ 29,384	3/1/2021	11/3/2021	320	8.00	1.8
Project Administrator	1.0	WKS	\$ 2,600	\$ 2,600	3/1/2021	11/3/2021	40	1.00	0.2
<i>Subtotal</i>				\$ 118,313					
TOTAL GENERAL CONDITIONS				\$ 118,313					

McCarthy Org Chart submitted with December 2019 proposal:



City of Chandler Water Reclamation Facility Improvements Project

Project No. WW1901.401

January 8, 2021 Rev. February 16, 2021

McCarthy Non-Staff Unit Rates

	Hourly
General Foreman	\$72.70
Foreman	\$58.31
Carpenter	\$54.59
Finisher	\$48.92
Laborer	\$39.16
Operator - Crane / Equipment	\$61.80
Operator - Forklift	\$57.97
Millwright	\$62.57
Pipefitter / Pipelayer	\$49.64
Welder	\$69.19
Plumber	\$49.24
HVAC Installer	\$47.09

Rates include wages plus burden, cell phone, travel, safety incentive, and training. Overtime hours to be billed at 1.43 times the straight time rate.

City of Chandler Water Reclamation Facility Improvements Project

Project No. WW1901.401

January 8, 2021 Rev. February 16, 2021

McCarthy Staff Unit Rates

	Hourly
Project Director	\$146.21
Senior Project Manager	\$137.90
Project Manager	\$129.20
Assistant Project Manager	\$108.87
Project Safety Manager	\$123.83
General Superintendent	\$137.53
Project Superintendent	\$126.76
Area Superintendent	\$124.88
Assistant Project Superintendent	\$108.97
Project Engineer	\$91.83
Project Administrator	\$65.00

Rates include salary and burden, vehicle, fuel, oil, parts, cell phone, computer, software & maintenance, subsistence, travel, training and relocation. Sick and Vacation are included in the rates; holidays have been included as cost of the work.

EXHIBIT E



Chandler • Arizona

[TITLE]

Project No. [####]

SUBCONTRACTOR'S LIST FORM

If Bidder intends to subcontract any portion of this contract, the bidder 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. Bidder may make multiple copies of this form as needed.

Company Name:	
Contact Name:	
Contact Email:	
Contact Phone:	
Work Component:	
Percentage of Total Work Performed:	

Company Name:	
Contact Name:	
Contact Email:	
Contact Phone:	
Work Component:	
Percentage of Total Work Performed:	

Company Name:	
Contact Name:	
Contact Email:	
Contact Phone:	
Work Component:	
Percentage of Total Work Performed:	

Company Name:	
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Percentage of Total Work Performed:	

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Percentage of Total Work Performed:	