



CITY OF CHANDLER, ARIZONA

Water System Upgrades Program

CITY PROJECT NO. WA2100.401

CONSTRUCTION SERVICES AGREEMENT (CONSTRUCTION MANAGER AT RISK)

**Daniel Haskins, P.E.
CIP City Engineer**

CITY OF CHANDLER, ARIZONA

**Water System Upgrades Program
CITY PROJECT NO.: WA2100.401**

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**CONSTRUCTION MANAGER AT RISK
CONSTRUCTION SERVICES AGREEMENT
PROJECT NO.: WA2100.401**

This Agreement (the "AGREEMENT") is made and entered into on the ____ day of _____, 2024, ("Effective Date") by and between City of Chandler, an Arizona municipal corporation, hereinafter called "City" and **Archer Western** the "Construction Manager at Risk" or "CM@Risk" designated below (City and CM@Risk may individually be referred to as "Party" and collectively referred to as "Parties").

City and CM@Risk agree as follows:

ARTICLE 1 - PARTICIPANTS AND PROJECT

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

CITY: Construction Project Manager: Gina Ishida-Raybourn
Public Works & Utilities Department
P.O. Box 4008, Mail Stop 409 Chandler, AZ 85244-4008
Phone: 480-782-3584 Email: Gina.Ishida-Raybourn@chandleraz.gov

CM@RISK:	Legal Company Name:	<u>Archer Western Construction</u>
	Mailing Address:	<u>4710 E. Elwood Street, Suite 6, Phoenix, AZ 85040</u>
	Physical Address:	<u>SAME</u>
	Arizona Roc No.:	<u>275896 & 275897</u>
	Federal Tax Id No.:	<u>27-0887868</u>
	State Where Organized:	<u>Arizona</u>
	Business Organization:	<u>Limited Liability Company</u>
	Statutory Agent Name:	<u>Corporation Service Company</u>
	Statutory Agent Mailing Address:	<u>8825 North 23rd Avenue, Suite 100, Phoenix, AZ 85021</u>
	Statutory Agent Physical Address:	<u>SAME</u>
	CM@Risk's Authorized Project Representative:	
	Name:	<u>Kyle Ledbetter</u>
	Title:	<u>Project Executive</u>
	Phone:	<u>602-293-7835</u>
	Email:	<u>kledbetter@walshgroup.com</u>

PROJECT DESCRIPTION:

Filters 9-12 media replacement with GAC/Sand media and structural rehabilitation. Includes installation of a new polymer pump and polymer piping to the filters.

PROJECT LOCATION:

Pecos Surface Water Treatment Plant
1475 East Pecos Road
Chandler AZ 85244

ARTICLE 2 - AGREEMENT DOCUMENTS

2.1 AGREEMENT DOCUMENTS

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

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

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

2.3 DEFINITIONS

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

ARTICLE 3 - PRE-CONSTRUCTION SERVICES

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

ARTICLE 4 - CONSTRUCTION SERVICES

4.1 GENERAL

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

- 4.1.2 CM@Risk must provide all of the labor and materials, and perform the Work in accordance with Section 4 of the General Conditions. Some, but not all, of the major components of the Construction Services and the corresponding subsections of Section 4 of the General Conditions are set forth below.
- 4.1.3 This is an Agreement for complete construction services in accordance with the Construction Manager at Risk method of delivery of construction services. CM@RISK has participated in the design process and been an active member of the Project Design Team and is fully aware of any issues and constraints involved in this Construction Project.
- 4.1.4 CM@RISK is the CITY's fiduciary responsible for undertaking all necessary action contemplated under the Agreement documents to construct the Project and ensure timely and quality completion of the Project at a cost within the Guaranteed Maximum Price (GMP).
- 4.1.5 At all times relevant to this Agreement and performance of the Work, the CM@Risk must fully comply with all Laws, Regulations, or Legal Requirements applicable to City, the Project and the Agreement, including, without limitation, those set forth on attached **Exhibit A**.
- 4.1.6 CM@Risk must perform the Work under this Agreement using only those firms, team members and individuals designated by CM@Risk consistent with the Statement of Qualifications, the GMP Proposal, or otherwise approved by City pursuant to the General Conditions. No other entities or individuals may be used without prior approval of the Project Manager
- 4.1.7 CM@Risk will comply with all terms and conditions of the General Conditions.
- 4.1.8 In the event of a conflict between this Agreement and the General Conditions or an exhibit hereto or appendix thereto, the terms of this Agreement will control.
- 4.1.9 Ownership of Work Product. Notwithstanding anything to the contrary in this Agreement, all Work Product prepared or otherwise created in connection with the performance of this Agreement, including the Work, are to be and remain the property of City. For purposes of this provision, "Work Product" will include all designs, drawings, plans, specifications, ideas, renderings and other information or matter, in whatever form created (e.g., electronic or printed) and in all media now known or hereinafter created. All Work Product will be considered Work Made for Hire as defined in the United States Copyright Act 17 U.S.C. § 101 (Copyright Act). If for any reason, any such Work is found not to be a Work Made for Hire, CM@Risk hereby transfers and assigns ownership of the copyright in such Work to City. The rights in this Section are exclusive to City in perpetuity.

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

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

4.3 **PRE-CONSTRUCTION CONFERENCE**

Refer to Section 4.3 of the General Conditions.

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

Refer to Section 4.4 of the General Conditions.

4.5 **CONTROL OF THE PROJECT SITE**

Refer to Section 4.5 of the General Conditions.

4.6 **PROJECT SAFETY**

Refer to Section 4.6 of the General Conditions.

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

Refer to Section 4.7 of the General Conditions.

4.8 **PROJECT RECORD DOCUMENTS**

Refer to Section 4.8 of the General Conditions.

4.9 **WARRANTY AND CORRECTION OF DEFECTIVE WORK**

Refer to Section 4.9 of the General Conditions.

ARTICLE 5 - CITY RESPONSIBILITIES

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

ARTICLE 6 - AGREEMENT TIME

6.1 **GENERAL**

6.1.1 The Agreement Duration is **235** Calendar Days.

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

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

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

6.2 **PROJECT SCHEDULE**

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

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

6.3 **SUBSTANTIAL COMPLETION**

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

6.4 **FINAL ACCEPTANCE**

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

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

6.5 **LIQUIDATED DAMAGES**

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

6.5.2 Final Acceptance Liquidated Damages. For the same reasons set forth in Article 6.5.1 above, City and CM@Risk further agree that if CM@Risk fails to achieve Final Acceptance of the Work within the Agreement Time, City will be entitled to retain or recover from

CM@Risk, as liquidated damages and not as a penalty, the sum per calendar day as indicated in MAG § 108.9 commencing from the actual date of Substantial Completion or Final Acceptance as required under the Agreement.

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

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

6.6 **MUTUAL WAIVER OF CONSEQUENTIAL DAMAGES ONLY**

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

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

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

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

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

ARTICLE 7 - AGREEMENT PRICE

7.1 AGREEMENT PRICE

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

The sum of the CM@Risk's Fee and reimbursable Cost of the Work, as defined in Section 15 of the General Conditions, which the CM@Risk guarantees will not exceed the GMP set forth in **Exhibit D** in the amount of **\$2,094,455**. Costs which would cause the GMP to be exceeded must be paid by CM@Risk without reimbursement from City.

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

7.2 CHANGES TO AGREEMENT PRICE

Shall be determined under Section 9 of the General Conditions.

ARTICLE 8 - FORCED LABOR OF ETHNIC UYGHURS PROHIBITED

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

SIGNATURE PAGE TO FOLLOW

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

"CITY" CITY OF CHANDLER

"CM@Risk"

Archer Western Construction, LLC

MAYOR

Signature _____ Date

RECOMMENDED BY:

Daniel Haskins
Daniel Haskins, P.E.
CIP City Engineer

Daniel P. Walsh
Print Name

President
Title

APPROVED AS TO FORM:

dpwalsh@walshgroup.com
Signer Email Address

City Attorney *JNB*

ATTEST:

City Clerk Seal

EXHIBIT A

PROJECT SPECIFIC SPECIAL PROVISIONS

4.2.7 Aerial Construction Photography

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

4.2.8 Government Approvals and Permits

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

Subletting of Agreement

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

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

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

EXHIBIT B

GENERAL CONDITIONS



GENERAL CONDITIONS

Approved date: July 20, 2022

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Appendix 2 – Cost Reduction Incentive Proposals for Design Bid Build Agreements

Appendix 3 – Contractor's Affidavit Regarding Settlement of Claims

Appendix 4 – Forms of Performance Bond

Appendix 5 – Forms of Payment Bond

Appendix 6 – Dispute Resolution

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Appendix 8 – Construction Sign Detail

Appendix 9 – Cost of the Work (Applicable solely to Construction Manager at Risk and Job Order Contracting)

Appendix 10 Landscape Establishment Period

SECTION 1 - SCOPE OF THESE GENERAL CONDITIONS

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

SECTION 2 - GENERAL DEFINITIONS

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

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

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

Consultant: Person or firm that provides professional services.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

MAG: The Maricopa Association of Governments.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

SECTION 3 - STANDARD SPECIFICATIONS AND DETAILS

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

- 3.2 Copies of the MAG Specifications and MAG Standard Details are available at the Maricopa Association of Governments office, 302 N. 1st Avenue, Suite 300, Phoenix, Arizona. They may also be downloaded from their website at: <http://www.azmag.gov/Newsroom/Publications>
- 3.3 The MAG Specifications and Standard Details and City's amendments thereto are incorporated into the Agreement by this reference.

SECTION 4 - CONTRACTOR'S RESPONSIBILITIES FOR CONSTRUCTION SERVICES

4.1 GENERAL

- 4.1.1 Contractor must construct the Work in accordance with the Agreement Documents and as outlined in Exhibit A of the Agreement to the satisfaction of City, exercising the degree of professional care, skill, diligence, quality and judgment that a professional construction manager engaged, experienced and specializing in the construction management of construction and facilities of similar scope, function, size, quality, complexity and detail in urban areas throughout the United States comparable to Chandler, Arizona would exercise at such time, under similar conditions. Contractor must, at all times, perform the Work in conformance with sound and generally accepted engineering principles and construction management and construction contracting practices.
- 4.1.2 If Contractor observes errors, discrepancies or omissions in the Agreement Documents, Contractor must promptly notify the Design Professional and City and request clarification. If Contractor, with the exercise of reasonable care, should have recognized such error, inconsistency, omission, or difference and fails to report it to City, and if Contractor proceeds with the Work affected by such observed errors, discrepancies or omissions, without receiving such clarifications, Contractor does so at its own risk and will be liable to City for damages resulting from proceeding without clarification.
- 4.1.3 Project Team and agents of each of them, testing agencies and governmental agencies with jurisdictional interests will be provided access to the Work at reasonable times for their observation, inspection, and testing. Contractor must provide proper and safe conditions for such access.
- 4.1.4 Contractor must comply with, and require all Subcontractors to comply with, the Arizona Contractors' license laws, including all requirements with respect to being duly registered and licensed.
- 4.1.5 Contractor must ensure that all employees performing any Work for which Contractor is responsible have a legal right to live and work in the United States. In addition, all compensation of any such employee must meet all applicable requirements of the Fair Labor Standards Act (FLSA) and Federal Minimum Wage laws.
- 4.1.6 Contractor must comply with the Immigration Reform and Control Act of 1986 (IRCA). Contractor understands and acknowledges the applicability of the IRCA activities. Contractor agrees to comply with the IRCA while performing their work and to permit City inspection of Contractor personnel records to verify such compliance.
- 4.1.7 Pursuant to MAG Specifications §§ 107.4, Contractor must report immediately any discovery of archeological ruins or artifacts. Excavation must stop immediately so that City can decide on the pertinent steps to follow such discovery.

- 4.1.8 All property owners that may be affected by the proposed construction activities must be notified of the scope, duration of the construction activities and possible interference with their day-to-day activities by Contractor prior to start of construction. In addition, individual residential or commercial interferences, such as driveway restrictions, water outages, and all other Work adjacent to residence/business, require 48-hour notification in advance of specific adjoining Work. Notification may be through door hangers or other procedures approved by the City.
- 4.1.9 Access must be maintained to adjacent properties at all times during construction. Where property has more than one point of access, no more than one access will be restricted or closed at any one time. Access to adjacent private driveways will be maintained during all non-working hours.
- 4.1.10 Contractor must furnish and erect construction signs in accordance with Project Specifications. The signs must be professionally prepared and subject to approval by City, must be maintained by Contractor for the duration of the project, and must be removed by Contractor during the final project clean up.
- 4.1.11 The number of signs required, the size, shape, installation requirements and information to be included for construction signs is established on the detail sheet, provided, however, signs must be a minimum of 4 foot by 8 foot and must be installed so that the bottom of the sign is at least 4 foot above grade. No direct payment will be made for furnishing and erecting construction signs. The cost thereof must be included in other items for which direct payment is made. Sign locations will be determined by City.
- 4.1.12 All required construction signs must be installed by Contractor within 7 Days of Notice to Proceed.
- 4.1.13 The Work to be accomplished under these Agreement Documents has been designed for City by a Design Professional retained by City for this purpose. It is understood that normal construction Administration for the purpose of interpretation of the Agreement Documents is provided by City. Should any services of the Design Professional be required to assist in the corrections of errors or omissions by Contractor, or services of the Design Professional be required because of changes in structure or equipment where Contractor has requested approval of substitute methods or material, or any other items detailed herein below, those services will be provided by the Design Professional at the standard hourly rates previously negotiated with City and must be paid for by the Contractor.
- 4.1.14 Contractor must reimburse City for costs incurred by the Design Professional for additional services to the Project through no fault of City or the Design Professional including, but not limited to, the following conditions:
- a. Additional Site visits, investigations, inspections, design work or reports by the Design Professional which are required due to damages to existing facilities or completed Work caused by the Contractor in his performance, Contractor's negligence, or Contractor's Work which is rejected as defective or as failing to conform to the Agreement Documents;
 - b. Design Professional construction phase services rendered on the project during the time the project remains incomplete after the Agreement date of final completion will be charged to Contractor at a rate previously negotiated City; and

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

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

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

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

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

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

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

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

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

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

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

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

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

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

4.2.7 Aerial Drone Construction Photography.

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

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

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

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

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

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

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

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

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

4.2.8 **Government Approvals and Permits.**

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

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

4.3 **PRE-CONSTRUCTION CONFERENCE**

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

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

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

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

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

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

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

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

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

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

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

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

- 4.4.8 Before ordering materials or doing Work, Contractor and each Subcontractor must verify measurements at the Site and will be responsible for the correctness of such measurements. No extra charge or compensation will be allowed because of differences between actual dimensions and the dimensions indicated on the Agreement Documents, including the Drawings.
- 4.4.9 Ground Level Construction Photography.
- 4.4.9.1 The Contractor must furnish progress photographs of the project. The photographer selected by the Contractor must be approved by the City and must be either a commercial photographer or an individual experienced and equipped for such photography.
- 4.4.9.2 The Contractor must deliver to City all photographs taken during that period with each application for payment. If the current photographs do not accompany the application, the application will not be reviewed and will be returned to the Contractor as incomplete.
- 4.4.9.3 Photographs must be identified by use of typewritten labels affixed to the back of the photograph. The label must provide a description of the view, the direction from which the photograph was taken, the name of the project, City's project number, the name of Contractor and the date of the photography. The stationing must also be included for all pipeline installations.
- 4.4.9.4 Photographs must be taken during the construction period and must be of aesthetic composition and depict the progress of the Work from the beginning of construction through and including the finished product. City may vary the specified frequency so that significant progress or changes can be recorded on the photographs.
- 4.4.10 Underground Facilities.
- 4.4.10.1 The existence and number of facilities as shown on the Plans are estimated from information furnished by the particular utility. Contractor is responsible for field verification and location of all utilities prior to the start of construction. No field work will be allowed to start until Contractor has contacted Arizona 811 and all affected utilities have been located. In addition, Contractor must expose and physically locate all potentially conflicting utilities prior to construction. The actual locations of the utilities must be compared to locations shown on the Plans and any required changes in alignment and grade must be made at the time of construction in consultation with Project Manager. It is generally recognized and Contractor should anticipate that information from Arizona 811 or information from utility companies during project design, frequently fails to disclose all underground facilities. The fact that more utility lines or other underground facilities are located in the Project Site than shown on the Project Plans does not constitute an "unforeseen Condition" and such undisclosed underground facilities do not differ materially from the conditions which Contractor should expect. The provisions of Sections 105.4, 105.6, 107.11 and 109.8.1 of the MAG Uniform Standard Specifications for Public Works Construction apply and are incorporated herein by this reference.
- 4.4.10.2 Contractor is responsible for all coordination with utility companies. The provisions of Sections 105.4, 105.6, 107.11 and 109.8.1 of the MAG Uniform Standard Specifications for Public Works Construction strictly apply and no additional compensation will be paid to Contractor for delays due to utility work on the project.
- 4.4.11 Relocation of Existing Water Meters. When a service line has been extended and a line

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

4.4.12 Water Turn-On or Turn-Off.

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

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

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

4.4.13 Tests and Inspections.

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

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

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

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

- 4.4.14 Uncovering Work. If any Work that is to be observed, inspected, tested or approved is covered without written concurrence of City, it must, if requested by City be uncovered for observation. Unless Contractor has given City timely notice of Contractor's intention to cover such Work and City has not acted with reasonable promptness in response to such notice, Contractor must furnish all necessary labor, material and bear all the expenses of such uncovering, exposure, observation, inspection and testing and of satisfactory reconstruction, including compensation for additional professional services, and an appropriate deductive Change Order will be issued.
- 4.4.15 In all cases of interconnection of its Work with existing or other Work, Contractor must verify at the Site all dimensions relating to such existing or other Work. Any errors due to Contractor's failure to so verify all such grades, elevations, locations or dimensions must be promptly rectified by Contractor without any increase in the Agreement Price. Any design errors or omissions noted by Contractor during this review must be reported promptly to City.
- 4.4.16 Contractor must establish and maintain all construction grades, lines, levels, and benchmarks, and will be responsible for accuracy and protection of same. This Work must be performed or supervised by a licensed civil engineer or surveyor in the State of Arizona.
- 4.4.17 Contractor must photograph all buried piping of greater than four (4) inches in diameter prior to backfill.
- 4.4.18 Contractor is responsible for the proper performance of the work of Subcontractors and any acts and omissions in connection with such performance. Nothing in the Agreement Documents is intended or deemed to create any legal or contractual relationship between City and any Subcontractor or Sub-Subcontractor, including but not limited to any third-party beneficiary rights.
- 4.4.19 Contractor must coordinate the activities of all Subcontractors. Contractor must coordinate performance of the Work with City's Public Works & Utilities Department and other departments or agencies within City. The Design Professional and other contractors or parties involved in the Project. If City performs other work on the Project or at the Site with separate contractors under City's control, Contractor agrees to cooperate and coordinate its activities with those of such separate contractors so that the Project can be completed in an orderly and coordinated manner without unreasonable disruption.
- 4.4.20 Contractor will not substitute or change any Subcontractor or Supplier without the prior written approval of City. Any substitute or replacement Subcontractor or Supplier must be required to meet the same qualifications and selection criteria and process as the original Subcontractor or Supplier. If a Subcontract/Supplier selection plan has been approved by City, Contractor will follow that plan unless otherwise approved by City in writing.
- 4.4.21 Contractor must not change or replace any members of its Project team, including Contractor's Representative, Project Manager, or Superintendent, without an explanation for the change being given to City, and receiving prior written approval of the change from City, which approval will not be unreasonably withheld.
- 4.4.22 Subcontractors whose scope of work has a value greater than 15% of the total Agreement Price are required to furnish performance and payment bonds to Contractor, unless

otherwise approved in writing by City.

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

4.5 **CONTROL OF THE PROJECT SITE**

- 4.5.1 Throughout all phases of construction, including suspension of Work, Contractor must keep the Site reasonably free from debris, trash and construction wastes to permit Contractor to perform its construction services efficiently, safely and without interfering with the use of adjacent land areas. Prior to Final Acceptance of the Work, or a portion of the Work, Contractor must remove all debris, trash, construction wastes, materials, equipment, machinery and tools arising from the Work or applicable portions thereof to permit City to occupy the Project or a portion of the Project for its intended use.
- 4.5.2 Contractor must take whatever steps, procedures or means necessary to prevent dust nuisance due to construction operations. The dust control measures must be maintained at all times to the satisfaction of City and in accordance with the requirements of the Maricopa County Bureau of Air Pollution Control Rules and Regulations.
- 4.5.3 Contractor must maintain Americans with Disabilities Act (ADA) and American National Standards Institute (ANSI) accessibility requirements during construction activities, including without limitation compliance with the 2010 regulations governing implementation of the ADA to the extent applicable. ADA and ANSI accessibility requirements must include, but not be limited to, parking, building access, areas of refuge, and emergency exit paths of travel. Contractor is responsible for the coordination of all Work to minimize disruption to residents and the public.
- 4.5.4 Only materials and equipment used directly in the Work will be brought to and stored on the Site by Contractor. When equipment is no longer required for Work, it must be removed promptly from the Site. Protection of construction materials and equipment stored at the Site from weather, theft, damage and all other adversity is solely the responsibility of the Contractor.
- 4.5.5 Contractor agrees all persons working on the Site must act at all times in the best interest of the Project and will comply with all applicable rules and regulations reasonably set forth by City related to the Site. Notwithstanding the foregoing or anything in this Agreement to the contrary, City may remove from the Site any individual who City deems in their reasonable discretion to be creating a disturbance or causing any problem on the Site.
- 4.5.6 Contractor will be responsible to City for the acts and omissions of Contractor's employees, Subcontractors and their agents and employees, and any other person performing any of the Work under an Agreement with Contractor, or claiming by, through or under Contractor, for all damages, losses, costs and expenses resulting from such acts or omissions.
- 4.5.7 City may conduct criminal, drive history, and all other requested background checks of Contractor and Subcontractor personnel performing Work or who have access to City's information, data, or facilities in accordance with City's current background check policies, or the provisions of the Project Specific Conditions. Any officer, employee or agent that fails to background check must be replaced immediately.
- 4.5.8 City will have a final authority, based upon security reasons: (i) to determine when

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

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

4.6 **PROJECT SAFETY**

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

- a. Williams-Steiger Occupational Safety & Health Act of 1970, Public Law, 91-596.
- b. Part 1910 and Part 1926 – Occupational Safety and Health Standards, Chapter XVII of Title 29, Code of Federal Regulations.
- c. Part 1518 – Safety and Health Regulations for Construction, Chapter XIII of Title 29, Code of Federal Regulations.

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

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

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

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

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

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

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

- 4.6.9 Contractor's responsibility for safety under this Section is not intended in any way to relieve Subcontractors and Sub-Subcontractors of their own contractual and legal obligations and responsibility for (i) complying with all Legal Requirements, including those related to health and safety matters, and (ii) taking all necessary measures to implement and monitor all safety precautions and programs to guard against injury, losses, damages or accidents resulting from their performance of the Work.
- 4.6.10 As between City and Contractor, Contractor is responsible to City for any and all the safety issues relating to the Work on the Project. Contractor must administer and manage the safety program. This will include, but not necessarily be limited to review of the safety programs of each Subcontractor. Contractor must monitor the establishment and execution of compliance with all applicable regulatory and advisory agency construction safety standards. Contractor's responsibility for review, monitoring, and coordination of the Subcontractor's safety programs will not extend to direct control over execution of the Subcontractors' safety programs. Notwithstanding Contractor's safety obligations to City, it is agreed and understood that each individual Subcontractor will remain controlling employer responsible for the safety programs and precautions applicable to its own work and the activities of other's work in areas designated to be controlled by such Subcontractor for purposes of workers compensation insurance coverage.
- 4.6.11 Nothing in this agreement will relieve Contractor of his responsibility to maintain traffic, structures, etc., as noted on the Plans, Specifications, and Project Specific Conditions. Contractor is responsible to provide all necessary shoring, bracing and trench support as is necessary to maintain traffic structures, etc., as stipulated in the Plans, Specifications, and Special Provisions. If the stability of adjoining building, walls, roadways, etc., is endangered by Contractor's excavation, shoring, bracing, or under pinning must be provided as necessary to ensure project safety. Cost for shoring, bracing, underpinning, and trench support will be included in the appropriate items listed in the Agreement Price, and no additional payment will be made for this work.

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

4.7.1 **Quality Control and Quality Assurance Testing.**

- 4.7.1.1 All construction materials to be used or incorporated in the Project are subject to inspection, Quality Control & Quality Assurance Testing, and approval or rejection by City. Any material rejected by City must be removed immediately and replaced in an acceptable manner to City at no additional cost to City. When QC/QA tests indicate noncompliance with the Agreement Documents, retesting must be performed by the same testing laboratory that performed the tests that indicated noncompliance.
- 4.7.1.2 The Contractor must establish, provide, and maintain an effective Quality Control Testing Program (QCTP). The Contractor must develop his own program or procure the services of a consultant. In either case, the party performing the tests must be currently certified by the National Bureau of Standards in the National Voluntary Laboratory Accreditation Program (NVLAP) for construction services or the AASHTO Accreditation Plan (AAP) for Soils, Asphalt and Concrete. The Contractor must provide all support necessary to perform QC and QA testing and sampling (i.e. shoring for testing trench backfill, backhoes, motor graders, loaders, etc. to facilitate testing and sampling). The City will perform the QA testing.
- 4.7.1.3 The Contractor must submit a written QCTP to the City as a required submittal. The Contractor must not begin Work until the Quality Control Program has been reviewed and

- accepted by the City. Resumes of all personnel that will be associated directly or indirectly with the QCTP must be included.
- 4.7.1.4 The QCTP must include, but not be limited to, on-site/field and laboratory testing of all material delivered to the Site and any existing materials or conditions pertinent to the project.
- 4.7.1.5 All testing must be under the direction of a Professional Engineer registered in the State of Arizona, knowledgeable in Materials Testing. All "Test Report" forms must be stamped by said Engineer.
- 4.7.1.6 The written QCTP will set forth the responsibilities of the engineer, project manager, supervisory personnel and each technician assigned to this project. Substitutions or replacement of personnel must require prior written approval by the City. All personnel must be proficient within their assigned duties and possess certification(s) commensurate with their position and responsibilities. The minimum certification(s) for each technician must be NICET Level II, Arizona Technical Testing Institute, American Concrete Institute, or other nationally recognized program applicable to the project and approved by the City of Chandler. The written QCTP must include a description of the required field and construction materials laboratory tests, including required frequencies that meet the minimums established herein.
- 4.7.1.7 The Contractor must establish a system to record and report all material test results. The daily test reports must include, but not be limited to:
- a. Test designation;
 - b. Date of test;
 - c. Name of tester;
 - d. Location of test/sample (station and offset);
 - e. Product suppliers and product codes (as applicable);
 - f. Depth/elevation of test/sample;
 - g. Test result;
 - h. Control requirement(s);
 - i. Cause of rejection (if applicable);
 - j. Results of retests (if applicable); and
 - k. Remedial action (if applicable).
- 4.7.1.8 The Contractor must submit test results to the designated City representative.
- 4.7.1.9 The Contractor must also submit a weekly report to the City summarizing the testing and construction activities completed by emailing the report to the email addresses noted above. All weekly reports must be submitted simultaneously to the Contractor and the City of Chandler. The report must include individual summary sheets for each utility line, structure, and portion of the pavement section. Cores must be numbered sequentially throughout the Project. Re-cores must reference the original core by number and must contain the averaged values for thickness and density. Total pavement thickness must be reported. Vertical location of tests for underground utilities must indicate the depth of the

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

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

- a. Order the Contractor to replace ineffective or unqualified quality control personnel.
- b. Order the Contractor to stop operations until appropriate corrective action is taken.

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

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

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

4.7.2 Trade Names and Substitutions.

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

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

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

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

4.7.3 Shop Drawings.

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

- 4.7.3.2 Contractor must submit a schedule of Shop Drawing submissions, which avoids bulk submissions to the extent reasonably possible, with the Project Schedule for City approval. The schedule of Shop Drawing submissions must include all of the items for which Shop Drawings are required by the Agreement Documents, including the Specifications. Unless otherwise noted, Shop Drawings will not be required for items specified or detailed in the Uniform Standard Specifications and Details or the Technical Specifications.
- 4.7.3.3 Shop Drawings must be numbered consecutively for each Specification section and must accurately and distinctly present the following:
- a. All working and erection dimensions.
 - b. Arrangements and sectional views.
 - c. Necessary details, including complete information for making connections between work under this Agreement and work under other Agreements.
 - d. Kinds of materials and finishes.
 - e. Parts list and description thereof.
- 4.7.3.4 Each Drawing or page must include:
- a. Project Name, City of Chandler Project Number and descriptions.
 - b. Submittal date and space for revision dates.
 - c. Identification of equipment, product or material.
 - d. Name of Contractor and Subcontractor.
 - e. Name of Supplier and Manufacturer.
 - f. Relation to adjacent structure of material.
 - g. Physical dimensions clearly identified.
 - h. ASTM and Federal Specifications references.
 - i. Identification of and justification for deviations from the Agreement Documents.
 - j. Contractor's stamp, initialed or signed, dated and certifying the review of submittal, certification of field measurements and compliance with Agreement.
 - k. Location at which the equipment or materials are to be installed.
- 4.7.3.5 Location will mean both physical location and location relative to other connected or attached material. City will return unchecked any submittal, which does not contain complete data on the Work and full information on related matters.
- 4.7.3.6 Stock or standard drawings will not be accepted for review unless full identification and supplementary information is shown thereon in ink or typewritten form.
- 4.7.3.7 Contractor must schedule, prepare and submit all Shop Drawings in accordance with a 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 Agreement requirements, Contractor must make specific mention thereof in the Letter of Transmittal; otherwise review of such submittals by City will not constitute review of the departure. Review of the Drawings will constitute review of the specific subject matter for which the Drawings were submitted and not of any other structure, material, equipment, or apparatus shown on the Drawings.
- 4.7.3.9 The review of Shop Drawings will be general and will not relieve Contractor of responsibility for the accuracy of such Drawings, nor for the proper fitting and construction of the Work, nor for the furnishing of materials or Work required by the Agreement. No construction called for by Shop Drawings will be initiated until such Drawings have been reviewed and approved by City.
- 4.7.3.10 The procedure in seeking review of the Shop Drawings will be as follows:
- a. Contractor must submit complete sets of Shop Drawings and other descriptive data as specified in this Section.
 - b. After Contractor's submittal or resubmittal of Shop Drawings, if Contractor has submitted Shop Drawings in accordance with the City-approved submittal schedule, or upon resubmission, City will be provided with three (3) calendar weeks for review. Should City require additional review time above and beyond the three (3) calendar weeks, Contractor may ask for a time extension or monetary compensation, if they can present valid, factual evidence that actual damages were incurred by Contractor. City will determine the amount of the time extension or the monetary compensation to be awarded Contractor, if any, in accordance with City's Policy Statement for Calculating Delays and Damages, Appendix 1.
- 4.7.3.11 Contractor will be responsible for all extra costs incurred by City caused by Contractor's failure to comply with the procedure outline above.
- 4.7.4 Long Lead Time Items. Contractor must submit Shop Drawings, as required by the Engineer, on all long lead items to be furnished and installed as part of the project within 10 Days after the date of the executed Agreement letter issued by City. In addition, Contractor must order all long lead items to be furnished and installed as part of this Project within 3 Days after receiving approved Shop Drawings. For all long lead times for which Shop Drawings are not required, Contractor must order said long lead items within 15 Days after the date of the executed Agreement letter issued by City. Within 2 Days after ordering long lead items, Contractor must supply copies of all purchase orders, along with an accurate delivery schedule from the supplier.
- 4.7.5 Construction Water. If Contractor uses water from City's water system for construction water, Contractor must obtain a fire hydrant meter from City of Chandler Utility Services (480-782-2280) and all construction water must be obtained through the hydrant meter. Contractor must pay all fees related to the hydrant meter and all water bills for construction water. All cost for meters and construction water will be included in the Agreement Price.
- 4.8 **PROJECT RECORD DOCUMENTS**
- 4.8.1 During the construction period, Contractor must maintain at the jobsite a full-size set of prints of the Construction Document Drawings and Shop Drawings for Project Record Document purposes.

- 4.8.2 Contractor must mark these Drawings to indicate the actual installation where the installation varies from the original Construction Documents. Contractor must give particular attention to information on elements that will be concealed, which would be difficult to identify or measure and record later. Items required to be marked include but are not limited to:
- a. Dimensional changes to the Drawings.
 - b. Revisions to details shown on Drawings.
 - c. Locations and depths of underground utilities.
 - d. Revisions to routing of piping and conduits.
 - e. Actual equipment locations.
 - f. Changes made by Change Order or Addendum.
 - g. Details not on original Agreement Drawings.
- 4.8.3 Contractor must mark completely and accurately Project Record Drawing sets of Construction Documents.
- 4.8.4 Contractor must mark Project Record Drawings sets with red erasable colored pencil.
- 4.8.5 Contractor must note Request for Information (RFI) Numbers and Change Order numbers, etc., as required to identify the source of the change to the Construction Documents.
- 4.8.6 Contractor must submit Project Record Drawing sets and Shop Drawings to City or its representative for review and comment.
- 4.8.7 Upon receipt of the reviewed Project Record Drawings from City, Contractor must correct any deficiencies and omissions to the Drawings and submit the final original of the Project Record Drawings to City prior to Final Payment.
- 4.8.8 Project Manager will review the Project Record Drawings monthly prior to the date established for the Payment Request and will be the sole judge of acceptance of these Drawings.
- 4.9 **WARRANTY AND CORRECTION OF DEFECTIVE WORK**
- 4.9.1 Contractor warrants to City that the construction, including all materials and equipment furnished as part of the Work, will be new unless otherwise specified in the Agreement Documents, of good quality, and free of defects in materials and workmanship. Contractor's warranty obligation excludes defects caused by abuse, alterations, or unreasonable failure to maintain the construction by persons other than Contractor, subcontractors, or others under Contractor's control. Nothing in this warranty will limit any manufacturer's warranty which provides City with greater warranty rights than set forth herein or in the Agreement. Contractor will provide City with all manufacturers' warranties and operation and maintenance manuals upon substantial completion of the Work. Contractor's warranty must be for one (1) year, in accordance with MAG Specification § 108.8, and will commence for all portions of the Work upon Final Acceptance of the entire Work as determined by City under the Agreement. All statutory or other warranties, express or implied, related to latent defects will remain in force and are not limited by this provision.
- 4.9.2 City May Stop the Work. If the Work is defective, or Contractor fails to supply sufficient skilled workmen or suitable materials or equipment, City may order Contractor to stop the

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

4.9.3 Correction or Removal of Defective Work.

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

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

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

4.9.5 Correction or Removal of Unauthorized Work.

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

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

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

4.9.6 Correction Period - One Year Guarantee.

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

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

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

4.9.7 Acceptance of Defective Work.

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

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

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

- 4.9.9 Contractor's warranty obligation must be in accordance with MAG Specifications.
- 4.9.10 Nothing in the warranties contained in the Agreement Documents are intended to limit any manufacturer's warranty which provides City with greater warranty rights than set forth in this Section or the Agreement Documents. Contractor must provide City with all manufacturers' warranties prior to Substantial Completion, if applicable, or Final Acceptance.
- 4.9.11 Contractor agrees that it will be responsible to manage and administer the correction of any Work that is not in conformance with the Agreement Documents during the warranty periods set forth in this Section, or during any longer periods to the extent required by the Agreement Documents. A progress payment, or partial or entire use or occupancy of the Project by City, will not constitute acceptance of Work not in accordance with the Agreement Documents.
- 4.9.12 When notified of a warranty issue, Contractor must respond in writing within 48-hours and must perform warranty Work as soon as material for said repairs are available (as judged solely by City), and in any event Contractor must, take immediate steps to commence and complete correction of nonconforming Work no later than the time period set forth in City's written notification in accordance with the Agreement Documents. This includes the correction, removal or replacement of the nonconforming Work and any damage caused to other parts of the Work affected by the nonconforming Work. If defects develop which are determined by City to be an emergency, City will notify Contractor, via the most expeditious means regarding the nature and condition of the defects. In turn, Contractor must immediately dispatch necessary forces to correct the defect or the emergency condition in accordance with Agreement Documents.
- 4.9.13 The time periods referenced in this Section apply only to Contractor's obligation to correct nonconforming Work and is not intended to constitute a period of limitations for any other rights or remedies that City may have regarding Contractor's other obligations under the Agreement Documents.
- 4.9.14 Without limiting the foregoing or anything in these General Conditions or the Agreement to the contrary, Contractor must obtain and provide to City all warranties for any portion of the Project offered by the manufacturer, installer or provider thereof. City and the user of the facility will have the right to the full value and benefit of all such warranties. Contractor must ensure all such warranties are fully transferrable to facilitate the full value of this Section.
- 4.9.15 Contractor's warranty excludes damages or defects caused by abuse, alterations to the Work not executed by or through Contractor, improper or insufficient maintenance, improper operation, or normal wear and tear and normal usage.
- 4.9.16 In the event of any noncompliance with this entire Section 4, City may require Contractor to stop or suspend the Work in whole or in part.

SECTION 5 - CITY RESPONSIBILITIES

5.1 CITY PROJECT MANAGER AND INSPECTORS

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

- 5.1.2 Project Manager will also provide Contractor with prompt notice when it observes any failure on the part of Contractor to fulfill its contractual obligations, including any default or defect in the Project or non-conformance with the Drawings and Specifications.
- 5.1.3 City may utilize Field Inspectors to assist Project Manager during construction in observing performance of Contractor. City's use of Inspectors is for the purpose of assisting Project Manager.
- 5.1.4 The Inspectors are authorized to inspect all Work and materials furnished. Such inspections may extend to all or part of the Work and to preparation, fabrication or manufacture of the materials to be used. The Inspectors have the authority to issue instructions contrary to the Construction Documents if approved and coordinated with the directions of Project Manager.
- 5.1.5 The Inspectors have the authority to reject work or materials until any questions at issue can be decided by Project Manager.
- 5.1.6 The use of Inspectors by City will not make City responsible for or give City control over construction means, methods, techniques, sequences or procedures or for safety precautions or programs or responsibility for Contractor's failure to perform the Work in accordance with Agreement Documents. The Inspectors are not authorized to direct any of Contractor's activities, employees or Subcontractors.

5.2 **DESIGN PROFESSIONAL SERVICES**

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

5.3 **CITY'S SEPARATE CONTRACTORS**

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

5.4 **PERMIT REVIEW AND INSPECTIONS**

- 5.4.1 If requested by Contractor, Project Manager will provide assistance and guidance in obtaining necessary reviews, permits and inspections.
- 5.4.2 The regulating agencies of City, such as Development and Sustainability, Fire and Planning Departments, enforce legal requirements. The enforcement activities of City are independent and separate from this Agreement.

5.5 **PLANS AND SPECIFICATIONS TO THE CONTRACTOR**

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

upon request, at the cost of reproduction.

SECTION 6 - AGREEMENT TIME

6.1 AGREEMENT TIME

- 6.1.1 The Agreement Time will start with the Notice to Proceed ("NTP") and end with Final Acceptance.
- 6.1.2 Beginning on the date of the NTP, Contractor must begin to fulfill Contractor's obligations under the Agreement. Contractor's obligations include providing City and other agencies with any submittals required by the Project Specific Special Provisions, including but not limited to, an approved Project Schedule, Traffic Control Plans, and a Stormwater Pollution Prevention Plan. Contractor must submit all such required submittals before any physical construction work commences on the Site. NTP does not authorize construction work until all agreement insurance, bonds, and schedules are submitted to and accepted by the City.
- 6.1.3 The Agreement Time will be as set forth in the Project Schedule. Contractor agrees that it will commence performance of the Work and complete the Project through both Substantial Completion and Final Acceptance within the Agreement Time.
- 6.1.4 Time is of the essence of this Agreement, for the Project, for the Work, and for each phase and designated Milestone thereof.
- 6.1.5 Failure of Contractor to perform any covenant or condition contained in the Agreement Documents within the time periods specified herein, will constitute a material breach of this Agreement entitling City to terminate the Agreement unless Contractor applies for and receives an extension of time, in accordance with the procedures set forth in the Agreement Documents.
- 6.1.6 Failure of City to insist upon the performance of any covenant or condition within the time periods specified herein, will not constitute a waiver of Contractor's duty to perform every other covenant or condition within the designated periods, unless a specific waiver is granted in writing for each such covenant or condition.
- 6.1.7 City's agreement to waive a specific time provision or to extend the time for performance will not constitute a waiver of any other time provisions contained in the Agreement Documents. Failure of Contractor to complete performance promptly within the additional time authorized in the waiver or extension of time agreement constitutes a material breach of this Agreement entitling City to all the remedies set forth herein or provided by law.

6.2 PROJECT SCHEDULE

- 6.2.1 The Project Schedule must be in Microsoft Project standard file format, must be updated and maintained throughout the Agreement Time, and must contain the following:
 - 6.2.1.1 Detailed representation of all activities for the project, both on-site construction and major procurement. All significant activities together with the resource loading requirements for each and all items appearing on the schedule of values or bid schedule for progress payments must be shown on the Project Schedule or in attached transmittal letter as described in Section 6.2.8.

- 6.2.1.2 Dependencies between activities must be indicated so that it may establish as to the effect the progress of any one activity would have on other activities and on the Schedule.
- 6.2.1.3 Activities for submission, review, and approval of all required submittals.
- 6.2.1.4 An amount of time will be established prior to the final completion date for “punch list and cleanup”. No other activities will be scheduled during this period. Punch list and cleanup must be shown on the Project Schedule and must be entirely completed prior to the expiration of the Agreement Time.
- 6.2.2 Within 10 Days of receipt of City’s comments, Contractor must make all required corrections, adjustments, and additions to complete the Project Schedule and resubmit to City for review. City’s review of and response to the Project Schedule is for the purpose of: (1) City planning and staffing for the Project as may be required from time to time; (2) ensuring Contractor’s general conformance with the scheduling requirements of the Agreement Documents and completion of the Project within the Agreement Time; and (3) monitoring and evaluating the construction status for purposes of approving monthly progress payments. Acceptance of a submitted schedule by City should in no way be construed as an affirmation or admission that the schedule is reasonable or workable by Contractor. The responsibility for completing the Work on the Project within the Agreement Time remains the obligation of Contractor. City’s review does not relieve Contractor from compliance with the requirements of the Agreement Documents or be construed as relieving Contractor of its complete and exclusive control over the means, methods, sequences and techniques for executing the work.
- 6.2.3 The Project Schedule must show milestones, including milestones for City-furnished information, and must include activities for City-furnished material and construction by other contractors when those activities are interrelated with Contractor activities.
- 6.2.4 The Project Schedule must be revised as required by conditions and progress of the Work, but such revisions do not relieve Contractor of its obligations to complete the Work within the Agreement Time, as adjusted in accordance with the Agreement Documents. No modification to the Agreement Documents or the Agreement Time will be effective unless approved in advance by City.
- 6.2.5 For all items of materials and equipment that are critical or may require long lead times to acquire, the Project Schedule must show dates for submission, review and approval of submittals, ordering, and delivery.
- 6.2.6 An updated Project Schedule must be submitted monthly to City as part of the Payment Request. The monthly submittal must include one full size plot of the entire schedule and one electronic copy containing the schedule in Microsoft Project standard file format. In addition, Contractor must, upon request by City, provide a copy of all submitted schedule data in electronic format which must be clearly labeled with the Project description, scheduling program name and version number, and schedule print/data date.
- 6.2.7 Contractor must provide City with a monthly status report with each Project Schedule detailing the progress of the Work, including: (i) if the Work is proceeding according to schedule, (ii) any discrepancies, conflicts, or ambiguities found to exist in the Agreement Documents that require resolution, and (iii) other information detailing items that require resolution so as not to jeopardize the ability to complete the Work in the Agreement Time.

- 6.2.8 With each Project Schedule submittal, Contractor must include a transmittal letter including the following:
- a. Description of problem tasks, referenced to field instructions or requests for information (RFI's), as appropriate.
 - b. Current and anticipated delays including:
 - (i) Cause of the delay.
 - (ii) Corrective action and schedule adjustments to correct the delay.
 - (iii) Known or potential impacts and their delay on other activities, milestones, and their impact on the Substantial Completion and Final Acceptance dates.
 - (iv) Changes in construction sequence.
 - c. Pending items and status thereof including but not limited to:
 - (i) Time Extension requests;
 - (ii) Substantial Completion date status;
 - (iii) Final Acceptance date status.
 - d. If ahead of schedule, the number of calendar Days ahead.
 - e. If behind schedule, the number of calendar Days behind.
 - f. Other Project or scheduling concerns.
- 6.2.9 Critical Path Method (CPM).
- 6.2.9.1 Unless otherwise specified in the Agreement, the Project Schedule must include a Critical Path Method (CPM) diagram schedule showing the sequence of activities, the interdependence of each activity and identifies the Critical Path.
- 6.2.9.2 The CPM diagram schedule must be in calendar Days and indicate duration, earliest and latest start and finish dates for all activities, and total Float Times for all activities except critical activities. The CPM diagram must be presented in a time scaled graphical format for the Project as a whole.
- 6.2.9.3 The CPM diagram schedule must indicate all relationships between activities.
- 6.2.9.4 The activities making the Project Schedule must contain sufficient detail to assure that adequate planning has been done for proper execution of the Work and such that it provides an appropriate basis for monitoring and evaluation the progress of the Work. Individual activities must not exceed 30 Days in length, in most cases.
- 6.2.9.5 The CPM diagram schedule must be based upon activities, which coincide with the Schedule of Values.
- 6.2.9.6 The CPM diagram schedule must show all submittals associated with each work activity and the review time for each submittal.
- 6.2.10 Float Time.
- 6.2.10.1 The total Float Time within the overall schedule is for the exclusive use of City, but City may approve Contractor's use of Float as needed to meet Agreement Milestones and

the Project completion date.

- 6.2.10.2 Contractor will not be allowed to sequence, hide, or reallocate Float Time through such strategies, as extending activity duration estimates to consume available Float, using preferential logic, or using extensive crew/resource sequencing, etc. No time extensions will be granted nor delay damages paid until a delay occurs which extends the Work beyond the Agreement Time.
- 6.2.11 City-Caused Delays. City-caused delays on the Project, if any, may be offset by City-caused time savings (i.e., Critical Path submittals returned in less time than allowed by the Agreement, approval of substitution requests and credit changes which result in savings of time to Contractor, etc.) In such an event, Contractor will not be entitled to receive a time extension or delay damages until all City-caused time savings are exceeded and the Agreement Time is also exceeded.
- 6.2.12 Rain-Related Delays. Contractor is required, in preparing the Project Schedule to take into account all relevant weather conditions, including normal rainfall and distribution. No additional compensation will be given for any rain-related delays or impacts on the Work or the Project Schedule. No time extension will be granted in the Project Schedule unless the rainfall during the construction of Work is unusually severe, was not reasonably anticipated, and the total rainfall was significantly in excess of the normal rainfall for the Project Site location. Normal rainfall for the Project will be determined from the 10-year average rainfall for the Site as measured by the National Oceanic and Atmospheric Administration or comparable source of reliable information for rainfall in Chandler, Arizona. In addition, the excessive rainfall must have actually impacted Work activities on the Critical Path and caused delay beyond any remaining Float at the time of the rain-caused delay. The burden of documenting normal rainfall, the excessive rainfall and the impact on Critical Path activities is on Contractor. All other provisions in the Agreement Documents relating to claims, including without limitation notice requirements, apply to any claim by Contractor for a rain delay.
- 6.2.13 City's "Policy Statement for Calculating Delays and Damages," Appendix 1 to these General Conditions, will apply to all claims of delay and delay damages.
- 6.2.14 Force Majeure. If Contractor is delayed or prevented from the performance of any Work required under this Agreement by reason of acts of God or other causes beyond the control and without fault of Contractor (financial inability excepted), performance of that Work will be excused, but only for the period of the delay. The time for performance of the Work will be extended for a period equivalent to the period of delay. In addition, the parties agree if Contractor's delayed or suspended performance directly arises out of or directly results from the COVID-19 pandemic, Contractor's delayed or suspended performance may be excused as set forth in this clause. Provided, however; Contractor must give the City written notice within 30 days of the occurrence of the event giving rise to COVID-19 pandemic related delayed or suspended performance. For COVID-19 pandemic related delay or suspended performance, the parties must agree in writing to the length of the excused delay or suspended performance. Further, Contractor must obtain the City's written approval to use any allowance established as part of the project for delays and costs related to the COVID-19 pandemic.

6.3 **SUBSTANTIAL COMPLETION**

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

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

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

6.3.3 Certificate of Substantial Completion.

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

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

Project Manager's Punch List.

6.4 **PARTIAL UTILIZATION**

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

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

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

6.5 **FINAL ACCEPTANCE**

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

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

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

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

6.6 **CONTINUATION OF WORK**

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

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

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

SECTION 7 - AGREEMENT PRICE

7.1 UNIT PRICE AGREEMENTS

- 7.1.1 The Agreement Price for all Unit Price Agreements will be the amount set forth in the Agreement or Change Order multiplied by the verified quantity provided.
- 7.1.2 Measurements of quantities to determine the total Agreement Price must be in accordance with MAG Specification §§ 109.1 and 109.2.
- 7.1.3 The Unit Price may only be changed as set forth in Section 9 below.

7.2 CHANGE ORDERS

- 7.2.1 Unit Price Change Orders. The Change Order Price for all Unit Price Change Orders will be the amount set forth in the Change Order multiplied by the verified quantity provided.
- 7.2.2 Measurements of quantities to determine the total Change Order Price must be in accordance with MAG Specifications §§ 109.1 and 109.2.
- 7.2.3 The Unit Price may only be changed as set forth in Section 9 below.
- 7.2.4 MAG Specification § 109.4.1 is modified as follows: Before § 109.4.1, the following is added: Any deduction or increase in the Agreement Price must be supported by a signed, written Change Order fully executed by City, and supported by such backup as the Project Manager may require.

7.3 SALES TAX

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

SECTION 8 - PAYMENT

8.1 PAYMENT FOR CONSTRUCTION SERVICES

- 8.1.1 Payment for the Work will be made in accordance with MAG Standard Specification § 109 as amended below.
- 8.1.2 Contractor must submit to City for review a completed Contractor Payment Request signed

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

- 8.1.3 Except for Work performed under a JOC Agreement, the Contracting Agency will retain 10 percent of all estimates as a guarantee for complete performance of the Agreement in accordance with Arizona Revised Statutes Section 34-221 or 34-607. The Contractor may elect to deposit securities in lieu of retention in accordance with Arizona Revised Statutes Section 34-221, Paragraph C.5. or 34-607, Paragraph B.5.
- 8.1.4 The payment process functions as follows: Prior to the payment cycle date, Contractor must send a draft Contractor Payment Request to Project Manager. The Project Team will review the Request and agree upon any necessary adjustments. Contractor must certify the final Request by signing and returning to Project Manager.
- 8.1.5 When construction of the Project is fifty percent (50%) completed, Contractor may request payment of one-half of the retention pursuant to A.R.S. § 34-609(B)(3), subject to all of City's rights to withhold or offset payments, and other rights of City, under the Agreement.
- 8.1.6 City reserves the right under A.R.S. § 34-609(B)(3) to reinstate the ten percent (10%) retention if City determines that satisfactory progress is not being made.
- 8.1.7 Contractor's Warranty of Title.
 - 8.1.7.1 Contractor warrants and guarantees that title to all Work, materials and equipment covered by any Contractor Payment Request, whether incorporated in the Project or not, will pass to City at the time of payment, free and clear of all liens, claims, security interests, and encumbrances, provided that this will not preclude the Contractor from installing metering devices or other equipment of utility companies or municipalities, the title of which is commonly retained by the utility company or municipality.
 - 8.1.7.2 No materials, supplies, or equipment for the Work under this Agreement will be purchased subject to any chattel mortgage or under a conditional sale contract or other agreement by which an interest therein, or any part thereof, is retained by the seller or supplier.
 - 8.1.7.3 Nothing contained in this Section will defeat or impair the right of such persons furnishing materials or labor under any bond given by the Contractor for their protection, or any right under any law permitting such persons to look to funds due the Contractor in the hands of the City. The provisions of this Section must be inserted in all subcontracts and material agreements, and notices of its provision must be given to all persons furnishing materials for the Work when no formal agreement is entered into for such materials.

8.2 **PAYMENT UPON SUBSTANTIAL COMPLETION**

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

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

8.3 **FINAL PAYMENT**

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

- a. Work has been fully completed (including completion of all incorrect or incomplete work items) and the written Final Acceptance has been issued by City;
- b. Necessary operating manuals, any excess materials and supplies necessary for matching materials and supplies incorporated into the Work, acceptable sewer video results (if applicable), and complete "as-built" Drawings (including the Building Information Model, if required by the Agreement Documents) have been delivered to City, as specified in this Section 8.3;
- c. Full and unconditional lien waivers and releases by Contractor and any person performing labor or supplying material, machinery, fixtures, or tools for the Work have been delivered to Contractor;
- d. All conditions and requirements imposed by City or any financing entity for the corresponding disbursement have been met; and
- e. Contractor delivers to City a Contractor Payment Request requesting Final Payment.

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

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

- a. Name, Model and Manufacturer.
- b. Complete parts lists and Drawings.
- c. Local source of supply for replacement parts along with suppliers' telephone numbers.
- d. Local service organizations serving the equipment and their telephone numbers.
- e. All tags, inspection slips, instruction packages, etc., removed from equipment must be properly identified as to pieces of equipment from which they were taken.

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

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

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

- a. Defective Work not remedied;
- b. Third party claims filed or reasonable evidence indicating probable filing of such claims unless security acceptable to City is provided by Contractor;
- c. Failure of Contractor to make payments properly to Subcontractors or for labor, materials or equipment;
- d. Reasonable evidence that the Work cannot be completed for the unpaid balance of the Agreement Price;
- e. Damage to City or another Contractor;
- f. Reasonable evidence that the Work will not be completed within the Agreement Time, and that the unpaid balance would not be adequate to cover actual or liquidated damages for the anticipated delay;
- g. Failure to carry out the Work in accordance with the Agreement Documents;
or
- h. Contractor is in default of any of its other obligations under the Agreement Documents.

8.5 **JOINT/DIRECT CHECKS**

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

8.6 **PAYMENT NOT A WAIVER**

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

8.7 **LIENS AND BOND CLAIMS**

Contractor must make all payments, in the time required, of all labor and materials furnished to Contractor in the course of the Work and must promptly furnish evidence of such payments as City may require. Contractor must pay when due all claims arising out of performance of the Work covered by this Agreement for which a lien may be filed either against the real estate or leasehold interest of City, or against payments due from City to Contractor, or for which a claim may be made against any payment or performance bond or both. To the fullest extent permitted by law, Contractor agrees that no liens or other claims in the nature of a lien against the real estate, leasehold, or other interest of City,

against payment due from City to Contractor, or against any payment or performance bond, must be filed or made in connection with the Work by any party who has supplied professional services, labor, materials, machinery, fixtures, tools, or equipment used in or in connection with the performance of this Agreement, and Contractor agrees to remove or to cause to be removed any such liens or claims in the nature of a lien or bond claim within 10 Days upon receiving notice or obtaining actual knowledge of the existence of such liens or claim. In addition, Contractor agrees to defend, indemnify, and hold harmless City from and against any and all such liens and claims. This paragraph does not apply to claims and liens of Contractor due to non-payment for work performed.

8.8 FINANCIAL RECORDKEEPING AND CITY'S AUDIT RIGHT

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

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

- a. Compliance with Agreement requirements for deliverables;
- b. Compliance with approved Plans and Specifications;
- c. Compliance with § 14.9 below;
- d. Compliance with Agreement provisions regarding the pricing of Change Orders;
- e. Accuracy of Contractor representations regarding the pricing of invoices; or
- f. Accuracy of Contractor representations related to claims submitted by

Contractor or any of their employees.

- 8.8.3 Contractor must require all payees (examples of payees include Subcontractors, Suppliers, Insurance Carriers, etc.) to comply with the provisions of this Section by including the requirements hereof in a written agreement between Contractor and payee. Contractor will ensure that all payees (including those entering into lump sum agreements) have the same right to audit provisions contained in this Agreement included in their agreements with Contractor.
- 8.8.4 City's authorized representative(s) (including, without limitation, Project Manager) must have reasonable access to Contractor's facilities, must be allowed to interview all current or former employees to discuss matters pertinent to the performance of this Agreement and must be provided adequate and appropriate work space, in order to conduct audits in compliance with this Section.
- 8.8.5 If an audit inspection or examination in accordance with this Section, discloses overpricing or overcharges to City (of any nature) by Contractor or Contractor's Subcontractors in excess of \$100,000 in addition to making adjustments for the overcharges, the reasonable actual cost of City's audit must be reimbursed to City by Contractor. Any adjustments or payments which must be made as a result of any such audit or inspection of Contractor's invoices or records must be made within a reasonable amount of time (not to exceed 90 Days) from presentation of City's findings to Contractor.
- 8.8.6 In addition to the normal paperwork documentation Contractor typically furnishes to City, Contractor agrees to furnish, upon written request from City, any of the documentation necessary for City to exercise its audit rights under this Section 8.8 in computer readable file formats (Word, Excel, or .pdf), as City may designate.
- 8.8.7 City, its authorized representative, and the appropriate agency, reserve the right to audit Contractor's records in compliance with local, state or federal policies, statutes or at City's discretion, within three (3) years of Final Acceptance of the Work.

SECTION 9 - CHANGES TO THE AGREEMENT

9.1 FIELD ORDERS

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

9.2 EXTRA WORK/CHANGES IN THE WORK

- 9.2.1 City reserves the right to make such changes in the Plans and Specifications for the Work, as it may deem appropriate and any such change as set forth in a written Change Order must be deemed a part of this Agreement as if originally incorporated herein.
- 9.2.2 In the event City and Contractor cannot agree on the terms of a Change Order, or when circumstances otherwise require, the Project Manager has the authority to direct the Contractor to perform extra work, if the work in question is an item not provided for in the

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

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

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

- a. By mutual acceptance of a lump sum properly itemized in a form acceptable to City;
- b. By unit prices stated in the Agreement Documents;
- c. When the City determines that a Unit Price Book Job Order associated with a Job Order Agreement requires a Change Order, by using the same Total Cost Data and CCI that are in effect when the Change Order is anticipated to be issued; or
- d. By actual cost and a percentage fee covering overhead and profit, as follows:
 - (i) Contractor will perform the extra work and be compensated for actual cost of labor, materials and equipment.
 - (ii) Contractor will have the right to add the fee percentage applicable to the Work under the Agreement, or if no such fee has been agreed to by the parties, not more than five percent (5%) to the Subcontractor's prices for authorized extra work performed solely by Subcontractors. Such percentage will include all of Contractor's charges for overhead, profit, administration and supervision.
 - (iii) Contractor or Subcontractor will have the right to add the fee percentage applicable to Work under the Agreement for self-performed extra work, or if no such fee has been agreed to by the parties, Contractor's or Subcontractor's maximum total allowable additions for overhead, profit, administration and supervision will

not exceed ten percent (10%) of actual verifiable labor, materials and equipment for such self- performed extra work.

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

9.3 **ACCURACY OF CHANGE ORDER PRICING INFORMATION**

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

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

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

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

9.4 **EMERGENCIES**

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

9.5 **DIFFERING SITE CONDITIONS**

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

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

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

SECTION 10 -SUSPENSION AND TERMINATION

10.1 **SUSPENSION**

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

10.2 **TERMINATION BY THE CITY FOR CAUSE**

10.2.1 MAG Specifications § 108.11 applies to the Agreement.

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

- a. After prior written notice, refused or failed to supply enough properly skilled workers or proper materials;
- b. After prior written notice, failed to make payment to Subcontractors for materials or labor in accordance with the respective agreements between Contractor and the Subcontractors;
- c. After prior written notice, disregards laws, ordinances, or rules, regulations or orders of a public authority having jurisdiction;
- d. After prior written notice, repeatedly failed to comply with written directives from City;

- e. Is adjudged as bankrupt or insolvent;
- f. Made a general assignment for the benefit of creditors;
- g. Appointed a trustee or receiver for itself or any of its property;
- h. Filed a petition to take advantage of any debtor's act, or to reorganize under the bankruptcy or similar laws; or
- i. Otherwise breached a provision of the Agreement Documents or any other Agreement between City and Contractor.

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

10.3 **TERMINATION BY CITY FOR CONVENIENCE**

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

10.4 **A.R.S. § 38-511**

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

SECTION 11 -INSURANCE AND BONDS

11.1 **INSURANCE REQUIREMENTS**

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

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

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

- 11.1.4 The City in no way warrants that the minimum insurance limits contained in this Agreement are sufficient to protect Contractor from liabilities that might arise out of the performance of the Agreement services under this Agreement by Contractor, its agents, representatives, employees, or Subcontractors and the Contractor is free to purchase any additional insurance as may be determined necessary.
- 11.1.5 Failure to demand evidence of full compliance with the insurance requirements in this Agreement or failure to identify any insurance deficiency will not relieve the Contractor from, nor will it be considered a waiver of its obligation to maintain the required insurance at all times during the performance of this Agreement.
- 11.1.6 Use of Subcontractors: If any Work is subcontracted in any way, the Contractor must execute a written agreement with Subcontractor containing the same Indemnification Clause and Insurance Requirements as the City requires of the Contractor in this Agreement. The Contractor is responsible for executing the Agreement with the Subcontractor and obtaining Certificates of Insurance and verifying the insurance requirements.
- 11.2 **MINIMUM SCOPE AND LIMITS OF INSURANCE**
- 11.2.1 The Contractor must provide coverage with limits of liability not less than those stated below.
- 11.2.1.1 Commercial General Liability-Occurrence Form. Contractor must maintain "occurrence" form Commercial General Liability insurance with a limit of not less than \$2,000,000 for each occurrence, \$4,000,000 aggregate. Said insurance must also include coverage for products and completed operations, independent contractors, personal injury and advertising injury. If any Excess insurance is utilized to fulfill the requirements of this paragraph, the Excess insurance must be "follow form" equal or broader in coverage scope than underlying insurance.
- 11.2.1.2 Automobile Liability-Any Automobile or Owned, Hired and Non-Owned Vehicles. Contractor must maintain Business/Automobile Liability insurance with a limit of \$1,000,000 each accident on Contractor owned, hired, and non-owned vehicles assigned to or used in the performance under this Agreement. If any Excess or Umbrella insurance is utilized to fulfill the requirements of this paragraph, the Excess or Umbrella insurance must be "follow form" equal or broader in coverage scope than underlying insurance.
- 11.2.1.3 Workers Compensation and Employers Liability Insurance. Contractor must maintain Workers Compensation insurance to cover obligations imposed by federal and state statutes having jurisdiction of Contractor employees engaged in the performance of Work under this Agreement and must also maintain Employers' Liability insurance of not less than \$1,000,000 for each accident and \$1,000,000 disease for each employee.
- 11.2.1.4 Builders' Risk/Installation Floater Insurance. The Contractor bears all responsibility for loss to all equipment or Work under construction. Unless waived in writing by the City the Contractor will purchase and maintain in force Builders' Risk/Installation Floater insurance on the entire Work until completed and accepted by the City. This insurance will be Special Causes of Loss policy form, (minimally including perils of fire, flood, lightning, explosion, windstorm and hail, smoke, aircraft and vehicles, riot and civil commotion, theft, vandalism, malicious mischief, and collapse), completed value, replacement cost policy form equal to the Agreement Price and all subsequent modifications. The Contractor's Builders'

Risk/Installation Floater insurance must be primary and not contributory.

- a. Builders' Risk/Installation Floater insurance must cover the entire Work including reasonable compensation for architects and engineers' services and expenses and other "soft costs" made necessary by an insured loss. Builders' Risk/Installation Floater insurance must provide coverage from the time any covered property comes under the Contractor's control and or responsibility, and continue without interruption during course of construction, renovation and or installation, including any time during which any Project property or equipment is in transit, off Site, or while on Site for future use or installation. Insured property must include, but not be limited to, scaffolding, false work, and temporary buildings at the Site. This insurance must also cover the cost of removing debris, including demolition as may be legally required by operation of any law, ordinance, regulation or code.
- b. The Contractor must also purchase and maintain Boiler and Machinery insurance with the same requirements as Builders' Risk/Installation Floater insurance cited above if the Work to be performed involves any exposures or insurable property normally covered under a Boiler and Machinery insurance policy or made necessary as required by law or testing requirements in the performance of this Agreement. The Contractor will be responsible for any and all deductibles under these policies and the Contractor waives all rights of recovery and subrogation against the City under the Contractor- Builders' Risk/Installation Floater insurance described herein.
- c. Builders' Risk/Installation Floater Insurance must be maintained until whichever of the following first occurs: (i) final payment has been made; or, (ii) until no person or entity, other than the City, has an insurable interest in the property required to be covered.
- d. The Builders' Risk/Installation Floater insurance must be endorsed so that the insurance will not be canceled or lapse because of any partial use or occupancy by the City.
- e. The Builders Risk/Installation Floater insurance must include as named insureds, the City, the Contractor, and all tiers of Subcontractors and others with an insurable interest in the Work who will be named as additional insureds unless they are able to provide the same level of coverage with the City and Contractor named as additional insureds. Certificates must contain a provision that the insurance will not be canceled or materially altered without at least 30 Days advance notice to the City. The City must also be named as a Loss Payee under the Builders' Risk/Installation Floater coverage.
- f. The Builders Risk/Installation Floater insurance must be written using the Special Causes of Loss policy form, replacement cost basis.
- g. All rights of subrogation under the Builders Risk/Installation Floater insurance are, by this Agreement, waived against the City, its officers, officials, agents and employees.
- h. The Contractor is responsible for payment of all deductibles under the Builders' Risk/Installation Floater insurance policy.

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

- a. The policy must provide for complete professional service coverage, including coverage for pollution liability that is a result of a breach of professional duties.
- b. The policy must provide for protection again claims for third-party bodily injury, property damage, or environmental damage caused for pollution conditions resulting from general contracting activities for which Contractor is legally liable.
- c. The policy must provide for cleanup costs when mandated by governmental entities, when required by law, or as a result of third-party claims.
- d. Completed Operations Coverage must be kept in place for up to the statute of repose.
- e. The policy must be endorsed to include the following additional insured language: "City, its elected officials, trustees, employees, agents, and volunteers must be named as additional insureds with respect to liability arising out of the activities performed by, or on behalf of Contractor".
- f. If Work under this Agreement requires the transportation of any hazardous material or regulated substances, Contractor must carry Auto Liability with a CA 9948 endorsement or equivalent.
- g. If Work under this Agreement requires the disposal of any hazardous materials from the job site, Contractor must obtain a certificate of insurance for Pollution Legal Liability from the disposal site operator with a limit of not less than \$5,000,000 per loss, \$5,000,000 aggregate.

11.3 **ADDITIONAL POLICY PROVISIONS REQUIRED**

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

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

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

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

11.3.5 Coverage provided by the Contractor must not be limited to the liability assumed under the

indemnification provisions of this Agreement.

- 11.3.6 The policies must contain a severability of interest clause and waiver of subrogation against the City, its officers, officials, agents, and employees, for losses arising from Work performed by the Contractor for the City.
- 11.3.7 The Contractor, its successors and or assigns, are required to maintain Commercial General Liability insurance as specified in this Agreement for a minimum period of 3 years following completion and acceptance of the Work. The Contractor must submit a Certificate of Insurance evidencing Commercial General Liability insurance during this 3 year period containing all the Agreement insurance requirements, including naming the required Additional Insureds set forth herein.
- 11.3.8 If a Certificate of Insurance is submitted as verification of coverage, the City will reasonably rely upon the Certificate of Insurance as evidence of coverage but this acceptance and reliance will not waive or alter in any way the insurance requirements or obligations of this Agreement.
- 11.3.9 Insurance Cancellation During Agreement Term.
- 11.3.9.1 If any of the required policies expire during the life of this Agreement, the Contractor must forward renewal or replacement Certificates to the City within 10 Days after the renewal date containing all the required insurance provisions.
- 11.3.9.2 Each insurance policy required by the insurance provisions of this Agreement must provide the required coverage and must not be suspended, voided or canceled except after 30 Days prior written notice has been given to the City, except when cancellation is for non-payment of premium, then 10 Days prior notice may be given. Such notice must be sent directly to Chandler Law-Risk Management Department, Post Office Box 4008, Mailstop 628, Chandler, Arizona 85225. If any insurance company refuses to provide the require notice, the Contractor or its insurance broker must notify the City of any cancellation, suspension, non-renewal of any insurance within 7 Days of receipt of insurers' notification to that effect.
- 11.3.10 City as Additional Insured. The above-referenced policies are to contain, or be endorsed to contain, the following provisions:
- 11.3.10.1 The Commercial General Liability and Automobile Liability policies are to contain, or be endorsed to contain, the following provisions: The City, its officers, officials, agents, and employees are additional insureds with respect to liability arising out of activities performed by, or on behalf of, the Contractor including the City's general supervision of the Contractor; Products and Completed Operations of the Contractor; and automobiles owned, leased, hired, or borrowed by the Contractor.
- 11.3.10.2 The City, its officers, officials, agents, and employees must be additional insureds to the full limits of liability purchased by the Contractor even if those limits of liability are in excess of those required by this Agreement.
- 11.4 **BONDS AND OTHER PERFORMANCE SECURITY**
- 11.4.1 After Agreement award, Contractor must provide a Performance Bond and a Payment Bond, each in an amount equal to the full amount of the Agreement Price.
- 11.4.2 Each such bond must be executed by a surety company or companies holding a Certificate

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

- 11.4.3 The bonds must be made payable and be acceptable to City. The bond forms for the performance and payment bonds must be in the forms required under A.R.S. § 34-221, *et. Seq.*, as in Appendices 4 and 5 of these General Conditions.
- 11.4.4 Upon the request of any person or entity appearing to be a potential beneficiary of bonds covering payment of obligations arising under the Agreement Documents, Contractor must promptly furnish a copy of the bonds or must permit a copy to be made.
- 11.4.5 All bonds submitted for this Project must be provided by a company which has been rated AM Best rating of A- or better for the prior four quarters by the latest edition of the 'Results Best's Key Rating Guide (Property/Casualty)' published by the A.M. Best Company.
- 11.4.6 Personal or individual bonds are not acceptable.
- 11.4.7 If the surety on any Bond furnished by Contractor is declared a bankrupt or becomes insolvent, or Contractor's right to do business is terminated in any state where any part of the Project is located, or it ceases to meet the requirements of this Section 11.4, Contractor must within 5 Days thereafter substitute another Bond and surety, both of which must be acceptable to City.

SECTION 12 - INDEMNIFICATION

- 12.1 To the extent permitted by law, the Contractor and its owners, officers, directors, agents, employees, and subconsultants (collectively "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 Agreement, the Work or the Project, other than termination under Section 10, will be resolved pursuant to the Dispute Resolution process set forth in Appendix 6 of these General Conditions, and not pursuant to MAG Specifications § 110.
- 13.2 Contractor agrees that during any dispute between the parties, Contractor will continue to perform its obligations under the Agreement until such dispute is resolved.
- 13.3 Notwithstanding any other provision in this Agreement, City has the right to immediately file in court and pursue an action for a temporary restraining order and injunctive relief against Contractor if City determines that such action is necessary to protect its interests under the Agreement, to obtain specific performance of any provision of the Agreement, to advance the completion of the Project, or to protect health, welfare and safety.

SECTION 14 - MISCELLANEOUS PROVISIONS

14.1 AGREEMENT DOCUMENTS

- 14.1.1 The Agreement Documents are intended to permit the parties to complete the Work and all obligations required by the Agreement Documents within the Agreement Times for the Agreement Price. The Agreement Documents are intended to be complementary and interpreted in harmony so as to avoid conflict, with words and phrases interpreted in a manner consistent with construction and design industry standards.
- 14.1.2 It is the intent of the Agreement Documents to describe a functionally complete Project (or part thereof) to be constructed in accordance with the Agreement Documents. Any labor, documentation, services, materials, or equipment that may reasonably be inferred from the Agreement Documents or from prevailing custom or trade usage as being required to produce the intended result must be provided by Contractor whether or not specifically called for at no additional cost to City.
- 14.1.3 The Agreement Documents establish the rights and obligations of the parties and include the Agreement, Addenda (which pertain to the Agreement Documents), Contractor's Bid or Proposal (including documentation accompanying the Bid and any post-Bid documentation submitted prior to Agreement award) when attached as an exhibit to the Agreement, the accepted Project Schedule, the Notice to Proceed, the Performance Bond, the Payment Bond, Project Design, Engineering and Specifications, these General Conditions, the Project Specific Special Provisions, Technical Specifications, Agreement Drawings, as the same may be more specifically identified in the Agreement, Change Orders, Work Change Directives, Field Orders and the written interpretations and clarifications of the Design Professional or City representative and Modifications issued after execution of the Agreement. Approved Shop Drawings and the reports and drawings of subsurface and physical conditions are not Agreement Documents.
- 14.1.4 In the event of any inconsistency, conflict, or ambiguity between or among the Agreement Documents, the Agreement Documents will take precedence as follows from highest to lowest: Change Orders, Addenda, Agreement, Project Specific Special Provisions, General Conditions, Technical Specifications, Drawings/Plans, Chandler Amendments to MAG Standard Specifications and Chandler Standard Details, and MAG Uniform Standard Specifications and Details for Public Works Construction. If applicable to this Agreement, Federal Provisions prevail.

- 14.1.5 On the Drawings, given dimensions will take precedence over scaled measurements and large scale drawings over small-scale drawings.
- 14.1.6 Clarifications and interpretations of the Agreement Documents will be issued by the Design Professional through the City.
- 14.1.7 The headings used in this Agreement or any other Agreement Documents, are for ease of reference only and must not in any way be construed to limit or alter the meaning of any provision.
- 14.1.8 The Agreement Documents form the entire agreement between City and Contractor. No oral representations or other agreements have been made by the parties except as specifically stated in the Agreement Documents.
- 14.1.9 The Agreement Documents may not be changed, altered, or amended in any way except in writing signed by a duly authorized representative of each party in the form of a Change Order.
- 14.1.10 Re-Use of Documents. Neither Contractor nor any Subcontractor, manufacturer, fabricator, supplier or distributor will have or acquire any title to or ownership rights in any of the Drawings, Specifications or other documents (or copies of any thereof) prepared by or bearing the seal of the Design Professional; and they must not re-use any of them on extensions of the Project or any other project without written consent of City and the Design Professional and specific written verification or adaptation by the Design Professional.
- 14.2 **REFERENCE STANDARDS**
 - 14.2.1 Reference to standards, specifications, manuals, or codes of any technical society, organization, or association, or to Laws or Regulations, whether such reference be specific or by implication, will mean the standard, specification, manual, code, or Laws or Regulations in effect at the time of opening of Bids (or on the Effective Date of the Agreement if there were no Bids), except as may be otherwise specifically stated in the Agreement Documents.
 - 14.2.2 The provisions of any such standard, specification, manual or code, or any instruction of a Supplier will not change the duties or responsibilities of City, Contractor, Design Professional or Project Manager, or any of their Subcontractors, consultants, agents, or employees from those set forth in the Agreement Documents, nor will any such provision or instruction assign to City, Contractor, Design Professional, or any of their agents, or employees any duty or authority to supervise or direct the performance of the Work or any duty or authority to undertake responsibility inconsistent with the provisions of the Agreement Documents.
- 14.3 **COMPLIANCE WITH ARIZONA LAW AND FEDERAL LAW**
 - 14.3.1 Compliance with A.R.S. § 41-4401. Pursuant to the provisions of A.R.S. § 41-4401, the Contractor hereby warrants to the City that the Contractor and each of its subcontractors ("Subcontractors") must comply with all Federal Immigration laws and regulations that relate to the immigration status of their employees and the requirement to use E-Verify set forth in A.R.S. §23-214(A).
 - 14.3.2 A breach of the Contractor Immigration Warranty constitutes a material breach of this Agreement and subject to penalties up to and including termination of this Agreement.

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

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

14.3.5 The provisions of this Article must be included in any agreement the Contractor enters into with any and all of its subcontractors who provide services under this Agreement or any subcontract. "Services" are defined as furnishing labor, time or effort in the State of Arizona by a contractor or subcontractor. Services include construction or maintenance of any structure, building or transportation facility or improvement to real property.

14.4 **HAZARDOUS ENVIRONMENTAL CONDITIONS**

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

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

- a. Secure or otherwise isolate such condition;
- b. Stop all Work in connection with such condition and in any area affected thereby; and
- c. Notify City and promptly thereafter confirm such notice in writing.

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

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

14.5 **COOPERATION AND FURTHER DOCUMENTATION**

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

14.6 **ASSIGNMENT**

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

14.7 **SUCCESSORS**

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

14.8 **LAWFUL PRESENCE**

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

14.9 **NO BOYCOTT OF ISRAEL CERTIFICATION**

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

14.10 **NO THIRD PARTY BENEFICIARY**

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

14.11 **GOVERNING LAW AND VENUE**

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

14.12 **SEVERABILITY**

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

14.13 **LEGAL REQUIREMENTS**

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

forth on Exhibit C of the Agreement.

14.14 **PARTIAL INVALIDITY**

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

14.15 **ATTORNEYS' FEES**

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

14.16 **CONFLICT OF INTEREST**

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

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

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

14.17 **INDEPENDENT CONTRACTOR**

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

14.18 **NOTICE OF INJURY**

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

14.19 **CONFIDENTIALITY**

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

14.20 DATA CONFIDENTIALITY

- 14.20.1 As used in the Agreement, “data” means all information, whether written or verbal, including plans, specifications, renderings, **photographs**, studies, investigations, audits, analyses, samples, reports, calculations, internal memos, meeting minutes, data field notes, work product, proposals, correspondence and any other similar documents or information prepared by, obtained by, or transmitted to the City in the performance of this Agreement.
- 14.20.2 Contractor agrees that all data, regardless of form, including originals, images, and reproductions, prepared by, obtained by, or transmitted to City in connection with the Contractor’s performance of this Agreement is confidential and proprietary information belonging to City.
- 14.20.3 Except as specifically provided in this Agreement, Contractor or its Subcontractors must not divulge data to any third party without prior written consent of City. Contractor or its Subcontractors must not use data for any purposes except to perform Work required under this Agreement. These prohibitions will not apply to the following data provided Contractor has first given the required notice to City:
- a. Data which was known to Contractor or its Subcontractors prior to its performance under this Agreement unless such data was acquired in connection with Work performed for City;
 - b. Data which was acquired by Contractor or its Subcontractors in its performance under this Agreement and which was disclosed to Contractor or its Subcontractors by a third party, who to the best of Contractor’s or its Subcontractor’s knowledge and belief, had the legal right to make such disclosure and Contractor or its Subcontractors are not otherwise required to hold such data in confidence; or
 - c. Data which is required to be disclosed by virtue of law, regulation, or court order, to which the Contractor or its Subcontractors are subject.
- 14.20.4 In the event the Contractor or its Subcontractors are required or requested to disclose data to a third party, or any other information to which the Contractor or its Subcontractors became privy as a result of any other agreement with City, the Contractor must first notify City as set forth in this Section of the request or demand for the data. The Contractor or its Subcontractors must give City sufficient facts so that City can be given an opportunity to first give its consent or take such action that City may deem appropriate to protect such data or other information from disclosure.
- 14.20.5 Unless prohibited by law, within 10 Days after completion of services for a third party on real or personal property owned or leased by City, the Contractor must promptly deliver, as set forth in this Section, a copy of all data to City. All data will continue to be subject to the confidentiality agreements of this Agreement.
- 14.20.6 Contractor or its Subcontractors assume all liability for maintaining the confidentiality of the data in its possession and agree to compensate City if any of the provisions of this Section are violated by Contractor, its employees, agents, or Subcontractors. Solely for the purposes of seeking injunctive relief, it is agreed that a breach of this Section will be deemed to cause irreparable harm that justified injunctive relief in court. Contractor agrees that the requirements of this Section will be incorporated into all subcontracts entered into by Contractor. A violation of this Section may result in immediate termination of this

Agreement without notice.

14.21 **SURVIVAL**

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

14.22 **COVENANTS AGAINST CONTINGENT FEES**

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

14.23 **NO WAIVER**

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

14.24 **NONEXCLUSIVE REMEDIES**

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

14.25 **PROJECT COMMUNICATIONS**

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

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

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

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

14.26 **DRUG FREE WORKPLACE PROGRAM**

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

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

14.27 Failure to require a drug free workplace in accordance with the City's policy may result in termination of the Agreement and possible debarment from bidding on future City projects.

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

15.1 **ADDITIONAL DEFINITIONS**

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

Baseline Cost Model –

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

CM@Risk or Construction Manager at Risk –

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

CM@Risk Fee or Contractor's Fee –

An agreed to percentage in an accepted GMP that represents the Contractor's fee for performance of the Work.

Agreement Documents –

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

Agreement Price –

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

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

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

Cost of the Work –

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

General Conditions.

Deliverables –

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

Pre-Construction Services Agreement –

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

Pre-Construction Services –

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

Detailed Project Schedule –

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

General Conditions Costs –

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

GMP Plans and Specifications –

The plan and specifications upon which the Guaranteed Maximum price Proposal is based.

GMP Proposal –

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

Guaranteed Maximum Price or GMP –

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

15.2 **AGREEMENT PRICE**

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

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

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

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

15.3 **ALLOWANCES**

15.3.1 Contractor must include in the Agreement Price all Allowances stated in the Agreement Documents and agreed to in writing by City. Items covered by these Allowances must be supplied for such amounts and by such persons as City may direct, provided Contractor will not be required to employ persons against whom Contractor makes a reasonable objection. Materials, labor, and equipment under an Allowance will be selected by City in accordance with a schedule to be mutually agreed upon by City, Design Professional and Contractor or otherwise in reasonably sufficient time to avoid delay in the Work.

15.3.2 Unless otherwise provided in the Agreement Documents:

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

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

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

15.4 **CONTINGENCY**

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

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

item of the Project but may be used for any portion of the work as determined above. Any amount not used in the Construction Contingency will belong to City and will reduce the GMP.

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

15.5 **REDUCTION IN RETENTION**

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

15.6 **FINAL PAYMENT**

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

15.7 **OPEN BOOK**

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

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

A Change Order for increased costs under Section 9.5 or 9.6 above will only be considered

or granted by City to the extent such actual, documented costs are justified.

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

16.1 ADDITIONAL DEFINITIONS

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

Agreement –

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

JOC Contractor's Coefficient –

A numerical factor that represents JOC Contractor total costs (indirect and direct costs, sales tax, profit, etc.) and other adjustments for market conditions.

Job Order Request for Proposal (RFP) –

The Request for Proposals issued by City for each Job Order Project Agreement relating to a specific Project.

Job Order Cost Proposal –

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

Guaranteed Maximum Price (GMP) Job Order –

Job Order under which JOC Contractor is compensated for actual costs incurred.

Job Order Project Agreement (Job Order) –

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

16.2 ORDERING AND PROCESSING PROCEDURES FOR JOB ORDERS

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

16.2.2 RFP's For Job Orders

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

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

16.2.3 JOC Contractor's Job Order Cost Proposal

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

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

- a. JOC Contractor's Job Order Cost Proposal in PDF and electronic format;
- b. A Project Schedule and schedule of values that reflects the costs of each work element on the schedule. The schedule must show all milestones (e.g., permits, submittals, ordering materials, demolition, work phases, closeout and completion date); and
- c. Necessary documentation will be required to indicate that adequate scoping, layout, setup and planning to accomplish the Work has been done. Examples of documentation that might reasonably be expected include sketches, drawings, calculations, catalog cuts and specifications produced to a level of detail and skill that could be expected of experienced, competent Project Managers with five or more periods experience in their respective trade.

16.2.3.3 JOC Contractor must select Subcontractors based on qualifications alone or on a combination of qualifications and price and must not select Subcontractors based on price alone. A qualifications and price selection may be a one-step selection based on a combination of qualifications and price or two-step selection. In a two-step selection, the first step must be based on qualifications alone and the second step may be based 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 Agreement will generally be as follow, all of which will be signed and/or initialed by JOC Contractor's designated representative:

- a. The description of the Scope of the Work and Project Schedule (attached as Exhibit A to the Job Order);
- b. The address or location of the Work;
- c. The Agreement Price for Work (Construction) included in the Project (attached as Exhibit B to the Job Order);
- d. The name of the JOC Contractor representative for the Project;
- e. The Drawings and Specifications for the Project;
- f. If any shop drawings, project date and/or samples are required for the Job Order, the date for delivery of each required item (included in the Project Schedule, Exhibit A to the Job order); and
- g. Project Specific Provisions, if any, in Exhibit A to the Job Order, including, without limitation, whether any of the following are required: Pre-Construction Conference, weekly progress meetings, field office, storage enclosure, materials and equipment handling facility, submittals, shop drawings, product data, equipment list, samples, project manual, schedule of values, Construction progress schedule, narrative reports, progress report, progress charts, progress photographs, materials status report, Construction diagram, Construction status report, operation and maintenance data, operating maintenance instructions and parts list, and as-build drawings.

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

16.3 **INCIDENTAL DESIGN SERVICES**

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

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

16.3.3 JOC Contractor represents, covenants, and agrees, and contractually assumes the obligation to furnish, all of the required Design Services through properly licensed and

experienced Design Professionals in complete accordance with all of the duties imposed on a Design Professional under the Agreement Documents, Laws, Regulations, or Legal Requirements, and the common law.

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

16.4 **CONSTRUCTION SERVICES**

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

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

16.4.3 Construction Phasing

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

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

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

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

- 16.4.5 Ownership of Work Product. Work Product prepared or otherwise created in connection

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

16.5 **OPTIONAL LIQUIDATED DAMAGES**

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

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

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

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

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

16.6 **PERFORMANCE MEASUREMENT**

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

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

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

17.1 ADDITIONAL DEFINITIONS

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

17.2 GENERAL

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

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

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

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

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

- 17.2.6 **Ownership of Work Product.** All Work Product prepared or otherwise created in connection with the performance of this Agreement, including the Work, are to be and remain the property of City. For purposes of this provision, "Work Product" will include all designs, drawings, plans, specifications, ideas, renderings and other information or material, in whatever form created (e.g., electronic or printed) and in all media now know or hereinafter created. All Work Product will be considered Work Made for Hire as defined in the United States Copyright Act 17 U.S.C. §101 (Copyright Act). If for any reason any such Work is found not to be a work for hire, Contractor hereby transfers and assigns ownership of the copyright in such Work to City. The rights in this Section are exclusive to City in perpetuity.
- 17.2.7 CM@Risk represents to City in completing Pre-Construction Services and providing the reports and analysis required thereunder, that Work can be properly and timely constructed within the GMP Proposal, if accepted. CM@Risk does not assume any design responsibilities unless specifically called for in the scope of work, but CM@Risk will be responsible for their errors, omissions or inconsistencies included in the Work.
- 17.3 **DETAILED PROJECT SCHEDULE**
- 17.3.1 The fundamental purpose of the Detailed Project Schedule is to identify, coordinate and record the tasks and activities to be performed by all of the Project Team members and then for the Project Team to utilize that Deliverable as a basis for managing and monitoring all member's compliance with the schedule requirements of the Project. Each Project Team member is responsible for its compliance with the Detailed Project Schedule requirements. CM@Risk must, however, develop and maintain the Detailed Project Schedule on behalf of and to be used by the Project Team based on input from the other Project Team members. The Baseline Project Schedule must be developed as part of the Baseline Cost Model. The Detailed Project Schedule must use the Critical Path method ("CPM") technique, unless required otherwise, in writing by City. CM@Risk must use scheduling software acceptable to City to develop the Detailed Project Schedule. The Detailed Project Schedule must be presented in graphical and tabular reports as agreed upon by the Project Team. If Project phasing as described below is required, the Detailed Project Schedule must indicate milestone dates for the phases once determined. As part of construction phase, City may require CM@Risk to prepare a "resource loaded" schedule for all work, including work performed by Subcontractors, detailing each of the project tasks and the required/anticipated number of personnel per day for each task. CM@Risk must also indicate on the schedule its ability to meet said required/anticipated personnel requirements.
- 17.3.2 CM@Risk must include and integrate in the Detailed Project Schedule the services and activities required of City, Design Professional and CM@Risk including all construction phase activities based on the input received from City and the Design Professional. The Detailed Project Schedule must define activities as determined by City to the extent required to show: (a) the coordination between preliminary design and various pre-construction documents, (b) any separate long-lead procurements, (c) any permitting issues, (d) any land, right-of-way, or easement acquisition, (e) bid packaging strategy and awards to Subcontractors and Suppliers, (f) major stages of construction, (g) start-up and commissioning, and (h) occupancy of the completed Work by City. The Detailed Project Schedule must include by example and not limitation, proposed activity sequences and durations for design, procurement, construction and testing activities, milestone dates for actions and decisions by the Project Team, preparation and processing of shop drawings

and samples, delivery of materials or equipment requiring long-lead time procurement (if any), milestone dates for various construction phases, Total Float for all activities to the extent authorized by City, relationships between the activities, City's occupancy requirements showing portions of the Project having occupancy priority, and proposed dates for Final Acceptance.

- 17.3.3 A Baseline Project Schedule must be initiated with the project Baseline Cost Model and agreed to by the project team at the same time. CM@Risk must update and maintain a detailed Project Schedule throughout pre-construction such that it will not require major changes at the start of the construction phase to incorporate CM@Risk's plan for the performance of the construction phase Work. CM@Risk must provide updates and/or revisions to the Detailed Project Schedule for use by the Project Team, whenever required, but no less often than at the Project Team meetings. CM@Risk must include with such submittals a narrative describing its analysis of the progress achieved to-date vs. the Baseline Project Schedule, including any concerns regarding delays or potential delays, and any recommendations regarding mitigating actions.
- 17.3.4 If phased construction is deemed appropriate at the time of developing the Baseline Cost Model or during the development of the Detailed Project Schedule, and City approves, CM@Risk must review the design and make recommendations regarding the phased issuance of Construction Documents to facilitate phased construction of the Work, with the objective of reducing the Project Schedule and/or Cost of the Work. CM@Risk must take into consideration such factors as natural and practical lines of work severability, sequencing effectiveness, access and availability constraints, total time for completion, construction market conditions, labor and materials availability, and any other factors pertinent to saving time and cost.
- 17.3.5 Long Lead Time Items. As part of developing the Detailed Project Schedule, CM@Risk must identify all long lead time materials, fabrications, equipment, or other items which may impact the Project Schedule and may require early action on the part of the Project Team. Dates for selecting and ordering long lead time items will be included and highlighted in the Detailed Project Schedule
- 17.3.6 Equipment Plan. Contractor must develop an Equipment Plan that addresses all rental and owned equipment, regardless of whether such equipment will be provided by CM@Risk or subcontractor(s), that will be necessary to construct the Project and the cost of which will be included as a Cost of the Work in the GMP Proposal. The Equipment Plan will seek to minimize the cost of the equipment to City and maximize the efficient and coordinated use of the equipment for completion of the Project. The Equipment Plan will not only include the costs and allowable lease rates for the equipment, but will also include an equipment schedule that will be incorporated into the Detailed Project Schedule and the Schedule of Values submitted with the GMP Proposal.
- 17.4 **DESIGN DOCUMENT REVIEWS**
- 17.4.1 CM@Risk must evaluate periodically the availability of labor, materials/equipment, cost-sensitive aspects of the design; and other factors that may create an unacceptable variance to the Baseline Cost Model and/or Baseline Project Schedule.
- 17.4.2 CM@Risk must recommend, in conjunction with the Project Team, those additional surface and subsurface investigations that, in its professional opinion, are required to provide the necessary information for CM@Risk to construct the Project. These additional

- investigations, if agreed to be necessary by the Project Manager and the Design Professional, will be acquired by City and copies of the reports will be provided to CM@Risk.
- 17.4.3 CM@Risk must meet with the Project Team as required to review designs during their development. CM@Risk must familiarize itself with the evolving documents through pre- construction. CM@Risk must proactively advise the Project Team and make recommendations on factors related to construction costs, and concerns pertaining to the feasibility and practicality of any proposed means and methods, selected materials, equipment and building systems, and, labor and material availability. CM@Risk must furthermore advise the Project Team on proposed site improvements, excavation and foundation considerations, as well as, concerns that exist with respect to coordination of the Drawings and Specifications. CM@Risk must use established value analysis principles in recommending cost effective alternatives.
- 17.4.4 CM@Risk must routinely conduct constructability and bid-ability reviews of the Drawings and Specifications as necessary to satisfy the needs of the Project Team. The reviews must attempt to identify all discrepancies and inconsistencies in the Construction Documents especially those related to clarity, consistency, completeness and coordination of Work of Subcontractors and Suppliers.
- 17.4.4.1 CM@Risk must evaluate whether: (a) the Drawings and Specifications are configured to enable efficient construction; (b) design elements are standardized; (c) construction efficiency is properly considered in the Drawings and Specifications; (d) module/preassembly design is prepared to facilitate fabrication, transport and installation; (e) sequences of Work required by or inferable from the Drawings and Specifications are practicable; (f) the design has taken into consideration efficiency issues concerning access and entrance to the site, laydown and storage of materials, staging of site facilities, construction parking, and other similar pertinent issues; and (g) the design maintains continued operation of the existing City systems and maintains traffic on adjacent roadways. CM@Risk must also review the Drawings and Specifications to ensure that what is depicted therein can be constructed as designed and must promptly inform the Project Team of any issues.
- 17.4.4.2 CM@Risk must check cross-reference and complementary Drawings and sections within the Specifications and in general evaluate whether: (a) the Drawings and Specifications are sufficiently clear and detailed to minimize ambiguity and to reduce scope interpretation discrepancies; (b) named materials and equipment are commercially available and are performing well, or otherwise, in similar installations; (c) Specifications include alternatives in the event a requirement cannot be met in the field; and (d) in its professional opinion, the Project is likely to be subject to Differing Site Conditions.
- 17.4.4.3 The results of the reviews must be provided to Project Team in formal, written reports clearly identifying all reviewed documents and the discovered discrepancies and inconsistencies in the Drawings and Specifications with notations and recommendations made on the Drawings, Specifications and other documents. CM@Risk must meet with Project Team to discuss any findings and review reports.
- 17.4.4.4 CM@Risk's reviews must be from a Contractor's perspective, and though it will serve to eliminate/reduce the number of RFIs) and changes during the construction phase, responsibility for the Drawings and Specifications will remain with the Design Professional and not CM@Risk.

- 17.4.5 It is CM@Risk's responsibility to assist the Design Professional in ascertaining that, in CM@Risk's professional opinion, the Construction Documents are in accordance with applicable Laws, Regulations, or Legal Requirements, building codes, sound engineering principle's rules and regulations. If CM@Risk recognizes that portions of the Construction Documents are at variance with applicable laws, statutes, ordinances, building codes, sound engineering principle's rules and regulations, it must promptly notify the Project Team in writing, describing the apparent variance of deficiency. However, the Design Professional is ultimately responsible for the compliance of the Drawings and Specifications with those laws, statutes, ordinances, building codes, rules and regulations.
- 17.4.6 The Project Team will routinely identify and evaluate using value analysis principles and alternate systems, approaches, design changes that have the potential to reduce Project costs while still delivering a high quality and fully functional Project consistent with the Project Program. If the Project Team agrees, CM@Risk in cooperation with the Design Professional, will perform a cost/benefit analysis of the alternatives and submit such in writing to the Project Team. City, through the Project Manager, will direct which alternatives will be incorporated into the Project. The Design Professional will have full design responsibility for the review and incorporation of CM@Risk suggested alternatives into the Drawings and Specifications. CM@Risk must analyze the costs and schedule impacts of the alternatives against the Baseline Cost Model and Schedule and provide a recommendation for the Project Team's consideration and City's approval prior to the establishment of the GMP.
- 17.5 **BASELINE COSTS MODEL, DETAILED COST ESTIMATES, AND SCHEDULE OF VALUES**
- 17.5.1 At the conclusion of the Master Planning and Programming, if required, CM@Risk will review all available information regarding the design and scope of the Project using CM@Risk's experience in performing similar work, knowledge of similar projects and current and projected construction costs and, based upon that review, must develop a Baseline Cost Model for review by the Project Team and approval by City. Once approved by City, the Baseline Cost Model will be continually referenced as detailed estimates are created as the design progresses throughout Pre-Construction until the final GMP for the entire Project is established. A final GMP for the entire Project must be established and approved by City prior to the start of construction. It is the responsibility of CM@Risk to ensure City has sufficient information to evaluate and approve a final GMP prior to the time necessary to start construction so construction can be completed within the Agreement Time. The Project Detailed Cost Estimate will be the best representation from CM@Risk of what the complete functional Project's construction costs will be as indicated by the most current available documents and will be constantly checked against the Baseline Cost Model. CM@Risk must communicate to the Project Team and assumptions made in preparing the Baseline Cost Model. The Baseline Cost Model must support CM@Risk's Detailed Cost Estimates and may be broken down initially as dictated by the available information, as required by City.
- 17.5.2 After receipt of the Design Professional's most current documents from certain specified pre- construction milestones, CM@Risk must provide a draft Detailed Cost Estimate including a detailed written report detailing any variances to the Baseline Cost Model and Baseline Project Schedule. The Design Professional and CM@Risk will reconcile any disagreements on the estimate to arrive at an agreed upon Detailed Cost Estimate for the construction costs based on the scope of the Project through that specified pre-construction milestone. Pre-Construction milestones applicable to this paragraph are:

Master Planning and Programming, Schematic Design, 50% Design Development, 100% Design Development, and 50% Construction Drawings, If no consensus is reached, City will make the final determination. If the Project Team requires additional updates of the Detailed Cost Estimate beyond that specified in this paragraph, CM@Risk must provide the requested information in a timely manner.

- 17.5.3 If at any point the Detailed Cost Estimate submitted to City exceeds the previously accepted Baseline Cost Model or previously approved Detailed Cost Estimate agreed to as set forth in Section 17.5.2 above, CM@Risk must make appropriate recommendations to project Team on means/methods, materials, and or other design elements that it believes will reduce the estimated construction costs, such that it is equal to or less than the established Project Team's Baseline Cost Model.
- 17.5.4 Unless other levels of completion are agreed to in writing in the Construction Documents, at 50% Construction Drawings and included with the associated report, CM@Risk must also submit to the Project Team for review and approval a Schedule of Values that complies with the following requirements. The Schedule of Values must be based on City standard bid schedule and highlight significant variances from any previously submitted Schedule of Values. The Schedule of Values must be directly related to the breakdowns reflected in the Detailed Project Schedule and CM@Risk's Detailed Cost Estimate. In addition, the Schedule of Values must: (a) detail unit prices and quantity take-offs, (b) detail all other contingencies and unit price Work shown and specified in the detailed design documents.
- 17.5.5 CM@Risk is to track, estimate/price and address the Project Team's overall project cost issues that arise outside of the Baseline Cost Model and the latest approved Detailed Cost Estimate such as: City generated changes, Project Team proposed changes, alternate system analysis, constructability items and value engineering analysis. The system used to implement this process will be referred to as the Design Evolution Log. This is to be addressed between the Baseline Cost Model and the Master Planning and Programming Detailed Cost Estimate, and then (unless other levels of completion are agreed to in writing in the Construction Documents) between the Detailed Cost Estimates for each of the pre-construction milestones thereafter, Schematic Design, 50% Design Development, 100% Design Development, and 50% Construction Documents, and the bid packages for all Phases.
- 17.5.6 Upon request by City, CM@Risk must submit to City a cash flow projection for the Project based on the current updated/revised Detailed Project Schedule and the anticipated level of payments for CM@Risk during the design and construction phases. In addition, if requested by City and based on information provided by City, CM@Risk must prepare a cash flow projection for the entire Project based on historical records for similar types of projects to assist City in the financing process.
- 17.5.7 Construction Water. CM@Risk must estimate the quantity of water to be used and include the cost thereof in each Detailed Cost Estimate and GMP Proposal provided by City.

17.6 **SUBCONTRACTOR AND MAJOR SUPPLIER SELECTIONS**

- 17.6.1 There are two ways to select Subcontractors and major Suppliers prior to submission of a GMP Proposal: (1) qualifications-based selection; or (2) a combination of qualifications and price. Except as noted below, the selection of Subcontractors/Suppliers is the sole responsibility of CM@Risk. In any case, CM@Risk is solely responsible for the performance of the selected Subcontractors/Suppliers, and for compliance with the requirements of

- Title 34 of the Arizona Revised Statutes in the selection of a Subcontractors/Suppliers, to the extent applicable. CM@Risk must comply with its Subcontractor Selection Plan submitted with its Statement of Qualifications.
- 17.6.2 City may approve the selection of a Subcontractor(s) or Suppliers(s) based only on their qualifications when CM@Risk can demonstrate it is in the best interest of the Project. All Work that is performed, after such a qualifications-based selection, for a price that is negotiated by CM@Risk will be billed in accordance with the GMP for actual costs and may be subject to audit by City.
- 17.6.2.1 Qualifications based selection of a Subcontractor(s)/Supplier(s) should only occur prior to the submittal of the GMP Proposal.
- 17.6.2.2 If a Subcontractor/Supplier selection plan was submitted and agreed to by City, CM@Risk must apply the plan in the evaluation of the qualifications of a Subcontractor(s) or Supplier(s) and provide City with its review and recommendations.
- 17.6.2.3 CM@Risk must receive written City approval for each selected Subcontractor(s) and Supplier(s).
- 17.6.2.4 CM@Risk must negotiate costs for services/supplies from each Subcontractor/Supplier selected under this method.
- 17.6.3 All Work must be competitively bid unless a Subcontractor or Supplier was selected pursuant to Section 17.6.2 above.
- 17.6.3.1 CM@Risk must develop Subcontractor and Supplier interest, submit the names of a minimum of three qualified Subcontractors or Suppliers for each trade in the Project for approval by City and solicit bids for the various Work categories. If there are not three qualified Subcontractors/Suppliers available for a specific trade or there are extenuating circumstances warranting such, CM@Risk may request approval by City to submit less than three names. Without prior written notice to City, no change in the recommended Subcontractors/Supplies will be allowed.
- 17.6.3.2 If City objects to any nominated Subcontractor/Supplier or to any self-performed Work for good reason, CM@Risk must nominate a substitute Subcontractor/Supplier that is acceptable to City.
- 17.6.3.3 CM@Risk must distribute Drawings and Specifications, and when appropriate, conduct a Pre- Bid Conference with prospective Subcontractors and Suppliers.
- 17.6.3.4 If CM@Risk desires to self-perform certain portions of the Work, it must request to be one of the approved Subcontractor bidders for those specific bid packages. CM@Risk's bid will be evaluated in accordance with the process identified below. If events warrant and City concurs that it is necessary in order to ensure compliance with the Project Schedule and/or the most recent Detailed Cost Estimate, CM@Risk may be authorized to self-perform Work without bidding or rebidding the Work. When CM@Risk self-performs work without bidding, only the actual costs associated with performing the Work in accordance with the approved GMP will be billed and may be subject to audit by City.
- 17.6.3.5 CM@Risk must receive, open, record and evaluate the bids; provided, however, that if CM@Risk or one of its affiliates is bidding to self-perform the Work that is the subject of the bid, then the bids must be received, opened, recorded and evaluated by Project Manager

instead of CM@Risk. Bids for each category of Work must be opened and recorded at a pre-determined time. The apparent low bidders must be interviewed to determine the responsiveness of their proposals. In evaluating the responsiveness of bid proposals CM@Risk, in addition to bid price, may consider the following factors: past performance on similar projects, qualifications and experience of personnel assigned, quality management plan, approach or understanding of the Work to be performed, and performance schedule to complete the Work. The final evaluation of Subcontractor/Supplier bids must be done with Project Manager in attendance to observe and witness the process. CM@Risk must resolve any Subcontractor/Supplier bid withdrawal, protest or disqualification in connection with the award at no increase in the Cost of Work.

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

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

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

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

17.6.6 If after receipt of sub-bids or after award to Subcontractors and Suppliers, City objects to any nominated Subcontractor/Supplier or to any self-performed Work without any reasonable basis, CM@Risk must nominate a substitute Subcontractor or Supplier, preferably if such option is still available, from those who submitted Subcontractor bids for the Work affected. Once such substitute Subcontractors and Suppliers are consented to by City, CM@Risk's proposed GMP for the Work or portion thereof must be correspondingly adjusted to reflect any higher or lower costs 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 Agreement Price until acceptance of ALL Pre-Construction Services and award of the final approved Construction Services Agreement for the entire Project by City Council. If CM@Risk does not prepare a

GMP Proposal that is acceptable to City, or the GMP Proposal exceeds the City's Construction Budget, then CM@Risk understands and acknowledges that it will forfeit any right to receive the 25% of the Agreement Price being retained by City.

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

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

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

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

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

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 Agreements
- Appendix 3 – Contractor's Affidavit Regarding Settlement of Claims
- Appendix 4 – Forms of Performance Bond
- Appendix 5 – Forms of Payment Bond
- Appendix 6 – Dispute Resolution
- Appendix 7 – Certificate of Completion
- Appendix 8 – Construction Sign Detail
- Appendix 9 – Cost of the Work (Applicable solely to Construction Manager at Risk and Job Order Contracting)
- Appendix 10 – Landscape Establishment Period

CALCULATING DELAYS AND DAMAGES

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

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

I. TYPES OF DELAYS:

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

A. Excusable/Compensable:

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

compensation.

B. Excusable/Non-compensable:

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

C. Non-excusable/Non-compensable:

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

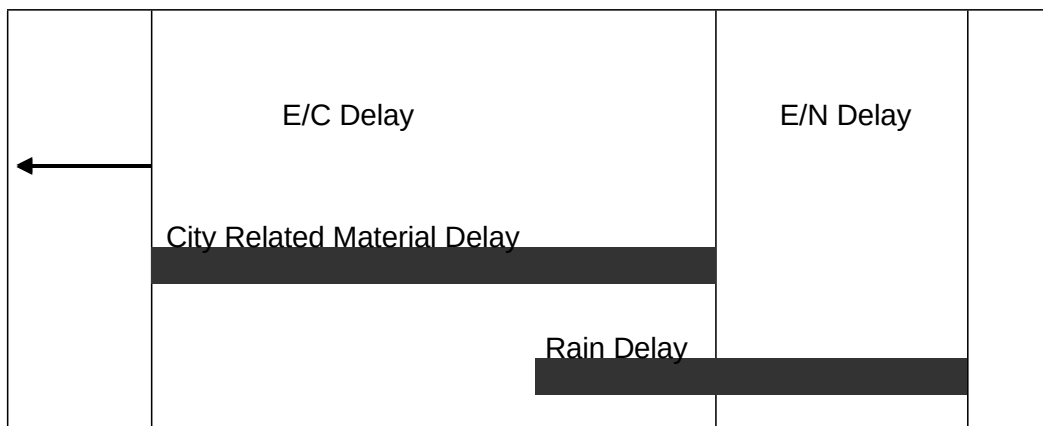
D. Concurrent:

When two or more delays occur simultaneously or overlap, each delay is analyzed separately to determine its impact on the overall project completion date based on when that delay started. Once again, only those delays which actually extend the Agreement completion time are considered as delays. The concurrent delay is considered an additional delay only to the extent it prolongs

the delay to the Agreement Completion Time beyond the date that the one it is concurrent with had already delayed that date. For example, if two delays are concurrent, and one is five days long and the second is seven days long, the second concurrent delay will only extend the Agreement Completion Time by two days. The same method of analysis is used when there are multiple concurrent delays. Only those extending the Project Completion Date are considered to be delays for the purposes of this policy. The portion of each concurrent delay that delays the completion of the work is classified in the same manner as described previously for individual delays and being either E/C, E/N or N/N.

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

Example of a Concurrent Delay:



II. ANALYZING THE DELAY:

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

General Conditions

Appendix 1

The Engineer will accept delay analyses in CPM format, as these may demonstrate to his/her satisfaction whether or not Project Completion has been impacted by a specific event. If the Contractor chooses not to use CPM scheduling procedures, then the burden will be on the Contractor to prove to the Engineer's satisfaction that the Project Completion has been impacted. The procedures below assume that the Contractor is using CPM scheduling methods. As a minimum the Contractor must provide the following materials to the Engineer:

- A. As-Planned Schedule. The initial construction schedule, required by the Agreement Documents, will be considered the baseline schedule. It is to the Contractor's advantage that the As-Planned (baseline) Schedule be as detailed as possible in order for delays, as they occur, to be incorporated into the schedule in representative locations. It is also to the Contractor's advantage to use a computer software program to generate the schedule since updated schedules are required monthly by the Agreement Documents and since updated schedules are required to support delays and requests for additional compensation for delays. The As-Planned (baseline) Schedule must be presented in network format which clearly shows the interrelationships of the activities. The Contractor must also provide a printout of the activities showing early start, early finish, late start, late finish, duration and float. The activity list printout must also indicate predecessor and successor activities.
- B. As-Built Schedules. The as planned (baseline) schedule must be updated with complete progress-to-date information (actualized) up to the date of the start of the alleged delay. Each updated schedule will serve as the as-built schedule for analyzing the alleged delay and provide a new baseline as-planned schedule for the next delay. This process must be repeated for each alleged delay as it occurs. In updating the baseline schedule, the alleged delay must be treated as an activity and inserted into the schedule as a predecessor to the impacted activity (ies). When an activity that has already started is impacted, it is preferable to divide this activity into two parts and show the impact affecting the second part. For schedules which incorporate a time line (or data date), the delay activity must be inserted at the time it actually occurred. Some software scheduling programs have a PAUSE-RESUME feature that can be used to facilitate the requirements. The updated schedule must also be accompanied by a listing of activities as with the baseline schedule. This activities list must contain the alleged delay as an activity showing the duration and the activities which are predecessors and successors to it. When computer generated schedules are used, the Contractor must provide, in electronic media format, the complete data files for the updated schedule that included the delay activity, preferably either in Suretrak or in Microsoft Project. Each electronic media must contain a label identifying the Project name, Contractor's name, program name and version number, data date and project finish date.
- C. Other Documents: In order to determine the amount of the alleged delay and if it is compensable, the Contractor must provide all backup documentation relevant to the issue and as required by the Engineer. This documentation must include copies of such items as: purchase orders; delivery schedules; correspondence; memoranda of telephone calls; force account daily worksheets (initialed by the Inspector); payroll data; estimating (bid) worksheets; and any other materials which may be

requested by the Engineer.

- D. Procedure: Only after receipt of sufficient documentation will the Engineer analyze each alleged delay and determine if it is supported or refuted. If supported, the Engineer will determine if it is excusable or non-excusable, compensable or non-compensable. If the Engineer determines that the delay did not affect the Project Completion, the as-planned schedule, which has been updated to the date of the alleged delay, must be revised to indicate this. If the Engineer determines the delay did occur but was N/N, then no time extension will be granted. It is imperative that an actualized schedule be submitted as soon as the occurrence of the alleged delay is known. In no event will the Contractor submit an actualized updated schedule later than 60 days after the occurrence of the alleged delay becomes known.

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

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

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

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

III. CALCULATING MONETARY DELAY DAMAGES:

Additional compensation for delay, when authorized by the Engineer, will be calculated in accordance

with MAG Section 109.5 ACTUAL COST WORK with the following exceptions:

- A. No additional compensation or other monetary damages will be awarded or paid for any loss of anticipated profits by the Contractor, Subcontractors or Suppliers.
- B. No additional compensation or other monetary damages will be awarded for home office overhead or non-project general conditions of the Contractor, Subcontractors or Suppliers.
- C. Equipment:
 - 1. Contractor-owned equipment rate calculations must be computed in accordance with Section 109.04(D)(3), Arizona Department of Transportation "Standard Specifications for Road and Bridge Construction," 2008 or latest edition and as modified herein. Year and regional adjustment factors must be based on the most recent publications of the Rental Rate Blue Book for Construction Equipment, published by the Equipment Guide-Book Company, San Jose, CA, same as provided by ADOT and in print as of the date of alleged delay. In no event will the compensation for Contractor-owned equipment exceed the purchase price, including tax, paid by the Contractor for the equipment. Compensation will not be allowed for small tools or equipment that show a daily equipment rental rate of less than \$5.00 per day or for unlisted equipment that has a value of less than for hundred dollars (\$400.00).
 - 2. For leased and rented equipment or equipment not otherwise listed in the Blue Book, rental contracts, or other supporting data will be used to establish the hourly rate. No hourly operating expense will be allowed for delay on standby equipment. In no case will equipment be considered for rental which exceeds the hourly rate for the first eight hours and the daily rate divided by eight for all additional hours as compared with similar equipment listed in the Blue Book. The hourly standby rate must be computed as the lesser of:
 - a. Dividing the monthly invoice or rental value by 176 hours per month when the equipment is utilized by the Contractor for more than three weeks;
 - b. Dividing the monthly invoice or rental value by 40 hours per week when the equipment is utilized by the Contractor for more than three days.In no event will compensation be paid for delay at more than 8 hours per day or 40 hours per week.
 - 3. Except for vehicles used by supervisory personnel, all equipment will be paid at the "standby" rate during the delay period.
 - 4. Equipment brought solely to mitigate the delay (such as pumps, light plants, etc.) may be paid in accordance with ADOT section 109.04(D) (3).

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

D. Material:

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

E. Labor:

1. Except for Supervisory Personnel (Superintendent, Project Engineer, and Foremen), labor wages will not be paid after the first one-half day of claimed delay or impact. It is expected the Contractor will reassign or layoff unneeded employees.
2. For Foreman wages to be included, that Foreman must have been actively employed on the project prior to the commencement of the delay and be directly responsible for the activity being delayed.
3. Labor burden must be actual amounts incurred but must not exceed the ADOT approved rate.

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

IV. DOCUMENT REQUIRED FOR CLAIM ANALYSIS:

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

A. Labor:

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

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

B. Materials:

For all materials for which compensation is requested, if any, total quantities of materials, prices, extensions and transportation costs must be provided on a daily

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

1. Invoices for all materials incorporated.
2. Weigh tickets.
3. Purchase orders.
4. Delivery schedules.
5. Quotes or proposals from manufacturers or supplier.
6. Freight bills, Bills of Lading, or other documentation to show transportation costs.
7. Restocking charges-invoices from vendor.

C. Equipment:

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

1. Owned:
 - a. Purchase contracts(s).
 - b. Depreciation schedule(s).
 - c. Invoices for fuel, lube, repairs and other operating costs.
2. Leased:
 - a. Lease agreement with hourly rate, overtime rate, double shift rate, etc.
 - b. Invoices or other documentation showing hours worked on a daily basis.

D. Subcontractors/Owner-Operators:

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

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

E. Miscellaneous:

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

1. Evidence of payment for bonds and insurance premiums (MAG 109.5.6).

General Conditions

Appendix 1

2. Taxes – unless the Contractor can show otherwise, taxes are reimbursable at 65% of the total cost (less bonds and insurance).

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

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

COST REDUCTION INCENTIVE PROPOSALS FOR DESIGN BID BUILD AGREEMENTS

The Contractor may submit to the Engineer proposals for modifying the Plans, Specifications, or other requirements of the Agreement for the sole purpose of reducing the total cost of Project construction. The proposals must not impair in any manner the essential functions or characteristics of the project; including but not limited to service life, economy of operations, ease of maintenance, desired appearance, compatibility with existing or planned equipment, standardization of systems, or design and safety standards.

It must not be inferred from this Policy that the Engineer is required to consider any proposal submitted.

Submissions that propose changes in the basic design of a bridge, propose changes in pipe line size, materials, bedding conditions, pipe specifications; or that propose any change in pavement design will not be considered.

Proposals submitted pursuant to this Policy will be identified as Cost Reduction Incentive Proposals. They must be submitted in writing and, at a minimum, contain the following.

1. Complete the attached or similar cost reduction incentive proposal form.
2. A description of both the existing Agreement Requirements for performing the work and the proposed changes.
3. All Engineering Drawings and computations necessary for the thorough and expeditious evaluation.
4. An itemization of the existing Agreement Requirements that must be changed if the Proposal is adopted and a recommendation as to the manner in which the change should be made.
5. A detailed estimate of the cost of performing the Work under the existing Agreement and under the proposed changes, including the cost of developing and implementing the changes.
6. The Agreement items affected by the proposed changes and any variations in quantities resulting from the changes.
7. An objective estimate of any effects the proposal will have on collateral cost to the City, costs of related items, and cost of maintenance and operation.
8. A statement as to the effect that the Proposal will have on the time for the completion of the Project.
9. A statement as to the time by which a Change Order adopting the Proposal must be executed or when the Engineer must have given verbal approval.

General Conditions Appendix 2

Proposals will be processed expeditiously; however, the City will not be liable for any delay in acting upon any Proposal nor for any failure to accept any Proposal pursuant to this Special Provision.

The Engineer will be the sole judge of the acceptability of a Proposal and of the estimated net savings in construction costs from the adoption of all or any part of the Proposal. The Contractor will be notified in writing by the Engineer as to whether his/her Proposal has been accepted. The decision by the Engineer is final.

When the City deems such action to be appropriate, it reserves the right to require the Contractor to share equally in the cost to the City of investigating, evaluating, and processing the proposal as a condition for the consideration of such Proposal. Such cost must be shared whether the Proposal is accepted or rejected. When such a condition is imposed, the City will estimate these costs and the Contractor must indicate his acceptance thereof in writing. Such acceptance will authorize the City to deduct the Contractor's share of the costs from any monies due or that may become due to the Contractor under the Agreement.

If the Contractor's Proposal is accepted in whole or in part, the necessary Agreement Modifications and Agreement Price Adjustments will be affected by the execution of a Change Order which will specifically state that it is executed pursuant to this Special Provision.

The Contractor must continue to perform the work in accordance with the requirements of the Agreement until a Change Order incorporating the Proposal has been executed or until he/she has been given verbal approval by the Engineer that his/her Proposal has been accepted. If the Change Order has not been executed or he/she has not been given verbal approval on or before the date specified on the attached cost reduction incentive proposal form or on or before such other date as the Contractor may have subsequently specified in writing, the Proposal may be deemed to be rejected.

The executed Change Order will incorporate the changes in the Plans, Specifications, or other requirements of the Agreement which are necessary to permit the Proposal, or such part of it which has been accepted, to be put into effect, and will include any condition – upon which the City's approval thereof is based, if such approval is conditional. The executed Change Order may also extend the time for the completion of the Agreement if such an extension has been deemed to be warranted by the Engineer as a result of his evaluation of the Proposal.

The executed Change Order will also establish the estimated net savings in the cost of performing the Work attributable to the Proposal effectuated by the Change Order. In determining the net savings, the right is reserved to the Engineer to disregard the Agreement bid prices if, in his/her judgment, such prices do not represent a fair measure of the value of the Work to be performed or to be deleted. The net savings will be established by determining the Contractor's cost of performing the Work, taking into account his/her cost of developing the Proposal and implementing the change, and reducing this amount by any ascertainable collateral costs to the City. The executed Change Order may provide that the Contractor be paid 50 percent of the estimated net savings amount.

The executed Change Order may also provide for the adjustment in Agreement prices. Agreement prices may be adjusted by subtracting the City's share of the accrued net savings.

General Conditions Appendix 2

The amount specified to be paid to the Contractor in the executed Change Order which effectuates a Cost Reduction Proposal will constitute full compensation to the Contractor for the Cost Reduction Proposal and the performance of the work thereof pursuant to the said Change Order.

Upon acceptance of a Cost Reduction Incentive Proposal, any restrictions imposed by the Contractor on its use or on disclosure of the information will become void, and the City thereafter will have the right to use all or any part of the Proposal without obligation or compensation of any kind to the Contractor.

COST REDUCTION INCENTIVE PROPOSAL FORM

TO: CIP City Engineer

FROM:

PROJECT NAME: Water System Upgrades Program

CITY PROJECT NUMBER: WA2100.401

DATE:

Summary of Change (Brief description of proposed change including advantages and disadvantages):

ESTIMATED COST SUMMARY (Attached detailed estimate):

A.	Original Cost:	\$
B.	Proposed Cost:	\$ _____
C.	Construction Savings (A-B):	\$ _____
D.	Gross Savings (Included OH %, Bond %)	\$ _____
E.	Contractor Implementing	\$ _____
F.	City Implementing Cost:	\$ _____
	Reduction in Agreement Price (C+D-E-F) x 50%:	\$ _____

Date by which a Change Order must be issued so as to obtain maximum cost reduction:

**CITY OF CHANDLER, ARIZONA
PUBLIC WORKS & UTILITIES DEPARTMENT**

CONTRACTOR'S AFFIDAVIT REGARDING SETTLEMENT OF CLAIMS

_____, Arizona
Date _____

**Project Name: Water System Upgrades Program
City Project No.: WA2100.401**

To the City of Chandler, Arizona

Gentlemen:

This is to certify that all lawful claims for materials, rental of equipment and labor used in connection with the construction of the above project, whether by subcontractor or claimant in person, have been duly discharged.

The undersigned, for the total compensation of \$_____, as set out in the final pay application, as full and complete payment under the terms of the Agreement, hereby waives and relinquishes any and all further claims or right of lien under, in connection with, or as a result of the above described project. The undersigned further agrees to indemnify and save harmless the City of Chandler against any and all liens, claims or liens, suits, actions, damages, charges and expenses whatsoever, which said City may suffer arising out of the failure of the undersigned to pay for all labor performances and materials furnished for the performance of said installation.

Signed and dated at _____, this _____ day of _____ 20_____.

CONTRACTOR

By _____

STATE OF ARIZONA)
) SS
COUNTY OF MARICOPA)

The foregoing instrument was subscribed and sworn to before me this _____ day of _____ 20_____.

Notary Public

My Commission Expires

PERFORMANCE BOND

ARIZONA STATUTORY PERFORMANCE BOND
PURSUANT TO TITLES 28, 34, AND 41, ARIZONA REVISED STATUTES
(Penalty of this bond must be 100% of the Agreement amount)

KNOW ALL MEN BY THESE PRESENTS THAT:_____

(hereinafter "Principal"), and _____ (hereinafter "Surety"), a corporation organized and existing under the laws of the State of _____ with its principal office in the City of _____, holding a certificate of authority to transact surety business in Arizona issued by the Director of Insurance pursuant to Title 20, Chapter 2, Article 1, as Surety, are held and firmly bound unto _____(hereinafter "Obligee") in the amount of _____ (Dollars) (\$_____), for the payment whereof, Principal and Surety bind themselves, and their heirs, administrators, executors, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, the Principal has entered into a certain written Agreement with the Obligee, dated the _____ day of _____, 20__ for construction of **Water System Upgrades Program, WA2100.401** which Agreement is hereby referred to and made a part hereof as fully and to the same extent as if copies at length herein.

NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION IS SUCH, that if the Principal faithfully performs and fulfills all the undertakings, covenants, terms, and conditions of the Agreement during the original term of the Agreement and any extension of the Agreement, with or without notice of the Surety, and during the life of any guaranty required under the Agreement, and also performs and fulfills all the undertakings, covenants, terms, conditions, and agreements of all duly authorized modifications of the Agreement that may hereafter be made, notice of which modifications to the Surety being hereby waived, the above obligation is void. Otherwise it remains in full force and effect.

PROVIDED, HOWEVER that this bond is executed pursuant to the provisions of Title 34, Chapter 2, Article 2, Arizona Revised Statutes, and all liabilities on this bond will be determined in accordance with the provisions of Title 34, Chapter 2, Article 2, Arizona Revised Statutes, to the same extent as if it were copied at length in this Agreement.

The prevailing party in a suit on this bond may recover as part of the judgment reasonable attorney fees that may be fixed by a judge of the court.

Witness our hands this _____ day of _____, 20__.

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 Agreement amount)

KNOW ALL MEN BY THESE PRESENTS THAT: _____

(hereinafter "Principal"), as Principal, and _____ (hereinafter "Surety"), a corporation organized and existing under the laws of the State of _____ with its principal office in the City of _____, holding a certificate of authority to transact surety business in Arizona issued by the Director of the Department of Insurance pursuant to Title 20, Chapter 2, Article 1, as Surety, are held and firmly bound unto _____ (hereinafter "Obligee") in the amount of _____ (Dollars) (\$_____), for the payment whereof, the Principal and Surety bind themselves, and their heirs, administrators, executors, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, the Principal has entered into a certain written Agreement with the Obligee, dated the _____ day of _____, 20__ for construction of **Water System Upgrades Program, WA2100.401** which Agreement is hereby referred to and made a part hereof as fully and to the same extent as if copied at length herein.

NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION IS SUCH, that if the Principal promptly pays all moneys due to all persons supplying labor or materials to the Principal or the Principal's subcontractors in the prosecution of the work provided for in said Agreement, this obligation is void. Otherwise it remains in full force and effect.

PROVIDED, HOWEVER that this bond is executed pursuant to the provisions of Title 34, Chapter 2, Article 2 Arizona Revised Statutes, and all liabilities on this bond will be determined in accordance with the provisions, conditions and limitations of Title 34, Chapter 2, Article 2, Arizona Revised Statutes, to the same extent as if it were copied at length in this Agreement.

The prevailing party in a suit on this bond may recover as part of the judgment reasonable attorney fees that may be fixed by a judge of the court.

Witness our hands this _____ day of _____, 20__.

AGENT OF RECORD

PRINCIPAL

SEAL

By _____

SURETY

SEAL

AGENT ADDRESS

DISPUTE RESOLUTION

A. INFORMAL DISPUTE RESOLUTION

The parties to the Agreement agree that time is of the essence in relation to performance of the Agreement and completion of the Project, therefore any and all disputes in relation to the Agreement will initially be referred to the Project Manager, the Design Professional Representative and/or the Contractor Representative as applicable to the dispute, for immediate resolution. If, after good faith efforts to reach a resolution, none is reached, any party to the dispute may submit the dispute to the Dispute Resolution Representative ("DRR") process set forth below, which is intended to be an expedited process.

B. DISPUTE RESOLUTION REPRESENTATIVE ("DRR") PROCESS

1. The Parties under the Agreement agree that all claims and disputes in relation to the Project which are not resolved in the ordinary course of the Project ("Claim" or "Claims") will, as a prerequisite to any mediation, or litigation of the Claim, first be submitted for resolution between the designated Dispute Resolution Representatives of the Parties as set forth herein (the "DRR Process").
2. The DRR Process will be initiated through service of a DRR Notice as set forth below:
 - a. For claims by the Contractor or the Design Professional, the DRR Process will be initiated by the party asserting the claim serving written notice on the City setting forth in detail: (i) the basis for the claim; (ii) the effect of the Claim upon the construction of, and/or Project Schedule for, the Project; (iii) the specific relief requested, the amount thereof, and how such was calculated; (iv) the parties involved in the Claim, and how they are involved; (v) the specific Agreement provisions in the Agreement Documents (including, if applicable, drawings and specifications) which apply; and (vi) efforts made to date to resolve the Claim.
 - b. For claims by the City, the DRR process will be initiated by the City providing written notice to the other parties of the basis and amount of its claim, the parties involved in the Claim, and how they are involved, the provisions in the Agreement Documents that apply, and the relief requested.
 - c. The DRR Notice will be hand-delivered and e-mailed to the other parties' designated Dispute Resolution Representatives.
3. The other parties will respond in writing to the DRR Notice ("DRR Response") within ten (10) calendar days of receipt of the DRR Notice, setting forth those items set forth in the DRR Notice that they agree with, dispute, and/or have questions concerning. The DRR Response will be hand-delivered and e-mailed to the other parties' Dispute Resolution Representatives.

4. The designated Dispute Resolution Representatives for the Parties to the claim will then meet as soon as possible and in any event within twenty (20) calendar days of submission of the DRR Notice (regardless of whether a DRR Response has been submitted by all parties involved in the dispute), at a mutually agreed upon time and place, to attempt to resolve the Claim based upon the DRR Notice and DRR Response.
5. At any time after the first meeting required above, either party may terminate the DRR Process by written notice to the other party.
6. The parties may agree, in writing, to extend or modify the time limits or other provisions of the DRR process in relation to a specific pending Claim.
7. Unless otherwise designated in a written notice to the other parties, the City and the representatives of the Contractor and of the Design Professional will act as the parties' designated Dispute Resolution Representatives.
8. If a resolution of the Claim is reached, that resolution must be set forth in writing and must be signed by the Parties' designated Dispute Resolution Representative. If the resolution involves a change in any Agreement Documents, the Agreement Price, the Project Schedule, or any other change requiring a written Change Order or Amendment, the parties must execute an appropriate written Change Order or Amendment pursuant to the terms of the Agreement Documents.

C. MEDIATION

1. Unless extended by written agreement of the parties involved in the dispute, any Claim not resolved through the DRR process set forth above within five (5) calendar days after the meeting required under B (4) above, or after the DRR is terminated pursuant to B (5) above, whichever is earlier, will be submitted to mediation as a condition precedent to litigation by either party.
2. The mediation will be commenced by written demand upon the other party for mediation. If the parties cannot agree upon a mediator within ten (10) calendar days of the written demand, either party may make a request to the Civil Presiding Judge of the Maricopa County Superior Court to appoint a mediator. The mediation will occur within forth (40) calendar days of the written demand for mediation, unless the parties agree, in writing, to a longer period of time.
3. The qualifications for the mediator will be that he/she be: (a) an experienced mediator, arbitrator or litigator of construction disputes; and (b) having engaged a significant portion of his/her time involving and/or resolving construction disputes for at least the past five (5) years.
4. Each party will provide to the other party and the mediator all of the information and documentation required under B(1) and (2) above, together with any additional information and documentation which the party believes relevant. In addition, the parties will exchange, and provide to the mediator

such additional memoranda, information and/or documentation, as the mediator may request, and in the form and at such times, as the mediator may direct.

5. The parties will share the mediator's fee and any filing fees equally. The mediation will be held in Chandler, Arizona, unless another location is mutually agreed upon. Agreements reached in mediation will be specifically enforceable in any court having jurisdiction thereof.

D. LITIGATION

Any claim arising out of or related to the Agreement, except Claims relating to aesthetic effect and except those claims waived as provided for in the Agreement Documents, must be resolved through litigation in the Maricopa County, Arizona Superior Court.



**CITY OF CHANDLER, ARIZONA
PUBLIC WORKS & UTILITIES DEPARTMENT**

CERTIFICATE OF COMPLETION

PROJECT NAME:	Water System Upgrades Program		
CITY PROJECT NO.:	WA2100.401		
If Federally Funded:			
FEDERAL NO.:		ADOT NO:	

(This section to be completed by Prime)

I HEREBY CERTIFY THAT ALL GOODS AND/OR SERVICES REQUIRED BY CITY OF CHANDLER FOR THIS PROJECT HAVE BEEN DELIVERED IN ACCORDANCE WITH THE AGREEMENT DOCUMENTS AND BID SPECIFICATIONS AND ALL ACTIVITIES REQUIRED BY THE AGREEMENTOR UNDER THE AGREEMENT HAVE BEEN COMPLETED AS OF THE COMPLETION DATE LISTED HERE:

<u>FINAL ACCEPTANCE DATE:</u>	
--------------------------------------	--

PRIME CONTRACTOR:

FIRM NAME:			
PRINCIPAL:			
TITLE:			
SIGNATURE:		DATE:	

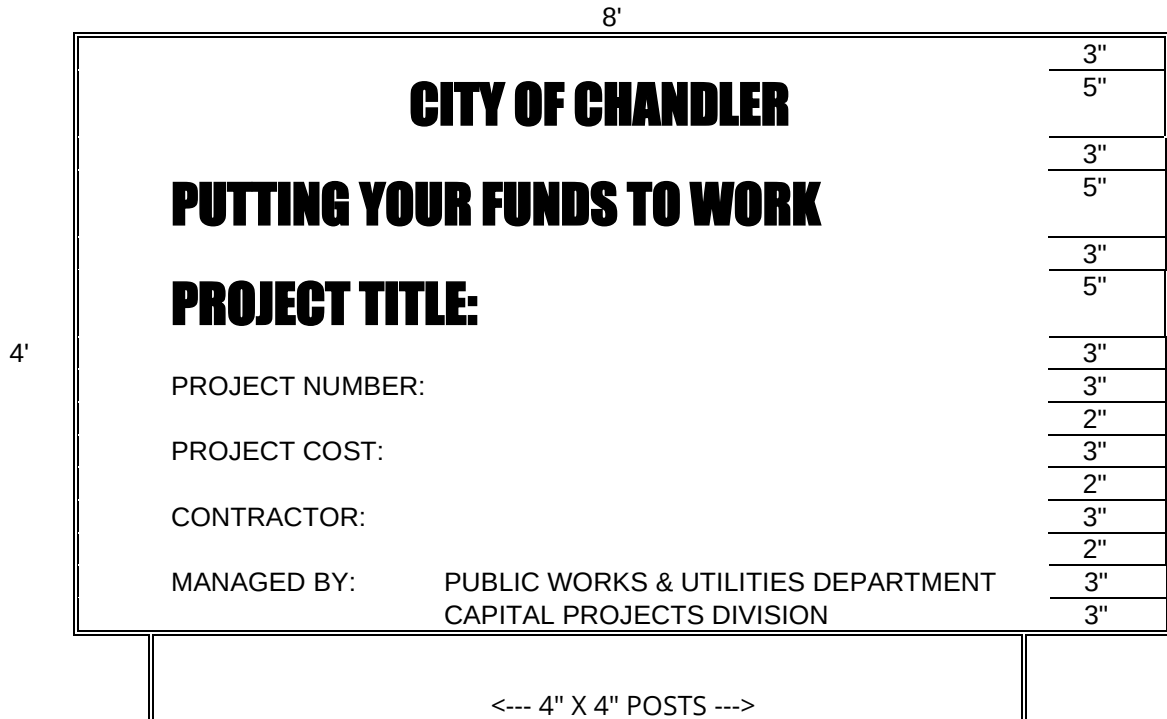
CERTIFIED BY **[INSERT NAME AND TITLE OF PARTY THAT OVERSEES CONSTRUCTION]:**

FIRM NAME:			
SIGNATURE:		DATE:	

PROJECT ACCEPTED BY CITY OF CHANDLER:

NAME:			
SIGNATURE:		DATE:	

CONSTRUCTION SIGN DETAIL



NOTES:

SIGN(S) MUST BE FURNISHED AND ERECTED PRIOR TO COMMENCEMENT OF CONSTRUCTION. POSTS MUST BE ANCHORED A MINIMUM OF TWO FEET INTO THE GROUND. BOTTOM OF SIGN MUST BE A MINIMUM OF FOUR FEET ABOVE THE GROUND.

TYPICAL PROJECT IDENTIFICATION SIGN FOR GENERAL PROJECTS MUST BE NON-REFLECTORIZED GREEN BACKGROUND, AND NON-REFLECTORIZED WHITE LETTERS AND NUMERALS.

ONE SIGN MUST BE ERECTED FOR BUILDINGS AND OTHER LIMITED AREA SINGLE SITES. FOR MULTIPLE SITES, ONE SIGN MUST BE ERECTED AT EACH SITE.

FOR LINEAR PROJECTS ONE HALF MILE OR LONGER, PLACE ONE SIGN AT EACH END OF THE PROJECT.

COST OF THE WORK

(APPLICABLE SOLELY TO CONSTRUCTION MANAGER AT RISK AND JOB ORDER CONTRACTING)

SECTION 1 – COSTS TO BE REIMBURSED

1.1 Cost of the Work

The term Cost of the Work will mean costs necessarily incurred by Contractor in the proper performance of the Work. Such costs must be at rates not higher than the standard paid at the place of the Project except with prior consent of City. The Cost of the Work will include only the items set forth in this Section 1.

1.2 Labor Costs

- 1.2.1 Wages of construction workers directly employed by the Contractor to perform the construction of the Work at the site or, with City's approval, at off-site workshops. Cost to be reimbursed will be the actual wages paid to the individuals performing the work.
- 1.2.2 Wages or salaries of the Contractor's supervisory and administrative personnel when stationed at the site with City's approval. No Contractor personnel stationed at the Contractor's home or branch offices will be charged to the Cost of the Work. Non-field office based Contractor management and support personnel are expected to provide service and advice from time to time throughout the job and his/her time devoted to Project matters is considered to be covered by the Contractor's Fee.
- 1.2.3 Wages and salaries of Contractor's supervisory or administrative personnel who would normally be stationed at the field office in accordance with Section 1.2.2 but who become engaged, at factories, workshops or on the road, in expediting the production or transportation of materials or equipment required for the Work, but only for that portion of his/her time required for the Work. Employee bonuses and/or costs associated with Employee Stock Ownership Plans ("ESOP") will not be considered reimbursable labor or labor burden costs and will be considered non-reimbursable costs considered to be covered by the Contractor's Fee.
- 1.2.4 Costs paid or incurred by Contractor for taxes, insurance, contributions, assessments and benefits required by law or collective bargaining agreements and, for personnel not covered by such agreements, customary benefits such as sick leave, medical and health benefits, holiday, vacations and pensions, provided such costs are based on wages and salaries included in the Cost of the Work under Subparagraphs 1.2.1 through 1.2.3.
 - 1.2.4.1 Cost of the Work will include the actual net cost to Contractor for worker's compensation insurance attributable to the wages chargeable to the Cost of Work per this Agreement. The actual net cost of worker's compensation must take into consideration all cost adjustments due to experience modifiers, premium discounts, policy dividends, retrospective rating plan premium adjustments, assigned risk pool rebates, any applicable weekly maximums, etc. Contractor may charge an estimated amount for worker's compensation insurance costs, but will make appropriate cost adjustments to actual costs within 45 days of receipt of actual cost adjustments from the insurance carrier.

- 1.2.4.3 Overtime wages paid to salaried personnel (if approved in advance in writing by City) will be reimbursed at the actual rate of overtime pay paid to the individual. No time charges for overtime hours worked on the Project will be allowed if the individual is not paid for the overtime worked.
- 1.2.4.4 Any overtime premium or shift differential expense to be incurred by Contractor for hourly workers will require City's advance written approval before the incremental cost of the overtime premium or shift differential will be considered a reimbursable cost. If the Contractor is required to work overtime as a result of an inexcusable delay or other coordination problems caused by the Contractor or anyone he/she is responsible for, the overtime premium and/or shift differential expense portion of the payroll expense and related labor burden costs will be considered as cost not to be reimbursed.
- 1.2.4.5 Reimbursable labor burden costs will be limited to payroll taxes, worker's compensation insurance, the employer's portion of union benefit costs for union employees working on the Project, and the actual verifiable fringe benefit costs incurred by Contractor for non-union individuals working on the Project subject to the following maximum percentages for the following reimbursable non-union fringe benefit costs. The following maximums (as a percentage of reimbursable actual wages by individual) will apply for each of the following types of fringe benefit costs specifically attributable to each of the non-union personnel working on the Project:

- | | |
|---|--------|
| • Medical Insurance, Dental, Life & AD&D Insurance: | 12.00% |
| • Holiday, vacation and other paid time not worked: | 10.00% |
| • Pension Plan Contributions to Vested Employee Account, Simplified Employee Pension Plans, or 401K matching plans (Note: ESOP related costs are covered by the Contractor Fee) | 10.00% |

For non-union personnel, no other fringe benefit costs (other than the three specific categories listed immediately above, will be considered reimbursable Cost of Work. Any labor burden costs that are in excess of the amounts considered reimbursable or are otherwise not considered reimbursable under the terms of this agreement are intended to be covered by the Contractor Fee.

1.3 Subcontract Costs

- 1.3.1 Payments made by Contractor to Subcontractors in accordance with the requirements of the subcontracts.
- 1.3.2 For Scope of Work Bid Packages typically performed by Subcontractors, Contractor may "self- perform" such work on an actual cost basis subject to an agreed upon Guaranteed Maximum Price for the "self-performed work". The Contractor must, unless agreed to by City in writing, bid his/her proposed guaranteed Maximum Price for the work to be "self-performed" against at least three other interested trade Contractors. All savings under any such Subcontract for "self-performed work" must be applied to reduce the Cost of Work under the Agreement and the Guaranteed Maximum Price. For purposes of defining "self-performed work" subject to this provision, any division of Contractor, or any separate Contractor or Subcontractor that is partially owned or wholly owned by the Contractor or any of his/her employees or employee's relatives will be considered a related party entity

and will be subject to this provision regarding “self-performed work”. No self-performed work will be allowed to be performed on a Fixed Price basis.

- 1.3.3 Contractor (with respect to its Suppliers, Subcontractors and all lower tier Subcontractors) must provide City advance written notice and must obtain City's approval for any proposed Subcontract Change Order, Material Purchase Order, or other financial commitment in an amount in excess of \$5,000 prior to placing such order or entering into such agreement (regardless of whether or not any such commitment will affect the prime Agreement Guaranteed Maximum Cost). It is agreed that sums applicable to any Subcontract Change Order, Purchase Order or other financial commitment entered into in violation of the above notice and approval requirement will not be included in the amounts 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 Agreement Documents will mean the estimated price a reasonable purchaser would pay to purchase the used material or equipment at the time it was initially needed for the job. Note: This is usually lower than the price a reasonable purchaser would pay for similar new construction material or construction equipment.

1.5.2.6 All losses resulting from lost, damaged or stolen tools and equipment will be the sole responsibility of Contractor, and not City, and the cost of such losses will not be reimbursable under the Agreement.

1.5.2.7 Contractor will be required to maintain a detailed equipment inventory of all job-owned equipment (either purchased and charged to job cost or job-owned through aggregate rentals) and such inventory must be submitted to City each month. For each piece of equipment, such inventory should contain at a minimum (1) original purchase price or acquisition cost (2) acquisition date (3) approved Fair Market Value at the time the piece of equipment was first used on the job and (4) final disposition.

1.5.2.8 All costs incurred for minor maintenance and repairs will be reimbursed at actual cost. Such costs include routine and preventative maintenance, minor repairs and other incidental costs. Repairs and/or replacement of a capital nature are considered to be covered by the rental rates. Major repairs and overhauls are not considered routine and ordinary; consequently such costs are not reimbursable and are intended to be covered by the rental

rates.

- 1.5.3 Costs of removal of debris from the Site.
- 1.5.4 Costs of document reproductions, facsimile transmissions and long-distance telephone calls, postage and parcel delivery charges, telephone service at the site and reasonable petty cash expenses of the site office.
- 1.5.5 That portion of the reasonable expenses of Contractor's personnel incurred while traveling in discharge of duties connected with the Work.
 - 1.5.5.1 No travel expenses will be reimbursed to Contractor's representatives unless Project related travel required them to travel to a destination more than 100 miles from the Project location. Any travel involving airfare will require advance written approval by an authorized City's representative.
- 1.5.6 Costs of materials and equipment suitably stored off the site at a mutually acceptable location, if approved in advance by the City.
- 1.5.7 Reproduction costs will be the actual costs of reproduction subject to a maximum of five cents (\$.05) per square foot for prints and a maximum of five cents (\$.05) per 8 ½ by 11-inch page for offset print or photo copied agreement documents, specifications, etc. Telephone costs will be the actual costs paid to the third party telephone company for the field office telephone.

1.6 Miscellaneous Costs

- 1.6.1 That portion of insurance and bond premiums that can be directly attributed to the Agreement. The City will reimburse Contractor for contractually required bond at time of first pay application for GMP and Cost-Based Agreements upon receipt of proof of payment from the Contractor. If the Contractor completes Work for less than the Agreement Price, Contractor must credit the City a pro-rated amount for the unused portion of the bond payment
 - 1.6.1.1 Contractor's actual cost for insurance will be considered to be included within the Maximum limit for General Conditions Costs. All premiums for any insurance and bonds required for the Project must reflect the net actual costs to Contractor after taking into consideration cost adjustments due to experience modifiers, premium discounts, policy dividends, retrospective rating plan premium adjustments, assigned risk pool rebates, refunds, etc.
 - 1.6.1.2 The amount to be reimbursed to Contractor for all contractually required insurance will be actual costs not to exceed a total of 2% of the Agreement Value, unless Contractor establishes to City's satisfaction that the actual cost is higher and City agrees to such actual higher cost in writing. If Contractor's cost of contractually required insurance is greater than the amount agreed to be reimbursed per this Agreement Provision, the difference will be considered to be covered by the Contractor's Fee. The City will reimburse Contractor for contractually required insurance on a monthly basis for GMP and Cost-Based Agreements. If Contractor can demonstrate substantial savings by paying for all insurance in advance, the City may agree to reimburse all insurance costs at time of first pay

application for GMP and Cost-Based Agreements with proof of payment from Contractor.

- 1.6.2 Sales, use or similar taxes imposed by a governmental authority that are related to the Work.
- 1.6.3 Fees and assessments for the building permit and for other permits, licenses and inspections for which Contractor is required by the Agreement Documents to pay.
- 1.6.4 Fees of laboratories for tests required by the Agreement Documents, except those related to defective or nonconforming Work and which do not fall within the scope of ¶ 1.7.3 below.
- 1.6.5 Royalties and license fees paid for the use of a particular design, process or product required by the Agreement Documents; the cost of defending suites or claims for infringement of patent rights arising from such requirement of the Agreement Documents; and payments made in accordance with legal judgments against Contractor resulting from such suites or claims and payments of settlements made with City's consent. However, such costs of legal defenses, judgments and settlements must not be included in the calculation of the Contractor's Fee or subject to the Guaranteed Maximum Price.
- 1.6.6 Data processing costs related to the Work. However, any such data processing costs will be limited to the cost of personal computer hardware used at the field office in the normal day to day administration, management and control of the Project. The aggregate charges for any such hardware must not exceed the Fair Market Value of the hardware at the time it was brought to the field office. If the total charges for any particular piece of hardware reach an amount equal to the Fair Market Value, that particular piece of hardware must be turned over to City whenever it is no longer needed for the Project. If Contractor elects to keep the particular piece of hardware, the job costs must be credited with a mutually agreeable amount which will represent the Fair Market Value of the particular piece of hardware at the time it was no longer needed for the job. Software or other costs associated with the use of computer programs will not be considered to be a reimbursable cost and will be considered to be covered by the Contractor's Fee.
- 1.6.7 Deposits lost for causes other than Contractor's negligence or failure to fulfill a specific responsibility to City as set forth in the Agreement Documents.
- 1.6.8 Legal, mediation and arbitration costs, including attorneys' fees, other than those arising from disputes between City and Contractor, reasonably incurred by Contractor in the performance of the Work and with City's prior written approval; which approval will not be unreasonably withheld.
- 1.6.9 Expenses incurred in accordance with Contractor's standard personnel policy for relocation and temporary living allowances of personnel required for the Work, if pre-approved by City in writing. If City authorizes the reimbursement of relocation costs, the reimbursable relocation expenses will be limited to a maximum of \$50,000 per person. Any relocation cost incurred by Contractor in excess of the amount reimbursed by City will be considered to be covered by the Contractor's Fee.

1.7 Other Costs and Emergencies

- 1.7.1 Other costs incurred in the performance of the Work if and to the extent approved in

advance in writing by City.

- 1.7.2 Costs due to emergencies incurred in taking action to prevent threatened damage, injury or loss in case of an emergency affecting the safety of persons and property.
- 1.7.3 Costs of repairing or correcting damaged or nonconforming Work executed by Contractor, Subcontractors or Suppliers, provided that such damaged or nonconforming Work was not caused by negligence or failure to fulfill a specific responsibility of Contractor and only to the extent that the cost of repair or correction is not recoverable by Contractor from insurance, sureties, Subcontractors or Suppliers.

1.8 Related Party Transactions

- 1.8.1 The term “related party” will mean a parent, subsidiary, affiliate or other entity having common ownership or management with Contractor; any entity in which any stockholder in, or management employee of, Contractor owns any interest in excess of ten percent in the aggregate; or any person or entity which has the right to control the business or affairs of Contractor. The term “related party” includes any member of the immediate family of any person identified above.
- 1.8.2 If any of the costs to be reimbursed arise from a transaction between Contractor and a related party, Contractor must notify City in writing of the specific nature of the contemplated transaction, including the identity of the related party and the anticipated cost to be incurred, before any such transaction is consummated or cost incurred. If City, after such notification, authorizes in writing the proposed transaction, then the cost incurred will be included as a cost to be reimbursed, and Contractor must procure the Work, equipment, goods or service from the related party, as a Subcontractor. If City fails to authorize the transaction, Contractor must procure the Work, equipment, goods or service from some person or entity other than a related party.

SECTION 2 – COSTS NOT TO BE REIMBURSED

- 2.1 The Cost of Work must not include:
 - 2.1.1 Salaries and other compensation of Contractor’s personnel stationed at Contractor’s principal office or offices other than the site office, except as specifically provided in Subparagraphs 1.2.2 and 1.2.3.
 - 2.1.2 Expenses of Contractors’ principal office and offices other than the site office.
 - 2.1.3 Overhead and general expenses, except as may be expressly included in Section 1.
 - 2.1.3.1 Costs of Contractor’s home office computer services or other outside computer processing services will be considered overhead and general expense. Accordingly, Contractor should not plan to perform any such computer related services or alternatives at the field office when such services or functions can be performed at Contractor’s home or branch offices, or other outside service locations.
 - 2.1.4 Contractor’s capital expenses, including interest on Contractor’s capital employed for the Work.

- 2.1.5 Rental costs of machinery and equipment, except as specifically provided in subparagraph 1.5.2.
- 2.1.6 Except as provided in Subparagraph 1.7.3 of the Agreement, costs due to the negligence or failure to fulfill a specific responsibility of Contractor, Subcontractors and Suppliers or anyone directly or indirectly employed by any of them or for whose acts of them may be liable.
- 2.1.7 Any cost not specifically and expressly described in Section 1.
- 2.1.8 Costs, other than costs included in Change Orders approved by City that would cause the GMP to be exceeded.

SECTION 3 – DISCOUNTS, REBATES, REFUNDS AND SAVINGS

- 3.1 Cash discounts obtained on payments made by Contractor will accrue to City if (1) before making the payment, Contractor included them in an Application for Payment and received payment therefore from City, or (2) City has deposited funds with Contractor with which to make payments; otherwise, cash discounts will accrue to Contractor. Trade discounts, rebates, refunds and amounts received from sales or surplus materials and equipment will accrue to City, and Contractor must make provisions so that they can be secured.
 - 3.1.1 Cost of the Work will be credited with all insurance policy discounts, performance and payment bond rebates or refunds, refunds or return premiums from any Subcontractor default insurance, refunds or rebates from any Contractor controlled insurance programs applicable to the Project, merchandise rebates of any nature, refunds of any nature, insurance dividends; and a portion of any volume rebates or free material credits earned with purchase of material or other goods and services charged to the job.
 - 3.1.2 “Cash” discounts which may accrue to Contractor will be limited to a maximum of 1.5% of invoice cost. Any portion of “Cash” discounts greater than 1.5% will automatically accrue to City if Contractor is eligible to take advantage of the discounts.
- 3.2 Amounts that accrue to City in accordance with the provisions of Paragraph 3.1 will be credited to City as a deduction from the Cost of the Work.
- 3.3 Any and all savings on the GMP, or any separately guaranteed items comprising the GMP, will belong to City, subject to any express right in the Agreement for Contractor to share in savings. Savings are subject to City's right to audit, and may be audited separately.

SECTION 4 – GENERAL CONDITIONS COSTS

- 4.1 General Conditions Costs may include, but are not limited to, the following types of costs incurred by Contractor during construction of the Work to the extent they are reimbursable Costs of the Work as delineated above: payroll costs for Work conducted at the site, payroll costs for the superintendent and full-time general foremen, payroll costs for management

personnel resident and working on the site workers not included as direct labor costs engaged in support (e.g. loading/unloading, clean-up, etc.), administrative office personnel, costs of offices and temporary facilities including office materials, office supplies, office equipment, minor expenses, utilities, fuel, sanitary facilities and telephone services at the site, costs of liability insurance premiums not included in labor burdens for direct labor costs, costs of bond premiums, costs of consultants not in the direct employ of Contractor or Subcontractors, fees for permits and licenses.

- 4.2 General Conditions Costs may be paid on a percentage of the Agreement Price or on a lump/stipulate sum basis as set forth in the Agreement. All costs included in the General Conditions Costs will not be separately invoiced to or paid by City.
- 4.3 The total amount of General Conditions Costs for the Work may be divided by the number of days allowed for performance of the Work, to determine a fixed daily rate for General Conditions Costs that may be used in computing the General Conditions Costs allocated to any period of time, or for any adjustments in the General Conditions Costs agreed to in writing by City.

LANDSCAPE ESTABLISHMENT PERIOD

Section 1 – Description and General

Contractor is in direct control of work performed under the Landscape Establishment Period. If work is subcontracted, a representative of the Contractor will be present at the site of the work for all hours that the subcontractor works. Subcontracting of Landscape Establishment work will be permitted for weed eradication with herbicides, because of special licensing. A licensed temporary service may be used to supply labor to Contractor if Contractor has received approval from City Representatives. Contractor will submit the required subcontract documentation.

Contractor must provide adequate personnel to accomplish the required maintenance of the plant materials at intervals acceptable to City Representatives.

If not healthy at the end of the maintenance period, the maintenance must be continued until the plant material is approved by City.

1.1 Time and Schedule

Unless otherwise expressly agreed to in writing by City, the Landscape Establishment Period will be per General Conditions Section 6.5.4.

1.2 Planted Stock and Seeding Establishment

- 1.2.1 Tree planting and staking must be per City of Chandler Standard Detail C-801.
- 1.2.2 All trees will stand erect on their own without stakes when brought to this site. If the tree cannot stand on its own when nursery stakes are removed, the tree will be removed and replaced.

1.3 Pre-Emergent Herbicide and Weed Control

- 1.3.1 Contractor will provide three applications of an approved pre-emergent herbicide on all unpaved areas of the project, as directed by City Representatives, to control weed growth in all areas of the project. The number of applications may be increased as directed by the City Representative, and at no additional cost to City, if the City Representative deems additional applications are required to control weed growth.
- 1.3.2 Application sequence will be approved in advance by City. The first application of pre-emergent will be completed prior to the application of Decomposed Granite and will be included with the cost of the Decomposed Granite as specified and part of the Construction Phase portion of work. The second application of pre-emergent will be completed after installation of the Decomposed 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

TECHNICAL SPECIFICATIONS

FOR

**PW3-925-4631: PECOS SURFACE WATER TREATMENT
PLANT FILTER IMPROVEMENTS - PHASE III**

AUGUST 2024

90% SUBMITTAL

VOLUME 1 OF 1

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DIVISION 03 – CONCRETE

Section	Title
03 01 30	Concrete Repairs
03 60 00	Grout

DIVISION 05 – METALS

Section	Title
05 05 23	Metal Fastening
05 10 00	Metal Materials
05 13 00	Stainless Steel

DIVISION 07 – THERMAL AND MOISTURE PROTECTION

Section	Title
07 16 16	Crystalline Waterproofing
07 90 00	Joint Fillers, Sealants and Caulking

DIVISION 09 – FINISHES

Section	Title
09 90 00	Painting

DIVISION 26 – ELECTRICAL

Section	Title
26 05 00	Basic Electrical Requirements
26 05 19	Low-Voltage Conductors and Cables
26 05 26	Grounding and Bonding for Electrical Systems
26 05 29	Hangers and Supports for Electrical Systems
26 05 33.13	Conduit for Electrical Systems
26 05 33.16	Boxes for Electrical Systems
26 05 53	Identification for Electrical Systems
26 05 73	Power System Studies
26 27 26	Wiring Devices

DIVISION 40 – PROCESS INTERCONNECTIONS

Section	Title
40 05 00	Basic Mechanical Requirements
40 05 07	Pipe Supports
40 05 31	PVC/CPVC Pipe
40 05 51	Valves, General
40 05 57	Valve Operators and Electric Valve Actuators
40 05 63	Ball Valves
40 05 68.13	PVC and CPVC Valves
40 06 20	Process Pipe, Valve, and Gate Schedules
40 61 13	Process Control System General Provisions
40 61 15	Process Control System Submittals
40 61 21.72	Field Testing
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40 61 22	Tools, Supplies, and Spare Parts, General
40 61 23	Signal Coordination Requirements
40 61 91	Process Control System Instrument List
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40 78 00	Panel Mounted Instruments
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DIVISION 46 – WATER AND WASTEWATER EQUIPMENT

Section	Title
46 00 00	Equipment General Provisions
46 33 44	Peristaltic Tube Metering Pumps
46 61 16	GAC Filter Media
46 61 17	Sand Filter Media

SECTION 01 11 00
SUMMARY OF WORK

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Summary
2. Location and Description of Work
3. Construction Contracts, This Project
4. Construction Contracts, Other Projects
5. Work by Others
6. Work by Owner
7. Owner Furnished Equipment and Materials
8. Owner Assigned Procurement Contracts
9. Owner Pre-selected Equipment and Materials
10. Sequence and Progress of Work
11. Contractor's Use of Site
12. Easements and Rights-of-Way
13. Notices to Owners and Authorities of Properties Adjacent to the Work
14. Salvage of Equipment and Materials
15. Partial Utilization by Owner

1.02 LOCATION AND DESCRIPTION OF WORK

A. The Work is located at the following Site:

1. Pecos Surface Water Treatment Plant
1475 E. Pecos Road, Chandler, AZ 85286

B. The Work to be performed under this Contract includes, but is not limited to, constructing the Work described below and all appurtenances related to the Work. The Work shall be as follows:

1. The work to be performed under this Contract and in accordance with these specifications consists of the furnishing and installation of equipment, materials, superintendence, labor, skill and all other items necessary for the removal of anthracite media and coordination with the Owner over installation of sand media and GAC filter media in Filters 9, 10, 11 and 12, structural rehabilitation of Filters 9 through 12, and expansion of the filter aid polymer system at the Pecos Surface Water Treatment Plant, located in the City of Chandler, Arizona. The Contractor shall perform all work required for such construction in accordance with the Contract Documents and subject to the terms and conditions of the Contract, complete and ready for use.
2. The principal features of the work to be performed for this Project under this Contract include, but are not limited to, the following:
 - a. Remove and dispose of existing anthracite media in Filters 9 through 12 (Owner and GAC Manufacturer with Contractor assistance).
 - b. Repair concrete and filter appurtenances in Filters 9 through 12, dependent upon condition observed during inspection that shall be performed after the anthracite filter media has been removed (Contractor).
 - c. Coordinate with Owner for the installation of the sand media in Filters 9 through 12 (Contractor).
 - d. Coordinate with Owner and GAC Manufacturer for the installation of the GAC filter media in Filters 9 through 12 (Contractor).
 - e. Furnish and install a filter polymer metering pump and associated instrumentation in the Disinfection Building (Contractor).
 - f. Furnish and install process piping, motorized valves and flow meters at Filters 9 through 12 (Contractor).
 - g. Furnish and install electrical power and control signals to the new filter aid polymer system, flow meters and motorized valves (Contractor).
3. Construction includes, but is not limited to, process equipment, process piping, yard piping, site work, plumbing, electrical systems, security features and integrated instrumentation. This is a general description only and shall not be construed as a complete description of the work to be performed.

1.03 CONSTRUCTION CONTRACTS, THIS PROJECT

A. The Contracts under which the Project will be constructed are:

1. Work specified in Divisions 01 through 46 (inclusive) of the Specifications.
2. Work shown on sheets 1 through 26 (inclusive) of the Drawings.

1.04 CONSTRUCTION CONTRACTS, OTHER PROJECTS (NOT USED)

1.05 WORK BY OTHERS

- A. All aspects of PLC programming and system integration shall be by Others. Contractor shall coordinate with the Owner for all programming related coordination.
- B. Hazen and Sawyer, Inc. shall perform engineering services during construction.
- C. GAC Manufacturer shall perform services including removing and disposing of the existing anthracite media in Filters 9 through 12, furnishing and installing the GAC filter media in Filters 9 through 12 per the specifications on the Contract Documents.

1.06 WORK BY OWNER

- A. Owner will perform the following in connection with the Work: Operate all existing valves, gates, pumps, equipment, and appurtenances that will affect Owner's operation, unless otherwise specified or indicated.
- B. Owner will provide water required for backwashing and flushing filter boxes.
- C. Owner will coordinate with the services provided by the GAC Manufacturer in regards to the removal and disposal of the existing anthracite media in Filters 9 through 12 and the installation of the GAC filter media in Filters 9 through 12. Owner will also coordinate with the services provided by the Sand Media Manufacturer and the Contractor for the installation of the Sand Media in Filters 9 through 12.

1.07 OWNER-FURNISHED EQUIPMENT AND MATERIALS

- A. The Owner shall furnish sand filter media in Filters 9 through 12 as specified in Section 46 61 17.
- B. The Owner shall furnish GAC filter media in Filters 9 through 12 as specified in Section 46 61 16.

1.08 OWNER ASSIGNED PROCUREMENT DOCUMENTS

- A. The Owner shall use Section 46 61 17 for the procurement of the sand filter media in Filters 9-12.
- B. The Owner shall use Section 46 61 16 for the procurement of the GAC filter media in Filters 9-12.

1.09 OWNER PRE-SELECTED EQUIPMENT AND MATERIALS (NOT USED)

1.10 SEQUENCE AND PROGRESS OF WORK

- A. Requirements for sequencing and coordinating with Owner's operations, including maintenance of plant operations during construction, and requirements for tie-ins and shutdowns, are in Section 01 14 00 – Coordination with Owner's Operations.

1.11 CONTRACTOR'S USE OF SITE

- A. Contractors' use of the Site shall be confined to the areas shown. Contractors shall share use of the Site with other contractors and others specified in this Section.
- B. Contractor shall move stored products that interfere with operations of Owner, other contractors, or others performing work for Owner.

1.12 EASEMENTS AND RIGHTS-OF-WAY

- A. Easements and rights-of-way will be provided by Owner in accordance with the General Conditions. Confine construction operations to within Owner's property, public rights-of-way, easements obtained by Owner, and the limits shown. Use care in placing construction tools, equipment, excavated materials, and products to be incorporated into the Work to avoid damaging property and interfering with traffic. Do not enter private property outside the construction limits without permission from the owner of the property.

1.13 SALVAGE OF EQUIPMENT AND MATERIALS

- A. Existing equipment and materials removed and not shown or specified to be reused in the Work will be Contractor's property, except as noted on Contract Drawings.
- B. Existing equipment and material removed by Contractor shall not be reused in the Work, except where specified or indicated.
- C. Carefully remove in manner to prevent damage all equipment and materials specified or indicated to be salvaged and reused or to remain property of Owner. Store and protect salvaged items specified or indicated to be used in the Work. Replace in kind or with new items equipment, materials, and components damaged in removal, storage, or handling through carelessness or improper procedures.
- D. Contractor may furnish and install new items, with Engineer's approval, instead of those specified or indicated to be salvaged and reused, in which case such removed items will become Contractor's property.

1.14 PARTIAL UTILIZATION BY OWNER

- A. Owner reserves the right to enter and use portions of the Work prior to Certificate of Substantial Completion is issued by Engineer.

- B. Owner shall be responsible to prevent premature connections by private and public parties, persons or groups of persons, before Engineer issues Certificate of Substantial Completion for the portion of Work being partially utilized by Owner.
- C. Contractor shall cooperate with Owner, Owner's agents, and Engineer to accelerate completion of Work designed for partial utilization by Owner in accordance with Contractor's progress schedule.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

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SECTION 01 11 00
SUMMARY OF WORK

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Summary
2. Location and Description of Work
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8. Owner Assigned Procurement Contracts
9. Owner Pre-selected Equipment and Materials
10. Sequence and Progress of Work
11. Contractor's Use of Site
12. Easements and Rights-of-Way
13. Notices to Owners and Authorities of Properties Adjacent to the Work
14. Salvage of Equipment and Materials
15. Partial Utilization by Owner

1.02 LOCATION AND DESCRIPTION OF WORK

A. The Work is located at the following Site:

1. Pecos Surface Water Treatment Plant
1475 E. Pecos Road, Chandler, AZ 85286

B. The Work to be performed under this Contract includes, but is not limited to, constructing the Work described below and all appurtenances related to the Work. The Work shall be as follows:

1. The work to be performed under this Contract and in accordance with these specifications consists of the furnishing and installation of equipment, materials, superintendence, labor, skill and all other items necessary for the removal of anthracite media and coordination with the Owner over installation of sand media and GAC filter media in Filters 9, 10, 11 and 12, structural rehabilitation of Filters 9 through 12, and expansion of the filter aid polymer system at the Pecos Surface Water Treatment Plant, located in the City of Chandler, Arizona. The Contractor shall perform all work required for such construction in accordance with the Contract Documents and subject to the terms and conditions of the Contract, complete and ready for use.
2. The principal features of the work to be performed for this Project under this Contract include, but are not limited to, the following:
 - a. Remove and dispose of existing anthracite media in Filters 9 through 12 (Owner and GAC Manufacturer with Contractor assistance).
 - b. Repair concrete and filter appurtenances in Filters 9 through 12, dependent upon condition observed during inspection that shall be performed after the anthracite filter media has been removed (Contractor).
 - c. Coordinate with Owner for the installation of the sand media in Filters 9 through 12 (Contractor).
 - d. Coordinate with Owner and GAC Manufacturer for the installation of the GAC filter media in Filters 9 through 12 (Contractor).
 - e. Furnish and install a filter polymer metering pump and associated instrumentation in the Disinfection Building (Contractor).
 - f. Furnish and install process piping, motorized valves and flow meters at Filters 9 through 12 (Contractor).
 - g. Furnish and install electrical power and control signals to the new filter aid polymer system, flow meters and motorized valves (Contractor).
3. Construction includes, but is not limited to, process equipment, process piping, yard piping, site work, plumbing, electrical systems, security features and integrated instrumentation. This is a general description only and shall not be construed as a complete description of the work to be performed.

1.03 CONSTRUCTION CONTRACTS, THIS PROJECT

A. The Contracts under which the Project will be constructed are:

1. Work specified in Divisions 01 through 46 (inclusive) of the Specifications.
2. Work shown on sheets 1 through 26 (inclusive) of the Drawings.

1.04 CONSTRUCTION CONTRACTS, OTHER PROJECTS (NOT USED)

1.05 WORK BY OTHERS

- A. All aspects of PLC programming and system integration shall be by Others. Contractor shall coordinate with the Owner for all programming related coordination.
- B. Hazen and Sawyer, Inc. shall perform engineering services during construction.
- C. GAC Manufacturer shall perform services including removing and disposing of the existing anthracite media in Filters 9 through 12, furnishing and installing the GAC filter media in Filters 9 through 12 per the specifications on the Contract Documents.

1.06 WORK BY OWNER

- A. Owner will perform the following in connection with the Work: Operate all existing valves, gates, pumps, equipment, and appurtenances that will affect Owner's operation, unless otherwise specified or indicated.
- B. Owner will provide water required for backwashing and flushing filter boxes.
- C. Owner will coordinate with the services provided by the GAC Manufacturer in regards to the removal and disposal of the existing anthracite media in Filters 9 through 12 and the installation of the GAC filter media in Filters 9 through 12. Owner will also coordinate with the services provided by the Sand Media Manufacturer and the Contractor for the installation of the Sand Media in Filters 9 through 12.

1.07 OWNER-FURNISHED EQUIPMENT AND MATERIALS

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- A. The Owner shall use Section 46 61 17 for the procurement of the sand filter media in Filters 9-12.
- B. The Owner shall use Section 46 61 16 for the procurement of the GAC filter media in Filters 9-12.

1.09 OWNER PRE-SELECTED EQUIPMENT AND MATERIALS (NOT USED)

1.10 SEQUENCE AND PROGRESS OF WORK

- A. Requirements for sequencing and coordinating with Owner's operations, including maintenance of plant operations during construction, and requirements for tie-ins and shutdowns, are in Section 01 14 00 – Coordination with Owner's Operations.

1.11 CONTRACTOR'S USE OF SITE

- A. Contractors' use of the Site shall be confined to the areas shown. Contractors shall share use of the Site with other contractors and others specified in this Section.
- B. Contractor shall move stored products that interfere with operations of Owner, other contractors, or others performing work for Owner.

1.12 EASEMENTS AND RIGHTS-OF-WAY

- A. Easements and rights-of-way will be provided by Owner in accordance with the General Conditions. Confine construction operations to within Owner's property, public rights-of-way, easements obtained by Owner, and the limits shown. Use care in placing construction tools, equipment, excavated materials, and products to be incorporated into the Work to avoid damaging property and interfering with traffic. Do not enter private property outside the construction limits without permission from the owner of the property.

1.13 SALVAGE OF EQUIPMENT AND MATERIALS

- A. Existing equipment and materials removed and not shown or specified to be reused in the Work will be Contractor's property, except as noted on Contract Drawings.
- B. Existing equipment and material removed by Contractor shall not be reused in the Work, except where specified or indicated.
- C. Carefully remove in manner to prevent damage all equipment and materials specified or indicated to be salvaged and reused or to remain property of Owner. Store and protect salvaged items specified or indicated to be used in the Work. Replace in kind or with new items equipment, materials, and components damaged in removal, storage, or handling through carelessness or improper procedures.
- D. Contractor may furnish and install new items, with Engineer's approval, instead of those specified or indicated to be salvaged and reused, in which case such removed items will become Contractor's property.

1.14 PARTIAL UTILIZATION BY OWNER

- A. Owner reserves the right to enter and use portions of the Work prior to Certificate of Substantial Completion is issued by Engineer.

- B. Owner shall be responsible to prevent premature connections by private and public parties, persons or groups of persons, before Engineer issues Certificate of Substantial Completion for the portion of Work being partially utilized by Owner.
- C. Contractor shall cooperate with Owner, Owner's agents, and Engineer to accelerate completion of Work designed for partial utilization by Owner in accordance with Contractor's progress schedule.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

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SECTION 01 14 00
COORDINATION WITH OWNER'S OPERATIONS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Requirements for coordinating with Owner's operations during the Work and included requirements for tie-ins and shutdowns necessary to complete the Work without impact on Owner's operations except as allowed in this Section.
2. Contractor shall provide labor, materials, tools, equipment and incidentals shown, specified and required to coordinate with Owner's operations during the Work.

B. General Requirements:

1. Except for shutdowns specified in this Section, perform the Work such that Owner's facility remains in continuous satisfactory operation during the Project. Schedule and conduct the Work such that the Work does not: impede Owner's production or processes, create potential hazards to operating equipment and personnel, reduce the quality of the facility's products or effluent, or cause odors or other nuisances.
2. Work not specifically covered in this Section or in referenced Sections may, in general, be completed at any time during regular working hours in accordance with the General Conditions and Supplementary Conditions, subject to the requirements in this Section.
3. Contractor has the option of providing additional temporary facilities that can eliminate or mitigate a constraint without additional cost to Owner, provided such additional temporary facilities: do not present hazards to the public, personnel, structures, and equipment; that such additional temporary facilities do not adversely affect Owner's ability to comply with Laws and Regulations, permits, and operating requirements; that such temporary facilities do not generate or foster the generation of odors and other nuisances; and that requirements of the Contract Documents are fulfilled.
4. Coordinate shutdowns with Owner and Engineer. When possible, combine multiple tie-ins into a single shutdown to minimize impacts on Owner's operations and processes.
5. Do not shut off or disconnect existing operating systems, unless accepted by Engineer in writing. Operation of existing equipment will be by Owner unless

otherwise specified or indicated. Where necessary for the Work, Contractor shall seal or bulkhead Owner-operated gates and valves to prevent leakage that may affect the Work, Owner's operations, or both. Provide temporary watertight plugs, bulkheads, and line stops as required. After completing the Work, remove seals, plugs, bulkhead, and line stops to satisfaction of Engineer.

C. Continuous Treatment Provision:

1. Contractor shall provide labor, equipment, materials, and incidentals to provide continuous treatment to the level prior to construction Work.
2. Contractor shall be responsible for providing temporary pumping facilities, systems, piping, valve, appurtenances, equipment, materials, and temporary utilities necessary to complete the Work without treatment bypassing.

D. Related Sections:

1. Section 01 11 00 – Summary of Work

1.02 REFERENCES

- A. Definitions: A "shutdown" is when a portion of the normal operation of Owner's facility, whether equipment, systems, piping, or conduit, has to be temporarily suspended or taken out of service to perform the Work.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Review installation procedures under other Specification sections and coordinate Work that must be performed with or before the Work specified in this Section.
2. Notify other contractors in advance of Work requiring coordination with Owner's operations, to provide other contractors sufficient time for work included in their contracts that must be installed with or before Work specified in this Section.
3. When possible, combine multiple tie-ins into a single shutdown to minimize impacts on Owner's operations and processes.

- B. Pre-Shutdown Meetings: Contractor shall schedule and conduct meeting with Owner and Engineer at least thirty 30 days prior to scheduling shutdown.

C. Sequencing:

1. Perform the Work in the specified sequence. Certain phases or stages of the Work may require working 24-hour days or work during hours outside of regular working hours. Work may be accelerated from a later stage to an earlier stage if Owner's

operations are not adversely affected by proposed sequence change, with Engineer's acceptance. Stages specified in this Section are sequential in performance of the Work.

D. Scheduling:

1. Work that may interrupt normal operations shall be accomplished at times convenient to Owner.
2. Furnish at the Site, in close proximity to the shutdown and tie-in work areas, tools, equipment, spare parts and materials, both temporary and permanent, necessary to successfully complete the shutdown. Complete to the extent possible, prefabrication of piping and other assemblies prior to the associated shutdown. Demonstrate to Engineer's satisfaction that Contractor has complied with these requirements before commencing the shutdown.
3. If Contractor's operations cause an unscheduled interruption of Owner's operations, immediately re-establish satisfactory operation for Owner.
4. Unscheduled shutdowns or interruptions of continued safe and satisfactory operation of Owner's facilities that result in fines or penalties by authorities having jurisdiction shall be paid solely by Contractor if, in Engineer's opinion, Contractor did not conform to the requirements of the Contract Documents, or was negligent in the Work, or did not exercise proper precautions in conducting the Work.
5. Work requiring service interruptions for tie-ins shall be performed during scheduled shutdowns.
6. Temporary, short-term shutdowns of smaller piping, conduits, equipment, and systems may be required. Coordinate requirements for such shutdowns with Engineer and Owner.

1.04 SUBMITTALS

A. Action/Informational Submittals:

1. Substitute Sequence Submittal: When deviation from specified sequence is proposed, provide submittal explaining in detail the proposed sequence change and its effects, including evidence that Owner's operations will not be adversely affected by proposed change. List benefits of proposed sequence change, including benefits to Progress Schedule.
2. Shutdown Planning Submittal:
 - a. For each shutdown, submit an inventory of labor and materials required to perform the shutdown and tie-in tasks, an estimate of time required to accomplish the complete shutdown including time for Owner to take down

and start up existing equipment, systems, or conduits, and written description of steps required to complete the Work associated with the shutdown.

- b. Furnish submittal to Engineer at least thirty (30) days prior to proposed shutdown start date. Do not start shutdown until obtaining Engineer's acceptance of shutdown planning submittal.
3. Shutdown Notification: After acceptance of shutdown planning submittal and prior to starting the shutdown, provide written notification to Owner and Engineer of date and time each shutdown is to start. Provide notification at least 72 hours in advance of each shutdown.

1.05 SITE CONDITIONS

- A. General Constraints: Specified in the Contract Documents are the sequence and shutdown durations, where applicable, for Owner's equipment, systems, and conduits that are to be taken out of service temporarily for the Work. New equipment, materials, and systems may be used by Owner after the specified field quality controls and testing are successfully completed and the materials or equipment are Substantially Complete.
- B. The following constraints apply to coordination with Owner's operations:
 1. Operational Access: Owner's personnel shall have access to equipment and areas that remain in operation.
 2. Schedule and perform equipment and system start-ups for Monday through Thursday. Equipment and systems shall not be placed into operation on Friday, Saturday, and Sunday without prior approval of Owner.
 3. Dead End Valves or Pipe: Provide blind flanges, watertight bulkheads, or valves at temporary and permanent terminuses of pipes and conduits. Blind flanges and bulkheads shall be suitable for the service and braced and blocked, as required, or otherwise restrained as directed by Engineer. Temporary valves shall be suitable for their associated service. Where valve is provided at permanent terminus of pipe or conduit, also provide on downstream side of valve a blind flange with drain/flushing connection.
 4. Owner will assist Contractor in dewatering process tanks, basins, conduits, and other work areas to be dewatered for shutdowns. Maintain clean and dry work area by pumping and properly disposing of fluid that accumulates in work areas.
 5. Draining and Cleaning of Conduits, Tanks, and Basins: Unless otherwise specified, Owner will dewater process tanks and basins at beginning of each shutdown. Owner will flush and wash down tanks and basins with plant non-

potable water. Draining and cleaning conducted by Contractor shall be as specified below:

- a. Contractor shall remove liquids and solids and dispose of them at appropriate location at the Site as directed by Engineer. Contents of pipes, tanks, basins, and conduits undergoing modifications shall be transferred to existing process tanks or conduits at the Site with capacity sufficient to accept such discharges, using hoses, piping, pumps, or other means provided by Contractor. Discharge of fluids across floors is not allowed.
 - b. If drainage point is not available on the piping or conduit to be drained, provide a wet tap using tapping saddle and valve or other method approved by Engineer. Uncontrolled spillage of pipe's or conduit's contents is not allowed.
 - c. Spillage shall be brought to Engineer's attention immediately, both verbally and in writing, and reported in accordance with Laws and Regulations. Contractor shall wash down spillage to floor drains or sumps and flush the system to prevent clogging and odors. If spillage is not suitable for discharge to the drainage system, such as chemical spills, as determined by Engineer, Contractor shall remove spillage by other method, such as vactor truck, acceptable to Engineer.
6. Electrical, Control, Communication, and Monitoring Systems:
- a. Owner's existing SCADA system and fiber optic network shall remain functional, subject to the constraints herein.
 - b. Unless Contractor elects to use existing fiber and/or temporary fiber, at his/her discretion, at least one communication path through the new dual redundant fiber optic ring to all communication points shall be in place at all times until substantial completion.
 - c. Each process area shall be permitted to have a single, non-concurrent, scheduled outage for the purpose of making PLC panel hardware modifications, loading the associated PLC logic, and its field testing/demonstration. Field testing and demonstration shall immediately follow modifications in an effort to keep scheduled shutdowns as short as possible. A 14-day day period of no SCADA outage shall proceed each scheduled shutdown.

1.06 SUGGESTED SEQUENCE OF WORK

- A. Perform the Work in the specified sequence or as otherwise approved by Engineer. Certain phases or stages of the Work may require working 24-hour days or work during hours outside of regular working hours. Work may be accelerated from a later stage to

an earlier stage if Owner's operations are not adversely affected by proposed sequence change, and with Engineer's acceptance. Construction may occur on all four filters simultaneously after contractor schedule has been approved.

B. Stages specified in this Section are sequence-dependent.

1. Stage 1: Removal and reinstallation of filter media

- Removal of existing anthracite media
- Filter condition assessment and potential concrete and filter repair.
- Installation of sand media.
 - 1) Disinfection of filters
- Installation of GAC media
- Installation of polymer metering pump, piping and valves.
- Installation of instrumentation, power, and electrical components
- Electrical and mechanical tie-ins

2. Stage 2: Testing, commissioning, and startup.

1.07 TIE-INS

A. Contractor shall perform tie-ins required to complete the Work and obtain requirements for tie-ins from Engineer.

1.08 SHUTDOWNS

A. General:

1. Work that may interrupt normal operations shall be accomplished at times convenient to Owner.
2. Furnish at the Site, in close proximity to the shutdown and tie-in work areas, tools, equipment, spare parts and materials, both temporary and permanent, necessary to successfully complete the shutdown. Complete to the extent possible, prefabrication of piping and other assemblies prior to the associated shutdown. Demonstrate to Engineer's satisfaction that Contractor has complied with these requirements before commencing the shutdown.
3. If Contractor's operations cause an unscheduled interruption of Owner's operations, immediately re-establish satisfactory operation for Owner.

4. Unscheduled shutdowns or interruptions of continued safe and satisfactory operation of Owner's facilities that result in fines or penalties by authorities having jurisdiction shall be paid solely by Contractor if, in Engineer's opinion, Contractor did not conform to the requirements of the Contract Documents, or was negligent in the Work, or did not exercise proper precautions in conducting the Work.
 5. Shutdowns shall be in accordance with this Section. Work requiring service interruptions for tie-ins shall be performed during scheduled shutdowns.
 6. Contractor shall coordinate requirements for temporary, short-term shutdowns of smaller piping, conduits, equipment, and systems shutdowns with Engineer and Owner.
- B. Treatment Process Shutdown and Site Access Constraints:
1. Owner shall have the following unit processes and equipment operational at all times during the Project, unless specified herein:
 - a. All conveyance and existing treatment processes at the Pecos Surface Water Treatment Plant.
 2. Contractor shall maintain clear access to a minimum 15-foot roadway for Owner access.
- C. Shutdowns of Electrical Systems: Comply with Laws and Regulations, including the National Electric Code. Contractor shall lock out and tag circuit breakers and switches operated by Owner and shall verify that affected cables and wires are de-energized to ground potential before shutdown Work is started. Upon completion of shutdown Work, remove the locks and tags and notify Engineer that facilities are available for use.
- D. Shutdowns of Communications, SCADA, and Networking:
1. SCADA outages shall be approved by the Engineer and shall be coordinated with and scheduled at times suitable to the Owner.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.01 GENERAL

- A. In addition to requirements of this Section, conform to requirements of the General Conditions.

3.02 DETAILED SHUTDOWN REQUIREMENTS:

A. Prior to Typical Shutdown:

1. Obtain Engineer's acceptance of proposed shutdown planning submittal and shutdown notification submittal.
2. Submittal and approval of all shop drawings required.
3. Coordinate with plant operations on timing of shutdown and provide required notice to Owner.
4. Bring necessary piping, couplings, valves, equipment, and appurtenances to the work areas.
5. Assist Owner in preparing to take equipment, tanks, basins, and conduits temporarily out of service.
6. Coordinate other tie-ins to be performed simultaneously.
7. Install and ensure functionality of temporary systems as applicable.

B. During Typical Shutdown:

1. Owner will dewater tanks and basins.
2. Remove existing equipment, piping, and accessories as required.
3. Verify operation of new equipment, materials, and systems.
4. Following approval from Engineer, return equipment and system to operation with Owner.

C. Following Typical Shutdown:

1. Verify functionality of equipment and system.
2. Verify operation of new equipment and systems, and verify that joints in piping are watertight or gastight as applicable.
3. Repair joints that are not watertight or gastight as applicable.
4. Remove temporary systems as applicable.

3.03 PROPOSED SHUTDOWN SEQUENCE (NOT USED)

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SECTION 01 25 00
SUBSTITUTION PROCEDURES

PART 1 – GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Procedural requirements for product substitutions.
 - 2. Procedural requirements for substitute construction methods or procedures, when construction methods or procedures are specified.
- B. Requests for substitutions of equipment and material shall conform to the requirements of the General Conditions and Supplemental Conditions.
- C. Procedure for substitution requests and review including evaluation, reimbursement, acceptance, and determination shall be in accordance with General Conditions and Supplemental Conditions.

1.02 REFERENCES

- A. Definitions: The following words or terms are not defined but, when used in this Section, have the following meaning:
 - 1. “Acceptable Manufacturers” considered for substitution include Suppliers of equipment and material of proven reliability, and as manufactured by reputable manufacturers having experience in the production of specified equipment and material. Equipment furnished shall be designed, constructed, and installed in accordance with the industry accepted practices and shall operate satisfactorily when installed in accordance with the Contract Documents.
 - 2. “Products” includes materials, equipment, machinery, components, fixtures, systems, and other goods incorporated in the Work. Products do not include machinery and equipment used for preparing, fabricating, conveying, erecting, or installing the Work. Products include Owner-furnished goods incorporated in the Work where use of such goods is specifically required in the Contract Documents.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Contractor’s Responsibilities: In submitting request for substitution, Contractor represents that:
 - 1. Contractor has investigated proposed substitution and determined that it is equivalent to item, product, method, or procedure specified, as applicable.

2. Contractor will provide the same or better guarantees or warranties for proposed substitution as for the specified product, manufacturer, method, or procedure, as applicable.
 3. Contractor waives all Claims for additional costs or extension of time related to proposed substitution that subsequently may become apparent.
 4. Contractor shall submit a minimum of five (5) successful installations of the manufacturer's equipment of the same model, size, and type as specified in the Contract Documents.
 5. All costs associated with incorporation of a substitution shall be borne by the Contractor, including but not limited to, the cost of redesign and construction provisions.
- B. Engineer's Review: A proposed substitution will not be accepted for review if:
1. Approval would require changes in design concept or a substantial revision of the Contract Documents.
 2. Approval would delay completion of the Work or the work of other contractors.
 3. Substitution request is indicated or implied on a Shop Drawing or other submittal, or on a request for interpretation or clarification, and is not accompanied by Contractor's formal request for substitution.
 4. If the substitution is not clearly substantiated by performance criteria as providing an equivalent or superior performing installation.
 5. All costs associated with Engineer's review of a substitution shall be recorded by Engineer, submitted to Owner, and charged to Contractor.
- C. If Engineer does not approve the proposed substitute, Contractor shall provide the specified product, manufacturer, method, or procedure, as applicable.
- D. Approval of a substitution request will not relieve Contractor from requirement for submitting Shop Drawings as set forth in the Contract Documents.
- E. Product Substitutions Procedure:
1. Requests for approval of substitute products or items will be considered for a period of 30 days after the Effective Date of the Agreement. After end of specified period, requests will be considered only in case of unavailability of a specified product or other conditions beyond Contractor's control.
 2. Submit copies of request for substitution.
 3. Submit separate request for each substitution.

4. In addition to requirements of the General Conditions and information required on substitution request forms, include with request the following:
 - a. Product identification, including manufacturer's name and address.
 - b. Manufacturer's literature with product description, performance and test data, and reference standards with which product complies.
 - c. Samples, if appropriate.
 - d. Name and address of similar projects on which product was used, and date of installation.
 - e. Certified tests, where applicable, by an independent laboratory attesting the proposed substitution is equal.
 - f. Cost information for the proposed substitution and the specified products.
 - g. Lead time information for the proposed substitution and specified products.
 - h. All other submittal requirements indicated in the individual Specification Sections associated with the specified equipment and material.

F. Construction Methods Substitutions Procedures:

1. Where construction methods or procedures are specified, for a period of 30 days after the Effective Date of the Agreement, Engineer will consider Contractor's written requests for substitute construction methods or procedures specified.
2. Submit copies of request for substitution.
3. Submit separate request for each substitution.
4. In addition to requirements of the General Conditions and information required on substitution request forms, include with request the following:
 - a. Detailed description of proposed method or procedure.
 - b. Itemized comparison of the proposed substitution with the specified method or procedure.
 - c. Drawings illustrating method or procedure.
 - d. Other data required by Engineer to establish that proposed substitution is equivalent to specified method or procedure.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 01 29 73
SCHEDULE OF VALUES

PART 1 – GENERAL

1.01 SUMMARY

A. Section includes:

1. General requirements for preliminary and final Schedule of Values.
2. Schedule of Values and the Progress Schedule updates shall be basis for preparing each Application for Payment. Schedule of Values may be used as a basis for negotiating price of changes, if any, in the Work.

1.02 ADMINISTRATIVE REQUIREMENTS

A. General Requirements:

1. Schedule of Values shall include breakdown of costs for materials and equipment, installation, and other costs used in preparing the Bid by Contractor and each Subcontractor. List purchase and delivery costs for materials and equipment for which Contractor may apply for payment as stored materials.
2. Include separate amounts for each Specification Section in the Contract Documents by structure, building, and work area.
3. Identify each line item with number corresponding to the associated Specification Section number. List sub-items of major products or systems, as appropriate or when requested by Engineer.
4. Include in Schedule of Values unit price payment items with their associated quantity. Provide in the Schedule of Values detailed breakdown of unit prices when required by Engineer.
5. Include in Schedule of Values itemized list of Work for each major part of the Contract, for each payment item specified in Section 01 20 00 – Measurement and Payment.
6. Sum of individual values shown on the Schedule of Values shall equal the total of associated payment item. Sum of payment item totals in the Schedule of Values shall equal the Contract Price.

B. Specific Requirements:

1. Include in each line item a directly proportional amount of Contractor's overhead and profit. Do not include overhead and profit as separate item(s).

2. Include separate line item for each allowance, and for each unit price item
 3. Include line item for bonds and insurance in amount not exceeding two percent of the Contract Price. This may be applied for in the first Application for Payment.
 4. Include items for the General Conditions, permits (when applicable), construction Progress Schedule, and other items required by Engineer. Include such items in Applications for Payment on schedule accepted by Engineer
 5. Line items for Site maintenance such as dust control, snow removal, compliance with storm water pollution prevention plans and permits, spill prevention control and countermeasures plans, and for construction photographic documentation; temporary utilities and temporary facilities, field offices, temporary controls, field engineering, and similar Work shall be included in the Schedule of Values and proportioned in Applications for Payment throughout duration of the Work.
 6. Include separate line items under each appropriate payment item for mobilization and demobilization. Document for Engineer the activities included in mobilization and demobilization line items.
 - a. Mobilization will be limited to two percent of the Contract Price, and will be paid in two payments, each of 50 percent of total amount for mobilization.
 - b. Demobilization shall be at least one percent of the Contract Price and shall be included with the Application for Payment following Substantial Completion, or other schedule accepted by Engineer.
 7. Costs for submittals, operations and maintenance manuals, field testing, and training of operations and maintenance personnel shall be as follows, unless otherwise accepted by Engineer:
 - a. Up to three percent of total cost of each item (including overhead and profit), including materials and equipment, and installation, may be apportioned to testing and included in the Application for Payment following Engineer's acceptance of the associated written Site testing report(s).
- C. Preliminary Schedule of Values: Submit preliminary Schedule of Values to Engineer for initial review. Contractor shall incorporate Engineer's comments into the Schedule of Values and resubmit to Engineer. Engineer may require corrections and re-submittals until Schedule of Values is acceptable.
- D. Time Frame for Submittals:
1. Submit preliminary Schedule of Values within ten days of date that the Contract Times commence running in accordance with the Notice to Proceed.

2. Submittal of the Schedule of Values shall be in accordance with the General Conditions. Engineer will not accept Applications for Payment without an acceptable Schedule of Values.
3. When required by Engineer, promptly submit updated Schedule of Values to include cost breakdowns for changes in the Contract Price.

1.03 SUBMITTALS

A. Submit the following:

1. Electronic copy of preliminary Schedule of Values.
2. Electronic copy of Schedule of Values.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

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SECTION 01 31 19
PROJECT MEETINGS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Progress Meetings:

- a. Progress meetings will be held throughout the Project. Contractor shall attend each progress meeting prepared to discuss in detail all items on the agenda.
- b. Engineer will preside at progress meetings and will prepare and distribute minutes of progress meetings to all meeting participants and others as requested.
- c. Date, Time and Location:
 - 1) Regular Meetings: Every month on a day and time agreeable to Owner, Engineer, and Contractor.
 - 2) At the Site or other location mutually agreed upon by Owner, Contractor, and Engineer.
- d. Additional meetings may be conducted as progress of Work requires at a mutually agreed date, time and location.

1.02 ADMINISTRATIVE REQUIREMENTS

A. Progress Meetings:

- 1. Progress meetings frequency shall be conducted as specified in this Section, unless modified and agreed upon by Owner, Contractor, and Engineer. Additional meetings may be conducted as progress of Work requires.
- 2. Contractor shall provide submittals specified in this Section prior to each progress meeting.
- 3. Attendance:
 - a. Contractor, including project manager, site superintendent, safety representative, and representatives of Subcontractors and Suppliers as required.

- b. Engineer, including project manager (or designated representative), Resident Project Representative (if any), others as required by Engineer.
 - c. Owner, including Owner's Site Representative (if any).
 - d. Subcontractors, only with Engineer's approval or request, as required in the agenda.
4. Agenda, minimum:
- a. Review, comment, and amendment (if required) of minutes of previous progress meeting.
 - b. Review of progress since the previous progress meeting.
 - c. Planned progress through next 30 – 60 days.
 - d. Review of Progress Schedule
 - 1) Contract Times, including Milestones (if any)
 - 2) Critical path.
 - 3) Schedules for fabrication and delivery of materials and equipment.
 - 4) Corrective measures, if required.
 - e. Submittals:
 - 1) Review of status of critical submittals.
 - 2) Review revisions to schedule of submittals.
 - f. Contract Modifications:
 - 1) Requests for interpretation
 - 2) Clarification notices
 - 3) Field Orders
 - 4) Proposal requests
 - 5) Change Proposals
 - 6) Work Change Directives.
 - 7) Change Orders.
 - 8) Claims.

- g. Applications for progress payments.
- h. Problems, conflicts, and observations.
- i. Quality standards, testing, and inspections.
- j. Coordination between parties.
- k. Site management issues, including access, security, maintenance and protection of traffic, maintenance, cleaning, and other Site issues.
- l. Safety.
- m. Permits.
- n. Record documents status.
- o. Punch list status, as applicable.
- p. Other business.

1.03 SUBMITTALS

A. Progress Meeting Submittals:

- 1. List of Work accomplished since the previous progress meeting.
- 2. Up-to-date Progress Schedule.
- 3. Up-to-date Schedule of Submittals.
- 4. Detailed “look-ahead” schedule of Work planned through the next progress meeting, with specific starting and ending dates for each activity, including shutdowns, deliveries of important materials and equipment, Milestones (if any), and important activities affecting the Owner, Project, and Site.
- 5. When applicable, list of upcoming, planned time off (with dates) for personnel with significant roles on the Project, and the designated contact person in their absence.

1.04 EMERGENCY CONTACT INFORMATION

- A. Contractor shall provide list of emergency contact information for 24-hour use throughout the Project. Emergency contact information shall be updated and kept current throughout the Project. If personnel or contact information change, provide updated emergency contact information list at the next progress meeting.
- B. Contractor’s list of emergency contact information shall include:

1. Contractor's project manager's office, field office, cellular, and home telephone numbers.
2. Contractor's Site superintendent's office, field office, cellular, and home telephone numbers.
3. Contractor's foreman's field office, cellular (if available), and home telephone numbers.
4. Major Subcontractors' and Suppliers' office, cellular, and home telephone numbers of project manager and foreman (when applicable).

C. Additional Emergency Contact Information:

1. Owner's Project Manager: office, cellular, and home telephone numbers.
2. Owner's central 24-hour emergency telephone number.
3. Engineer's project engineer's office, cellular, and home telephone numbers.
4. Resident Project Representative's office, field office, cellular, and home telephone numbers.
5. Emergency telephone numbers, including: "Emergency: Dial 911", and seven-digit telephone numbers for the hospital, ambulance, police, and fire department nearest to the Site. Provide names of each of these institutions.
6. Other involved entities as applicable.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 01 33 00
SUBMITTAL PROCEDURES

PART 1 – GENERAL

1.01 SUMMARY

A. Section includes:

1. Contractor shall provide submittals in accordance with the General Conditions as modified by the Supplementary Conditions, and this Section.
2. Contractor is responsible to confirm and correct dimensions at the Site, for information pertaining to the fabrication processes and to techniques of construction, and for coordinating the work of all trades. Contractor's signature of submittal's stamp and letter of transmittal shall be Contractor's representation that Contractor has met his obligations under the Contract Documents relative to that submittal.

B. Related Sections:

1. Section 01 78 23 – Operation and Maintenance Data.
2. Section 01 78 43 – Spare Parts and Extra Material.
3. Section 01 79 00 – Instruction of Owner's Personnel.

1.02 ADMINISTRATIVE REQUIREMENTS

A. Types of Submittals: When type of submittal is not specified and is not specified in this Section, Engineer will determine type of submittal.

1. Action/Informational Submittals:

- a. Shop Drawings.
- b. Product data.
- c. Delegated design submittals in accordance with the General Conditions and as modified by the Supplemental Conditions.
- d. Samples.
- e. Testing plans, procedures, and testing limitations.
- f. Design data not sealed and signed by a design professional retained by Contractor, Subcontractor, or Supplier.

- g. Pre-construction test and evaluation reports, such as reports on pilot testing, subsurface investigations, potential Hazardous Environmental Conditions, and similar reports.
 - h. Supplier instructions, including installation data, and instructions for handling, starting-up, and troubleshooting.
 - i. Sustainable design submittals (other than sustainable design closeout documentation).
 - j. Lesson plans for training and instruction of Owner's personnel.
- 2. Closeout Submittals:
 - a. Maintenance contracts.
 - b. Operations and maintenance data.
 - c. Bonds, such as maintenance bonds and bonds for a specific product or system.
 - d. Warranty documentation.
 - e. Record documentation.
 - f. Sustainable design closeout documentation.
 - g. Software.
- 3. Maintenance Material Submittals:
 - a. Maintenance materials schedule and checklist.
 - b. Spare parts.
 - c. Extra stock materials.
 - d. Tools.
- 4. Quality Assurance Submittals:
 - a. Performance affidavits.
 - b. Certificates.
 - c. Source quality control submittals (other than testing plans, procedures, and testing limitations), including results of shop testing.

- d. Field or Site quality control submittals (other than testing plans, procedures, and testing limitations), including results of operating and acceptability tests at the Site.
- e. Supplier reports.
- f. Special procedure submittals, including health and safety plans and other procedural submittals.
- g. Qualifications statements.

B. Submittal Requirements:

- 1. Contractor shall submit electronic copy of submittals for Engineer's review via Procore Document Management, unless otherwise specified in individual Specification Sections. Acceptable electronic formats are Adobe PDF, Microsoft Word, Autodesk DWF and AutoCAD.
- 2. Submittals shall be furnished in two dimensional PDF.
- 3. Submittal shall be accompanied by letter of transmittal containing date, project title, Contractor's name, number and title of submittal, list of relevant Specification Sections, notification of deviations from Contract Documents, and other material required for Engineer's review.

C. Scheduling:

- 1. Provide submittals well in advance of the Work following Engineer's approval or acceptance of the associated submittal. Work covered by a submittal will not be included in progress payments until approval or acceptance of related submittals has been obtained in accordance with the Contract Documents.
- 2. Submittals shall be provided by Contractor with at least fifteen (15) working days for review and processing.

1.03 SCHEDULE OF SUBMITTALS

A. Schedule of Submittals, as specified in this Section:

- 1. Timing:
 - a. Provide submittal within time frames specified in the Contract Documents.
 - b. Provide updated Schedule of Submittals with each submittal of the updated Progress Schedule.
- 2. Content: In accordance with the General Conditions as modified by the Supplementary Conditions, and this Section. Requirements for content of

preliminary Schedule of Submittals and subsequent submittals of the Schedule of Submittals are identical.

- a. Identify submittals required in the Contract Documents. Updates of Schedule of Submittals shall show scheduled dates and actual dates for completed tasks. Indicate submittals that are on the Project's critical path.
- b. Indicate the following for each submittal:
 - 1) Date when submittals are requested and received from Supplier.
 - 2) Date when certification is received from Supplier and when submitted to Engineer.
 - 3) Date when submittals are submitted to Engineer and returned with disposition from Engineer.
 - 4) Date when submittals are revised by Supplier and submitted to Engineer.
 - 5) Date when submittals are returned with "Furnish as Submitted" (FAS) or "Furnish as Corrected" (FAC) disposition from Engineer.
 - 6) Date when approved submittals are returned to Supplier.
 - 7) Date of Supplier scheduled delivery of equipment and material.
 - 8) Date of actual delivery of equipment and material.
 - 9) Whether submittal will be for a substitution or "equal". Procedures for substitutions and "or equals" are specified in the General Conditions.
 - 10) For submittals for materials or equipment, date by which material or equipment must be at the Site to avoid delaying the Work and to avoid delaying the work of other contractors.
3. Prepare Schedule of Submittals using same software, and in same format, specified for Progress Schedules.
4. Coordinate Schedule of Submittals with the Progress Schedule.
5. Schedule of Submittals that is not compatible with the Progress Schedule, or that does not indicate submittals on the Project's critical path, or that places extraordinary demands on Engineer for time and resources, is unacceptable. Do not include submittals not required by the Contract Documents.
6. In preparing Schedule of Submittals:

- a. Considering the nature and complexity of each submittal, allow sufficient time for review and revision.
- b. Reasonable time shall be allowed for: Engineer's review and processing of submittals, for submittals to be revised and resubmitted, and for returning submittals to Contractor.
- c. Identify and accordingly schedule submittals that are expected to have long anticipated review times.

1.04 ACTION/INFORMATIONAL SUBMITTALS

- A. Provide the following Submittals in accordance with the individual Specification Sections, including, but not limited to, the following:

- 1. Product Data:

- a. Catalog cut-sheets
- b. Descriptive bulletins/brochures/specifications
- c. Material of construction data, including details on all components including applicable ASTM designations.
- d. Lifting, erection, installation, and adjustment instructions, and recommendations.
- e. Finish/treatment data, including interior and exterior shop coating systems.
- f. Equipment/material weight/loading data, including total uncrated weight of the equipment plus the approximate weight of shipped materials. Support locations and loads that will be transmitted to bases and foundations following installation. Size, placement, and embedment requirements of anchor bolts.
- g. Complete information regarding location, type, size, and length of all field welds in accordance with "Standard Welding Symbols" AWS A2.0 of the American Welding Society. Special conditions shall be fully explained by notes and details.
- h. Motor data including horsepower; enclosure type; voltage; insulation class; temperature rise and results of dielectric tests; service-rating; rotative speed; motor speed-torque relationship; efficiency and power factor at $\frac{1}{2}$, $\frac{3}{4}$, and full load; slip at full load; running, full load, and locked rotor current values; safe running time-current curves; motor protective devices; and interconnection diagrams.
- i. Engineering design data, calculations, and system analyses

- j. Digital system documentation
 - k. Operating sequence descriptions
 - l. Software/programming documentation
 - m. Manufacturer's instructions
2. Shop Drawings:
- a. Equipment and material layout drawings, including panel layout drawings.
 - b. System schematics and diagrams including, but not limited to, piping systems; HVAC and ventilation systems; process equipment systems; electrical operating systems; wiring diagrams; controls, alarm and communication systems.
 - c. Layout and installation drawings (interior and exterior) for all pipes, valves, fittings, sewers, drains, heating and ventilation ducts, all electrical, heating, ventilating and other conduits, plumbing lines, electrical cable trays, lighting fixture layouts, and circuiting, instrumentation, interconnection wiring diagrams, communications, power supply, alarm circuits, etc.
 - d. Layout and installation drawings shall show connections to structures, equipment, sleeves, valves, fittings, etc.
 - e. Drawings shall show the location and type of all supports, hangers, foundations, etc., and the required clearances to operate valves, equipment, etc.
 - f. Drawings for pipes, ducts, conduits, etc., shall show all 3 inch and larger electrical conduits and pressure piping, electrical cable trays, heating and ventilation ducts or pipes, structure, manholes or any other feature within four (4) feet (measured as the clear dimension) from the pipe duct, conduit, etc., for which the profile is drawn.
 - g. Equipment and material schedules.
3. Delegated design submittals, which include documents prepared, sealed, and signed by a design professional retained by Contractor, Subcontractor, or Supplier for materials and equipment to be incorporated into the completed Work. Delegated design submittals do not include submittals related to temporary construction unless specified otherwise in the related Specification Section. Delegated design submittals include: design drawings, design data including calculations, specifications, certifications, and other submittals prepared by such design professional.

B. Samples:

1. General Requirements:

- a. Conform submittal of Samples to the General Conditions as modified by the Supplementary Conditions, this Section, and the Specification Section in which the Sample is specified.
- b. Furnish at the same time Samples and submittals that are related to the same unit of Work or Specification Section. Engineer will not review submittals without associated Samples and will not review Samples without associated submittals.
- c. Samples shall clearly illustrate functional characteristics of product, all related parts and attachments, and full range of color, texture, pattern, and material.

2. Submittal Requirements:

- a. Securely label or tag Samples with submittal identification number. Label or tag shall not cover, conceal, or alter appearance or features of Sample. Label or tag shall not be separated from the Sample.
- b. Submit number of Samples required in Specifications. If number of Samples is not specified in the associated Specification Section, provide at least one identical Samples of each item required for Engineer's approval. If Contractor requires Sample(s) for Contractor's use, notify Engineer in writing and provide additional Sample(s). Contractor is responsible for furnishing, shipping, and transporting additional Samples.
- c. Deliver one Sample to Engineer's field office at the Site. Deliver balance of Samples to location directed by Engineer.

1.05 CLOSEOUT SUBMITTALS

- A. Provide the following Closeout Submittals in accordance with the individual Specification Sections, including, but not limited to, the following:
 - 1. Maintenance contracts
 - 2. Bonds for specific products or systems
 - 3. Warranty documentation
 - 4. Sustainable design closeout documentation.
 - 5. Software programming and documentation.
- B. On documents such as maintenance contracts and bonds, include on each document furnished original signature of entity issuing the document.

- C. Operations and Maintenance Data: Submit in accordance with Section 01 78 23 – Operations and Maintenance Data.
- D. Record Documentation: Submit in accordance with the General Conditions.
- E. Disposition: Dispositions and meanings are the same as specified for Informational Submittals.

1.06 MAINTENANCE MATERIAL SUBMITTALS

- A. For spare parts, extra stock materials, and tools, submit quantity of items specified in associated Specification Section. Furnish in accordance with Section 01 78 43 – Spare Parts and Extra Materials.
- B. Disposition: Dispositions and meanings are the same as specified for Informational Submittals.

1.07 CONTRACTOR'S RESPONSIBILITIES

- A. Contractor shall review, coordinate, and verify submittals with Subcontractors, Manufacturers, and Suppliers, including field measurements at Site, in accordance with the General Conditions and as modified by Supplemental Conditions prior to submitting material for Engineer's review.
- B. Contractor shall provide Contractor's stamp of approval certifying submittal material has been reviewed and conform to the Contract Documents prior to submitting material for Engineer's review.
- C. Contractor shall provide written notice of deviations or variations that submittal may have with the Contract Documents.
- D. Contractor shall provide bound, dated, labeled, tabulated, and consecutively numbered submittals as specified in the individual Specification Section. Label shall contain the following:
 - 1. Specification Section.
 - 2. Referenced Drawing number.
 - 3. Subcontractor or Supplier name.
 - 4. Type of equipment and/or materials.
- E. Contractor shall perform the following after receiving Engineer's review disposition:
 - 1. Order, fabricate, or ship equipment and materials included in the submittal (pending Engineer's review of source quality control submittals) with the following disposition:

- a. "Furnish as Submitted" (FAS).
 - b. "Furnish as Corrected" (FAC).
 - c. "Furnish as Corrected – Confirm" (FACC), only portions of Work that do not require resubmittal for Engineer's review.
2. Resubmittal requirements:
- a. Partial resubmittal of "Furnish as Corrected – Confirm" (FACC) returned dispositions, until Engineer's disposition is either "Furnish as Submitted" (FAS) or "Furnish as Corrected" (FAC).
 - b. Full resubmittal of material with Engineer's disposition of "Revise and Resubmit" (R&R), until Engineer's disposition is "Furnish as Submitted" (FAS), "Furnish as Corrected" (FAC), or "Furnish as Corrected – Confirm" (FACC) that requires a partial resubmittal.
 - c. Contractor shall be responsible for Engineer's charges to Owner if submittals are not approved within the number of specified submittals in accordance with the General Conditions. Engineer's charges shall include, but not limited to, additional review effort, meetings, and conference calls with Contractor, Subcontractor, or Supplier.

1.08 ENGINEER'S REVIEW

- A. Engineer's review of the Contractor's submittal shall not relieve Contractor's responsibility under the Contract Document in accordance with the General Conditions and as modified in the Supplemental Conditions. An acceptance of a submittal shall be intended to mean the Engineer does not have specific objection to the submitted material, subject to conformance with the Contract Drawings and Specifications.
- B. Engineer's review of Contractor's submittal shall be confined to general arrangement and compliance with the Contract Documents, and shall not be for the purpose of checking dimensions, weights, clearances, fittings, tolerances, interferences, coordination of Subcontractor work, etc.
- C. Review Dispositions:
 - 1. "Furnish as Submitted" (FAS) – No exceptions are taken.
 - 2. "Furnish as Corrected" (FAC) – Minor corrections are noted for Contractor's correction.
 - 3. "Furnish as Corrected – Confirm" (FACC) – Corrections are noted and partial resubmittal shall be made as noted.

4. "Revise and Resubmit" (R&R) – Corrections are noted and complete resubmittal shall be made. Submittal does not conform to applicable requirements of the Contract Documents and is not acceptable. Revise submittal and re-submit to indicate acceptability and conformance with the Contract Documents.
 5. "Receipt Acknowledged" (RA) –
 - a. Information included in submittal conforms to the applicable requirements of the Contract Documents and is acceptable. No further action by Contractor is required relative to this submittal, and the Work covered by the submittal may proceed, and products with submittals with this disposition may be shipped or operated, as applicable.
 - b. Information included in submittal is for Project record purposes and does not require Engineer's review or approval.
 6. "Rejected" (R) – Information included in submittal does not conform to the applicable requirements of the Contract Documents and is unacceptable. Contractor shall submit products and materials as specified in the Contract Documents or provide required information for substitution as specified in the Contract Documents for consideration by Engineer.
- D. Electronic Submittal Return to Contractor: Electronic submittals shall be returned electronically with dispositions provided.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 01 42 00

REFERENCES

PART 1 – GENERAL

1.01 SUMMARY

- A. Definitions and terminology applicable to all the Contract Documents are included in the General Conditions and Supplementary Conditions.

1.02 REFERENCES

- A. Abbreviations and Acronyms: Common abbreviations that may be found in the Contract Documents are listed below:

alternating current	a-c
ampere	A
Architectural Barriers Act	ABA
Americans with Disabilities Act	ADA
Americans with Disabilities Act Accessibility Guidelines	ADAAG
ante meridian	a.m.
average	avg
biochemical oxygen demand	BOD
brake horsepower	bhp
British thermal unit	Btu
Centigrade (or Celsius)	C
chlorinated polyvinyl chloride	CPVC
Code of Federal Regulations	CFR
cubic inch	cu in
cubic foot	cu ft
cubic yard	cdu yd, or CY
cubic feet per minute	cfm
cubic feet per second	cfs
degree Centigrade (or Celsius)	degrees C or °C

degrees Fahrenheit	degrees F or °F
diameter	dia
direct current	d-c
dollars	\$
each	ea
efficiency	eff
Fahrenheit	F
feet	ft
feet per hour	fph
feet per minute	fpm
feet per second	fps
figure	Fig
flange	flg
foot-pound	ft-lb
gallon	gal
gallons per hour	gph
gallons per minute	gpm
gallons per second	gps
gram	g
grams per liter	g/L
Hertz	Hz
horsepower	hp or HP
hour	hr
human-machine interface	HMI
inch	in.
inches water gage	in. w.g.
inch-pound	in.-lb
inside diameter	ID
iron pipe size	IPS

thousand pounds	kips
thousand pounds per square inch	ksi
kilovolt-ampere	kva
kilowatt	kw
linear foot	lin ft or LF
liter	L
maximum	max
mercury	Hg
milligram	mg
milligrams per liter	mg/l or mg/L
milliliter	ml
millimeter	mm
million gallons per day	mgd or MGD
million gallons	MG
minimum	min
national pipe threads	NPT
net positive suction head	NPSH
net positive suction head available	NPSHA
net positive suction head required	NPSHR
nominal pipe size	NPS
number	no.
operator interface terminal	OIT
ounce	oz
ounce-force	ozf
outside diameter	OD
parts per hundred	pph
parts per million	ppm
parts per billion	ppb
polyvinyl chloride	PVC

post meridian	p.m.
pound	lb
pounds per square inch	psi
pounds per square inch absolute	psia
pounds per square inch gauge	psig
pounds per square foot	psf
process control system	PCS
programmable logic controller	PLC
revolutions per minute	rpm
second	sec
specific gravity	sp gr or SG
square	sq
square foot	sq ft or sf
square inch	sq in.
square yard	sq yd or SY
standard	std
standard cubic feet per minute	scfm
total dynamic head	TDH

B. Definitions: Terminology used in the Specifications includes:

1. "Indicated" refers to graphic representations, notes, or schedules on the Drawings, or to other paragraphs or schedules in the Specifications and similar locations in the Contract Documents.
2. "Shown", "noted", "scheduled", and "specified" are used to help the user locate the reference without limitation on the location.
3. "Installer", "applicator", or "erector" is Contractor or another entity engaged by Contractor, either as an employee or subcontractor, to perform a particular construction activity, including installation, erection, application or similar Work. Installers shall be experienced in the Work that installer is engaged to perform.
4. "Experienced", when used with the term "installer" means having successfully completed a minimum of five previous projects similar in size and scope to this Project; being familiar with the special requirements indicated; being familiar with

Laws and Regulations; and having complied with requirements of authorities having jurisdiction, and complying with requirements of the Supplier of the material or equipment being installed.

5. Trades: Use of a term such as “carpentry” does not imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as “carpenter”, unless otherwise indicated in the Contract Documents or required by Laws or Regulations. Such terminology also does not imply that specified requirements apply exclusively to trade personnel of the corresponding generic name.
6. “Assigned specialists” and similar terms: Certain Sections of the Specifications require that specific construction activities be performed by specialists recognized as experts in those operations. Engage said specialists for those activities, and their engagement is a requirement over which Contractor has no option. These requirements do not conflict with enforcement of building codes and other Laws and Regulations. Also, such requirements are not intended to interfere with local trade union jurisdictional settlements and similar conventions. Such assignments shall not relieve Contractor of responsibility for complying with the requirements of the Contract Documents.

C. Reference Standards:

1. Refer to General Conditions, as may be modified by the Supplementary Conditions, relative to reference standards and resolving discrepancies between reference standards and the Contract Documents. Provisions of reference standards are in effect in accordance with the Specifications.
2. Copies of Standards: Each entity engaged in the Work shall be familiar with reference standards applicable to its construction activity. Copies of applicable reference standards are not bound with the Contract Documents. Where reference standards are needed for a construction activity, obtain copies of standards from the publication source.
3. Abbreviations and Names: Where reference standards, specifications, codes, manuals, Laws or Regulations, or other published data of international, national, regional or local organizations are referred to in the Contract Documents, the organization issuing the standard may be referred to by their acronym or abbreviation only.
4. Following acronyms or abbreviations that may appear in the Contract Documents shall have the meanings indicated below. Listing is alphabetical by acronym.

AA	Aluminum Association
AABC	Associated Air Balance Council
AAMA	American Architectural Manufacturers Association

AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
ACIFS	American Cast Iron Flange Standards
ACS	American Chemical Society
ADC	Air Diffusion Council
ADSC	International Association of Foundation Drilling.
AEIC	Association of Edison Illuminating Companies
AF&PA	American Forest and Paper Association
ABMA	American Bearing Manufacturers Association (formerly Anti- Friction Bearing Manufacturers Association (AFBMA))
AGA	American Gas Association
AGMA	American Gear Manufacturers Association
AHDGA	American Hot Dip Galvanizers Association
AI	Asphalt Institute
AIA	American Institute of Architects
AIChE	American Institute of Chemical Engineers
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AITC	American Institute of Timber Construction
ALSC	American Lumber Standards Committee
AMA	Acoustical Materials Association
AMCA	Air Movement and Control Association
AMP	National Association of Architectural Metal Manufacturers, Architectural Metal Products Division
ANSI	American National Standards Institute
APA	The Engineered Wood Association
API	American Petroleum Institute
APHA	American Public Health Association
AREA	American Railway Engineering Association
ARI	Air Conditioning and Refrigeration Institute
ASA	American Standards Association

ASAE	American Society of Agricultural Engineers
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASNT	American Society for Non-Destructive Testing
ASQ	American Society for Quality
ASSE	American Society of Safety Engineers
ASTM	American Society for Testing and Materials
AWCI	Association of the Wall and Ceiling Industry
AWI	Architectural Woodwork Institute
AWPA	American Wood Protection Association
AWPI	American Wood Preservers Institute
AWS	American Welding Society
AWWA	American Water Works Association
BAAQMD	Bay Area Air Quality Management District
BHMA	Builders Hardware Manufacturers Association
BIA	Brick Industry Association
BOCA	Building Officials and Code Administrators
CBMA	Certified Ballast Manufacturers Association
CDA	Copper Development Association
CEMA	Conveyor Equipment Manufacturers Association
CGA	Compressed Gas Association
CISCA	Ceilings and Interior Systems Construction Association
CISPI	Cast Iron Soil Pipe Institute
CLFMI	Chain Link Fence Manufacturers Institute
COC	City of Chandler
CMAA	Crane Manufacturers Association of America
CPSC	Consumer Product Safety Commission
CRSI	Concrete Reinforcing Steel Institute

CSI	Construction Specifications Institute
DIN	Deutsches Institut für Normung eV (German Institute for Standardization)
DIPRA	Ductile Iron Pipe Research Association
EJCDC	Engineers Joint Contract Documents Committee
EJMA	Expansion Joint Manufacturers Association, Inc.
ETL	Intertek Testing Services, Inc. (formerly ETL Testing Laboratories, Inc.)
FCC	Federal Communications Commission
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
FM	Factory Mutual (FM Global)
FRPI	Fiberglass Reinforced Plastics Institute
FS	Federal Specification
GA	Gypsum Association
GANA	Glass Association of North America
HEW	United States Department of Health, Education and Welfare
HI	Hydraulic Institute
HMI	Hoist Manufacturers Institute
HUD	United States Department of Housing and Urban Development
IBC	International Building Code
ICC	International Code Council
ICEA	Insulated Cable Engineers Association
IEEE	Institute of Electrical and Electronics Engineers
IESNA	Illuminating Engineering Society of North America
IFI	Industrial Fasteners Institute
IFCEA	Insulated Power Cable Engineers Association
IRI	Industrial Risk Insurers
ISA	Instrumentation, Systems, and Automation Society (formerly Instrument Society of America)
ISO	Insurance Services Office

IOS	International Organization for Standardization
LPI	Lightning Protection Institute
MAG	Maricopa Association of Governments
MIA	Marble Institute of America
ML/SFA	Metal Lath/Steel Framing Association
MS	Military Specifications
MSS	Manufacturers' Standardization Society
MMA	Monorail Manufacturers Association
NAAMM	National Association of Architectural Metal Manufacturers
NACE	National Association of Corrosion Engineers
NAPF	National Association of Pipe Fabricators, Inc.
NARUC	National Association of Regulatory Utilities Commissioners
NBHA	National Builders Hardware Association
NBS	United States Department of Commerce, National Bureau of Standards
NCMA	National Concrete Masonry Association
NEC	National Electric Code
NELMA	Northeastern Lumber Manufacturers' Association
NEMA	National Electrical Manufacturers Association
NESC	National Electrical Safety Code
NETA	International Electrical Testing Association
NFPA	National Fire Protection Association
NFRC	National Fenestration Rating Council
NGA	National Glass Association
NHLA	National Hardwood Lumber Association
NHPMA	Northern Hardwood and Pine Manufacturers Association
NIST	United States Department of Commerce, National Institute of Standards and Technology
NLGA	National Lumber Grades Authority
NRCA	National Roofing Contractors Association
NRMCA	National Ready Mixed Concrete Association

NSF	National Sanitation Foundation
NSSGA	National Stone, Sand, and Gravel Association
NTMA	National Terrazzo and Mosaic Association
OSHA	Occupational Safety and Health Administration
PCA	Portland Cement Association
PCI	Precast/Prestressed Concrete Institute
PEI	Porcelain Enamel Institute
PFI	Pipe Fabrication Institute
PPI	Plastics Pipe Institute
PGMC	Primary Glass Manufacturers Council
PS	Product Standards Section, United States Department of Commerce
RCSC	Research Council on Structural Connections (part of AISC)
RMA	Rubber Manufacturers Association
SAE	Society of Automotive Engineers
SBCCI	Southern Building Code Congress International, Inc.
SCAQMD	Southern California Air Quality Management District
SCPRF	Structural Clay Products Research Foundation
SCTE	Society of Cable Telecommunications Engineers
SDI	Steel Deck Institute
SDI	Steel Door Institute
SIGMA	Sealed Insulating Glass Manufacturing Association
SJI	Steel Joist Institute
SMACNA	Sheet Metal and Air Conditioning Contractor's National Association
SPI	Society of the Plastics Industry
SPIB	Southern Pine Inspection Bureau
SSPC	Society for Protective Coatings
SWI	Steel Window Institute
TCNA	Tile Council of North America
TEMA	Tubular Exchanger Manufacturers Association

TIA/EIA	Telecommunications Industry Association/Electronic Industries Alliance
UBC	Uniform Building Code
UL	Underwriters Laboratories, Inc.
USAB	United States Access Board
USDOE	United States Department of Energy
USEPA	United States Environmental Protection Agency
USGBC	United States Green Building Council
USGS	United States Geological Survey
USPHS	United States Public Health Service
WCLIB	West Coast Lumber Inspection Bureau
WCMA	Window Covering Manufacturers Association
WCMA	Wood Component Manufacturers Association
MDMA	Window and Door Manufacturers Association
WWEMA	Water and Wastewater Equipment Manufacturers Association
WWPA	Western Wood Products Association

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

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SECTION 01 45 23
TESTING SERVICES FURNISHED BY CONTRACTOR

SECTION TO IDENTIFY TESTING REQUIREMENTS BY THE CONTRACTOR. THIS SECTION REQUIRES COORDINATION WITH OWNER AND CIVIL & STRUCTURAL DESIGN LEADERS TO ESTABLISH TESTING REQUIREMENTS.

TESTING IS REQUIRED FOR MOST PROJECTS. EITHER OWNER OR CONTRACTOR WILL RETAIN TESTING SERVICES.

THIS SECTION DOES NOT APPLY FOR TESTING INDICATED TO BE PROVIDED BY OWNER IN ACCORDANCE WITH OTHER SECTIONS OF SPECIFICATIONS. SPECIAL INSPECTIONS CANNOT BE PROVIDED BY THE CONTRACTOR PER THE GOVERNING BUILDING CODES. SEE SECTION 01 45 33 – SPECIAL INSPECTIONS. OTHER INDIVIDUAL SECTIONS INCLUDE REQUIREMENTS AND REQUIRED TESTS FOR TESTING OF SPECIFIC MATERIALS AND CONDITIONS.

PART 1 – GENERAL

1.01 SUMMARY

- A. This specification addresses requirements for testing services specifically required to be provided by the Contractor. This section does not apply to any testing required to be provided by the Owner or Owner's representative.
- B. This section does not apply to any Special Inspections as required by Section 01 45 33. Special Inspections cannot be provided by the Contractor in accordance with the Governing Building Code.
- C. Contractor shall employ and pay for independent testing entity to perform specified services covered by this specification. Entity selected shall be subject to approval by Engineer.
- D. Inspection, sampling, and testing shall be as specified in the individual Specification Sections.
- E. Related Sections, but not limited to, the following:
 - 1. Section 01 88 16 – Watertightness Testing of Concrete Structures
 - 2. Section 03 01 30 – Concrete Repairs
 - 3. Section 07 16 16 – Crystalline Waterproofing

1.02 ADMINISTRATIVE REQUIREMENTS

A. Contractor's Responsibilities:

1. Provide to laboratory representative samples of materials to be tested, in required quantities.
2. Provide labor and facilities:
 - a. To provide access to the Work to be tested, and where required, to Suppliers' operations.
 - b. To obtain and handle samples at the Site.
 - c. To facilitate inspections and tests.
 - d. For testing entity's exclusive use for storage and curing of test samples.
 - e. Forms for preparing concrete test beams and cylinders.
3. Notify testing entity and Engineer sufficiently in advance of operations to allow for assignment of personnel and scheduling of tests.
4. Arrange with testing entity and pay for additional services, sampling, and testing required for Contractor's convenience.
5. Provide to testing entity the preliminary design mix proposed for concrete, and other material mixes that require testing by the testing laboratory.

B. Testing Entity's Responsibilities:

1. Cooperate with Contractor and Engineer and provide qualified personnel promptly when notified.
2. Perform specified inspections, sampling, and testing of materials and methods of construction; comply with applicable standards; ascertain compliance with requirements of the Contract Documents.
3. Promptly notify Engineer and Contractor of irregularities or deficiencies in the Work observed during performance of services.
4. Submit specified quantity of report copies of inspections and tests to Contractor and Engineer.
5. Perform additional tests and services as required to ensure compliance with the Contract Documents.

C. Report Requirements:

1. Electronic Submittal of testing reports.
2. Include the following information:
 - a. Date issued.
 - b. Project title, number, and name of the Site.
 - c. Testing laboratory name and address.
 - d. Name and signature of inspector or person obtaining samples.
 - e. Date of inspection or sampling.
 - f. Record of temperature and weather.
 - g. Date of test.
 - h. Identification of material or product tested and associated Specification Section.
 - i. Location in the Project.
 - j. Type of inspection or test.
 - k. Results of tests and observations regarding compliance with the Contract Documents.

1.03 SUBMITTALS

- A. Submit copies of material and product test reports where required by the Contract Documents and as requested by Engineer.
- B. Quality Assurance Submittals:
 1. Qualifications statement indicating experience and facilities for tests required under the Contract Documents.
 2. Copy of report of inspection of facilities during most recent NIST inspection tour. Include memorandum of remedies of deficiencies reported during inspection.
 3. Copy of certificate of calibration for each instrument or measuring device proposed for use, by accredited calibration agency.

1.04 QUALIFICATIONS

- A. Comply with applicable requirements of ASTM E329, Specification for Agencies Engaged in Construction Inspection and/or Testing.

- B. Laboratory shall be authorized to operate in the same State or Commonwealth as the Site. Where applicable, laboratory shall be certified by the authority having jurisdiction for the types of testing required.
- C. Testing equipment used by laboratory will be calibrated at maximum twelve month intervals by devices of accuracy traceable to either NIST's Standard Reference Materials (SRM), ISO 17025, General Requirements for the Competence of Testing and Calibration Laboratories, or certified by State, Commonwealth, or local bureau of weights and measures, or values of natural physical constants generally accepted in the engineering and scientific community.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 01 51 00
TEMPORARY UTILITIES

PART 1 – GENERAL

1.01 SUMMARY

- A. Contractor shall provide temporary utilities required for the Project and to complete the Work.
1. Make arrangements with utility service companies for temporary services and obtain required permits and approvals for temporary utilities.
 2. Pay utility service costs, including connection fees, required for the Work as needed.
 3. Continuously maintain adequate utilities for all purposes during the Project, until removal of temporary utilities and temporary facilities. At minimum, provide and maintain temporary utilities through Substantial Completion and removal of temporary field offices and sheds.
 4. Should Owner occupy part of the Project prior to Substantial Completion of the entire Work, cost of utilities consumed via temporary utilities serving the portion occupied by Owner will be shared proportionately between Owner and Contractor as mutually agreed to by the parties.
 5. Maintain, including cleaning, temporary utilities and continuously provide consumables as required.
 6. Temporary utilities and temporary facilities shall be adequate for personnel using the Site and requirements of Project.
 7. Provide temporary utilities and temporary facilities in compliance with Laws and Regulations and, when applicable, requirements of utility owners.
- B. Provide the following temporary utilities at minimum:
1. Electricity and lighting.
 2. Telephone and communications.
 3. Sanitary facilities.
 4. Water service.
 5. First-aid facilities.

6. Fire protection.

1.02 ADMINISTRATIVE REQUIREMENTS

A. Use of Owner's System:

1. Existing Utility Systems: Do not use systems in existing buildings or structures for temporary utilities without Owner's written permission and mutually acceptable basis agreed upon by the parties for proportionate sharing of costs between Owner and Contractor.
2. Use of Permanent Utility Systems Provided Under the Project:
 - a. Permanent lighting, water, heating, ventilating, and fire protection systems and first-aid facilities may be used to provide temporary utilities and temporary facilities if the following are met:
 - 1) Obtain Owner's written permission to use permanent systems.
 - 2) Permanent systems to be used for temporary utilities or temporary facilities shall have achieved Substantial Completion, including complete functionality of all controls.
 - 3) Contractor shall pay all costs while using permanent system, including operation, maintenance, replacement of consumables, and provide replacement parts.
 - b. Do not use the following permanent facilities:
 - 1) Telephone and communication facilities.
 - 2) Sanitary facilities.

1.03 SYSTEM DESCRIPTION

A. Electricity and lighting:

1. Contractor shall provide electrical and lighting service for construction field offices, sheds, storage containers, etc. and as required for the Work.

B. Telephone and communications: Contractor shall provide temporary telephone and communications required for its operations at the Site and for summoning emergency medical assistance.

C. Heating:

1. Contractor shall provide temporary heating, ventilation coverings and enclosures necessary to protect the Work and materials against wetness and temperature damage, to dry out the Work, and to facilitate the Work in structures.

2. Equipment, fuel, materials, personnel and methods used shall be adequate to maintain critical installation temperatures and ventilation of Work at all times in areas where necessary to perform the Work.
3. Contractor shall provide sufficient heat to maintain a minimum temperature of 65°F before and during application of interior finishing, painting, coating, etc.
4. Contractor shall replace any Work damaged by dampness or insufficient/abnormal heating at no cost to the Owner.

D. Sanitary facilities:

1. Contractor shall provide suitably-enclosed chemical or self-contained toilets for Contractor's employees and visitors to the Site. Location of temporary toilets shall be acceptable to Owner and screened from public observation.
2. Facilities shall be maintained and provided in accordance with State or Commonwealth Labor Regulations and local ordinances. Contents shall be removed and disposed in accordance with local and state or commonwealth regulations as required.
3. Contractor shall be prohibited from committing nuisances within, on, or in the vicinity of the Site.

E. Water service:

1. Contractor shall provide temporary water service for the Work including for construction purposes, sanitary facilities, fire protection, field office, and cleaning purposes.
2. Contractor shall provide potable water for Contractor's personnel either by portable containers or drinking fountains.
3. Contractor shall provide temporary hose bibs, hoses, and watertight barrels for the distribution of water.
4. Contractor shall provide freeze protection for water service.

F. First-aid facilities:

1. Contractor shall provide temporary first-aid stations at or immediately adjacent to the Site's major work areas. Contractor shall provide temporary first-aid stations inside its temporary field office. Locations of first-aid stations shall be determined by Contractor's safety representative.
2. Contractor shall provide list of emergency telephone numbers at each hardwired telephone at the Site. List shall be in accordance with the list of emergency contact information required in Section 01 31 19 – Project Meetings.

G. Fire protection:

1. Contractor shall comply with NFPA 241, Safeguarding Building Construction, Alteration, and Demolition Operations, and requirements of fire marshals and authorities having jurisdiction at the Site.
2. Contractor shall provide temporary fire exits, fire extinguishers, hoses and safety devices as required by authorities having jurisdiction.
3. Contractor shall notify Engineer, Owner, and fire marshals in the event of fire at the Site including, but not limited to, fuel tanks and similar hazardous utilities and devices. Contractor shall cooperate with Owner of fuel tank and utilities to prevent occurrence of fire or explosion.
4. Contractor shall perform safety precautions and comply with fire marshal's instructions in the event of fire.

PART 2 – PRODUCTS

2.01 EQUIPMENT

- A. Materials and equipment for temporary systems may be new or used but shall be adequate for purposes intended and shall not create unsafe conditions and shall comply with Laws and Regulations.
- B. Provide required materials, equipment, and facilities, including piping, wiring, and controls.
- C. Electrical system requirements: System shall consist of wiring, switches, insulated supports, poles, fixtures, sockets, receptacles, lamps, guards, cutouts and fuses as required for completion of the Work.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. Install temporary facilities in neat, orderly, manner, and make structurally, mechanically, and electrically sound throughout.
- B. Location of Temporary Utilities and Temporary Facilities:
 1. Locate temporary systems for proper function and service.
 2. Temporary systems shall not interfere with or provide hazards or nuisances to: the Work under this and other contracts, movement of personnel, traffic areas, materials handling, hoisting systems, storage areas, finishes, and work of utility companies.

3. Do not install temporary utilities on the ground, with the exception of temporary extension cords, hoses, and similar systems in place for short durations.
- C. Modify and extend temporary systems as required by progress of the Work.

3.02 MAINTENANCE

- A. Maintain temporary systems to provide safe, continuous service as required.
- B. Properly supervise operation of temporary systems:
1. Enforce compliance with Laws and Regulations.
 2. Enforce safe practices.
 3. Prevent abuse of services.
 4. Prevent nuisances and hazards caused by temporary systems and their use.
 5. Prevent damage to finishes.
 6. Ensure that temporary systems and equipment do not interrupt continuous progress of construction.
- C. At end of each work day, check temporary systems and verify that sufficient consumables are available to maintain operation until work is resumed at the Site. Provide additional consumables if the supply on hand is insufficient.
- D. Contractor shall replace broken and burned out lamps, blown fuses, and damaged wiring and appurtenances as required to maintain adequate and safe operating conditions.
- E. Contractor shall permit subcontractors and others at a mutually agreed arrangement to use temporary electrical system that meet the following requirements:
1. Equipment are suitable for 120 V, single phase, 60 Hz operation.
 2. Operating input does not exceed 1,500 volt-amperes.
 3. Single piece of equipment connected to one outlet.
 4. Contractor shall restrict use of equipment as required to prevent overloading circuits.

3.03 CLOSEOUT ACTIVITIES

- A. Completely remove temporary utilities, facilities, equipment, and materials when no longer required. Repair damage caused by temporary systems and their removal and restore the Site to condition required by the Contract Documents; if restoration of damaged areas is not specified, restore to preconstruction condition.

- B. Contractor is responsible for and shall return to original condition those portions of permanent electric system used in completing the Work.
- C. Where temporary utilities are disconnected from existing utility, provide suitable, watertight or gastight (as applicable) cap or blind flange, as applicable, on service line, in accordance with requirements of utility owner.
- D. When permanent utilities and systems that were used for temporary utilities, upon Substantial Completion replace all consumables such as filters and light bulbs and parts used during the Work.

END OF SECTION

SECTION 01 52 00
CONSTRUCTION FACILITIES

PART 1 – GENERAL

1.01 SUMMARY

- A. Contractor shall provide construction facilities for performance of the Work, including the following:
 - 1. Contractor's field office, sheds, and storage containers that shall be erected within 30 days of Notice to Proceed on the Project.
 - 2. Project sign and panel that shall be erected prior to commencement of construction.

1.02 FACILITY DESCRIPTION

- A. Contractor's Field Office, Sheds, and Storage:
 - 1. Contractor shall provide and maintain a field office at the Site, including temporary utility services specified.
 - 2. Size and Furnishings: As required by Contractor
 - 3. Features: Exterior Contractor identification sign, night lighting for security, and temporary utilities specified in Section 01 51 00 – Temporary Utilities.
 - 4. Location: As shown on the Contract Documents.
 - 5. Contractor shall provide and maintain one set of Contract Documents, latest approved Shop Drawings, Field Orders, request for interpretations, clarification notices, Work Change Directives, proposal requests, Change Proposals, Change Orders, and other pertinent Project related correspondence.
- B. Project Identification Sign:
 - 1. Contractor shall provide in accordance to the General Conditions.
 - 2. Contractor shall maintain project identification sign for the duration of the Contract.
 - 3. Contractor shall remove and dispose of project identification sign at the completion of the Project when notified by the Engineer.
 - 4. Contractor shall not receive additional payment for deterioration or replacement of names and other pertinent sign information throughout the duration of the Project.

1.03 SUBMITTALS

- A. Action/Informational Submittals: Project identification sign layout, details, and materials of construction.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 01 55 00
CONTRACTOR ACCESS AND PARKING

PART 1 – GENERAL

1.01 SUMMARY

A. Section includes:

1. Contractor shall provide and maintain temporary laydown and employee parking areas and appurtenances required during the Project for use by Contractor, other contractors employed on the Project, Owner's, and emergency vehicles, as shown on the Drawings.
2. Laydown and employee parking areas shall be designed and maintained by Contractor and shall be fully passable to vehicles in all weather conditions.

1.02 ADMINISTRATIVE REQUIREMENTS

A. Access roads:

1. Contractor shall construct and maintain such temporary access roads as required to perform the Work.
2. Contractor shall construct access roads, where possible, in locations over the areas of future road systems.
3. Access roads shall be located within the property lines of the Owner unless the Contractor independently secures easements for use and convenience.
 - a. Contractor shall submit written documentation to the Engineer for Contractor secured easements across privately held property.
 - b. Easement agreements shall specify terms and conditions of use and provisions for Site restoration.
 - c. Written release from property owner certifying that terms of the easement agreement have been complied by the Contractor shall be furnished to the Engineer prior to final payment.

B. Use of existing access roads:

1. Contractor will be allowed to use Owner's existing roads as shown on the Drawings.
2. Prevent interference with traffic on existing roads and parking areas. At all times, keep access roads and entrances serving the Site clear and available to Owner,

Owner's employees, emergency vehicles, and other contractors. Do not use access roads or Site entrances for parking or storage of materials or equipment.

3. Contractor shall indemnify and hold harmless Owner and Engineer from expenses caused by Contractor's operations over existing roads and parking areas.
4. Schedule deliveries to minimize use of driveways and Site entrances.
5. Contractor shall suitably maintain existing access road at Contractor's expense for the duration of the Contract time.

C. Contractor parking areas:

1. Contractor employee vehicles shall park in area(s) designated by Owner or as shown on the Drawings.
2. Contractor shall construct and maintain parking area at the Site.

D. State/Commonwealth and local regulations:

1. Contractor shall obtain and pay all cost associated with bonds required by authorized entity (i.e. State or Commonwealth Department of Transportation) for the use of State or Commonwealth maintained roads.
2. Contractors shall obey traffic laws and comply with requirements, rules and regulations of the authorized entity (i.e. State or Commonwealth Department of Transportation), including local authorities having jurisdiction, to maintain warning signs, lights, barriers, etc. for the protection of traffic on public roadways.

E. Site security:

1. Contractor shall safely guard all the Work, the Project, products, equipment, and property from loss, theft, damage, and vandalism until Substantial Completion. Contractor's duty includes safely guarding Owner's property in vicinity of the Work and Project, and other private property in the vicinity of the Project from injury and loss in connection with performance of the Project.
2. Employ watchmen as required to provide required security and prevent unauthorized entry.
3. Costs for security required under this Section shall be paid by Contractor.
4. Make no claim against Owner for damage resulting from trespass.
5. Pay full compensation for, or repair or replace, damage to property of Owner and others arising from failure to furnish adequate security.
6. Provide temporary fencing in accordance with the Contract Documents.

7. Security requirements specified in the Section shall begin as soon as the contractor delivers materials to the Site and/or begins work, and shall continue until the date of Final Completion.
8. Procedures:
 - a. Contractor shall conform to Owner's security procedures and access restrictions at Site throughout entire Project.
 - b. Contractor, including Subcontractors and Suppliers, shall comply with the following:
 - 1) Personnel Identification: All Contractor personnel shall wear at all times on-Site a badge bearing Contractor's name, employee's name and, as applicable, employee number.
 - 2) Parking: Do not park outside of designated Contractor parking area, which is shown on the Drawings. Prepare and maintain parking area as required. Personal vehicles are not allowed outside Contractor parking area.
9. Contractor shall provide and maintain temporary security fencing if existing security fencing or barriers are breached or temporarily removed for the Project at no additional cost to the Owner. Temporary security fencing shall be equal to existing, unless otherwise specified, and provided and maintained in a manner satisfactory to Engineer and Owner.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.01 INSTALLATION

- A. Contractor shall determine if and where temporary fencing is necessary, unless existing security fencing is damaged, which will be determined by Engineer and Owner.
- B. Install temporary fencing used for site security in accordance with the Contract Documents and fence manufacturer's instructions. Provide temporary fencing for site security so that integrity of site security is maintained throughout the Project.
- C. Maintain temporary fencing. Repair damage to temporary fencing and replace fencing when required to maintain site security.
- D. Remove temporary fencing when permanent site security fencing is in place and fully functional, or when otherwise directed by Owner or Engineer.

END OF SECTION

SECTION 01 57 00
TEMPORARY CONTROLS

PART 1 – GENERAL

1.01 SUMMARY

- A. Contractor shall provide and maintain methods, equipment, and temporary construction as required to control environmental conditions at the Site and adjacent areas.
- B. Maintain controls until no longer required.
- C. Temporary controls include, but are not limited to, the following:
 - 1. Dust control.
 - 2. Noise controls.
 - 3. Pest and rodent control.
 - 4. Pollution control.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.01 DUST CONTROL

- A. Contractor shall take measures to control dust from Contractor's operations and prevent spillage of excavated materials on public roads.
- B. Contractor shall remove spillage of excavated materials, debris and dust from public roads by methods approved by Engineer.
- C. Contractor shall provide temporary dust-proof partitions where required to protect unaltered portions of existing structures and facilities and as directed by Engineer or Owner. Temporary partitions shall be provided where demolition Work is required, to protect equipment and material, and shall consist of the following:
 - 1. Wood studs with plywood on both sides and extend from floor to ceiling.
 - 2. Closure plate at floor and ceiling.
 - 3. One door (minimum) with hardware.

- D. Contractor shall refer to applicable sections of local and state/commonwealth regulations on dust control for additional guidance.
 - 1. Contractor shall apply water at locations, quantities, and frequencies required by Engineer to control dust for nuisance prevention to Owner, Engineer, and properties in the vicinity of the Site.
 - 2. Dust control and cleaning measures shall be provided at no additional cost to the Owner.

3.02 NOISE CONTROL

- A. Contractor's vehicles and equipment shall minimize noise emissions to greatest degree practicable. Provide mufflers, silencers, and sound barriers when necessary.
- B. Noise levels shall comply with Laws and Regulations, including OSHA requirements and local ordinances.
- C. Noise emissions shall not interfere with the work of Owner or others.

3.03 PEST AND RODENT CONTROL

- A. Provide rodent and pest control as required to prevent infestation of the Site and storage areas.
- B. Employ methods and use materials that do not adversely affect conditions at the Site or on adjoining properties.
- C. In accordance with laws and regulations, promptly and properly dispose of pests and rodents trapped or otherwise controlled.

3.04 POLLUTION CONTROL.

- A. General:
 - 1. Provide means, methods, and facilities required to prevent contamination of soil, water, and atmosphere caused by discharge of noxious substances from construction operations.
 - 2. Equipment used during construction shall comply with Laws and Regulations.
- B. Spills and Contamination:
 - 1. Provide equipment and personnel to perform emergency measures required to contain spills and to remove contaminated soils and liquids.
 - 2. Excavate contaminated material and properly dispose of off-site, and replace with suitable compacted fill and topsoil.

- C. Protection of Surface Waters: Implement special measures to prevent harmful substances from entering surface waters. Prevent disposal of wastes, effluents, chemicals, and other such substances in or adjacent to surface waters and open drainage routes, in sanitary sewers, or in storm sewers.
- D. Atmospheric Pollutants:
 - 1. Provide systems for controlling atmospheric pollutants related to the Work.
 - 2. Prevent toxic concentrations of chemicals and vapors.
 - 3. Prevent harmful dispersal of pollutants into atmosphere.
- E. Solid Waste:
 - 1. Provide systems for controlling and managing solid waste related to the Work.
 - 2. Prevent solid waste from becoming airborne, and from discharging to surface waters and drainage routes.
 - 3. Properly handle and dispose of solid waste.

END OF SECTION

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SECTION 01 61 00
PRODUCT REQUIREMENTS AND OPTIONS

PART 1 – GENERAL

1.01 SUMMARY

- A. Section includes:
1. Common requirements for products.
 2. Contractor's options for selecting products.
 3. Requirements for consideration of "or equal" products.
 4. Warranty requirements of products.

1.02 REFERENCES

- A. Definitions:
1. "Products" includes materials, equipment, machinery, components, fixtures, systems, and other goods incorporated in the Work. Products do not include machinery and equipment used for preparing, fabricating, conveying, erecting, or installing the Work. Products include Owner-furnished goods incorporated in the Work where use of such goods is specifically required in the Contract Documents.
 2. "Special Warranties" includes additions or modifications to standard warranty requirements specified in the Contract Documents.
 3. "Or-Equal" Items: If in Engineer's sole discretion an item of material or equipment proposed by Contractor is functionally equal to that named and sufficiently similar so that no change in related Work will be required, it may be considered by Engineer as an "or-equal" item, in which case review and approval of the proposed item may, in Engineer's sole discretion, be accomplished without compliance with some or all of the requirements for approval of proposed substitute items. For the purposes of this Paragraph, a proposed item of material or equipment will be considered functionally equal to an item so named if:
 - a. In the exercise of reasonable judgment Engineer determines that:
 - 1) it is at least equal in materials of construction, quality, durability, appearance, strength, and design characteristics;
 - 2) it will reliably perform at least equally well the function and achieve the results imposed by the design concept of the completed Project as a functioning whole; and

- 3) it has a proven record of performance and availability of responsive service.
- b. Contractor certifies that, if approved and incorporated into the Work:
 - 1) there will be no increase in cost to the Owner or increase in Contract Times; and
 - 2) it will conform substantially to the detailed requirements of the item named in the Contract Documents.

1.03 SUBMITTALS

A. Warranty Log Book:

1. Submit warranty log book prepared specifically for this Project. Submittal shall include a summary listing of all equipment and material warranties furnished in the Contract, date received, and start/end date of warranty period. Individual warranty documentation shall be provided in the submittal.
2. Submit prior to submittal of final application for payment.

B. Patent Documentation: Submit licensing arrangement and agreement documentation.

1.04 REQUIREMENT

A. Common Products:

1. Provide products that have not been previously incorporated into another project or facility unless otherwise indicated in the Contract Documents.
2. Provide products of the same generic kind from a single source.
3. Provide products complete with accessories, trim, finish, fasteners, and other items shown, indicated, or required for a complete installation for the indicated use and performance.
4. Standard Products: When available, and unless custom or nonstandard options are specified or indicated, provide standard products of types that have been produced and used successfully in similar situations on other projects.
5. Visual Matching: Where required in the Contract Documents, provide products that match referenced existing construction, approved mock-ups, or approved Sample, as determined by Engineer.
6. Where the Contract Documents include the phrase "as selected" for product color, finish pattern, option, or similar phrase, provide products selected by Engineer as follows:

- a. Standard Range: Where the Contract Documents include the phrase “standard range of colors, patterns, textures” or similar phrase, provide color, pattern, density, or texture selected by Engineer from manufacturer’s product line that does not include premium items.
- b. Full Range: Where the Contract Documents include the phrase “full range of colors, patterns, textures” or similar phrase, Engineer will select color, pattern, density, or texture from manufacturer’s entire product line, including standard and premium items.

B. Product Compatibility:

1. Similar products by the same Supplier shall be compatible with each other, unless otherwise indicated in the Contract Documents.
2. Provide products compatible with products previously selected or installed on the Project.

C. Product Options:

1. For products specified only by reference standard or description, without reference to Supplier, provide products meeting that standard, by a Supplier or from a source that complies with the Contract Documents.
2. For products specified by naming one or more products or Suppliers, provide the named products that comply with the Contract Documents, unless an “or equal” or substitute product is approved by Engineer.
3. For products specified by naming one or more products or Suppliers and the term, “or equal”, when Contractor proposes a product or Supplier as an “or equal”, submit to Engineer a request for approval of an “or equal” product or Supplier.
4. For products specified by naming only one product or manufacturer and followed by words indicating that no substitution is allowed, there is no option and no substitution will be allowed.

D. Concerning Patents:

1. Owner shall be provided a guarantee by Contractor and equipment Supplier that equipment and material furnished in accordance with the Contract Documents is not the subject of patent litigation.
2. Patent litigation or controversy shall include, but not limited to, the following:
 - a. Actual furnished equipment and material the is subject or could be subject to patent litigation or is known to infringe on a patent.

- b. Furnished equipment and material that may result in a process that use of equipment and material in a manner that infringes upon or violates a patent.
- 3. When patent infringement may occur, Contractor and Supplier shall submit license arrangements among parties, including Contractor, Supplier, and patent owner (controller of patent) at a minimum, which shall permit use of equipment and material as specified in the Contract Documents.
- 4. Supplier shall indemnify and hold harmless Owner and Engineer against all claims, costs, losses, and damages arising out of or relating to any infringement or patent rights or copyrights incident to the use of equipment and material specified in the Contract Documents and as required in General Conditions and as modified in the Supplemental Conditions.

E. "Or Equal" Products:

- 1. For proposed products not named in the Contract Documents and considered as an "or equal", Contractor shall request in writing Engineer's approval of the "or equal". Request for approval of an "or equal" product shall accompany the Shop Drawing or product data submittal for the proposed product and shall include:
 - a. Contractor's request that the proposed product be considered as an "or equal" in accordance with the Contract Documents, accompanied by Contractor's certifications.
 - b. Documentation adequate to demonstrate that proposed product does not require revisions to the Contract Documents, that proposed product is consistent with the Contract Documents, and that proposed product will produce results and performance required in the Contract Documents, and that proposed product is compatible with other portions of the Work.
 - c. Detailed comparison of significant qualities of proposed product with the products and manufacturers named in the Contract Documents. Significant qualities include attributes such as performance, weight, size, durability, visual effect, performance and specific features and requirements shown or indicated.
 - d. Evidence that proposed product manufacturer will furnish warranty equal to or better than specified, if any.
 - e. List of similar installations for completed projects with project names and physical addresses of installation along with the names, telephone numbers, email addresses and physical address of design professionals and owners associated with the referenced installation, if requested.
 - f. Samples, if requested.
 - g. Other information requested by Engineer.

1.05 WARRANTY

- A. Warranties specified for products shall be in addition to, and run concurrent with, Contractor's general warranty and guarantee and requirements for the required correction period. Disclaimers and limitations in specific product warranties do not limit Contractor's general warranty and guarantee.
 - 1. Product manufacturer's warranty is preprinted written warranty published by product manufacturer and specifically endorsed by product manufacturer to Owner.
 - 2. Equipment and material shall be guaranteed to be free from defects in workmanship, design, and/or materials for a period of one (1) year unless otherwise specified in the individual Specification Section for a Special Warranty.
 - 3. Warranty period shall start on the date of the particular equipment and material is substantially complete, which includes requirements specified in Section 01 75 00 – Checkout and Startup Procedures for start-up certification and specified elsewhere in the Contract Documents.
 - 4. Warranty requirements may be added to or modified in the individual Specification Sections. Special warranty is written warranty required by or incorporated into the Contract Documents, either to extend time limit provided by product manufacturer's warranty or to provide increased rights to Owner.
 - 5. Special warranty information, if any, will be located in the Specification Section for that product.
- B. Requirements for Special Warranties: Provide written special warranty document that contains appropriate terms and identification, ready for execution by product manufacturer and Owner. Submit draft warranty with submittals required for product.
 - 1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed by product manufacturer and other parties as appropriate.
 - 2. Specified Form: When specified forms are included in the Contract Documents, prepare written document, properly executed by product manufacturer and Owner, using appropriate form.
 - 3. Refer to Specifications for content and requirements for submitting special warranties.
- C. Submit product manufacturer's warranties and special warranties as submittals in accordance with Schedule of Submittals accepted by Engineer.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 01 65 00
PRODUCT DELIVERY REQUIREMENTS

PART 1 – GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. General requirements for preparing for shipping, delivering, and handling materials and equipment.
 - 2. Contractor shall make all arrangements for transporting, delivering, and handling of materials and equipment required for prosecution and completion of the Work.

1.02 SUBMITTALS

- A. Refer to individual Specification Sections for submittal requirements relative to delivery and handling materials and equipment.

1.03 SHIPMENT REQUIREMENTS

- A. When practical, factory-assemble materials and equipment. Match mark or tag separate parts and assemblies to facilitate field assembly. Cover machined and unpainted parts that may be damaged by the elements with strippable, protective coating.
- B. Package materials and equipment to facilitate handling, and protect materials and equipment from damage during shipping, handling, and storage. Mark or tag outside of each package or crate to indicate the associated purchase order number, bill of lading number, contents by name, Owner's contract name and number, Contractor name, equipment number, and approximate weight. Include complete packing lists and bills of materials with each shipment.
- C. Protect materials and equipment from exposure to the elements and keep thoroughly dry and dust-free at all times. Protect painted surfaces against impact, abrasion, discoloration, and other damage. Lubricate bearings and other items requiring lubrication in accordance with manufacturer's instructions.
- D. Advance Notice of Shipments:
 - 1. Keep Engineer informed of delivery of all materials and equipment to be incorporated in the Work.
- E. Do not ship materials and equipment until:

1. Related Shop Drawings, Samples, and other submittals have been approved or accepted (as applicable) by Engineer, including, but not necessarily limited to, Submittals associated with the materials and equipment being delivered.
2. Manufacturer's instructions for handling, storing, and installing the associated materials and equipment have been submitted to and accepted by Engineer in accordance with the Specifications.
3. Results of source quality control testing (factory testing), when required by the Contract Documents for the associated materials or equipment, have been reviewed and accepted by Engineer.
4. Facilities required for handling materials and equipment in accordance with manufacturer's instructions are in place and available.
5. Required storage facilities have been provided.

1.04 DELIVERY REQUIREMENTS

A. Scheduling and Timing of Deliveries:

1. Arrange deliveries of materials and equipment in accordance with the accepted Progress Schedule and in ample time to facilitate inspection prior to installation.
 - a. Equipment and material shall not be delivered to the Site prior to 90 days in advance of scheduled installation.
 - b. Partial payment requests will not be processed for materials delivered prior to 90 days before installation or for materials that are improperly stored.
2. Schedule deliveries to minimize space required for and duration of storage of materials and equipment at the Site or delivery location, as applicable.
3. Coordinate deliveries to avoid conflicting with the Work and conditions at Site, and to accommodate the following:
 - a. Work of other contractors and Owner.
 - b. Owner's operations and maintenance.
 - c. Storage space limitations.
 - d. Availability of equipment and personnel for handling materials and equipment.
 - e. Owner's use of premises.
4. Deliver materials and equipment to the Site during regular working hours.

5. Deliver materials and equipment to avoid delaying the Work and the Project, including work of other contractors, as applicable. Deliver anchor system materials, including anchor bolts to be embedded in concrete or masonry, in ample time to avoid delaying the Work.

B. Deliveries:

1. Shipments shall be delivered with Contractor's name, Subcontractor's name (if applicable), Site name, Project name, and contract designation clearly marked.
2. Site may be listed as the "ship to" or "delivery" address; but Owner shall not be listed as recipient of shipment unless otherwise directed in writing by Engineer.
3. Provide Contractor's telephone number to shipper; do not provide Owner's telephone number.
4. Arrange for deliveries while Contractor's personnel are at the Site. Contractor shall receive and coordinate shipments upon delivery. Shipments delivered to the Site when Contractor is not present will be refused by Owner, and Contractor shall be responsible for the associated delays and additional costs, if incurred.

C. Containers and Marking:

1. Have materials and equipment delivered in manufacturer's original, unopened, labeled containers.
2. Clearly mark partial deliveries of component parts of materials and equipment to identify materials and equipment, to allow easy accumulation of parts, and to facilitate assembly.

D. Inspection of Deliveries:

1. Immediately upon delivery, Contractor shall inspect shipment to verify that:
 - a. Materials and equipment comply with the Contract Documents and approved or accepted (as applicable) submittals.
 - b. Quantities are correct.
 - c. Materials and equipment are undamaged.
 - d. Containers and packages are intact and labels are legible.
 - e. Materials and equipment are properly protected.
2. Promptly remove damaged materials and equipment from the Site and expedite delivery of new, undamaged materials and equipment, and remedy incomplete or lost materials and equipment to furnish materials and equipment in accordance with the Contract Documents, to avoid delaying progress of the Work.

3. Advise Engineer in writing when damaged, incomplete, or defective materials and equipment are delivered, and advise Engineer of the associated impact on the Progress Schedule.

1.05 HANDLING REQUIREMENTS

- A. Provide equipment and personnel necessary to handle materials and equipment, including those furnished by Owner, by methods that prevent soiling or damaging materials and equipment and packaging.
- B. Provide additional protection during handling as necessary to prevent scraping, marring, and otherwise damaging materials and equipment and surrounding surfaces.
- C. Handle materials and equipment by methods that prevent bending and overstressing.
- D. Lift heavy components only at designated lifting points.
- E. Handle materials and equipment in safe manner and as recommended by the manufacturer to prevent damage. Do not drop, roll, or skid materials and equipment off delivery vehicles or at other times during handling. Hand-carry or use suitable handling equipment.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 01 66 00
PRODUCT STORAGE AND PROTECTION REQUIREMENTS

PART 1 – GENERAL

1.01 SUMMARY

- A. General requirements of storing and protecting equipment and materials.

1.02 STORAGE

- A. Store and protect materials and equipment in accordance with manufacturer's recommendations and the Contract Documents.
- B. Contractor shall make all arrangements and provisions necessary for, and pay all costs for, storing materials and equipment. Construction equipment, and materials and equipment to be incorporated into the Work shall be placed to avoid injuring the Work and existing facilities and property, and so that free access is maintained at all times to all parts of the Work and to public utility installations in vicinity of the Work. Store materials and equipment neatly and compactly in locations that cause minimum inconvenience to Owner, other contractors, public travel, and owners, tenants, and occupants of adjoining property. Arrange storage in manner to allow easy access for inspection.
- C. Areas available at the Site for storing materials and equipment are shown or indicated in the Contract Documents, or as approved by Engineer.
- D. Store materials and equipment to become Owner's property to facilitate their inspection and ensure preservation of quality and fitness of the Work, including proper protection against damage by freezing, moisture, and high ambient temperatures. Store in indoor, climate-controlled storage areas all materials and equipment subject to damage by moisture, humidity, heat, cold, and other elements, unless otherwise acceptable to Owner.
- E. Contractor shall be fully responsible for loss or damage (including theft) to stored materials and equipment.
- F. Do not open manufacturer's containers until time of installation, unless recommended by the manufacturer, directed by Engineer or otherwise specified in the Contract Documents.
- G. Do not store materials or equipment in structures being constructed unless approved by Engineer in writing.
- H. Do not use lawns or other private property for storage without written permission of the owner or other person in possession or control of such premises.

- I. Contractor shall not store unnecessary equipment and materials at the Site.
- J. Contractor shall prevent structures from being loaded with a weight that endanger its security and/or safety of persons.
- K. Stored equipment and materials shall not be placed within 10 feet of fire hydrants.
- L. Gutters, drainage channels and inlets shall be kept unobstructed at all times.

1.03 PROTECTION

- A. Contractor shall provide temporary storage containers/facilities, if required, to protect equipment and materials at the Site.
- B. Equipment to be incorporated into the Work shall be boxed, crated, or otherwise completely enclosed and protected during shipping, handling, and storage, in accordance with Section 01 65 00 – Product Delivery Requirements.
- C. Store all materials and equipment off the ground (or floor) on raised supports such as skids or pallets.
- D. Protect painted surfaces against impact, abrasion, discoloration, and other damage. Painted equipment surfaces that are damaged or marred shall be repainted in their entirety in accordance with equipment manufacturer and paint manufacturer requirements, to the satisfaction of Engineer.

1.04 SPECIFIC STORAGE REQUIREMENTS

- A. Uncovered:
 - 1. The following types of materials may be stored outdoors without cover on supports so there is no contact with the ground:
 - a. Piping, except polyvinyl chloride (PVC) or chlorinated PVC (CPVC) pipe.
- B. Covered:
 - 1. The following materials and equipment may be stored outdoors on supports and completely covered with covering impervious to water:
 - a. Grout and mortar materials.
 - b. Rough lumber.
 - c. PVC and CPVC pipe.
 - 2. Tie down covers with rope, and slope covering to prevent accumulation of water.
- C. Fully Protected:

1. All materials and equipment not named as uncovered or covered in this Section, shall be stored on supports in buildings or trailers that have concrete or wooden flooring, roof, and fully closed walls on all sides. Covering with plastic sheeting or similar material in space without floor, roof, and walls is not acceptable. Comply with the following:
 - a. Provide heated storage for materials and equipment that could be damaged by low temperatures or freezing.
 - b. Provide air-conditioned storage for materials and equipment that could be damaged by high temperatures.
 - c. Protect mechanical and electrical equipment from being contaminated by dust, dirt, and moisture.
 - d. Maintain humidity at levels recommended by manufacturers of electrical and electronic equipment.
 - e. Energize space heaters for electrical equipment and material.
- D. Maintenance of Storage: On scheduled basis, periodically inspect stored materials and equipment to ensure that:
 1. Condition and status of storage facilities is adequate to provide required storage conditions.
 2. Required environmental conditions are maintained on continuing basis.
 3. Materials and equipment exposed to elements are not adversely affected.

1.05 RECORDS

- A. Keep up-to-date account of materials and equipment in storage to facilitate preparation of Applications for Payment, if the Contract Documents provide for payment for materials and equipment not incorporated in the Work but delivered and suitably stored at the Site or at another location agreed to in writing.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

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SECTION 01 71 33
PROTECTION OF WORK AND PROPERTY

PART 1 – GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Protection of existing utilities and structures.
 - 2. Protection of installed equipment and materials.
 - 3. Protection during inclement weather.
 - 4. Reporting of accidents.
 - 5. Barricades and warning signals.
- B. Contractor shall be responsible for taking all precautions, providing all programs, and taking all actions necessary to protect the Work and all public and private property and facilities from damage, as specified in the General Conditions, Supplementary Conditions, and this Section.
- C. To prevent damage, injury, or loss, Contractor's actions shall include the following:
 - 1. Storing apparatus, materials, supplies, and equipment in an orderly, safe manner that does not unduly interfere with progress of the Work or work of other contractors or utility companies.
 - 2. Providing suitable storage facilities for equipment and materials subject to damage or degradation by exposure to weather, theft, breakage, or other cause.
 - 3. Placing upon the Work or any part thereof only loads consistent with the safety and integrity of that portion of the Work and existing construction.
 - 4. Frequently removing and disposing of refuse, rubbish, scrap materials, and debris caused by Contractor's operations so that, at all times, the Site is safe, orderly, and workmanlike in appearance.
- D. Contractor has full responsibility for preserving public and private property and facilities on and adjacent to the Site. Direct or indirect damage done by, or on account of, any act, omission, neglect, or misconduct by Contractor in executing the Work, shall be restored by Contractor, at his expense to condition equal to that existing before damage was done.

- E. Contractor shall comply with safety regulations required by Owner or authorities having jurisdiction. Contractor shall comply with and correct unsafe conditions created or caused by Contractor's personnel. In the event Contractor fails to comply, Owner receives the right to take necessary measures to correct conditions or practices for reimbursement by Contractor.

1.02 REFERENCES

A. Definitions:

1. "Existing utilities" shall refer to both publicly-owned and privately-owned utilities such as, but are not limited to, electric power and lighting, telephone, water, gas, storm drains, process lines, sanitary sewers and all appurtenant structures.
2. "Surface structures" are existing buildings, structures, and other facilities at or above ground surface, including their foundations or any extension below ground surface. Surface structures include, but are not limited to, buildings, tanks, walls, channels, open drainage, exposed piping and utilities, poles, exposed wires, posts, signs, markers, curbs, walks, fencing, and other facilities visible at or above ground surface.

1.03 SITE CONDITIONS

A. Location of Existing Utilities and Structures:

1. Contractor shall confirm and verify location of existing utilities and structures at the Site prior to commencing the Work.
2. Contractor shall notify and obtain approval from authority having jurisdiction prior to performing the Work in the vicinity of the existing utilities and structures.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.01 PROTECTION OF EXISTING UTILITIES AND STRUCTURES

A. General:

1. Contractor shall satisfy Engineer that methods and procedures for protection have been approved by authorities having jurisdiction prior to proceeding with the Work.
2. Contractor shall provide temporary support and protection, as required, to existing utilities and structures during the Work, including excavation.
 - a. Temporary support and protection of existing utilities shall be provided in accordance with requirements of the authority having jurisdiction.

- b. Temporary support and protection of existing structures shall be provided as directed by the Engineer.
- 3. Contractor shall be responsible for costs incurred for temporary support or protection provided by a third-party or authority having jurisdiction to insure safety of the existing utility, Owner, and public and private parties.

B. Existing Buried Utilities:

- 1. Contractor shall perform field investigate to identify conflicts or interferences between existing utilities and utility Work prior to excavation Work.
 - a. Investigation of conflicts and interferences shall be performed on Site locations, elevations, slopes, etc. of the existing utilities determined during the field investigations.
 - b. Contractor shall notify Engineer and Owner in writing of identified conflicts or interferences. Contractor shall not proceed with the Work until written authorization is provided by the Engineer.
 - c. Identified conflicts and interferences shall be handled in accordance with the Contract Documents. If required, potential modification to the Contract Documents shall be performed in accordance with the General Conditions.
- 2. Contractor shall perform the Work to prevent disruption of existing service and damage to existing utilities.
 - a. Temporary connections shall be provided, as required, to provide un-interrupted service of existing utilities.
 - b. Contractor shall repair damage to existing utilities as directed by the Engineer or the authority having jurisdiction at Contractor's own expense.
 - c. Contractor shall be responsible for damages and repair costs to the authority having jurisdiction if third-party or authority having jurisdiction personnel repair damaged existing utilities.

C. Protection of Existing Structures:

- 1. Contractor shall sustain existing surface structures in existing place and protect from direct or indirect injury located within or adjacent to the limits of the Work. Such sustaining and supporting shall be done carefully and as required by the party owning or controlling such structure or facility.
- 2. Contractor shall bear all risks attending the presence or proximity of all surface structures within or adjacent to limits of the Work, in accordance with the Contract Documents.

3. Contractor shall be responsible for damage and expense for direct or indirect injury caused by his Work to structures and facilities.
 4. Contractor shall repair immediately damage caused by his Work, to the satisfaction of owner of damaged structure or facility at no cost to the Owner.
 5. Contractor shall provide temporary weather protection for existing structures and buildings where exterior walls or roofs are modified or disturbed in the Work. Contractor shall be responsible for damages due to inadequate protection of existing structures and building.
- D. Relocation of Surface Structures: Existing surface facilities, including but not limited to guard rails, posts, guard cables, signs, poles, markers, curbs, and fencing, that are temporarily removed to facilitate the Work shall be replaced and restored to their original condition at Contractor's expense.

3.02 PROTECTION OF INSTALLED EQUIPMENT AND MATERIALS

- A. Contractor shall protect installed equipment and materials equipment to prevent damage, injury or loss from subsequent operations. Remove protection facilities when no longer needed prior to completion of the Work.
- B. Control traffic to prevent damage to equipment, materials, and surfaces.
- C. Coverings: Provide coverings to protect materials and equipment from damage.

3.03 PROTECTION DURING INCLEMENT WEATHER

- A. Contractor shall not perform Work during inclement or unsuitable weather that will affect the quality of the completed Work.
- B. Contractor shall take necessary precautions in the event of impending inclement weather to protect equipment, materials and Work from damage or deterioration due to floods, driving rain, wind, or snow storms.
 1. Owner reserves the right to require additional protection measures beyond Contractor's proposed protection measures to protect the Work.
 2. Contractor shall not claim additional compensation for additional protection measures required by Owner nor for damages to equipment, material, or Work due to the inclement weather.
- C. When directed by Engineer, Contractor shall stop Work and protect new Work by protective covering during rain storms for, but not limited to, the following:
 1. Concrete mixing and placement.
 2. Paving placement.

3. Masonry installation.
4. Buried piping, valve and appurtenance installation.
5. Additional inclement weather requirements and limitations are specified in individual Specification Sections.

3.04 REPORTING OF ACCIDENTS

- A. Contractor shall immediately report, in writing, to Engineer and Owner accidents out of, or in conjunction with, the performance of Work.
 1. Accident reporting includes on Site and adjacent to Site, which cause death, personal injury, or property damage.
 2. Written report shall provide full details and witness statements.
 3. If claim is made against Contractor, Supplier, or Subcontractor due to accident, Contractor shall promptly report facts, in writing, to Engineer and Owner, with full account of the claim.
- B. Contractor shall immediately report death, serious injury, or serious damage caused by telephone or messenger to Engineer and Owner.

3.05 BARRICADES AND WARNING SIGNALS

- A. General:
 1. Where the Work is performed on or adjacent to roadway, access road, right-of-way, or public place:
 - a. Provide barricades, fences, lights, warning signs, danger signals, watchmen, and take other precautionary measures for protecting persons, property, and the Work.
 - b. Paint barricades to be visible at night.
 - c. From sunset to sunrise, furnish and maintain at least one light at each barricade.
 - d. Erect sufficient barricades to keep vehicles from being driven on or into Work under construction.
 - e. Furnish watchmen in sufficient numbers to protect the Work.
- B. Provide temporary barricades to protect personnel and property for Work not in or adjacent to vehicular travel areas, including indoor work, in accordance with Laws and Regulations.

- C. Contractor's responsibility for maintaining temporary barricades, signs, lights, and for providing watchmen shall continue until the Work is accepted in accordance with the Contract Documents.

END OF SECTION

SECTION 01 73 23
ANCHORAGE AND BRACING OF NONSTRUCTURAL COMPONENTS

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. Furnish all equipment, labor, materials, and services required to design and provide anchorage and bracing for all nonstructural components in accordance with the Contract Documents and Building Code requirements, including the seismic design requirements of Chapter 13 in ASCE 7.
- B. This Section covers requirements for only the anchorage and bracing of nonstructural components. Design requirements for nonstructural components (other than their anchorage and bracing) are covered in the Section for that component.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 05 10 00 – Metal Materials
- B. Section 05 05 23 – Metal Fastening
- C. Section 05 12 00 – Structural Steel
- D. Section 05 13 00 – Stainless Steel
- E. Further requirements for anchorage and bracing are included in other Sections of the Specifications. See Section for the specific nonstructural component in question.

1.03 DEFINITIONS

- A. Nonstructural components: All architectural, mechanical, electrical, or plumbing elements or systems and their supports or attachments provided under this contract which are permanently attached to new or existing structures.
 - 1. Architectural nonstructural components include, but are not limited to, interior nonstructural walls and partitions, exterior wall panels and glazing elements, glass curtain walls, skylights, cabinets, suspended ceilings, fascia, and cladding.
 - 2. Mechanical nonstructural components include, but are not limited to, HVAC units, fans, water and wastewater treatment process equipment, instrumentation cabinets, piping and ductwork.
 - 3. Electrical nonstructural components include, but are not limited to, conduit systems, cable tray systems, boxes, transformers, panelboards, switchboards, switchgear, busway, individual motor controllers, motor control centers, variable frequency drives, automatic transfer switches, and lighting systems.

4. Plumbing nonstructural components include, but are not limited to, sprinkler systems and associated piping, and sump pumps.
- B. Attachment: Elements including anchor bolts, welded connections, and mechanical fasteners which secure nonstructural components or supports to the structure.
- C. Essential Components: Nonstructural components considered necessary to public safety for which the component importance factor I_p is required by chapter 13 in ASCE 7 to be taken as 1.5, including:
 1. Life safety systems which must function following an earthquake, including but not limited to, sprinklers for fire protection, emergency lighting, egress corridors and stairways, and smoke purge systems.
 2. Components which contain, convey or support toxic, highly toxic, or explosive substances where the quantity of the material exceeds a threshold quantity established by the Building Code.
 3. Components which are within or attached to an Occupancy or Risk Category IV structure as defined in ASCE 7 Chapter 1 and are needed for continued operation of the facility or failure could impair the continued operation of the facility.
 4. Components which contain, convey, or support hazardous substances and are attached to a structure or portion thereof classified by the Building Code as a hazardous occupancy.
- D. Nonbuilding Structures: All self-supporting structures which are supported by an independent foundation or by other structures which include, but are not limited to, storage tanks, silos, exhaust stacks, storage racks, and towers.
- E. Delegated Design: Design of a structure or structural element(s) which has been deferred by the contract documents to be performed during the project construction stage, by a registered design professional retained by the Contractor and with the design submitted as a shop drawing to the Engineer.

1.04 REQUIREMENTS

- A. Anchorage and bracing of nonstructural components shall be designed and installed to resist the controlling load combination of gravity loads, operational forces (including static and dynamic), wind forces, seismic forces and any other applicable forces required in accordance with the governing Building Code.
- B. Anchorage and bracing of nonstructural components shall comply with seismic design requirements of ASCE 7 Chapter 13 unless the nonstructural component meets the criteria to be exempt. The following nonstructural components are exempt from requirements specific to seismic anchorage and bracing: (See paragraph 1.07.F.3 herein for Seismic Design Category)

1. Storage cabinets no more than 6 feet tall, furniture, and movable equipment, regardless of Seismic Design Category.
2. All architectural, mechanical, electrical, and plumbing nonstructural components in Seismic Design Category A.
3. All mechanical, electrical, and plumbing nonstructural components in Seismic Design Category B.
4. Architectural nonstructural components in Seismic Design Category B, other than parapets, provided that $I_p = 1.0$.
5. Mechanical, electrical, and plumbing nonstructural components in Seismic Design Category C provided that either:
 - a. $I_p = 1.0$, and the component is positively attached to the structure, or
 - b. Component weighs 20 lbs. or less, or 5 lb/ft or less for distribution systems.
6. Mechanical, electrical, and plumbing nonstructural components in Seismic Design Category D, E or F that are positively attached to the structure, provided that either:
 - a. $I_p = 1.0$, component weighs 400 lbs or less and its center of mass is 4 ft or less above a floor level, and flexible connections are provided between the components and associated ductwork, piping and conduit: or
 - b. Component weighs 20 lbs. or less, or 5 lb/ft or less for distribution systems.
7. Other exemptions as allowed by the Specifications, Codes and Standards referenced herein.

1.05 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Without limiting the generality of the Specifications, all work herein shall conform to or exceed the applicable requirements of the following documents. The Building Code shall be the version in effect at the time of Bid within the jurisdiction where the Work is located. All other referenced specifications, codes, and standards refer to the version as referenced by the Building Code. If no version is referenced by the Building Code, then the most current issue available at the time of Bid shall be used.

1. International Building Code
2. ASCE/SEI 7 Minimum Design Loads for Buildings and Other Structures
3. NFPA 13 Standard for Installation of Sprinkler Systems
4. FEMA 412 Installing Seismic Restraints for Mechanical Equipment

5. FEMA 413 Installing Seismic Restraints for Electrical Equipment
6. FEMA 414 Installing Seismic Restraints for Duct and Pipe
7. SMACNA Sheet Metal and Air Conditioning Contractors' National Association, Seismic Restraint Manual: Guidelines for Mechanical Systems
8. ACI 318 Building Code Requirements for Structural Concrete and Commentary
9. ACI 355.2 Qualifications of Post-Installed Mechanical Anchors in Concrete
10. ACI 355.4 Qualifications of Post-Installed Adhesive Anchors in Concrete

1.06 SUBMITTALS

- A. Submit the following in accordance with Section 01 33 00 – Submittal Procedures.
 1. Anchorage and bracing submittals for all architectural, mechanical, electrical, and plumbing nonstructural components, elements and systems that do not have a design for anchorage and bracing provided within the Contract Documents. Submittals shall include the following:
 - a. Component manufacturer's cut sheets and fabrication details for equipment bases and foundations, including dimensions, structural member sizes, support point locations and equipment operational loads. Equipment anchorage details shall clearly indicate anchor size, pattern, embedment, and edge distance requirements to satisfy operational, wind, seismic and other forces required by the governing Building Code. Details shall also indicate grout, bearing pads, isolators, etc. required for complete installation.
 - b. Design calculations, signed and sealed by a Professional Engineer registered in the State of Arizona. Design shall include all loads and load combinations required by the governing Building Code. Separate calculation submittals for vertical and lateral load support systems shall not be allowed.
 - c. Detailed Shop Drawings, signed and sealed by a Professional Engineer registered in the State of Arizona, showing specific details of the support design including material, installation, attachments, connection hardware, etc., and the layout and location of all hangers and supports (resisting both gravity and lateral loads), including bracing orientation and direction of force(s) to be resisted.
 - d. Seismic loads and requirements are not required to be included in design for anchorage and bracing of components which are exempt in accordance with Section 1.04B.
 - e. For components required to be certified as seismically qualified in accordance with paragraph 1.06.A.1.f below, submit installation guidelines

provided by the equipment manufacturer for proper seismic mounting of the equipment.

- f. Seismic qualification testing shall be based on ASCE 7 and on a nationally recognized testing standard procedure such as ICC-ES AC 156.

1.07 DESIGN REQUIREMENTS

- A. Mechanical fasteners used to secure nonstructural components shall meet the requirements of Section 05 05 23 – Metal Fastening. Post-installed concrete anchors shall be prequalified for use in seismic applications.
- B. No reaction loads (either vertical or lateral) from nonstructural component anchorage and bracing shall be allowed on any element where design has been delegated unless the additional loads on the element have been coordinated with the delegated designer and the submittal is accompanied by a sealed letter from the delegated designer indicating the element has been designed to support the reaction loads.
- C. Reaction loads from nonstructural component anchorage and bracing shall be transferred directly to the primary structural members (girders, beams, etc.), with no components supported from secondary members (purlins, bracing, etc.) unless otherwise approved.
- D. No holes shall be drilled into any structural steel for attachment of component supports without prior approval of the Engineer.
- E. Attachments of nonstructural component anchorage and bracing that cause overstressing of any structural element shall not be permitted.
- F. Seismic Requirements
 - 1. Seismic anchorage and bracing for nonstructural components shall be subject to the current local Building Code in conjunction with the seismic provisions of the International Building Code (IBC) Section 1613 and referenced ASCE 7 Chapter 13.
 - 2. Where the weight of a nonstructural component is greater than or equal to 25 percent of the effective seismic weight (as defined by ASCE 7) of the structure it is attached to, the component shall be classified as a nonbuilding structure for purposes of seismic design. Seismic design for nonbuilding structures shall comply with Building Code requirements in conjunction with the provisions of ASCE 7 Chapter 15.
 - 3. Nonstructural components shall be assigned to the same Seismic Design Category as the structure they occupy or to which they are attached. Design of seismic support system and anchorage shall incorporate the site-specific seismic criteria given on the Contract Drawings. Criteria shall include site-specific spectral response coefficients, Site Class, Seismic Design Category, and Risk Category.

4. Component Importance Factor I_p shall be 1.5 for all essential nonstructural components noted in item 1.03.E above. All other nonstructural components shall utilize $I_p = 1.0$ unless noted otherwise.
 5. Components shall be anchored and braced for earthquake forces both in the vertical and each orthogonal direction. Seismic anchorage and bracing shall limit deflections of components per ASCE 7, and the displacements shall not impede component functionally and containment.
 6. Anchorage design shall account for disparate seismic response behavior of supporting structures. Seismic supports or bracing shall not cross structural expansion joints. Nonstructural components shall not be attached to multiple structural elements which may respond differently during a seismic event without provisions to accommodate independent movement. Flexible expansion loops or offsets, flexible joints, bellows type pipe expansion joints, couplings, etc. shall be provided at structure expansion joints to allow for independent structure movement and thermal movement of piping, ductwork, and conduit. Minimum movement capability in the vertical and each orthogonal direction shall equal the width of the joint.
 7. Provide flexible connections, piping, conduit, etc. at foundation levels where below grade utilities enter the structure.
 8. Design of support system for components with multiple attachments shall consider the stiffness and ductility of the supporting members. Equipment designed as free-standing shall only be attached at its base. Use of non-free-standing equipment requiring both vertical and lateral attachment is contingent upon loads applied to the structure and requires approval by the Engineer.
 9. The seismic anchorage and bracing design shall be based on actual equipment data (dimensions, weight, center of gravity, etc.) obtained from the specifications or the approved equipment manufacturer. The equipment manufacturer shall verify the attachment points on the equipment can safely withstand the combination of seismic, self-weight and other loads imposed.
- G. Powder actuated fasteners in steel or concrete shall not be used for sustained tension loads in Seismic Design Categories D, E or F unless approved for seismic loading or specifically exempted by ASCE 7. Powder actuated fasteners in masonry shall not be used unless approved for seismic loading regardless of Seismic Design Category.
- H. Friction clips shall not be used in Seismic Design Categories D, E or F for supporting sustained tension loads in combination with resisting seismic forces. C-type and large flange clamps may be used for hanger attachments provided restraining straps meeting NFPA 13 requirements are utilized and loosening of threaded connections is prevented by lock nuts, burred threads, etc.

PART 2 – PRODUCTS

2.01 MATERIALS

- A. Anchorage and bracing of nonstructural components shall be constructed of appropriate materials and connecting hardware to provide a continuous load path between the component and supporting structure of sufficient strength and stiffness to resist the calculated design seismic forces and displacements.
- B. Component anchorage, bracing and connection materials shall be compatible with and in general match the component and component gravity support materials. Contact between dissimilar metals shall be prevented.

PART 3 – EXECUTION

3.01 INSTALLATION OF ANCHORAGE AND BRACING

- A. No anchorage and bracing of nonstructural components shall be installed prior to review and acceptance by the Engineer and permitting agency.
- B. Equipment shall be installed per the manufacturer's recommendations. Fasteners shall meet manufacturer's requirements.
- C. Following installation, all anchorage and bracing and seismically qualified equipment shall be inspected unless it meets requirements in Section 1.04 above.

END OF SECTION

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SECTION 01 75 00
CHECKOUT AND STARTUP PROCEDURES

PART 1 – GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Checkout of products and equipment.
 - 2. Startup procedures of products and equipment
- B. Contractor shall initially start up and place equipment installed under the Contract into successful operation, in accordance with the equipment manufacturer's written instructions and as instructed by Supplier at the Site.
- C. Provide all material, labor, tools, and equipment required to complete equipment checkout and start-up.
- D. Provide chemicals, lubricants, and other required operating fluids.
- E. Owner to provide water for flushing chemical lines and chemicals for startup.
- F. General activities include:
 - 1. Cleaning, as required under other provisions of the Contract Documents.
 - 2. Removing temporary protective coatings.
 - 3. Checking and correcting (if necessary) leveling plates, grout, bearing plates, anchorage devices, fasteners, and alignment of piping, conduits, and ducts that may place stress on the connected equipment.
 - 4. All adjustments required.

1.02 ADMINISTRATIVE REQUIREMENTS

- A. Definitions:
 - 1. Displacement, as used herein, shall mean total peak-to-peak movement of vibrating equipment, in mils; velocity or speed of the vibration cycle, measured in distance per time, velocity and acceleration of the vibration cycle. Displacement, velocity and acceleration shall be measured by instruments/equipment equal to IRD Mechanalysis, Bentley, Nevada.
- B. Coordination:

1. Coordinate checkout and start-up with other contractors performing Work at the Site.
2. Do not start up system or subsystem for continuous operation until all components of that system or subsystem, including instrumentation and controls, have been tested to the extent practicable and proven to be operable as intended by the Contract Documents.
3. Responsibility for proper operation is by Contractor.
4. Supplier shall be present during checkout, start-up, and initial operation, except as otherwise specified.
5. Do not start up system, unit process, or equipment without submitting acceptable preliminary operations and maintenance manuals by Contractor, in accordance with Section 01 78 23 – Operations and Maintenance Data.

C. Contractor's Requirements Prior to Owner's Responsibility:

1. Owner will assume responsibility for the equipment upon Substantial Completion.
2. Prior to turning over to Owner responsibility for operating and maintaining system or equipment shall be in accordance with this Section and the following requirements:
 - a. Submit acceptable final operations and maintenance manuals in accordance with Section 01 78 23 – Operations and Maintenance Data.
 - b. Provide training of operations and maintenance personnel in accordance with Section 01 79 00 – Instruction of Owner's Personnel.
 - c. Complete system field quality control testing in accordance with the Contract Documents including, but not limited to, the following:
 - 1) Start-up certification shall be performed and completed by the equipment Supplier for the equipment and material prior to be placed into intended use by Owner as specified in the Contract Documents.
 - 2) Equipment and material shall be operated for a minimum 30-day operational period to verify performance. In addition to specific requirements specified in the individual specification sections, process data that is recorded in the PLC shall be submitted to the Engineer in tabular format showing hourly process performance data. A log of all alarms shall also be submitted, along with notes describing corrective measures applied in response to alarm condition.

- 3) If equipment and material does not perform satisfactorily during the 30-day operational period, then the warranty period start shall be delayed until satisfactory performance is verified.
 - a) Contractor shall repair or replace equipment and material that does not perform satisfactorily at no cost to Owner.
 - b) Contractor shall furnish all equipment and material, labor, and incidentals necessary to provide equipment and material to the performance level required by the Contract Documents.
- d. Obtain from Engineer final certificate of Substantial Completion for either entire Work or the portion being turned over to Owner.

1.03 SUBMITTALS

- A. Startup Schedule: Detailed summary of schedule, duration, manpower requirement, and Contractor's means and methods for startup.
- B. Closeout Submittals: Manufacturer's certification of installation in accordance with this Section.
- C. Startup testing and operational demonstration performance data.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.01 PRELIMINARY REQUIREMENTS

- A. Prior to the start-up of the facilities, Contractor shall have prepared and tested all equipment, subsystems and systems in accordance with the requirements of the individual Specification Section to check its ability for sustained operation, including inspections and adjustments by Manufacturer's representative.
- B. Contractor shall develop and submit schedule in accordance with this Section.
- C. After the facilities are sufficiently complete to permit start-up, Contractor shall furnish competent personnel to start-up the facilities. Contractor will be responsible for startup of all facilities constructed under this Contract. During the initial start-up period the Contractor shall check and provide for mechanical operation in accordance with the Contract Documents.

3.02 FIELD QUALITY CONTROL

- A. Manufacturers' Field Services:

1. When specified, furnish services of factory trained representatives of material and equipment manufacturers as specified, including supervising installation, adjusting, checkout, start-up, and testing of materials and equipment.
2. Certification:
 - a. When services by manufacturer are required at the Site, within 14 days after first test operation of equipment, submit to Engineer a letter from manufacturer, on manufacturer's letterhead, stating that materials and equipment are installed in accordance with manufacturer's requirements and installation instructions, and in accordance with the Contract Documents.
 - b. Include in the final operations and maintenance manual for the associated equipment a copy of the letter or completed form, as applicable.
3. Manufacturer shall bring any discrepancies to the immediate attention of the Contractor for correction. Contractor shall promptly correct any discrepancies noted by the Manufacturer. Manufacturer shall coordinate correction of discrepancies with the Contractor. Discrepancies and their correction shall be noted in inspection records and in all required reports. Any corrections that result in changes to the work as shown on the Contract Documents shall be approved by the Engineer prior to their execution.

3.03 VIBRATION TESTING (NOT USED)

3.04 SYSTEM START-UP

- A. Equipment and materials shall be provided in conformance with the manufacturer's installation instructions and in accordance with the Contract Documents.
- B. Provide start-up services as specified in the individual Specification Sections.
- C. Contractor shall furnish consumables required for startup including, but not limited to, temporary electricity (if required) and lubrication. Contractor shall provide a plan for disposal of water used for testing unless otherwise specified in the Contract Documents.
- D. Contractor to start up chemical system using water for as long as practicable prior to introduction of chemical to the system.
- E. General system requirements:
 1. Start-up of the plant by Contractor shall include all mechanical systems, including but not limited to, pumps, compressors, and like equipment, and the ventilating, air conditioning (or heating), plumbing, and electrical systems. Start-up of either the heating or air conditioning systems is dependent upon the time of year that the plant start up is initiated. Contractor will be required to return at the beginning of the next heating or air conditioning season (whichever is applicable) to start the appropriate system.

2. Cleaning as required under provisions of the Contract Documents.
3. Remove temporary protective coatings.
4. Flushing and replacing greases and lubricants as required by Manufacturer
5. Lubrication.
6. Verify the following:
 - a. Shaft and coupling alignments and reset where needed.
 - b. Set motor, pump and other equipment rotation, safety interlocks, and belt tensions.
 - c. Leveling plates, grout, bearing plates, anchor bolts, fasteners, and alignment of piping, conduits and ducts that may apply stress on equipment.
7. Valves:
 - a. Tighten packing glands to ensure no leakage but allow valve stems to operate without galling.
 - b. Replace packing in valves to retain maximum adjustment after system is determined to be complete.
 - c. Replace packing on valves that continue to leak.
 - d. Remove and repair bonnets that leak.
 - e. After cleaning, coat packing gland threads and valve stems with surface preparation of "Molycote" or "Fel-Pro".
8. Verify that control valve seats are free of foreign matter and are properly positioned for intended service.
9. Tighten flanges and other pipe joints after system has been placed in operation.
10. Replace gaskets that show signs of leakage after tightening.
11. Inspect all joints for leakage:
 - a. Promptly remake each joint that appears to be faulty; do not wait for rust or other corrosion to form.
 - b. Clean threads on both parts and apply compound and remake joints.
12. After system has been placed in operation, clean valve seats and headers in fluid system to ensure freedom from foreign matter.

13. Remove rust, scale, and foreign matter from equipment and renew defaced surfaces.
14. Repair damaged insulation.

END OF SECTION

SECTION 01 77 19
CLOSEOUT REQUIREMENTS

PART 1 – GENERAL

1.01 SUMMARY

- A. Section includes:
1. Substantial Completion.
 2. Final inspection.
 3. Request for final payment.

1.02 REFERENCES

- A. Definitions:
1. Substantial completion procedures for requesting and documenting are in the General Conditions, as modified by Supplemental Conditions.
 2. Final inspection procedures for requesting and documenting are in the General Conditions, as modified by Supplemental Conditions.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Request for Final Payment:
1. Procedure: Submit request for final payment in accordance with the Agreement and General Conditions, as may be modified by the Supplementary Conditions.
- B. Request for final payment shall include:
1. Documents required for progress payments in the General Conditions.
 2. Documents required in the General Conditions, as may be modified by the Supplementary Conditions.
 3. Releases or Waivers of Lien Rights:
 - a. Provide a final release or waiver by Contractor and each Subcontractor and Supplier that provided Contractor with labor, material, or equipment totaling \$10,000 or more.
 - b. Provide list of Subcontractors and Suppliers for which release or waiver of Lien is required.

- c. Each release or waiver of Lien shall be signed by an authorized representative of the entity submitting release or waiver to Contractor, and shall include Subcontractor's or Supplier's corporate seal, when applicable.
 - d. Release or waiver of Lien may be conditional upon receipt of final payment.
 - e. Manufacturer's Affidavit of Release of Liens – furnish a separate, completed form from the manufacturer.
4. Consent of Surety Company to Final Payment.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 01 78 23
OPERATION AND MAINTENANCE DATA

PART 1 – GENERAL

1.01 SUMMARY

- A. Section Includes: Requirements for operation and maintenance data, manuals, and documentation.
1. Submit operation and maintenance data, in accordance with this Section and in accordance with requirements elsewhere in the Contract Documents, as instructional and reference manuals by operations and maintenance personnel at the Site.
 2. Required operation and maintenance data groupings are listed in this Section. At minimum, submit operation and maintenance data for:
 - a. All equipment and systems
 - b. Valves, gates, actuators, and related accessories
 - c. Instrumentation and control devices
 - d. Electrical gear
 3. For each operation and maintenance manual, submit the following:
 - a. Preliminary Submittal: Electronic copy of entire operation and maintenance manual, except for test data and service reports by Supplier.
 - b. Final Submittal: Electronic Copy and Printed and bound copy of complete operations and maintenance manual and electronic copy, including test data and service reports by Supplier.

1.02 ADMINISTRATIVE REQUIREMENTS

- A. Quantity Required and Timing of Submittals:
1. Preliminary Submittal:
 - a. Electronic Copies: One copy.
 - b. Submit to Engineer, whichever occurs first:
 - 1) 60 days prior to starting training of operations and maintenance personnel.

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- 2) 30 days prior to field quality control testing at the Site.
 - c. Furnish preliminary operation and maintenance data submittal in acceptable form and content, as determined by Engineer, before associated materials and equipment will be eligible for payment.
2. Preliminary Submittal shall be reviewed by Engineer. One printed or electronic copy shall be returned to Contractor with required revisions noted.
 3. Final Submittal: Provide 14 days prior to checkout and startup procedures specified in Section 01 75 00 – Checkout and Startup Procedures, unless Submittal is specified as required prior to an interim Milestone.
 - a. Printed Copies: One copy.
 - b. Electronic Copies: One copy.

B. Format of Printed Copies:

1. Binding and Cover:
 - a. Bind each operation and maintenance manual in durable, permanent, stiff-cover binder(s), comprising one or more volumes per copy as required. Binders shall be minimum one-inch wide and maximum of three-inch wide. Binders for each copy of each volume shall be identical.
 - b. Provide the following information on cover of each volume:
 - 1) Title: "OPERATING AND MAINTENANCE INSTRUCTIONS".
 - 2) Name or type of material or equipment covered in the manual.
 - 3) Volume number, if more than one volume is required, listed as "Volume ___ of ___", with appropriate volume-designating numbers filled in.
 - 4) Name of Project and, if applicable, Contract name and number.
 - 5) Name of building or structure, as applicable.
 - c. Provide the following information on spine of each volume:
 - 1) Title: "OPERATING AND MAINTENANCE INSTRUCTIONS".
 - 2) Name or type of material or equipment covered in the manual.
 - 3) Volume number, if more than one volume is required, listed as "Volume ___ of ___", with appropriate volume-designating numbers filled in.

- 4) Project name and building or structure name.
 2. Drawings:
 - a. Bind into the manual drawings, diagrams, and illustrations up to and including 11 inches by 17 inches in size, with reinforcing.
 - b. Documents larger than 11 inches by 17 inches shall be folded and inserted into clear plastic pockets bound into the manual. Mark pockets with printed text indicating content and drawing numbers. Include no more than three drawing sheets per pocket.
 3. Copy Quality and Document Clarity:
 - a. Contents shall be original-quality copies. Documents in the manual shall be either original manufacturer-printed documents or first-generation photocopies indistinguishable from originals. If original is in color, copies shall be in color.
 - b. Clearly mark in ink to indicate all components of materials and equipment on catalog pages for ease of identification. In standard or pre-printed documents, indicate options furnished or cross out inapplicable content.
 4. Organization:
 - a. Provide table of contents in each volume for each chapter or section.
 - b. Use dividers and indexed tabs between major categories of information, such as operating instructions, preventive maintenance instructions, and other major subdivisions of data in each manual.
- C. Format of Electronic Copies:
1. Each electronic copy shall include all information included in the corresponding printed copy.
 2. Submit electronic copy via transferable method and format acceptable to Engineer.
 3. File Format:
 - a. Acceptable formats include Adobe PDF, Microsoft Word, Autodesk DWF, and AutoCAD.
 - b. Files shall be electronically searchable, including text in all drawings and figures.
 - c. Submit separate file for each separate document in the printed copy.
 - d. Within each file, provide bookmarks for the following:

- 1) Each chapter and subsection listed in the corresponding printed copy document's table of contents
 - 2) Each figure
 - 3) Each table
 - 4) Each appendix
4. Submit drawings and figures in one of the following formats: ".bmp", ".tif", ".jpg", ".gif", ".dwf", or ".dwg".

D. General Content Requirements:

1. Prepare each operations and maintenance manual specifically for the Project. Include in each manual all pertinent instructions, as-built drawings as applicable, bills of materials, technical bulletins, installation and handling requirements, maintenance and repair instructions, and other information required for complete, accurate, and comprehensive data for safe and proper operation, maintenance, and repair of materials and equipment furnished for the Project. Include in manuals specific information required in the Specification Section for the material or equipment, data required by Laws and Regulations, and data required by authorities having jurisdiction.
2. Submit complete, detailed written operating instructions for each material or equipment item including: function; operating characteristics; limiting conditions; operating instructions for start-up, normal and emergency conditions; regulation and control; operational troubleshooting; and shutdown. Also include, as applicable, written descriptions of alarms generated by equipment and proper responses to such alarm conditions.
3. Submit written explanations of all safety considerations relating to operation and maintenance procedures.
4. Submit complete, detailed, written preventive maintenance instructions including all information and instructions to keep materials, equipment, and systems properly lubricated, adjusted, and maintained so that materials, equipment, and systems function economically throughout their expected service life. Instructions shall include:
 - a. Written explanations with illustrations for each preventive maintenance task such as inspection, adjustment, lubrication, calibration, and cleaning. Include pre-startup checklists for each equipment item and maintenance requirements for long-term shutdowns.
 - b. Recommended schedule for each preventive maintenance task.

- c. Lubrication charts indicating recommended types of lubricants, frequency of application or change, and where each lubricant is to be used or applied.
 - d. Table of alternative lubricants.
 - e. Troubleshooting instructions.
 - f. List of required maintenance tools and equipment.
5. Submit complete bills of material or parts lists for materials and equipment furnished. Lists or bills of material may be furnished on a per-drawing or per-equipment assembly basis. Bills of material shall indicate:
- a. Manufacturer's name, address, telephone number, fax number, and Internet website address.
 - b. Manufacturer's local service representative's or local parts supplier's name, address, telephone number, fax number, Internet website address, and e-mail addresses, when applicable.
 - c. Manufacturer's shop order and serial number(s) for materials, equipment or assembly furnished.
 - d. For each part or piece include the following information:
 - 1) Parts cross-reference number. Cross-reference number shall be used to identify the part on assembly drawings, Shop Drawings, or other type of graphic illustration where the part is clearly shown or indicated.
 - 2) Part name or description.
 - 3) Manufacturer's part number.
 - 4) Quantity of each part used in each assembly.
 - 5) Current unit price of the part at the time the operations and maintenance manual is submitted. Price list shall be dated.
6. Submit complete instructions for ordering replaceable parts, including reference numbers (such as shop order number or serial number).
7. Submit manufacturer's recommended inventory levels for spare parts, extra stock materials, and consumable supplies for the initial two years of operation. Consumable supplies are items consumed or worn by operation of materials or equipment, and items used in maintaining the operation of material or equipment, including items such as lubricants, seals, reagents, and testing chemicals used for calibrating or operating the equipment. Include estimated delivery times, shelf life limitations, and special storage requirements.

8. Submit manufacturer's installation and operation bulletins, diagrams, schematics, and equipment cutaways. Where materials pertain to multiple models or types, mark the literature to indicate specific material or equipment supplied. Marking may be in the form of checking, arrows, or underlining to indicate pertinent information, or by crossing out or other means of obliterating information that does not apply to the materials and equipment furnished.
9. Submit original-quality copies of each approved and accepted Shop Drawing, product data, and other submittal, updated to indicate as-installed condition. Reduced drawings are acceptable only if reduction is to not less than one-half original size and all lines, dimensions, lettering, and text are completely legible on the reduction.
10. Submit complete electrical schematics and wiring diagrams, including complete point-to-point wiring and wiring numbers or colors between all terminal points.
11. Submit copy of warranty bond and service contract as applicable.
12. When copyrighted material is used in operations and maintenance manuals, obtain copyright holder's written permission to use such material in the operation and maintenance manual.

1.03 SUBMITTALS

- A. Action/Informational Submittals: Submit preliminary schedule (listing) of operations and maintenance data for Engineer's review. Preliminary operations and maintenance data shall be grouped as major equipment and material systems and divided into sub-systems as required for clarity, subject to Engineer's approval.
- B. Closeout Submittals:
 1. Operation and maintenance data: Submit the operations and maintenance data indicated in the Contract Documents, grouped into submittals as approved by Engineer.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.01 SCHEDULE

- A. Contractor shall furnish Operation & Maintenance Manuals for the following systems and equipment, at a minimum. Operation & Maintenance Manual Schedule:

Spec. Section	Specification Title
40 05 57	Valve Operators and Electric Valve Actuators
Div 40	Instrumentation
46 33 44	Peristaltic Tube Metering Pumps

END OF SECTION

SECTION 01 78 43
SPARE PARTS AND EXTRA MATERIAL

PART 1 – GENERAL

1.01 SUMMARY

- A. Contractor shall furnish spare parts data and extra materials for materials and equipment in accordance with the Contract Documents.
- B. Spare Parts and Extra Materials:
 - 1. Provide spare parts, extra stock materials, maintenance supplies, and special tools required for maintenance (“spare parts and extra materials”) for one year of operation (unless otherwise specified in the individual Specification Section).
 - a. Provide Supplier recommended lubricating oil and grease in accordance with this Section and the Contract Documents.
 - 2. Provide list of Supplier recommended spare parts and extra material.
 - a. Include list of four standard lubricants, minimum, that shall be interchangeable for each type of lubricant required in the Contract Documents.
 - b. Include unit prices in current United States funds
 - c. Source(s) of supply for each.
- C. Packaging and Labeling:
 - 1. Furnish spare parts and extra materials in manufacturer’s unopened cartons, boxes, crates, or other original, protective covering suitable for preventing corrosion and deterioration for maximum length of storage normally anticipated by manufacturer.
 - 2. Packaging of spare parts and extra materials shall be clearly marked and identified with name of manufacturer, applicable equipment, part number, part description, and part location in the equipment.
 - 3. Protect and package spare parts and extra materials for maximum shelf life normally anticipated by manufacturer.
- D. Finishes: Spare parts and extra material shall have painting, protective coating, and finishes identical to original installed equipment and material. Where painting, protective coating, or finishes are not specified, suitable provisions shall be furnished to protect from corrosion.

- E. Special Tools: Contractor shall provide special tools necessary to operate, disassemble, service, repair, and adjust equipment and material in accordance with the manufacturer's operation and maintenance manual. Special tool requirements shall be the same as spare parts and extra material specified in this Section.
- F. Storage Prior to Delivery to Owner: Prior to furnishing spare parts and extra materials to Owner, store spare parts and extra materials in accordance with the Contract Documents and manufacturers' recommendations.
- G. Delivery Time and Eligibility for Payment:
 - 1. Deliver to Owner spare parts and extra materials prior to date of Substantial Completion for equipment or system associated with the spare parts and extra materials. Do not deliver spare parts and extra materials before commencing start-up for associated equipment or system.
 - 2. Spare parts and extra materials are not eligible for payment until delivered to Owner and Contractor's receipt of Owner's countersignature on letter of transmittal.
- H. Procedure for Delivery to Owner:
 - 1. Deliver spare parts and extra materials to Owner's permanent storage rooms at the Site or area(s) at the Site designated by Owner.
 - 2. When spare parts and extra materials are delivered, Engineer and Owner will mutually inventory the spare parts and extra materials delivered to verify compliance with the Contract Documents regarding quantity and part numbers.
 - 3. Additional procedures for delivering spare parts and extra materials to Owner, if required, will be developed by Engineer and complied with by Contractor.
- I. Transfer Documentation:
 - 1. Furnish on Contractor letterhead a letter of transmittal for spare parts and extra materials furnished under each Specification Section. Letter of transmittal shall accompany spare parts and extra materials. Do not furnish letter of transmittal separate from associated spare parts and extra materials.
 - 2. Furnish three original, identical, signed letters of transmittal for each Specification Section. Upon delivery of specified quantities and types of spare parts and extra materials to Owner, designated person from Owner will countersign each original letter of transmittal indicating Owner's receipt of spare parts and extra materials.
 - a. Owner will retain one fully signed original.
 - b. Contractor shall submit one fully signed original to Engineer.

- c. Contractor shall retain one fully signed original for Contractor's file.
- 3. Letter of transmittal shall include the following:
 - a. Information required for letters of transmittal in Section 01 33 00 – Submittal Procedures.
 - b. Transmittal shall list spare parts and extra materials furnished under each Specification Section. List each individual part or product and quantity furnished.
 - c. Provide space for countersignature by Owner as follows: space for signature, space for printed name, and date.
- J. Contractor shall be fully responsible for loss or damage to spare parts and extra materials until spare parts and extra materials are received by Owner.

1.02 SUBMITTALS

- A. Action/Informational Submittals: Individual Specification Sections that require spare parts, extra material, or tools, Contractor shall submit inventory checklist for each individual Specification Section that includes the following information:
 - 1. Specification Section number and title.
 - 2. Name of spare parts, extra material, or tools.
 - 3. Manufacturer, part number and description.
 - 4. Quantity specified and furnished.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

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SECTION 01 79 00
INSTRUCTION OF OWNER'S PERSONNEL

PART 1 – GENERAL

1.01 SUMMARY

- A. Contractor shall furnish services of operation and maintenance training specialists to instruct Owner's personnel in recommended operation and maintenance procedures for materials and equipment furnished, in accordance with the Contract Documents.
- B. Contractor shall provide a combination of classroom and field training at the Site, unless otherwise required elsewhere in the Contract Documents.
- C. Owner reserves the right to record training sessions on video for Owner's later use in instructing Owner's personnel.

1.02 ADMINISTRATIVE REQUIREMENTS

- A. Definitions:
 - 1. Training – Manufacturer will provide verbal, visual, and written presentation of materials to Owner's staff to ensure that any Owner personnel undergoing training understand the Manufacturer's recommended procedures to properly operate and maintain the equipment and systems for the expected service life.
- B. Qualifications:
 - 1. Contractor's instructors shall be factory-trained by manufacturer of material or equipment.
 - 2. Contractor's instructors shall be proficient and experienced in conducting training of type required.
 - 3. Qualifications of instructors are subject to acceptance by Engineer. If Engineer does not accept qualifications of proposed instructor, Contractor shall furnish services of replacement instructor with acceptable qualifications.
- C. Scheduling:
 - 1. General:
 - a. Contractor shall coordinate training services with start-up and initial operation of materials and equipment on days and times, and in manner, acceptable to Owner, in accordance with the Contract Documents.

- b. Training may be required outside of normal business hours to accommodate schedules of operations and maintenance personnel. Furnish training services at the required days and times at no additional cost to Owner.
 - c. Prerequisites to Training: Training of Owner's personnel shall commence after acceptable preliminary operation and maintenance data has been submitted and work required in Section 01 75 00 – Checkout and Startup Procedures is complete.
- 2. Training Schedule Submittal:
 - a. Training Schedule Required: Contractor shall prepare and submit proposed training schedule for review and acceptance by Engineer and Owner. Proposed training schedule shall show all training required in the Contract Documents, and shall demonstrate compliance with specified training requirements relative to number of hours of training, number of training sessions, and scheduling.
 - b. Timing of Training Schedule Submittal: Submit initial training schedule at least thirty days before scheduled start of first training session. Submit final training schedule, incorporating revisions in accordance with Engineer's comments, no later than seven days prior to starting the first training session.
 - c. Owner reserved the right to modify personnel availability for training in accordance with process or emergency needs at the Site.

D. Video Recording

- 1. Contractor shall provide a training specialist for a minimum of three (3) days, for each item of equipment specified, to meet with the Engineer to prepare training scripts and to participate in video recording of training. Video recorded training sessions shall be conducted separately from training sessions held for the Owner's personnel.
- 2. Manufacturer shall have the ownership rights to one unedited and one edited copy of the video recorded training.
- 3. As an alternative to video recording training at the Site, the Manufacturer may submit pre-recorded digital media covering the equipment supplied for approval. Submitted pre-recorded digital media shall meet the intent of this Section for approval consideration. If approved, Owner shall have the right to permanent ownership and use of at least one complete copy.

1.03 TRAINING REQUIREMENTS

A. General Lesson Plan Requirements:

1. Contractor's lesson plan shall describe specific instruction topics, system components for which training will be furnished, and training procedures. Handouts, if any, to be used in training shall be included with the lesson plan. Describe in lesson plan "hands-on" demonstrations planned for training sessions.
2. Lesson plan shall be approved a minimum of 30 days prior to starting associated training.
3. Lesson plan shall include estimated duration of each training segment.

B. Specific Lesson Plans Requirements:

1. Equipment overview shall cover the following:
 - a. Equipment's operating (process) function, performance objectives, and fundamental operating principles.
 - b. Equipment's mechanical, electrical, and electronic components and features. Group related components into subsystems and describe function of subsystem and subsystem's interaction with other subsystems.
 - c. Support equipment and appurtenances.
 - d. Safety and potential hazards.
 - e. Safety and control interlocks.
2. Operations personnel training shall cover the following:
 - a. Equipment overview: As described in this Section.
 - b. Operation:
 - 1) Principles, operating, start-up, and shutdown procedures.
 - 2) Abnormal or emergency start-up, operating, and shutdown procedures.
 - 3) Alarm conditions and responses.
 - 4) Monitoring and recordkeeping.
 - 5) Housekeeping.
 - c. Troubleshooting: Required corrective maintenance or an operating parameter adjustment.
3. Maintenance personnel training:
 - a. Equipment overview: As described in this Section.

b. Equipment preventive maintenance:

1) Inspection procedures:

- a) Operation.
- b) Trouble symptoms and anticipate breakdowns.
- c) Predictive maintenance.

2) Preventative maintenance intervals.

3) Lubricant and replacement parts.

4) Cleaning practices and intervals.

5) Special tools required.

6) Removal, installation, and disassembly and assembly procedures.

7) “Hands-on” demonstrations of preventive maintenance procedures.

8) Measuring instruments and procedures

9) Torqueing, mounting, calibrating, and aligning procedures and settings requirements.

10) Check and test equipment following corrective maintenance.

4. Equipment Troubleshooting:

- a. Systematic troubleshooting procedures.
- b. Checklists.
- c. Testing and diagnostic procedures.
- d. Corrective maintenance procedures with “hands on” demonstrations.

C. Training Aids:

1. Contractor’s instructor shall incorporate training aids as appropriate to assist in the instruction. Provide handouts of text, tables, graphs, and illustrations as required. Other appropriate training aids include:

- a. Audio-visual aids
- b. Equipment cutaways and samples
- c. Tools, including special tools

2. Podium presentation aids: Presentation shall cover equipment, products and materials provided. Provide electronic version of presentation material to Engineer.
 - a. Electronic version of presentation aids shall be Microsoft PowerPoint or equivalent format.
 - b. Presentation shall include the following sections:
 - 1) Complete system overview including, but not limited to, related and associated equipment specific to the system.
 - 2) Specific equipment requirements and how equipment functions within the overall system.
 - 3) Site specific system and equipment requirements.
 - c. Hardcopy handouts of the electronic presentation aids shall be provided prior to each training session for review during podium presentation.
3. Handouts:
 - a. Contractor's instructor shall distribute and use descriptive handouts during training.
 - b. Handouts should be coordinated with the instruction
 - c. Provide at least ten copies of handouts for each training session
4. Audio-visual Equipment: Training provider shall provide audio-visual equipment required for training sessions.

1.04 SUBMITTALS

A. Action/Informational Submittals:

1. Training Schedule: Detailed schedule of training sessions, demonstrating compliance with number of training sessions, hours required in the Contract Documents, and complying with the Contract Times. Submit training schedule submittals in accordance with timeframes specified in this Section.
2. Lesson Plan: Acceptable lesson plan for training on each material or equipment item, in accordance with the Contract Documents. Lesson plan shall comply with requirements of this Section. Include with lesson plan copy of handouts that will be used during training sessions. Provide lesson plan submittals in accordance with timeframes specified in this Section.
3. Podium presentation material, electronic version.

4. Qualifications: Credentials of Contractor's proposed operations and maintenance instructor(s). Credentials shall demonstrate compliance with requirements of this Section and shall include brief resume and specific details of instructor's operating, maintenance, and training experience relative to the specific material and equipment for which instructor will provide training.

B. Closeout Submittals:

1. Trainee sign-in sheet for each training session. Submit to Owner's training coordinator.

C. Quality Assurance Submittals:

1. Qualifications: Credentials of Contractor's proposed operations and maintenance instructor(s). Credentials shall demonstrate compliance with requirements of this Section and shall include brief resume' and specific details of instructor's operating, maintenance, and training experience relative to the specific material and equipment for which instructor will provide training.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.01 “HANDS-ON” DEMONSTRATIONS

- A. Contractor's instructor shall provide “hands-on” demonstration of operations and maintenance of equipment and materials for each training session.
- B. Contractor shall furnish tools and appurtenances required for demonstrations.

3.02 SCHEDULE

- A. Contractor shall furnish the hours of training and number of sessions indicated, at a minimum. Travel time and expenses are the responsibility of the manufacturer and are excluded from required training time indicated in the Contract Documents.
- B. Owner's operations at the Site occur 24 hours per day, divided into three shifts. Training shall be scheduled during day shift, normal working hours unless otherwise approved by Engineer.
- C. Training shall be provided for a minimum of two identical sessions, unless otherwise specified, with each session scheduled for different weeks.
- D. Contractor shall furnish training for the following systems and equipment, at a minimum. Training Schedule:

Spec. Section	Specification Title
40 05 57	Valve Operators and Electric Valve Actuators
Div 40	Instrumentation
46 33 44	Peristaltic Tube Metering Pumps

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SECTION 01 88 16
WATERTIGHTNESS TESTING OF CONCRETE STRUCTURES

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. All concrete work and sealing work around built-in items and penetrations shall be performed as required to ensure that groundwater, surface water, and water or liquids in tanks, channels, and containers will not intrude into any equipment rooms, pipe galleries, habitable areas, or other generally dry areas.
- B. The required watertightness shall be achieved by quality concrete construction and proper sealing of all joints and penetrations.
- C. Each unit shall be tested separately, and the leakage tests shall be made prior to backfilling and before equipment is installed. Testing water shall be from any potable, non-potable, or natural moving source such as a river or stream, but not from any still water source such as a lake or pond, and not from any wastewater source.
- D. All water holding structures shall be tested for leakage by the Contractor. The Contractor shall provide at their own expense all labor, material, temporary bulkheads, pumps, water measuring devices, etc., necessary to perform the required tests.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 01 45 23 – Testing Services Furnished by Contractor
- B. Section 03 01 30 – Concrete Repairs

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. ACI 350.1-10 - Specification for Tightness Testing of Environmental Engineering Concrete Structures

1.04 SUBMITTALS

- A. Testing procedures shall be submitted for approval prior to the test.
- B. Testing Report: Prior to placing the structure in service, submit for review and approval a detailed bound report summarizing the watertightness test data, describing the testing procedure, and showing the calculations confirming the test data.

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PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.01 TEST PREPARATION

- A. The design capability of the structure to withstand testing shall be verified for the pressures to be applied. Another type of test shall not be substituted for hydrostatic tightness testing without approval of the Engineer.
- B. The structure shall not be tested before all elements of the structure which resist any portion of the retained liquid pressure are in place and the concrete has attained its specified compressive strength.
- C. Unless otherwise specified, coatings shall not be applied until after the hydrostatic tightness testing is complete. Liners that are mechanically locked to the surface during the placement of the concrete shall be installed before the hydrostatic tightness testing. Interior liners shall be visually examined for deficiencies (pinholes, tears, and partially fused splices) and must pass integrity testing. Deficiencies shall be repaired.
- D. Clean the exposed concrete surfaces of the structure, including the floor, of all foreign material and debris. Prior to testing, standing water in or outside of the structure that would interfere with the inspection of the exposed concrete surfaces of the structure shall be removed.
- E. The concrete surfaces and concrete joints shall be thoroughly inspected for potential leakage points. Areas of potential leakage shall be repaired before filling the containment structure with water.
- F. All openings, fittings, and pipe penetrations in the structure shall be inspected at both faces of the concrete, if practical. Defective or cracked concrete shall be repaired prior to testing. All structural penetrations and inlet/outlets shall be securely sealed to prevent the loss of water from the structure during the test. All structural penetrations shall be monitored before and during the test to determine the watertightness of these appurtenances. If the structure will be filled using the inlet/outlet pipe, positive means shall be provided to check that water is not entering or leaving through this pipe once the structure is filled to the test level. Leakage at these inlet/outlets shall be repaired prior to testing. No allowance shall be made in test measurements for uncorrected known points of leakage.
- G. The flow from any underdrain system, if a system is provided, shall be monitored during this same period, and any increase in flow shall be recorded and considered for information as a part of the hydrostatic tightness testing.
- H. The ground water level shall be brought to a level below the top of the base slab and kept at that elevation or at a lower elevation during the test.

- I. No backfill shall be placed against the walls or on the wall footings of the structure to be tested unless otherwise specified.

3.02 PROCEDURE

- A. The initial filling of a new structure should not exceed a rate of 4 ft/hour. Filling shall be continued until the water surface is at the design maximum liquid level, or either 1 in. below any fixed overflow level in covered containment structures or 4 in. in open structures, whichever is lower.
- B. The exterior surfaces of the structure shall be inspected during the period of filling the structure. If any flow of water is observed from the structure exterior surfaces, including joints or cracks, the defect causing the leakage shall be repaired prior to testing.
- C. Watertightness Test - Part 1: Qualitative Criteria
 1. The water shall be kept at the test level for at least 3 days prior to Part 2 of the testing.
 2. The exterior surfaces of the structure shall be observed in both the early mornings and later afternoons during the 3-day period before Part 2 of the test. If any water is observed on the structure exterior surfaces, including joints, repaired honeycombed areas and cracks, where water droplets can be picked up on a dry hand, the containment structure shall be considered to have failed Part 1 of the test.
 3. Wet areas on top of wall footing shall not indicate a failure of Part 1 of the test unless the water can be observed to be flowing.
 4. Part 2 of the test may begin prior to completion of repairs for Part 1. However, all defects causing the failure of Part 1 shall be repaired before the structure is accepted. The 3-day period of keeping water at the test level shall be observed again after completion of all repairs and prior to acceptance of structure.
- D. Watertightness Test - Part 2: Quantitative Criteria
 1. The test measurements shall not be scheduled when the weather forecast predicts a difference of more than 35°F between the ambient temperature readings at the times of the initial and final level measurements of the water surface. The test shall also not be scheduled when the weather forecast indicates the water surface could be frozen before the test is completed.
 2. The vertical distance to the water surface shall be measured to within 1/16 in. from a fixed point on the structure above the water surface. Measurements shall be recorded at 24-hour intervals. Measurements taken at the same time of day will reduce the probability of temperature difference.

3. Measurements shall be taken at two locations, 180° apart, to minimize the possible effect of differential settlement. Measurements shall be taken at the same locations to reduce the probability of measurement differences.
4. The test period shall be at least the theoretical time required to lower the water surface 3/8 in. assuming a loss of water at 0.050% of the water volume per 24-hour period. The test period shall not be longer than five days.
5. The water temperature shall be recorded at a depth of 18 in. below the water surface at the start and end of the test.
6. A floating, restrained, partially filled, calibrated, open container for evaporation and precipitation measurement should be positioned in open structures and the water level in the container recorded at 24-hour intervals. Determination of evaporation by a shallow pan-type measuring device is not acceptable due to possible heating of the bottom of the shallow pan resulting in accelerated evaporation.

3.03 EVALUATION

- A. The containment structure shall continue to be observed in both the early mornings and late afternoons to verify compliance with Part 1 of the test during Part 2.
- B. At the end of the test period, the water surface shall be recorded to within 1/16-in at the location of original measurements. The water temperature and the evaporation and precipitation measurements shall be recorded.
- C. The allowable loss of water for tightness tests shall not exceed 0.050% of the test water volume in 24 hours.
- D. The change in water volume in the structure shall be calculated and corrected, if necessary, for evaporation, precipitation, and temperature based on the change recorded in the water level from the open container. If the loss exceeds the allowable loss, the structure shall be considered to have failed the test.
- E. During Part 2 of the test, observed flow or seepage of water from the exterior surface, including that from cracks and joints, should be considered as a failed test. Excessive wetness resulting in water droplets on dry hand after contact will also be considered a failed test. Slight dampness with only slight wetting of dry hand will not necessarily qualify as a failed test, depending on application, location, and visibility. Dampness or wetness on top of a footing shall not be considered as a failed test.

3.04 RETESTING

- A. A restart of the test shall be required when test measurements become unreliable due to unusual precipitation or other external factors.
- B. The Contractor shall be permitted to immediately retest when no visible leakage is exhibited. If the structure fails the second test or if the Contractor does not exercise the

option of immediately retesting after the first test failure, the interior of the structure shall be inspected by a diver or by other means to determine probable areas of leakage. The structure shall only be retested after the most probable areas of leakage are repaired.

- C. If the leakage exceeds the allowable limit, the work shall be corrected by methods approved by the Engineer.
- D. Upon completion of the necessary remedial work, the leakage test shall be repeated until it is successfully passed. A minimum of three days shall occur between completion of any repairs with water level remaining at required test level without further issues prior to structure being deemed as satisfying all requirements of testing.

3.05 NOTIFICATION BY ENGINEER

- A. If any leaks greater than the specified amount are not remedied by the Contractor within four (4) weeks of notification by the Engineer, regardless of whether the cause of these leaks is or is not determined, the Engineer shall have the authority to have these leaks repaired by others. The cost of repairs, by others, shall be deducted from monies due or to become due to the General Contractor.

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SECTION 02 41 00

DEMOLITION

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish all labor, materials, and equipment in accordance with the requirements of
 - 1. Section 02 41 16 – Removal of Filter Media.
- B. In addition, the Contractor shall demolish and remove all concrete and asphalt paving, curbs, sidewalk, and miscellaneous yard piping, utilities, and structures as required and shown on the Contract Drawings during the construction work.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Generation Conditions, Section 4.4 – Performance of Work
- B. General Conditions, Section 4.7 – Materials Quality, Substitutions, and Shop Drawings

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. References shall be in accordance with reference standards, codes, and specifications as set forth herein and in MAG Section 201 – Clearing and Grubbing.

1.04 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in Section 01 33 00 – Submittal Procedures, the Contractor shall submit the following:
 - 1. Copies of all photographs and other records from the joint existing conditions surveys.

PART 2 – EXECUTION

2.01 DEMOLITION

- A. Existing concrete and asphalt paving, curbs, sidewalk and miscellaneous yard piping, utilities, and structures within the areas designated for new construction work shall be completely demolished and all debris removed from the site.
- B. Excavation caused by demolition shall be backfilled with fill free from rubbish and debris.
- C. Work shall be performed in such manner as not to endanger the safety of the workmen or the public or cause damage to nearby structures.

- D. Provide all barriers and precautionary measures in accordance with Owner's requirements and other authorities having jurisdiction.
- E. Where parts of existing pavements or structures are to remain in service, demolish the portions to be removed, repair damage, and leave the pavement or structure in proper condition for the intended use. Remove asphalt or concrete pavement, concrete, and masonry by saw-cutting, drilling, chipping, or other suitable methods. Leave the resulting surfaces reasonably true and even, with sharp straight corners that will result in neat joints with new construction and be satisfactory for the purpose intended. Where existing reinforcing rods are to extend into new construction, remove the concrete so that the reinforcing is clean and undamaged. Cut off other reinforcing 1/2-inch below the surface and fill with epoxy resin binder flush with the surface.
- F. Prior to the execution of the work, the Contractor, Owner and Engineer shall jointly survey the condition of the adjoining and/or nearby pavements and structures. Photographs and records shall be made of any prior settlement or cracking of structures, pavements, and the like, that may become the subject of possible damage claims. Contractor shall provide Owner a copy of all records of the joint survey of conditions before demolition activities may begin. Contractor shall provide copies of the existing conditions survey report to the Owner and Engineer before any demolition or construction activities begin.

2.02 DISPOSAL OF MATERIAL

- A. All debris resulting from the demolition and removal work shall be disposed of by the Contractor at a properly permitted facility as part of the work of this Contract. Material designated by the Engineer to be salvaged shall be stored on the construction site as directed. All other material shall be disposed of off-site by the Contractor at his expense.
- B. Burning of any debris resulting from the demolition will not be permitted at the site.

PART 3 – EXECUTION

3.01 DEMOLITION

- A. General:
 - 1. Demolition Work shall comply with the applicable provisions and recommendation of ANSI A10.2, Safety Code for Building Construction, all governing codes, and as specified in this Section.
 - 2. Contractor shall furnish competent and experienced personnel for the various type of demolition and removal Work. Demolition and removal Work shall be performed with regard to the safety of Owner employees, individuals at the Site, and the public.

3. Contractor shall remove temporary work, such as enclosures, signs, guards, etc. when such temporary Work is no longer required or when directed at the completion of the Work.
4. Contractor shall perform patching, restoration and Work in accordance with individual Specification Sections and details shown on Contract drawings.
5. Contractor shall be responsible for damage caused by demolition Work to existing structures, equipment and materials indicated for reuse or to remain at no additional cost to Owner.
6. Contractor shall maintain a clean working environment during the demolition Work.

B. Protection during Demolition:

1. Contractor shall provide, erect, and maintain catch platforms, lights, barriers, weather protection, warning signs and other items as required for proper protection of the public, occupants of the building, personnel engaged in demolition Work, and adjacent construction.
2. Contractor shall provide and maintain weather protection at exterior openings so as to fully protect the interior premises against damage from the elements until such openings are closed by the Work.
3. Contractor shall provide and maintain temporary protection of the existing structure designated to remain where demolition, removal and Work is being done, connections made, materials handled or equipment moved.
4. Contractor shall take necessary precautions to prevent dust from rising by wetting demolished masonry, concrete, plaster and similar debris. Unaltered portions of the existing buildings affected by the operations in the Contract Documents shall be protected by dust proof partitions and other adequate means. Dust control shall be provided.
5. Contractor shall provide adequate fire protection in accordance with authorities having jurisdiction.
6. Contractor shall perform the demolition Work with minimum traffic interference. Contractor shall not close or obstruct walkways, passageways, or stairways. Contractor shall not store or place materials in passageways, stairs or other means of egress.
7. Contractor shall minimize disturbances to exterior walls and roofs to small sections that are readily repaired and patched to maintain watertight conditions in existing structures and buildings.

C. Maintenance during Demolition:

1. Contractor shall maintain the buildings, structures and public properties free from accumulations of waste, debris and rubbish, generated by the demolition Work.
2. Contractor shall provide cleaning and waste management of demolition equipment and materials.

3.02 CUTTING AND CORING

A. General:

1. Contractor shall notify Engineer in writing and receive Engineer's approval prior to cutting load bearing walls (concrete or masonry) and structural concrete floors.
2. Perform cutting and coring to limit extent of patching required.
3. Structural Elements: Do not cut or core structural elements in manner that would change structural element's load-carrying capacity as load deflection ratio.
4. Operating Elements: Do not cut or core operating elements in manner that would reduce capacity to perform as intended. Do not cut or core operating elements or related components in manner that would increase maintenance requirements or decrease operational life or safety.
5. Replace, patch, and repair materials and surfaces cut or damaged during cutting and coring Work, Contractor shall use methods that do not void required or existing warranties.
6. Provide temporary or permanent bypass provisions prior to cutting existing pipe, conduit, ductwork, or other utilities serving facilities scheduled to be removed or relocated in accordance with the Contract Documents.
7. Inspection: Examine and prepare surfaces prior to commencing Work. Contractor shall report unsatisfactory or questionable conditions to Engineer in writing. Contractor shall not proceed with the Work until unsatisfactory conditions are corrected.
8. Preparation:
 - a. Provide temporary support required to maintain structural integrity, to protect adjacent Work from damage, and to support the element(s) to be cut or cored.
 - b. Protection of Existing Construction During Cutting and Coring:
 - 1) Protect existing structures, equipment, and materials during cutting and coring to prevent damage.
 - 2) Provide protection from adverse weather conditions that will be exposed during cutting and coring Work.

- 3) Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.

9. Restoration:

- a. Clean equipment, materials, piping systems, valves, conduit and appurtenances that were damaged due to the Work prior to applying paint or other finishing materials.
- b. Restore damaged pipe coverings, including insulation, to original condition.

Coring:

10. Core-drill holes through concrete and masonry walls, slabs, or arches, in accordance with the Contract Documents, unless written authorization is furnished by Engineer.
11. Protection: Protect existing structures, equipment, materials, utilities, and adjacent areas from water and other damage by core-drilling Work.
12. Coring:
 - a. Perform coring with non-impact rotary tool using diamond core-drills.
 - b. Size holes for pipe, conduit, sleeves, equipment or mechanical seals, as required, to be installed through the penetration and in accordance with the Contract Documents.
 - c. After core-drilling and before installing equipment and material through the penetration, trim back exposed steel then coat exposed concrete and steel with protective coating material specified in this Section. Apply protective coating in accordance with manufacturer's instructions.
13. Cleaning: Vacuum or otherwise remove slurry and tailings from the work area following core-drilling.

3.03 PATCHING

A. General:

1. Construction shall be patched by filling, repairing, refinishing, closing-up, and similar methods at completion of the Work.
2. Provide equipment and materials in accordance with the Contract Documents for patching Work. Comply with manufacturer's installation instructions.
3. Provide airtight connections to pipes, sleeves, ducts, conduit, and other penetrations through surfaces when patching the Work. Provide durable patching seams that minimize visual appearance.

4. Patched areas shall be tested to demonstrate integrity of installation as directed by the Engineer. Contractor shall provide testing equipment, material and services for patch testing.

B. Restoration:

1. Restore exposed finishes of patched areas to minimize evidence of patching and refinishing.
2. Contractor shall extend refinishing and restoration into adjoining areas to blend patched areas with existing adjacent areas.
 - a. Refinish to nearest intersection for continuous surfaces.
 - b. Refinish the entire assembly and system for equipment and materials.
 - c. Repair and rehang existing ceilings to provide an even-plane surface of uniform appearance.
 - d. Apply plaster and finishes to match adjacent interior walls and partition areas for openings sealed with brick and/or masonry block.

3.04 DISPOSAL OF MATERIAL

- A. All debris resulting from the demolition and removal work shall be disposed of by the Contractor as part of the work of this Contract. Material designated by the Engineer to be salvaged shall be stored on the construction site as directed. All other material shall be disposed of off-site by the Contractor at his expense.
- B. Burning of any debris resulting from the demolition will not be permitted at the site.

END OF SECTION

SECTION 02 41 16
REMOVAL OF FILTER MEDIA

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. This Section covers the demolition, removal, and disposal of filter media as indicated on the Drawings and as specified hereinafter. The Contractor shall furnish all labor, materials, and equipment to perform this work.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 01 14 00 - Coordination with Owner's Operations
- B. Section 01 42 00 - References
- C. Section 02 41 00 - Demolition

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.01 DEMOLITION AND REMOVALS

- A. The removal of the materials shall be done by the Contractor, and shall become the Contractor's property, for disposition in any manner not contrary to the Contract requirements and shall be removed from the site to the Contractor's own place of disposal.
- B. The Contractor shall proceed with the removal of the material/media in a sequence designed to maintain the plant in continuous operation as directed by City of Chandler Operations and shall proceed only after approval of the Engineer.
- C. Any equipment piping and appurtenances removed without proper authorization, which are necessary for the operation of the existing facilities shall be replaced to the satisfaction of the Engineer at no cost to the Owner.
- D. Prior to the execution of the work, the Contractor, Owner and Engineer shall jointly survey the condition of the adjoining and/or nearby structures. Photographs and records shall be made of any cracking of structures, that may become the subject of possible damage claims.

3.02 PROTECTION

- A. Demolition and removal work shall be performed by competent experienced workmen for the various type of demolition and removal work and shall be carried out through to completion with due regard to the safety of Owner employees, workmen on-site and the public. The work shall be performed with as little nuisance as possible.
- B. The work shall comply with the applicable provisions and recommendation of OSHA all governing codes, and as hereinafter specified.

3.03 EQUIPMENT AND MATERIALS RETAINED BY OWNER

- A. All debris resulting from the demolition and removal work shall be disposed of by the Contractor as part of the work of this Contract. Material designated by the Engineer to be salvaged shall be stored on the construction site as directed. All other material shall be disposed of off-site by the Contractor at his expense.

END OF SECTION

SECTION 03 01 30
CONCRETE REPAIRS

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish all materials, labor, equipment, tools, etc., required for the pH testing, repair, renovation, and replacement of concrete and/or reinforcing steel as indicated on the Drawings, specified herein, and determined by field survey.
- B. The Contractor, in conjunction with the Engineer, shall determine the extent of cracked or deteriorated concrete to be rehabilitated and/or resurfaced. A summary of the work to be performed shall be submitted to the Engineer for review, and such summary shall be approved by the Engineer prior to commencement of the Work. The extent of damaged concrete material to be removed prior to installation of repair material shall be determined by parent material soundness as well as surface pH levels. Prepared surfaces to receive repair materials or coatings shall have a minimum surface pH level of 11. Removal of materials shall continue until the exposed surface pH level is 11 or higher.
- C. Concrete repairs include the following:
 - 1. Leaking crack repair and leaking base of wall joints at the existing media filter basins.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Division 01 – General Requirements
- B. Section 01 20 00 – Measurement and Payment
- C. Division 03 – Concrete

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Shall be as specified in Section 01 42 00 – References.
- B. ICRI CSP – International Concrete Repair Institute Concrete Surface Profile.

1.04 SUBCONTRACTOR/APPLICATOR QUALIFICATIONS

- A. The Contractor shall furnish the name of all subcontractors/applicators which they proposes to use for this work, including necessary evidence and/or experience records to ascertain their qualifications in the application of epoxy, urethane, and polymer-modified and silica fume enhanced repair materials.

- B. Approved applicator qualifications shall include a minimum of 5 years of experience in applying epoxy, urethane, and polymer-modified and silica fume enhanced cement-based repair materials like those materials specified in this Section.
- C. A letter from the manufacturer of the specified materials, on the manufacturer's letterhead, signed by an officer of the company, stating that the subcontractor/applicator has been trained in the proper techniques for applying the product, including surface preparation and mixing, placing, curing, and caring for the manufacturer's products shall be submitted. This letter shall further state that the subcontractor/applicator is on the manufacturer's approved list of contractors.

1.05 SUBMITTALS

- A. Material certifications and technical data sheets on all grouts, mortars, epoxy resins, aggregates and repair products specified in this Section.
- B. Subcontractor/Applicator qualifications as specified in Section 1.04.
- C. Shop Drawings detailing any planned deviation from the proposed construction sequence and/or method of repair.
- D. The Contractor, based on their experience in their profession, and/or recommendation from product manufacturers, may submit to the Engineer for approval, alternative materials and/or methods of work to assure the durability and watertight integrity of the repair work performed.
- E. Detailed repair procedures for each repair type.
- F. Letter from repair material manufacturer(s) certifying that all repair materials to be used to create single repairs are compatible for use together

1.06 ADDITIONAL GUARANTEE

- A. The Contractor shall guarantee all repair work performed under this Contract against defects in workmanship resulting in leakage and/or failure of concrete bond for a period of three (3) years from the date of the Certificate of Substantial Completion.

PART 2 – MATERIALS

2.01 GENERAL

- A. All concrete repair materials shall conform to NSF Standards for contact with potable water supplies.
- B. All concrete repair materials, when used in combination to create a single repair, shall be compatible.

2.02 WATER

- A. The water used for mixing concrete repair products shall be clear, potable, and free of deleterious substances.

2.03 AGGREGATE

- A. All aggregate shall conform to ASTM C-33. The aggregate supplier shall submit to the Engineer documentation that the proposed aggregates comply with ASTM C-33 and the requirements listed below:
- B. Pea Gravel - Pea gravel shall meet the gradation and material requirements of Standard Size 14 as defined by ASTM C-33. Pea gravel shall be clean and free from deleterious matter and shall contain no limestone.

2.04 EPOXY BONDING AGENT

- A. Epoxy bonding agent shall conform to ASTM C-881 Type I, II, IV or V; Grade 2 for epoxy resin adhesives, depending on the application. The class of epoxy bonding agent shall be suitable for all ambient and substrate temperatures. The epoxy resin shall be "Sikadur Hi-Mod Series" as manufactured by the Sika Corp, Lyndhurst, NJ, "Duralbond" as manufactured by Euclid Chemical Company, Cleveland, OH, "Euco #452 Series" by the Euclid Chemical Company, or "MasterEmaco ADH series" by Master Builders Solutions.

2.05 ANTI-CORROSION REBAR COATING

- A. Anti-corrosive coating shall be a polymer-modified cementitious material such as "Sika Armatec 110 EpoCem " manufactured by Sika Corp., Lyndhurst, NJ, Atlanta, GA, "Duralprep A.C." by the Euclid Chemical Company, or "MasterEmaco P 124" by Master Builders Solutions.

2.06 TYPE I CRACK REPAIR - CEMENTITIOUS SURFACE SEAL

- A. Type I Crack Repair - Cementitious Surface Seal shall be a polymer-modified or silica fume enhanced trowel grade cementitious mortar and shall conform to EPA/USPHS standards for surface contact with potable water supplies. Type I Crack Repair material shall be "Sikatop 123 Plus" manufactured by Sika Corp., Lyndhurst, NJ, "Verticoat" or "Verticoat Supreme" by Euclid Chemical Company; or "Emaco S88 CI" or by Master Builders Solutions.

2.07 TYPE II CRACK REPAIR – EPOXY INJECTION CRACK REPAIR

- A. Type II Crack Repair – Epoxy Injection Crack Repair shall be a 100% solids, high-modulus, low viscosity, moisture insensitive epoxy adhesive designed for structural repair. The epoxy adhesive shall be "Sikadur 52" manufactured by Sika Corp., Lyndhurst, NJ, "Dural 452 LV" manufactured by Euclid Chemical Company, Cleveland,

OH, "Eucopoxy Injection Resin" by the Euclid Chemical Company, or "MasterInject 1500" by Master Builders Solutions.

2.08 TYPE III CRACK REPAIR - WATERPROOF INJECTION GROUT

- A. Type III Crack Repair - Waterproof Injection Grout shall be a one-component, water-activated, extra-low viscosity polyurethane or methacrylic acrylate hydrophobic injection grout capable of 400% expansion. Injection grout shall form a tough rigid foam seal that is impenetrable to water. Hydrophilic injection grout shall be "MasterInject 1210" manufactured by Master Builders Solutions, "Prime Flex 900 XLV" manufactured by Prime Resins, Conyers, GA, "AV-330 Safeguard" manufactured by Avanti International, Webster, TX, or "DeNeef Sealfoam PURE" or "Gelacryl Superflex" manufactured by Grace Construction Products/GCP Applied Technologies or "SikaFix HH Hydrophilic" manufactured by Sika Corp., Lyndhurst, NJ. Hydrophobic injection grout shall be "MasterInject 1230" manufactured by Master Builders Solutions, "Prime Flex 940" manufactured by Prime Resins, Conyers, GA, "Sikafix HHLV" or "Sikafix HH+" manufactured by Sika Corp., Lyndhurst, NJ, "AV-248-LV Flexseal LV" manufactured by Avanti International, Webster, TX, or "DeNeef Flex SLV one or PURE" manufactured by Grace Construction Products.

2.09 SPALL REPAIR PATCHING MATERIAL

- A. All spall repairs not requiring formwork shall be repaired using a polymer-modified cementitious mortar and shall have a minimum 28-day compressive strength of 7,000 psi. Spall repair mortar for use in horizontal applications shall be "Sikatop 122 Plus" manufactured by Sika Corp., Lyndhurst, NJ, "Eucocrete Supreme" or "Duraltop Flowable Mortar" by the Euclid Chemical Company, or "MasterEmaco T-302" or "MasterEmaco T310CI" by Master Builders Solutions. Spall repair mortar for use in vertical and overhead applications shall be "Sikatop 123 Plus" manufactured by Sika Corp., Lyndhurst, NJ, "Verticoat or Verticoat Supreme" by the Euclid Chemical Company, or "MasterEmaco N 425" or "MasterEmaco N 400" by Master Builders Solutions.
- B. All spall repairs requiring formwork shall be repaired using a polymer-modified cementitious mortar/pea gravel mixture and shall have a minimum 28-day compressive strength of 7,000 psi. Spall repair mortar shall be "SikaTop 111 PLUS" manufactured by Sika Corp., Lyndhurst, NJ, "Eucocrete Supreme" manufactured by Euclid Chemical Company, Cleveland, OH, or "MasterEmaco T 310 CI" by Master Builders Solutions.
- C. All spall repair materials shall conform to EPA/USPHS standards for surface contact with potable water supplies.

2.10 WATERSTOP REPAIR SYSTEM

- A. Waterstop repair system shall be a flexible rubber sealing strip secured to the concrete substrate with an epoxy adhesive. System shall be provided by a single manufacturer, installed per manufacturer's recommendations and shall be "Sikadur Combiflex" manufactured by Sika Corp., Lyndhurst, NJ or Engineer approved equal. Minimum width

of waterproof membrane patch shall be twelve (12) inches unless shown otherwise on Contract Drawings.

2.11 STORAGE OF MATERIALS

- A. The Contractor shall provide an area for repair material storage free from exposure to moisture in any form, before, during, and after delivery to the site. Manufactured materials shall be delivered in unbroken containers labeled with the manufacturer's name and product type. All mortar products shall be stored on raised platforms. Materials susceptible to damage by freezing shall be stored in a dry, heated, insulated area. Any material that has hardened, partially set, become caked and/or has been contaminated or deteriorated shall be rejected. All aggregates shall be stored in clean bins, scows or platforms.

PART 3 – INSTALLATION

3.01 GENERAL REQUIREMENTS

- A. No repair work shall be undertaken when ambient temperatures are below manufacturer's safe recommendations. No admixtures, except those required by the manufacturer, shall be used in the repairs specified herein.
- B. All products shall be applied in strict accordance with manufacturer's recommendations. The Contractor shall furnish and install safe scaffolding and ladders for the Engineer's prework inspection, the repair work activities, and the Engineer's final inspection.
- C. Sandblast or waterblast (3000-5000 psi waterjet) or use low impact hand chipping tools to clean deteriorated areas to remove all loose concrete, existing coatings, unsound material, debris, and laitance. All surfaces shall be clean, free of dirt, grease, loose particles, and deleterious substances and shall be prepared according to manufacturer's requirements.

3.02 EPOXY BONDING AGENT

- A. An epoxy bonding agent shall be used when applying fresh concrete to previously placed concrete unless otherwise recommended by the manufacturer.
- B. Existing concrete surfaces shall be roughened (1/16" or CSP 5 minimum profile) unless otherwise recommended by the manufacturer prior to application of bonding agent. Concrete surface shall be clean and sound, free of all foreign particles and laitance. Repair material shall be placed while bonding agent is still tacky. If bonding agent cures prior to placement of repair material, bonding agent shall be reapplied.
- C. Repairing concrete with epoxy mortars shall conform to all the requirements of ACI 503.4 "Standard Specification for Repairing Concrete with Epoxy Mortars" (latest edition), except as modified herein.

3.03 ANTI-CORROSION REBAR COATING

- A. Reinforcing steel cut or exposed during demolition and/or repair operations shall be sandblasted and cleaned prior to coating with an anti-corrosive coating. Anti-corrosive coating shall be applied as soon as the reinforcement is exposed and cleaned. Coating shall thoroughly cover all exposed parts of the steel and shall be applied according to manufacturer's recommendations.

3.04 TYPE I CRACK REPAIR – CEMENTITIOUS SURFACE SEAL

- A. Where indicated on the Drawings, or as directed by the Engineer, existing nonstructural cracks 1/16" and wider in vertical and overhead surfaces or existing cracks between 1/16" and 1/4" wide in horizontal surfaces shall be repaired with Type I Crack Repair Material. Rout crack to 3/4" wide by 3/4" deep V-notch to expose sound concrete. Provide a 3/8" high vertical shoulder at the top of notch on each side. Where rebar has deteriorated, or where deteriorated concrete extends below the top of rebar, crack shall be routed to expose 3/4" all around rebar. The resulting void in concrete shall be patched flush with the existing concrete surface using Type I Crack Repair material.

3.05 TYPE II CRACK REPAIR – EPOXY INJECTION

- A. Vertical and Overhead Surfaces
 - 1. Where indicated on the Drawings, or as directed by the Engineer, existing structural cracks 1/4" wide or narrower shall be repaired by pressure injecting Type II Crack Repair material into the prepared crack. Seal crack surface using epoxy resin binder and install injection ports per manufacturer's recommendations. Holes drilled for injection ports shall not cut rebar. If rebar is encountered during drilling, the hole shall be abandoned and relocated, and the abandoned hole shall be patched immediately with non-shrink grout flush with the surface of the existing concrete. Once the surface sealing material has fully cured, inject crack with Type II Crack Repair material using standard pressure injection equipment as directed by the manufacturer.
- B. Horizontal Surfaces
 - 1. Where indicated on the Drawings, or as directed by the Engineer, existing structural cracks 1/4" wide or narrower shall be repaired using Type II Crack Repair by pressure injecting Type II Crack Repair material into the prepared crack. Seal crack surface using epoxy resin binder and install injection ports per manufacturer's recommendations. Holes drilled for injection ports shall not cut rebar. If rebar is encountered during drilling, the hole shall be abandoned and relocated, and the abandoned hole shall be patched immediately with non-shrink grout flush with the surface of the existing concrete. Once the surface sealing material has fully cured, inject crack with Type II Crack Repair material using standard pressure injection equipment as directed by the manufacturer.

2. Where indicated on the Drawings, or as directed by the Engineer, existing structural cracks wider than 1/4" shall be repaired by gravity feeding Type II Crack Repair material into the prepared crack. First rout the concrete surface to form a 1/4" wide by 1/4" deep v-notch and clean the crack to remove all loose and foreign particles. Fill the crack with clean, dry sand and then pour structural crack repair binder into V-notch, completely filling crack. As binder penetrates crack, additional binder shall be applied to the V-notch.

3.06 TYPE III CRACK REPAIR – WATERPROOF INJECTION GROUT

- A. Existing, leaking cracks 1/4" or smaller, identified as nonstructural by the Engineer, shall be repaired by pressure injecting a Type III Crack Repair material into the prepared crack. Seal crack surface with epoxy binder and install injection ports per manufacturer's recommendations. Holes drilled for injection ports shall not cut rebar. If rebar is encountered during drilling, the hole shall be abandoned and relocated, and the abandoned hole shall be patched immediately with non-shrink grout flush with the surface of the existing concrete. Once the surface sealing material has cured, clean, potable water shall be injected into the ports to flush the crack and provide the water necessary for chemical reaction of the grout. Immediately following injection of water, inject the crack with Type III Crack Repair material using standard pressure injection equipment as directed by the manufacturer.
- B. All existing, leaking cracks larger than 1/4", not identified as structural by the Engineer, shall be repaired by first soaking oakum rope or open cell backer rod in waterproof injection grout, and then tightly packing the soaked oakum into the crack so as to completely fill the crack.

3.07 SPALL REPAIR PATCHING MATERIAL

- A. All voids or spalled areas to be repaired shall be chipped back to sound concrete a minimum 1/8" deep, with a minimum surface profile of CSP-5, cleaned and repaired with spall repair patching material according to manufacturer's recommendations. All patching shall provide a final finished surface which is flat, level and even with the existing concrete surface. Repair mortar shall not be feathered to meet existing concrete surface. Prior to commencing repair surface preparation, saw cut or grind a 1/2" deep groove around the perimeter around the repair area, perpendicular to the finished concrete surface to provide a square shoulder to the repair area. Repair areas shall be formed using clean, straight rectangular edges where possible. Final patching on horizontal surfaces shall receive a broom finish consistent with the finish on the existing structure.

3.08 EXPANSION JOINT REPAIR SYSTEM

- A. Thoroughly clean the concrete substrate and apply Expansion Joint Repair System according to the manufacturer's recommendations.

3.09 CURING

- A. All repair products shall be cured in strict accordance with manufacturer recommendations. Wet curing is preferred where possible.

3.10 WORK IN CONFINED SPACES

- A. The Contractor shall provide and maintain safe working conditions for all employees and subcontractors. Fresh air shall be supplied continuously to confined spaces through the combined use of existing openings, forced-draft fans and temporary ducts to the outside, or by direct air supply to individual workers. Fumes shall be exhausted to the outside from the lowest level of the confined space. Electrical fan motors shall be explosion-proof if in contact with fumes. No smoking or open fires shall be permitted in or near areas where volatile fumes may accumulate.

END OF SECTION

SECTION 03 60 00

GROUT

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. Furnish all materials, labor, and equipment required to provide all grout used in concrete work and as bearing surfaces for base plates, and as grout repair for filter underdrains, in accordance with the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Requirements of related work are included in Division 01 and Division 02 of these Specifications.

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.
 - 1. CRD-C 621 – Corps of Engineers Specification for Non-shrink Grout
 - 2. ASTM C 33 – Standard Specification for Concrete Aggregates
 - 3. ASTM C 109 – Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2 inch or 50 mm cube Specimens)
 - 4. ASTM C 531 – Standard Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts and Monolithic surfacing's
 - 5. ASTM C 579 – Test Method for Compressive Strength of Chemical-Resistant Mortars and Monolithic Surfacing's
 - 6. ASTM C 827 – Standard Test Method for Early Volume Change of Cementitious Mixtures
 - 7. ASTM C 1107 – Standard Specification for Packaged Dry, Hydraulic Cement Grout (Nonshrink)

1.04 SUBMITTALS

- A. Submit the following in accordance with Section 01 33 00 – Submittal Procedures.

1. Certified test results verifying the compressive strength and shrinkage and expansion requirements specified herein.
2. Manufacturer's literature containing instructions and recommendations on the mixing, handling, placement, and appropriate uses for each type of grout used in the work.

1.05 QUALITY ASSURANCE

A. Field Tests

1. Compression test specimens will be taken during construction from the first placement of each type of grout and at intervals thereafter as selected by the Engineer to ensure continued compliance with these Specifications. The specimens will be made by the Engineer or its representative.
 - a. Compression tests and fabrication of specimens for cement grout and non-shrink grout will be performed as specified in ASTM C 109 at intervals during construction as selected by the Engineer. A set of three specimens will be made for testing at seven days, 28 days, and any additional times as appropriate.
 - b. Compression tests and fabrication of specimens for epoxy grout will be performed as specified in ASTM C 579, Method B, at intervals during construction as selected by the Engineer. A set of three specimens will be made for testing at seven days and any other time as appropriate.
2. The cost of all laboratory tests on grout will be borne by the Owner, but the Contractor shall assist the Engineer in obtaining specimens for testing. The Contractor shall be charged for the cost of any additional tests and investigation on work performed which does not meet the specifications. The Contractor shall supply all materials necessary for fabricating the test specimens, at no additional cost to the Owner.
3. All grout, already placed, which fails to meet the requirements of these Specifications, is subject to removal and replacement at no additional cost to the Owner.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Cement Grout

1. Cement grout shall be composed of Portland Cement conforming to ASTM C150, Type II for general use, and sand in the proportion specified in the Contract Documents and the minimum amount of water necessary to obtain the desired

consistency. Cement-sand ratio by weight shall be 1:2, i.e., two portions of sand by weight shall be used for one portion of cement by weight. Cement grout shall conform to NSF 61 requirements.

2. The minimum compressive strength at 28 days shall be 4000 psi.
3. For beds thicker than 1-1/2 inch and/or where free passage of grout will not be obstructed by coarse aggregate, 1-1/2 parts of coarse aggregate having a top size of 3/8 inch should be added. This stipulation does not apply for grout being swept in by a mechanism. These applications shall use a plain cement grout without coarse aggregate regardless of bed thickness.
4. Sand shall be cleaned and washed masonry sand per ASTM C144. When tested in accordance with ASTM C144, 100% of sand particles shall pass No. 4 Sieve (4.75mm) and not more than 4% of sand particles shall pass No. 200 Sieve (0.075mm).

B. Non-Shrink Grout

1. Non-shrink grout shall conform to CRD-C 621 and ASTM C 1107, Grade B or C when tested at a max. fluid consistency of 30 seconds per CDC 611/ASTM C939 at temperature extremes of 45°F and 90°F and an extended working time of 15 minutes. Grout shall have a min. 28-day strength of 7,000 psi. Non-shrink grout shall be, "Euco N-S" by the Euclid Chemical Company, "SikagROUT 212" by Sika Corporation, "Conspec 100 Non-Shrink Non-Metallic Grout" by Conspec, "MasterFlow 928" by Master Builders Solutions.

C. Epoxy Grout

1. Epoxy grout shall be "Sikadur 32 Hi-Mod" by Sika Corporation, "Duralcrete LV" by Tamms Industries, or "Euco #452 Series" by Euclid Chemical, "MasterEmaco ADH 1090 RS" by Master Builders Solutions.
2. Epoxy grout shall be modified as required for each application with aggregate per manufacturer's instructions.

2.02 CURING MATERIALS

- A. Curing materials shall be as specified in Section 03 39 00 – Concrete Curing for cement grout and as recommended by the manufacturer for prepackaged grouts.

PART 3 – EXECUTION

3.01 GENERAL

- A. The different types of grout shall be used for the applications stated below unless noted otherwise in the Contract Documents. Where grout is called for in the Contract

Documents which does not fall under any of the applications stated below, non-shrink grout shall be used unless another type is specifically referenced.

1. Cement grout shall be used for grout toppings and for patching of fresh concrete.
 2. Non-shrink grout shall be used for grouting beneath base plates of structural metal framing.
 3. Epoxy grout shall be used for bonding new concrete to hardened concrete.
- B. New concrete surfaces to receive cement grout shall be as specified in Section 03 35 00 – Concrete Finishes, and shall be cleaned of all dirt, grease, and oil-like films. Existing concrete surfaces shall likewise be cleaned of all similar contamination and debris, including chipping, or roughening the surface if a laitance or poor concrete is evident. The finish of the grout surface shall match that of the adjacent concrete. Curing and protection of cement grout shall be as specified in Section 03 39 00 – Concrete Curing.
- C. All mixing, surface preparation, handling, placing, consolidation, and other means of execution for prepackaged grouts shall be done according to the instructions and recommendations of the manufacturer.
- D. The Contractor, through the manufacturer of a non-shrink grout and epoxy grout, shall provide on-site technical assistance upon request, at no additional cost to the Owner.

3.02 CONSISTENCY

- A. The consistency of grouts shall be that necessary to completely fill the space to be grouted for the application. Dry pack consistency is such that the grout is plastic and moldable but will not flow.

3.03 MEASUREMENT OF INGREDIENTS

- A. Measurements for cement grout shall be made accurately by volume using containers. Shovel measurement shall not be allowed.
- B. Prepackaged grouts shall have ingredients measured by means recommended by the manufacturer.

3.04 GROUT INSTALLATION

- A. Grout shall be placed quickly and continuously, shall completely fill the space to be grouted and be thoroughly compacted and free of air pockets. The grout may be poured in place, pressure grouted by gravity, or pumped. The use of pneumatic pressure or dry-packed grouting requires approval of the Engineer. For grouting beneath base plates, grout shall be placed from one side only and allowed to flow across to the open side to avoid air-entrapment.

END OF SECTION

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SECTION 05 05 23
METAL FASTENING

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. Furnish all materials, labor, and equipment required to provide all metal welds and fasteners not otherwise specified, in accordance with the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 05 10 00 – Metal Materials
- B. Section 05 13 00 – Stainless Steel
- C. Section 05 12 00 – Structural Steel

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.
 - 1. International Building Code
 - 2. AC 193 – Acceptance Criteria for Mechanical Anchors in Concrete Elements
 - 3. AC 308 – Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements
 - 4. ACI 318 – Building Code Requirements for Structural Concrete
 - 5. ACI 355.2 – Qualifications of Post-Installed Mechanical Anchors in Concrete
 - 6. ACI 355.4 – Qualifications of Post-Installed Adhesive Anchors in Concrete
 - 7. AISC – RCSC Specification for Structural Joints Using High Strength Bolts
 - 8. AISC – Code of Standard Practice
 - 9. AWS D1.1 – Structural Welding Code – Steel
 - 10. AWS D1.2 – Structural Welding Code – Aluminum

11. AWS D1.6 – Structural Welding Code – Stainless Steel
12. Aluminum Association – Specifications for Aluminum Structures
13. ASTM A572/A572M-94C – Standard Specification for High Strength Low-Alloy Columbium-Vanadium Structural Steel Grade 50
14. ASTM A36 – Standard Specification for Carbon Structural Steel
15. ASTM A489 – Standard Specification for Eyebolts
16. ASTM A563 – Standard Specifications for Carbon and Alloy Steel Nuts
17. ASTM D1785 – Standard Specification for Polyvinyl Chloride (PVC) Plastic Pipe
18. ASTM E3121 – Standard Test Methods for Field Testing of Anchors in Concrete or Masonry
19. ASTM F436 – Standard Specification for Hardened Steel Washers
20. ASTM F467 – Standard Specification for Nonferrous Nuts for General Use
21. ASTM F593 – Standard Specification for Stainless Steel Bolts; Hex Cap Screws, and Studs
22. ASTM F594 – Standard Specification for Stainless Steel Nuts
23. ASTM F1554 – Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength
24. ASTM F3125 – Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi and 150 ksi Minimum Tensile Strength, Inch and Metric Dimension

1.04 SUBMITTALS

- A. Submit the following in accordance with Section 01 33 00 – Submittal Procedures.
 1. Shop Drawings providing the fastener's manufacturer and type and certification of the fastener's material and capacity.
 2. Anchor design calculations sealed by a Professional Engineer currently registered in the State of Arizona. Only required if design not shown on Contract Drawings.
 3. A current Evaluation Report shall be submitted for all anchors that will be considered for use on this project.
 4. Manufacturer's installation instructions.

5. Copy of valid certification for each person who is to perform field welding.
6. Certified weld inspection reports, when required.
7. Welding procedures.
8. Installer qualifications.
9. Certification of Installer Training.
10. Inspection Reports.
11. Results of Anchor Proof Testing.
12. Manufacturer's Literature for Resistance of Adhesive to Appropriate Chemical Exposure, where deemed necessary.

1.05 QUALITY ASSURANCE

- A. Fasteners not manufactured in the United States shall be tested and certification provided with respect to specified quality and strength standards. Certifications of origin shall be submitted for all U.S. fasteners supplied on the project.
- B. Evaluation Report: A current Evaluation Report from an independent testing and evaluation agency (ITEA) shall be submitted for all anchors that will be used on this project. The ITEA producing the evaluation report shall be accredited in accordance with the requirements for ITEA's in ACI 355.2 (mechanical anchors) or 355.4 (adhesive anchors). Acceptable ITEA's include but are not necessarily limited to the International Code Council Evaluation Service (ICC-ES) and the International Association of Plumbing and Mechanical Officials Uniform Evaluation Service (IAPMO-UES).
- C. Installer Qualifications: All concrete anchors shall be installed by an Installer with at least three years of experience performing similar installations. Concrete adhesive anchor installers for anchor installations shall be certified as an Adhesive Anchor Installer in accordance with ACI-CRSI Adhesive Anchor Installation Certification Program.
- D. Installer Training: For concrete anchors, conduct a thorough training with the manufacturer or the manufacturer's representative for the Installer on the project. Training shall consist of a review of the complete installation process to include but not be limited to the following:
 1. Hole drilling procedure.
 2. Hole preparation and cleaning technique.
 3. Adhesive injection technique and dispenser training/maintenance.
 4. Concrete adhesive anchor preparation and installation.

5. Proof loading/torquing.
 6. Provide a list of names of all installers who are trained by the Manufacturer's Field Representative on this jobsite prior to installation of products. Record must include the installer name, date of training, products included in the training and trainer name and contact information.
 7. Provide a copy of the current ACI/CRSI "Adhesive Anchor Installer" certification cards for all installers.
- E. All steel welding shall be performed by welders certified in accordance with AWS D1.1. All aluminum welding shall be performed by welders certified in accordance with AWS D1.2. All stainless-steel welding shall be performed by welders certified in accordance with AWS D1.6. Certifications of field welders shall be submitted prior to performing any field welds.
- F. Welds and high strength bolts used in connections of structural steel will be visually inspected in accordance with Article 3.04.
- G. The Owner may engage an independent testing agency to perform testing of welded connections and to prepare test reports in accordance with AWS. Inadequate welds shall be corrected or redone and retested to the satisfaction of the Engineer and/or an acceptable independent testing laboratory, at no additional cost to the Owner.
- H. Provide a welding procedure for each type and thickness of weld. For welds that are not prequalified, include a Performance Qualification Report. The welding procedure shall be given to each welder performing the weld. The welding procedure shall follow the format in Annex E of AWS D1.1 with relevant information presented.
- I. Special inspections for concrete adhesive anchors shall be conducted in accordance with the requirements of the ESR published by the manufacturer. Downward installations require periodic inspection and horizontal and overhead installations require continuous inspection.

PART 2 – PRODUCTS

2.01 ANCHOR RODS

- A. Anchor rods shall conform to ASTM F1554 Grade 55 except where stainless steel or other approved anchor rods are shown on the Drawings or stated herein. Anchor rods shall have hexagonal heads and shall be supplied with hexagonal nuts meeting the requirements of ASTM A563 Grade A. Washers shall meet the requirements of ASTM A436.
- B. All anchors into concrete shall be cast-in-place anchors unless specifically referenced otherwise on Drawings.

- C. Where anchor rods are used to anchor galvanized steel or are otherwise specified to be galvanized, anchor rods and nuts shall be hot dipped galvanized in accordance with ASTM F1554.
- D. Where pipe sleeves around anchor rods are shown on the Drawings, pipe sleeves shall be cut from Schedule 40 PVC plastic piping meeting the requirements of ASTM D1785.

2.02 HIGH STRENGTH BOLTS

- A. High strength bolts and associated nuts and washers shall be in accordance with ASTM F3125, Grade A325 Type 1 or Grade F1852 Type 1. Bolts, nuts, and washers shall meet the requirements of RCSC "Specification for Structural Joints Using High Strength Bolts".
- B. Where high strength bolts are used to connect galvanized steel or are otherwise specified to be galvanized, bolts, nuts, and washers shall be hot dipped galvanized in accordance with ASTM A325.

2.03 STAINLESS STEEL BOLTS

- A. Stainless steel bolts shall conform to ASTM F-593 for alloy groups 1 and 2, Condition CW1, or ASTM F-3125. All fasteners for aluminum and stainless steel members that are underwater, in confined areas containing fluid, and in corrosive environments shall be Type 316 stainless steel unless noted otherwise. Fasteners for aluminum and stainless-steel members not subject to the above conditions shall be Type 304 stainless steel unless otherwise noted.
- B. Stainless steel bolts shall have hexagonal heads with a raised letter or symbol on the bolts indicating the manufacturer and shall be supplied with hexagonal nuts meeting the requirements of ASTM F594. Nuts, washers, and lock washers shall be of the same alloy as the bolts.

2.04 CONCRETE ANCHORS

- A. General
 - 1. Where concrete anchors are called for on the Drawings, one of the types listed below shall be used. Where one of the types listed below is specifically called for on the Drawings, only that type shall be used. If no specific type is indicated on the Drawings, the concrete anchor shall be a cast-in-place anchor. The determination of anchors equivalent to those listed below shall be based on test data performed by an approved independent testing laboratory. Two types of anchors shall be used:
 - a. Mechanical anchors include any of the following anchors:
 - 1) Expansion anchors shall be mechanical anchors of the wedge, sleeve, or drop-in type that are set by expanding against the sides of the drilled hole.

- 2) Screw anchors are mechanical anchors that derive tensile holding strength by the mechanical interlock provided by threads cutting into the concrete during installation. Screw anchors shall be one-piece, heavy duty screw anchors with a finished head.
 - b. Adhesive anchors shall consist of threaded rods anchored with an adhesive system into hardened concrete. Adhesive anchors shall be two-part injection type using the manufacturer's static mixing nozzle and shall be supplied as an entire system.
2. Adhesive anchors shall conform to the requirements of ACI 355.4 or alternately to AC 308. Mechanical anchors shall conform to the requirements of ACI 355.2 or alternately to AC 193. Anchors in Seismic Design Categories C through F shall conform to the International Building Code and ACI 318 Chapter 17 requirements as applicable, including seismic test requirements.
3. Engineer's approval is required for use of concrete anchors in locations other than those shown on the Drawings.

B. Wedge Anchors:

- a. Do not use when subjected to vibration.
- b. Do not use in exterior locations or locations subjected to freezing.
- c. Do not use in submerged, intermittently submerged, or buried locations.
- d. Suitable for use in overhead applications.

C. Screw Anchors:

- a. Do not use when subjected to vibration.
- b. Do not use in exterior locations or locations subjected to freezing.
- c. Do not use in submerged, intermittently submerged, or buried locations.
- d. Suitable for use in overhead applications.

D. Sleeve Anchors:

- a. Do not use when subjected to vibration.
- b. Do not use in exterior locations or locations subjected to freezing.
- c. Do not use in submerged, intermittently submerged, or buried locations.
- d. Suitable for use in overhead applications.

E. Undercut Anchors:

- a. Suitable for use where subjected to vibration.
- b. Do not use in exterior locations or locations subjected to freezing.
- c. Do not use in submerged, intermittently submerged, or buried locations.
- d. Suitable for use in overhead applications.

F. Adhesive Anchors in Concrete:

- a. Suitable for use where subjected to vibration.
- b. Suitable for use in exterior locations or locations subjected to freezing.
- c. Suitable for use in submerged, intermittently submerged, or buried locations.
- d. Do not use in overhead applications, unless otherwise shown or approved by Engineer.
- e. Suitable for use in chemical areas provided manufacturer's literature confirms appropriate chemical resistance.
- f. Do not use for pipe hangers, unless otherwise shown or approved by Engineer.

G. Concrete Anchor Design:

- 1. Basis of design shall include the following design parameters:
 - a. Actual compressive strength of concrete.
 - b. Cracked concrete conditions.
 - c. Dry or water saturated installation conditions.
 - d. Base material temperature between 40- and 104-degrees Fahrenheit.
 - e. Installation with hammer drill or hollow-drill bit system drilling methods.
 - f. Installation not prior to 21-day minimum age of concrete.
- 2. An anchor design consists of specifying anchor size, quantity, spacing, edge distance and embedment to resist all applicable loads. Where an anchor design is indicated on the Drawings, the anchors shall be installed to the prescribed size, spacing, embedment depth, and edge distance. If all parts of an anchor design are provided on the Drawings except embedment depth, the Contractor shall provide the embedment depth as indicated in Paragraph B.3 unless otherwise directed by

the Engineer. Where an anchor design is not indicated on the Drawings, the Contractor shall provide the anchor design per the requirements listed below.

- a. The Contractor shall submit design with sealed calculations and drawings performed by an Engineer currently registered in the State of Arizona. Anchors shall be of a type recommended by the anchor manufacturer for use in cracked concrete and shall be designed by the Contractor in accordance with ACI 318 Chapter 17.
- b. Embedment Depth
 - 1) Minimum anchor embedment shall be as indicated on the Drawings unless anchor design is stipulated to be by Contractor or equipment provider. The provider of equipment including pumps, blowers, etc. shall provide anchor design including size of anchors, pattern, and embedment depth. If the equipment provider is unable to provide design of embedment depth, the design shall be provided by the contractor using the loads furnished by the equipment provider. Although all manufacturers listed are permitted, the embedment depth indicated on the Drawings is based on “Pure 110+ by DeWalt” ESR 3298 issued 7/2023. If the contractor submits one of the other concrete adhesive anchors listed, the Engineer shall evaluate the required embedment and the Contractor shall provide the required embedment depth stipulated by the Engineer specific to the approved dowel adhesive.
 - 2) Where the embedment depth is not shown on the Drawings, concrete anchors shall be embedded no less than the manufacturer’s standard embedment (mechanical anchors) or to provide a minimum allowable bond strength equal to the allowable yield capacity of the rod according to the manufacturer (adhesive anchors).
 - 3) The embedment depth shall be determined using the actual concrete compressive strength, a cracked concrete state, maximum long-term temperature of 110 degrees F, and maximum short-term temperature of 140 degrees F. In no case shall the embedment depth be less than the minimum or more than the maximum stated in the manufacturer’s literature.

H. Anchors:

1. Mechanical Anchors:

- a. Wedge Anchors: Wedge anchors shall be “Kwik Bolt TZ” by Hilti, Inc., “Strong-Bolt 2” by Simpson Strong-Tie Co. or “Power-Stud+SD1” or “Power-Stud+ SD-2” by DeWalt.

- b. Screw Anchors: Screw anchors shall be “KWIK HUS-EZ”, “KWIK HUS-EZ-I”, or “KWIK HUS-EZ CRC” by Hilti, Inc., “Titen HD” or “Stainless Steel Titen HD” by Simpson Strong-Tie Co., or “Screw-Bolt+” by DeWalt.
- c. Sleeve Anchors: Sleeve anchors shall be “HSL-3 Heavy Duty Sleeve Anchor” by Hilti, Inc. or “Power-Bolt +” by DeWalt.
- d. Shallow Embedment Internally Threaded Insert (3/4” max embedment): “Mini-Undercut +Anchor” by DeWalt, “HDI-P-TZ” by Hilti, Inc. or approved equal.
- e. Concrete Undercut Anchors: Concrete undercut anchors shall be “HDA Undercut Anchors” by Hilti, Inc., “DUC Ductile Undercut Anchor”, by USP Structural Connectors, or approved equal.
- f. Mechanical anchor systems shall comply with ACI 355.2 or alternatively the latest revision of AC 193 and shall have a valid evaluation report in accordance with the applicable building code.

2. Adhesive Anchors:

- a. Adhesive anchors shall be “HIT HY-200 Adhesive Anchoring System” by Hilti, Inc., “SET-3G Epoxy Adhesive Anchors” by Simpson Strong-Tie Co., or “Pure 110+ Epoxy Adhesive Anchor System” by DeWalt.
- b. Adhesive anchor systems shall be IBC compliant and capable of resisting short term wind and seismic loads (Seismic Design Categories A through F) as well as long term and short term sustained static loads in both cracked and uncracked concrete in all Seismic Design Categories. Adhesive anchor systems shall comply with ACI 355.4 or alternatively the latest revision of AC308 and shall have a valid evaluation report in accordance with the applicable building code. **No or equal products will be considered unless prequalified and approved by the Engineer and Owner.**

I. Concrete Anchor Materials:

- 1. Concrete anchors used to anchor structural steel shall be a threaded steel rod per anchor manufacturer’s recommendations but shall not have a yield strength (fy) less than 58 ksi nor an ultimate strength (fu) less than 72.5 ksi, unless noted otherwise. Where steel to be anchored is galvanized, concrete anchors shall also be galvanized unless otherwise indicated on the Drawings.
- 2. Concrete anchors used to anchor aluminum, FRP, or stainless steel shall be manufactured from stainless steel unless noted otherwise. All underwater fasteners, fasteners in confined areas containing fluid, and fasteners in corrosive environments shall be Type 316 stainless steel unless noted otherwise. Fasteners for aluminum and stainless-steel members not subject to the above conditions shall be Type 304 stainless steel unless otherwise noted.

3. Nuts, washers, lock washers and other hardware shall be of a material to match the anchors.

2.05 WELDS

- A. Electrodes for welding structural steel and all ferrous steel shall comply with AWS Code, using E70 series electrodes for shielded metal arc welding (SMAW), or F7 series electrodes for submerged arc welding (SAW).
- B. Electrodes for welding aluminum shall comply with the Aluminum Association Specifications and AWS D1.2.
- C. Electrodes for welding stainless steel and other metals shall comply with AWS D1.6.

2.06 EYEBOLTS

- A. Eyebolts shall conform to ASTM A489 unless noted otherwise.

2.07 ANTISEIZE LUBRICANT

- A. Antiseize lubricant shall be C5-A Anti-Seize by Loctite Corporation, Molykote P-37 Anti-Seize Paste by Dow Corning, 3M Anti-Seize by 3M, or equal.

PART 3 – EXECUTION

3.01 MEASUREMENTS

- A. The Contractor shall verify all dimensions and review the Drawings and shall report any discrepancies to the Engineer for clarification prior to starting fabrication.

3.02 FASTENER INSTALLATION

- A. Anchor Rods, Concrete Anchors, and Masonry Anchors
 1. Anchor rods shall be installed in accordance with AISC "Code of Standard Practice" by securing rods where concrete will be placed and positioned by means of a rigidly secured template. Overhead anchors, and base plates or elements being anchored, shall be shored as required and securely held in place during anchor setting to prevent movement during anchor installation. Movement of anchors during curing is prohibited.
 2. The Contractor shall verify that all concrete and masonry anchors have been installed in accordance with the manufacturer's recommendations and that the capacity of the installed anchor meets or exceeds the specified safe holding capacity.
 3. Post-installed concrete anchors shall not be used in place of cast-in-place anchor rods without Engineer's approval.

4. All stainless-steel threads shall be coated with anti-seize lubricant.

B. High Strength Bolts

1. All bolted connections for structural steel shall use high strength bolts. High strength bolts shall be installed in accordance with RCSC "Specification for Structural Joints Using High Strength Bolts". All bolted joints shall be Type N, snug-tight, bearing connections in accordance with AISC Specifications unless noted otherwise on the Drawings.

C. Stainless Steel Bolts

1. Where connections indicate the use of stainless-steel bolts, the bolts shall be installed to the snug tight condition. Connections shall include stainless steel washers under both the bolt head and the nut head. Lock washers shall be utilized for all connections and shall be placed under the nut head.

D. Concrete Anchors

1. Concrete at time of anchor installation shall be a minimum age of 21 days, have a minimum compressive strength of 2500 psi, and ambient temperature at time of installation shall be at least 50 degrees F.
2. Concrete Anchor Testing:
 - a. At all locations, at least 10 percent of all concrete anchors installed shall be proof tested to 80% of the yield strength of the anchor rod, with a minimum of one tested anchor per anchor group.
 - b. Contractor shall submit a plan and schedule indicating locations of anchors to be proof tested, load test values and proposed anchor testing procedure (including a diagram of the testing equipment proposed for use) to the Engineer for review prior to conducting any testing. Proof testing of anchors shall be in accordance with ASTM E3121 for the static tension test. If additional tests are required, inclusion of these tests shall be as stipulated on Contract Drawings.
 - c. Where Contract Documents indicate anchor design to be the Contractor's responsibility, the Contractor shall submit a plan and schedule indicating locations of anchors to be proof tested and load test values, sealed by a Professional Engineer currently registered in the State of Arizona. Documentation shall also be submitted indicating the Contractor's proof testing procedures have been reviewed and the proposed procedures are acceptable. Proof testing procedures shall be in accordance with ASTM E3121.

- d. Concrete Anchors shall have no visible indications of displacement or damage during or after the proof test. Concrete cracking in the vicinity of the anchor after loading shall be considered a failure. Anchors exhibiting damage shall be removed and replaced. If more than 5 percent of tested anchors fail, then 100 percent of anchors shall be proof tested.
 - e. Proof testing of concrete anchors shall be performed by an independent testing laboratory hired directly by the Contractor and approved by the Engineer. The Contractor shall be responsible for costs of all proof testing, including additional testing required due to previously failed tests.
- 3. All concrete anchors shall be installed in strict conformance with the manufacturer's printed installation instructions. A representative of the manufacturer shall be on site when required by the Engineer.
- 4. All holes shall be drilled in accordance with the manufacturer's instructions except that cored holes shall not be allowed unless specifically approved by the Engineer. If cored holes are allowed, cored holes shall be roughened in accordance with manufacturer requirements. If hammer drills are used to drill holes in slabs, the drills shall be equipped with a depth stop device. The depth of hole shall be the minimum depth required for anchor embedment and development of required capacity. Prior to drilling, the contractor shall use GPR or other means to confirm anchor installation will not interfere with reinforcement or embedded items, especially electrical conduit. Thoroughly clean drill holes of all debris, drill dust, and water in accordance with the manufacturer's instructions prior to installation of adhesive and threaded rod unless otherwise recommended by the manufacturer. Degree of hole dampness shall be in strict accordance with manufacturer recommendations. Installation conditions shall be either dry or water saturated. Water filled or submerged holes shall not be permitted unless specifically approved by the Engineer. Injection of adhesive into the hole shall be performed to minimize the formation of air pockets in accordance with the manufacturer's instructions. Wipe rod free from oil that may be present from shipping or handling.
- 5. All adhesive anchor installations shall be conducted by a certified Adhesive Anchor Installer as certified by ACI/CSRI per ACI 318-19 17.8.2.2. Current AAI Certificate must be submitted to the Engineer of Record prior to commencement of any adhesive anchor installations.

E. Other Bolts

- 1. All dissimilar metal shall be connected with appropriate fasteners and shall be isolated via an approved dielectric.
- 2. All stainless-steel bolts shall be coated with anti-seize lubricant.

3.03 WELDING

- A. All welding shall comply with AWS Code for procedures, appearance, quality of welds, qualifications of welders and methods used in correcting welded work.
- B. Welded stud connectors shall be installed in accordance with AWS D1.1.
- C. Welds shown on the Drawings with a field weld symbol shall be field welded. All other welds shall be shop welded unless specifically approved by the Engineer.

3.04 INSPECTION

- A. High strength bolting will be visually inspected in accordance with RCSC "Specification for Structural Joints Using High Strength Bolts". Rejected bolts shall be either replaced or retightened as required.
- B. Field welds will be visually inspected in accordance with AWS Codes. Inadequate welds shall be corrected or redone as required in accordance with AWS Codes.
- C. Post-installed concrete anchors shall be inspected as required by ACI 318.

3.05 CUTTING OF EMBEDDED REBAR

- A. The Contractor shall not cut embedded rebar cast into concrete during installation of post-installed anchors without prior approval of the Engineer.

END OF SECTION

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SECTION 05 10 00
METAL MATERIALS

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. Metal materials not otherwise specified shall conform to the requirements of this Section.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Materials for fasteners are included in Section 05 05 23 – Metal Fastening.
- B. Requirements for specific products made from the materials specified herein are included in other sections of the Specifications. See the section for the specific item in question.

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. ASTM A36 – Standard Specification for Structural Steel
- B. ASTM A47 – Standard Specification for Malleable Iron Castings
- C. ASTM A48 – Standard Specification for Gray Iron Castings
- D. ASTM A53 – Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
- E. ASTM A167 – Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
- F. ASTM A276 – Standard Specification for Stainless and Heat-Resisting Steel Bars and Shapes
- G. ASTM A307 – Standard Specification for Carbon Steel Externally Threaded Standard Fasteners
- H. ASTM A446 – Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Structural (Physical) quality
- I. ASTM A500 – Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
- J. ASTM A501 – Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing

- K. ASTM A529 – Standard Specification for Structural Steel with 42 000 psi (290 Mpa) Minimum Yield Point (1/2 in. (12.7 mm) Maximum Thickness)
- L. ASTM A536 – Standard Specification for Ductile Iron Castings
- M. ASTM A570 – Standard Specification for Hot-Rolled Carbon Steel Sheet and Strip, Structural Quality
- N. ASTM A572 – Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel
- O. ASTM A992 – Standard Specification for Structural Steel Shapes
- P. ASTM A666 – Standard Specification for Austenitic Stainless Steel, Sheet, Strip, Plate, and Flat Bar for Structural Applications
- Q. ASTM A1085 – Standard Specification for Cold-Formed Welded Carbon Steel Hollow Structural Sections (HSS)
- R. ASTM B26 – Standard Specification for Aluminum-Alloy Sand Castings
- S. ASTM B85 – Standard Specification for Aluminum-Alloy Die Castings
- T. ASTM B108 – Standard Specification for Aluminum-Alloy Permanent Mold Castings
- U. ASTM B138 – Standard Specification for Manganese Bronze Rod, Bar, and Shapes
- V. ASTM B209 – Standard Specification for Aluminum-Alloy Sheet and Plate
- W. ASTM B221 – Standard Specification for Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes
- X. ASTM B308 – Standard Specification for Aluminum-Alloy Standard Structural Shapes, Rolled or Extruded
- Y. ASTM B574 – Standard Specification for Nickel-Molybdenum-Chromium Alloy Rod
- Z. ASTM F468 - Standard Specification for Nonferrous Bolts, Hex Cap Screws, and Studs for General Use
- AA. ASTM F593 – Standard Specification for Stainless Steel Fasteners

1.04 SUBMITTALS

- A. Material certifications shall be submitted along with any shop drawings for metal products and fabrications required by other sections of the Specifications.

1.05 QUALITY ASSURANCE

- A. Owner may engage the services of a testing agency to test any metal materials for conformance with the material requirements herein. If the material is found to be in conformance with Specifications the cost of testing will be borne by the Owner. If the material does not conform to the Specifications, the cost of testing shall be paid by the Contractor and all materials not in conformance as determined by the Engineer shall be replaced by the Contractor at no additional cost to the Owner. In lieu of replacing materials, the Contractor may request further testing to determine conformance, but any such testing shall be paid for by the Contractor regardless of outcome of such testing.

PART 2 – PRODUCTS

2.01 CARBON AND LOW ALLOY STEEL

- A. Material types and ASTM designations shall be as listed below:

Steel W, C, and MC Shapes	A992
Steel HP Shapes	A572 Grade 50
Steel M and S shapes and Angles, Bars, and Plates	A36
Rods	F 1554 Grade 36
Pipe - Structural Use	A53 Grade B
Hollow Structural Sections	A500 Grade C or A1085 Grade A
Cold-Formed Steel Framing	A 653

2.02 STAINLESS STEEL

- A. All stainless steel fabrications exposed to underwater service shall be Type 316. All other stainless steel fabrications shall be Type 304, unless noted otherwise.
- B. Material types and ASTM designations are listed below:

Plates and Sheets	ASTM A167 or A666 Grade A
Structural Shapes	ASTM A276
Fasteners (Bolts, etc.)	ASTM F593

2.03 ALUMINUM

- A. All aluminum shall be alloy 6061-T6, unless otherwise noted or specified herein.

B. Material types and ASTM designations are listed below:

Structural Shapes	ASTM B308
Castings	ASTM B26, B85, or B108
Extruded Bars	ASTM B221 - Alloy 6061
Extruded Rods, Shapes and Tubes	ASTM B221 - Alloy 6063
Plates	ASTM B209 - Alloy 6061
Sheets	ASTM B221 - Alloy 3003

C. All aluminum structural members shall conform to the requirements of Section 05 14 00 – Structural Aluminum.

D. All aluminum shall be provided with mill finish unless otherwise noted.

E. Where bolted connections are indicated, aluminum shall be fastened with stainless steel bolts.

2.04 DISSIMILAR METALS

A. Dielectric isolation shall be installed wherever dissimilar metals are connected according to the following table.

	Zinc	Galvanized Steel	Aluminum	Cast Iron	Ductile Iron	Mild Steel/ Carbon Steel	Copper	Brass	Stainless Steel
Zinc			•	•	•	•	•	•	•
Galvanized Steel			•	•	•	•	•	•	•
Aluminum	•	•		•	•	•	•	•	•
Cast Iron	•	•	•				•	•	•
Ductile Iron	•	•	•				•	•	•
Mild Steel/ Carbon Steel	•	•	•				•	•	•
Copper	•	•	•	•	•	•			•
Brass	•	•	•	•	•	•			•

	Zinc	Galvanized Steel	Aluminum	Cast Iron	Ductile Iron	Mild Steel/ Carbon Steel	Copper	Brass	Stainless Steel
Stainless Steel	•	•	•	•	•	•	•	•	

1. "•" signifies dielectric isolation is required between the two materials noted.
2. Consult Engineer for items not listed in table.

PART 3 – EXECUTION (NOT USED)

END OF SECTION

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SECTION 05 13 00
STAINLESS STEEL

PART 1 – GENERAL

1.01 SECTION INCLUDES

- A. The Contractor shall furnish, install and erect the stainless steel work as shown on the Contract Drawings and specified herein.
- B. Stainless steel work shall be furnished complete with all accessories, mountings and appurtenances of the type of stainless steel and finish as specified or required for a satisfactory installation.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 01 33 00 – Submittal Procedures
- B. Section 05 10 00 – Metal Materials
- C. Section 05 05 23 – Metal Fastening
- D. Section 05 50 00 – Metal Fabrications

1.03 REFERENCES

- A. ASTM A193 – Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
- B. ASTM A194 – Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service
- C. ASTM A262 – Practice for Detecting Susceptibility to Intergranular Attack in Austenitic Stainless Steel
- D. ASTM A276 – Stainless and Heat-Resisting Steel Bars and Shapes
- E. ASTM A314 – Stainless and Heat-Resisting Steel Billets and Bars for Forging
- F. ASTM A380 – Practice for Cleaning and Descaling Stainless Steel Parts, Equipment and Systems
- G. ASTM A473 – Stainless and Heat-Resisting Steel Forgings
- H. ASTM A666 – Austenitic Stainless Steel, Sheet, Strip, Plate and Flat Bar
- I. ASTM A774 – Stainless Steel Pipe Fittings

- J. ASTM A778 – Stainless Steel Pipe
- K. ASTM F593 – Stainless Steel Bolts, Hex Cap Screws and Studs
- L. ASTM F594 – Stainless Steel Nuts
- M. ANSI/ASME B1.1 – Unified Inch Screw Thread (UN and UNR Thread Form)

1.04 TESTS

- A. All stainless steel materials including stainless test welds, shall be checked for compliance with tests for susceptibility to intergranular attack. Such tests shall be Practices A, B and E of ASTM A262. Detailed procedures for the tests shall be submitted to the Engineer for approval prior to start of work. Practice A shall be used only for acceptance of materials but not for rejection of materials, and shall be used for screening material intended for testing in Practice B and Practice E. The maximum acceptable corrosion rate under Practice B shall be 0.004 inch per month, rounded off to the third decimal place. If the certified mill report indicates that such test has been satisfactory performed, the fabricator may not be required to repeat the test. Material passing Practice E shall be acceptable.
- B. Sample selection for the susceptibility to intergranular attack tests shall be as follows:
 - 1. One (1) sample per heat treatment lot for plates and forgings;
 - 2. One (1) sample per each Welding Procedure Qualification regardless of the joint design;
 - 3. If tests indicate a reduction in corrosion resistance, welding procedure shall be adjusted or heat treatment determined as needed to restore required corrosion resistance.
 - 4. The samples so chosen shall have received all the post-weld heat treatments identical to the finished part.

1.05 SUBMITTALS

- A. The Contractor shall prepare and submit for approval shop drawings for all stainless steel fabrication in accordance with Section 01 33 00 – Submittal Procedures.
- B. Submittals shall include, but not be limited to, the following:
 - 1. Certified test reports for susceptibility to intergranular attack.
 - 2. Affidavit of compliance with type of stainless steel shown on the Contract Drawings or specified herein.
 - 3. Certified weld inspection reports.

- 4. Cleaning and handling of stainless steel in accordance with Paragraph 3.04, Cleaning and Handling.
- C. Samples of finish, on each type of stainless steel to be furnished, shall be submitted to the Engineer upon request.

1.06 QUALITY ASSURANCE

- A. Shop inspections may be made by the Engineer. The Contractor shall give ample notice to the Engineer prior to the beginning of any stainless steel fabrication work so that inspection may be provided. The Contractor shall furnish all facilities for the inspection of materials and workmanship in the shop, and the inspectors shall be allowed free access to the necessary parts of the works.
- B. Inspectors shall have the authority to reject any materials or work which does not meet the requirements of the Contract Drawings or the Specifications.
- C. Inspection at the shop is intended as a means of facilitating the work and avoiding errors, but is expressly understood that it will in no way relieve the Contractor from his responsibility for furnishing proper materials or workmanship.

1.07 HANDLING, STORAGE AND DELIVERY

- A. Mechanical damage (e.g., scratches and gouges) to the stainless steel material shall not be permitted and is cause for rejection. Care shall be taken in the material handling since such mechanical damage will result in the passive oxide film being "punctured" leading to a possible lower resistance to the initiation of corrosion than the surrounding chemically-passivated surface.
- B. Stainless steel plates and sheets shall be stored vertically in racks and not be dragged out of the racks or over one another. Racks shall be protected to prevent iron contamination.
- C. Heavy stainless steel plates shall be carefully separated and chocked with wooden blocks so that the forks of a fork-lift could be inserted between plates without mechanically damaging the surface.
- D. Stainless steel plates and sheets laid out for use shall be off the floor and be divided by wooden planks to prevent surface damage and to facilitate subsequent handling.
- E. Plate clamps, if used, shall be used with care as the serrated faces can dig in, indent and gouge the surface.
- F. Stainless steel fabrications shall be loaded in such a manner that they may be transported and unloaded without being overstressed, deformed or otherwise damaged.
- G. Stainless steel fabrications and packaged materials shall be protected from corrosion and deterioration and shall be stored in a dry area. Materials stored outdoors shall be

supported above ground surfaces on wood runners and protected with approved effective and durable covers.

- H. Stainless steel fabrications shall not be placed in or on a structure in a manner that might cause distortion or damage to the fabrication. The Contractor shall repair or replace damaged stainless steel fabrications or materials as directed by the Engineer.

1.08 FIELD MEASUREMENTS

- A. The Contractor shall verify all dimensions and shall make any field measurements necessary and shall be fully responsible for accuracy and layout of the work.
- B. The Contractor shall review the Contract Drawings and any discrepancies shall be reported to the Engineer for clarification prior to starting fabrication.

PART 2 – PRODUCTS

2.01 MATERIALS AND FINISHES

- A. Stainless steel shall be Type 304 unless it is used for underwater service. Stainless steel for underwater service shall be Type 316. Minimum mechanical finish shall be No. 4 as stated in Table 2 unless otherwise noted on the Contract Drawings.
- B. The basic mill forms (sheet, strip, plate and bar) are classified by size as shown on Table 1. Tables 2, 3 and 4 identify finishes and conditions in which sheet, bar and plate are available.
- C. Tables 2, 3 and 4 show numbered finishes and conditions for sheet, bar and plate. While there are no specific designations for polished finishes on bar or plate, the sheet finish designations are used to describe the desired effect. This also applies to finishes on ornamental tubing.
- D. There are three standard finishes for strip, which are broadly described by the finishing operations employed:
 - 1. No. 1 Strip Finish
 - a. No. 1 strip finish is approximately the same as No. 2D Sheet Finish. It varies in appearance from dull gray matte to a fairly reflective surface, depending largely on alloy composition and amount of cold reduction.
 - 2. No. 2 Strip Finish is approximately the same as a No. 2B sheet finish. It is smoother, more reflective than No. 1, and likewise varies with alloy composition.
 - 3. Bright annealed finish is a highly reflective finish that is retained by final annealing in a controlled atmosphere furnace.

Table 1: Classification of Stainless Steel Product Form

Item	Description	Dimensions		
		Thickness	Width	Diameter or Size
Sheet	Coils and cut length:			
	Mill finishes Nos. 1, 2D and 2B	under 3/16"	24" and over all widths	-
	Polished finishes Nos. 3, 4, 6, 7 & 8			
Strip	Cold finished, coils or cut lengths:			
	Polished finishes Nos. 3, 4, 6, 7 & 8	under 3/16"	under 24" all widths	-
Plate	Flat rolled or forged	3/16" and over	over 10"	-
Bar	Hot finished rounds, squares, octagons and hexagons	-	-	1/4" and over
	Hot finished flats	1/8" to 8" incl.	1/4" to 10" incl.	-
	Cold finished rounds, squares, octagons and hexagons	-	-	over 1/8"
	Cold finished flats	1/8" to 4-1/2"	3/8" to 4-1/2"	-
Wire	Cold finishes only: (in coil)			
	Round, square, octagon, hexagon and flat wire	under 3/16"	under 3/8"	-
Pipe & Tubing	Several different classifications, with differing specifications, are available.			
Extrusion	Not considered "standard" shapes. Currently limited in size to approximately 6-1/2" diameter or structurals.			

Table 2: Standard Mechanical Sheet Finishes

Unpolished or Rolled Finishes		Polished Finishes	
No. 1	A rough dull surface which results from hot rolling to the specified thickness followed by annealing and descaling.	No. 3	An intermediate polish surface obtained by finishing with a 100 grit abrasive. Generally used where a semi-finished polished surface is required. A No. 3 finish usually receives additional polishing during fabrication
No. 2D	A dull finish which results from cold rolling followed by annealing and descaling, and may perhaps get a final light roll pass through unpolished rolls. A 2D finish is used where appearance is of no concern.	No. 4	A polished surface obtained by finishing with a 120-150 mesh abrasive, following initial grinding with coarser abrasives. This is a general purpose bright finish with a visible "grain" which prevents mirror reflection.
No. 2B	A bright cold-rolled finish resulting in the same manner as No. 2D finish, except that the annealed and descaled sheet receives a final light roll pass through polished rolls. This is the general purpose cold-rolled finish that can be used as is, or as a preliminary step to polishing.	No. 6	A dull satin finish having lower reflectivity than No. 4 finish. It is produced by Tampico brushing the No. 4 finish in a medium of abrasive and oil. It is used for architectural applications and ornamentation where a high luster is undesirable, and to contrast with brighter finishes.
		No. 7	A high reflective finish that is obtained by buffing finely ground surfaces but not to the extent of completely removing the "grit" lines. It is used chiefly for architectural and ornamental purposes.
		No. 8	The most reflective surface, which is obtained by polishing with successively finer abrasives and buffing extensively until all grit lines from preliminary grinding operations are removed. It is used for applications such as mirrors and reflectors.

Table 3: Conditions and Finishes for Bar

Conditions	Surface Finishes ¹
Hot worked only	(a) Scale not removed (excluding spot conditioning) (b) Rough turned ² (c) Pickled or blast cleaned and pickled.
Annealed or otherwise heat treated	(a) Scale not removed (excluding spot conditioning) (b) Rough turned (c) Pickled or blast cleaned and pickled (d) Cold drawn or cold rolled (e) Centerless ground (f) Polished
Annealed and cold worked to high tensile strength ³	(a) Cold drawn or cold rolled (b) Centerless ground (c) Polished

Table 4: Conditions and Finishes for Plate

Condition and Finish	Description and Remarks
Hot rolled	Scale not removed. Not heat treated. Plates not recommended for final use in this condition. ⁴
Hot rolled, annealed or heat treated	Scale not removed. Use of plates in this condition is generally confined to heat resisting applications. Scale impairs corrosion resistance. ¹
Hot rolled, annealed or heat treated, blast cleaned or pickled	Condition and finish commonly preferred for corrosion resisting and most heat resisting applications.
Hot rolled, annealed, descaled and temper passed	Smoother finish for specialized applications.
Hot rolled, annealed, descaled cold rolled, annealed, descaled, optionally temper passed	Smooth finish with greater freedom from surface imperfection than the above.
Hot rolled, annealed or heat treated, surface cleaned and polished	Polished finishes refer to Table 2.

¹ Surface finishes (b), (e) and (f) are applicable to round bars only.

² Bars of the 4xx series stainless steels which are highly hardenable, such as Types 414, 420, 420F, 431, 440A, 440B and 440C, are annealed before rough turning. Other hardenable grades, such as Types 403, 410, 416 and 416Se, may also require annealing depending on their composition and size.

³ Produced in Types 302, 303Se, 304 and 316.

⁴ Surface inspection is not practicable on plates which have not been pickled or otherwise descaled.

PART 3 – EXECUTION

3.01 FABRICATION

- A. Holes for bolts and screws shall be drilled. Fastenings shall be concealed where practicable. Joints exposed to the weather shall be formed to exclude water.
- B. As far as practicable, all fabricated units shall be fitted and assembled in the shop, with all cuts and bends made to precision measurements in accordance with details shown on approved shop drawings.
- C. Work shall be fabricated so that it is installed in a manner that will provide for expansion and contraction, prevent the shearing of bolts, screws and other fastenings, ensure rigidity, and provide close fitting of sections.
- D. All finished and/or machined faces shall be true to line and level. Stainless steel sections shall be well formed to shape and size with sharp lines and angles; curved work shall be sprung evenly to curves.
- E. All work shall be fitted together at the shop as far as possible, and delivered complete and ready for erection. Proper care shall be exercised in handling all work so as not to injure the finished surfaces.

3.02 WELDING

- A. Welding shall be done in a manner that will prevent buckling and in accordance with Section 05 05 23 – Metal Fastening, and as modified hereinafter.
- B. All welds exposed in the work shall be ground smooth and finished to match the finish of the adjacent stainless steel surfaces.
- C. Select weld rods that provide weld filler metal having corrosion resistant properties as nearly identical or better than the base metal to insure preservation of the corrosion-resistant properties. Provide heat treatment at welds where testing of weld procedure indicates it is required to restore the corrosion resistance.
- D. Thermal conductivity of stainless steel is about half that of other steels; and the following methods may be used to accommodate this situation:
 - 1. Use lower weld current setting.
 - 2. Use skip-weld techniques to minimize heat concentration.
 - 3. Use back-up chill bars or other cooling techniques to dissipate heat.
- E. Edges of the stainless steel to be welded shall be cleaned of contaminants.

3.03 FASTENERS

- A. Stainless steel fasteners shall be used for joining stainless steel work.
- B. Stainless steel fasteners shall be made of alloys that are equal to or more corrosion resistant than the materials they join.

3.04 CLEANING AND HANDLING

- A. All stainless steel surfaces shall be precleaned, descaled, passivated and inspected before, during and after fabrication in accordance with the applicable sections of ASTM A380 and as detailed in the procedures to be submitted to the Engineer for approval prior to start of work. Degreasing and passivation of stainless steel articles shall be conducted as the last step after fabrication.
- B. Measures to protect cleaned surfaces shall be taken as soon as final cleaning is completed and shall be maintained during all subsequent handling, storage and shipping.
 - 1. The Contractor shall submit for approval specific procedures listing all the steps to be followed in detecting contamination and in descaling, cleaning, passivation and protecting of all stainless steel.
 - 2. Area showing clear indications of contamination shall be recleaned, repassivated and reinspected.
- C. At approved stages in the shop operations, contaminants such as scale, embedded iron, rust, dirt, oil, grease and any other foreign matter shall be removed from the metal, as directed or approved by the Engineer. The adequacy of these operations shall be checked by the Engineer. Operations in the shop shall be conducted so as to avoid contamination of the stainless steel and to keep the metal surfaces free from dirt and foreign matter.
- D. In order to prevent incipient corrosion during fabrication, special efforts shall be made at all times to keep all stainless steel surfaces from coming in contact with other metals.
 - 1. Stainless steel and stainless steel welds shall be cleaned with clean sand free of iron, stainless steel wool, stainless steel brushes, or other approved means and shall be protected at all times from contamination by any materials, including carbon steel, that shall impair its resistance to corrosion.
 - 2. Approved methods of cutting, grinding and handling shall be used to prevent contamination. If air-arc, or carbon-arc cutting is used, additional metal shall be removed by approved mechanical means so as to provide clean, weldable edges. All grinding of stainless steel shall be performed with aluminum oxide or silicon carbide grinding wheels bonded with resin or rubber. Grinding wheels used on carbon steel shall not be used on stainless steel.

3. Sand, grinding wheels, brushes and other materials used for cleaning stainless steel shall be checked periodically by the Engineer for contaminants. Cleaning aids found to contain contaminants shall not be used on the work.

3.05 INSTALLATION

- A. All stainless steel fabrications shall be erected square, plumb and true, accurately fitted, adequately anchored in place, set at proper elevations and positions.
- B. All inserts, anchor rods and all other miscellaneous work specified in the Detailed Specifications or shown on the Contract Drawings or required for the proper completion of the work, which are embedded in concrete, shall be properly set and securely held in position in the forms before the concrete is placed.
- C. All stainless steel fabrications shall be installed in conformance with details shown on the Contract Drawings or on the approved shop drawings.

END OF SECTION

SECTION 07 16 16
CRYSTALLINE WATERPROOFING

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. Furnishing all labor, materials, services and equipment necessary for the supply and installation of topical cementitious crystalline waterproofing to concrete substrates, above-grade or below-grade, on either dry or wet side of substrates, as indicated on drawings and as specified herein.

- B. Principal items of work include:

Filters 9 through 12 located on the interior of the filter cells, center gullet between filter cells, and settled water channels.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 03 01 30 – Concrete Repairs

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Without limiting the generality of these specifications Work shall conform to the applicable requirements of the following documents:

1. American Society for Testing and Materials (ASTM)
2. Army Corps of Engineers (CRD)
3. NSF International (NSF)

1.04 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in Section 01 33 00 – Submittal Procedures, submit the following:

1. Submit product data, including manufacturer's specifications, installation instructions, and general recommendations for waterproofing applications. Include manufacturer's certification or other data substantiating that products comply with requirements of the Contract Documents.
2. Submit complete test reports from approved independent testing laboratories certifying that waterproofing system conforms to performance characteristics and testing requirements specified herein.

3. Provide certificates signed by manufacturer or manufacturer's representative certifying that the materials to be installed comply in all respects with the requirements of this specification, and that the applicator is qualified and approved to install the materials in accordance with manufacturer's product data.

1.05 SYSTEM PERFORMANCE REQUIREMENTS

- A. Testing Requirements: Crystalline waterproofing system shall be tested in accordance with the following standards and conditions, and the testing results shall meet or exceed the performance requirements as specified herein.
- B. Independent Laboratory: Testing shall be performed by an independent laboratory meeting the requirements of ASTM E 329 and certified by the United States Bureau of Standards. Testing laboratory shall obtain all concrete samples and waterproofing product samples.
- C. Crystalline Penetration: Crystallizing capability of waterproofing material shall be evidenced by independent SEM (Scanning Electron Microscope) photographs documenting penetration of crystal-forming waterproofing material to a depth of 2 inches.
- D. Permeability: Independent testing shall be performed according to U.S. Army Corps of Engineers CRD C48-73 "Permeability of Concrete".
 1. Concrete samples (treated and untreated) to have design strength of 2000 psi and thickness of 2 inches. No admixtures permitted.
 2. Coatings to have maximum thickness of 0.05 inches per coat with up to two coats permitted.
 3. Samples to be pressure tested to 175 psi (405 feet head of water).
 4. Treated samples, after crystalline growth has occurred, shall exhibit no measurable leakage.
- E. Chemical Resistance: Independent testing shall be performed according to ASTM C 267 "Chemical Resistance of Mortars" and ASTM C 39 "Compressive Strength of Cylindrical Concrete Specimens".
 1. Concrete samples (treated and untreated) to have design strength of 4000 psi. No admixtures permitted.
 2. Coatings to have maximum thickness of 0.05 inches per coat with up to two coats permitted.
 3. Untreated and treated specimens to be immersed for a minimum of 84 days in following chemical solutions: hydrochloric acid (3.5pH), brake fluid, transformer oil, ethylene glycol, toluene, caustic soda.

4. Treated specimens shall exhibit no detrimental effects after exposure, and shall have a minimum of 14% increase in compressive strength versus untreated control specimens.
- F. Potable Water Approval: Independent testing shall be performed according to NSF Standard 61/600 and approval for use of waterproofing material on structures holding potable water shall be evidenced by NSF certification.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials in manufacturer's unopened containers identified with name, brand, type, grade, class, and all other qualifying information.
- B. Store materials in dry location, in such manner as to prevent damage or intrusion of foreign matter. Conspicuously mark "Rejected" on materials which have been damaged and remove from the job site.

PART 2 – PRODUCTS

2.01 SYSTEM DESCRIPTION

- A. Cementitious Crystalline Waterproofing: Blend of portland cement, fine treated silica sand and active proprietary chemicals. When mixed with water and applied as a cementitious coating, the active chemicals cause a catalytic reaction which generates a non-soluble crystalline formation of dendritic fibers within the pores and capillary tracts of concrete. This process causes concrete to become permanently sealed against the penetration of liquids from either direction.

2.02 ACCEPTABLE MANUFACTURERS

- A. Subject to compliance with the Specifications provide products manufactured by one of the following:
 1. Xypex Chemical
 2. Tamms (Euclid)
 3. Vandex (Euclid)
 4. Kryton International

2.03 PRODUCTS

- A. Crystalline Waterproofing Materials as follows:
 1. Xypex Concentrate
 2. Tamms Hey'Di K-11

3. Vandex Super

4. Krystol T1

2.04 SOURCE QUALITY

- A. Obtain proprietary crystalline waterproofing products from a single manufacturer.

PART 3 – EXECUTION

3.01 EXAMINATION OF SURFACES

- A. Verify that the concrete surfaces are sound and clean, and that form release agents and materials used to cure the concrete are compatible with waterproofing treatment.
- B. Examine surfaces to be waterproofed for form tie holes and structural defects such as honeycombing, rock pockets, faulty construction joints and cracks. Such defects to be repaired in accordance with manufacturer's product data and Section 3.02 below.
- C. Coordinate all work under this Section with contiguous work of other trades.

3.02 PREPARATION

- A. Concrete Finish: Concrete surfaces to receive waterproofing treatment shall have an open capillary system to provide tooth and suction, and shall be free from scale, excess form oil, laitance, curing compounds and foreign matter. Horizontal surfaces shall have a rough wood float or broom finish. Where a smooth trowel finish is required on horizontal surface, crystalline waterproofing material shall be applied by dry shake method at time of concrete finishing in accordance with manufacturer's product data.
- B. Surface Preparation: Existing smooth surfaces (e.g. where steel forms are used) or surfaces covered with excess form oil or other contaminants shall be washed, lightly sand-blasted, water-blasted, or acid etched with muriatic acid as necessary. Surfaces to be acid-etched shall be saturated with water prior to application of acid. Procedures for preparing surface profile to receive waterproofing treatment shall be in accordance with the manufacturer's recommendations and instructions.
- C. Repair of Defects: Surface defects shall be repaired in accordance with Specification Section 03 01 30 – Concrete Repairs.
- D. Wetting Concrete: Prior to application of waterproofing treatment, thoroughly saturate concrete surfaces with clean water as required to ensure migration of crystalline chemicals into voids and capillary tracts of the concrete. Remove free surface water before application.

3.03 APPLICATION

- A. Surface Application: After repairs, surface preparation, treatment of construction joints, and sealing strip placement have been completed in accordance with manufacturer's product data and as specified herein, apply crystalline waterproofing treatment uniformly to concrete surfaces with semi-stiff bristle brush or broom, or suitable spray equipment. Application rates and locations shall be in accordance with manufacturer's product data, unless otherwise indicated on the Drawings. When brushing, work slurry well into surface of the concrete, filling surface pores and hairline cracks. When spraying, hold nozzle close enough to ensure that slurry is forced into pores and hairline cracks.
 - 1. First Coat (of one or two coat applications): Apply crystalline waterproofing slurry coat to specified locations and as indicated on the drawings in accordance with manufacturer's product data.
 - 2. Second Coat (of two coat applications): Where indicated on drawings or as required by manufacturer's product data, apply crystalline waterproofing slurry coat while first coat of crystalline waterproofing is still "green" but after it has reached an initial set. Use light pre-watering between coats. Contractor shall ensure that all curing requirements are met prior to application. If curing requirements are not met, contractor shall follow manufacturer recommendations to remediate.

3.04 CURING

- A. Begin curing as soon as crystalline waterproofing has hardened sufficiently so as not to be damaged by a fine spray. Cure with a mist fog spray of clean water at a frequency and duration as recommended by the waterproofing manufacturer, or cover treated surfaces with damp burlap for the prescribed period. In warm climates, more than three sprayings per day may be necessary to prevent excessive drying of coating.
- B. Do not lay plastic sheeting directly on the waterproofing coating as air contact is required for proper curing. If poor circulation exists in treated areas, it may be necessary to provide fans or blown air to aid in curing of waterproofing treatment.
- C. For concrete holding structures such as reservoirs, water treatment tanks and wet wells, cure for three days and allow treatment to set (air cure) for 12 days before filling structure with liquid. For structures holding hot or corrosive liquids, cure waterproofing treatment for three days and allow to set for 18 days before filling.
- D. During the curing period, protect treated surfaces from damage by wind, sun, rain and temperatures below 36°F. If plastic sheeting is used for protection, sheets must be elevated above waterproofing coating to allow sufficient air circulation.

3.05 FIELD QUALITY CONTROL

- A. Do not conceal installed waterproofing system before installation has been observed by Architect/Engineer and other designated entities.

- B. For watertightness testing after concrete repairs and coating are complete, refer to specification 01 88 16 – Watertightness Testing of Concrete Structures.

3.06 CLEANING AND PROTECTION

1. Clean spillage and soiling from adjacent surfaces using appropriate cleaning agents and procedures.
2. Take measures to protect completed coating from damage after application. Do not permit traffic on unprotected coating.

END OF SECTION

SECTION 07 90 00
JOINT FILLERS, SEALANTS AND CAULKING

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. Furnish labor, materials, equipment and appliances required for the complete execution of Work shown on the Drawings and specified herein.

1.02 RELATED WORK SPECIFIED ELSEWHERE

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.
 - 1. ASTM C-920 – Elastomeric Joint Sealants
 - 2. ASTM D-1056 – Flexible Cellular Materials – Sponge or Expanded Rubber
 - 3. SWRI – Sealant and Caulking Guide Specification

1.04 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in Section 01 33 00 – Submittal Procedures, submit the following:
 - 1. Manufacturers literature and installation instructions. Label each product submitted with Type as indicated in paragraph 2.01 A.
 - 2. Color samples of each type of sealant.

1.05 QUALITY ASSURANCE

- A. Applicator shall be a company specializing in the installation of sealants with a minimum of five years of experience.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials in unopened labeled packages.
- B. Store materials in location protected from freezing or damages.
- C. Reject and remove from the site materials within broken or damaged packaging.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Sealants

1. Type 1: Multi-component, non-sag, low-modulus polyurethane rubber sealant meeting ASTM C-920, Type M, Grade NS, Class 25, use NT, M, A, and O. Capable of withstanding 50% in extension or compression such as Sikaflex-2C NS/SL, Sika Corporation, or Sonolastic NP-2, Sonneborn, or DynaTrol II by Pecora Corporation.
2. Type 2: Single component polyurethane sealant meeting ASTM C-920, Type S, Grade NS, Class 25, Use NT, M, A, and O. Capable of withstanding 25% in extension or compression such as Sikaflex 1A by Sika Corporation, DynaTrol 1-XL by Pecora Corporation, or Sonolastic NP-1 by Master Builders Solutions.
3. Type 3: Single component, low-modulus moisture curing silicone meeting ASTM C-920, Type S, Grade NS, Class 25, Use NT, M, G, and A. Capable of withstanding 50% extension and compression. Pecora 890 by Pecora Corporation, Sonolastic Omni Seal by Master Builders Solutions.

- B. Primer: Non-staining primer recommended by sealant manufacturer for the substrates on this project.
- C. Backer Rod: Closed cell foam, nonreactive with caulking materials, non-oily, and approved by the sealant manufacturer. Minimum density shall be 2.00 pounds per cubic foot. Use no asphalt or bitumen-impregnated fiber with sealants.
- D. Joint Cleaner: Recommended by sealant or caulking compound manufacturer.
- E. Bond breaker: Either polyethylene film or plastic tape as recommended by the sealant manufacturer.
- F. Color: Where manufacturer's standard colors do not closely match materials being sealed, provide a custom color.

PART 3 – EXECUTION

3.01 QUALITY CONTROL

- A. Coordinate work with details shown on approved shop drawings prepared by other trades.
- B. Verify conditions in the field.
- C. Schedule work to follow closely the installation of other trades.

- D. Apply sealants and related items in temperatures and dry conditions recommended by the manufacturers.
- E. Do not paint sealant, unless recommended by sealant and paint manufacturer.

3.02 PREPARATION

- A. Protect finished surfaces adjoining by using masking tape or other suitable materials.
- B. Clean and prime joints before starting any caulking or sealing work.
- C. Thoroughly clean joints and spaces of mortar and other foreign materials. Cleaning agent shall be Xylol or similar non-contaminating solvent to remove any film from metal surfaces. Masonry or concrete surfaces shall be brushed or air jet cleaned.
- D. Joint Requirements
 - 1. All joints and spaces to be sealed in exterior work shall be less than ½-inch deep and not less than 1/4 inch wide. If joints in masonry are less than that specified herein, the mortar shall be cut out to the required width and depth. All joints and spaces to receive sealant shall be completely prepared and thoroughly dry before installation of sealant.
 - 2. Unless otherwise specified, joints and spaces which are open to a depth of 1/2 inch or greater shall be solidly filled with back-up material to within 1/4 inch of the surface. Back-up material shall be packed tightly and made continuous throughout the length of the joints. Bond breaker shall be applied as required. If joints are less than ¼-inch deep, the back-up material may be omitted, a bond breaker substituted and the joint completely filled with sealant. The back-up material shall not project beyond the ¼-inch depth of the open space in any joint. The following width-to-depth ratio table shall be adhered to, unless otherwise recommended by manufacturer.

Joint Width	Sealant Depth	
	Minimum	Maximum
¼ inch	1/4 inch	1/4 inch
Over 1/4 inch to 1/2 inch	1/4 inch	Equal to width
Over 1/2 inch to 1 inch	1/2 inch	Equal to width
Over 1 inch to 2 inches	1/2 inch	1/2 of width

3.03 APPLICATION

- A. Exercise care before, during, and after installation so as not to damage any material by tearing or puncturing. All finished work shall be approved before covering with any other material or construction.
- B. Apply sealant by an approved type of gun except where the use of a gun is not practicable, suitable hand tools shall be used. Avoid applying the compound to any surface outside of the joints or spaces to be sealed. Mask areas where required to prevent overlapping of sealant.
- C. All joints shall be waterproof and weathertight.
- D. Point sealed joints to make a slightly concave joint, the edges of which are flush with the surrounding surfaces. Exposed joints in the interior side of the door and other frames shall be neatly pointed flush or to match adjacent jointing work.
- E. Adjacent materials which have been soiled shall be cleaned immediately and the work left in neat and clean condition.
- F. Comply with sealant manufacturer's written instructions except where more stringent requirements are shown or specified and except where manufacturer's technical representative directs otherwise.

3.04 ADJUSTMENT AND CLEANING

- A. Remove misplaced sealant compounds promptly using methods and materials recommended by the manufacturer, as the work progresses.
- B. Allow sealants to cure and remove protective edging, of doors, louvers, saddles windows etc. as directed by the Engineer.

3.05 SCHEDULE

Schedule of Sealants

Application	Sealant	Color
Vertical and horizontal expansion and construction joints in concrete structures unless noted otherwise herein or on Drawings.	Type 1	To closely match adjacent surfaces or mortar and as selected by the Owner.
Vertical and horizontal joints bordered on both sides by masonry, precast concrete, natural stone or other porous building material, unless noted otherwise herein or on Drawings.	Type 2	To closely match adjacent surfaces or mortar and as selected by the Owner.
Vertical and horizontal joints bordered on both sides by painted metals, anodized aluminum, mill finished aluminum, PVC, glass or other non-porous building material.	Type 3	To closely match adjacent surfaces and as selected by the Owner.

Schedule of Sealants

Application	Sealant	Color
Masonry expansion and control joints less than 1¼" wide.	Type 2	To closely match adjacent surfaces and as selected by the Owner.
Masonry expansion and control joints equal or greater than 1¼ inches wide and not to exceed 2".	Type 1	To closely match adjacent surfaces and as selected by the Owner.
Submerged in liquids. ^{3,4}	Type 1	Manufacturer's standard
Other joints indicated on the drawings or customarily sealed but not listed.	Type recommended by manufacturer	To closely match adjacent surfaces and as selected by the Owner.

¹ Sealant for Laboratory Countertop shall be as recommended by countertop manufacturer.

² Provide UL approved sealants for penetrations thru fire-rated walls and as specified in Section 07 84 00 - Firestopping.

³ Sealants which will come in contact with potable water shall meet the requirements of NSF 61.

⁴ Where sealant will be immersed in liquid chemicals verify compatibility prior to installation of sealant.

END OF SECTION

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SECTION 09 90 00

PAINTING

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. Furnish labor, materials, equipment and appliances required for complete execution of Work shown on Drawings and Specified herein.
- B. Section Includes:
 - 1. Paint Materials
 - 2. Shop Painting
 - 3. Field Painting
 - a. Surface Preparation
 - b. Piping and Equipment Identification
 - c. Schedule of Colors
 - d. Work in Confined Spaces
 - e. OSHA Safety Colors

1.02 RELATED SECTIONS

- A. Section 40 05 97 – Piping and Equipment Identification Systems
- B. Section 07 90 00 – Joint Fillers, Sealants, and Caulking

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Without limiting the generality of these specifications, the Work shall conform to the applicable requirements of the following documents:
 - 1. SSPC – The Society for Protective Coatings Standards
 - a. SSPC-Vis 1 – Pictorial Surface Preparation Standards for Painting Steel Structures
 - b. SSPC-SP2 – Hand Tool Cleaning
 - c. SSPC-SP3 – Power Tool Cleaning

- d. SSPC-SP5/NACE 1 – White Metal Blast Cleaning
 - e. SSPC-SP6/NACE 3 – Commercial Blast Cleaning
 - f. SSPC-SP7/NACE 4 – Brush-off Blast Cleaning
 - g. SSPC-SP10/NACE 2 – Near-White Metal Blast
 - h. SSPC-SP11 – Power Tool Cleaning to Bare Metal
 - i. SSPC-SP13/NACE6 – Surface Preparation of Concrete
- 2. ICRI – International Concrete Repair Institute
 - 3. NACE – National Association of Corrosion Engineers
 - 4. NAFP – The National Association of Pipe Fabricators
 - 5. ASTM D1737 – Test Method for Elongation of Attached Organic Coatings with Cylindrical Mandrel Apparatus
 - 6. ASTM B117 – Method of Salt Spray (Fog) Testing
 - 7. ASTM D4060 – Test Method for Abrasion Resistance of Organic Coating by the Taber Abraser
 - 8. ASTM D3359 – Method for Measuring Adhesion by Tape Test

1.04 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in Section 01 33 00 – Submittal Procedures, submit the following:
 - 1. Manufacturer's literature and Material Safety Data Sheets for each product.
 - 2. Painting schedule identifying surface preparation and paint systems proposed. Cross reference with Tables 1 and 2. Provide the name of the paint manufacturer, and name, address, and telephone number of manufacturer's representative who will inspect the work. Submit schedule for approval as soon as possible following the Award of Contract, so approved schedule may be used to identify colors and specify shop paint systems for fabricated items. Manufacturer shall substitute paint system with equal performance where required for VOC compliance.
 - 3. Contractor shall submit Q.C. Inspection plan describing all tests and inspections task to be performed. Include copy of daily log showing environmental conditions measurements and frequency. Copy of completed log shall be provided at completion of work.

1.05 SYSTEM DESCRIPTION

- A. Work shall include surface preparation, paint application, inspection of painted surfaces and corrective action required, protection of adjacent surfaces, cleanup and appurtenant work required for the proper painting of all surfaces to be painted. Surfaces to be painted are designated within the Painting Schedule and may include new and existing piping, miscellaneous metals, equipment, buildings, exterior fiberglass, exposed electrical conduit and appurtenances.
- B. Perform Work in strict accordance with manufacturer's published recommendations and instructions, unless the Engineer stipulates that deviations will be for the benefit of the project.
- C. Paint surfaces which are customarily painted, whether indicated to be painted or not, with painting system applied to similar surfaces, areas and environments, and as approved by Engineer.
- D. Piping and equipment shall receive color coding and identification. Equipment shall be the same color as the piping system.

1.06 QUALITY ASSURANCE

- A. Painting operations shall be accomplished by skilled craftsman and licensed by the state/commonwealth to perform painting work.
- B. Provide a letter indicating that the painting applicator has five years of experience, and 5 references which show previously successful application of the specified or comparable painting systems. Include the name, address, and the telephone number for the Owner of each installation for which the painting applicator provided services.
- C. Contractor shall coordinate Q.C Inspections.
- D. Notify Owner and Engineer at completion of surface preparation, priming application and final cure to allow inspection by Owner and Engineer or their Third-Party Inspector.

1.07 STORAGE AND DELIVERY

- A. Bring materials to the job site in the original sealed and labeled containers.
- B. Container label to include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
- C. Store paint materials at minimum ambient temperature of 45 degrees F (7 degrees C) and a maximum of 90 degrees F (32 degrees C), in ventilated area, and as required by manufacturer's instructions.

PART 2 – MATERIALS

2.01 GENERAL INFORMATION

- A. The term "paint" is defined as both paints and coatings including emulsions, enamels, stains, varnishes, sealers, and other coatings whether organic or inorganic and whether used as prime, intermediate, or finish coats.
- B. Purchase paint from an approved manufacturer. Manufacturer shall assign a representative to inspect application of their product both in the shop and field. The manufacturer's representative shall submit a report to the Engineer at the completion the Work identifying products used and verifying that surfaces were properly prepared, products were properly applied, and the paint systems were proper for the exposure and service.
- C. Provide primers and intermediate coats produced by same manufacturer as finish coat. Use only thinners approved by paint manufacturer, and only within manufacturer's recommended limits.
- D. Ensure compatibility of total paint system for each substrate. Test shop primed equipment delivered to the site for compatibility with final paint system. Provide an acceptable barrier coat or totally remove shop applied paint system when incompatible with system specified, and repaint with specified paint system.
- E. Use painting materials suitable for the intended use and recommended by paint manufacturer for the intended use.
- F. Require that personnel perform work in strict accordance with the latest requirements of OSHA Safety and Health Standards for construction. Meet or exceed requirements of regulatory agencies having jurisdiction and the manufacturer's published instructions and recommendations. Maintain a copy of all Material Safety Data Sheets at the job site of each product being used prior to commencement of work. Provide and require that personnel use protective and safety equipment in or about the project site. Provide respiratory devices, eye and face protection, ventilation, ear protection, illumination and other safety devices required to provide a safe work environment.

2.02 ACCEPTABLE MANUFACTURERS

- A. Subject to compliance with the Specifications, provide products from one of the following manufacturers:
 - 1. Tnemec Company Inc.
 - 2. PPG
 - 3. CARBOLINE
 - 4. Sherwin-Williams

5. International Paints (Akzo Nobel)

PART 3 – EXECUTION

3.01 SHOP PAINTING

- A. Shop prime fabricated steel and equipment with at least one shop coat of prime paint compatible with finish paint system specified. Prepare surface to be shop painted in strict accordance with paint manufacturer's recommendations and as specified. Finish coats may be shop applied, if approved by the Engineer. Package, store and protect shop painted items until they are incorporated into Work. Repair painted surfaces damaged during handling, transporting, storage, or installation to provide a painting system equal to the original painting received at the shop.
- B. Identify surface preparation and shop paints on Shop Drawings. Verify compatibility with field applied paints.
- C. Coordinate shop painting and field coating to ensure item is delivered and field coating occurs within recoat window of shop painted system requirements.

3.02 SURFACE PREPARATION

- A. General
 - 1. Surfaces to be painted shall be clean and dry, and free of dust, rust, scale, and foreign matter. No solvent cleaning, power or hand tool cleaning shall be permitted unless approved by the Engineer.
 - 2. Protect or remove, during painting operations, hardware, accessories, machined surfaces, nameplates, lighting fixtures, and similar items not intended to be painted prior to cleaning and painting. Reposition items removed upon completion of painting operations.
 - 3. Examine surfaces to be coated to determine that surfaces are suitable for specified surface preparation and painting. Report to Engineer surfaces found to be unsuitable in writing. Do not start surface preparation until unsuitable surfaces have been corrected. Starting surface preparation precludes subsequent claim that such surfaces were unsuitable for the specified surface preparation or painting.
 - 4. Surface preparation shall be in accordance with specifications and manufacturer's recommendations. Provide additional surface preparation, and fill coats where manufacturer recommends additional surface preparation, in addition to requirements of specification.
 - 5. Touch-up shop or field applied coatings damaged by surface preparation or any other activity, with the same shop or field applied coating; even to the extent of applying an entire coat when required to correct damage prior to application of the

next coating. Touchup coats are in addition to the specified applied systems, and not considered a field coat.

6. Protect motors and other equipment during blasting operation to ensure blasting material is not blown into motors or other equipment. Inspect motors and other equipment after blasting operations and certify that no damage occurred, or where damage occurred, the proper remedial action was taken.
7. Field paint shop painted equipment in compliance with Color Coding and as approved by Engineer.

B. Metal Surface Preparation

1. Prepare all welds to a minimum NACE weld preparation level "C" per NACE Standard SP0178. Provide additional weld preparation where required by the coating manufacturer. Contractor shall provide NACE SP0178 weld mold visual aids on site for evaluation of all weld preparation.
2. Conform to current The Society for Protective Coatings Standards (SSPC) Specifications for metal surface preparation. Use SSPC-Vis-1 pictorial standards or NACE visual standards TM-01-70 or TM-01-75 to determine cleanliness of abrasive blast cleaned steel.
3. Perform blast cleaning operations for metal when following conditions exist:
 - a. Moisture is not present on the surface.
 - b. Relative humidity is below 80%.
 - c. Ambient and surface temperatures are 5°F or greater than the dew point temperature.
 - d. Painting or drying of paint is not being performed in the area.
 - e. Equipment is in good operating condition.
 - f. Proper ventilation, illumination, and other safety procedures and equipment are being provided and followed.
4. Abrasive blast ferrous metals to be shop primed, or component mechanical equipment in accordance with SSPC-SP5, White Metal Blast.
5. Abrasive blast field prepared ferrous metals in accordance with SSPC-SP10, Near White Metal Blast, where metal is to be submerged, in a corrosive environment, or in severe service. Provide a 3.0 mil minimum angular anchor profile unless recommended otherwise by the coating manufacturer in writing.
6. Abrasive blast field prepared ferrous metals in accordance with SSPC-SP6 Commercial Blast, where metal is to be used in mild or moderate service, or non-

corrosive environment or weathering exposure. Provide a 1.5 mil minimum angular anchor profile unless recommended otherwise by the coating manufacturer in writing.

7. Clean nonferrous metals, copper, or galvanized metal surfaces in accordance to SSPC-SP1, Solvent Cleaning, or give one coat of metal passivator or metal conditioner compatible with the complete paint system. Galvanized metal shall be prepared in accordance with SSPC SP-16. Abrasive blast clean to increase mechanical adhesion in accordance with ASTM D6386, Standard Practice for Preparation of Zinc (Hot-Dip Galvanized) Coated Iron and Steel Product and Hardware Surfaces for Painting when required by coating manufacturer. Provide a 1.5 mil minimum angular anchor profile unless recommended otherwise by the coating manufacturer in writing.
8. Abrasive blast clean internal and external ductile iron pipe surfaces prior to coating in accordance with NAPF 500-03-04, Surface Preparations Standard for Abrasive Blast Cleaning of Ductile Iron Pipe. Abrasive blast clean internal and external cast ductile iron and cast-iron fitting surfaces in accordance with NAPF-03-05.
9. Prime cleaned metals immediately after cleaning to prevent rusting.
10. Clean rusted metals down to bright metal by abrasive blasting and immediately field primed.

C. Concrete Surface Preparation

1. Cure concrete a minimum of 28 days at 75° F before surface preparation, and painting begins. Allow more time at lower temperatures if specified by paint manufacturer.
2. Test concrete for pH and salts using test methods recommended by the paint manufacturer. A minimum of one test per 1000 square feet of area to be coated shall be performed unless approved otherwise by Engineer. Do not begin surface preparation, or painting until acceptable to manufacturer.
3. Moisture content of concrete and masonry surfaces shall conform to manufacturer's recommended limits, and as listed in SSPC-SP13/NACE 6 Section 6 Acceptance Criteria Table 1. Floor surfaces to be coated shall be tested in accordance with ASTM F1869 – Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride or as required by the coating manufacturer. Moisture vapor transmission shall not exceed three pounds per 1,000 square feet in a 24-hour period or less if specified by Coating Manufacturer. Vertical and horizontal overhead surfaces shall be tested in accordance with ASTM F2170 – Standard Test Method for Determining Relative Humidity in Concrete using in situ Probes (relative humidity shall not exceed 80% or as required by the coating manufacturer) or with ASTM D4263 – Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Test Method (test results shall be no moisture present). Engineer or Coating

Manufacturer Representative shall specify all test locations. A minimum of one test per 1000 square feet of area to be coated shall be performed unless approved otherwise by Engineer.

4. Prepare concrete surfaces to receive coatings in accordance with NACE 6/SSPC-13 – Joint Surface Preparation Standards and ICRI Technical Guidelines. Remove contaminants, open bugholes, surface voids, air pockets, and other subsurface irregularities using abrasive blasting, shot blasting, water jetting or mechanical abrading. Use dry, oil-free air for blasting operations. Surface texture after blasting shall achieve profile as required by manufacturer or where not defined by manufacturer, profile shall be a minimum ICRI-CSP 5 surface profile. Remove residual abrasives, dust, and loose particles by vacuuming or other approved method.
5. Surface defects, such as hollow areas, bugholes, honeycombs, and voids shall be filled with polymeric or waterborne epoxy cementitious filler compatible with painting system. Complete fill coats may be used in addition to specified painting system and as approved by the Engineer. Fins, form marks, and all protrusions or rough edges shall be removed.
6. Repair existing concrete surfaces which are deteriorated to the point that surface preparation exposes aggregate with fill coats or patching mortar as recommended by paint manufacturer and as directed by the Engineer.
7. Clean concrete of all dust, form oils, curing compounds, oil, tar, laitance, efflorescence, loose mortar, and other foreign materials before paints are applied.
8. To ease coating around outside corners, provide $\frac{3}{4}$ -inch chamfered edges on all new concrete outside corners and grind existing concrete outside corners to a minimum radius of $\frac{3}{4}$ -inch.
9. Unless recommended otherwise by the coating manufacturer, provide $\frac{1}{4}$ " deep by $\frac{1}{4}$ " wide tool cut terminations at 1-inch maximum from all coating edges for anchorage. Provide terminations around all equipment, piping, openings, gates, top and bottom of walls, stop locations of each day's work and overlap onto previously completed work. Transition coating 3-inches onto interior lining of piping except where coating compatibility concerns are noted by coating manufacturer.
10. Apply epoxy or polymeric filler compatible with painting system to all inside corners of areas to be coated with a margin trowel to form a continuous 45-degree cant cove across corners with a minimum dimension of 1.5-inch. Roughen or prepare cured filler as recommended by coating manufacturer for proper coating adhesion.
11. All equipment grouting shall be installed and cured prior to starting coating work. Coating shall be applied over grout up to the edges of all equipment, gates and uninterrupted piping unless specifically noted otherwise.

D. Castings

1. Prepare castings for painting by applying a brush or a knife-applied filler. Fillers are not to be used to conceal cracks, gasholes, or excessive porosity.
2. Apply one coat of primer with a minimum thickness of 1.2 mils in addition to coats specified. Allow sufficient drying time before further handling.

E. Masonry

1. Cure for a minimum of 30 days prior to paint application.
2. Clean masonry surfaces free from all dust, dirt, oil, grease, loose mortar, chalky deposits, efflorescence, and other foreign materials.
3. Test masonry for moisture content. Use test method recommended by paint manufacturer. Do not begin painting until moisture content is acceptable to manufacturer.

F. Gypsum Drywall

1. Sand joint compound with sandpaper to provide a smooth flat surface. Avoid sanding of adjacent drywall paper.
2. Remove dust, dirt, and other contaminants.

G. Previously-Painted Surfaces

1. Totally remove existing paint when: surface is to be submerged in a severe environment, paint is less than 75% intact, brittle, eroded or has underfilm rusting.
2. Surfaces which are greater than 75% intact require removal of failed paints and then spot primed. Spot priming is in addition to coats specified.
3. Remove surface contamination such as oil, grease, loose paint, mill scale, dirt, foreign matter, rust, mold, mildew, mortar, efflorescence, and sealers.
4. Clean and dull glossy surfaces prior to painting in accordance with the manufacturer's recommendations.
5. Check existing paints for compatibility with new paint system. If incompatible, totally remove existing paint system or apply a barrier coat recommended by the paint manufacturer. Remove existing paints of undetermined origin. Prepare a test patch of approximately 3 square feet over existing paint. Allow test patch to dry thoroughly and test for adhesion. If proper adhesion is not achieved remove existing paint and repaint.

3.03 APPLICATION OF PAINT

- A. Apply paint by experienced painters with brushes or other applicators approved by the Engineer, and paint manufacturer.
- B. Apply paint without runs, sags, thin spots, or unacceptable marks.
- C. Apply at rate specified by the manufacturer to achieve at least the minimum dry mil thickness specified. Apply additional coats, if necessary, to obtain thickness.
- D. Special attention shall be given to nuts, bolts, edges, angles, flanges, welds, etc., where insufficient film thicknesses are likely. Stripe paint outside corners and edges in accordance with SSPC PA Guide 11. Stripe painting shall be in addition to coats specified.
- E. Perform thinning in strict accordance with the manufacturer's instructions, and with the full knowledge and approval of the Engineer and paint manufacturer.
- F. Allow paint to dry a minimum of twenty-four hours between application of any two coats of paint on a particular surface, unless shorter time periods are a requirement by the manufacturer. Longer drying times may be required for abnormal conditions as defined by the Engineer and paint manufacturer. Do not exceed manufacturer's recommended drying time between coats.
- G. Suspend painting when any of the following conditions exist:
 - 1. Rainy or excessively damp weather.
 - 2. Relative humidity exceeds 85%.
 - 3. General air temperature cannot be maintained at 50°F or above through the drying period, except on approval by the Engineer and paint manufacturer.
 - 4. Relative humidity will exceed 85% or air temperature will drop below 40°F within 18 hours after application of paint.
 - 5. Surface temperature of item is within 5 degrees of dewpoint.
 - 6. Dew or moisture condensation are anticipated.
 - 7. Surface temperature exceeds the manufacturer's recommendations.
- H. Where application of coating across concrete control joints or expansion joints has the potential to crack, turn coating into joints and caulk joints with a sealant compatible with coating rated for the intended service per Section 07 90 00 – Joint Fillers, Sealants, Caulking.

3.04 INSPECTION

- A. Each field coat of paint will be inspected and approved by the Engineer or his authorized representative before succeeding coat is applied. Tint successive coats so that no two coats for a given surface are exactly the same color. Tick-mark surfaces to receive black paint in white between coats.
- B. Use magnetic dry film thickness gauges and wet film thickness gauges for quality control. Furnish magnetic dry film thickness gauge for use by the Engineer.
- C. Coatings shall pass a holiday detector test.
- D. Determination of Film Thickness: Randomly selected areas, each of at least 107.5 contiguous square feet, totaling at least 5% of the entire control area shall be tested. Within this area, at least 5 squares, each of 7.75 square inches, shall be randomly selected. Three readings shall be taken in each square, from which the mean film thickness shall be calculated. No more than 20 percent of the mean film thickness measurements shall be below the specified thickness. No single measurement shall be below 80 percent of the specified film thickness. Total dry film thickness greater than twice the specified film thickness shall not be acceptable. Areas where the measured dry film thickness exceeds twice that specified shall be completely redone unless otherwise approved by the Engineer. When measured dry film thickness is less than that specified additional coats shall be applied as required.
- E. Holiday Testing: Holiday test painted ferrous metal surfaces which will be submerged in water or other liquids, or surfaces which are enclosed in a vapor space in such structures. Mark areas which contain holidays. Repair or repaint in accordance with paint manufacturer's printed instructions and retest.
 - 1. Dry Film Thickness Exceeding 20 Mils: For surfaces having a total dry film thickness exceeding 20 mils: Pulse-type holiday detector such as Tinker & Rasor Model AP-W, D.E. Stearns Co. Model 14/20, shall be used. The unit shall be adjusted to operate at the voltage required to cause a spark jump across an air gap equal to twice the specified coating thickness.
 - 2. Dry Film Thickness of 20 Mils or Less: For surfaces having a total dry film thickness of 20 mils or less: Tinker & Rasor Model M1 non-destructive type holiday detector, K-D Bird Dog, shall be used. The unit shall operate at less than 75-volts. For thicknesses between 10 and 20 mils, a non-sudsing type wetting agent, such as Kodak Photo-Flow, shall be added to the water prior to wetting the detector sponge.
- F. Paint manufacturer's NACE certified representative shall provide their services as required by the Engineer. Services shall include, but not be limited to, inspecting existing paint, determination of best means of surface preparation, inspection of completed work, and final inspection of painted work 11 months after the job is completed.

3.05 PROTECTION OF ADJACENT PAINT AND FINISHED SURFACES

- A. Use covers, masking tape, other method when protection is necessary, or requested by Owner or Engineer. Remove unwanted paint carefully without damage to finished paint or surface. If damage does occur, repair the entire surface adjacent to and including the damaged area without visible lapmarks and without additional cost to the Owner.
- B. Take all necessary precautions to contain dispersion of abrasive blasting debris and paint to the limits of the work. Take into account the effect of wind and other factors which may cause dispersion of the abrasive blasting debris and paint. Suspend painting operations when abrasive blasting debris or paint cannot be properly confined. Assume all responsibilities and cost associated with damage to adjacent structures, vehicles, or surfaces caused by the surface preparation and painting operations.

3.06 PIPING AND EQUIPMENT IDENTIFICATION

- A. Piping and equipment identification shall be in accordance with the Owner's scheme of identification. Contractor must submit to the Owner proposed colors, labels, and letter sizes for approval prior to execution of Work.

3.07 SCHEDULE OF COLORS

- A. Match colors existing colors. Contractor shall submit to the Owner proposed colors. No variation shall be made in colors without the Engineer's approval. Color names and numbers shall be identified according to the appropriate color chart issued by the manufacturer of the particular product in question.

3.08 WORK IN CONFINED SPACES

- A. Provide and maintain safe working conditions for all employees. Supply fresh air continuously to confined spaces through the combined use of existing openings, forceddraft fans and temporary ducts to the outside, or direct air supply to individual workers. Exhaust paint fumes to the outside from the lowest level in the contained space. Provide explosionproof electrical fans, if in contact with fumes. No smoking or open fires will be permitted in, or near, confined spaces where painting is being done. Follow OSHA, state/commonwealth, and local regulations at all times.

3.09 OSHA SAFETY COLORS

- A. Paint wall around wall-mounted breathing or fire apparatus with the appropriate safety red color; area not to exceed 2 feet wide by 3 feet high, unless apparatus covers the area. Fire apparatus include fire hoses, extinguisher, and hydrants.
- B. Paint hazardous areas and objects in accordance with OSHA regulations.

3.10 VOC REGULATIONS

- A. Provide paint systems in accordance with local, state, and federal regulations. Where paint systems shown in schedule do not comply substitute equal products with VOC limits which comply with local, state, and federal regulations.

Table 1: Painting Schedule

Surface	Application	Painting System and No. of Coats	Product Reference (Table 2)	Total Min. Dry Film Thickness (Mils)
Concrete and Masonry				
Interior masonry and concrete walls and ceilings		1 coat sealer 2 coats acrylic epoxy	101 116	75-85 sq.ft./gal. 4-6/coat
Interior masonry and concrete walls in chemical rooms		1 coat sealer 2 coats epoxy polyamide	117 102	60-80 sq.ft./gal. 4-6/coat
Metals				
Interior and exterior nonsubmerged (gloss)	All new valves, motors and mechanical equipment, piping, etc.	1 coat epoxy polyamide primer	104	4-6
		1 coat epoxy polyamide	102	4-6
		1 coat aliphatic polyurethane	115	3-5
Other				
PVC Piping		1 coat epoxy polyamide	102	5-8
		1 coat aliphatic polyurethane	115	3-4

1 Painting manufacturer shall verify compatibility of containment liner and chemical to be contained. Where incompatible substitute a compatible coating system.

Ref.	System	Purpose	Product			
			Tnemec Series	PPG/AMERON	CARBOLINE	Sherwin-Williams
101	Acrylic filler	Primer-sealer	130-6601	BLOXFIL 4000	Sanitile 100	Cement-Plex 875
102	Epoxy polyamide	Finish coat semi-gloss or gloss	N69	AMERLOCK 2	Carboguard 890	Macropoxy 646
103	Acrylic latex	Sealer	1028/1029	PITT TECH PLUS	Carbocrylic 3359DTM	DTM Acrylic Primer/Finish
104	Epoxy Polyamide – metal	Primer	66	AMERCOAT 385	Carboguard 893SG	Macropoxy 646
105	Epoxy	Primer/Finish	N140	AMERLOCK 2	Carboguard 61/891VOC	Macropoxy 646 PW
106	Coal tar epoxy	Finish high-coat build	46H-413	AMERCOAT 78HB	Bitumastic 300M	Hi-Mil Sher Tar Epoxy
107	Coal tar	Sealer	46-465	AMERCOAT 78HB	Bitumastic 300M	Hi-Mil Sher Tar Epoxy
108	Alkyd-medium oil	Finish coat	2H	DEVGUARD 4308	Carbocoat 8215	Industrial Enamel
109	Alkyd-long oil	Finish coat	1029	DEVGUARD 4308	Carbocoat 8215	Industrial Enamel
110	Epoxy polyamide	Primer	66-1211	AMERCOAT 385	Carboguard 893SG	Macropoxy 646
112	Epoxy polyamide	Sealer	66-1211	AMERCOAT 385	Carboguard 893SG	Macropoxy 920 Pre-Prime
113	Urethane	Barrier coat	530	AMERLOCK SEALER	Rustbond	-
114	Polyamine Epoxy	Intermediate coat	27	AMERLOCK 385	Carboguard 893SG	-
115	Aliphatic Polyurethane	Finish coat	1074 or 1075	AMERCOAT 450 HS	Carbothane 134HG	Acrolon 218HS
116	Acrylic epoxy	Finish coat	113 or 114	AQUAPON WB	Sanitile 255	Water-Based Catalyzed Epoxy
117	Epoxy block filler	Sealer	1254	AMERLOCK 114	Sanitile 500	Kem Cati-Coat HS Epoxy Filler
118	Catalyzed epoxy	Finish coat	84	AMERLOCK 2/400	Carboguard 890	Macropoxy 646
119	High solids epoxy	Finish coat	104	AMERLOCK 400	Carboguard 890	Dura-Plate 235
120	Epoxy	Top coat	N69	AMERLOCK 2/400	Carboguard 890	-

Table 2: Product Listing

END OF SECTION

SECTION 26 05 00
BASIC ELECTRICAL REQUIREMENTS

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish all labor, materials, tools, and equipment, and perform all work and services necessary for, or incidental, to the furnishing and installation of all electrical work as shown on the Drawings, and as specified in accordance with the provisions of the Contract Documents and completely coordinate with the work of other trades involved in the general construction. Although such work is not specifically shown or specified, all supplementary or miscellaneous items, appurtenances, and devices incidental to or necessary for a sound, secure, and complete installation shall be furnished and installed as part of this work. The Contractor shall obtain approved Shop Drawings showing wiring diagrams, connection diagrams, roughing-in and hook up details for all equipment and comply therewith. All electrical work shall be complete and left in operating condition in accordance with the intent of the Drawings and the Specifications for the electrical work.
- B. Reference Section 40 61 13 – Process Control System General Provisions and General Requirements for scope of work details as they relate to the Division 40 Subcontractor.
- C. The electrical scope of work for this project primarily includes, but is not limited to, the following:
 - 1. Furnish and install all aboveground raceway systems including conduit, fittings, boxes, supports, and other pertinent components.
 - 2. Furnish and install all low voltage wire and cable resulting in a complete and operable electrical system.
 - 3. Furnish and install new wiring devices.
 - 4. Other electrical work as specified herein and indicated on the Drawings.
- D. All material and equipment must be the product of an established, reputable, and approved manufacturer; must be new and of first class construction; must be designed and guaranteed to perform the service required; and must bear the label of approval of the Underwriters Laboratories, Inc., where such approval is available for the product of the listed manufacturer as approved by the Engineer.
- E. When a specified or indicated item has been superseded or is no longer available, the manufacturer's latest equivalent type or model of material or equipment as approved by the Engineer shall be furnished and installed at no additional cost to the Owner.

- F. Where the Contractor's selection of equipment of specified manufacturers or additionally approved manufacturers requires changes or additions to the system design, the Contractor shall be responsible in all respects for the modifications to all system designs, subject to approval of the Engineer. The Contractor's bid shall include all costs for all work of the Contract for all trades made necessary by such changes, additions or modifications or resulting from any approved substitution.
- G. Furnish and install all stands, racks, brackets, supports, and similar equipment required to properly serve the equipment which is furnished under this Contract, or equipment otherwise specified or indicated on the Drawings.
- H. All electrical components and systems, including electrical equipment foundations, shall be designed to resist operational forces as well as lateral sway and axial motion from seismic and thermal forces. Seismic support design shall be in accordance with Section 01 73 23 – Seismic Anchorage and Bracing.

1.02 EQUIPMENT LOCATION

- A. The Drawings show the general location of feeders, transformers, outlets, conduits, and circuit arrangements. Because of the small scale of the Drawings, it is not possible to indicate all of the details involved. The Contractor shall carefully investigate the structural and finish conditions affecting the work and shall arrange such work accordingly; furnishing such fittings, junction boxes, and accessories as may be required to meet such conditions. The Contractor shall refer to the entire Drawing set to verify openings, special surfaces, and location of other equipment, or other special equipment prior to roughing-in for panels, switches, and other outlets. The Contractor shall verify all equipment dimensions to ensure that proposed equipment will fit properly in spaces indicated.
- B. Where outlets are shown near identified equipment furnished by this or other Contractors, it is the intent of the Specifications and Drawings that the outlet be located at the equipment to be served. The Contractor shall coordinate the location of these outlets to be near the final location of the equipment served whether placed correctly or incorrectly on the Drawings.

1.03 LOCAL CONDITIONS

- A. The Contractor shall examine the site and become familiar with conditions affecting the work. The Contractor shall investigate, determine, and verify locations of any overhead or buried utilities on or near the site, and shall determine such locations in conjunction with all public and/or private utility companies and with all authorities having jurisdiction. All costs, both temporary and permanent to connect all utilities, shall be included in the Bid. The Contractor shall be responsible for scheduling and coordinating with the local utility for temporary and permanent services.

- B. In addition, the Contractor shall relocate all duct banks, lighting fixtures, receptacles, switches, boxes, and other electrical equipment as necessary to facilitate the Work included in this project. Costs for such work shall be included in the Bid.

1.04 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in Section 01 33 00 – Submittal Procedures and the requirements of the individual Specification Sections, the Contractor shall obtain from the equipment manufacturer and submit the following:
 - 1. Shop Drawings
 - 2. Operation and Maintenance Manuals
 - 3. Spare Parts List
 - 4. Proposed Testing Methods and Reports of Certified Shop Tests
 - 5. Reports of Certified Field Tests
 - 6. Manufacturer's Representative's Certification
- B. Submittals shall be sufficiently complete in detail to enable the Engineer to determine compliance with Contract requirements.
- C. Submittals will be approved only to the extent of the information shown. Approval of an item of equipment shall not be construed to mean approval for components of that item for which the Contractor has provided no information.
- D. Some individual electrical specification sections may require a Compliance, Deviations, and Exceptions (CD&E) letter to be submitted. If the CD&E letter is required and shop drawings are submitted without the letter, the submittal will be rejected. The letter shall include all comments, deviations and exceptions taken to the Drawings and Specifications by the Contractor AND Equipment Manufacturer/Supplier. This letter shall include a copy of this specification section. In the left margin beside each and every paragraph/item, a letter "C", "D", or "E" shall be typed or written in. The letter "C" shall be for full compliance with the requirement. The letter "D" shall be for a deviation from the requirement. The letter "E" shall be for taking exception to a requirement. Any requirements with the letter "D" or "E" beside them shall be provided with a full typewritten explanation of the deviation/exception. Handwritten explanation of the deviations/exceptions is not acceptable. The CD&E letter shall also address deviations, and exceptions taken to each Drawing related to this Specification Section.
- E. Seismic support design for all nonstructural electrical components (conduit, raceways, freestanding equipment, etc.) shall be in accordance with all applicable federal, state/commonwealth and local building code requirements and Section 01 73 23 – Seismic Anchorage and Bracing.

1.05 APPLICABLE CODES AND REQUIREMENTS

A. Conformance

1. Unless otherwise noted, all work, equipment and materials furnished shall conform with the latest available version of the existing rules, requirements and specifications of the following:
 - a. Insurance Rating Organization having jurisdiction
 - b. The serving electrical utility company
 - c. The currently adopted edition of the National Electrical Code (NEC)
 - d. The National Electric Manufacturers Association (NEMA)
 - e. The Institute of Electrical and Electronic Engineers (IEEE)
 - f. The Insulated Cable Engineers Association (ICEA)
 - g. The American Society of Testing Materials (ASTM)
 - h. The American National Standards Institute (ANSI)
 - i. The requirements of the Occupational Safety Hazards Act (OSHA)
 - j. The National Electrical Contractors Association (NECA) Standard of Installation
 - k. National Fire Protection Association (NFPA)
 - l. International Electrical Testing Association (NETA)
 - m. All other applicable Federal, State/Commonwealth and local laws and/or ordinances.
2. All material and equipment shall bear the inspection labels of Underwriters Laboratories, Inc., if the material and equipment is of the class inspected by said laboratories.

B. Nonconformance

1. Any paragraph of requirements in these Specifications, or Drawings, deviating from the rules, requirements and Specifications of the above organizations shall be invalid and their (the above organizations) requirements shall hold precedent thereto. The Contractor shall be held responsible for adherence to all rules, requirements and specifications as set forth above. Any additional work or material necessary for adherence will not be allowed as an extra, but shall be included in

the Bid. Ignorance of any rule, requirement, or Specification shall not be allowed as an excuse for nonconformity. Acceptance by the Engineer does not relieve the Contractor from the expense involved for the correction of any errors which may exist in the drawings submitted or in the satisfactory operation of any equipment.

C. Certification

1. Upon completion of the work, the Contractor shall obtain certificate(s) of inspection and approval from the National Board of Fire Underwriters or similar inspection organization having jurisdiction and shall deliver same to the Engineer and the Owner.

1.06 PERMITS AND INSPECTIONS

- A. The Contractor shall reference the General Conditions and Section 01 11 00 – Summary of Work.

1.07 TEMPORARY LIGHTING AND POWER

- A. The Contractor shall reference the General Conditions and Section 01 51 00 – Temporary Utilities.

1.08 TESTS

- A. Upon completion of the installation, the Contractor shall perform tests for operation, load (Phase) balance, overloads, and short circuits. Tests shall be made with and to the satisfaction of the Owner and Engineer.
- B. The Contractor shall perform all field tests and shall provide all labor, equipment, and incidentals required for testing and shall pay for electric power required for the tests. All defective material and workmanship disclosed shall be corrected by the Contractor at no cost to the Owner. The Contractor shall show by demonstration in service that all circuits and devices are in good operating condition. Test shall be such that each item of control equipment will function not less than five (5) times.
- C. Refer to each individual specification section for detailed test requirements.
- D. The Contractor shall complete the installation and field testing of the electrical installation at least two (2) weeks prior to the startup and testing of all other equipment. During the period between the completion of electrical installation and the startup and testing of all other equipment, the Contractor shall make all components of the Work available as it is completed for their use in performing Preliminary and Final Field Tests.
- E. Before each test commences, the Contractor shall submit a detailed test procedure, and also provide test engineer resume, personnel and scheduling information for the approval by the Engineer. In addition, the Contractor shall furnish detailed test

procedures for any electrical equipment required as part of the field tests of other systems.

1.09 PROTECTIVE DEVICE SETTING AND TESTING

- A. The Contractor shall provide the services of a field services organization to adjust, set, calibrate and test all protective devices in the electrical system. The organization shall be a subsidiary of or have a franchise service agreement with the electrical equipment manufacturer. The qualifications of the organization and resumes of the technicians as well as all data forms to be used for the field testing shall be submitted.
- B. All protective devices in the electrical equipment shall be set, adjusted, calibrated and tested in accordance with the manufacturers' recommendations, the coordination study, and best industry practice.
- C. Proper operation of all equipment associated with the device under test and its compartment shall be verified, as well as complete resistance, continuity and polarity tests of power, protective and metering circuits. Any minor adjustments, repairs and/or lubrication necessary to achieve proper operation shall be considered part of this Contract.
- D. All solid state trip devices shall be checked and tested for setting and operation using manufacturers recommended test devices and procedures.
- E. Circuit breakers and/or contactors associated with the above devices shall be tested for trip and close functions with their protective device.
- F. When completed, the Contractor shall provide a comprehensive report for all equipment tested indicating condition, readings, faults and/or deficiencies in same. Inoperative or defective equipment shall be brought immediately to the attention of the Engineer.
- G. Prior to placing any equipment in service, correct operation of all protective devices associated with this equipment shall be demonstrated by field testing under simulated load conditions.

1.10 POWER SYSTEM STUDIES

- A. The Contractor shall provide power systems studies performed by a registered professional engineer in accordance with Section 26 05 73 – Power System Studies.

1.11 SCHEDULES AND FACILITY OPERATIONS

- A. Since the equipment testing required herein shall require that certain pieces of equipment be taken out of service, all testing procedures and schedules must be submitted to the Engineer for review and approval one (1) month prior to any work beginning. When testing has been scheduled, the Engineer must be notified 48 hours prior to any work to allow time for load switching and/or alternation of equipment. In

addition, all testing that requires temporary shutdown of facility equipment must be coordinated with the Owner/Engineer so as not to affect proper facility operations.

- B. At the end of the workday, all equipment shall be back in place and ready for immediate use should a facility emergency arise. In addition, should an emergency condition occur during testing, at the request of the Owner, the equipment shall be placed back in service immediately and turned over to Owner personnel.
- C. In the event of accidental shutdown of Owner equipment, the Contractor shall notify Owner personnel immediately to allow for an orderly restart of affected equipment.
- D. Maintaining the operation of these facilities during the duration of the construction period is essential and required. The Contractor shall furnish and install temporary equipment as required to maintain facility operation. Reference Section 01 14 00 – Coordination with Owner's Operations for construction sequencing and specific operational constraint information.

1.12 MATERIALS HANDLING

- A. Materials arriving on the job site shall be stored in such a manner as to keep material free of rust and dirt and so as to keep material properly aligned and true to shape. Rusty, dirty, or misaligned material will be rejected. Electrical conduit shall be stored to provide protection from the weather and accidental damage. Rigid non-metallic conduit shall be stored on even supports and in locations not subject to direct sun rays or excessive heat. Cables shall be sealed, stored, and handled carefully to avoid damage to the outer covering or insulation and damage from moisture and weather. Adequate protection shall be required at all times for electrical equipment and accessories until installed and accepted. Materials damaged during shipment, storage, installation, or testing shall be replaced or repaired in a manner meeting with the approval of the Engineer. If space heaters are provided in a piece of electrical equipment, they shall be temporarily connected to a power source during storage. The Contractor shall store equipment and materials in accordance with Section 01 55 00 – Contractor Access and Parking.

1.13 WARRANTIES

- A. Unless otherwise specified in an individual specification section, all electrical equipment and electrical construction materials shall be provided with a warranty in accordance with the requirements of Section 46 00 00 – Equipment General Provisions and the General Conditions.

1.14 TRAINING

- A. Unless otherwise specified in an individual specification section, all training for electrical equipment shall be provided in accordance with the requirements of Section 46 00 00 – Equipment General Provisions.

PART 2 – PRODUCTS

2.01 PRODUCT REQUIREMENTS

- A. Unless otherwise indicated, the materials to be provided under this Specification shall be the products of manufacturers regularly engaged in the production of all such items and shall be the manufacturer's latest design. The products shall conform to the applicable standards of UL and NEMA, unless specified otherwise. International Electrotechnical Commission (IEC) standards are not recognized. Equipment designed, manufactured, and labeled in compliance with IEC standards is not acceptable.
- B. All items of the same type or ratings shall be identical. This shall be further understood to include products with the accessories indicated.
- C. All equipment and materials shall be new, unless indicated or specified otherwise.
- D. The Contractor shall submit proof if requested by the Engineer that the materials, appliances, equipment, or devices that are provided under this Contract meet the requirements of Underwriters Laboratories, Inc., in regard to fire and casualty hazards. The label of or listing by the Underwriters Laboratories, Inc., will be accepted as conforming to this requirement.

2.02 SUBSTITUTIONS

- A. Unless specifically noted otherwise, any reference in the Specifications or on the Drawings to any article, service, product, material, fixture, or item of equipment by name, make, or catalog number shall be interpreted as establishing the type, function, and standard of quality and shall not be construed as limiting competition. The Contractor, in such cases may use any article, device, product, material, fixture, or item of equipment which in the judgment of the Engineer, expressed in writing, is equal to that specified.

2.03 CONCRETE

- A. The Contractor shall furnish all concrete required for the installation of all electrical work, Concrete shall be Class A unless otherwise specified. Concrete and reinforcing steel shall meet the appropriate requirements of Division 03 of the Specifications.
- B. The Contractor shall provide concrete equipment pads for all free-standing electrical apparatus and equipment located on new or existing floors or slabs. The Contractor shall provide all necessary anchor bolts, channel iron sills, and other materials as required. The exact location and dimensions shall be coordinated for each piece of equipment well in advance of the scheduled placing of these pads. Equipment pads shall be 4 inches high unless otherwise indicated on the Drawings and shall conform to standard detail for equipment pads shown on the Contract Drawings. Equipment pads shall not have more than 3" excess concrete beyond the edges of the equipment.

2.04 RUBBER INSULATING MATTING

- A. Rubber insulating matting shall be furnished and installed on the floor and in front of each piece of electrical equipment that is located indoors and installed under this Contract. Rubber insulating matting shall not be installed outdoors. The mat shall be long enough to cover the full length of the equipment. The mat shall be ¼-inch thick with beveled edges, canvas back, solid type with corrugations running the entire length of the mat. The matting shall meet OSHA requirements and the requirements of ASTM D-178 for Type 2, Class 2 insulating matting. Matting shall be 36 inches wide, minimum. However, matting width shall be no less than the NEC working clearance for the equipment with which it is associated.
- B. Matting shall be provided for the following equipment:
 - 1. Variable Frequency Drives
 - 2. Panelboards

PART 3 – EXECUTION

3.01 CUTTING AND PATCHING

- A. Coordination
 - 1. The Work shall be coordinated between all trades to avoid delays and unnecessary cutting, channeling and drilling. Sleeves shall be placed in concrete for passage of conduit wherever possible.
- B. Damage
 - 1. The Contractor shall perform all chasing, channeling, drilling and patching necessary to the proper execution of this Contract. Any damage to the building, structure, or any equipment shall be repaired by qualified mechanics of the trades involved at the Contractor's expense. If, in the Engineer's judgment, the repair of damaged equipment would not be satisfactory, then the Contractor shall replace damaged equipment at the Contractor's expense.
- C. Existing Equipment
 - 1. Provide a suitable cover or plug for openings created in existing equipment as the result of work under this Contract. For example, provide round plugs in equipment enclosures where the removal of a conduit creates a hole and the enclosure. Covers and plugs shall maintain the NEMA rating of the equipment enclosure. Covers and plugs shall be watertight when installed in equipment located outdoors.

3.02 EXCAVATION AND BACKFILLING

- A. The Contractor shall perform all excavation and backfill required for the installation of all electrical work. All excavation and backfilling shall be in complete accordance with the applicable requirements of Division 31.

3.03 CORROSION PROTECTION

- A. Wherever dissimilar metals, except conduit and conduit fittings, come into contact, the Contractor shall isolate these metals as required with neoprene washers, nine (9) mil polyethylene tape, or gaskets.

END OF SECTION

SECTION 26 05 19
LOW VOLTAGE CONDUCTORS AND CABLES

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, install, connect, test, and place in satisfactory operating condition, all low voltage wire and cable indicated on the Drawings and as specified herein and/or required for proper operation. The work of connecting cables to equipment and devices shall be considered a part of this Section. All appurtenances required for the installation of wire and cable systems shall be furnished and installed by the Contractor.
- B. The scope of this Section does not include internal wiring factory installed by electrical equipment manufacturers.
- C. Reference Section 26 05 00 – Basic Electrical Requirements and Section 26 05 33.16 – Boxes for Electrical Systems.

1.02 CODES AND STANDARDS

- A. Low voltage wire, cable, and appurtenances shall be designed, manufactured, and/or listed to the following standards as applicable:
 - 1. Underwriters Laboratories (UL)
 - a. UL 13 – Standard for Power-Limited Circuit Cables
 - b. UL 44 – Thermoset-Insulated Wires and Cables
 - c. UL 83 – Thermoplastic-Insulated Wires and Cables
 - d. UL 1277 – Standard for Electrical Power and Control Tray Cables with Optional Optical-Fiber Members
 - e. UL 1581 – Reference Standard for Electrical Wires, Cables, and Flexible Cords
 - f. UL 1685 – Standard for Vertical-Tray Fire-Propagation and Smoke-Release Test for Electrical and Optical-Fiber Cables
 - g. UL 2250 – Standard for Instrumentation Tray Cable
 - h. UL 2556 – Wire and Cable Test Methods
 - 2. American Society for Testing and Materials (ASTM)

- a. ASTM B3 – Standard Specification for Soft or Annealed Copper Wire
 - b. ASTM B8 – Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
 - c. ASTM B33 – Standard Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes
 - d. ASTM D69 – Standard Test Methods for Friction Tapes
 - e. ASTM D4388 – Standard Specification for Nonmetallic Semi-Conducting and Electrically Insulating Rubber Tapes
3. Insulated Cable Engineers Association (ICEA)
- a. ICEA S-58-679 – Standard for Control, Instrumentation and Thermocouple Extension Conductor Identification
 - b. ICEA T-29-250 – Conducting Vertical Cable Tray Flame Tests with Theoretical Heat Input Rate of 210,000 B.T.U./Hour
4. Institute of Electrical and Electronics Engineers (IEEE)
- a. IEEE 1202 – Standard for Flame Testing of Cables

1.03 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01 33 00 – Submittal Procedures, the Contractor shall obtain from the wire and cable manufacturer and submit the following:
 - 1. Shop Drawings
 - 2. Reports of Field Tests
- B. Each submittal shall be identified by the applicable Specification Section.

1.04 SHOP DRAWINGS

- A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed material's compliance with the Contract Documents.
- B. Partial, incomplete, or illegible Submittals will be returned to the Contractor without review for resubmittal.
- C. Shop drawings shall include but not be limited to:

1. Product data sheets for the following:
 - a. Wire and cable
 - b. Power and control wire terminations
 - c. Instrumentation cable terminations
 - d. Pulling lubricant.
 2. Cable pulling calculations (if required).
 3. Wiring identification methods and materials.
- D. The shop drawing information shall be complete and organized in such a way that the Engineer can determine if the requirements of these specifications are being met. Copies of technical bulletins, technical data sheets from "soft-cover" catalogs, and similar information which is "highlighted" or somehow identifies the specific equipment items the Contractor intends to provide are acceptable and shall be submitted.

1.05 CABLE PULLING CALCULATIONS

- A. Prior to the installation of the wire and cable specified herein, the Contractor shall submit cable pulling calculations for Engineer review and approval when all of the following are true:
1. The amount of cable to be installed will be greater than 200 linear feet between pull points.
 2. The installation will have one or more bends.
 3. The wire and cable is size #1/0 AWG and larger.
- B. Cable pulling calculations shall be performed by a currently registered Professional Engineer in the State or Commonwealth in which the project is located and shall define pulling tension and sidewall loading (sidewall bearing pressure values).

PART 2 – PRODUCTS

2.01 MANUFACTURERS

- A. The wire and cable to be furnished and installed for this project shall be the product of manufacturers who have been in the business of manufacturing wire and cable for a minimum of ten (10) years. Wire and cable shall be designed, constructed, and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as specified herein and indicated on the Drawings. Only one (1) manufacturer for each wire and cable type shall be permitted.

2.02 POWER AND CONTROL WIRE AND CABLE

- A. Power wire for all other loads and control wire shall consist of insulated copper conductors with a nylon (or equivalent) outer jacket. Conductor insulation shall be rated 90°C for dry locations, 75°C for wet locations, and 600V. Insulated conductors shall be UL 83 Listed as NEC Type THHN/THWN.
- B. Unless specified otherwise herein, conductors shall be stranded copper per ASTM B-8 and B-3, with Class B or C stranding contingent upon the size. Power conductors for lighting and receptacle branch circuits shall be solid copper per ASTM B-3.
- C. Power conductor size shall be no smaller than No. 12 AWG and Control conductor size shall be no smaller than No. 14 AWG.
- D. Multi-conductor cable assemblies shall include a grounding conductor and an overall PVC jacket. The jacket shall be PVC and resistant to abrasion, sunlight, and flame in accordance with UL 1277. Multi-conductor cable assemblies shall be UL 1277 Listed as NEC Type TC (Power and Control Tray Cable).
- E. Power wire and cable shall be as manufactured by the Okonite Company, the Southwire Company, General Cable, Encore Wire, or equal.

2.03 INSTRUMENTATION CABLE

- A. For single-analog signal applications, instrumentation cable shall consist of a single, twisted pair or triad of individually insulated and jacketed copper conductors with an overall cable shield and jacket. Conductor insulation shall be rated 90°C in both wet and dry locations, and 600V. The jacket shall be PVC and resistant to abrasion, sunlight, and flame in accordance with UL 1277. Cable shall be UL 1277 Listed as NEC Type TC (Power and Control Tray Cable).
- B. For multiple-analog signal applications, instrumentation cable shall consist of multiple, twisted pairs or triads (i.e. groups) of individually insulated and jacketed copper conductors with individual pair/triad shields (i.e. group shields) and an overall cable shield and jacket. Conductor insulation shall be rated 90°C in both wet and dry locations, and 600V. The jacket shall be PVC and resistant to abrasion, sunlight, and flame in accordance with UL 1277. Cable shall be UL 1277 Listed as NEC Type TC (Power and Control Tray Cable).
- C. Cable and group shields shall consist of overlapped aluminum/polyester tape/foil providing 100% coverage. Instrumentation cables shall include an overall copper shield drain wire. Cables containing multiple twisted pairs or triads shall also include group shield drain wires.
- D. Conductors, including drain wires, shall be tin or alloy coated (if available), soft, annealed copper, stranded per ASTM B-8, with Class B stranding unless otherwise specified.

- E. Instrumentation signal conductor size shall be no smaller than No. 16 AWG.
- F. Instrumentation cable shall be Okoseal-N Type P-OS (for single pair or triad applications) or Okoseal-N Type SP-OS (for multiple pair or triad applications) as manufactured by the Okonite Company, Belden equivalent, Southwire Company equivalent, or equal.

2.04 CONDUCTOR IDENTIFICATION

- A. Conductors shall be identified using a color-coding method. Color coding for individual power, control, lighting, and receptacle conductors shall be as follows:
 - 1. 480/277V AC Power
 - a. Phase A – BROWN
 - b. Phase B – ORANGE
 - c. Phase C – YELLOW
 - d. Neutral – GREY
 - 2. 120/208V or 120/240V AC Power
 - a. Phase A – BLACK
 - b. Phase B – RED
 - c. Phase C – BLUE
 - d. Neutral – WHITE
 - 3. DC Power
 - a. Positive Lead – RED
 - b. Negative Lead - BLACK
 - 4. DC Control
 - a. All wiring – BLUE
 - 5. 120 VAC Control
 - a. 120 VAC control wire shall be RED except for a wire entering a motor control center compartment, motor controller, or control panel which is an interlock. This interlock conductor shall be color coded YELLOW. For the purposes of

this Section, an interlock is defined as any wiring that brings voltage into the above-mentioned equipment from a source outside that equipment.

6. 24 VAC Control
 - a. All wiring - ORANGE
 7. Equipment Grounding Conductor
 - a. All wiring - GREEN
- B. Individual conductors No. 2 AWG and smaller shall have factory color coded insulation. It is acceptable for individual conductors larger than No.2 AWG to be provided with factory color coded insulation as well, but it is not required. Individual conductors larger than No.2 AWG that are not provided with factory color coded insulation shall be identified by the use of colored tape in accordance with the requirements listed in Part 3 herein. Insulation colors and tape colors shall be in accordance with the color-coding requirements listed above.
- C. Conductors that are part of multi-conductor cable assemblies shall have black insulation. The conductor number shall be printed on each conductor's insulation in accordance with ICEA S-58-679, Method 4. Each conductor No.2 AWG and smaller within the cable assembly shall also be identified with a heat shrink tag with color coded background. Each conductor larger than No.2 AWG within the cable assembly shall also be identified by the use of colored tape. Heat shrink tags and colored tape shall be in accordance with the requirements listed in Part 3 herein. Tape color and heat shrink tag background color shall be in accordance with the color-coding requirements listed above.

2.05 CABLE PULLING LUBRICANTS

- A. Cable pulling lubricants shall be non-hardening type and approved for use on the type of cable installed. Lubricant shall be Yellow #77 Plus by Ideal, Cable Gel by Greenlee, Poly-Gel by Gardner Bender, or equal.

PART 3 – EXECUTION

3.01 WIRE AND CABLE INSTALLATION

- A. General
1. Wire and Cable shall be installed as specified herein and indicated on the Drawings. Unless specifically indicated otherwise on the Drawings, wire and cable shall be installed in separate raceways according to wiring type. For example, power wiring shall not be combined with control wiring, and control wiring shall not be combined with instrumentation wiring.

2. Wire shall be furnished and installed as single conductor cables, with limited exceptions. Multi-conductor cable assemblies shall only be installed where indicated on the Drawings, required by the NEC, or after obtaining written permission from the Engineer.
3. Where instrumentation cables are installed in control panels, motor controllers, and other locations, the Contractor shall arrange wiring to provide maximum clearance between these cables and other conductors. Instrumentation cables shall not be installed in same bundle with conductors of other circuits.
4. Instrumentation cable shielding shall be continuous and shall be grounded at one point only.

B. Splices

1. Splices shall not be allowed in power or control wire and cable unless approved in writing by the Engineer. If unique field conditions exist or pulling calculations indicate that splices may be required, the Contractor shall submit a detailed request indicating why splices are required to the Engineer. The Engineer shall be under no obligation to grant such request.
2. Splicing materials shall be barrel type butt splice connectors and heat shrink tubing as manufactured by 3M, Ideal, or equal. The use of screw-on wire connectors (wire nuts) shall only be permitted for lighting and receptacle circuits.
3. No splicing of instrumentation cable is permitted.

C. Wire and Cable Sizes

1. The sizes of wire and cable shall be as indicated on the Drawings, or if not shown, as approved by the Engineer. If required due to field routing, the size of conductors and respective conduit shall be increased so that the voltage drop measured from source to load does not exceed 2-1/2%.

D. Additional Conductor Identification

1. In addition to the color-coding identification requirements specified in Part 2 herein, individual conductors shall be provided with heat shrinkable identification tags. Identification tags for individual conductors shall have a white background where the conductor insulation is colored. Identification tags for individual conductors shall have a colored background where the conductor insulation is black. Background color shall match that of the taping provided on the individual black conductors.
2. Multi-conductor cables shall be provided with heat shrinkable identification tags in accordance with Part 2 herein.

3. All wiring shall be identified at each point of termination. This includes but is not limited to identification at the source, load, and in any intermediate junction boxes where a termination is made. The Contractor shall meet with the Owner and Engineer to come to an agreement regarding a wire identification system prior to installation of any wiring. Wire numbers shall not be duplicated.
4. Wire identification shall be by means of a heat shrinkable sleeve with appropriately colored background and black text. Wire sizes #14 AWG through #10 AWG shall have a minimum text size of 7 points. Wire sizes #8 AWG and larger shall have a minimum text size of 10 points. Sleeves shall be of appropriate length to fit the required text. The use of handwritten text for wire identification shall not be permitted.
5. Sleeves shall be suitable for the size of wire on which they are installed. Sleeves shall not be heat-shrunk onto control cables. Tags shall remain loose on cable to promote easier identification. For all other applications, sleeves shall be tightly affixed to the wire and shall not move. Sleeves shall be heat shrunk onto wiring with a heat gun approved for the application. Sleeves shall not be heated by any means which employs the use of an open flame. The Contractor shall take special care to ensure that the wiring insulation is not damaged during the heating process.
6. Sleeves shall be installed prior to the completion of the wiring terminations and shall be oriented so that they can be easily read.
7. Sleeves shall be polyolefin as manufactured by Brady, Seton, Panduit, or equal.
8. Wire identification in manholes, handholes, pull boxes, and other accessible components in the raceway system where the wiring is continuous (no terminations are made) shall be accomplished by means of a tag installed around the bundled group of individual conductors or around the outer conductor jacket of a multi-conductor cable. Identification shall utilize a FROM-TO system. Each group of conductors shall consist of all of the individual conductors in a single conduit or duct. The tag shall have text that identifies the bundle in accordance with the 'FROM' and 'TO' column for that particular conduit number in the conduit and wire schedule. Minimum text size shall be 10 point. The tag shall be affixed to the wire bundle by the use of nylon wire ties and shall be made of polyethylene as manufactured by Brady, Seton, Panduit, or equal.
9. Where colored tape is used to identify cables, it shall be wrapped around the cable with a 25% overlap and shall cover at least 2 inches of the cable.

E. Wiring Supplies

1. Rubber insulating tape shall be in accordance with ASTM D4388. Friction tape shall be in accordance with ASTM D69.

F. Training of Cable in Manholes, Handholes, and Vaults

1. The Contractor shall furnish all labor and material required to train cables around cable vaults, manholes, and handholes. Sufficient length of cable shall be provided in each handhole, manhole, and vault so that the cable can be trained and racked in an approved manner. In training or racking, the radius of bend of any cable shall be not less than the manufacturer's recommendation. The training shall be done in such a manner as to minimize chaffing.
2. Instrumentation cable shall be racked and bundled separate from AC wiring to maintain the required separation as follows:
 - a. 18 inches for 480/277 VAC wiring
 - b. 12 inches for 208/120 VAC wiring
 - c. 6 inches for 24 VAC wiring

G. Conductor Terminations

1. Where wires are terminated at equipment which requires lugs, connections shall be made by solderless mechanical lug, crimp type ferrule, or irreversible compression type lugs. Reference individual equipment Specification Sections as applicable for additional termination requirements.
2. Where enclosure sizes and sizes of terminals at limit switches, solenoid valves, float switches, pressure switches, temperature switches, and other devices make terminations impractical due to the size of the field wiring, the Contractor shall terminate field wiring in an adjacent junction box per the requirements of Section 26 05 33.16 – Boxes for Electrical Systems, complete with terminal strips. Contractor shall install the smaller wiring from the device to the junction box in a conduit, using the terminal strip as the means for joining the two different wire sizes. Splicing of wires in lieu of using terminal strips is not acceptable.
3. The cables shall be terminated in accordance with the cable and/or termination product manufacturer's instructions for the particular type of cable.
4. To minimize oxidation and corrosion, wire and cable shall be terminated using an oxide-inhibiting joint compound recommended for "copper-to-copper" connections. The compound shall be Penetrox E as manufactured by Burndy Electrical, or equal.
5. All spare conductors shall be terminated on terminal blocks mounted within equipment or junction boxes. Unless otherwise noted, coiling up of spare conductors within enclosure is not acceptable.

H. Pulling Temperature

1. Cable shall not be installed when the temperature of the jacket is such that damage will occur due to low temperature embrittlement. When cable will be pulled with an ambient temperature of 40°F or less within a three (3) day period prior to pulling, the cable reels shall be stored three (3) days prior to pulling in a protected storage area with an ambient temperature of 55°F or more. Cable pulling shall be completed during the workday for which the cable is removed from the protected storage. Any cable reels with wire remaining on them shall be returned to storage at the completion of the workday.

3.02 TESTING

- A. All testing shall be performed in accordance with the requirements of the General Conditions and Division 01. The following tests are required:

1. Shop Test

- a. Wires and cables shall be tested in accordance with the applicable ICEA Standards. Wire and cable shall be physically and electrically tested in accordance with the manufacturer's standards.

2. Field Tests

- a. After installation, all wires and cables shall be tested for continuity. Testing for continuity shall be "test light" or "buzzer" style.
 - b. After installation, wires and cables shall be tested for insulation resistance levels between conductors of the same circuit and between conductor and ground as follows:
 - 1) For #8 AWG and larger 600V wire and cable, apply 1,000 VDC from a Megohmmeter for one (1) minute. Resistance shall be no less than 100 Megohms.
 - 2) Instrumentation signal cable shall be tested from conductor to conductor, conductor to shield, and conductor to ground using a Simpson No. 260 volt-ohmmeter or approved equal. The resistance value shall be 200 Megohms or greater.
 - 3) Insulation resistance testing is not required for power and control cables smaller than #8 AWG.
 - c. Wires and cables shall be tested after required terminations are made, but before being connected to any equipment.
 - d. If tests reveal defects or deficiencies, the Contractor shall make the necessary repairs or shall replace the cable as directed by the Engineer, without additional cost to the Owner. All conductors of a multi-phase circuit

shall be replaced if one conductor fails the required testing. If part of a multi-set (parallel conductors per phase) circuit fails testing, only the set containing failure shall be replaced.

- e. All tests shall be made by and at the expense of the Contractor who shall supply all testing equipment. Test reports shall be submitted to the Engineer.

Exhibit A
Test Data – Megohms
Test No. _____

Date:			Company:				
Time:			Location:				
Circuit:	Circuit Length:	Aerial:	Duct:	Buried:	No. of Conductors	Size:	AWG MCM Shield:
Insulation Material:			Insulation Thickness:		Voltage Rating:		Age:
Type: _____ Pothead _____ Terminal					Location: Indoors _____ Outdoors _____		
Number and Type of Joints:							
Recent Operating History:							
Manufacturer:							
State if Potheads or Terminals were grounded during test:							
List associated equipment included in test:							
Miscellaneous Information:							

Exhibit A
Test Data – Megohms
Test No. _____

Part Tested:	Test Performed: _____ Hours/Days: _____ After Shutdown: _____
Grounding Time:	Dry Bulb Temperature: _____ Wet Bulb Temperature: _____
Test Voltage:	Equipment Temperature: _____ How Obtained: _____ Relative Humidity: _____ Absolute Humidity: _____ Dew Point: _____

Megohmmeter: Serial Number: _____ Range: _____
 Voltage: _____ Calibration Date: _____

Test Connections	To Line To Earth To Ground	To Line To Earth To Ground	To Line To Earth To Ground	Test Connections	To Line To Earth To Ground	To Line To Earth To Ground	To Line To Earth To Ground
1/4 Minute				5 Minutes			
1/2 Minute				6 Minutes			
3/4 Minute				7 Minutes			
1 Minute				8 Minutes			
2 Minutes				9 Minutes			
3 Minutes				10 Minutes			
4 Minutes				10/1 Minute Ratio			

Remarks:

END OF SECTION

SECTION 26 05 26
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish and install grounding systems complete in accordance with the minimum requirements established by Article 250 of the NEC. Article 250 of the NEC shall be considered a minimum requirement for compliance with this Specification.
- B. Grounding of all instrumentation and control systems shall be furnished and installed in accordance with the manufacturer/system requirements and IEEE 1100. Conflicts shall be promptly brought to the attention of the Engineer.
- C. In addition to the NEC requirements, building structural steel columns [and metallic chemical storage tanks] shall be permanently and effectively grounded.
- D. Reference Section 26 05 00 – Basic Electrical Requirements

1.02 CODES AND STANDARDS

- A. Equipment and materials covered under this Section shall be designed, manufactured, and/or listed to the following standards as applicable:
 - 1. UL 467 – Grounding and Bonding Equipment
 - 2. IEEE 81 – Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System.
 - 3. IEEE 1100 – Recommended Practice for Power and Grounding Electronic Equipment

1.03 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01 33 00 – Submittal Procedures, the Contractor shall obtain from the equipment manufacturer and submit the following:
 - 1. Shop Drawings
 - 2. Reports of certified field tests.
- B. Each submittal shall be identified by the applicable Specification Section.

1.04 SHOP DRAWINGS

- A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.
- B. Partial, incomplete, or illegible submittals will be returned to the Contractor without review for resubmittal.
- C. Shop drawings shall include but not be limited to:
 - 1. Product data sheets.
 - 2. Drawings and written description of how the Contractor intends to furnish and install the grounding system.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

- A. The equipment covered by these specifications shall be standard equipment of proven performance as manufactured by reputable concerns. Equipment shall be designed, constructed, and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.

2.02 GROUND RODS AND GRID

- A. Ground rods shall be rolled to a commercially round shape from a welded copper-clad steel manufactured by the molten-welding process or by the electro-formed process (molecularly bonded). They shall have an ultimate tensile strength of 75,000 pounds per square inch (psi) and an elastic limit of 49,000 psi. The rods shall be not less than 3/4 inch in diameter by 10 feet in length; and the proportion of copper shall be uniform throughout the length of the rod. The copper shall have a minimum wall thickness of 0.010 inch at any point on the rod. Ground rods shall be UL 467 listed. The ground rods shall be manufactured by Erico Products, Blackburn, or equal.
- B. Except where specifically indicated otherwise, all exposed non current-carrying metallic parts of electrical equipment, metallic raceway systems, grounding conductors in nonmetallic raceways and neutral conductors of wiring systems shall be grounded.
- C. The ground connection shall be made at the main service equipment and shall be extended to the ground grid surrounding the structure. The ground grid shall also be connected to the point of entrance of the metallic water service. Connection to the water pipe shall be made by a suitable ground clamp or lug connection to a plugged tee. If flanged pipes are encountered, connection shall be made with the lug bolted to the street side of the flanged connection.

- D. Where ground fault protection is employed, care shall be taken so that the connection of the ground and neutral does not interfere with the correct operation of the ground fault protection system.

2.03 FITTINGS

- A. Grounding connections to equipment shall be bolted. Cable end connections shall be made by hydraulic crimp or exothermically welded. Split bolt type connectors are not acceptable. Fittings shall be UL 467 listed.

2.04 EQUIPMENT GROUNDING CONDUCTORS

- A. An insulated equipment grounding conductor, which shall be separate from the electrical system neutral conductor, shall be furnished and installed for all circuits. Insulation shall be of the same type as the ungrounded conductors in the raceway and shall be green in color. Equipment grounding conductors shall be furnished and installed in all conduits. Use of conduits as the NEC required equipment grounding conductor is not acceptable.

2.05 EQUIPMENT GROUNDS

- A. Equipment grounds shall be solid and continuous from a connection at earth to all distribution panelboards. Ground connections at panelboards, outlets, equipment, and apparatus shall be made in an approved and permanent manner.
- B. For all control panels, disconnect switches, and other electrical enclosures, equipment grounds and bonding jumpers shall be terminated individually on a ground bar or mechanical lugs. No wire nuts will be permitted.

2.06 EXOTHERMIC WELDS

- A. All exothermic welding shall be completed per welding kit manufacturer's instructions. Exothermic welds shall be CadWeld by Erico or ThermoWeld.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. Metal surfaces where grounding connections are to be made shall be clean and dry. Steel surfaces shall be ground or filed to remove all scale, rust, grease, and dirt. Copper and galvanized steel shall be cleaned with emery cloth to remove oxide before making connections.
- B. Ground Grid
 - 1. A main ground grid shall be provided for each structure and interconnecting structure grids consisting of driven ground rods as shown on the Drawings.

Ground rods shall be driven straight down into the earth, or if objects are encountered, at an angle to avoid the obstruction.

2. The ground rods shall be interconnected by the use of copper cable exothermically welded to the rods. The grounding cables shall be installed after the excavations for the building have been completed and prior to the pouring of concrete for the footings, mats, etc. Copper "pigtails" shall be connected to the ground grid and shall enter the buildings and structure from the outside and shall be connected to steel structures, and equipment as described in this Section and as required to provide a complete grounding system. The copper pigtails shall be exothermically welded to the ground grid and connected to building reinforcement steel by hydraulic crimp.
3. Grounding conductors shall be continuous between points of connection; splices shall not be permitted.
4. Where conductors are exposed and subject to damage from personnel, traffic, etc., conductors shall be installed in metal raceway. The raceway shall be bonded to the grounding system.
5. Where subsurface conditions do not permit use of driven ground rods to obtain proper ground resistance, rods shall be installed in a trench or plate electrodes shall be provided, as applicable and necessary to obtain proper values of resistance.
6. Buried exothermic welds and ground ring shall not be backfilled until inspected by Engineer.

C. Raceways

1. Conduit which enters equipment such as switchgear, motor control centers, transformers, panelboards, variable frequency drives, instrument and control panels, and similar equipment shall be bonded to the ground bus or ground lug, where provided, and as otherwise required by the NEC.

3.02 TESTING

- A. All tests shall be performed in accordance with the requirements of the General Conditions and Division 01. The following tests are required:
 1. Witnessed Shop Tests
 - a. None required.
 2. Field Tests

- a. Field testing shall be done in accordance with the requirements specified in the General Conditions, Division 01, and NETA Acceptance Testing Specifications, latest edition.
- b. Fall of potential tests shall be performed on the ground grid per IEEE81 recommendations by a third party, independent testing firm. A fall of potential plot shall be submitted at the conclusion of testing for Engineer review. Documentation indicating the location of the rod and grounding system as well as the resistance and soil conditions at the time the measurements were made shall be submitted. Testing shall show that the ground grid has 5 ohms resistance or less. Due to soil conditions and/or unforeseen field conditions, ground resistances greater than 5 ohms may be acceptable if specifically approved in writing by the Engineer. Ground resistance measurements shall be made in normally dry weather not less than 48 hours after rainfall and with the ground grid under test isolated from other grounds.
- c. Continuity tests for the grounding electrode conductor shall be performed. Test will be accepted when a resistance of less than 1 ohm is shown for this conductor.

END OF SECTION

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SECTION 26 05 29
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish and install structural supports for mounting and installing all conduit, electrical equipment, lighting, alarm systems, instrumentation, and communications equipment furnished under this Contract.
- B. Equipment shall be installed strictly in accordance with recommendations of the manufacturer and best practices of the trade resulting in a complete, operable, and safe installation. The Contractor shall obtain written installation manuals from the equipment manufacturer prior to installation.
- C. Reference Section 26 05 00 – Basic Electrical Requirements.

1.02 CODES AND STANDARDS

- A. Equipment and materials covered under this Section shall be designed, manufactured, and/or listed to the following standards as applicable:
 - 1. ASTM A123 – Standard Specification for Zinc (Hot Dip Galvanized) Coatings on Iron and Steel Products.
 - 2. ASTM A153 – Standard Specification for Zinc Coating (Hot Dip) on Iron and Steel Hardware.
 - 3. ASTM A240 – Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
 - 4. ASTM A276 – Standard Specification for Steel Bars and Shapes
 - 5. ASTM B783 – Standard Specification for Materials for Ferrous Powder Metallurgy Structural Parts

1.03 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01 33 00 – Submittal Procedures, the Contractor shall obtain from the equipment manufacturer and submit the following:
 - 1. Shop drawings
 - 2. Structural support calculations (if required)

- B. Each submittal shall be identified by the applicable Specification Section.

1.04 SHOP DRAWINGS

- A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.
- B. Partial, incomplete, or illegible submittals will be returned to the Contractor without review for resubmittal.
- C. Shop drawings shall include but not be limited to:
1. Product data sheets.
 2. Complete assembly, layout, installation, and foundation drawings with clearly marked dimensions.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

- A. The equipment covered by this Specification is intended to be standard equipment of proven performance as manufactured by reputable concerns. Equipment shall be designed, constructed, and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.

2.02 MATERIALS

- A. Support channel shall be 1-5/8" by 1-5/8" minimum, with 12 gage material thickness.
- B. Support channel, support channel fittings, and threaded rod shall be furnished with the following material of construction, dependent upon the designation of the area in which they are to be installed. Area designations are indicated on the Drawings.

Area Designation	Material of Construction
Indoor Dry Non-process Area	Hot Dipped Galvanized Steel
Indoor Type 1 Chemical Storage/Transfer Area	Fiberglass
Indoor Type 2 Chemical Storage/Transfer Area	Type 304 Stainless Steel
All Outdoor Areas	Type 304 Stainless Steel

- C. Fastening hardware (bolts, nuts, washers, and screws) shall be furnished with the following material of construction, dependent upon the designation of the area in which they are to be installed. Area designations are indicated on the Drawings.

Area Designation	Material of Construction
Indoor Dry Non-process Area	Type 304 Stainless Steel

Indoor Type 1 Chemical Storage/Transfer Area	Fiberglass
Indoor Type 2 Chemical Storage/Transfer Area	Type 304 Stainless Steel
All Outdoor Areas	Type 304 Stainless Steel

PART 3 – EXECUTION

3.01 INSTALLATION

A. Concrete or Masonry Inserts

1. The Contractor shall be responsible for the furnishing and installation of all anchor bolts, masonry inserts, and similar devices required for installation of equipment furnished under this Contract.
2. If a time delay for the arrival of any special inserts or equipment drawings, etc. occurs, the Contractor may, if permitted by the Engineer, make arrangements for providing approved recesses and openings in the concrete or masonry and, upon subsequent installation, the Contractor shall be responsible for filling in such recesses and openings. Any additional costs that may be incurred by this procedure shall be borne by the Contractor.
3. The Contractor shall furnish leveling channels for all switchgear, switchboards, motor control centers, and similar floor mounted equipment. The leveling channels shall be provided for embedment in the equipment housekeeping pads. Coordination of the installation of these channels with the concrete pad is essential and required. Pad height shall be as required to maintain concrete coverage of the reinforcement bars while not causing associated equipment to exceed the maximum mounting height requirements of the NEC.

B. Support Fastening and Locations

1. All equipment fastenings to columns, steel beams, and trusses shall be by beam clamps or welded. No holes shall be drilled in the steel.
2. Unless otherwise indicated on the Drawings or in the Specifications, guards/handrails shall not be utilized as supports for electrical equipment, devices, or appurtenances. Guards/handrails shall not be cut, drilled, or otherwise modified in order to accommodate electrical supports without written approval from the Engineer.
3. All holes made in reflected ceilings for support rods, conduits, and other equipment shall be made adjacent to ceiling grid bars where possible, to facilitate removal of ceiling panels.
4. Support channel shall be provided wherever required for the support of starters, switches, panels, and miscellaneous equipment.

5. All equipment, devices, and raceways that are installed on the dry side of a water bearing wall shall not be installed directly onto the wall. Support channel shall be used to allow ventilation air to pass behind the equipment, devices, or raceway.
6. All supports shall be rigidly bolted together and braced to make a substantial supporting framework. Where possible, control equipment shall be grouped together and mounted on a single framework.
7. Aluminum support members shall not be installed in direct contact with concrete. Stainless steel or non-metallic "spacers" shall be used to prevent contact of aluminum with concrete.
8. Actual designs for supporting framework should take the nature of a picture frame of support channels and bracket with a plate for mounting the components. The Contractor is responsible for the design of supporting structure; Contractor shall submit design details to the Engineer for acceptance before proceeding with the fabrication.
9. Wherever dissimilar metals come into contact, the Contractor shall isolate these metals as required with neoprene washers, nine (9) mil polyethylene tape, or gaskets.
10. For all installations where fiberglass supporting materials are required, the Contractor shall submit structural calculations and the details of the proposed system of support. Structural calculations shall be signed and sealed by a registered Professional Engineer in the State or Commonwealth in which the project is located.
11. For the following installations where conduits are provided with a support system suspended from the above or attached to a vertical structure, the Contractor shall submit structural calculations and details of the proposed system of support. Structural calculations shall be signed and sealed by a registered Professional Engineer in the State or Commonwealth in which the project is located.
 - a. A quantity of twelve (12) or more conduits trade size 1" and smaller are proposed for a conduit support rack.
 - b. A quantity of eight (8) or more conduits trade sizes 1 1/2" to 2 1/2" are proposed for a conduit support rack.
 - c. A quantity of four (4) or more conduits trade sizes 3" and larger are proposed for a conduit support rack.
12. Single conduits installed exposed along walls and ceilings shall be secured to the wall or ceiling with a one-hole conduit clamp and clamp-back. Where multiple conduits are installed exposed together, support channel and conduit clamps shall be used.

- C. Equipment, boxes, and enclosures which are factory-constructed with integral mounting provisions (such as brackets., mounting feet, bolt holes, etc.) shall be installed/supported utilizing those mounting provisions. Equipment, boxes and enclosures shall not be field-modified by any means which compromises the UL listing or NEMA rating of the enclosure/assembly.

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SECTION 26 05 33.13
CONDUIT FOR ELECTRICAL SYSTEMS

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish and install conduits and conduit fittings to complete the installation of all electrically operated equipment as specified herein, indicated on the Drawings, and as required.
- B. Requirements for conduit clamps, support systems, and anchoring are not included in this Section. Reference Section 26 05 29 – Hangers and Supports for Electrical Systems, for these requirements.
- C. Reference Section 26 05 00 – Basic Electrical Requirements.

1.02 CODES AND STANDARDS

- A. Conduits and conduit fittings shall be designed, manufactured, and/or listed to the following standards as applicable:
 - 1. American National Standards Institute (ANSI)
 - a. ANSI B1.20.1 – Pipe Threads, General Purpose
 - b. ANSI C80.1 – Electrical Rigid Steel Conduit
 - c. ANSI C80.3 – Steel Electrical Metallic Tubing
 - d. ANSI C80.5 – Electrical Rigid Aluminum Conduit
 - e. ANSI FB 1 – Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable
 - 2. Underwriters Laboratories (UL)
 - a. UL 1 – Standard for Flexible Metal Conduit
 - b. UL 6 – Electrical Rigid Metal Conduit-Steel
 - c. UL 6A – Electrical Rigid Metal Conduit-Aluminum, Red Brass, and Stainless Steel
 - d. UL 360 – Standard for Liquid-tight Flexible Metal Conduit
 - e. UL 467 – Grounding and Bonding Equipment

- f. UL 514B – Conduit, Tubing, and Cable Fittings
- g. UL 651 – Standard for Schedule 40 and 80 Conduit and Fittings
- h. UL 797 – Electrical Metallic Tubing-Steel
- i. UL 1203 – Standard for Explosion-proof and Dust-ignition-proof Electrical Equipment for use in Hazardous (Classified) Locations
- j. UL 1479 – Standard for Fire Tests of Penetration Fire Stops
- k. UL 1660 – Liquid-tight Flexible Nonmetallic Conduit
- 3. National Electrical Manufacturer's Association (NEMA)
 - a. NEMA FB 2.40 – Installation Guidelines for Expansion and Expansion/Deflection Fittings
 - b. NEMA RN 1 – PVC Externally Coated Galvanized Rigid Steel Conduit
 - c. NEMA RV-3 – Application and Installation Guidelines for Flexible and Liquid-tight Flexible Metal and Nonmetallic Conduits
 - d. NEMA TC-2 – Electrical PVC Conduit
 - e. NEMA TC-3 – PVC Fittings for Use with Rigid PVC Conduit and Tubing
- 4. National Electrical Contractors Association (NECA)
 - a. NECA 1 – Standard for Good Workmanship in Electrical Construction
- 5. Others
 - a. ACI-318 – Building Code Requirements for Structural Concrete

1.03 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01 33 00 – Submittal Procedures, the Contractor shall obtain from the equipment manufacturer and submit the following:
 - 1. Shop Drawings
- B. Each submittal shall be identified by the applicable Specification Section.

1.04 SHOP DRAWINGS

- A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.
- B. Partial, incomplete, or illegible submittals will be returned to the Contractor without review for resubmittal.
- C. Shop drawings shall include but not be limited to:
 - 1. Product data sheets for conduits and fittings.
 - 2. Conduit identification methods and materials.
 - 3. Evidence of training for all personnel that will install PVC coated rigid metal conduit.

1.05 DEFINITIONS

- A. Conduits are categorized by the circuit type of the wiring to be installed inside. Conduits are defined as follows:
 - 1. Power Conduits – Conduits that carry AC or DC power wiring from a source to a load. Conduits that carry lighting and receptacle wiring.
 - 2. Control Conduits – Conduits that carry AC or DC discrete control wiring between devices and/or equipment. Conduits that carry fiber optic cables between devices and/or equipment.
 - 3. Instrumentation Conduits – Conduits that carry AC or DC analog signal wiring between devices and/or equipment. Conduits that carry Category 5e or Category 6 unshielded cables.
- B. Conduit categories are indicated on the Drawings by the leading letter of the conduit tag. Conduit tag leading letters are defined as follows:
 - 1. P – Power Conduit
 - 2. C – Control Conduit
 - 3. I – Instrumentation Conduit

PART 2 – PRODUCTS

2.01 GENERAL

- A. Conduit and conduit fitting products are specified in the text that follows this article. Reference Part 3 herein for the application, uses and installation requirements of these conduits and conduit fittings.
- B. All metallic conduit fittings shall be UL 514B and UL 467 Listed and constructed in accordance with ANSI FB 1. All metallic conduit fittings for use in Class I Division I hazardous areas shall be UL 1203 Listed. All non-metallic fittings shall be UL 651 Listed and constructed in accordance with NEMA TC-3.
- C. Where threading is specified herein for conduit fitting connections, the fittings shall be manufactured to accept conduit that is threaded to ANSI B1.20.1 requirements.
- D. Conduit expansion fittings for all conduit materials of construction shall be capable of 4 inches of movement along the axis of the conduit for trade sizes 2 inches or less. Expansion fittings shall be capable of 8 inches of movement along the axis of the conduit for trade sizes greater than 2 inches.
- E. Conduit deflection fittings for all conduit materials of construction shall be provided with a flexible neoprene outer jacket that permits up to $\frac{3}{4}$ inch of expansion/contraction along the axis of the conduit as well as up to $\frac{3}{4}$ inch of parallel misalignment between the conduit axes. Outer jacket shall be secured to the conduit hubs by stainless steel clamps.
- F. Conduit seals shall either be Listed and labeled for 40% fill, or conduit reducing fittings and a trade size larger conduit seal shall be provided to achieve 25% or less fill within the seal. Percentage fill calculation shall be based on the conductors to be installed. Conduit seals shall be provided with breathers and/or drains where required by the NEC.
- G. Conduit insulating bushings shall be constructed of plastic and shall have internal threading.
- H. Additional conduit and conduit fitting requirements are specified in the articles that follow based on the specific conduit material of construction to be used.

2.02 RIGID GALVANIZED STEEL (RGS) CONDUIT AND ASSOCIATED FITTINGS

- A. Conduit
 - 1. Conduit shall be hot dip galvanized on the inside and outside and made of heavy wall high strength ductile steel. Conduit shall be manufactured in accordance with ANSI C80.1 and shall be UL 6 Listed.
 - 2. Conduit shall be provided with factory-cut $\frac{3}{4}$ inch per foot tapered threads at each end in accordance with ANSI B1.20.1. Threads shall be cut prior to galvanizing to

ensure corrosion protection adequately protects the threads. Conduit shall be provided with a matching coupling on one end and a color-coded thread protector on the other.

B. Conduit Bodies for use with Rigid Galvanized Steel

1. Conduit bodies shall be constructed of an electro-galvanized malleable iron alloy which is coated with an acrylic paint finish. Conduit bodies shall have integral threaded conduit hubs.
2. Conduit bodies for all other areas shall be provided with covers that are affixed in place by stainless steel screws which thread directly into the conduit body. Covers that utilize wedge nuts or any other method of attachment to the conduit body are not acceptable. Covers shall be constructed of an electro-galvanized malleable iron alloy which is coated with an acrylic paint finish. Covers shall be provided with matching gasket.

C. Conduit Couplings, Nipples, and Unions for use with Rigid Galvanized Steel

1. Couplings and nipples shall be threaded and shall be constructed of hot dipped galvanized steel. Split-type couplings that use compression to connect conduits are not acceptable.
2. Unions shall be threaded, rain-tight, and constructed of an electro-galvanized malleable iron alloy which is coated with an acrylic paint finish.

D. Conduit Expansion and Deflection Fittings for use with Rigid Galvanized Steel

1. Conduit expansion fittings and conduit deflection fittings shall be constructed of bronze or an electro-galvanized malleable iron alloy. Expansion and deflection fittings shall have threaded conduit connections.
2. Expansion fittings shall have an integral bonding jumper and deflection fittings shall have an external bonding jumper.

E. Conduit Seals for use with Rigid Galvanized Steel

1. Conduit seals shall be constructed of an electro-galvanized malleable iron alloy which is coated with an acrylic paint finish. Conduit seals shall have threaded conduit connections.

F. Conduit Termination Fittings for use with Rigid Galvanized Steel

1. Conduit hubs shall be constructed of stainless steel and shall have threaded connections to the conduit and enclosure. Hubs shall have a plastic insulated throat and shall be watertight when assembled to an enclosure.

2. Conduit locknuts shall be constructed of zinc plated steel. Locknuts shall have internal threading. Locknuts with integral gasket or seal are not acceptable. Locknuts shall have integral bonding screw where required for proper bonding.
3. Conduit bonding bushings shall be constructed of zinc plated malleable iron. Bonding bushings shall have a threaded conduit connection. Bonding bushing shall be provided with properly sized set screw for connecting bonding conductor and an integral plastic insulator rated for 150 degrees C located in the throat.

2.03 RIGID NONMETALLIC CONDUIT AND ASSOCIATED FITTINGS

A. Conduit

1. Conduit shall be Schedule 40 or 80 (dependent on application) polyvinyl chloride (PVC) construction, manufactured in accordance with NEMA TC-2, UL 651 Listed, and suitable for conductors with 90 degree C insulation.

B. Conduit Bodies for use with Rigid Nonmetallic Conduit

1. Conduit bodies shall be constructed of PVC. Conduit hubs shall be integral to the conduit body and shall be smooth inside to accept a glued conduit connection.
2. Conduit body shall be provided with cover that is affixed in place by stainless steel screws which thread directly into the conduit body. Covers that utilize wedge nuts or any other method of attachment to the conduit body are not acceptable. Covers shall be provided with matching gasket.

C. Conduit Couplings and Unions for use with Rigid Nonmetallic Conduit

1. Conduit couplings and unions shall be constructed of PVC and shall be smooth inside to accept a glued conduit connection.

D. Conduit Expansion and Deflection Fittings for use with Rigid Nonmetallic Conduit

1. Conduit expansion fittings and conduit deflection fittings shall be constructed of PVC and shall be smooth inside to accept a glued conduit connection.

E. Conduit Termination Fittings for use with Rigid Nonmetallic Conduit

1. Conduit hubs shall be constructed of PVC and shall be smooth inside to accept a glued conduit connection. Hubs shall have external threads and an accompanying PVC locknut, and shall be watertight when assembled to an enclosure.
2. Conduit locknuts shall be constructed of zinc plated steel. Locknuts shall have internal threading. Locknuts constructed of PVC and locknuts with integral gasket or seal are not acceptable.

3. Conduit end bells shall be constructed of PVC and shall be smooth inside to accept a glued conduit connection. End bell shall have a smooth inner surface that curves outward towards the edge of the fitting.

2.04 PVC COATED RIGID GALVANIZED STEEL CONDUIT AND ASSOCIATED FITTINGS

A. General

1. Where an external coating of polyvinyl chloride (PVC) is specified for conduit and fittings, the coating shall be 40 mil (minimum) thickness. Where an internal coating of urethane is specified for conduit and fittings, the coating shall be 2 mil (minimum) thickness.
2. All conduit fittings shall have a sealing sleeve constructed of PVC which covers all connections to conduit. Sleeves shall be appropriately sized so that no conduit threads will be exposed after assembly.

B. Conduit

1. Conduit shall be hot dip galvanized on the inside and outside and made of heavy wall high strength ductile steel. Conduit shall be manufactured in accordance with ANSI C80.1 and shall be UL 6 Listed.
2. Conduit shall be provided with factory-cut 3/4 inch per foot tapered threads at each end in accordance with ANSI B1.20.1. Threads shall be cut prior to galvanizing to ensure corrosion protection adequately protects the threads. Conduit shall be provided with a matching coupling on one end and a color-coded thread protector on the other.
3. Conduit shall be coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane. Conduit shall be manufactured in accordance with NEMA RN 1.

C. Conduit Bodies for use with PVC Coated Rigid Galvanized Steel Conduit

1. Conduit bodies shall be constructed of an electro-galvanized malleable iron alloy which is coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane. Conduit bodies shall have integral threaded conduit hubs.
2. Conduit bodies for all other areas shall be constructed of an electro-galvanized malleable iron alloy which is coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane. Covers shall be affixed in place by stainless steel screws which thread directly into the conduit body and have a plastic encapsulated head. Covers that utilize wedge nuts or any other method of attachment to the conduit body are not acceptable. Covers shall be provided with matching gasket.

D. Conduit Couplings, Nipples, and Unions for use with PVC Coated Rigid Galvanized Steel Conduit

1. Couplings and nipples shall be threaded and shall be constructed of hot dipped galvanized steel which is coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane. Split-type couplings that use compression to connect conduits are not acceptable.
2. Unions shall be threaded, rain-tight, and constructed of an electro-galvanized malleable iron alloy which is coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane.

E. Conduit Expansion and Deflection Fittings for use with PVC Coated Rigid Galvanized Steel Conduit

1. Conduit expansion fittings and conduit deflection fittings shall be constructed of bronze or an electro-galvanized malleable iron alloy which is coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane. Expansion and deflection fittings shall have threaded conduit connections.
2. Expansion fittings shall have an integral bonding jumper and deflection fittings shall have an external bonding jumper.

F. Conduit Seals for use with PVC Coated Rigid Galvanized Steel Conduit

1. Conduit seals shall be constructed of an electro-galvanized malleable iron alloy which is coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane. Conduit seals shall have threaded conduit connections.

G. Conduit Termination Fittings for Use with PVC Coated Rigid Galvanized Steel Conduit

1. Conduit hubs shall be constructed of an electro-galvanized malleable iron alloy which is coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane. Hubs shall have threaded connections to the conduit and enclosure. Hubs shall have a plastic insulated throat and shall be watertight when assembled to an enclosure.
2. Conduit bonding bushings shall be constructed of zinc plated malleable iron which is coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane. Bonding bushings shall have a threaded conduit connection. Bonding bushing shall be provided with properly sized set screw for connecting bonding conductor and an integral plastic insulator rated for 150 degrees C located in the throat.

2.05 LIQUID TIGHT FLEXIBLE METAL CONDUIT (LFMC) AND ASSOCIATED FITTINGS

A. Conduit

1. Conduit shall be manufactured using a single strip of hot dip galvanized high strength steel alloy, helically formed into a continuously interlocked flexible metal conduit. Trade size 1-1/4 inch and smaller conduits shall be provided with an integrally woven copper bonding strip.
2. Conduit shall be covered with an outside PVC jacket that is UV resistant, moisture-proof, and oil-proof. Conduit shall be UL 360 Listed. Conduits shall be Listed for and marked with maximum temperature ratings as follows:
 - a. 105 degrees C dry, 60 degrees C wet for all conduit installed against or within 2 inches of equipment capable of having a surface temperature of 80 degrees C or greater (e.g. blowers, incinerators, etc)
 - b. 80 degrees C dry, 60 degrees C wet for all other locations

B. Conduit Termination Fittings for use with LFMC

1. Conduit termination fittings shall be constructed of either 304 stainless steel or an electro-galvanized malleable iron alloy which is coated on the exterior with a 40 mil (minimum) PVC jacket and coated on the interior with a 2 mil (minimum) layer of urethane. PVC coated fittings shall have a sealing sleeve constructed of PVC which covers the connection to conduit.
2. Termination fittings shall have a threaded end with matching locknut and sealing ring for termination to equipment and shall have an integral external bonding lug where required for proper bonding. Termination fittings shall have a plastic insulated throat and shall be watertight when assembled to the conduit and equipment.

2.06 LIQUID TIGHT FLEXIBLE NONMETALLIC CONDUIT (LFNC) AND ASSOCIATED FITTINGS

A. Conduit

1. Conduit shall be constructed of rigid polyvinyl chloride (PVC), fabricated to provide flexibility. Conduit shall be covered with an outside PVC jacket that is UV resistant, moisture-proof, and oil-proof. Conduit shall be UL 1660 Listed.

B. Conduit Termination Fittings for use with LFNC

1. Conduit termination fittings shall be constructed PVC and shall have a threaded end with matching locknut and sealing ring for termination to equipment. Termination fittings shall be watertight when assembled to the conduit and equipment.

2.07 FLEXIBLE METAL CONDUIT (FMC) AND ASSOCIATED FITTINGS

A. Conduit

1. Conduit shall be manufactured using a single strip of hot dip galvanized high strength steel alloy, helically formed into a continuously interlocked flexible metal conduit. Conduit shall be UL 1 Listed.

B. Conduit Termination Fittings for use with FMC

1. Conduit termination fittings shall be constructed of an electro-galvanized malleable iron alloy. Fittings shall have a threaded end with matching locknut for termination to equipment, and a compression-style connection to the associated conduit.

2.08 ELECTRICAL METALLIC TUBING (EMT) AND ASSOCIATED FITTINGS

A. Conduit

1. Conduit shall be hot dipped galvanized on the inside and outside and made of cold-rolled steel tubing. Conduit shall be manufactured in accordance with C80.3 and shall be UL 797 listed.

B. Conduit Bodies for use with EMT

1. Conduit bodies shall be constructed of an electro-galvanized malleable iron alloy which is coated with an acrylic paint finish. Conduit bodies shall have integral threaded conduit hubs.
2. Conduit bodies shall be provided with galvanized sheet steel covers that are affixed in place by stainless steel screws which thread directly into the conduit body. Covers that utilize wedge nuts or any other method of attachment to the conduit body are not acceptable. Covers shall be provided with matching gasket.

C. Conduit Couplings and Nipples for use with EMT

1. Couplings and nipples shall have threaded compression connectors with associated gland and shall be constructed of electro-galvanized steel. Fittings utilizing a set screw or indenter tool to secure the associated conduit to the fitting are not acceptable. Couplings and nipples shall be rain-tight and have a plastic insulated throat.

D. Conduit Expansion and Deflection Fittings for use with EMT

1. Conduit expansion fittings and conduit deflection fittings shall be constructed of an electro-galvanized malleable iron alloy which is coated with an acrylic paint finish. Expansion and deflection fittings shall have threaded conduit connections.
2. Expansion fittings shall have an integral bonding jumper and deflection fittings shall have an external bonding jumper.

E. Conduit Termination Fittings for use with EMT

1. Conduit termination fittings shall be constructed of electro-galvanized steel and have a plastic insulated throat. Termination fittings shall have a threaded compression connector with associated gland on one end and external threads on the other end. Termination fittings utilizing a set screw or indenter tool to secure the associated conduit to the fitting are not acceptable.
2. Conduit locknuts shall be constructed of zinc plated steel. Locknuts shall have internal threading. Locknuts shall have integral bonding screw where required for proper bonding.

2.09 CONDUIT BENDS

- A. Rigid conduit bends, both factory-fabricated and field-fabricated, shall meet the same requirements listed in the articles above for the respective conduit type and material of construction.
- B. Conduit bend radii for standard radius bends shall be no less than as follows:

Trade Size (inches)	3/4	1	1-1/4	1-1/2	2	2-1/2	3	3-1/2	4	5	6
Min. Radius (inches)	4-1/2	5-3/4	7-1/4	8-1/4	9-1/2	10-1/2	13	15	16	24	30

- C. Conduit bend radii for long radius bends shall be no less than as follows:

Trade Size (inches)	3/4	1	1-1/4	1-1/2	2	2-1/2	3	3-1/2	4	5	6
Min. Radius (inches)	N/A	12	18	24	30	30	36	36	48	48	60

2.10 MISCELLANEOUS

- A. Conduit Periphery Sealing
 1. The sealing of the exterior surface of conduits to prevent water and/or air from passing around the conduit periphery from one space to another (where required) shall be through the use of one of the following:
 - a. A conduit sleeve and pressure bushing sealing system. Acceptable products are FSK by OZ-GEDNEY, Link-Seal by Crouse-Hinds, or Engineer approved equal.
 - b. A conduit sleeve that is two trade sizes larger than the conduit being sealed, with 2-hour fire rated UL 1479 Listed caulk filling the entire void between the conduit and sleeve. This method is only suitable for penetrations in non-fire

rated walls and floors between spaces within buildings. This method shall not be used for the sealing of conduits leaving a building and/or structure.

2. Conduit penetrations through fire-rated walls and floors shall be made with an approved UL 1479 Listed product specifically intended for the trade size of the conduit.

B. Primer and Cement

1. Nonmetallic conduit shall be cleaned with primer and connected to fittings with the manufacturer's recommended cement that is labeled Low VOC.

C. Galvanizing Compounds

1. Galvanizing compounds for field application shall be the cold-applied type, containing no less than 93% pure zinc.

D. Conduit Interior Sealing

1. The sealing of the inside of conduits against water ingress shall be achieved through the use of one of the following:
 - a. Two-part expanding polyurethane foam sealing compound, dispensed from a single tube which mixes the two parts as it is injected into the conduit. Expanding foam shall be compatible with the conduit material of construction as well as the outer jacket of the cables in the conduit. Acceptable products are Q-Pak 2000 by Chemque, FST by American Polywater Corporation, or Hydra-seal S-60 by Duraline.
 - b. Inflatable bag that provides seal around cables and around inside diameter of conduit. Provide appropriate quantity of additional fittings for applications with three or more cables in the conduit to be sealed. Acceptable products are Rayflate by Raychem, or Engineer approved equal. This sealing method is only applicable to conduits trade size 2 inch and larger.
 - c. Neoprene sealing ring provided with the required quantity and diameter of holes to accommodate the cables in each conduit. Sealing ring shall be compressed by two stainless steel pressure plates. Acceptable products are type CSB by OZ-GEDNEY, or Engineer approved equal. This sealing method is only applicable to metallic conduits containing 4 or less cables.
2. The use of aerosol-based expanding foam sealants or any other method of sealing against water ingress not listed above is not acceptable.

E. Pull Rope

1. Pull ropes for empty and/or spare conduits shall be woven polyester, ½-inch wide, with a minimum tensile strength of 1250 lbs.

2. Pull ropes for the Contractors use in installing conductors shall be the size and strength required for the pull and shall be made of a non-metallic material.

PART 3 – EXECUTION

3.01 GENERAL

- A. All conduit and associated fittings and appurtenances shall be installed in accordance with NECA 1.
- B. Minimum trade size for all rigid conduits shall be 3/4 inch in exposed applications and 1 inch in embedded applications. Conduits installed within ductbanks shall be allowed to be increased in size to trade size 2 inch, at the Contractor's option, to accommodate the saddle size of the ductbank spacers. However, no combining of circuits shall be allowed in the larger conduits.
- C. Minimum trade size for flexible conduits (where specifically allowed herein) shall be 1/2 inch in all applications.
- D. Conduit routing and/or homeruns within structures is not shown on the Drawings. Conduits shall be installed concealed wherever practical and within the limitations specified herein. All other conduits not capable of being installed concealed shall be installed exposed.
- E. Empty and/or spare conduits shall be provided with pull ropes which have no less than 12 inches of slack at each end.
- F. Nonmetallic conduits for installations requiring less than a factory length of conduit shall be field cut to the required length. The cut shall be made square, cleaned of debris, and primer shall be applied to ready each joint for fusing. Conduits shall then be fused together with the conduit manufacturer's approved cement compound.
- G. Metallic conduits for installations requiring less than a factory length of conduit shall be field cut to the required length. The cut shall be made square, be cleaned of all debris and be de-burred, then threaded. Conduit threading performed in the field shall be 3/4 inch per foot tapered threads in accordance with ANSI B1.20.1.
- H. Conduits shall be protected from moisture, corrosion, and physical damage during construction. Install dust-tight and water-tight conduit fittings on the ends of all conduits immediately after installation and do not remove until conductors are installed.
- I. Conduits shall be installed to provide no less than 12 inches clearance from pipes that have the potential to impart heat upon the conduit. Such pipes include, but are not limited to, hot water pipes, steam pipes, exhaust pipes, and blower air pipes. Clearance shall be maintained whether conduit is installed in parallel or in crossing of pipes.

- J. Where non-metallic instrumentation conduits are installed exposed, the following clearances to other conduit types shall be maintained:
1. Instrumentation conduits installed parallel to conduits with conductors energized at 480V or above shall be 18 inches.
 2. Instrumentation conduits installed parallel to conduits with conductors energized at 240V and below shall be 12 inches.
 3. Instrumentation conduits installed at right angles to conductors energized at 480V and below shall be 6 inches.
 4. Instrumentation conduits installed at right angles to conductors energized at voltages above 480V shall be 12 inches.
- K. Where conduit fittings do not include an integral insulated bushing, an insulated bushing shall be installed at all conduit termination points.
- L. Conduits which serve multi-section equipment shall be terminated in the section where wiring terminations will be made.
- M. Conduits shall not penetrate the floors or walls inside liquid containment areas without specific written authorization from the Engineer. Liquid containment areas are indicated on the Drawings.
- N. Conduits that terminate at roof mounted equipment shall be installed through the roof curb for the associated equipment to avoid additional roof penetrations wherever possible. Conduits that are installed horizontally on roof surfaces shall be supported by roof blocks that do not impact the roof manufacturer's warranty and shall be installed at least 7/8 inch above the roof surface to avoid the need to further de-rate the conductors inside.
- O. In no case shall conduit be supported or fastened to another pipe or be installed in a manner that would prevent the removal of other pipes for repairs. Spring steel fasteners may only be used to affix conduits containing lighting branch circuits within EMT conduits to structural steel members.
- P. All field fabricated threads for rigid galvanized steel conduit shall be thoroughly coated with two coats of galvanizing compound, allowing at least two minutes to elapse between coats for proper drying.
- Q. The appropriate specialized tools shall be used for the installation of PVC coated conduit and conduit fittings. No damage to the PVC coating shall occur during installation. Conduit and conduit fittings with damaged PVC coating shall be replaced at the Contractor's cost. The use of PVC coating touch-up compounds is not permitted.

3.02 CONCEALED AND EMBEDDED CONDUITS

- A. Conduits are permitted to be installed concealed and/or embedded with the following requirements:
 - 1. Conduits shall not be installed horizontally when concealed within CMU walls, only vertical installation is acceptable.
 - 2. Where conduit bends emerge from concrete embedment, none of the curved portion of the bend shall be visible. Only the straight portion of the bend shall be visible. The straight portion shall emerge perpendicular to the embedment (i.e. neatly oriented 90-degrees to floor/slab/grade). Conduits that emerge in a non-perpendicular orientation are not acceptable.
 - 3. Where multiple conduits emerge from concrete embedment or from concealment below a concrete floor, ample clear space shall be provided between conduits to allow for the appropriate and required conduit termination fittings to be installed.
 - 4. Conduits installed embedded within concrete encasement of any kind shall be installed such that conduit couplings for parallel conduits are staggered so that they are not side by side.
- B. Conduits are NOT permitted to be installed concealed and/or embedded for the following situations:
 - 1. Conduits shall not be installed embedded within any water-bearing floors or walls. Conduits shall not be installed embedded within any liquid containment area floors or walls.
 - 2. Conduits shall not be installed concealed within CMU walls or gypsum walls that are adjacent to indoor Type 1 or Type 2 chemical storage/transfer areas.

3.03 CONDUIT USES AND APPLICATIONS

- A. Rigid Conduit
 - 1. Rigid conduit for non-hazardous areas shall be furnished and installed in the materials of construction as follows:

Rigid Conduit for Non-Hazardous Areas

Installation Area Designation / Scenario	Conduit Category by Wiring / Circuit Type	
	Power and Control	Instrumentation
Exposed in indoor dry non-process areas	Rigid galvanized steel conduit	Same as Power and Control
Exposed in indoor Type 1 chemical storage/transfer areas	Schedule 80 rigid non-metallic PVC conduit	Same as Power and Control
Exposed in indoor Type 2 chemical storage/transfer areas	PVC coated rigid galvanized steel conduit	Same as Power and Control
Exposed in outdoor areas	PVC coated rigid galvanized steel conduit	Same as Power and Control
Exposed within pre-fabricated electrical equipment center buildings	Electrical Metallic Tubing	Same as Power and Control
Concealed above suspended ceilings	Electrical Metallic Tubing	Same as Power and Control
Concealed within interior walls constructed of metal studs and gypsum wall board	Electrical Metallic Tubing	Same as Power and Control

2. The tables for the materials of construction for rigid conduits are intended to exhaustively cover all possible scenarios and installation areas under this Contract. However, if a scenario or installation area is found that is not explicitly governed by these tables, it shall be assumed for bid purposes that the conduit material of construction is to be rigid galvanized steel. This discrepancy shall be brought to the attention of the Engineer (in writing) immediately for resolution.

B. Conduit Bends

1. All conduit bends shall be the same material of construction as the rigid conduit listed in the tables above, with the following exceptions:
 - a. All 90-degree bends or combinations of adjacent bends that form a 90-degree bend where concealed within concrete or below a concrete slab shall be rigid galvanized steel.
2. Field fabricated bends of metallic conduit shall be made with a bending machine and shall have no kinks. Field fabricated standard radius and long radius bends shall have minimum bending radii in accordance with the associated tables in Part 2 herein.

3. Field bending of non-metallic conduits is not acceptable, factory fabricated bends shall be used.
4. Long radius bends shall be furnished and installed for the following specific applications, all other bends shall be standard radius:
 - a. All conduits containing medium voltage cable.
 - b. All conduits containing fiber optic cable.
 - c. All conduits containing shielded VFD cable.
 - d. Where specifically indicated on the Drawings.

C. Flexible Conduit

1. Flexible conduit shall only be installed for the limited applications specified herein. Flexible conduit shall not be installed in any other application without written authorization from the Engineer. Acceptable applications are as follows:
 - a. Connections to motors and engine-generator sets (and similar vibrating equipment)
 - b. Connections to solenoid valves and limit switches
 - c. Connections to lighting fixtures installed in suspended ceilings
 - d. Connections to lighting transformers and combination power units
 - e. Connections to pre-fabricated equipment skids
 - f. Connections to HVAC equipment
 - g. Connections to instrument transmitters and elements
 - h. Where specifically indicated in the Standard Details
2. Flexible conduit length shall be limited to three (3) feet, maximum. Flexible conduit shall not be installed buried or embedded within any material.
3. Unless otherwise specified herein, flexible conduits shall be installed in accordance with the Installation Guidelines published within NEMA RV-3.
4. Flexible conduit for non-hazardous areas shall be furnished and installed in the materials of construction as follows:

Flexible Conduit for Non-Hazardous Areas

Installation Area Designation / Scenario	Conduit Category by Wiring / Circuit Type	
	Power and Control	Instrumentation
Exposed in indoor dry non-process areas	Flexible metal conduit	Same as Power and Control
Exposed in indoor Type 1 chemical storage/transfer areas	Liquid-tight flexible non-metallic conduit	Same as Power and Control
Exposed in indoor Type 2 chemical storage/transfer areas	Liquid-tight flexible metal conduit	Same as Power and Control
Exposed in outdoor areas	Liquid-tight flexible metal conduit	Same as Power and Control
Concealed above suspended ceilings (all indoor areas)	Same material as exposed conduit in same area	Same as Power and Control

3.04 CONDUIT FITTING USES AND APPLICATIONS

A. General

1. Conduit fittings shall be furnished and installed in the materials of construction as indicated in Part 2, herein. Conduit fitting materials of construction are dependent on the material of construction used for the associated conduit.
2. Conduit fittings shall be provided in the trade size and configuration required to suit the application.

B. Conduit Bodies

1. Conduit bodies shall be installed where wire pulling points are desired or required, or where changes in conduit direction or breaking around beams is required.
2. Where conduit bodies larger than trade size 2 inches are intended to be used as a pull-through fitting during wire installation, oversized or elongated conduit bodies shall be used. Oversized or elongated conduit bodies shall not be required if the conduit body is intended to be used as a pull-out point during wire installation.

C. Conduit Nipples and Unions

1. Conduits with running threads shall not be used in place of 3-piece couplings (unions) or close nipples. After installation of a conduit fitting of any kind, there shall be no more than ¼ inch of exposed threads visible. Factory fabricated all-

thread nipples may be used between adjacent enclosures, however, the same restriction applies regarding the length of exposed threads that are visible.

D. Conduit Expansion and Deflection Fittings

1. Conduit expansion fittings shall be installed where required by the NEC and where indicated on the Drawings. Expansion fittings shall also be installed for exposed straight metallic conduit runs of more than 75 feet, in both indoor and outdoor locations. Expansion fittings for runs of non-metallic conduit shall be installed in accordance with the NEC.
2. Conduit deflection fittings shall be installed where required by the NEC and where conduits are installed (exposed and concealed) across structural expansion joints.
3. Unless otherwise specified herein, conduit expansion and deflection fittings shall be installed in accordance with the Installation Guidelines published within NEMA FB 2.40.

E. Conduit Seals

1. Conduit seals shall be installed for conduits installed within or associated with hazardous areas and other areas as required by the NEC. In addition, conduit seals shall also be furnished and installed as follows:
 - a. All conduits entering or leaving enclosed areas which store or distribute chlorine gas.
 - b. All conduits entering or leaving enclosed areas which store or distribute sulfur dioxide gas.

F. Conduit Termination Fittings

1. Where conduits terminate at enclosures with a NEMA 4, 4X, or 3R rating and the enclosure does not have integral conduit hubs, an appropriately sized watertight conduit hub shall be installed to maintain the integrity of the enclosure. The use of locknuts with integral gasket in lieu of watertight conduit hubs is not acceptable.
2. Where conduits terminate at enclosures that do not require conduit hubs, a two-locknut system shall be used to secure the conduit to the enclosure. One locknut shall be installed on the outside of the enclosure, and the other inside, drawn tight against the enclosure wall. The locknut on the interior of the enclosure shall be the type with integral bonding lug, or a conduit bonding bushing may be used in place of the interior locknut.
3. Conduits shall not be installed such that conduit fittings penetrate the top of any enclosure located outdoors, except in cases where specifically required by the serving electric utility. Conduits which serve outdoor equipment or an enclosure from above shall instead be routed into the side of the enclosure at the bottom.

The conduit termination fitting shall be provided with a conduit drain to divert moisture from the raceway away from the enclosure.

3.05 MISCELLANEOUS

A. Conduit Periphery Sealing

1. All conduit penetrations through exterior walls shall be sealed around the periphery using the appropriate products specified in Part 2 herein to prevent air and/or water entry into the structure.
2. All conduit penetrations through interior walls and floors shall be sealed through the use of with conduit sleeves and caulk as specified in Part 2 herein. Alternatively, mortar may be used to seal around the conduit periphery.
3. Conduit penetrations through fire-rated walls as floors shall be made with the appropriate fire rated penetration product.

B. Conduit Interior Sealing

1. All conduits (including spares) entering a structure below grade shall be sealed on the interior of the conduit against water ingress. Sealing shall be at an accessible location in the conduit system located within the building structure and shall be via one of the methods specified in Part 2 herein. If conduit sealing cannot be achieved at an accessible location within the building structure, sealing shall be placed in the conduits in the nearest manhole or handhole outside the structure.
2. Conduit interior sealing shall not be installed until conductors inside are tested and test results are deemed acceptable by the Engineer. Conduit interior sealing shall be installed prior to energization of the conductors inside.

3.06 CONDUIT IDENTIFICATION

- A. The identification system for the conduits furnished and installed under this Contract shall match the existing identification system used at the project location.

3.07 TESTING

- A. All tests shall be performed in accordance with the requirements of the General Conditions and Division 01. The following tests are required:
 1. All conduit installed below grade or concrete encased shall be tested to ensure continuity and the absence of obstructions by pulling through each conduit a swab followed by a mandrel 85% of the conduit inside diameter. After testing, all conduits shall be capped after installation of a suitable pulling rope.

3.08 TRAINING OF INSTALLATION PERSONNEL

- A. All Contractor personnel that install PVC coated RGS conduit shall be trained by the PVC coated RGS conduit manufacturer. Training shall include proper conduit system assembly techniques, use of tools appropriate for coated conduit systems, and field bending/cutting/threading of coated conduit. Training shall have been completed within the past 24 months prior to the Notice to Proceed on this Contract to be considered valid. Contractor personnel not trained within this timeframe shall not be allowed to install coated conduit or shall be trained/re-trained as required prior to commencement of conduit installation.

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SECTION 26 05 33.16
BOXES FOR ELECTRICAL SYSTEMS

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. The scope of work under this Section includes furnishing and installing all pull boxes, junction boxes, and outlet boxes.
- B. Requirements for other boxes and enclosures are not included in this Section. Reference each specific equipment Section for requirements related to that equipment's respective enclosure.
- C. Reference Section 26 05 00 – Basic Electrical Requirements and Section 26 05 33.13 – Conduit for Electrical Systems.

1.02 CODES AND STANDARDS

- A. Boxes shall be designed, manufactured, and/or listed to the following standards as applicable:
 - 1. UL 514A – Metallic Outlet Boxes
 - 2. UL 514C – Standard for Non-metallic Outlet Boxes, Flush Device Boxes, and Covers
 - 3. UL 50 – Enclosures for Electrical Equipment, Non-environmental Considerations
 - 4. UL 50E – Enclosures for Electrical Equipment, Environmental Considerations
 - 5. UL 1203 – Standard for Explosion-proof and Dust-ignition-proof Electrical Equipment for use in Hazardous (Classified) Locations.
 - 6. NEMA 250 – Enclosures for Electrical Equipment

1.03 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01 33 00 – Submittal Procedures, the Contractor shall obtain from the equipment manufacturer(s) and submit the following:
 - 1. Shop Drawings
- B. Each submittal shall be identified by the applicable Specification Section.

1.04 SHOP DRAWINGS

- A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.
- B. Partial, incomplete or illegible Submittals will be returned to the Contractor without review for resubmittal.
- C. Shop drawings shall include but not be limited to:
 - 1. Product data sheets for boxes, terminal strips, and all accessories

1.05 OPERATION AND MAINTENANCE MANUALS

- A. The Contractor shall submit operation and maintenance manuals in accordance with the procedures and requirements set forth in the General Conditions and Division 01.
- B. As-built drawings showing dimensions, internal box layout, terminal strip information, and terminal strip identification information shall be provided for all junction boxes. As-built drawings are not required for pull boxes or outlet boxes.

1.06 IDENTIFICATION

- A. Each pull and junction box shall be identified with the box name as indicated on the Contract Drawings (e.g. PPB-XXX, CJB-YYY) or as directed by the Engineer. A nameplate shall be securely affixed in a conspicuous place on each box. Nameplates shall be as specified in Section 26 05 53 – Identification for Electrical Systems.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

- A. The equipment covered by this Specification is intended to be standard equipment of proven performance as manufactured by reputable concerns. Equipment shall be designed, constructed, and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.

2.02 PULL AND JUNCTION BOXES

- A. General
 - 1. All pull and junction boxes shall be UL listed and labeled.
 - 2. Pull and junction boxes shall not be provided with eccentric or concentric knockouts.

3. Pull and junction boxes mounted embedded in concrete shall be UL listed for embedment.
4. Where metallic boxes are used, they shall be of all welded construction. Tack welded boxes are not acceptable.

B. Pull Boxes

1. Metallic pull boxes in non-hazardous locations and in hazardous locations where general-purpose enclosures are permitted (e.g. Class I, Division 2 locations) shall be provided with a matching gasketed cover. For covers with dimensions of less than 12 inches by 12 inches, the cover shall be held in place by stainless steel machine screws. Other screw types are not acceptable. For covers with dimensions 12 inches by 12 inches and larger, the cover shall be hinged and held in place by 1/4-turn style latches. Latch mechanism shall be all stainless steel. Hinge pins shall be removable.
2. Non-metallic pull boxes shall be provided with a matching gasketed cover. The cover shall be hinged and held in place by quick-release (e.g. "flip") latches. Latch material of construction shall match the box material, and include stainless steel hasps. For covers with dimensions 24 inches by 24 inches and larger, a 3-point latching mechanism with external pad-lockable handle may be substituted. Latch mechanism and handle shall be all stainless steel. Hinge pins shall be removable.
3. Pull boxes shall not have any wire terminations inside, other than those for grounding/bonding. A ground bar shall be provided with the necessary number of screw type terminals. Twenty (20) percent of the total amount of terminals otherwise required for the pull box (minimum of two) shall be provided as spare terminations. Boxes requiring any other wire terminations shall be furnished and installed in accordance with the requirements for junction boxes herein.
4. Pull boxes shall be 6 inches wide by 6 inches tall by 4 inches deep, minimum. For applications requiring larger boxes, the box shall be sized in accordance with the fill requirements and dimensional requirements of the NEC.
5. Barriers shall be provided in pull boxes to isolate conductors of different voltages, types, and functions. Barrier material of construction shall match that of the box. Isolation shall be provided between the following groups:
 - a. Power wiring
 - b. AC control wiring
 - c. DC control wiring
 - d. Instrumentation wiring

C. Junction Boxes

1. Metallic junction boxes in non-hazardous locations shall be provided with a matching gasketed cover. For covers with dimensions of less than 12 inches by 12 inches, the cover shall be held in place by stainless steel machine screws. Other screw types are not acceptable. For covers with dimensions 12 inches by 12 inches and larger, the cover shall be hinged and held in place by 1/4-turn style latches. Latch mechanism shall be all stainless steel. Hinge pins shall be removable.
2. Metallic junction boxes in hazardous locations shall be provided with a matching gasketed cover. Cover shall be hinged and held in place by stainless steel bolts. Hinge pins shall be removable. Covers shall be installed and bolts torqued in accordance with manufacturer requirements to maintain the hazardous location rating of the enclosure.
3. Non-metallic junction boxes shall be provided with a matching gasketed cover. The cover shall be hinged and held in place by quick-release (e.g. "flip") latches. Latch material of construction shall match the box material and include stainless steel hasps. For covers with dimensions 24 inches by 24 inches and larger, a 3-point latching mechanism with external pad-lockable handle may be substituted. Latch mechanism and handle shall be all stainless steel. Hinge pins shall be removable.
4. Barriers shall be provided in junction boxes to isolate conductors and terminal blocks of different voltages, types, and functions. Barrier material of construction shall match that of the box. Isolation shall be provided between the following groups:
 - a. Power wiring
 - b. AC control wiring
 - c. DC control wiring
 - d. Instrumentation wiring
5. Junction boxes used for lighting and receptacle circuits only shall be allowed to have screw-on (wire nut) type connectors for wire terminations/junctions.
6. Junction boxes for all uses other than lighting and receptacle circuits shall be provided with terminal strips, consisting the necessary number of screw type terminals. Current carrying parts of the terminal blocks shall be of ample capacity to carry the full load current of the circuits connected, with a 10A minimum capacity. Terminal strips shall be rated for the voltage of the circuits connected. A separate ground bar shall be provided with the necessary number of screw type terminals. Twenty (20) percent of the total amount of terminals otherwise required for the junction box (minimum of two) shall be provided as spare terminations.

When barriers are provided within the box, separate terminal strips shall be provided in each barrier area. Terminals shall be lettered and/or numbered to conform to the wiring labeling scheme in place on the project.

7. Junction boxes shall be 6 inches wide by 6 inches tall by 4 inches deep, minimum. For applications requiring larger boxes, the box shall be sized in accordance with the fill requirements and dimensional requirements of the NEC. Terminal blocks (including spare terminals) shall be considered when sizing the junction box.

D. Enclosure Types and Materials

1. In non-hazardous locations, pull and junction boxes shall be furnished with the following enclosure type and material of construction, dependent upon the designation of the area in which they are to be installed. Area designations are indicated on the Drawings.

Area Designation	Enclosure Type and Material
Indoor Dry Non-Process Area	NEMA 1, Painted Steel
Indoor Type 1 Chemical Storage/Transfer Area	NEMA 4X, Fiberglass or PVC
Indoor Type 2 Chemical Storage/Transfer Area	NEMA 4X, Type 304 Stainless Steel
All Outdoor Areas	NEMA 4X, Type 304 Stainless Steel

2. Non-metallic enclosures, NEMA 7 enclosures, and NEMA 9 enclosures shall be provided with threaded integral conduit hubs.
3. Where located outdoors or in indoor wet process areas, NEMA 7 and NEMA 9 enclosures shall also carry a NEMA 4X rating.

2.03 OUTLET BOXES

A. General

1. Outlet boxes shall be provided with a trim appropriate for the wiring device installed inside. Reference Section 26 27 26 – Wiring Devices for outlet box trim requirements. An appropriate outlet box trim is required to achieve the NEMA rating of the outlet boxes as specified herein.

B. Surface Mount Outlet Boxes

1. Outlet boxes shall be the deep type, no less than 2.5 inches deep.

2. Outlet boxes shall be provided in single or multi-gang configuration as required, sized in accordance with the requirements of the NEC.
3. In non-hazardous locations, outlet boxes shall be furnished with the following enclosure type and material of construction, dependent upon the designation of the area in which they are to be installed. Area designations are indicated on the Drawings.

Area Designation	Enclosure Type and Material
Indoor Dry Non-process Area	NEMA 1, Cast Aluminum
Indoor Type 1 Chemical Storage/Transfer Area	NEMA 4X, PVC
Indoor Type 2 Chemical Storage/Transfer Area	NEMA 4X, PVC Coated Steel
All Outdoor Areas	NEMA 4X, PVC Coated Steel

4. Outlet boxes shall be provided with integral threaded conduit hubs mounted external to the box. Boxes with threaded conduit hubs mounted internal to the box or as a part of the box wall are not acceptable.

C. Flush Mount Outlet Boxes

1. Outlet boxes shall be no less than 2-1/8 inches deep, and 4-11/16 inches square. Boxes shall be UL listed and labeled. Pre-punched single diameter conduit knockouts are acceptable; however, concentric and eccentric knockouts are not acceptable.
2. Outlet boxes mounted flush in CMU walls shall be made of galvanized, tack welded steel, and suitable for installation in masonry walls. Sectional type boxes are not acceptable for this application.
3. Outlet boxes mounted flush in gypsum walls shall be made of galvanized pressed steel. Tack welded boxes are not acceptable for this application. Sectional type boxes are not acceptable for this application.
4. Outlet boxes mounted cast into concrete shall be concrete tight and made of galvanized steel or PVC.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Pull and Junction Boxes

1. Pull boxes and junction boxes shall be solidly attached to structural members prior to installation of conduit and set true and plumb. Boxes shall not be supported by their associated conduits.
2. Wooden plugs are not permitted for securing boxes to concrete. Appropriately rated anchors specifically suited for use in concrete shall be used.
3. Box penetrations for conduits shall be made with a punch tool, and penetrations shall be of the size required for the conduit entry and/or hub. Oversized penetrations in boxes are not acceptable.
4. Watertight conduit hubs shall be provided for boxes where a NEMA 4X enclosure rating is specified. Reference Section 26 05 33.13 – Conduit for Electrical Systems for conduit hub requirements.
5. Pull and junction boxes may be installed flush mounted in gypsum, concrete or CMU walls where appropriate provided that covers are easily removed or opened.
6. Pull and junction boxes shall be provided in the enclosure type and material of construction required for the area in which it is installed. Reference the requirements in Part 2 herein, and the area designations indicated on the Drawings.

B. Outlet Boxes

1. Outlet boxes shall be solidly attached to structural members prior to installation of conduit and set true and plumb. Boxes shall not be supported by their associated conduits.
2. Wooden plugs are not permitted for securing boxes to concrete. Appropriately rated anchors specifically suited for use in concrete shall be used.
3. Flush mounted outlet boxes shall be arranged and located so that tile and grout lines fit closely around the boxes, and so placed that the cover or device plate shall fit flush to the finished wall surface.
4. Outlet boxes shall be flush mounted in finished areas and other areas where practical. Flush mounted outlet boxes shall not be installed in hazardous areas and type 1 or 2 chemical storage/transfer areas.
5. For the below-named items, mounting heights from finished floor, or finished grade to top is applicable, depending on the type of wiring device to be installed in the outlet box. Mounting heights for outlet boxes shall be as follows, unless otherwise specified herein, indicated on the Drawings, or required by the Americans with Disability Act (ADA):
 - a. Light switches and wall mounted occupancy sensors, 48 inches

- b. Receptacles in indoor dry process/non-process areas, 16 inches
 - c. Receptacles in indoor wet process areas and all indoor chemical storage/transfer areas, 48 inches
 - d. Receptacles in outdoor locations, 24 inches
 - e. Ceiling mounted occupancy sensors, as indicated on the Drawings
6. Outlet boxes shall be provided in the material of construction required for the area in which it is installed. Reference the requirements in Part 2 herein, and the area designations indicated on the Drawings.

END OF SECTION

SECTION 26 05 53
IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. All electrical equipment shall be properly identified in accordance with these Specifications and the Contract Drawings. All switchgear, switchboards, motor control centers, variable frequency drives, lighting and distribution panelboards, combination starters, control panels, pull and junction boxes, enclosures, disconnect switches, control stations, and similar equipment shall be identified in the manner described, or in an equally approved manner.
- B. The types of electrical identification specified in this Section include, but are not limited to, the following:
 - 1. Operational instructions and warnings.
 - 2. Danger signs.
 - 3. Equipment/system identification signs.
 - 4. Nameplates.

1.02 SIGNS

- A. "DANGER-HIGH-VOLTAGE" signs shall be securely mounted on the entry doors of all electrical rooms.

1.03 LETTERING AND GRAPHICS

- A. The Contractor shall coordinate names, abbreviations, and other designations used in the electrical identification work with the corresponding designations shown, specified or scheduled. Provide numbers, lettering, and wording as indicated or, if not otherwise indicated, as recommended by manufacturers or as required for proper identification and operation/maintenance of the electrical systems and equipment.

1.04 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01 33 00 – Submittal Procedures, the Contractor shall obtain from the equipment manufacturer and submit shop drawings. Each submittal shall be identified by the applicable Specification Section.

1.05 SHOP DRAWINGS

- A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.
- B. Partial, incomplete, or illegible submittals will be returned to the Contractor without review for resubmittal.
- C. Shop drawings shall include but not be limited to:
 - 1. Product data sheets.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

- A. The material covered by these Specifications is intended to be standard material of proven performance as manufactured by reputable concerns. Material shall be fabricated, constructed, and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as specified herein and shown on the Drawings.

2.02 NAMEPLATES

- A. Nameplates shall be engraved, high pressure plastic laminate, white with black lettering.
- B. Nameplates shall be attached to NEMA 4X enclosures utilizing UL-recognized mounting kits designed to maintain the overall UL Type rating of the enclosure. Mounting kit fasteners shall be stainless steel Type AHK10324X as manufactured by Hoffman, or equal.

2.03 HIGH VOLTAGE SIGNS

- A. Standard "DANGER" signs shall be of baked enamel finish on 20 gage steel; of standard red, black and white graphics; 14 inches by 10 inches size except where 10 inches by 7 inches is the largest size which can be applied where needed, and except where a larger size is needed for adequate identification.

2.04 CONDUIT IDENTIFICATION

- A. Conduit identification shall be as specified in Section 26 05 33.13 – Conduit for Electrical Systems.

2.05 WIRE AND CABLE IDENTIFICATION

- A. Field installed wire and cable identification shall be as specified in Section 26 05 19 – Low Voltage Conductors and Cable.
- B. A plastic laminate nameplate shall be provided at each panelboard, motor control center, switchgear assembly, and switchboard assembly. This nameplate shall be used to clearly convey the conductor identification means used at that piece of equipment (i.e. Phase A=Brown, Phase B=Orange, C = Yellow).
- C. Wiring identification for factory installed wiring in equipment enclosures shall be as specified in the respective Section.

2.06 BOX IDENTIFICATION

- A. Pull, junction and device box identification shall be as specified in Section 26 05 33.16 – Boxes for Electrical Systems.

PART 3 – EXECUTION

3.01 NAMEPLATES

- A. Nameplates shall be attached to the equipment enclosures with (2) two stainless steel sheet metal screws for nameplates up to 2-inches wide. For nameplates over 2-inches wide, four (4) stainless steel sheet metal screws shall be used, one (1) in each corner of the nameplate. The utilization of adhesives is not permitted.

3.02 OPERATIONAL IDENTIFICATION AND WARNINGS

- A. Wherever reasonably required to ensure safe and efficient operation and maintenance of the electrical systems and electrically connected mechanical systems and general systems and equipment, including prevention of misuse of electrical facilities by unauthorized personnel, install plastic signs or similar equivalent identification, instruction, or warnings on switches, outlets, and other controls, devices, and covers or electrical enclosures. Where detailed instructions or explanations are needed, provide plasticized tags with clearly written messages adequate for the intended purposes. Signs shall be attached as specified above for nameplates.

3.03 POWER SOURCE IDENTIFICATION

- A. After installation of all field equipment (i.e. valves, motors, fans, unit heaters, instruments, etc.) install nameplates at each power termination for the field equipment. Nameplate data shall include equipment designation (tag number), power source (MCC number, panelboard, etc.), circuit number, conduit number from schedule and voltage/phase.

- B. Contractor to coordinate with the Engineer and the Owner regarding exact nameplate placement during construction.
- C. Nameplates shall be as specified herein.

END OF SECTION

SECTION 26 05 73
POWER SYSTEM STUDIES

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall provide all power system studies for the project as specified herein. The following shall be performed:
 - 1. Short Circuit Studies
 - 2. Load Flow Analyses
 - 3. Protective Device Coordination Studies
 - 4. Equipment Evaluation
 - 5. Arc Flash Risk Assessment
- B. The scope of the work for these studies shall include all existing electrical equipment as well as new electrical equipment furnished under this Contract at the project site.
- C. The studies shall include all electric utility protective devices, transformers, generators, cables, switchgear, switchboards, motor control centers, individual motor controllers, variable-frequency drives, panelboards, protection relays, and control panels.
- D. Prior to receiving final approval of the distribution equipment shop drawings for the equipment proposed under this Contract and/or prior to release of that equipment for manufacture, the Preliminary Report, as specified herein, shall be submitted and approved. Contractor shall expedite the completion of the Preliminary Report so that final approval of proposed equipment is not delayed.
- E. The studies shall be performed with the aid of SKM Systems Analysis Power Tools for Windows (PTW) software, Version 9.0 or newer. No other software analysis packages are acceptable.

1.02 CODES AND STANDARDS

- A. All work shall be performed in accordance with the following Codes and Standards, as applicable (latest edition, unless otherwise specified):
 - 1. Institute of Electrical and Electronic Engineers (IEEE):
 - a. Standard 141, Recommended Practice for Electric Power Distribution for Industrial Plants

- b. Standard 241, Recommended Practice for Electric Power Systems in Commercial Buildings
 - c. Standard 242, Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems
 - d. Standard 3002.2, IEEE Recommended Practice for Conducting Load Flow Studies and Analysis of Industrial and Commercial Power Systems
 - e. Standard 3002.3, IEEE Recommended Practice for Conducting Short-Circuit Studies and Analysis of Industrial and Commercial Power Systems
 - f. Standard 1584-2018, IEEE Guide for Performing Arc-Flash Hazard Calculations
2. American National Standards Institute (ANSI):
- a. Standard C37.90, IEEE Standard for Relays and Relay Systems Associated with Electric Power Apparatus
 - b. Standard C37.91, Guide for Protective Relay Applications to Power Transformers
 - c. Standard C37.95, Guide for Protective Relaying of Utility-Consumer Interconnections
 - d. Standard C37.96, Guide for AC Motor Protection
 - e. Standard C57.12.59, Guide Dry-Type Transformer Through-Fault Current Duration
 - f. Standard C.57.13, Standard Requirements for Instrumentation Transformers
 - g. Standard C57.109, Guide for Liquid-Immersed Transformer Through Fault-Current Duration
3. National Fire Protection Agency (NFPA):
- a. NFPA 70, National Electrical Code (NEC)
 - b. NFPA 70E, Standard for Electrical Safety in the Workplace (2021 Edition)

1.03 SUBMITTALS

- A. The Contractor shall submit one (1) complete electronic copy of the final power system model and all required database files generated by the software analysis package used. Files shall be placed on portable storage media (USB 3.0 flash storage device) or be

uploaded to a cloud-based file sharing service and be submitted with the Final Report. Furnish any necessary documentation requiring the Owner's signature to allow model to be transferred to the Owner.

1.04 QUALIFICATIONS

- A. The studies shall be performed by a professional electrical engineer actively licensed in the state or commonwealth in which the project is located. The licensed professional electrical engineer shall have a minimum of five (5) years of experience in performing power system studies.
- B. The resume of the licensed professional electrical engineer shall be submitted for approval prior to the start of work. An experience table shall also be provided detailing the power system studies of similar scope to this Contract that have been performed by the proposed engineer over the last two (2) years. The table shall, at a minimum, list the facility owner's name, facility contact person with phone number and email address, and overall scope of work that was provided.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.01 DATA COLLECTION

- A. The Contractor shall collect all required utility transformer and service information for use in these studies. The serving electric utility representative contact information can be found in Section 26 05 00, Basic Electrical Requirements.
- B. Approved equipment shop drawings and product information for all equipment furnished under this Contract shall be used for these studies. Including data for equipment that is not yet approved is not acceptable.
- C. One (1) field visit to the project site to collect pertinent data from existing equipment by the personnel performing the studies is permitted. The visit shall span as many days as required to collect all necessary information. This visit shall occur as soon after the Contract is awarded as possible and shall be coordinated with the Owner. The Contractor and personnel performing these studies are responsible for collecting all required data for these studies. If equipment is to be examined while energized parts are exposed, the examining personnel shall wear appropriate PPE in accordance with the requirements of NFPA 70E.
- D. Using data from record drawings, "as-built" drawings, or a previous power system study is not acceptable. All data for existing equipment shall be field verified.

3.02 STUDY PARAMETERS

- A. The following parameters shall be used for all studies:
 - 1. Transformers 75kVA (nominal) and larger shall be modeled with actual nameplate data including impedance data. Motors 30hp and larger shall be modeled with actual nameplate power factor and efficiency data.
 - 2. Room heating and cooling loads are mutually exclusive. Only the larger of these two load types shall be modeled as in service.
 - 3. Each set of pumps for a specific application (e.g. Influent Sewage Pumps) has one redundant unit. For the purposes of these studies, that redundant unit shall be modeled as out of service.
 - 4. The sources that shall be used in these studies are the serving electric utility and the standby generator. These sources are incapable of paralleling with each other, so each one shall be considered independent of the other for the purposes of these studies.
- B. Other parameters may apply for specific studies if noted in the respective study requirements herein.

3.03 SHORT CIRCUIT STUDIES

- A. The short circuit studies shall be performed in accordance with IEEE Standard 3002.3.
- B. The study input data shall include the short circuit contribution obtained from each source. Short circuit close and latch duty values and interrupting duty values shall be calculated on the basis of assumed three-phase bolted short circuits at each bus. Single-line diagrams shall show the results of the analysis by using datablocks constructed as shown in Appendix A. Provide the results of this study in a tabular format as well, included as an appendix to the report.
- C. The short circuit study report shall include recommendations for equipment selection based on calculated short circuit values and all input and output data from the software model.

3.04 PROTECTIVE DEVICE COORDINATION STUDIES

- A. A protective device coordination study shall be performed to provide the necessary calculations and logic decisions required to select or to check the selection of power fuse ratings, protective relay characteristics and settings, ratios and characteristics of associated current transformers, and low voltage circuit breaker trip characteristics and settings.

- B. The coordination study shall include all equipment from the serving electric utility company source protective devices down to and including all adjustable circuit protective devices. The phase and ground overcurrent protection shall be included as well as settings of all other adjustable protective devices.
- C. The time-current characteristics of the proposed protective devices shall be printed on log-log scale coordination plots as specified below.
 - 1. Each plot shall be accompanied by a representative single-line diagram. The coordination plot and single-line diagram shall each occupy one-half of the same printed sheet for ease of cross reference. Each printed sheet shall have a distinct title that identifies the portion of the electrical system it represents.
 - 2. Each coordination plot shall include the following:
 - a. Sufficient number of separate curves shall be used to clearly indicate the coordination achieved
 - b. Identification of each curve with its respective component's name
 - c. Complete operating bands for fuse and low voltage circuit breaker trip curves
 - d. Transformer magnetizing inrush and ANSI transformer withstand parameters
 - e. Cable thermal overcurrent withstand limits
 - f. Significant symmetrical and asymmetrical fault currents for the portion of the electrical system represented by the plot
 - 3. Each accompanying single-line shall include datablocks as described in Appendix A.
 - 4. All restrictions of the National Electrical Code shall be adhered to, and proper coordination intervals and separation of characteristic curves shall be maintained.
- D. The selection and settings of all protective devices shall be provided separately in the report in a tabulated form listing circuit identification, IEEE device number, current transformer ratios and connections, manufacturer and type, range of adjustment and recommended settings.

3.05 LOAD FLOW ANALYSIS

- A. The load flow analysis shall be performed in accordance with IEEE Standard 3002.2.
- B. A load flow analysis shall be performed to determine the steady-state loading profile of the system(s) being studied. From the results of the load flow analysis, the report shall indicate areas of overloaded conductors, busses, or other equipment in the power

distribution system. The load flow analysis results shall be presented in a tabular format as well as a single-line diagram format. Single-line diagrams shall show the results of the analysis by using datablocks constructed as shown in Appendix A. All assumptions associated with the analysis shall be documented in the report.

3.06 EQUIPMENT EVALUATION

- A. An equipment evaluation shall be performed to determine the adequacy of existing circuit breakers, panelboards, motor control centers, automatic transfer switches, busses, etc. located at the facility by tabulating and comparing the short circuit ratings of these devices with the calculated fault currents that result from the short circuit study.
- B. Appropriate multiplying factors based on system X/R ratios and protective device rating standards shall be applied. A table shall be provided in the report showing the calculated fault currents and the corresponding short circuit ratings of the existing equipment along with a pass or fail status for each piece of equipment.

3.07 ARC FLASH RISK ASSESSMENT

- A. An arc flash risk assessment shall be performed in accordance with IEEE Std. 1584-2018, NFPA 70E, and OSHA 29-CFR, Part 1910 Subpart S. The assessment shall use the incident energy analysis method. The arc flash PPE category method shall not be used.
- B. The following parameters shall be used for the arc flash risk assessment:
 - 1. Working distance for all equipment: 18 inches
 - 2. Arcing duration limit: 2 seconds, or higher (based on engineering judgement) for equipment locations where additional time may be required to exit the arc flash boundary.
 - 3. Equipment box dimensions and electrode configuration shall be entered for each piece of equipment (existing and/or new) to be assessed. Using software default dimensions and electrode configuration is not acceptable.
 - 4. For equipment operating at 240VAC or below, report incident energy as “<1.2 cal/cm²” if the bolted fault current is calculated to be less than 2000A.
 - 5. Any protective device settings changes that were recommended as part of these studies shall be included. For devices where settings changes are recommended, the “as-found” settings shall be documented separately in dedicated tables for record purposes.
 - 6. The following operational scenarios shall be used in the assessment, with the worst-case values from each scenario being shown in the study report and on the arc flash labels:

- a. Scenario 1: All tie circuit breakers at distribution equipment are open, all main circuit breakers are closed, and the facility is served by the electric utility source.
- b. Scenario 2: All A-side main circuit breakers at distribution equipment are open, all tie circuit breakers are closed, all B-side main circuit breakers are closed, and the facility is served by the electric utility source.
- c. Scenario 3: All B-side main circuit breakers at distribution equipment are open, all tie circuit breakers are closed, all A-side main circuit breakers are closed, and the facility is served by the electric utility source.
- d. Scenario 4: All tie circuit breakers at distribution equipment are open, all main circuit breakers are closed, and the facility is served by the standby generator source.
- e. Scenario 5: All A-side main circuit breakers at distribution equipment are open, all tie circuit breakers are closed, all B-side main circuit breakers are closed, and the facility is served by the standby generator source.
- f. Scenario 6: All B-side main circuit breakers at distribution equipment are open, all tie circuit breakers are closed, all A-side main circuit breakers are closed, and the facility is served by the standby generator source.

C. The arc flash risk assessment report shall include but not be limited to the following:

- 1. A brief overview of what arc flash hazards are and how to avoid them.
- 2. Definitions of key terms used in the report.
- 3. Confirmation of all parameters and scenarios used in the report.
- 4. Documentation of any assumptions made for the report.
- 5. Serving electric utility information received. Copies of the information received shall be included in an appendix.
- 6. Any recommendations to reduce the arc flash incident energies via protective device settings changes where incident energies are found to exceed 12 cal/cm^2 . Protective device settings change recommendations shall not negatively impact selective coordination.
- 7. A copy of the PPE information from Table 130.5 G in NFPA 70E.
- 8. Arc flash labels as specified herein.

9. An NFPA 70E energized electrical work permit for each location where an arc flash label is provided.
10. An arc flash evaluation summary sheet, based on the worst-case scenario, that contains the following minimum information:
 - a. Bus name
 - b. Protective device name
 - c. Bus line-to-line voltage
 - d. Bus bolted fault
 - e. Protective device bolted fault
 - f. Protective device arcing fault
 - g. Trip/delay time
 - h. Breaker opening time
 - i. Equipment type
 - j. Gap
 - k. Electrode configuration
 - l. Box height, width, and depth
 - m. Arc flash boundary
 - n. Working distance
 - o. Incident energy
 - p. Notes

D. Arc Flash Labels

1. Arc flash labels shall be provided for each piece of equipment that is likely to require examination, adjustment, servicing, or maintenance while energized. When opening an enclosure exposes energized parts on both the line and load side of a device, provide a label with the worst case (line versus load) incident energy printed. The following equipment, at a minimum, shall be provided with labels in the quantities specified:

- a. Switchgear/Switchboards – quantity of 1 label per section on front, 1 label per section on rear if rear is accessible. Provide second label at main circuit breaker sections where it is possible to open covers and separately expose line side and load side energized parts.
 - b. Motor control centers – quantity of 1 label per section on front, 1 label per section on rear if rear is accessible. Provide second label at main circuit breaker sections where it is possible to open covers and separately expose line side and load side energized parts.
 - c. Panelboards – quantity of 1
 - d. Variable frequency drives – quantity of 1 label per section
 - e. Other stand-alone motor starters/controllers – quantity of 1 label per section
 - f. Automatic and manual transfer switches – quantity of 1
 - g. Enclosed circuit breakers – quantity of 1
2. Arc flash labels shall be thermal transfer type that is printed on adhesive backed polyester material. Labels shall be ANSI Z535.4 compliant, 4 inches tall by 6 inches wide, and provided with a 5-year warranty. For incident energy values of less than 40 cal/cm², the labels shall have an orange-colored header with the word “WARNING”. For incident energy values equal to and above 40 cal/cm², the labels shall have a red-colored header with the word “DANGER”. Each label shall include the following information:
 - a. Equipment name
 - b. Date of issue and name of firm performing assessment
 - c. Incident energy
 - d. Working distance
 - e. Arc flash boundary
 - f. Nominal system voltage
3. A generic arc flash label that has a red-colored header with the word “DANGER” and text in large letters that shows “ENERGIZED WORK NOT PERMITTED” shall be provided for the following equipment:
 - a. Any equipment that requires an arc flash label (as specified above) that is located within a hazardous area.

- b. Any equipment found to be in poor working condition, where in the judgement of the engineer performing the study, energized work should not be performed at all, regardless of the outcome of the incident energy analysis at that equipment.

3.08 STUDY REPORTS

- A. The results of the studies shall be documented in a series of reports. A total of three (3) separate reports shall be provided as follows:
 - 1. Preliminary Report – The Preliminary Report shall consist of all power systems studies as specified herein, with the following exceptions:
 - a. NFPA 70E energized electrical work permits shall not be included.
 - b. One (1) WARNING label and one (1) DANGER label shall be printed on plain paper for format review purposes only. Actual adhesive labels with calculated values shall not be included.
 - 2. Pre-final Report – The Pre-final Report shall incorporate all comments received from the previous report review and shall include specific equipment data from the approved shop drawings of the proposed electrical equipment. The Pre-final Report shall consist of all power systems studies as specified herein, with the following exceptions:
 - a. NFPA 70E energized electrical work permits shall not be included.
 - b. Sample arc flash hazard warning labels one (1) WARNING label and one (1) DANGER label) shall be printed on the proposed adhesive material for review purposes.
 - 3. Final Report – The Final Report shall consist of all power systems studies as specified herein, including final adhesive arc flash hazard warning labels. Final report shall incorporate all installed electrical equipment, including any field changes made during construction, and all comments received from the previous report review. All 'as-left' protective device settings shall be included in the report. The Final Report shall bear the signature and seal of the professional electrical engineer that performed the study.
- B. Hard copies of reports shall be furnished in the quantities specified herein, neatly organized into properly identified 3-ring binders. Tabs shall clearly separate each section of the report.
- C. Electronic copies of reports shall be provided in PDF file format. Electronic copies shall have searchable text and bookmarks for each section of the report.

- D. Each report shall begin with a table of contents followed by an executive summary. The executive summary shall detail the configuration of the electrical system and summarize any concerns or recommendations for the electrical distribution system that resulted from the studies specified herein.
- E. Reports shall include simplified single line diagrams with only the device name information displayed for all equipment, as well as single line diagrams with specific data displayed as specified herein for each study.
- F. All data used in the reports such as conductor sizes and lengths, motor sizes, utility contribution information, fault analysis input, fault contributions, and the like shall be included in the appendices of the report.
- G. All single line diagrams and time current curves shall be provided in the reports on 11x17 paper, properly folded to fit into the report binder. Use of standard 8.5x11 paper for these purposes is not permitted. Single line diagrams shall be appropriately split up between several sheets (if required) to allow the drawing scale to be adjusted in order to make text and symbols legible.

3.09 FIELD ADJUSTMENT

- A. The Contractor shall adjust all relay and other protective device settings according to the recommended settings table provided in the approved Pre-Final Report.
- B. The Contractor shall make minor modifications to equipment as required to accomplish conformance with short circuit and protective device coordination studies.

3.10 ARC FLASH LABEL PLACEMENT

- A. The Contractor shall place approved adhesive arc flash labels on equipment after the Final Report is reviewed and approved.

3.11 TRAINING

- A. The Contractor shall train the Owner's qualified electrical personnel of the potential arc flash hazards associated with working on energized equipment. The training shall be provided in two (2) separate sessions of no less than two (2) hours each. The training shall be certified for continuing education units (CEUs) by the International Association for Continuing Education Training (IACET), or equivalent. Training certificates shall be provided for all attendees.

END OF SECTION

APPENDIX A – SUPPLEMENTARY INFORMATION

REQUIRED DATABLOCK CONTENTS FOR POWER SYSTEM STUDIES

Component Type	Input Data Single-Line	Short Circuit and TCC Single-Lines	Load Flow Single-Line
Utility	Nominal Voltage	Nominal Voltage	Nominal Voltage LF kW and kVAR
Generator	Nominal Voltage Rating (kW) Power Factor	Nominal Voltage	Nominal Voltage LF kW and kVAR
Bus	Voltage	Voltage Fault Magnitude (3P RMS) Fault Magnitude (SLG RMS)	Voltage Percent Voltage Drop
Cable	Size (AWG or kcmil) Parallel Sets Length Type (Cu/Al/Cu-Al)	Total Ampacity	Total Ampacity Percent Voltage Drop LF kW, kVAR, and Amperes
Transformer	Rating (kVA) Impedance (%Z) X/R Ratio	N/A	Percent Voltage Drop LF kW, kVAR, and Amperes
Motor	Rating (hp) Rated Voltage FLA Power Factor	Rating (hp) FLA	Rating (hp) FLA
Non-Motor Load	Rating (A, kW, kVA) Rated Voltage Power Factor	N/A	N/A
Fuse	Manufacturer Model Rating (A)	Same as Input Data	Same as Input Data
Relay*	Manufacturer Model CT Ratio Curve Elements	Same as Input Data	Same as Input Data

Component Type	Input Data Single-Line	Short Circuit and TCC Single-Lines	Load Flow Single-Line
Circuit Breaker** (all others)	Manufacturer Model [SCCR (kA)] Frame/Sensor/Plug Ratings Settings** LTPU [LTD Curve Shape] [LTD] [STPU] [STD and I ² T On/Off] INST [GFPU] [GFD and I ² T On/Off] [AF Maint. Setting/Curve]	Same as Input Data	Same as Input Data
Motor Circuit Protector	Manufacturer Model [SCCR (kA)] Frame/Trip Ratings	Same as Input Data	Same as Input Data
Motor Overload Relay	Manufacturer Model [SCCR (kA)] Frame/Trip Ratings Settings	Same as Input Data	Same as Input Data

* Complex and/or non-overcurrent settings for multifunction relays (e.g. bus/winding differential, motor thermal model parameters, under/overvoltage, RTD alarm and trip setpoints, etc.) are excluded from the model.

** Hide setting elements where not applicable for a given circuit breaker. Recommended settings for non-overcurrent settings for electronic trip circuit breakers (e.g. under/overvoltage, zone-selective interlocking, alarm setpoints, etc.) are excluded from the model.

SECTION 26 27 26

WIRING DEVICES

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish and install all switches, occupancy sensors, and receptacles as shown on the Drawings.
- B. All switches and receptacles shall be furnished and installed in outlet boxes. Reference Section 26 05 33.16 – Boxes for Electrical Systems for outlet box requirements.
- C. Reference Section 26 05 00 – Basic Electrical Requirements and Section 26 05 19 – Low-Voltage Conductors and Cables.

1.02 CODES AND STANDARDS

- A. Wiring devices shall be designed, manufactured, and/or listed to the following standards as applicable:
 - 1. UL 20 – General Use Snap Switches
 - 2. UL 498 – Standard for Attachment Plugs and Receptacles
 - 3. UL 943 – Ground Fault Circuit Interrupters
 - 4. UL 1203 – Standard for Explosion-proof and Dust-ignition-proof Electrical Equipment for use in Hazardous (Classified) Locations.

1.03 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01 33 00 – Submittal Procedures, the Contractor shall obtain from the equipment manufacturer and submit shop drawings. Each submittal shall be identified by the applicable Specification Section.

1.04 SHOP DRAWINGS

- A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.
- B. Partial, incomplete, or illegible submittals will be returned to the Contractor without review for resubmittal.

C. Shop drawings shall include, but not be limited to:

1. Product data sheets.

1.05 SPARE PARTS

- A. The Contractor shall furnish 10% (minimum of 1) spare of each receptacle, switch, and plug furnished and installed for this project.
- B. Spare parts lists, included with the shop drawing submittal, shall indicate specific sizes, quantities, and part numbers of the items to be furnished. Terms such as "1 lot of packing material" are not acceptable.
- C. Parts shall be completely identified with a numerical system to facilitate parts inventory control and stocking. Each part shall be properly identified by a separate number. Those parts which are identical for more than one size shall have the same parts number.

1.06 IDENTIFICATION

- A. Each switch and receptacle shall be identified with the equipment item number, manufacturer's name or trademark, and such other information as the manufacturer may consider necessary, or as specified, for complete identification.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

- A. The equipment covered by these Specifications is intended to be standard equipment of proven performance as manufactured by reputable concerns. Equipment shall be designed, constructed and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.
- B. The Contractor shall use the products of a single manufacturer for each type of wiring device.
- C. The Contractor shall use the products of a single manufacturer for all device plates. Plate variations are allowed for the following devices:
 1. Where the selected plate manufacturer does not manufacture a suitable finish plate.
 2. For heavy-duty receptacles rated at more than 30A.
 3. Where non-standard plates are required, specified, or shown.
- D. The Contractor shall furnish and install all wiring devices and device plates.

- E. In non-hazardous areas, provide specification grade devices manufactured by Appleton, Crouse-Hinds, Leviton, Hubbell, Pass & Seymour, or Engineer approved equal.
- F. In hazardous areas, provide devices manufactured by Appleton, Cooper Crouse-Hinds, Hubbell-Killark, or Engineer approved equal.

2.02 WIRING DEVICES

- A. Wall switches for non-hazardous areas shall be rated for the current required to suit the application, but not less than 20A. Double pole, three-way, and four-way switches shall be provided where indicated on the Drawings, and as required. Switches shall be rated for 120-277VAC and shall be UL 20 Listed.
- B. Convenience receptacles for non-hazardous areas shall be rated for 20A at 125VAC and shall be UL 498 Listed. Receptacles shall be weather resistant where installed in wet or damp locations.
- C. Special purpose receptacles (welders, lab equipment, etc.) shall be provided with the proper NEMA configuration and ampacity as indicated on the Drawings. The coordinating plug for each special purpose receptacle shall be provided with the equipment which it is serving.
- D. Ground fault circuit interrupter receptacles shall be rated for 20A at 125VAC and shall be UL 943 Listed. Receptacles shall be weather resistant where installed in wet or damp locations.
- E. Wall switches for hazardous areas shall be the factory sealed type, UL 1203 Listed for use in the hazardous area. Wall switches shall be rated for 120-277VAC, and shall be rated for the current required to suit the application, but not less than 20A
- F. Receptacles for hazardous areas shall be rated 20A at 120-240VAC. Receptacles shall be UL 1203 listed for use in the hazardous area, utilizing delayed-action construction.
- G. All wiring devices shall be approved for use with stranded conductors, if stranded conductors are to be used with the device. Reference Section 26 05 19 – Low-Voltage Conductors and Cable for conductor requirements

2.03 DEVICE PLATES

- A. Device plates for indoor flushmounted receptacles and switches shall be made of Type 304 stainless steel, not less than 0.032 of an inch thick, with beveled edges and milled on the rear so as to lie flat against the wall. Devices plates shall be provided with a gasket.
- B. Device plates for outdoor installations, indoor wet process areas, and chemical storage/transfer areas shall be Appleton Type FSK, Crouse-Hinds #DS185, or equal for wall switches. Device plates for receptacles shall be “in-use” style. “In-use”

weatherproof covers shall be rugged, minimum 3 1/4" depth, die-cast aluminum as manufactured by Thomas & Betts "Red Dot," Intermatic International, Inc., or equal.

- C. Device plates for indoor dry process and non-process areas with surface mounted boxes shall be Crouse-Hinds DS32, or equal for switches, and Crouse-Hinds DS23 or equal for receptacles.

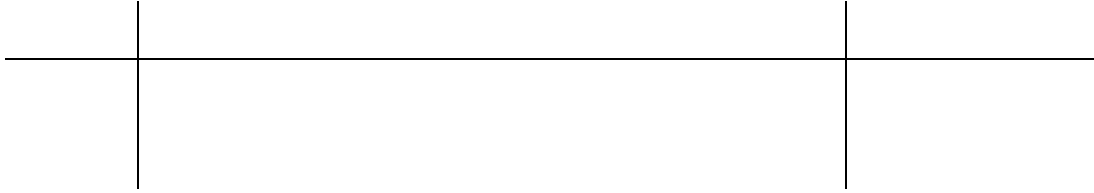
2.04 PLUGS

- A. The Contractor shall furnish suitable plugs with equipment furnished under the respective Specification Section. Plugs shall be black rubber or plastic. For waterproof receptacles, the plugs shall be similar in construction to the receptacles and shall be encased in corrosion resistant yellow housing provided with clamping nuts and stuffing gland cable outlets.

2.05 PROCESS INSTRUMENTS

- A. The Contractor shall furnish and install a local disconnect switch at each process instrument (e.g., level transmitter, flow transmitter, analytical instrument etc.) to disconnect the 120VAC power supply to the instrument. The device shall be a NSSC series manual motor starting switch without overload protection as manufactured by Crouse-Hinds, Appleton equivalent, or equal. For hazardous locations, the device shall be UL 1203 Listed.

2.06



PART 3 – EXECUTION

3.01 INSTALLATION

- A. Where more than one (1) switch occurs at one (1) location, gang plates shall be used.
- B. All device plates shall be set true and plumb and shall fit tightly against the finished wall surfaces and outlet boxes.
- C. Wiring device box (outlet box) mounting heights shall be as specified in Section 26 05 33.16 – Boxes for Electrical Systems.
- D. When indicated height would place any of the equipment at an unsuitable location such as at a molding or break in wall finish, the Contractor shall bring it to the attention of the Engineer for a decision.
- E. Receptacles installed in toilet, locker, and bathrooms, and within 6 feet of a sink, shall be of ground fault interrupter type. Ground fault circuit interrupter receptacles shall also be furnished and installed in additional locations where indicated on the Drawings, and as required by the NEC.
- F. All receptacles shall have a self-adhesive label installed on the top at the respective device plate that indicates which panel and which circuit number the receptacle is supplied from. Labels shall have a white background and black lettering in 14-point font.
- G. The turn-off time delay for each occupancy sensor shall initially be set to 10 minutes. Contractor shall be responsible for the proper commissioning and testing of each occupancy sensor to ensure that it operates to the Owner and Engineer's satisfaction.

3.02 CIRCUITING

- A. Convenience receptacles shall be grouped on circuits separate from the lighting circuits. A maximum of eight (8) convenience receptacles are permitted per 20A, 120V circuit, unless otherwise indicated on the Drawings.

END OF SECTION

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SECTION 40 05 00
BASIC MECHANICAL REQUIREMENTS

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish and install to the required line and grade, all piping together with all fittings and appurtenances, required for a complete installation. Piping to be backfilled and/or encased in concrete is considered to be buried piping. Piping that is not buried is considered to be exposed.
- B. The Contractor shall furnish and install fittings, couplings, connections, sleeves, adapters, harness rods and closure pieces as required to connect pipelines of dissimilar materials and/or sizes herein included under this Section and other concurrent Contracts for a complete installation.
- C. The Contractor shall furnish all labor, materials, equipment, tools, and services required for the furnishing, installation and testing of all piping as shown on the Drawings, specified in this Section and required for the Work. Piping shall be furnished and installed of the material, sizes, classes, and at the locations shown on the Drawings and/or designated in this Section. Piping shall include all fittings, adapter pieces, couplings, closure pieces, harnessing rods, hardware, bolts, gaskets, wall sleeves, wall pipes, hangers, supports, and other associated appurtenances for required connections to equipment, valves, or structures for a complete installation.
- D. Piping assemblies under 4-inch size shall be generally supported on walls and ceilings, unless otherwise shown on the Drawings or ordered by the Engineer, being kept clear of openings and positioned above "headroom" space. Where practical, such piping shall be run in neat clusters, plumb and level along walls, and parallel to overhead beams.
- E. The Contractor shall provide taps on piping where required or shown on the Drawings. Where pipe or fitting wall thicknesses are insufficient to provide the required number of threads, a boss or pipe saddle shall be installed.
- F. The work shall include, but not be limited to, the following:
 - 1. Connections to existing pipelines.
 - 2. Test excavations necessary to locate or verify existing pipe and appurtenances.
 - 3. Installation of all new pipe and materials required for a complete installation.
 - 4. Cleaning, testing and disinfecting as required.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Division 01 – General Requirements
- B. Division 02 – Existing Conditions
- C. Division 05 – Metals
- D. Division 09 – Finishes
- E. Division 26 – Electrical
- F. Division 46 – Water and Wastewater Equipment

1.03 MATERIAL CERTIFICATION AND SHOP DRAWINGS

- A. The Contractor shall furnish to the Owner (through the Engineer) a Material Certification stating that the pipe materials and specials furnished under this Section conform to all applicable provisions of the corresponding Specifications. Specifically, the Certification shall state compliance with the applicable standards (ASTM, AWWA, etc.) for fabrication and testing.

PART 2 – PRODUCTS

2.01 GENERAL

- A. All specials and every length of pipe shall be marked with the manufacturer's name or trademark, size, class, and the date of manufacture. Special care in handling shall be exercised during delivery, distribution, and storage of pipe to avoid damage and unnecessary stresses. Damaged pipe will be rejected and shall be replaced at the Contractor's expense. Pipe and specials stored prior to use shall be stored in such a manner as to keep the interior free from dirt and foreign matter.
- B. Testing of pipe before installation shall be as described in the corresponding ASTM or AWWA Specifications and in the applicable standard specifications listed in the following sections. Testing after the pipe is installed shall be as specified in Part 3.
- C. Joints in piping shall be of the type as specified in the appropriate Piping System Schedule in Section 40 06 20 – Process Pipe, Valve, and Gate Schedules.
- D. The Drawings indicate work affecting existing piping and appurtenances. The Contractor shall excavate test pits as required of all connections and crossings which may affect the Contractor's work prior to ordering pipe and fittings to determine sufficient information for ordering materials. The Contractor shall take whatever measurements that are required to complete the work as shown or specified.

2.02 UNIONS

- A. For copper piping, unions shall have ground joints and conform to ANSI B16.18.
- B. For PVC and CPVC piping, unions shall be socket weld type with Viton O-ring.

2.03 THERMOPLASTIC TUBING AND FITTINGS

- A. Thermoplastic tubing shall be manufactured from polyallomor tubing. Tubing shall be protected from ultraviolet radiation degradation with a black coating or integral color conforming to ASTM D-1248, Type 1, Class C, Category 3. Fittings and connectors used with thermoplastic tubing shall be the flareless tube type constructed of brass conforming to SAE CA377, SAE CA360 or equal. Brass sleeves shall be used.
- B. Assembly of the thermoplastic tubing shall consist of pushing the tubing into the fitting and hand tightening the nut with final tightening with a wrench. Care shall be taken not to overtighten the nut. Plastic tube racks and bend holders shall be provided for holding the tubing in position. Needle valves used with thermoplastic tubing shall be the globe type constructed with a brass body, stem and seat and Buna-N "O"-ring seals. Installation shall be in accordance with the manufacturer's recommendations. Thermoplastic tubing, shall be the Impolene (polyallomor) system and needle valves, fittings and connectors shall be the Poly-Flo with 261 UB Universal Nut and Sleeve system as manufactured by Imperial Eastman, or equal.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. All piping shall be installed by skilled workmen and in accordance with the best standard practice for piping installation as shown on the Drawings, specified or recommended by the pipe manufacturer. Proper tools and appliances for the safe and convenient handling and installing of the pipe and fittings shall be used. Great care shall be taken to prevent any pipe coating from being damaged on the inside or outside of the pipe and fittings. All pieces shall be carefully examined for defects, and no piece shall be installed which is known to be cracked, damaged, or otherwise defective. If any defective pieces should be discovered after having been installed, it shall be removed and replaced with a sound one in a satisfactory manner by the Contractor and at his own expense. Pipe and fittings shall be thoroughly cleaned before they are installed and shall be kept clean until they are accepted in the complete work. All piping connections to equipment shall be provided with unions or coupling flanges located so that piping may be readily dismantled from the equipment. All piping shall be installed in such a manner that it will be free to expand and contract without injury to itself or to structures and equipment to which it is connected. All piping shall be erected to accurate lines and grades with no abrupt changes in line or grade and shall be supported and braced against movement, temporary, or permanent. All exposed piping shall be installed with vertical and horizontal angles properly related to adjoining surfaces or pipes to give the appearance

of good workmanship. Unless otherwise shown or approved, provided a minimum headroom clearance under all piping of 7 feet 6 inches.

- B. Unless otherwise shown or specified, all waste and vent piping shall pitch uniformly at a 1/4-inch per foot grade and accessible cleanouts shall be furnished and installed as shown and as required by local building codes. Installed length of waste and vent piping shall be determined from field measurements in lieu of the Drawings.
- C. All excavation shall be made in such a manner and to such widths as will provide ample room for properly installing the pipe and permit thorough compaction of backfill around the pipe. The minimum trench widths shall be in strict accordance with the "Trench Width Excavation Limits" as shown on the Drawings. All excavation and trenching shall be done in strict accordance with these specifications and all applicable parts of the OSHA Regulations, 29CFR 1926, Subpart P.
- D. ALL EXCAVATION REQUIRED BY THIS CONTRACT SHALL BE UNCLASSIFIED. NO ADDITIONAL PAYMENT WILL BE MADE FOR ROCK EXCAVATION REQUIRED FOR THE INSTALLATION OF PIPE OR STRUCTURES SHOWN ON THE DRAWINGS.
- E. Hand excavation shall be employed wherever, in the opinion of the Engineer, it is necessary for the protection of existing utilities, poles, trees, pavements, or obstructions.
- F. JOINT DEFLECTION SHALL NOT EXCEED 75 PERCENT OF THE MANUFACTURER'S RECOMMENDED DEFLECTION. Excavation and backfilling shall conform to the requirements of Maricopa Association of Government (MAG) Specification Section 206 – Structure Excavation and Backfill, MAG Specification Section 301 – Trench Excavation, Backfilling, and Compaction, and as specified herein. Maximum trench widths shall conform to the Trench Width Excavation Limits shown on the Drawings. All exposed, submerged, and buried piping shall be adequately supported and braced by means of hangers, concrete piers, pipe supports, or otherwise as may be required by the location.
- G. Following proper preparation of the trench subgrade, materials shall be carefully lowered into the trench so as to prevent dirt and other foreign substances from gaining entrance into the pipe and fittings. Proper facilities shall be provided for lowering sections of pipe into trenches. UNDER NO CIRCUMSTANCES SHALL ANY OF THE MATERIALS BE DROPPED OR DUMPED INTO THE TRENCH.
- H. Water shall be kept out of the trench until jointing and backfilling are completed. When work is not in progress, open ends of pipe, fittings, and valves shall be securely closed so that no water, earth, or other substance will enter the pipes, fitting, or valves. Pipe ends left for future connections shall be valved, plugged, or capped, and anchored as required.
- I. All piping shall be installed in such a manner that it will be free to expand and/or contract without injury to itself or to structures and equipment to which it is connected. All piping shall be erected to accurate lines and grades with no abrupt changes in line or grade and shall be supported and braced against movement, temporary, or permanent. All

exposed piping shall be installed with vertical and horizontal angles properly related to adjoining surfaces or pipes to give the appearance of good workmanship. Pipes crossing within a vertical distance of less than or equal to one (1) foot shall be encased and supported with concrete at the point of crossing to prevent damage to the adjacent pipes as shown on the Drawings.

- J. The full length of each section of pipe shall rest solidly upon the bed of the trench, with recesses excavated to accommodate bells, couplings, joints, and fittings. Before joints are made, each pipe shall be well bedded on a solid foundation; and no pipe shall be brought into position until the preceding length has been thoroughly bedded and secured in place. Pipe that has the grade or joint disturbed after laying shall be taken up and relaid by the Contractor at his own expense. Pipe shall not be laid in water or when trench conditions are unsuitable for work.
- K. Proper and suitable tools and appliances for the safe convenient handling and laying of pipe shall be used and shall in general agree with manufacturer's recommendations.
- L. AT THE CLOSE OF EACH WORK DAY, THE END OF THE PIPELINE SHALL BE TIGHTLY SEALED WITH A CAP OR PLUG SO THAT NO WATER, DIRT, OR OTHER FOREIGN SUBSTANCE MAY ENTER THE PIPELINE, AND THIS PLUG SHALL BE KEPT IN PLACE UNTIL PIPE LAYING IS RESUMED.
- M. Ordinarily only full lengths of pipe (as furnished by the pipe manufacturer) shall be used exceptions: closure pieces at manholes and areas where joint deflection is required.
- N. AT THE CLOSE OF WORK EACH DAY, IN PAVED AREAS THE SURFACE SHALL BE RESTORED SO AS TO ALLOW FOR TRAFFIC OVER THE TRENCH DURING NON-WORKING HOURS. TRENCHES IN NON-PAVED AREAS WILL HAVE SUFFICIENT MEASURES TAKEN TO ENSURE SAFETY REQUIREMENTS ARE MET.

3.02 JOINTS IN PIPING

- A. Threaded and/or screwed joints shall have long tapered full depth threads to be made with the appropriate paste or jointing compound, depending on the type of fluid to be processed through the pipe. All pipe up to, and including 1-1/2-inches, shall be reamed to remove burr and stood on end and well pounded to remove scale and dirt. Wrenches on valves and fittings shall be applied directly over the joint being tightened. Not more than three pipe threads shall be exposed at each connection. Pipe, in all lines subject to temperature changes shall be cut short and cold sprung into place to compensate for expansion when hot. Joints in all piping used for chlorine gas lines shall be made up with a glycerine and litharge cement. Joints in plastic piping (PVC/CPVC) shall be laid and joints made with compounds recommended by the manufacturer. Installation shall conform to the requirements of ASTM D2774 and ASTM D2855. Unions required adjacent to valves and equipment.
- B. Solvent or adhesive welded joints in plastic piping shall be accomplished in strict accordance with the pipe manufacturer's recommendations, including necessary field cuttings, sanding of pipe ends, joint support during setting period, etc. Care shall be

taken that no droppings or deposits of adhesive or material remain inside the assembled piping. Solvent or adhesive material shall be compatible with the pipe itself, being a product approved by the pipe manufacturer. Unions are required adjacent to valves and equipment. Sleeve-type expansion joints shall be supplied in exposed piping to permit 1-inch minimum of expansion per 100 feet of pipe length.

- C. Dielectric isolation such as flange isolation kits, dielectric unions, or similar, shall be installed wherever dissimilar metals are connected according to the following table.

	Zinc	Galvanized Steel	Aluminum	Cast Iron	Ductile Iron	Mild Steel/ Carbon Steel	Copper	Brass	Stainless Steel
Zinc			•	•	•	•	•	•	•
Galvanized Steel			•	•	•	•	•	•	•
Aluminum	•	•		•	•	•	•	•	•
Cast Iron	•	•	•				•	•	•
Ductile Iron	•	•	•				•	•	•
Mild Steel/ Carbon Steel	•	•	•				•	•	•
Copper	•	•	•	•	•	•			•
Brass	•	•	•	•	•	•			•
Stainless Steel	•	•	•	•	•	•	•	•	

Notes:

• signifies dielectric isolation is required between the two materials noted.

Consult Engineer for items not listed in table.

Provide flange isolation kits for all flanged connections of dissimilar metals and hardware including connections to equipment.

Contractor shall include all isolation descriptions with piping submittals.

- D. Joints in polypropylene and polyvinylidene fluoride pipe shall be butt fusion weld. All butt welding shall follow the requirements of ASTM D-2657 and the manufacturer's recommendations.

3.03 FLUSHING AND TESTING

- A. All piping shall be properly flushed and tested unless specifically exempted elsewhere in the Specifications or otherwise approved by the Engineer. All liquid conveying pipelines shall be flushed and tested with water. The Contractor shall furnish and install all means and apparatus necessary for getting the water into the pipeline for flushing and testing including pumps, gauges, and meters, any necessary plugs and caps, and any required

blow-off piping and fittings, etc., complete with any necessary reaction blocking to prevent pipe movement during the flushing and testing. All pipelines shall be flushed and tested in such lengths or sections as agreed upon among the Owner, Engineer, and Contractor. Test pressures shall be as specified in Section 40 06 20 – Process Pipe, Valve and Gate Schedules and shall be measured at the lowest point of the pipe segment being tested. The Contractor shall give the Owner and Engineer reasonable notice of the time when he intends to test portions of the pipelines. The Engineer reserves the right, within reason, to request flushing and testing of any section or portion of a pipeline.

- B. The Contractor shall provide water for all flushing and testing of liquid conveying pipelines. Only potable water shall be used for flushing and testing the potable water system.
- C. At the conclusion of the installation work, the Contractor shall thoroughly clean all new liquid conveying pipe by flushing with water or other means to remove all dirt, stones, pieces of wood, etc., which may have entered the pipe during the construction period. If after this cleaning any obstructions remain, they shall be corrected by the Contractor, at his own expense, to the satisfaction of the Engineer. Liquid conveying pipelines shall be flushed at the rate of at least 2.5 feet per second for a duration suitable to the Engineer or shall be flushed by other methods approved by the Engineer.
- D. During testing the piping shall show no leakage. Any leaks or defective piping disclosed by the leakage test shall be repaired or replaced by the Contractor, at his own expense, and the test repeated until all such piping shows tight.
- E. After flushing, all liquid conveying pipelines shall be hydrostatically tested at the test pressure specified in the appropriate Piping System Schedule in Section 40 06 20 – Process Pipe, Valve and Gate Schedules. The procedure used for the hydrostatic test shall be in accordance with the requirements of AWWA C600. Each pipeline shall be filled with water for a period of no less than 24 hours and then subjected to the specified test pressure for 2 hours. During this test, exposed piping shall show no leakage. Allowable leakage in buried piping shall be in accordance with AWWA C600.
- F. Any leaks or defective pipe disclosed by the hydrostatic test shall be repaired or replaced by the Contractor, at his own expense, and the test repeated until all such piping shows tight.
- G. After flushing, all gas piping shall be leak tested in accordance with all local codes and regulations and in conformance with the recommendations or requirements of any National Institute or Association for the specific service application.

3.04 PAINTING AND COLOR-CODING SYSTEM

- A. All exposed piping specified shall be color coded in accordance with the Owner's standard color designation system for pipe recognition. Contractor must submit to the Owner proposed colors, labels, and letter sizes for approval prior to execution of Work. Paint shall be in accordance with Section 09 90 00 – Painting.

END OF SECTION

SECTION 40 05 07
PIPE SUPPORTS

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. Furnish all equipment, labor, materials, and design calculations required to provide pipe supports in accordance with the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 01 73 23 – Seismic Anchorage and Bracing
- B. Division 03 – Concrete
- C. Section 05 05 13 – Galvanizing
- D. Section 05 05 23 – Metal Fastening
- E. Section 05 10 00 – Metal Materials
- F. Section 05 13 00 – Stainless Steel
- G. Section 40 05 00 – Basic Mechanical Requirements

1.03 SUBMITTALS

- A. Applicable and associated cut sheets and drawings for materials and support components shall be submitted with the Shop Drawings in accordance with or in addition to the submittal requirements specified in Section 01 33 00 – Submittal Procedures, Section 40 05 00 – Basic Mechanical Requirements and other referenced Sections above.
 - 1. Catalog cut information on all system components such as pipe supports, hangers, guides, anchors, and channel-type support.
 - 2. Drawings of the piping support systems, locating each support, brace, hanger, guide, component, and anchor. Identify support, hanger, guide and anchor type by catalog number and Shop Drawing detail number.
 - 3. With each piping support system Shop Drawing, the Contractor shall attach calculations prepared and sealed by a Professional Engineer, licensed in the State or Commonwealth in which the project is located, showing that the piping support system complies with the specified requirements, including all building code and seismic code requirements pertaining to support of piping and other non-structural components. See notes specified in the Structural Drawings.

4. Table showing the manufacturer's recommended hanger support spacing for PVC, CPVC and FRP pipe for the services listed in Section 40 06 20 – Process Pipe, Valve and Gate Schedules.

PART 2 – PRODUCTS

2.01 GENERAL

- A. The Contractor shall be responsible for the design of all piping support systems unless noted otherwise herein or specifically detailed on the Contract Drawings. The absence of pipe supports and details on the Drawings shall not relieve the Contractor of the responsibility of providing a pipe support design sealed by a Professional Engineer, licensed in the State of Arizona. Standard details for pipe supports have been included on the Drawings to define minimum requirements as to the types of Contractor designed pipe supports that will be acceptable.
- B. Where a specific location or type of support is shown on the Drawings, the location and type shall be incorporated in the Contractor's pipe support design.
- C. Existing piping support systems to support new piping shall only be used if the Contractor can show and demonstrate by submitting supporting calculations that they are adequate for the additional load imposed by the new piping, or if the supports are strengthened to support the additional load.
- D. Contractor's pipe support design should include, but not be limited to, the following criteria and loads imposed on the piping system:
 1. Thrust Loads based on the design pressures as specified in Piping Schedules in Section 40 06 20 – Process Pipe, Valve and Gate Schedules. Pipe support design shall not utilize process equipment for thrust restraint or support of piping loads.
 2. Dead loads and live loads per the latest version of ASCE/SEI 7 or the local building code if more stringent. Loads shall include, but not be limited to, the following:
 - a. Weight of pipe
 - b. Weight of pipe contents
 - c. Weight of insulation
 - d. Ice loads (If applicable by location, ice loads per code shall be applied as indicated in the governing building code)
 - e. Seismic loading requirements and conditions as specified in the governing building code and referenced seismic design codes. Refer to Structural Notes in the Drawings and the structural code drawing for project specific

seismic design criteria. Seismic and sway bracing shall be provided at maximum 10-foot centers.

- f. Wind loads
- 3. Loads associated with thermal expansion and contraction of the piping system over the full range of potential temperatures the piping system could experience that should include, but not be limited to, the following:
 - a. Ambient temperature range per local historical weather data (historic high and low obtained from NOAA)
 - b. Process operating temperature range
 - c. Exposure to sunlight where applicable
- 4. Additional pipe support design considerations shall include the following:
 - a. A minimum safety factor of 2 or as approved by the Engineer, based upon the yield strength of the support material, shall be used for pipe supports, braces, hangers, and guides as well as for beam and column members used in channel-type support systems.
 - b. The horizontal pipe hanger and/or floor support spacing shall be as recommended by the pipe and/or hanger manufacturer but shall not exceed 10 feet on center unless indicated otherwise herein or on the Drawings.
 - c. The design, sizing and spacing of anchors, including concrete anchors, shall be based on withstanding shear and pullout loads imposed by loading at each support. The minimum anchor size shall be ½ inches in diameter. Refer to Section 05 59 00 – Bearing Devices and Anchoring.

2.02 HANGERS AND SUPPORTS

- A. All piping shall be adequately supported and braced by means of steel hangers and/or supports, concrete piers, supplemental lateral bracing components, pre-fabricated brackets, or otherwise as may be required by the location and forces applied per governing code, including gravity and lateral forces from seismic and/or wind. Generally, concrete supports shall be used where pipe centerline is less than 3 feet above floor, and hangers above 6 feet unless specified or shown otherwise. Supports shall be not more than 10 feet on center for steel and cast iron, 5 feet on center for plastic unless otherwise shown on the Drawings or required by the specific manufacturer. All necessary inserts or appurtenances shall be furnished and installed in the concrete or structures for adequately securing hangers and supports to the structure. Refer to Standard Detail Drawings.

1. Metal pipe support materials, where stainless steel pipe is supported, shall be Type 304L stainless steel meeting the requirements of Section 05 13 00 – Stainless Steel.
2. Metal pipe supports indicated as standard type pipe hangers are designed and detailed for gravity loading only. Resulting lateral loads from wind, seismic, or other lateral loads per code, or special loading conditions during construction, shall be applied to the pipe in accordance with the governing building code. Supplemental lateral stiffening members (when necessary) shall be provided along pipe or at gravity supports using appropriate supplemental members and connections when required by calculations. The Contractor shall include design calculations and details with all pipe hanger and support submissions for review by the Engineer. The main structure and structural components that will support the pipe hangers and other appurtenant components of the facility have been designed to resist all resulting secondary lateral loading from pipe hangers and other non-structural members for gravity and resulting lateral loads.

B. Hangers and supports shall conform to the following requirements:

1. All fabricated metal hangers and supports shall be capable of adjustment after installation. Different types of hangers and supports along a pipe length, including bends, shall be kept to a minimum.
2. Hanger rods shall be straight and vertical. Chain, wire, strap, or perforated bar hangers shall not be used. Hangers shall not be suspended from other piping.
3. Vertical piping shall be properly supported at each floor and between floors by stays or braces to prevent rattling and vibration.
4. Supports and hangers for plastic and FRP piping shall include wide saddles or bands as recommended by the manufacturer and approved by the Engineer to distribute load and thus avoid localized deformation of the pipe.
5. Hanger and supports shall prevent contact between dissimilar metals by use of copper plated, rubber, vinyl coated or stainless-steel hangers.
6. Ferrous pipes to be painted shall be painted in accordance with Section 09 90 00 – Painting. Ferrous pipes that require painting or galvanizing shall be supported by galvanized hangers and supports. Stainless steel piping shall be supported by stainless steel saddles and straps (if required).
7. Copper piping shall be supported by plastic coated or copper plated steel hangers and supports.
8. Plastic piping shall be supported by plastic coated steel hangers and supports.
9. Hangers and supports shall provide for thermal expansion throughout the full operating temperature range.

10. Expansion and adhesive type anchors used for pipe hangers and supports shall be Type 316 stainless steel.
- C. Metallic hangers and supports may be standard make by Anvil International, Inc., "Witch" by Carpenter & Paterson, Ltd., B-Line Systems, Inc., or equal; and data on the types and sizes to be used shall be furnished to the Engineer for approval. Metallic support system brackets, rods, support clips, clevis hangers, hardware, etc. shall be cast iron or welded steel construction. All gravity type hangers and supports shall be restrained laterally to resist seismic loading and other loading as required by the governing code.
- D. Non-metallic support system shall be a heavy-duty channel framing system. Channel frames shall be manufactured by the pultrusion process using corrosion grade polyester or vinyl ester resins. All fiberglass construction shall include suitable ultraviolet inhibitors for UV exposure and shall have a flame spread rating of 25 or less per ASTM E84. Piping accessories, pipe clamps, clevis hangers, support posts, support racks, fasteners, etc., shall be constructed of vinyl ester or polyurethane resin. Non-metallic support systems shall be standard make Aickinstrut by Aickinstrut, Inc., Unistrut Fiberglass by Unistrut, Inc., Enduro Fiberglass Systems, or equal. The Contractor shall submit data on the types and sizes of approval. Unless otherwise shown or specified the Contractor shall provide support spacings in the conformance with the pipe and support system manufacturer's requirements.

PART 3 – EXECUTION

3.01 GENERAL INSTALLATION REQUIREMENTS

- A. Support piping connections to equipment by pipe support and not by the equipment.
- B. Support large or heavy valves, fittings, flow meters and appurtenances independently of the connected piping.
- C. Support no pipe from the pipe above it.
- D. Support piping at changes in direction or in elevation, adjacent to flexible joints, expansion joints, and couplings, and where shown.
- E. The Contractor shall not install piping supports and hangers in equipment access areas or bridge crane runs.
- F. Brace hanging pipes against horizontal movement by both longitudinal and lateral sway bracing.
- G. Install pipe anchors (fixed supports and/or guides) where shown and/or as may otherwise be required to withstand expansion thrust loads and to direct and control thermal expansion. The Contractor may install additional pipe anchors and flexible

couplings to facilitate piping installation, provided that complete details describing location, pipe supports, and hydraulic thrust protection are submitted.

END OF SECTION

SECTION 40 05 31

PVC/CPVC PIPE

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. Reference Section 40 05 00 – Basic Mechanical Requirements.

PART 2 – PRODUCTS

2.01 POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS

- A. PVC pipe and fittings shall be manufactured in accordance with NSF 60/61 approved ASTM D1785, D1784 and F441, "normal impact" pipe, Schedule 40 or 80 as specified.
- B. Fittings used with this pipe shall be socket type or flanged type as specified herein, in Section 40 06 20 – Process Pipe, Valve, and Gate Schedules, or indicated on the Drawings. Plastic piping shall be installed in full accordance with the manufacturer's recommendations for the specific installation. No field bending or distortion of the pipe will be permitted.
- C. PVC pipe shall be Type 1 Grade 1 conforming to ASTM D1784 and D1785. Fittings shall conform to the following standard specifications:
1. Socket Type: (Schedule 40); ASTM D2466
 2. Socket Type: (Schedule 80); ASTM D2467
- D. Provide flanged fittings of the same material as the specified pipe and material conforming to ANSI B16.5 at all valves and equipment except at true (double) union valves. Flange gaskets shall be natural rubber or other material fully compatible with the fluid being conveyed. Where flanged piping is used with chemical systems, the gasket material shall conform to the requirements of the following table. Flange bolts shall be type 316 stainless steel minimum, with higher grade materials used where necessary for fluid (chemical) compatibility.

Chemical	Elastomer Material
Polymers	FKM

- E. Acceptable materials of construction of elastomers for non-chemical service shall be as follows:

Non-Chemical Service	Elastomer Material
Potable Water	EPDM

- F. Solvent cement for socket type joints shall conform to ASTM D2564 for PVC pipe and fittings. Solvent cement for chemical service shall be Weld-On 724 as manufactured by IPS Corporation, or equal.

2.02 CHLORINATED POLYVINYL CHLORIDE (CPVC) PIPE AND FITTINGS

- A. CPVC shall be manufactured in accordance with NSF 60/61 approved ASTM D1785, D1784 and F441, "normal impact" pipe, Schedule 40 or 80 as specified.
- B. Fittings used with this pipe shall be socket type or flanged type as specified herein or indicated on the Drawings. Plastic piping shall be installed in full accordance with the manufacturer's recommendations for the specific installation. No field bending or distortion of the pipe will be permitted.
- C. CPVC pipe shall be Type 4, Grade 1, Schedule 80, conforming to ASTM D1784 and ASTM F441. CPVC fittings shall be socket type conforming to ASTM F439.
- D. Solvent cement for socket type joints shall conform to ASTM F493 for CPVC pipe and fittings. Solvent cement for chemical service shall be Weld-On 724 as manufactured by IPS Corporation, or equal.

2.03 REINFORCED THERMOPLASTIC HOSE AND FITTINGS

- A. Reinforced thermoplastic hose shall be clear type, reinforced with polyester yarn. Hose material shall be PVC, EVA (Ethyl Vinyl Acetate), or Low-Density Polyethylene, depending on the application, as indicated in Section 40 06 20 – Process Pipe, Valve, and Gate Schedules. Hose shall be rated for the following working pressures:

Internal Diameter	Minimum Working Pressure (at 68°F)
½"	200 psi (75 psi at 150°F)
1"	125 psi (50 psi at 150°F)
1-½"	100 psi
2"	75 psi

- B. Wetted materials shall be completely resistant to corrosion by the specified chemicals. Hose manufacturer shall guarantee that the hose is suitable for the intended service.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. Polyvinyl chloride (PVC), chlorinated polyvinyl chloride (CPVC) and High Density Polyethylene (HDPE) pipe shall be laid and joints assembled according to the respective manufacturer's recommendation. PVC pipe installation shall comply with applicable sections of the Uni-Bell PVC Pipe Association Recommended Standard Specifications.
- B. Plastic piping shall not be installed when the temperature is less than 60 degrees F except as otherwise recommended by the manufacturer and approved by the Engineer.

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SECTION 40 05 51
VALVES, GENERAL

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish and install, complete with all assemblies and accessories, all valves shown on the Drawings and specified herein including all fittings, appurtenances and transition pieces required for a complete and operable installation.
- B. All valves shall be constructed of first quality materials which have strength, wearing, and corrosion resistance characteristics entirely suitable for the types of service for which the individual valves are designated. Except where noted otherwise, valves designated for water service shall conform to pertinent sections of the latest revision of AWWA C500 Specifications. Cast iron valve bodies and parts shall meet the requirements of the latest revision of ASTM Designation A-126, "Standard Specifications for Gray Iron Castings for Valves, Flanges, and Pipe Fittings, Class B." All valves shall be in compliance with NSF 60/61.
- C. All valve body castings shall be clean, sound, and without defects of any kind. No plugging, welding, or repairing of defects will be allowed.
- D. Valves shall have flanged ends for exposed service and mechanical joint ends for buried service, unless otherwise shown on the Drawings or specified herein. Flanged ends shall be flat-faced, 125 lb. American Standard unless otherwise shown or specified in accordance with ANSI B16.1. All bolt heads and nuts shall be hexagonal of American Standard size. The Contractor shall be responsible for coordinating connecting piping. Valves with screwed ends shall be made tight with Teflon tape. Unions are required at all screwed joint valves.

1.02 SUBMITTALS

- A. The following items shall be submitted in accordance with, or in addition to the submittal requirements specified in 01 33 00 – Submittal Procedures and Section 46 00 00 – Equipment General Provisions:
 - 1. Performance tests shall be conducted in accordance with the latest revision of AWWA C500.
 - 2. Shop Drawings conforming to the requirements of General Conditions, Section 4.7, are required for all valves, and accessories. Submittals shall include all layout dimensions, size and materials of construction for all components, information on support and anchoring where necessary, pneumatic and hydraulic characteristics and complete descriptive information to demonstrate full compliance with the Documents. Shop Drawings for electrically operated/controlled valves shall include

all details, notes, and diagrams which clearly identify required coordination with the electrical power supply and remote status and alarm indicating devices. Electrical control schematic diagrams shall be submitted with the Shop Drawings for all electrical controls. Diagrams shall be drawn using a ladder-type format in accordance with JIC standards. Shop Drawings for pneumatically operated/controlled valves shall include all details, notes, and diagrams which clearly identify required coordination with the compressed air (service air) system and electrical controls.

3. Operation and maintenance manuals and installation instructions shall be submitted for all valves and accessories in accordance with the Specifications. The manufacturer(s) shall delete all information which does not apply to the equipment being furnished.

1.03 CONTRACTOR'S RESPONSIBILITIES

- A. The Contractor shall provide the services of a qualified representative of the manufacturer(s) of the equipment named below to check out and certify the installation(s), to supervise the initial operation, and to instruct the Owner's operating personnel in proper operation and maintenance procedures in accordance with the following schedule:

Item	Valve/Operator Type	Minimum On-Site Time Requirements
1	Automatic Control Check Valve	One (1) 8-hour day
2	Surge Anticipators	One (1) 8-hour day
3	Motor Operated Modulating Valves	One (1) 8-hour day
4	Motor Operated Open-Close Valves (required only if manufacturer is other than for Item 3 above)	One (1) 8-hour day

- B. Any additional time required to achieve successful installation and operation shall be at the expense of the Contractor. The manufacturer's representative shall sign in and out at the office of the Engineer's Resident Project Representative on each day he is at the project.
- C. A written report covering the representative's findings and installation approval shall be mailed directly to the Engineer covering all inspection and outlining in detail any deficiencies notes.
- D. The times specified are exclusive of travel time to and from the facility and shall not be construed as to relieve the manufacturer of any additional visits to provide sufficient service to place the equipment in satisfactory operation.

PART 2 – PRODUCTS

2.01 FLOW INDICATORS

- A. Flow indicators shall be the Akron ball-type as manufactured by Brooks Instrument Co., Fischer and Porter, or equal, and shall have bronze bodies, glass dome, and plastic ball.

2.02 STRAINERS

- A. Y-Strainers shall be Y-pattern cast iron body, flanged or screwed ends with stainless steel or Monel, 20 mesh strainers. Strainers shall be 200 psi, cold-water service strainers, as manufactured by WATTS, Crane Co., Zurn, or equal.
- B. PVC and CPVC y-strainers shall be provided in PVC and CPVC piping and as shown on the Drawings. Strainer shall be provided with PVC or CPVC body and end cap, EPDM or Viton seal as required for the chemical service, and 20 mesh screen. Temperature rating shall be 30°F to 140°F, and pressure rating shall be 150 psi @ 70°F, non-shock. PVC and CPVC y-Strainers shall be as manufactured by Asahi/America, Hayward, or equal.
- C. PVC and CPVC simplex basket strainers shall be provided in PVC and CPVC piping as shown on the Drawings. 1/2"-4" strainers shall be one-piece molded body with (3) ports to facilitate straight-thru flow pattern or u-shape flow pattern as required. Connections shall be true union type to ease installation/future maintenance. The cover, vent plug, and drain plug shall all be hand-removable, requiring no tools. EPDM or Viton seals shall be used as required for chemical service, and internal baskets shall be 1/32" perforation (20-mesh) for 1/2"-1" sizes, and 1/8" perforation for 1-1/2"-8" sizes. 6" and 8" strainers shall be fabricated construction and shall contain flanged connections as standard. The pressure rating for 1/2"-8" sizes shall be 150 psi @ 70°F, non-shock. Strainers shall be manufactured by Hayward Industrial Products, or equal.

2.03 BACKFLOW PREVENTERS

- A. Backflow preventer shall be the size shown on the Drawings and shall be of the double check valve principle. Backflow preventer installation shall include isolation valves and four test cocks, furnished as an assembly. For backflow preventers less than 2-1/2", the installation assembly also shall include a strainer. Isolation valves for backflow preventers shall be ball valves, except for size 2-1/2" and larger which shall be resilient seat gate valves. Test cocks shall be located as recommended by the manufacturer to facilitate functional testing of the assembly. The backflow preventer shall be a WATTS 709, or equal.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. Except where noted otherwise herein, all valves shall be installing and tested in accordance with the latest revision of AWWA C500. Before installation, all valves shall

be lubricated, manually opened and closed to check their operation and the interior of the valves shall be thoroughly cleaned. Valves shall be placed in the positions shown on the Drawings. Joints shall be made as directed under the Piping Specifications. The valves shall be so located that they are easily accessible for operating purposes and shall bear no stresses due to loads from the adjacent pipe. The Contractor shall be responsible for coordinating connecting piping.

- B. All valves shall be tested at the operating pressures at which the particular line will be used. Any leakage or "sweating" of joints shall be stopped, and all joints shall be tight. All motor operated and cylinder operated valves shall be tested for control operation as directed by the Engineer.
- C. Provide valves in quantity, size, and type with all required accessories as shown on the Drawings.
- D. Install all valves and appurtenances in accordance with manufacturer's instructions. Install suitable corporation stops at all points shown or required where air binding of pipe lines might occur. Install all valves so that operating handwheels or wrenches may be conveniently turned from operating floor but without interfering with access, and as approved by Engineer. Unless otherwise approved, install all valves plumb and level. Valves shall be installed free from distortion and strain caused by misaligned piping, equipment or other causes.
- E. Valve boxes shall be set plumb and centered with the bodies directly over the valves so that traffic loads are not transmitted to the valve. Earth fill shall be carefully tamped around each valve box to a distance of 4 feet on all sides of the box, or to the undisturbed trench face, if less than 4 feet.

3.02 SHOP AND FIELD TESTING

- A. Shop and field testing of valves shall be as follows:
 - 1. Certified factory testing shall be provided for all components of the valve and operator system. Valves and operators shall be shop tested in accordance with the requirements in the latest revision of AWWA C500, including performance tests, leakage test, hydrostatic tests, and proof-of-design tests. The manufacturer through the Contractor shall submit certified copies of the reports covering the test for acceptance by the Engineer.
 - 2. Shop testing shall be provided for the operators consisting of a complete functional check of each unit. Any deficiencies found in shop testing shall be corrected prior to shipment. The system supplier through the Contractor shall submit written certification that shop tests for the electrical/pneumatic system and all controls were successfully conducted and that these components provide the functions specified and required for proper operation of the valve operator system.
 - 3. The Contractor shall conduct field tests to check and adjust system components, and to test and adjust operation of the overall system. Preliminary field tests shall

be conducted prior to start-up with final field tests conducted during start-up. The factory service representative shall assist the Contractor during all field testing and prepare a written report describing test methods, and changes made during the testing, and summarizing test results. The service representative shall certify proper operation of the valve operator system upon successful completion of the final acceptance field testing.

4. Preliminary and final field tests shall be conducted at a time approved by the Engineer. The Engineer shall witness all field testing.
5. All costs in connection with field testing of equipment such as energy, light, lubricants, water, instruments, labor, equipment, temporary facilities for test purposes, etc. shall be borne by the Contractor. The Contractor shall be fully responsible for the proper operation of equipment during tests and instruction periods and shall neither have nor make any claim for damage which may occur to equipment prior to the time when the Owner formally takes over the operation thereof.
6. Preliminary field tests shall be conducted prior to start-up and shall include a functional check of the entire valve operator system and all system components. Preliminary field tests shall demonstrate that the valve operator system performs according to specifications and that all equipment, valves, controls, alarms, interlocks, etc., function properly. The preliminary field test report must be approved by the Engineer prior to conducting final field acceptance tests. Based on results of preliminary field tests, the Contractor shall make any adjustments required to settings, etc., to achieve the required valve closing time and operation specified or otherwise directed by the Engineer.
7. Final field acceptance tests shall be conducted simultaneously with the start-up and field testing of the pumps, air compressors, process air blowers, etc. Field tests shall be conducted for the full range of operating modes and conditions specified and as directed by the Engineer. Each of the valves shall be tested at minimum, maximum, and normal head/flow conditions, and under all specified conditions of opening and closing. Performance of pneumatic valves and compressed air system under normal operating conditions and during simulated power failures shall be checked.
8. Field testing shall include optimization of opening and closing times of the valves. The Contractor shall provide the means for accurate measurement of pipeline pressures as directed by the Engineer. Valve opening and closing times shall be adjusted based on process requirements to optimize operation of the valves. Final valve opening and closing times as determined by field tests shall be approved by the Engineer prior to final acceptance of the system.

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SECTION 40 05 57
VALVE OPERATORS AND ELECTRIC VALVE ACTUATORS

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. Equipment shall be provided in accordance with the requirements of Section 46 00 00 – Equipment General Provisions and Section 40 05 00 – Basic Mechanical Requirements.
- B. Reference Section 40 06 20 – Process Pipe, Valve, and Gate Schedules for additional information on valves and operators/actuators.
- C. The electric valve actuators shall meet the signal requirements described in Section 40 61 23 – Signal Coordination, Section 40 61 93 – Process Control System Input/Output List, and Section 40 61 96 – Process Control Descriptions.
- D. Valve operators and electric valve actuators shall be designed to unseat, open or close, and seat the valve under the most adverse operating condition to which the valves will be subjected.
- E. Operator mounting arrangements shall be as indicated on the Drawings or as directed by the manufacturer and/or Engineer. There shall be no mounting restrictions on the electric valve actuator.
- F. The valve operators and electric actuators shall be the full and undivided responsibility of the valve manufacturer in order to ensure complete coordination of the components and to provide unit responsibility.

1.02 SUBMITTALS

- A. The following items shall be submitted in accordance with, or in addition to the submittal requirements specified in Section 01 33 00 – Submittal Procedures and Section 46 00 00 – Equipment General Provisions:
 - 1. Shop Drawings
 - 2. O&M Manuals
 - 3. Certification that the force required to operate all valves is as specified herein.

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PART 2 – PRODUCTS

2.01 GENERAL

- A. Electric actuators shall be provided where specified in the Valve Schedule in Section 40 06 20 – Process Pipe, Valve, and Gate Schedules.
- B. Manual operators shall be provided on all valves which do not receive electric actuators. Manual operator type shall be as specified herein and as shown on the Drawings.
- C. Operators/actuators shall be furnished with conservatively sized extension bonnets, extension stems, or torque tubes, and all required appurtenances required for a complete installation. Operators furnished with extension bonnets shall include stainless steel extension stems, or stainless steel torque tubes.

2.02 MANUAL OPERATORS

- A. Unless otherwise specified or shown on the Drawings, manual operator type shall be as follows:
 - 1. Exposed valves up to 6-inch shall be lever operated (except gate valves).
 - 2. Exposed gate valves shall be handwheel operated.
 - 3. Valves with centerline of operator located more than 6-feet above the floor or platform from which it is to be operated shall have a chainwheel operator unless otherwise indicated on the Drawings.
- B. Manual operators shall be rigidly attached to the valve body unless otherwise specified or shown on the Drawings.
- C. All operators shall turn counter-clockwise to open and shall have the open direction clearly and permanently marked.
- D. Valve operators shall be designed so that the force required to operate the handwheel, lever, or chain (including breakaway torque requirements) does not exceed 80 pounds applied at the extremity of handwheel or chainwheel operator. Design pressures for sizing of valve operators shall be the piping test pressure for the piping in which the valve is to be installed as shown in the Piping Schedule in Section 40 06 20 – Process Pipe, Valve, and Gate Schedules.
- E. Nut operators shall have standard 2-inch square AWWA operating nuts designed in accordance with AWWA C504-94.
- F. Geared manual operators shall be of the worm gear, traveling nut or scotch yolk type except manual operators for butterfly valves 18-inch in diameter or larger which shall be worm gear, unless otherwise indicated in the individual valve specification. Gear operators shall be of the worm gear or bevel gear type. Gear box designs incorporating

end of travel stops in the housing shall be equipped with AWWA input stops. Each gearbox shall require a minimum of 10 turns for 90 degree rotation or full valve stem travel and shall be equipped with a mechanical valve position indicator.

2.03 ELECTRIC VALVE ACTUATORS

- A. Electric Actuators shall be open/close service or modulating service as specified in the Valve Schedule in Section 40 06 20 – Process Pipe, Valve, and Gate Schedules.
 - 1. Modulating valve actuators shall be manufactured by Rotork, AUMA, EIM Controls or approved equal.
- B. Performance Requirements
 - 1. The actuators shall be designed for indoor and outdoor service and shall be capable of mounting in any position.
 - 2. Torque capacity of the actuators shall be sufficient to operate the valves with the maximum pressure differential, as indicated in the Valve Schedule in Section 40 06 20 – Process Pipe, Valve, and Gate Schedules, with a safety factor of 1.5. Actuators in modulating service will be selected such that the required dynamic valve torque is no more than 60% of the electric actuator's maximum rated breakaway of torque.
 - 3. Operating time for full limits of travel shall be not more than 2 seconds per inch diameter of the valve, +/- 50 percent through 20 inches; +/- 30 percent for valves 24 inches and larger. Operating time shall not be less than 60 seconds for all modulating valves.
 - 4. Actuators shall be capable of operating in ambient temperatures ranging from 0 degrees F – 160 degrees F.
 - 5. For modulating actuators, the gearing, motor and contactor shall be capable of 1200 starts per hour without overheating.
- C. The actuators shall include, in one integral housing, individual compartments for the motor, gearing, wiring terminals, and control circuits. The terminal compartment shall be separated from the inner electrical components of the actuator by means of a watertight seal. The inner seal shall protect the motor and all other internal electrical elements of the actuator from entrance of moisture and dust when the terminal cover is removed. Double cartridge shaft seals shall be provided on the hand wheel and output shafts for weatherproof protection. All external fasteners shall be stainless steel. Compartments shall be provided with moisture and dust-proof rigid cast covers meeting NEMA 6, certified to submergence in 6 ft of water for 30 minutes. Actuators located in classified areas shall be suitable for use in Class 1, Division 1, Group D environments.
- D. The actuators shall be provided with externally operable and lockable 120VAC circuit breakers integral to the control housing

- E. All gearing shall be hardened alloy steel or bronze and shall be rated at twice the output torque of the operator and shall be designed to withstand the stall torque of the motor without failure. Output drive gearing shall consist of a worm shaft and worm gear pinion operating in an oil bath. The worm gear pinion shall be alloy bronze. Worm gear drive shall be self-locking to prevent creeping of the valve disc in an intermediate position. Heavy-duty grease shall protect gearing and sealed ball bearings of the main shaft for five years without changing. Motor reduction gearing shall be spur or planetary gearing and shall allow for field repair and change in gear ratio. For quarter turn applications, overtravel of the operator shall be prevented by internal mechanical stops cast into the actuator.
- F. A mechanical dial position indicator shall be furnished to continuously indicate the position of the valve at and between the fully open and fully closed positions. The indicator shall be driven by gearing driven off of the main worm gear pinion and shall operate when the actuator is in either the electrical mode or manual mode.
- G. A handwheel shall be permanently attached for manual operation. A gear assembly shall be provided between the handwheel and the worm shaft if required to reduce the force necessary to operate the handwheel to less than 40 pounds. A positive declutch mechanism shall engage the handwheel when required. When the actuator is set in the declutched position for handwheel operation, it shall return automatically to electric operation when actuator motor is energized. The handwheel shall not rotate during electric operation nor shall a fused motor prevent handwheel operation.
 - 1. Modulating actuators shall be furnished with solid state reversing starters utilizing thyristors.
- H. Leads from the motor shall be brought to the control circuit (limit switch) compartment without external piping or conduit box. An adequately sized space heater shall be installed in the control circuit compartment to aid in the prevention of damage resulting in from condensation. The following items shall be located in the control circuit compartment.
 - 1. Torque limit switches shall be provided to de-energize the motor control circuit in the event of a stall when attempting to unseat a jammed valve and when torque is exceeded during valve travel. Each actuator shall have an open direction torque switch and a close direction torque switch. The torque switches shall be mechanically operated and able to be set in torque units. Torque switches shall be calibrated prior to the actuator's assembly to the valve.
 - 2. Travel limit switches shall be provided to de-energize the motor control circuit when the actuator reaches the limits of travel in the open and close directions. The limit switch drive shall be of the counter gear type and "in step" with the actuator output drive at all times in either the electrical or manual mode of operation. A minimum of six (6) contacts, three (3) normally open and three (3) normally closed, shall be supplied at each end of valve travel. Four (4) additional

contacts shall be provided to report end of travel or any desired position between ends of travel.

- I. Modulating actuators shall have a position feedback potentiometer mounted directly to the valve actuator gearing inside the gearing compartment. The potentiometer shall provide a 4-20 mA signal corresponding to valve position. Modulating valve actuators shall be designed to respond to either a 4-20mADC analog signal or a digital pulse signal as specified herein or as required to coordinate with the requirements of Division 40.
 - 1. Modulating valve actuators designed to respond to a 4-20mADC signal shall be provided with a valve positioner which shall position the valve proportional to an externally generated 4-20mADC signal. The valve positioning control circuitry shall position the valve by comparing the command signal with the present valve position as indicated by the feedback potentiometer. The positioner shall be field adjustable to fail to the "open," "closed," or "last" position on loss of 4-20 mADC command signal.
 - 2. Modulating valve actuators designed to respond to "pulse" open/close signals shall operate the valve during the time the open or close pulse signal is high. Modulating actuators designed to respond to "pulse" open/close signals shall have the latching circuitry described above for open/close actuators disabled.
- J. The electrical terminals shall be housed in a double sealed terminal compartment isolated from the rest of the actuator components. The actuators shall be designed to operate from a single 120 VAC, 1-phase source. The actuators shall be furnished with fuses inside of the terminal compartment. A quantity of two – ¾ inch NPT conduit entries shall be furnished.
- K. Actuators shall contain wiring and terminals for the following control functions. All dry contacts shall be rated for 5A at 250VAC.
 - 1. Open, Close, and Stop commands from external dry contacts (utilizing internal 24VDC) and/or from an external signal of 12V to 120V. The inputs for the open, close, stop signals shall be field selectable to be respond to either maintained or momentary remote signals. In momentary mode, the actuator shall have internal latching circuitry that causes the operator to drive the valve to its limit of travel upon receipt of the momentary contact signal unless a stop signal is received.
 - 2. Emergency override input from a normally closed or normally open contact. The actuator shall either open or close (field selectable) upon receiving the emergency override input.
 - 3. Remote Local-Off-Remote selector switch, Open/Close pushbuttons, and Open/Closed pilot lights for a remote manual control station (see below). The remote Local-Off-Remote selector switch and Open/Close pushbuttons shall be a dry contact input to the actuator control circuitry. The Open/Closed pilot lights shall be powered from the valve actuator control power.

4. Four (4) unpowered contacts shall be provided which can be selected to indicate valve "Opened" and "Closed" position, "Remote" status of the actuator, and fail status of the actuator. The fail status contacts shall activate upon motor overtemperature and actuator overtorque as a minimum.
5. Terminals for 4-20mADC position command and 4-20mADC position feedback as described above for modulating actuators.

L. Local Controls

1. Actuators shall be furnished with a Local-Off-Remote selector switch; Open, Close, and Stop pushbuttons for local control; a red lamp indicating closed and a green lamp indicating open. L-O-R switch shall be padlockable in any of the three positions.
 - a. When the LOR is in the "Local" position, open/close control shall be by the open and close pushbuttons on the actuator. The stop push button shall stop the actuator travel.
 - b. When the LOR is in the "Off" position, the actuator shall not operate.
 - c. When the LOR is in the "Remote" position, the actuator shall be controlled by remote inputs from the PLC or from the remote manual controls station.
2. The local controls shall be arranged so that the direction of travel can be reversed without the necessity of stopping the actuator.

M. Remote Manual Control Station

1. Where indicated in the Valve Schedule in Section 40 06 20 – Process Pipe, Valve, and Gate Schedules, manual actuator controls shall be furnished in a separate NEMA 4X stainless steel enclosure (NEMA 7 if located in a classified area). Manual control station controls shall include Hand–Off-Auto Selector switch; Open, Stop, and Close pushbuttons; a red lamp indicating closed and a green lamp indicating open.
 - a. When the HOA is in the "Hand" position, open/close control shall be by the open and close pushbuttons on the remote manual control station. The stop push button shall stop actuator travel.
 - b. When the HOA is in the "Off" position, the actuator shall not operate.
 - c. When the HOA is in the "Auto" position, the actuator shall be controlled by remote inputs to the valve actuator from the PL

2.04 ELECTRIC OPERATORS FOR PVC/CPVC VALVES

- A. Automatic electric operators shall be provided for PVC/CPVC valves where specified and/or as shown on the Drawings. Operators shall operate on 120 volt AC, single phase, 60 hertz power and be equipped with solid state electronic internal controls. Motors shall be brushless, capacitor-run, reversing type, suitable for high duty cycle applications and shall be specifically designed for open/close service. Motors shall be provided with integral thermal overload protection with auto-reset. Operator gears and shafts shall be constructed of heat treated high-alloy steel. Operator output shaft shall be electro-less nickel plated. Operator gear trains shall be permanently lubricated. The gear train shall withstand operator stall torque. Operator enclosures shall be NEMA 4. Operators shall be provided with internally wired, thermostatically controlled enclosure heaters to maintain an enclosure temperature of at least 40 degrees F. Operators shall be provided with positive visual position indication markings permanently affixed to the operator body and final output shaft. Operator drive output shall be provided with a declutchable manual override. A manual lever shall be provided for manual valve positioning. Operators shall be failsafe, utilizing a mechanical spring with a clutch mechanism to uncouple the motor during spring return operation, allowing the spring to relax and either open or close the valve. Selection of either fail-opened or fail-closed shall be made by selection of field wiring terminals.
- B. Independently adjustable cam-operated position limit switches shall be provided with dry contacts for remote fully opened and fully closed valve position indication. Operators shall respond to external dry contact open/close controls. The actuator shall have internal latching circuitry that causes the operator to drive the valve to its limit of travel upon receipt of the momentary contact open or close signal unless a stop signal is received. The all actuator control circuitry, including latching circuitry, shall be internal to the valve actuator. Valve control circuits and components mounted in a separate enclosure external to the valve actuator assembly will not be permitted. Connections for external remote controls shall be powered from an internal 24VDC or 120VAC power supply. Limit switches shall be rated for 15 amps at 120 VAC. Valve remote status shall also be provided as specified in Section 40 61 96 – Process Control Descriptions. The Contractor shall coordinate operator controls with the functional requirements specified in Section 40 61 96 – Process Control Descriptions.

PART 3 – EXECUTION

3.01 MANUFACTURER'S FIELD SERVICES

- A. The services of a qualified manufacturer's technical representative shall be provided in accordance with Section 46 00 00 – Equipment General Provisions and shall include the following site visits for electric actuators:

Service	Number of Trips	Number of Days/Trip
Installation and Testing	1	1

Startup and Training	1	1
Services after Startup	1	1

3.02 INSTALLATION

- A. All valve actuators shall be installed in accordance with the manufacturer's published recommendations and the applicable Specification Sections for valves and motor controls.
- B. Valve actuators shall be factory coated in accordance with the manufacturer's standard paint system.

3.03 SHOP TESTING

- A. Shop testing shall be in accordance with Section 46 00 00 – Equipment General Provisions and with the following additional requirements:
 - 1. Conduct a complete functional check of each unit. Correct any deficiencies found in shop testing prior to shipment.
 - 2. Submit written certification that:
 - a. Shop tests for the electrical system and all controls were successfully conducted;
 - b. Electrical system and all controls provide the functions specified and required for proper operation of the valve operator system.
 - 3. Each actuator shall be performance tested and individual test certificates shall be supplied free of charge. The test equipment shall simulate each typical valve load and the following parameters should be recorded:
 - a. Current at maximum torque setting
 - b. Torque at maximum torque setting
 - c. Flash Test Voltage
 - d. Actuator Output Speed or Operating Time
 - e. In addition, the test certificate should record details of specification, such as gear ratios for both manual and automatic drive, closing direction, and wiring diagram code number.
 - f. Verification of actuator torque rating with valve.

3.04 FIELD TESTS

- A. Field testing shall be in accordance with Section 46 00 00 – Equipment General Provisions and with the following additional requirements:
 - 1. Valve actuators shall be field-tested together with the associated valves.
 - 2. Test all valves at the operating pressures at which the particular line will be used.
 - 3. Test all valves for control operation as directed.
 - 4. Field testing shall include optimization of opening and closing times of the valves. Valve opening and closing times shall be adjusted based on process requirements to optimize operation of the valves. Final valve opening and closing times as determined by field tests shall be approved by the Engineer prior to final acceptance of the system.
- B. Preliminary Field Tests
 - 1. General: Preliminary field tests shall be conducted prior to start-up and shall include a functional check of the entire valve operator system and all system components.
 - 2. Scope: Preliminary field tests shall demonstrate that the valve operator system performs according to specifications and that all equipment, valves, controls, alarms, interlocks, etc., function properly.
 - 3. Based on results of preliminary field tests, the Contractor shall make any adjustments required to settings, etc., to achieve the required valve closing time and operation, as specified or otherwise directed.
- C. Final Field Tests
 - 1. Final field tests shall be conducted in accordance with the latest revision of AWWA C500.
 - 2. Final field tests shall be conducted simultaneously with the start-up and field testing of the pumps.
 - 3. Final field tests shall be conducted for the full range of operating modes and conditions specified and as directed by the Engineer. Each of the valves shall be tested at minimum, maximum, and normal head/flow conditions, and under all specified conditions of opening and closing.
 - 4. Certification of Equipment Compliance: After the final field tests are completed and passed, submit affidavit according to Section 46 00 00 – Equipment and General Provisions.

END OF SECTION

SECTION 40 05 63

BALL VALVES

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. Reference Section 40 05 00 – Basic Mechanical Requirements.
- B. Valves required for chemical service shall be constructed of materials suitable for the intended service.

PART 2 – PRODUCTS

2.01 V-PORT BALL VALVES (TYP BV-4)

- A. V-port ball valves shall have ANSI Class 150 bodies and raised face flanges. Valves shall meet ANSI/FCI 70-2 Class IV requirements for unidirectional shutoff. Valve material shall be in compliance with NSF 60/61. Valves shall be suitable for 10 psi CWP.
- B. Valve segment shall contain a 90 to 120 degree V-port. Valve and actuator shall be suitable for a throttling differential of 120 psi over the entire range of segment travel.
- C. Valve materials shall be as follows:
 - 1. Body: ASTM A 351 gr. CF8M or CG8M
 - 2. Segment: AISI 316, 317 or 329, hard-chrome plated
 - 3. Shaft: AISI 316, 317, or 329
 - 4. Seat: Filled PTFE or spring- loaded metal
 - 5. Packing: PTFE
- D. Manufacturers:
 - 1. DeZurik Corporation
 - 2. KTM Products
 - 3. Neles Controls

11-21-21

PART 3 – EXECUTION

3.01 GENERAL

- A. All valves shall be tested for unidirectional or bi-directional shut-off as required by service conditions.

END OF SECTION

SECTION 40 05 68.13
PVC AND CPVC VALVES

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. Reference Section 40 05 00 – Basic Mechanical Requirements.

PART 2 – PRODUCTS

2.01 MATERIALS OF CONSTRUCTION

- A. Valves shall be constructed of materials suitable for the intended service. PVC valves shall be provided in PVC piping and CPVC valves shall be provided in CPVC piping.
- B. PVC valve bodies shall be constructed of PVC which shall meet or exceed the requirements of cell classification 12454 according to ASTM D1784 and shall be in accordance with NSF 60/61. CPVC valve bodies shall be constructed of CPVC which shall meet or exceed the requirements of cell classification 23447 according to ASTM D1784 and shall be in accordance with NSF 60/61.
- C. Materials of construction of other valve components shall be as specified below for the particular type of valve.
- D. Acceptable materials of construction of elastomers for chemical service shall be as follows:

Chemical Service	Elastomer Material
Polymers	FKM

- E. Acceptable materials of construction of elastomers for non-chemical service shall be as follows:

Non-Chemical Service	Elastomer Material
Potable Water	EPDM

- F. All flanged valves shall be flat face flanged end type conforming to ANSI B16.5 bolt pattern for 150 lb. flanges.

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SECTION 40 06 20

PROCESS PIPE, VALVE, AND GATE SCHEDULES

PART 1 - GENERAL

1.01 THE REQUIREMENT

- A. Reference Section 40 05 00 - Basic Mechanical Requirements.

1.02 PIPING SCHEDULES

- A. Piping requirements for this Section are outlined on the Drawings and in the Piping Schedules. In the absence of a specified test pressure, pipe shall be tested at the greater of: 1) 150 percent of working pressure as determined by the Engineer or 2) 10 psig, unless the Schedule indicates no test is required.
- B. If the pipe material is not shown on the Piping Schedule or otherwise specified, the following materials shall be used.

PIPE SIZE	MATERIAL	TYPE OF JOINT	CLASS/DESIGN	TEST PRESSURE
4-IN AND LARGER	DIP	FLANGED (EXPOSED)	CLASS 53	(1)
		RESTRAINED (BURIED)	PRESSURE CLASS 350	
LESS THAN 4-IN	PVC/CPVC (2)	SOCKET	SCH 80	(1)
(1) Test at 150 percent of working pressure or 10 psi, whichever is greater. (2) For all PVC / CPVC designations, if piping is exposed to direct sunlight or if heat tracing is required, CPVC shall be used. Otherwise, PVC shall be used.				

1.03 VALVE SCHEDULES

- A. All valves shall be tagged by the manufacturer according to the control valve designations listed in this Section.
- B. Valves not listed in this Section shall be manually operated, unless otherwise shown on the Drawings.

1.04 GATE SCHEDULES

- A. Gates shall be tagged by the manufacturer according to locations listed in this Section.

02-01-22

CHEMICAL PIPING SCHEDULE									
PIPE DESIGNATIONS		MATERIAL	BURIED PIPING		EXPOSED PIPING			DESIGN PRESSURE (PSI) ¹	
			TYPE OF JOINT	CLASS/ DESIGN	TYPE OF JOINT	CLASS/ DESIGN	HEAT TRACE ²	WORKING	FIELD TEST
FAP	FILTER AID POLYMER	< 4" PVC / CPVC ³	SOCKET	SCH 80	SOCKET/ FLANGED	SCH 80	NO	200	300
1) Surge pressure is the maximum pressure in the system during a surge event. Restraint pressure shall be used to determine pipe joint design and if required, the size, number, material, and dimensions of tabs and threaded-rods and thrust blocking for thrust restraint of piping and piping system components specified. 2) Provide heat tracing and insulation as specified in Section 40 41 13 on all exposed outdoor piping indicated. 3) For all PVC / CPVC designations, if piping is exposed to direct sunlight or if heat tracing is required, CPVC shall be used. Otherwise, PVC shall be used. 4) Flanges shall be provided as shown on the drawings or as approved by the Engineer.									

ELECTRICALLY OPERATED VALVE SCHEDULE								
TAG NO.	VALVE TYPE	OPERATOR TYPE	SIZE (in.)	FLOW	MAX DIFFERENTIAL PRESSURE (psi)	CLASS	SERVICE	LOCATION
PWTP-PLY-VLV-3509	V-PORT BALL VALVE	MODULATING	1	0.5 - 10 gph	10	150	FAP	FILTER 9
PWTP-PLY-VLV-3510	V-PORT BALL VALVE	MODULATING ¹	1	0.5 - 10 gph	10	150	FAP	FILTER 10
PWTP-PLY-VLV-3511	V-PORT BALL VALVE	MODULATING ¹	1	0.5 - 10 gph	10	150	FAP	FILTER 11
PWTP-PLY-VLV-3512	V-PORT BALL VALVE	MODULATING ¹	1	0.5 - 10 gph	10	150	FAP	FILTER 12
1) Pulse Control - See Specifications 40 05 57 and 40 61 96 2) Provide remote control station as specified in section 40 05 57								

SECTION 40 06 20

PROCESS PIPE, VALVE, AND GATE SCHEDULES

PART 1 - GENERAL

1.01 THE REQUIREMENT

- A. Reference Section 40 05 00 - Basic Mechanical Requirements.

1.02 PIPING SCHEDULES

- A. Piping requirements for this Section are outlined on the Drawings and in the Piping Schedules. In the absence of a specified test pressure, pipe shall be tested at the greater of: 1) 150 percent of working pressure as determined by the Engineer or 2) 10 psig, unless the Schedule indicates no test is required.
- B. If the pipe material is not shown on the Piping Schedule or otherwise specified, the following materials shall be used.

PIPE SIZE	MATERIAL	TYPE OF JOINT	CLASS/DESIGN	TEST PRESSURE
4-IN AND LARGER	DIP	FLANGED (EXPOSED)	CLASS 53	(1)
		RESTRAINED (BURIED)	PRESSURE CLASS 350	
LESS THAN 4-IN	PVC/CPVC (2)	SOCKET	SCH 80	(1)
(1) Test at 150 percent of working pressure or 10 psi, whichever is greater. (2) For all PVC / CPVC designations, if piping is exposed to direct sunlight or if heat tracing is required, CPVC shall be used. Otherwise, PVC shall be used.				

1.03 VALVE SCHEDULES

- A. All valves shall be tagged by the manufacturer according to the control valve designations listed in this Section.
- B. Valves not listed in this Section shall be manually operated, unless otherwise shown on the Drawings.

1.04 GATE SCHEDULES

- A. Gates shall be tagged by the manufacturer according to locations listed in this Section.

02-01-22

CHEMICAL PIPING SCHEDULE									
PIPE DESIGNATIONS		MATERIAL	BURIED PIPING		EXPOSED PIPING			DESIGN PRESSURE (PSI) ¹	
			TYPE OF JOINT	CLASS/ DESIGN	TYPE OF JOINT	CLASS/ DESIGN	HEAT TRACE ²	WORKING	FIELD TEST
FAP	FILTER AID POLYMER	< 4" PVC / CPVC ³	SOCKET	SCH 80	SOCKET/ FLANGED	SCH 80	NO	200	300
1) Surge pressure is the maximum pressure in the system during a surge event. Restraint pressure shall be used to determine pipe joint design and if required, the size, number, material, and dimensions of tabs and threaded-rods and thrust blocking for thrust restraint of piping and piping system components specified. 2) Provide heat tracing and insulation as specified in Section 40 41 13 on all exposed outdoor piping indicated. 3) For all PVC / CPVC designations, if piping is exposed to direct sunlight or if heat tracing is required, CPVC shall be used. Otherwise, PVC shall be used. 4) Flanges shall be provided as shown on the drawings or as approved by the Engineer.									

ELECTRICALLY OPERATED VALVE SCHEDULE								
TAG NO.	VALVE TYPE	OPERATOR TYPE	SIZE (in.)	FLOW	MAX DIFFERENTIAL PRESSURE (psi)	CLASS	SERVICE	LOCATION
PWTP-PLY-VLV-3509	V-PORT BALL VALVE	MODULATING	1	0.5 - 10 gph	10	150	FAP	FILTER 9
PWTP-PLY-VLV-3510	V-PORT BALL VALVE	MODULATING ¹	1	0.5 - 10 gph	10	150	FAP	FILTER 10
PWTP-PLY-VLV-3511	V-PORT BALL VALVE	MODULATING ¹	1	0.5 - 10 gph	10	150	FAP	FILTER 11
PWTP-PLY-VLV-3512	V-PORT BALL VALVE	MODULATING ¹	1	0.5 - 10 gph	10	150	FAP	FILTER 12
1) Pulse Control - See Specifications 40 05 57 and 40 61 96 2) Provide remote control station as specified in section 40 05 57								

2.02 PVC/CPVC BALL VALVES (BLV-P/BLV-C)

- A. Ball valves shall be true union design with flanged, socket, or threaded ends as required and as specified in Section 40 06 20 – Process Pipe, Valve, and Gate Schedules. All valves shall be full-port design and allow for bi-directional flow. Valve stems shall contain double o-ring seals. Valves shall have removable handles and integrally molded mounting features for actuator installation. Ball valves shall be rated for a minimum pressure of 150 psi at 70°F.
- B. Valve bodies, stems, balls, and unions shall be constructed of PVC or CPVC as specified in 2.01 B. Ball seats shall be made of PTFE, and o-ring seals shall be as specified in 2.01 D and 2.01 E.
- C. Ball valves shall be manufactured by Asahi/America, Nibco/Chemtrol, IPEX, Hayward Flow Control, Plastomatic, or equal.

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 40 61 13
PROCESS CONTROL SYSTEM GENERAL PROVISIONS

PART 1 – GENERAL

1.01 SCOPE

- A. The Contractor shall provide, through the services of an instrumentation and control system subcontractor, components, system installation services, as well as required and specified ancillary services in connection with the Instrumentation, Control and Information System.
- B. The System includes materials, labor, tools, fees, charges, and documentation required to furnish, install, test and place in operation a complete and operable instrumentation, control and information system.
- C. The system shall include measuring elements, signal converters, transmitters, local control panels, digital hardware and software, operator workstations, remote telemetry units, signal and data transmission systems, interconnecting wiring, and pertinent accessories.
- D. The scope of the work to be performed under this Division includes but is not limited to the following:
 - 1. The Contractor shall retain overall responsibility for the instrumentation and control system as specified herein.
 - 2. Furnish and install process instrumentation and associated taps and supports as scheduled or shown on the Drawings, unless otherwise noted or supplied by equipment vendors.
 - 3. Furnish and install local control panels, field panels and associated cabinets and panels as shown on the Drawings and as specified in Sections 40 60 00 through 40 79 99, inclusive and where included.
 - 4. Furnish and install digital control system hardware and software as specified in Sections 40 60 00 through 40 79 99, inclusive and where included.
 - 5. Final termination and testing of instrumentation and control system signal wiring and power supply wiring at equipment furnished under Sections 40 60 00 through 40 79 99, inclusive and where included.
 - 6. Furnish, install and terminate special cables for devices (e.g., instruments, printers, radios). Furnish and terminate control system communication network cables.

7. Furnish and install surge protection devices for digital equipment, local control panels, remote telemetry units, and instrumentation provided under this Division, including connections to grounding system(s) provided under Division 26.
 8. Coordinate grounding requirements with the electrical subcontractor for digital equipment, local control panels, remote telemetry units, and instrumentation provided under this Division. Terminate grounding system cables at equipment provided under this Division.
 9. Provide system testing, calibration, training and startup services as specified herein and as required to make systems fully operational.
- E. It is the intent of the Contract Documents to construct a complete and working installation. Items of equipment or materials that may reasonably be assumed as necessary to accomplish this end shall be supplied whether or not they are specifically stated herein.

1.02 RELATED ITEMS

- A. Field mounted switches, torque switches, limit switches, gauges, valve and gate operator position transmitters, sump pump controls, and other instrumentation and controls furnished with mechanical or electrical equipment not listed in the instrument schedule shall be furnished, installed, tested, and calibrated as specified under other Divisions unless otherwise indicated.
- B. Additional and related work performed under Division 26 includes the following:
1. Instrument A.C. power source and disconnect switch for process instrumentation, A.C. grounding systems, and A.C. power supplies for equipment, control panels and accessories furnished under Sections 40 60 00 through 40 79 99, inclusive and where included.
 2. Conduit and raceways for instrumentation and control system signal wiring, grounding systems, special cables and communication network cables.
 3. Instrumentation and control system signal wiring.
 4. Install control system communication network cables.
 5. Furnish and install grounding systems for digital equipment, local control panels, remote telemetry units, and instrumentation provided under Sections 40 60 00 through 40 79 99, inclusive and where included. Grounding systems shall be complete to the equipment provided under Sections 40 60 00 through 40 79 99, inclusive, and where included, ready for termination by the instrumentation subcontractor.
 6. Termination of instrumentation and control system signal wiring at equipment furnished under other Divisions of the Specifications.

7. Final wiring and termination to A.C. grounding systems and to A.C. power sources (e.g., panelboards, motor control centers, and other sources of electrical power).

1.03 GENERAL INFORMATION AND DESCRIPTION

- A. Where manufacturers are named for a particular item of equipment, it is intended as a guide to acceptable quality and performance and does not exempt such equipment from the requirements of these Specifications or Drawings.
- B. In order to centralize responsibility, it is required that equipment (including field instrumentation and control system hardware and software) offered under this Division shall be furnished and installed by the instrumentation subcontractor, or under the supervision of the instrumentation subcontractor, who shall assume complete responsibility for proper operation of the instrumentation and control system equipment, including that of coordinating signals, and furnishing appurtenant equipment.
- C. The Contractor shall retain total responsibility for the proper detailed design, fabrication, inspection, test, delivery, assembly, installation, activation, checkout, adjustment and operation of the entire instrumentation and control system as well as equipment and controls furnished under other Divisions of the Specifications. The Contractor shall be responsible for the delivery of detailed drawings, manuals and other documentation required for the complete coordination, installation, activation and operation of mechanical equipment, equipment control panels, local control panels, field instrumentation, control systems and related equipment/systems and shall provide for the services of a qualified installation engineer to supervise activities required to place the completed facility in stable operation under full digital control.
- D. The instrumentation and control system shall be capable of simultaneously implementing all real time control and information system functions, and servicing all operator service requests as specified, without degrading the data handling and processing capability of other system components.
- E. Control system inputs and outputs are listed in Section 40 61 93 – Process Control System Input/Output List. This information, together with the functional control descriptions, process and instrumentation diagrams, and electrical control schematics, describes the real time monitoring and control functions to be performed. In addition, the system shall provide various man/machine interface and data reporting functions as specified in the software sections of this Specification.
- F. The mechanical, process, and electrical drawings indicate the approximate locations of field instruments, control panels, systems and equipment as well as field mounted equipment provided by others. The instrumentation subcontractor shall examine the mechanical, process and electrical drawings to determine actual size and locations of process connections and wiring requirements for instrumentation and controls furnished under this Contract. The instrumentation subcontractor shall inspect equipment, panels, instrumentation, controls, and appurtenances, either existing or furnished on the Project to determine requirements for interfacing with the control and information system. The

Contractor shall coordinate the completion of required modifications with the associated supplier of the item furnished.

- G. The instrumentation subcontractor shall review and approve the size and routing of instrumentation and control cable and conduit systems furnished by the electrical subcontractor for suitability for use with the associated cable system.
- H. The Contractor shall coordinate the efforts of each supplier to aid in interfacing systems. This effort shall include, but shall not be limited to, the distribution of approved shop drawings to the electrical subcontractor and to the instrumentation subcontractor furnishing the equipment under this Division.
- I. The Contractor shall be responsible for providing a signal transmission system free from electrical interference that would be detrimental to the proper functioning of the instrumentation and control system equipment.
- J. The Owner shall have the right of access to the subcontractor's facility and the facilities of his equipment suppliers to observe materials and parts; witness inspections, tests and work in progress; and examine applicable design documents, records, and certifications during all stages of design, fabrication, and tests. The instrumentation subcontractor and his equipment suppliers shall furnish office space, supplies, and services required for these observation activities.
- K. The terms "Instrumentation," "Instrumentation and Control System," and "Instrumentation, Control and Information System" shall hereinafter be defined as equipment, labor, services, and documents necessary to meet the intent of the Specifications.

1.04 INSTRUMENTATION AND CONTROL SYSTEM SUBCONTRACTORS

- A. Instrumentation and control system subcontractors shall be regularly engaged in the detailed design, fabrication, installation, and startup of instrumentation and control systems for water and wastewater treatment facilities, remote telemetry systems for water supply/distribution systems, and remote telemetry systems for wastewater collection systems. Instrumentation and control system subcontractors shall have a minimum of five years of such experience and shall have completed a minimum of three projects of similar type and size as that specified herein. Where specific manufacturers/models of major hardware or software products (PLC, HMI software, network, etc.) are specified to be used on this project, the instrumentation and control system subcontractor shall have completed at least one project using that specified hardware or software. As used herein, the term "completed" shall mean that a project has been brought to final completion and final payment has been made.
- B. Acceptable instrumentation and control system subcontractors shall be Jacobs Engineering.

1.05 DEFINITIONS

- A. Solid State: Wherever the term solid state is used to describe circuitry or components in the Specifications, it is intended that the circuitry or components shall be of the type that convey electrons by means of solid materials such as crystals or that work on magnetic principles such as ferrite cores. Vacuum tubes, gas tubes, slide wires, mechanical relays, stepping motors or other devices will not be considered as satisfying the requirements for solid state components of circuitry.
- B. Bit or Data Bit: Whenever the terms bit or data bit are used in the Specification, it is intended that one bit shall be equivalent to one binary digit of information. In specifying data transmission rate, the bit rate or data bit rate shall be the number of binary digits transmitted per second and shall not necessarily be equal to either the maximum pulse rate or average pulse rate.
- C. Integrated Circuit: Integrated circuit shall mean the physical realization of a number of circuit elements inseparably associated on or within a continuous body to perform the function of a circuit.
- D. Mean Time Between Failures (MTBF): The MTBF shall be calculated by taking the number of system operating hours logged during an arbitrary period of not less than six months and dividing by the number of failures experienced during this period plus one.
- E. Mean Time to Repair (MTTR): The MTTR shall be calculated by taking the total system down time for repair over an arbitrary period of not less than six months coinciding with that used for calculation of MTBF and dividing by the number of failures causing down time during the period.
- F. Availability: The availability of a non-redundant device or system shall be related to its MTBF and MTTR by the following formula:

$$A = 100 \times (\text{MTBF} / (\text{MTBF} + \text{MTTR})) \text{ Percent}$$

The availability of a device or system provided with an automatically switched backup device or system shall be determined by the following formula:

$$A = A_2 + 1 - ((1 - A_1) * (1 - A_1))$$

where:

A1 = availability of non-redundant device or system

A2 = availability of device or system provided with an automatically switched backup device or system

- G. Abbreviations: Specification abbreviations include the following:

- 1. A - Availability

2. ADC - Analog to Digital Converter
3. AI - Analog Input
4. AO - Analog Output
5. AVAIL - Available
6. BCD - Binary Coded Decimal
7. CSMA/CD - Carrier Sense Multiple Access/Collision Detect
8. CPU - Central Processing Unit
9. CRC - Cyclic Redundancy Check
10. CS - Control Strategy
11. DAC - Digital to Analog Converter
12. DBMS - Data Base Management System
13. DI - Discrete Input
14. DMA - Direct Memory Access
15. DO - Discrete Output
16. DPDT - Double Pole, Double Throw
17. DVE - Digital to Video Electronics
18. EPROM - Erasable, Programmable Read Only Memory
19. FDM - Frequency Division Multiplexing
20. FSK - Frequency Shift Keyed
21. HMI - Human Machine Interface (Software)
22. I/O - Input/Output
23. LAN - Network and Communication Equipment
24. LCD - Liquid Crystal Display
25. LDFW - Lead Follow
26. MCC - Motor Control Center

- 27. MTBF - Mean Time Between Failures
 - 28. MTTR - Mean Time to Repair
 - 29. OS - Operating System
 - 30. PAC - Programmable Automation Controller
 - 31. PCB - Printed Circuit Board
 - 32. PID - Proportional Integral and Derivative Control
 - 33. PLC - Programmable Logic Controller or Programmable Controller
 - 34. PROM - Programmable Read Only Memory
 - 35. RAM - Random Access Memory
 - 36. RDY - Ready
 - 37. RMSS - Root Mean Square Summation
 - 38. RNG - Running
 - 39. ROM - Read Only Memory
 - 40. RTU - Remote Telemetry Unit
 - 41. SPDT - Single Pole, Double Throw
 - 42. ST/SP - Start/Stop
 - 43. TDM - Time Division Multiplexing
 - 44. UPS - Uninterruptible Power Supply
 - 45. VFD - Variable Frequency Drive
- H. To minimize the number of characters in words used in textual descriptions on displays, printouts and nameplates, abbreviations may be used subject to the Engineer's approval. If a specified abbreviation does not exist for a particular word, an abbreviation may be generated using the principles of masking and or vowel deletion. Masking involves retaining the first and last letters in a word and deleting one or more characters (usually vowels) from the interior of the word.

1.06 ENVIRONMENTAL CONDITIONS

- A. Instrumentation equipment and enclosures shall be suitable for ambient conditions specified. All system elements shall operate properly in the presence of telephone lines, power lines, and electrical equipment.
- B. Inside control rooms and climate-controlled electrical rooms, the temperature will normally be 20 to 25 degrees C; relative humidity 40 to 80 percent without condensation and the air will be essentially free of corrosive contaminants and moisture. Appropriate air filtering shall be provided to meet environmental conditions (e.g., dust).
- C. Other indoor areas may not be air conditioned/heated; temperatures may range between 0 and 40 degrees C with relative humidity between 40 and 95 percent.
- D. Field equipment including instrumentation and panels may be subjected to wind, rain, lightning, and corrosives in the environment, with ambient temperatures from -20 to 40 degrees C and relative humidity from 10 to 100 percent. All supports, brackets, interconnecting hardware, and fasteners shall be aluminum, type 316 stainless steel, or metal alloy as otherwise suitable for chemical resistance within chemical feed/storage areas shown on the installation detail drawings.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.01 CLEANING

- A. The Contractor shall thoroughly clean soiled surfaces of installed equipment and materials.
- B. Upon completion of the instrumentation and control work, the Contractor shall remove surplus materials, rubbish, and debris that has accumulated during the construction work. The entire area shall be left neat, clean, and acceptable to the Owner.

3.02 FINAL ACCEPTANCE

- A. Final acceptance of the Instrumentation, Control and Information System will be determined complete by the Engineer, and shall be based upon the following:
 - 1. Receipt of acceptable start up completion and availability reports and other documentation as required by the Contract Documents.
 - 2. Completion of the Availability Demonstration.
 - 3. Completion of control system training requirements.
 - 4. Completion of punch-list items that are significant in the opinion of the Engineer.

B. Final acceptance of the System shall mark the beginning of the warranty period.

END OF SECTION

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SECTION 40 61 15
PROCESS CONTROL SYSTEM SUBMITTALS

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall submit for review complete Shop Drawings for all equipment in accordance with the General and Supplemental Conditions and Division 01 of the Specifications. All submittal material shall be complete, legible, and reproducible, and shall apply specifically to this project.
- B. All submittal materials shall be tailored to this project by highlighting relevant items or crossing out non-applicable items. Generic submittals without identified options will be returned the Contractor without review.
- C. Compliance, Deviations, and Exceptions (CD&E) Letter:
 - 1. Where a named manufacturer and product is specified and a substitution or an “or equal” product is submitted, the submittal shall be accompanied by a “Compliance, Deviations, and Exceptions (CD&E) letter.” If the required submittal is submitted without the letter, the submittal will be rejected.
 - 2. The letter shall include all comments, deviations and exceptions taken to the Drawings and Specifications by the Contractor, subcontractor (if applicable), and the equipment Manufacturer/Supplier. This letter shall include a copy of the Specification Section to which the submittal pertains. In the left margin beside each and every paragraph/item, a letter "C", "D", or "E" shall be typed or written in.
 - a. The letter "C" shall be for full compliance with the requirement.
 - b. The letter "D" shall be for a deviation from the requirement.
 - c. The letter "E" shall be for taking exception to a requirement.
 - 3. Any requirements with the letter "D" or "E" beside them shall be provided with a full typewritten explanation of the deviation/exception. Handwritten explanation of the deviations/exceptions shall not be acceptable.
 - 4. The CD&E letter shall also address deviations, and exceptions taken to each Drawing related to this Specification Section.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 01 33 00 – Submittal Procedures
- B. Section 40 61 13 – Process Control System General Provisions

1.03 DIGITAL HARDWARE SUBMITTALS

- A. Submit system block diagram(s) showing:
 - 1. All equipment to be provided.
 - 2. All interconnecting cable.
 - 3. Equipment names, manufacturer, and model numbers.
 - 4. Equipment locations.
- B. Submit information for all digital equipment including, but not limited to, the following:
 - 1. Bill of materials with equipment names, manufacturers, complete model numbers and locations.
 - 2. Catalog cuts, including complete part number breakdown information.
 - 3. Complete technical, material and environmental specifications.
 - 4. Assembly drawings.
 - 5. Mounting requirements.
 - 6. Color samples.
 - 7. Nameplates.
 - 8. Environmental requirements during storage and operation.

1.04 INSTRUMENT SUBMITTALS

- A. Submit information on all field instruments, including but not limited to the following:
 - 1. Product (item) name and tag number used herein and on the Contract Drawings.
 - 2. Catalog cuts, including complete part number breakdown information.
 - 3. Manufacturer's complete model number.
 - 4. Location of the device.
 - 5. Input output characteristics.
 - 6. Range, size, and graduations.
 - 7. Physical size with dimensions, NEMA enclosure classification, and mounting details.

8. Materials of construction of all enclosures, wetted parts and major components.
9. Instrument or control device sizing calculations where applicable.
10. Certified calibration data on all flow metering devices.
11. Environmental requirements during storage and operation.
12. Associated surge protection devices.
13. Installation drawings/details.

1.05 WIRING AND LOOP DIAGRAMS

- A. Submit interconnection wiring and loop diagrams for all panels and signals in the Control and Information System.
- B. Electrical interconnection diagrams shall show all terminations of equipment, including terminations to equipment and controls furnished under other Divisions, complete with equipment and cable designations. Where applicable, interconnection wiring diagrams shall be organized by input/output card. Interconnecting diagrams shall be prepared in a neat and legible manner on 11 X 17-inch reproducible prints.
- C. Loop drawings shall conform to the latest version of ISA Standards and Recommended Practices for Instrumentation and Control. Loop Drawings shall conform to ISA S5.4, Figures 1-3, Minimum Required Items..
- D. Loop drawings shall not be required as a separate document provided that the interconnecting wiring diagrams required in Paragraph B., above, contain all information required by ISA 5.4.

1.06 OPERATION AND MAINTENANCE MANUALS

- A. The Contractor shall deliver equipment operation and maintenance manuals in compliance with Section 01 33 00 – Submittal Procedures. Operation and maintenance (O&M) manuals shall consist of two basic parts:
 1. Manufacturer standard O&M manuals for all equipment and software furnished under this Division.
 2. Custom O&M information describing the specific configuration of equipment and software, and the operation and maintenance requirements for this particular project.
- B. The manuals shall contain all illustrations, detailed drawings, wiring diagrams, and instructions necessary for installing, operating, and maintaining the equipment. The illustrated parts shall be numbered for identification. All modifications to manufacturer standard equipment and/or components shall be clearly identified and shown on the drawings and schematics. All information contained therein shall apply specifically to the

equipment furnished and shall only include instructions that are applicable. All such illustrations shall be incorporated within the printing of the page to form a durable and permanent reference book.

- C. The manuals shall be prepared specifically for this installation and shall include all required cuts, drawings, equipment lists, descriptions, etc. that are required to instruct operation and maintenance personnel unfamiliar with such equipment. The maintenance instructions shall include troubleshooting data and full preventive maintenance schedules. The instructions shall be bound in locking 3-D-ring binders with bindings no larger than 3.5 inches. The manuals shall include 15% spare space for the addition of future material. The instructions shall include drawings reduced or folded and shall provide the following as a minimum.
 - 1. A comprehensive index.
 - 2. A functional description of the entire system, with references to drawings and instructions.
 - 3. A complete "as built" set of all approved shop drawings, which shall reflect all work required to achieve final system acceptance.
 - 4. A complete list of the equipment supplied, including serial numbers, ranges, and pertinent data.
 - 5. Full specifications on each item.
 - 6. Detailed service, maintenance, and operation instructions for each item supplied.
 - 7. Special maintenance requirements particular to this system shall be clearly defined, along with special calibration and test procedures.
 - 8. Complete parts lists with stock numbers and name, address, and telephone number of the local supplier.
 - 9. References to manufacturers' standard literature where applicable.
 - 10. Warning notes shall be located throughout the manual where such notes are required to prevent accidents or inadvertent misuse of equipment.
- D. The operating instructions shall clearly describe the step by step procedures that must be followed to implement all phases of all operating modes. The instructions shall be in terms understandable and usable by operating personnel and maintenance crews and shall be useful in the training of such personnel.
- E. The maintenance instructions shall describe the detailed preventive and corrective procedures required, including environmental requirements during equipment storage and system operation, to keep the System in good operating condition. All hardware maintenance documentation shall make reference to appropriate diagnostics, where

applicable, and all necessary wiring diagrams, component drawings and PCB schematic drawings shall be included.

- F. The hardware maintenance documentation shall include, as a minimum, the following information:
1. Operation Information: This information shall include a detailed description of how the equipment operates and a block diagram illustrating each major assembly in the equipment.
 2. Preventive Maintenance Instructions: These instructions shall include all applicable visual examinations, hardware testing and diagnostic routines, and the adjustments necessary for periodic preventive maintenance of the System.
 3. Corrective Maintenance Instructions: These instructions shall include guides for locating malfunctions down to the card replacement level. These guides shall include adequate details for quickly and efficiently locating the cause of an equipment malfunction and shall state the probable source(s) of trouble, the symptoms, probable cause, and instructions for remedying the malfunction.
 4. Parts Information: This information shall include the identification of each replaceable or field repairable component. All parts shall be identified on a list in a drawing; the identification shall be of a level of detail sufficient for procuring any repairable or replaceable part. Cross references between equipment numbers and manufacturer's part numbers shall be provided.
 5. A program abstract that includes:
 - a. Program Name - The symbolic alphanumeric program name.
 - b. Program Title - English text identification.
 - c. Program Synopsis - A brief text shall be provided that specifies the need for the program, states when it shall be used and functionally describes all inputs, outputs and functions performed. This descriptive text shall be written in a language that is understandable by non-programming-oriented readers.
 6. A program description that shall include, but not be limited to, the following:
 - a. Applicable Documents - List all documents (standard manufacturer's literature, other program descriptions, etc.) by section, if practical, that apply to the program. One complete copy of all applicable reference material shall be provided.
 - b. Input Output - Identify each input and output parameter, variable, and software element used by the program. State the purpose of all inputs, outputs, and variables.

- c. Processing - This section shall contain a description of the overall structure and function of the program. Describe the program run stream and present a detailed description of how the program operates. Describe the timing and sequencing of operations of the program relative to other programs. Describe all interactions with other programs. Processing logic that is not readily described without considerable background information shall be handled as a special topic with references to an appendix or to control strategy document that details the necessary information. Reference shall also be made to an appendix or control strategy document for equation and program algorithm derivations.
- d. System Configuration - Describe in detail the system configuration or status required for program implementation, if appropriate.
- e. Limitations and Constraints - Summarize all known or anticipated limitations of the program, if appropriate.
- f. Storage - Define program storage requirements in terms of disk or RAM memory allocation.
- g. Verification - Describe, as a minimum, a test that can be used by the operator to assure proper program operation. Define the required system configuration, input requirements and criteria for successful test completion.
- h. Diagnostics - Describe all program diagnostics, where applicable. Descriptions shall list each error statement, indicate clearly what it means, and specify what appropriate actions should be taken.
- i. Malfunction Procedures - Specify procedures to follow for recovering from a malfunction due to either operator error or other sources.

1.07 FINAL SYSTEM DOCUMENTATION

- A. All documentation shall be delivered to the Owner prior to final system acceptance in accordance with the Contract Documents. As a minimum, final documentation shall contain all information originally part of the control system submittals.
- B. Provide a complete set of detailed electrical interconnection diagrams required to define the complete instrumentation and control system. All diagrams shall be 11 X 17-inch original reproducible prints. All diagrams shall be corrected to describe final "as built" hardware configurations and to reflect the system configuration and control methodology adopted to achieve final system acceptance.
- C. Provide system software documentation for the operation and maintenance of all system software programs provided as a part of the digital system. All system software documentation shall be amended as required to delineate all modifications and to accurately reflect the final as built software configurations.

- D. Provide application software documentation that contains program descriptions for the operation, modification, and maintenance of all application programs provided for the digital system.
- E. Provide control strategy documentation which shall include control strategy (block oriented or ladder logic) diagrams to describe the control of all processes. Control strategy documentation shall reflect the system configuration and control methodology adopted to achieve final system acceptance. Control strategy documentation shall conform to the submittal requirements listed hereinabove.
- F. O&M documentation shall be amended with all final, adjusted values for all setpoints and other operating parameters for Owner reference.
- G. The Owner recognizes the fact that not all possible problems related to real time events, software interlocks, and hardware maintenance and utilization can be discovered during the Acceptance Tests. Therefore, the instrumentation subcontractor through the Contractor shall investigate, diagnose, repair, update, and distribute all pertaining documentation of the deficiencies that become evident during the warranty period. All such documentation shall be submitted in writing to the Owner within 30 days of identifying and solving the problem.

1.08 SUBMITTAL/DOCUMENTATION FORMAT

- A. All drawing-type submittals and documentation shall be rendered and submitted in the latest version of AutoCAD.
- B. All textual-type submittals and documentation shall be rendered and submitted in the latest version of Microsoft Word or in searchable Adobe Portable Document Format (PDF). Raster scans will not be accepted.

1.09 ELECTRONIC O&M MANUALS

- A. Subject to acceptance by the Engineer, the O&M information may be submitted in part or in whole in an electronic format on digital media.
- B. Electronic O&M manuals shall contain information in standard formats (searchable Adobe PDF, Word, AutoCAD, HTML, etc.) and shall be easily accessible using standard, "off-the-shelf" software such as an Internet browser. Raster scans will not be accepted.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

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SECTION 40 61 21.72

FIELD TESTING

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall perform field testing on the Control and Information System as specified herein to demonstrate compliance with the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 40 61 13 – Process Control System General Provisions
- B. Section 40 61 21.73 – Final Acceptance Test
- C. Section 40 70 00 – Instrumentation for Process Systems

1.03 GENERAL REQUIREMENTS

- A. Control system start-up and testing shall be performed to ensure that all plant processes shall be systematically and safely placed under digital control in the following order:
 - 1. Primary elements such as transmitters and switch devices shall be calibrated and tested as specified in Section 40 70 00 – Instrumentation for Process Systems.
 - 2. Each final control element shall be individually tested as specified hereinafter.
 - 3. Each control loop shall be tested as specified hereinafter.
 - 4. Each control strategy shall be tested under automatic digital control as specified hereinafter.
 - 5. The entire control system shall be tested for overall monitoring, control, communication, and information management functions, and demonstrated for system availability as specified hereinafter.
- B. System start-up and test activities shall include the use of water, if necessary, to establish service conditions that simulate, to the greatest extent possible, normal operating conditions in terms of applied process loads, operating ranges and environmental conditions.
- C. Each phase of testing shall be fully and successfully completed and all associated documentation submitted and approved prior to the next phase being started. Specific exceptions are allowed if written approval has been obtained in advance from the Engineer.

1.04 CONTRACTOR'S RESPONSIBILITIES

- A. The Contractor shall ensure that all mechanical equipment, equipment control panels, local control panels, field instrumentation, control system equipment and related equipment and/or systems are tested for proper installation, adjusted and calibrated on a loopbyloop basis prior to control system startup to verify that each is ready to function as specified. Each test shall be witnessed, dated and signed off by both the Contractor (or designee) and the Engineer upon satisfactory completion.
- B. The Contractor shall be responsible for coordination of meetings with all affected trades. A meeting shall be held each morning to review the day's test schedule with all affected trades. Similarly, a meeting shall be held each evening to review the day's test results and to review or revise the next day's test schedule as appropriate.
- C. The Contractor shall ensure that the electrical subcontractor conforms to the startup, test and signoff procedures specified herein to assure proper function and coordination of all motor control center control and interlock circuitry and the transmission of all discrete and/or analog signals between equipment furnished by the electrical subcontractor and the control system specified herein.
- D. All aspects of PLC programming and system integration shall be done as part of a separate project by owner. Contractor shall coordinate with owner for all programming related needs.
- E.

1.05 FINAL CONTROL ELEMENT TESTING

- A. The proper control of all final control elements shall be verified by tests conducted in accordance with the requirements specified herein.
- B. All modulating final control elements shall be tested for appropriate speed or position response by applying power and input demand signals, and observing the equipment for proper direction and level of reaction. Each final control element shall be tested at 0, 25, 50, 75, and 100 percent of signal input level and the results checked against specified accuracy tolerances. Final control elements, such as VFDs, that require turndown limits shall be initially set during this test.
- C. All non-modulating final control elements shall be tested for appropriate position response by applying and simulating control signals, and observing the equipment for proper reaction.

1.06 LOOP CHECKOUT

- A. Prior to control system startup and testing, each monitoring and control loop shall be tested on an individual basis from the primary element to the final element, including the operator workstation or loop controller level, for continuity and for proper operation and calibration.

- B. Signals from transducers, sensors, and transmitters shall be utilized to verify control responses. Simulated input data signals may be used subject to prior written approval by the Engineer. All modes of control shall be exercised and checked for proper operation.
- C. The accuracy of all DACs shall be verified by manually entering engineering unit data values at the operator workstation and then reading and recording the resulting analog output data.
- D. The accuracy of all ADCs shall be verified using field inputs or by manually applying input signals at the final controller, and then reading and recording the resulting analog input data at the operator workstation.
- E. Each loop tested shall be witnessed, dated and signed off by both the Contractor (or designee) and the Engineer upon satisfactory completion.

1.07 CONTROL SYSTEM STARTUP AND TESTING

- A. Control system startup and testing shall be performed to demonstrate complete compliance with all specified functional and operational requirements. Testing activities shall include the simulation of both normal and abnormal operating conditions.
- B. All digital hardware shall be fully inspected and tested for function, operation and continuity of circuits. All diagnostic programs shall be run to verify the proper operation of all digital equipment.
- C. Final control elements and ancillary equipment shall be tested under start-up and steady-state operating conditions to verify that proper and stable control is achieved using local area control panels, motor control center circuits, and local field mounted control circuits. All hardwired control circuit interlocks and alarms shall be operational. The control to final control elements and ancillary equipment shall be tested using both manual and automatic (where provided) control circuits.
- D. Signals from transducers, sensors, and transmitters shall be utilized to verify control responses for final control elements. Simulated input data signals may be used subject to prior written approval by the Engineer.
- E. Each control strategy shall be tested to verify the proper operation of all required functions. The control system start-up and test activities shall include procedures for tuning all control loops incorporating PID control modules, and for adjusting and testing all control loops as required to verify specified performance.
- F. The control system start-up and test activities shall include running tests to prove that the Instrumentation, Control and Information System is capable of continuously, safely and reliably regulating processes, as required by the Contract, under service conditions that simulate, to the greatest extent possible, normal plant operating ranges and environmental conditions.

- G. A witnessed functional acceptance test shall be performed to demonstrate satisfactory performance of individual monitoring and control loops and control strategies. At least one test shall be performed to verify that the control and instrumentation system is capable of simultaneously implementing all specified operations.
- H. Each loop and control strategy test shall be witnessed and signed off by both the Contractor (or designee) and the Engineer upon satisfactory completion.

1.08 FACILITY STARTUP COORDINATION

- A. Facility start-up shall comply with requirements specified in the Contract Documents and those requirements specified herein. Facility start-up shall commence after all previously described start-up and test activities have been successfully completed and shall demonstrate that the Instrumentation, Control and Information System can meet all Contract requirements with equipment operating over full operating ranges under actual operating conditions.
- B. The control system start-up period shall be coordinated with process startup activities and shall be extended as required until all plant processes are fully operational and to satisfy the Engineer that all control system Contract requirements have been fulfilled in accordance with the Contract Documents.
- C. The instrumentation subcontractor's personnel shall be resident at the facility to provide both full time (eight hours/day, five days/week) and 24 hours on call (seven days/week) support of operating and maintenance activities for the duration of the start-up period.
- D. At least one qualified control systems technician shall be provided for control system startup and test activities and at least two when loop checkout is being performed.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 40 61 21.73
FINAL ACCEPTANCE TEST

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall perform the Final Acceptance Test on the Instrumentation and Control System as specified herein to demonstrate compliance with the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 40 61 13 – Process Control System General Provisions
- B. Section 40 61 21.72 – Field Testing

1.03 AVAILABILITY DEMONSTRATION AND FINAL SYSTEM ACCEPTANCE

- A. Upon completion of all control system startup activities and prior to final system acceptance, the Contractor shall demonstrate that the availability of the entire control system, including operation under conditions of digital equipment fail-over, initiated either automatically or manually, shall be not less than 99.8 percent during a 30-day availability test period. The Owner shall be given two (2) weeks' notice of the starting date of the 30-day availability test.
- B. For purposes of determining availability figures, downtime of each system or portions of each system resulting from the causes specified hereunder will not be considered system failures.
 - 1. Downtime of any network-connected device that is automatically backed-up upon failure shall not be considered a system failure provided that the downtime of the failed component does not exceed 24 hours.
 - 2. Downtime of a portion of the system resulting from failure of any field sensor shall not be considered a system failure provided that the system operates as specified under this condition.
- C. If the system fails the 30-day availability test, the 30-day test period shall be restarted after the failed component or software is repaired/replaced and full operation is restored. The system shall be demonstrated for the full 30-day period following the restart.
- D. The Contractor shall submit an availability demonstration report that shall state that all system availability requirements have been met.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 40 61 22
TOOLS, SUPPLIES, AND SPARE PARTS, GENERAL

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall provide tools, supplies, and spare parts as specified herein for the operation and maintenance of the Control and Information System.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 01 33 00 – Submittal Procedures
- B. Section 40 61 13 – Process Control System General Provisions

PART 2 – PRODUCTS

2.01 TOOLS

- A. Provide special tools, other than those normally found in an electronic technician's tool box, required to test, diagnose, calibrate, install, wire, connect, disconnect, assemble and disassemble any digital equipment, instrument, panel, rack, cabinet or console mounted equipment for service and maintenance. This shall include, but not be limited to, the following: connector pin insertion and removal tools, wire crimping tools, special wrenches, special instrument calibrators, indicator lamp insertion and removal tools, etc.
- B. Provide tools and test equipment together with items such as instruction manuals, carrying/storage cases, unit battery charger where applicable, special tools, calibration fixtures, cord extenders, patch cords and test leads, which are not specified but are necessary for checking field operation of equipment supplied under this Division.

2.02 -SUPPLIES

- A. The Contractor shall provide supplies as specifically required in other Sections of Division 40.

2.03 SPARE PARTS

- A. Provide spare parts for items of control and instrumentation equipment as recommended by the manufacturer and in accordance with the Contract Documents.
- B. Furnish all spares in moisture-proof boxes designed to provide ample protection for their contents. Label all boxes to clearly identify contents and purpose.

- C. The Contractor shall replace all spare parts consumed during installation, testing, start-up, the system availability demonstration, and the guarantee period.
- D. Refer to individual digital hardware and instrument sections for additional requirements specific to those devices.

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 40 61 23
SIGNAL COORDINATION REQUIREMENTS

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall conform to the signal coordination requirements specified herein.
- B. The Contractor shall be responsible for coordinating signal types and transmission requirements between the various parties providing equipment under this Contract. This shall include, but not be limited to, distribution of appropriate shop drawings among the equipment suppliers, the electrical subcontractor, the HVAC subcontractor, and the instrumentation subcontractor.
- C. Analog signals shall be signals for transmitting process variables, etc. from instruments and to and from panels, equipment PLCs and Control System PLCs.
- D. Discrete signals shall consist of contact closures or powered signals for transmitting status/alarm information and control commands between starters, panels, equipment PLCs, the Control System, etc

1.02 ANALOG SIGNAL TRANSMISSION

- A. Signal transmission between electric or electronic instruments, controllers, and all equipment and control devices shall be individually isolated, linear 4-20 milliamperes and shall operate at 24 VDC.
- B. Signal output from all transmitters and controllers shall be current regulated and shall not be affected by changes in load resistance within the unit's rating.
- C. All cable shields shall be grounded at one end only, at the control panel, with terminals bonded to the panel ground bus.
- D. Analog signal isolation and/or conversion shall be provided where necessary to interface with instrumentation, equipment controls, panels, and appurtenances.
- E. Non-standard transmission systems such as pulse duration, pulse rate, and voltage regulated shall not be permitted except where specifically noted in the Contract Documents. Where transmitters with nonstandard outputs do occur, their outputs shall be converted to an isolated, linear, 4-20 milliamperes signal.
- F. The Contractor shall provide 24 V power supplies for analog signals and instruments where applicable and as required inside panels, controls, etc.

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- G. Where two-wire instruments transmit directly to the Control and Information System, the instrumentation subcontractor shall provide power supplies at the PLC-equipped control panels for those instruments.
- H. Where four-wire instruments with on-board loop power supplies transmit directly to the Control and Information System, the instrumentation subcontractor shall provide necessary signal isolators or shall otherwise isolate the input from the Control and Information System loop power supply. Similar provisions shall be made when a third element such as a recorder, indicator, or single loop controller with integral loop power supply is included in the loop.

1.03 DISCRETE INPUTS

- A. All discrete inputs to equipment and Control and Information System PLCs, from field devices, starters, panels, etc., shall be unpowered (dry) contacts in the field device or equipment, powered from the PLCs, unless specified otherwise.
- B. Sensing power (wetting voltage) supplied by the PLC shall be 24 VDC .

1.04 DISCRETE OUTPUTS

- A. All discrete outputs from local control panels and Control and Information System PLCs to field devices, starters, panels, etc., shall be 24 VDC powered (sourced) from PLC's.
- B. PLC powered discrete outputs shall energize 24 VDC pilot relay coils in the field devices, starters, panels, etc. which in turn open or close contacts in the associated control circuit. The 24 VDC relay coil, contacts, and associated control circuitry shall be furnished integral with the field device, starter, panel, etc. by the supplier and contractor furnishing the field device, starter, or panel.
- C. Where required or specified herein, discrete outputs from equipment and Control and Information System PLC's to field devices, starters, panels, motor operated valves, etc., shall be dry contact or relay outputs.
- D. Outputs to solenoid valves shall be 120 VAC, powered from the PLC or control panel unless specified or shown otherwise.

1.05 OTHER DISCRETE SIGNALS

- A. Discrete signals between starters, panels, etc. where no 24 VDC power supply is available may be 120 VAC, as long as such contacts are clearly identified in the starter, panel, etc. as being powered from a different power supply than other starter/panel components.
- B. Where applicable, warning signs shall be affixed inside the starter, panel, etc. stating that the panel is energized from multiple sources.

- C. Output contacts in the starter, panel, etc., that are powered from other locations shall be provided with special tags and/or color-coding. Disconnecting terminal strips shall be provided for such contacts.
- D. The above requirements shall apply to all starters and panels, regardless of supplier.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

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SECTION 40 61 91
PROCESS CONTROL SYSTEM INSTRUMENT LIST

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, test, install and place in satisfactory operation all instrumentation as herein specified and as shown on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 40 61 93 – Process Control System Input/Output List
- B. Section 40 61 96 – Process Control Descriptions

PART 2 – PRODUCTS

2.01 NAMEPLATES

- A. Items of equipment listed in the instrument schedule, control panels, and digital hardware items shall be identified with nameplates. Each nameplate shall be located so that it is readable from the normal observation position and is clearly associated with the device or devices it identifies. Nameplates shall be positioned so that removal of the device for maintenance and repair shall not disturb the nameplate. Nameplates shall include, as necessary, the equipment identification number, description, calibrated range, and set point(s). Abbreviations of the description shall be subject to the Engineer's approval.
- B. Nameplates shall be made of 1/16-inch thick machine engraved laminated phenolic plastic having white numbers and letters not less than 3/16-inch high on a black background. Nameplates attached to instruments may be black laser etched 1/8-inch high text on stainless steel with sharp edges made smooth. Stamped text shall not be acceptable.
- C. Nameplates shall be attached to metal equipment by NEMA rated stainless steel screws and to other surfaces by an epoxy-based adhesive that is resistant to oil and moisture. In cases where the label cannot be attached by the above methods, it shall be drilled and attached to the associated device by means of a braided stainless steel wire affixed with a permanent crimp.
- D. Submit sample nameplate of each type.

PART 3 – INSTRUMENT SCHEDULE

Inline Magnetic Flow Meters – Section 40 71 13.13

Tag Number	Service Description	State/Span	P&ID	Remarks
PWTP-PLY-FE/FIT-3509	POLYMER TO FILTER 9	0.05 – 15.0 gph	I04	PROVIDE SUN SHIELD; 1-INCH PIPE
PWTP-PLY-FE/FIT-3510	POLYMER TO FILTER 10	0.05 – 15.0 gph	I04	PROVIDE SUN SHIELD; 1-INCH PIPE
PWTP-PLY-FE/FIT-35011	POLYMER TO FILTER 11	0.05 – 15.0 gph	I04	PROVIDE SUN SHIELD; 1-INCH PIPE
PWTP-PLY-FE/FIT-3512	POLYMER TO FILTER 12	0.05 – 15.0 gph	I04	PROVIDE SUN SHIELD; 1-INCH PIPE

Pressure and Differential Pressure Gauges – Section 40 73 13

Tag Number	Service Description	State/Span	P&ID	Remarks
PWTP-PLY-PI-3505	POLYMER PUMP 5 DISCHARGE	0 – 60 psi	I03	

Pressure Switches – Section 40 73 36

PWTP-PLY-PSH-3505	POLYMER PUMP 5 DISCHARGE	30 psi	I03	CONNECT TO DIS AREA PLC
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Flow Switches – Section 40 71 79.13

Tag Number	Service Description	State/Span	P&ID	Remarks
PWTP-PLY-FSL-3503	DILUTION WATER TO FILTER 9-12	0.45 gpm	I04	CONNECT TO DIS AREA PLC

END OF SECTION

SECTION 40 61 93
PROCESS CONTROL SYSTEM INPUT / OUTPUT LIST

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, test, install and place in satisfactory operation all control system inputs and outputs as herein specified and as shown on the Drawings. Inputs and outputs listed here represent hardwired inputs and outputs and do not include networked I/O from the MBR Master Control Panel, the Chlorine On-Site Generation Control Panel.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 40 61 90 – Schedules and Control Descriptions, General
- B. Section 40 61 91 – Process Control System Instrument List
- C. Section 40 61 96 – Process Control Descriptions

PART 2 – CONTROL SYSTEM INPUT / OUTPUT SCHEDULE

Tag Number	Description	Function	I/O Type	PLC	DWG Number
PWTP-PLY-PMP-YAR-3505	POLYMER FEED PUMP 5	RUNNING	DI	DIS AREA PLC	I03
PWTP-PLY-YS-PMP-3505	POLYMER FEED PUMP 5	START/STOP	DO	DIS AREA PLC	I03
PWTP-PLY-PMP-HS-3505	POLYMER FEED PUMP 5	IN REMOTE	DI	DIS AREA PLC	I03
PWTP-PLY-PMP-SI-3505	POLYMER FEED PUMP 5	SPEED	AI	DIS AREA PLC	I03
PWTP-PLY-PMP-SIC-3505	POLYMER FEED PUMP 5	SPEED CONTROL	AO	DIS AREA PLC	I03
PWTP-PLY-PSH-3505	POLYMER FEED PUMP 5 DISCHARGE	HIGH PRESSURE	DI	DIS AREA PLC	I03
PWTP-PLY-FSL-3503	PROCESS WATER TO FILTERS 9-12	LOW FLOW	DI	DIS AREA PLC	I04
PWTP-PLY-VLV-HS-3509	POLYMER TO FILTER 9 VALVE	IN REMOTE	DI	FILTER 9 AREA PLC	I04
PWTP-PLY-VLV-ZT-3509	POLYMER TO FILTER 9 VALVE	POSITION FEEDBACK	AI	FILTER 9 AREA PLC	I04
PWTP-PLY-VLV-ZC-3509	POLYMER TO FILTER 9 VALVE	POSITION CONTROL	AO	FILTER 9 AREA PLC	I04
PWTP-PLY-FIT-3509	POLYMER TO FILTER 9	FLOW	NAI	FILTER 9 AREA PLC	I04
PWTP-PLY-VLV-HS-3510	POLYMER TO FILTER 10 VALVE	IN REMOTE	DI	FILTER 10 AREA PLC	I04
PWTP-PLY-VLV-ZT-3510	POLYMER TO FILTER 10 VALVE	POSITION FEEDBACK	AI	FILTER 10 AREA PLC	I04

Tag Number	Description	Function	I/O Type	PLC	DWG Number
PWTP-PLY-VLV-ZC-3510	POLYMER TO FILTER 10 VALVE	POSITION CONTROL	AO	FILTER 10 AREA PLC	I04
PWTP-PLY-FIT-3510	POLYMER TO FILTER 10	FLOW	NAI	FILTER 10 AREA PLC	I04
PWTP-PLY-VLV-HS-3511	POLYMER TO FILTER 11 VALVE	IN REMOTE	DI	FILTER 11 AREA PLC	I04
PWTP-PLY-VLV-ZT-3511	POLYMER TO FILTER 11 VALVE	POSITION FEEDBACK	AI	FILTER 11 AREA PLC	I04
PWTP-PLY-VLV-ZC-3511	POLYMER TO FILTER 11 VALVE	POSITION CONTROL	AO	FILTER 11 AREA PLC	I04
PWTP-PLY-FIT-3511	POLYMER TO FILTER 11	FLOW	NAI	FILTER 11 AREA PLC	I04
PWTP-PLY-VLV-HS-3512	POLYMER TO FILTER 12 VALVE	IN REMOTE	DI	FILTER 12 AREA PLC	I04
PWTP-PLY-VLV-ZT-3512	POLYMER TO FILTER 12 VALVE	POSITION FEEDBACK	AI	FILTER 12 AREA PLC	I04
PWTP-PLY-VLV-ZC-3512	POLYMER TO FILTER 12 VALVE	POSITION CONTROL	AO	FILTER 12 AREA PLC	I04
PWTP-PLY-FIT-3512	POLYMER TO FILTER 12	FLOW	NAI	FILTER 12 AREA PLC	I04

1. NOTES: Input/Output types are as follows:

- a. DI – Discrete Input
- b. DO – Discrete Output
- c. AI – Analog Input
- d. AO – Analog Output
- e. NAI – Networked Analog Input

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 40 61 96
PROCESS CONTROL DESCRIPTIONS

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, test, install and place in satisfactory operation all equipment as herein specified and as shown on the Drawings. THE CONTRACTOR SHALL BE RESPONSIBLE FOR FURNISHING A COMPLETE FUNCTIONING SYSTEMS AS DESCRIBED HEREIN.
- B. Together with the control system input/output schedule, the equipment specifications (including functional descriptions for local equipment control panels), and the Drawings, the functional control descriptions describe the required operation, monitoring, and control of the facilities included in this Contract.
- C. THE FUNCTIONAL DESCRIPTIONS CONTAIN REQUIREMENTS FOR FURNISHING AND INSTALLING LABOR AND MATERIALS THAT MAY NOT APPEAR ELSEWHERE IN THE CONTRACT DOCUMENTS.
- D. All equipment and services required in equipment local control panels provided to implement the monitoring and control functions described herein or in the process input/output schedules shall be provided by the Contractor through individual equipment suppliers.
- E. Unless specifically stated otherwise, all interconnected wiring between all instruments, panels, controls, and other devices listed in the functional descriptions as required to provide all functions specified herein shall be furnished by the electrical subcontractor under Division 26. The electrical subcontractor shall provide all cable and conduit required to carry all signals listed in the process input/output schedules. Special cables that are required for interconnection between sensors or probes and transmitters or signal conditioners shall be furnished with the instrumentation devices by the equipment supplier.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 01 14 00 – Coordination with Owner's Operations
- B. Section 40 61 90 – Schedules and Control Descriptions, General
- C. Section 40 61 91 – Process Control System Instrument List
- D. Section 40 61 93 – Process Control System Input/Output List

PART 2 – FUNCTIONAL CONTROL DESCRIPTIONS, GENERAL

2.01 DEFINITIONS

- A. RUNNING status signals shall be from auxiliary contacts provided with the motor control equipment (i.e., starter, VFD, SCR, etc.).
- B. AUTO status signals shall be defined as HAND-OFF-AUTO switch in the AUTO position or process control system in AUTO (versus MANUAL).
- C. FAIL status signals shall be defined as motor overload and/or any other shut down mode such as overtorque, overtemperature, low oil pressure, high vibration, etc.
- D. READY status signal shall be defined as all conditions, including equipment control power, satisfied to permit remote control of the equipment.

2.02 CONVENTIONS

- A. Operator workstation graphic display symbols and indicator lights on all MCC's, control panels, starter enclosures, etc. shall conform to the following color convention:
 - 1. Running/On/Open: Green
 - 2. Auto/Ready: White
 - 3. Stopped/Off/Closed: Red
 - 4. Fail/Alarm: Amber
 - 5. Generic Status: Blue or White

2.03 PROCESS CONTROL

- A. Where setpoints, operating limits, and other control settings are provided by the functional descriptions, these settings shall be initial settings only and shall be used for assistance in the initial startup of the plant. All such settings shall be fully adjustable and, based on actual operating conditions, the instrumentation subcontractor shall make all necessary adjustments to provide smooth, stable operation at no additional cost to the Owner.
- B. Provision shall be made in PLC logic to suppress nuisance alarms and control actions by the following means:
 - 1. For alarms and control actions derived from analog input signals, use adjustable time delays and deadbands.
 - 2. For alarms and control actions derived from discrete input signals, use adjustable time delays.

3. Initial settings for time delays shall be 10 seconds (range 0-120 seconds). Initial settings for deadbands shall be 5% of span (range 0-100%).
 4. Equipment that is started or stopped manually by the operator shall start or stop immediately, with no time delay.
- C. All setpoint control shall be by PID control algorithms. Where only proportional control is specified, tuning constants shall be used to reduce the Integral and Derivative functions to zero. All setpoints, sequence times, sequence orders, dead bands, PID tuning parameters, PLC delay timers, variable speed operating range limits, and similar control constants shall be accessible and alterable from the operator workstations.
 - D. Unless otherwise specified, all equipment shall automatically restart after a power failure utilizing adjustable start delay timers in PLC control logic. Unless otherwise specified, all PLC control strategies shall be based upon automatic restart after a power failure and shall return to a normal control mode upon restoration of power.
 - E. The PLC shall be capable of receiving initial run-time values for existing and proposed equipment. Initial run-time shall not automatically be assumed to be zero.
 - F. A control discrepancy alarm shall be generated through the PLC for any drive, motor, etc. for which a command has been issued, but for which the PLC is not receiving a confirming status signal (e.g., start command with no run feedback). The failure shall be logged.
 - G. An instrument failure alarm shall be generated for any instrument which is generating a signal that is less than 4 mA or greater than 20 mA.
 - H. Unless otherwise specified in an individual control description, an instrument failure or control discrepancy alarm shall cause the control strategy to maintain last values and to generate an alarm. Manual initiation of the automatic control strategy shall be required.
 - I. A control program that controls multiple pieces of equipment shall not be prevented from running because not all of the equipment is in AUTO. If equipment within an equipment chain is required to be running for program operation and it is running in HAND or MANUAL, then the program shall run and control the other equipment that is in AUTO.
 - J. All PLC wait states (internal time delays, etc.) after an operator action shall be displayed on the operator workstation.

PART 3 – FUNCTIONAL CONTROL DESCRIPTIONS

3.01 POLYMER FEED TO FILTERS 5, 6, 7, AND 8

A. Process Overview

The polymer feed pump (PWTP-PLY-PMP-3505) shall draw from the polymer

preparation system holding tank and feed polymer to filters 9, 10, 11 and 12. Dilution water will blend with the polymer post feed pump and act as carrier water to the filters. Motor operated valves (PWTP-PLY-VLV-3509, -VLV-3510, -VLV-3511, and -VLV-3512) located at the filters shall modulate to control flow to each of the filters 9, 10, 11, and 12 based on flow meters (PWTP-PLY-FIT-3509, -FIT-3510, -FIT-3511, and -FIT-3512) on each polymer feed line.

B. Equipment

1. The following is controlled and monitored through DIS AREA PLC:
 - a. Feed pump (PMP-3505):
 - 1) PUMP RUNNING
 - 2) PUMP START/STOP
 - 3) PUMP IN REMOTE
 - 4) PUMP SPEED
 - 5) PUMP SPEED CONTROL
 - b. High pressure switch (PSH) on the discharge of the feed pump.
 - c. Low flow to filters 9 - 12.
2. The following is controlled and monitored through FILTER 9 AREA PLC
 - a. Filter 9 motor operated valve (VLV-3509) and flow transmitter (FIT-3509)
3. The following is controlled and monitored through FILTER 10 AREA PLC
 - a. Filter 10 motor operated valve (VLV-3510) and flow transmitter (FIT-3510)
4. The following is controlled and monitored through FILTER 11 AREA PLC
 - a. Filter 11 motor operated valve (VLV-3511) and flow transmitter (FIT-3511)
5. The following is controlled and monitored through FILTER 12 AREA PLC
 - a. **Filter 12** motor operated valve (VLV-3512) and flow transmitter (FIT-3512)

C. Control Operation

- a. Local Feed pump control:

- 1) The feed pump shall be furnished with integrated controls. The operator shall have the ability to start and stop the pump and set the speed via the LCD Keypad.
- 2) PLC Based Controls:
 - i) When the pump is set to remote status, the pump shall be controlled by the PLC.
 - j) In REMOTE-MANUAL mode, the pump speed (RPM) shall be set manually on the PLC OIT or at SCADA. The pump shall START and STOP using the PLC OIT or SCADA Operator Workstation.
 - k) In REMOTE-AUTO mode, the PLC shall control the pump based on the logic as described below:
 - l) The speed of the polymer feed pump (PMP-3505) shall be flow paced to meet a calculated pump speed using the following equation:

$$\text{Polymer Feed Pump Speed (RPM)} = \frac{[(F9 \times D9) + (F10 \times D10) + (F11 \times D11) + (F12 \times D12)] \times 8.34}{(\text{Conc} \times \text{Density} \times \text{Capacity} \times 1440)}$$

Where:

Table 1: Pump Speed Equation Variables

Variable	Units	Description
F9	MGD	Effluent process water flow for Filter No. 9 measured by the sum of flows from existing flow meters FIT-706A and FIT-706B.
F10	MGD	Effluent process water flow for Filter No. 6 measured by the sum of flows from existing flow meters FIT-716A and FIT-716B.
F11	MGD	Effluent process water flow for Filter No. 7 measured by the sum of sum of flows from existing flow meters FIT-726A and FIT-726B.
F12	MGD	Effluent process water flow for Filter No. 8 measured by the sum of flows from existing flow meters FIT-736A and FIT-736B

D9	mg/L	Operator set filter aid polymer dose for Filter No. 9
D10	mg/L	Operator set filter aid polymer dose for Filter No. 10
D11	mg/L	Operator set filter aid polymer dose for Filter No. 11
D12	mg/L	Operator set filter aid polymer dose for Filter No. 12
Capacity	gal/min/rpm	Operator set polymer feed pump capacity 100% speed and stroke
Density	lbs/gal	Operator set polymer bulk density
Conc	%	Operator set polymer concentration

b. Polymer Flow Modulating Control Valves

Polymer flow to each filter is controlled by a modulating motor operated valve on each polymer feed line. The polymer flow will be based on the ratio of pounds per day (ppd) for an individual filter to the combined total ppd of polymer to filters 9, 10, 11, and 12. The system shall modulate VLV-3509, VLV-3510, VLV-3511, VLV-3512 via a PID control function block to control the flow rate as required. The target flow rate (gpm) for the MOVs shall be calculated using the following equation (typical for four filters):

Filter 1 Target Flow Rate (gpm)

$$= \frac{F5 \times D5}{(F5 \times D5) + (F6 \times D6) + (F7 \times D7) + (F8 \times D8)} \times [PF5 + PF6 + PF7 + PF8]$$

Where:

Table 2: Target Flow Rate Variables

Variable	Units	Description
PF9	gpm	Filter aid polymer flow for Filter No. 9 measured by flow meter FIT-3509.
PF10	gpm	Filter aid polymer flow for Filter No. 10 measured by flow meter FIT-35010.
PF11	gpm	Filter aid polymer flow for Filter No. 11 measured by flow meter FIT-3511.

PF12	gpm	Filter aid polymer flow for Filter No. 12 measured by flow meter FIT-3512.
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See Table 1 for additional Variables.

D. Interlocks

1. Hardwired

a. Feed pump PMP-3505

- 1) The feed pumps shall be stopped in a fault condition regardless of local or remote control.
- 2) Refer to Section 46 77 10 for additional interlock and alarm requirements.

2. Software

- a. Feed pump PMP-3505 shall be stopped on low level condition in the 420 gallon holding tank.
- b. Feed pump s 1 and 2 shall be stopped on the respective high pressure switch calibrated to 30 psig.
- c. Feed pump s 1 and 2 shall be stopped on the respective low flow switch calibrated to 0.45 gpm.

END OF SECTION

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SECTION 40 66 00
PROCESS CONTROL SYSTEM NETWORKS

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, test, install and place in satisfactory operation IEEE 802.3 Ethernet local area network(s) for communications among plant devices.
- B. Local area network shall be provided with all spare parts, accessories, and appurtenances as herein specified.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 40 61 13 – Process Control System General Provisions
- B. Section 40 63 43 – Programmable Logic Controllers

1.03 TOOLS, SUPPLIES AND SPARE PARTS

- A. The following specific spare parts items shall be provided:
 - 1. A termination tool kit shall be provided containing all required tools and consumables for up to 25 connections of each connection type furnished. Termination kit shall be as manufactured by Black Box, Corning Cable Systems, Optical Cable Corporation, or equal.
 - 2. One (1) spare switch of each type furnished under this Contract.
 - 3. Two (2) spare patch cables of each type and of the maximum length used.
 - 4. Two (2) spare GBIC or SFP modules for each type used.
 - 5. One (1) spare media converter for each type used.

1.04 SUBMITTALS

- 1. Fiber optic testing results, including signal attenuation for each fiber

PART 2 – PRODUCTS

2.01 LOCAL AREA NETWORK (LAN)

- A. An IEEE 802.3 Ethernet local area network shall be used for communications between plant devices.

- B. Network wiring shall be unshielded, twisted-pair copper cables for connections within buildings. Fiber optic media shall be used for all inter-device communication links extended outside of a building, unless specifically noted. Cables shall be as specified herein.
- C. The Contractor may provide a network configuration different from that shown in the Contract Drawings with written approval of the Engineer, but the Contractor shall coordinate with all affected trades and pay for all additional charges incurred.
- D. The Contractor shall supply all hardware, cables, connectors, adapters, modules, and software to implement a network as specified herein and shown on Drawings.

2.02 INDUSTRIAL ETHERNET NETWORK SWITCHES

- A. Except where specifically allowed on the Control System Architecture Drawing, industrial Ethernet network switches shall be provided for each device connected to the process control system network. The switches shall create switched Ethernet networks that conform to the IEEE 802.3 and 802.3u standards using copper wires or optical fibers in a bus, tree or ring network topology as shown on the Drawings. Ethernet network switches shall be modular, rack mounted, or standard DIN-rail mounted within the PLC cabinet or in an adjacent communication cabinet, as shown on the Drawings.
- B. Ethernet network switches shall support ring, bus, tree, or point-to-point network topologies. On-line signal monitoring shall be provided to detect and locate impending faults. Ethernet network switches shall be replaceable on-line without disrupting the network. The Ethernet network switches shall be integrated into the in-plant Ethernet network to form a redundant ring network with self-healing communication recovery. Switches shall support the non-proprietary Media Redundancy Protocol (MRP) and Rapid Spanning Tree Protocol (RSTP) in addition to the switch manufacturer's standard redundant ring network protocol, all of which shall provide self-healing communication recovery.
- C. Ethernet network switches shall meet the following minimum performance requirements:
 - 1. Functions: Modular managed switch with store and forward switching mode, 10 Mbps Ethernet, or 100 Mbps Fast-Ethernet, or gigabit Ethernet support, multi-address capability, auto-crossing, auto-negotiation, auto-polarity. Port speed and duplex auto-negotiation shall be configurable. Each network switch shall manage up to eight (8) ports possible via integrated media modules specified below.
 - 2. Management: Simple Network Management Protocol (SNMP) (v1/v2/v3) and Common Industrial Protocol (CIP) support; IGMP filtering and snooping.
 - 3. Power Requirements: Redundant 24 VDC power supply
 - 4. Operating Temperature: 0 to 60 degrees C

5. Relative Humidity: 10 - 95%
 6. Network Size: Up to 50 nodes in ring structure
 7. Port Type & Quantity (at each PLC location): minimum of four (4) 10/100Base-TX, twisted pair cable, RJ-45 sockets, 0-100 meters LAN segment and two (2) 100/1000Base-FX, multimode fiber optic cables (62.5/125 μ m), LC, ST or SC sockets, 0-5000 meters LAN segment
 8. Link Budget: 8 dB @ 1300 nm; 10 dB @ 850 nm
 9. Wavelength: 850 or 1300 nm
- D. Acceptable industrial Ethernet network switches shall be as manufactured by Cisco Systems, Hirschmann, Phoenix Contact, Weidmuller, or equal.

2.03 UNSHIELDED TWISTED PAIR CABLE

- A. Unshielded twisted pair cable for drops within buildings shall consist of 4 pair of 24 AWG copper conductors in a flame-retardant jacket. Cable shall be plenum rated (UL 910) and meet EIA/TIA-568 Category 6 specifications. Unshielded twisted pair cable shall be Hyper Grade Extended Distance cable as manufactured by Berk-Tek, Belden equivalent, or equal. Connectors shall be modular RJ-45 plug.
- B. Provide copper patch panels where more than one copper communication cable leaves the enclosure.

2.04 MULTIMODE FIBER OPTIC CABLE

- A. Fiber optic cable shall conform to the following specifications:
 1. Fiber Type: Graded Index (GI) Multimode
 2. Fiber/Cladding Diameter: 62.5/125 microns
 3. No. Fibers: 12, Color-coded
 4. Cable Construction: Loose Tube w/ Ripcords
 5. Filling: Water Swellable Dry Block
 6. Armored: No
 7. Central Member: Dielectric (Kevlar)
 8. Rating: Gigabit Ethernet, unless otherwise indicated
 9. Modal bandwidth: As required for link speed and distance

10. Maximum Attenuation: 3.5 dB/km at 850 nm; 1.5 dB/km at 1300 nm
 11. Application Type: Direct-burial/Conduit/Aerial
 12. Sheath: UV Resistant
 13. Max. Tensile Load: 600 lb (2700 N) installation; 200 lb (890 N) long term
 14. Minimum Bend Radius: 7 in (17.4 cm) under maximum tensile load; 4.6 in (11.6 cm) unloaded (installed)
 15. Operating Temperature: -40 to 70 degrees C
 16. Operating Relative Humidity: 0 to 100%
- B. Fiber optic cable shall utilize mechanically spliced, field installable, SC, LC, or ST compatible connectors. Connections shall have a typical loss of 0.35 dB or better and shall provide stable optical performance after numerous rematings. Connections shall utilize physical contact terminations utilizing UV or heat cured adhesive. Where applicable, field terminations shall use a simple procedure requiring minimal training.
- C. Fiber optic cable shall be ALTOS All Dielectric Loose Tube Optical Cable as manufactured by Corning Cable Systems, the Extended Performance Fiber Optic Cable Series as manufactured by Phoenix Digital, Inc., Belden equivalent, equivalent system by Optical Cable Corporation, or equal.

PART 3 – EXECUTION

3.01 GENERAL REQUIREMENTS

- A. The destination of all network data cables (both copper and fiber) leaving an enclosure, patch panel, or building shall be labeled at each end using industry-standard wire markers.
- B. Refer to Section 40 61 13 – Process Control System General Provisions for additional requirements.

3.02 FIBER OPTIC CABLE

- A. Fiber optic cable for installation within buildings shall comply with all applicable fire and building safety codes for such applications.
- B. Testing
 1. Bulk fiber shall be tested on-site to prior to installation to provide a reference for the installed test data.

2. All individual fibers, including spares, shall be terminated and all connections shall be tested after installation.
3. Complete installed fiber optic cable shall be tested for continuity with a visual fault locator or fiber tracer and the connections verified and documented. Cabling shall also be tested for optical/insertion loss in compliance with Tier 1 testing per TIA-568.
4. Submit all test results.

3.03 FIBER OPTIC PATCH PANELS

- A. All patch panels shall be labeled with destination/function of each port. Provide printed directory mounted to or adjacent to patch panel with this information where sufficient space is not available.

END OF SECTION

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SECTION 40 70 00
INSTRUMENTATION FOR PROCESS SYSTEMS

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. The instrumentation subcontractor shall furnish, install, test and place in operation instruments as scheduled together with all signal converters, transmitters, isolators, amplifiers, etc. to interface with the process control system as shown on the Drawings and as specified. The Contractor may elect to install sensors on process lines provided that the instrumentation subcontractor provides full on-site supervision during installation. Mounting of associated indicators, sensors, sampling pumps, power supplies, brackets and appurtenances shall be provided as indicated.
- B. It is the intent of the Contract Documents that all process taps, isolation valves, nipples, penetrations, embedded instrumentation supports, conduit, wiring, terminations, and the installation of process instrumentation on process lines shall be provided under this Contract. The Instrumentation Subcontractor shall supervise installation of equipment provided where installation is by other Subcontractors or Contractors.
- C. Tapping and connections for primary process sensors shall be sized to suit each individual installation and the requirements of the instrument served. The Contractor shall ensure that the location, supports, orientation and dimensions of the connections and tapping for instruments are such as to provide the proper bracing, the required accuracy of measurement, protection of the sensor from accidental damage and accessibility for maintenance while the plant is in operation. Isolation valves shall be provided at all process taps.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 40 61 13 – Process Control System General Provisions
- B. Section 40 67 00 – Control System Equipment Panels and Racks
- C. Section 40 79 00 – Miscellaneous Instruments, Valves, and Fittings
- D. Section 40 61 22 – Tools, Supplies, and Spare Parts, General
- E. Instruments furnished with mechanical equipment shall be furnished, installed, tested and calibrated as specified elsewhere in the Contract Documents.

1.03 TOOLS, SUPPLIES AND SPARE PARTS

- A. Tools, supplies and spare parts shall be provided as specified in Section 40 61 22 -- Tools, Supplies, and Spare Parts, General.

- B. Additional items as recommended by the analytical instrument manufacturers or as described for the specified analytical instrument sections shall be provided.

PART 2 – PRODUCTS

2.01 GENERAL

- A. All instrumentation supplied shall be the manufacturer's latest design. Unless otherwise specified, instruments shall be solid state, electronic, using enclosures to suit specified environmental conditions. Microprocessor-based equipment shall be supplied unless otherwise specified. All instruments shall be provided with mounting hardware and floor stands, wall brackets, or instrument racks as shown on the Drawings, or as required.
- B. Equipment installed in a hazardous area shall meet or exceed Class, Group, and Division requirements as shown on the Drawings, to comply with the National Electrical Code.
- C. All field instrumentation for outdoor service shall be provided with enclosures that are suitable for outdoor service, as follows:
 - 1. Where the manufacturer's enclosures are suitable for outdoor service, they shall be provided with instrument sunshades. Sunshades shall be Style E as manufactured by O'Brien Corporation, or equal. Where possible, these instruments shall be mounted in a north facing direction.
 - 2. Where the manufacturer's standard enclosures are not suitable for outdoor service, instruments shall be mounted in Field Panels in accordance with Section 40 67 00 – Control System Equipment Panels and Racks, or may be furnished with Vipak instrument field enclosures as manufactured by O'Brien Corporation, equivalent by Intertec, or equal. It shall not be necessary to provide the manufacturer's NEMA 4 or 4X enclosures for instruments that will be subsequently mounted in separate field panels.
- D. All instruments shall return to accurate measurement without manual resetting upon restoration of power after a power failure.
- E. Unless otherwise shown or specified, local indicators shall be provided for all instruments. Where instruments are located in inaccessible locations, local indicators shall be provided and shall be mounted as specified in Paragraph 3.01 B herein. All indicator readouts shall be linear in process units. Readouts of 0 to 100% shall not be acceptable (except for speed and valve position). Isolated outputs shall be provided for all transmitters.
- F. Unless otherwise specified, field instrument and power supply enclosures shall be Type 316 stainless steel, fiberglass (or similar, per Engineer's judgement) or PVC coated copper-free cast aluminum NEMA 4X construction.

- G. Where separate elements and transmitters are required, they shall be fully matched, and unless otherwise noted, installed adjacent to the sensor. Special cables or equipment shall be supplied by the associated equipment manufacturer.
- H. Electronic equipment shall utilize printed circuitry and shall be coated (tropicalized) to prevent contamination by dust, moisture and fungus. Solid state components shall be conservatively rated for long term performance and dependability over ambient atmosphere fluctuations. Ambient conditions shall be -20 to 50 degrees C and 20 to 100 percent relative humidity, unless otherwise specified. Field mounted equipment and system components shall be designed for installation in dusty, humid, and corrosive service conditions.
- I. All devices furnished hereunder shall be heavy duty type, designed for continuous industrial service. The system shall contain products of a single manufacturer, insofar as possible, and shall consist of equipment models that are currently in production. All equipment provided, where applicable, shall be of modular construction and shall be capable of field expansion.
- J. All non-loop-powered instruments and equipment shall be designed to operate on a 60 Hz AC power source at a nominal 117 V, plus or minus 10 percent, except where specifically noted. All regulators and power supplies required for compliance with the above shall be provided. Where equipment requires voltage regulation, constant voltage transformers shall be supplied.
- K. All analog transmitter and controller outputs shall be isolated, 4 to 20 milliamps into a load of 0 to 750 ohms, unless specifically noted otherwise. All switches shall have double pole, double throw contacts rated at a minimum of 600 VA, unless specified otherwise.
- L. Materials and equipment used shall be UL approved wherever such approved equipment and materials are available.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. General
 - 1. Equipment shall be located so that it is accessible for operation and maintenance. The instrumentation subcontractor shall examine the Drawings and shop drawings for various items of equipment in order to determine the best arrangement for the work as a whole and shall supervise the installation of process instrumentation supplied under this Division.
 - 2. Work shall be performed in compliance with all applicable local codes and practices. Where the Contract Documents do not delineate precise installation

procedures, the latest version of the American Petroleum Institute (API) Recommended Practice 551 manual (API RP 551) shall be used as a guide to installation procedures.

B. Equipment Mounting and Support

1. Field equipment shall be wall mounted or mounted on two inch diameter pipe stands welded to a 10 inch square by 1/2 inch thick base plate unless shown adjacent to a wall or otherwise noted. Materials of construction shall be aluminum or 316 stainless steel. Instruments attached directly to concrete shall be spaced out from the mounting surface not less than 1/2 inch by use of phenolic spacers. Expansion anchors in walls shall be used for securing equipment or wall supports to concrete surfaces. Unless otherwise noted, field instruments shall be mounted between 48 and 60 inches above the floor or work platform.
2. Embedded pipe supports and sleeves shall be Schedule 40, Type 316 stainless steel pipe, ASA B 36.19, with stainless steel blind flange for equipment mounting, unless otherwise indicated.
3. Materials for miscellaneous mounting brackets and supports shall be Type 316 stainless steel construction.
4. Pipe stands, miscellaneous mounting brackets and supports shall comply with the requirements of Division 05 of the specifications.
5. Transmitters shall be oriented such that output indicators are readily visible.

C. Control and Signal Wiring

1. Electrical, control and signal wiring connections to transmitters and elements mounted on process piping or equipment shall be made through liquid tight flexible conduit. Conduit seals shall be provided where conduits enter all field instrument enclosures and all cabinetry housing electrical or electronic equipment.

3.02 ADJUSTMENT AND CLEANING

- A. The instrumentation subcontractor shall comply with the requirements of Division 01 of these Specifications and all instrumentation and control system tests, inspection, and calibration requirements for all instrumentation and controls provided under this Contract and specified herein. The Engineer, or his/her designated representative(s), reserves the right to witness any test, inspection, calibration or start up activity. Acceptance by the Engineer of plans, reports, or documentation relating to testing or commissioning activity shall not relieve the Contractor of his/her responsibility for meeting all specified requirements.
- B. The instrumentation subcontractor shall provide the services of factory trained technicians, tools and equipment to field calibrate, test, inspect and adjust each

instrument to its specified performance requirement in accordance with manufacturer's specifications and instructions. Instruments which fails to meet Contract requirements, or published manufacturer performance specification for functional and operational parameters, shall be repaired or replaced, at the discretion of the Engineer, at no cost to the Owner. The Contractor shall bear all costs and provide all personnel, equipment and materials necessary to implement all installation tests and inspection activities for equipment specified herein.

- C. At least 60 days before the anticipated initiation of installation testing, the Contractor shall submit to the Engineer a detailed description of the installation test(s) to be conducted to demonstrate the correct operation of the instrumentation supplied hereunder.
- D. Field instrument calibration shall conform to the following requirements:
 - 1. The instrumentation subcontractor shall provide the services of factory trained instrumentation technicians, tools and equipment to field calibrate or verify factory calibration of each instrument supplied under this Contract and existing instruments shown to its specified accuracy in accordance with the manufacturer's specification and instructions for calibration. Calibration and verification shall take place under actual process conditions. Forcing outputs shall not be acceptable.
 - 2. Each instrument shall be calibrated/verified at 0, 25, 50, 75 and 100 percent of span using test instruments to simulate inputs and read outputs. Test instruments shall be rated to an accuracy of at least five (5) times greater than the specified accuracy of the instrument being calibrated. Where applicable, such test instruments shall have accuracy's as set forth by the National Institute for Standards and Technology (NIST).
 - 3. The instrumentation subcontractor shall provide a written calibration/verification sheet to the Engineer for each instrument, certifying that it has been calibrated to its published specified accuracy. The Contractor shall submit proposed calibration sheets for various types of instruments for Engineer approval prior to the start of calibration. This sheet shall include but not be limited to date, instrument tag numbers, brief description of how the calibration process was performed, calibration data for the various procedures described herein, name of person performing the calibration, a listing of the published specified accuracy, permissible tolerance at each point of calibration, calibration reading as finally adjusted within tolerance, defect noted, corrective action required and corrections made. For electronic or powered instruments, the calibration/verification sheet shall also list all configurable parameters that have been modified from their default factory setting.
 - 4. If doubt exists as to the correct method for calibrating or checking the calibration/verification of an instrument, the manufacturer's printed

recommendations shall be used as an acceptable standard, subject to the approval of the Engineer.

5. Upon completion of calibration, devices calibrated hereunder shall not be subjected to adjustments, sudden movements, accelerations, or shocks, and shall be installed in permanent protected positions not subject to moisture, dirt, and excessive temperature variations. Caution shall be exercised to prevent such devices from being subjected to over-voltages, incorrect voltages, overpressure or incorrect air. Damaged equipment shall be replaced and re-calibrated/verified at no cost to the Owner. Equipment that has been adjusted, modified, or moved or there is evidence of such activity shall be re-calibrated/verified at no cost to the Owner.
6. After completion of instrumentation installation, the instrumentation subcontractor shall perform a loop check. The Contractor shall submit final loop test results with all instruments listed in the loop. Loop test results shall be signed by all representatives involved for each loop test.

END OF SECTION

SECTION 40 71 13.13
INLINE MAGNETIC FLOW METERS

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, test, install and place in satisfactory operation the magnetic flow meters, with all spare parts, accessories, and appurtenances as herein specified and as shown on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 40 61 13 – Process Control System General Provisions
- B. Section 40 70 00 – Instrumentation for Process Systems

1.03 TOOLS, SUPPLIES AND SPARE PARTS

- A. Furnish one spare signal converter.

PART 2 – PRODUCTS

2.01 MAGNETIC FLOW METER SYSTEMS

- A. Magnetic flow meter systems shall include a magnetic flow tube and a microprocessor-based "smart" transmitter that is capable of converting and transmitting a signal from the flow tube. Magnetic flow meters shall utilize the characterized field principle of electromagnetic induction and shall produce DC signals directly proportional to the liquid flow rate.
- B. Each meter shall be furnished with a 316 stainless steel or carbon steel metering tube and carbon steel flanges with a polyurethane, ceramic, neoprene, hard rubber, or Teflon liner as required by the application and/or as specified herein. Liner shall have a minimum thickness of 0.125 inches. The inside diameter of the liner shall be within 0.125 inches of the inside diameter of the adjoining pipe. Liner protectors shall be provided on all flow tubes. All material shall be in compliance with NSF 60/61.
- C. The flow tube shall be provided with flush mounted electrodes.
- D. Grounding rings shall be provided for both ends of all meters and shall be constructed of 316 stainless steel.
- E. The transmitter shall have Ethernet/IP, as the communication protocol.

- F. All materials of construction for metallic wetted parts (electrodes, grounding rings, etc.) shall be minimum 316 stainless steel, but shall be compatible with the process fluid for each meter in accordance with the recommendations of the manufacturer.
- G. Flow tube shall be rated for pressures up to 1.1 times the flange rating of adjacent piping. System shall be rated for ambient temperatures of -30 to +65°C. Meter and transmitter housings shall meet NEMA 4X/IP66 requirements as a minimum. When meter and transmitter are located in classified explosion hazard areas, the meter and transmitter housings shall be selected with rating to meet the requirements for use in those areas. Where the flow tube is subject to submergence through installation in a meter vault or similar location, the flow tube assembly shall be rated NEMA 6P/IP68 and electronics shall be factory sealed against moisture intrusion. The use of field kits for modifying NEMA 4/4X/IP66 flow tubes to submergence duty shall not be acceptable. The associated transmitter shall be located in an area not subject to submergence.
- H. The transmitter shall provide pulsed DC coil drive current to the flow tube and shall convert the returning signal to a linear, isolated 4-20 mA DC signal. The transmitter shall utilize "smart" electronics and shall contain automatic, continuous zero correction, signal processing routines for noise rejection, and an integral LCD readout capable of displaying flow rate and totalized flow. The transmitter shall continuously run self-diagnostic routines and report errors via English language messages.
- I. The transmitter's preamplifier input impedance shall be a minimum of 10⁹-10¹¹ ohms which shall make the system suited for the amplification of low-level input signals and capable of operation with a material build up on the electrodes.
- J. The transmitter shall provide an automatic low flow cutoff below a user configurable low flow condition (0-10%). The transmitter's outputs shall also be capable of being forced to zero by an external contact operation.
- K. Each flow tube shall be factory calibrated and assigned a calibration constant or factor to be entered into the associated transmitter as part of the meter configuration parameters. Manual calibration of the flow meter shall not be required. Meter configuration parameters shall be stored in non-volatile memory in the transmitter. An output hold feature shall be provided to maintain a constant output during configuration changes.
- L. The transmitter shall be capable of communicating digitally with a remote configuration device via a frequency-shift-keyed, high frequency signal superimposed on the 4-20 mA output signal. The remote configuration device shall be capable of being placed anywhere in the 4-20 mA output loop. The remote configuration device shall be as specified under Section 40 70 00 – Instrumentation for Process Systems. A password-based security lockout feature shall be provided to prevent unauthorized modification of configuration parameters.
- M. Accuracy shall be 0.30% of rate over the flow velocity range of 1.0 to 10.0 m/s (3.0 to 33 ft/sec) and 0.5% between 0.1 m/s and 1.0 m/s (1-3 ft/s). Repeatability shall be + 0.1%

of rate; minimum turndown shall be 100:1. Minimum required liquid conductivity shall not be greater than 5 uS/cm. Maximum response time shall be adjustable between 1 and 100 seconds as a minimum. Transmitter ambient temperature operating limits shall be -10 to +60°C. Power supply shall be 115 VAC, 60 Hz.

- N. Flow tubes shall be 150-lb flange mounted unless otherwise noted. The cables for interconnecting the meter and transmitter shall be furnished by the manufacturer. Transmitter shall be mounted integrally on flow tube, wall, or 2-inch pipe mounted as shown in the Drawings and/or as specified.
- O. Magnetic flow meter systems shall be Model 8750W with optional high accuracy as manufactured by Rosemount, or equivalent by ABB, Endress + Hauser, Foxboro, Krohne, Siemens, Toshiba or equal.

PART 3 – EXECUTION

3.01 REQUIREMENTS

- A. Ground magnetic flow meter flow tubes and grounding rings in strict accordance with the manufacturer's recommendations.
- B. Flow meter shall be installed according to the minimum straight pipe diameter lengths upstream and downstream as specified by the manufacturer.
- C. Refer to Section 40 70 00 – Instrumentation for Process Systems.

END OF SECTION

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SECTION 40 71 79.13
FLOW SWITCHES (VANE)

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, test, install and place in satisfactory operation all vane operated flow switches, with all spare parts, accessories, and appurtenances as herein specified and as shown on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 40 61 13 – Process Control System General Provisions
- B. Section 40 70 00 – Instrumentation for Process Systems

PART 2 – PRODUCTS

2.01 VANE OPERATED FLOW SWITCHES

- A. Vane operated flow switches shall consist of a paddle or vane, a magnet that moves with the paddle or piston and a reed switch. Motion from the vane shall be passed through a sealed, magnetically coupled mechanism to actuate the switch.
- B. Vane operated flow switches shall have the following specifications:
 - 1. Temperature Limit: 275° F
 - 2. Max. Operating Pressure: 1,000 psig
 - 3. Switch Type: SPDT snap action micro switch
 - 4. Switch Rating: 10 A, 125 VAC; 106 cycle contact life
 - 5. Body Type/Material: Single piece milled, bored brass
 - 6. Enclosure Classification: Class I, Groups C, D
 - 7. Enclosure Classification: Class II, Groups E, F, G
 - 8. Vane Type/Material: Layered, 316 stainless steel
- C. Manufacturer/Model: Model V4-2-U Flotect by W.E. Anderson, or equal.

PART 3 – EXECUTION

3.01 REQUIREMENTS

- A. Refer to Section 40 70 00 – Instrumentation for Process Systems.

END OF SECTION

SECTION 40 73 13
PRESSURE AND DIFFERENTIAL PRESSURE GAUGES

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, test, install and place in satisfactory operation the pressure gauges, with all spare parts, accessories, and appurtenances as herein specified and as shown on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 40 61 13 – Process Control System General Provisions
- B. Section 40 70 00 – Instrumentation for Process Systems
- C. Section 40 79 00 – Miscellaneous Instruments, Valves, and Fittings

PART 2 – PRODUCTS

2.01 PRESSURE GAUGES

- A. All gauges shall be designed in accordance with the ASME B40.1 entitled, "Gauges, Pressure, Indicating Dial Type - Elastic Element".
- B. All gauges shall be direct reading type. Snubbers shall be provided on all gauges. Gauge full-scale pressure range shall be selected such that the maximum operating pressure shall not exceed approximately 75% of the full-scale range.
- C. Features
 - 1. Mounting: ½" NPT, lower stem mount type
 - 2. Accuracy: 0.5% full scale
 - 3. Case: Solid front, black phenolic material
 - 4. Dial: White background and black letters
 - 5. Glass: Shatterproof
 - 6. Blow-out protection: Back
 - 7. Pressure element: stainless steel bourdon tube
 - 8. Movement: Stainless steel, Teflon coated pinion gear and segment

9. Gaskets: Buna-N

- D. Liquid-filled or equivalent mechanically-damped gauges shall be used if the gauges are installed with pumps, or where gauges are subjected to vibrations or pulsation. Filling fluid shall be silicone unless oxidizing agents such as sodium hypochlorite are present, where halocarbon shall be used.
- E. Gauge size shall be 4-1/2".
- F. Diaphragm seals and isolating ring seals shall be furnished in accordance with the requirements specified under Section 40 79 00 – Miscellaneous Instruments, Valves, and Fittings.
- G. The complete gauge assembly and appurtenances shall be fully assembled and tested prior to field mounting. A 1/2" isolation stainless steel ball valve shall be provided for each gauge assembly.
- H. Pressure and vacuum gauges shall be Ashcroft Duragauge Model 1279, Ametek-U.S. Gauge Division, H.O. Trerice Co., WIKA Instrument Corporation, or equal.

PART 3 – EXECUTION

3.01 REQUIREMENTS

- A. Refer to Section 40 70 00 – Instrumentation for Process Systems.

END OF SECTION

SECTION 40 73 36

PRESSURE AND DIFFERENTIAL PRESSURE SWITCHES

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, test, install and place in satisfactory operation the pressure switches, with all spare parts, accessories, and appurtenances as herein specified and as shown on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 40 61 13 – Process Control System General Provisions
- B. Section 40 70 00 – Instrumentation for Process Systems

PART 2 – PRODUCTS

2.01 PRESSURE SWITCHES

- A. Pressure, vacuum, and differential pressure switches shall be single or dual action with an adjustable setpoint for the process requirement and/or as specified herein. Switches shall be diaphragm or piston operated and activate S.P.D.T. snap action switches on increasing or decreasing pressure. Minimum differential shall be less than 10 percent of the range. Deadband shall be adjustable. Allowable surge pressure shall be a minimum 1.5 times the range. Each pressure switch shall have visible scale.
- B. Pressure switches shall have a contact rating of 10 amperes at 120 volts AC. Pressure switches shall be in NEMA 4X enclosures. Switches shall have a repeatable accuracy of 1 percent of range. Pressure switches shall be isolated from the process fluid by a diaphragm seal or an isolation ring in locations as shown on the Contract Drawings and/or as specified. Wetted parts materials shall be compatible with the process fluid for corrosion resistance. Pressure switches shall be manufactured by ASCO, SOR, Inc., Ashcroft, or equal.

PART 3 – EXECUTION

3.01 REQUIREMENTS

- A. Refer to Section 40 70 00 – Instrumentation for Process Systems.

END OF SECTION

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SECTION 40 78 00
PANEL MOUNTED INSTRUMENTS

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, test, install and place in satisfactory operation the panel mounted instruments, with all spare parts, accessories, and appurtenances as specified herein and as shown on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 40 61 13 – Process Control System General Provisions
- B. Section 40 67 00 – Control System Equipment Panels and Racks

1.03 GENERAL INFORMATION AND DESCRIPTION

- A. All equipment mounted on the face of a panel shall conform to the same NEMA rating specified for the panel construction.

1.04 TOOLS, SUPPLIES AND SPARE PARTS

- A. Tools, supplies and spare parts shall be provided as specified in Section 40 61 22 – Tools, Supplies, and Spare Parts, General. In addition, the following specific spare parts items shall be provided:
 - 1. One of each type of panel mounted equipment (i.e., indicators, signal converters, etc.) provided under this Contract.
 - 2. Five of each type of interposing control relay provided under this Contract.

PART 2 – PRODUCTS

2.01 OPERATORS

- A. Control operators shall be 30.5 mm, round, heavy-duty, oil tight NEMA 4X corrosion resistant. For Hazardous areas, control operators shall be rated NEMA 7.
- B. Pushbuttons shall be non-illuminated, spring release type. Pushbuttons shall include a full guard. Panic stop/alarm pushbuttons shall be red mushroom type with manual-pull release. Selector switches shall be non-illuminated, maintained contact type, unless otherwise indicated.

- C. Pilot lights shall be of the proper control voltage, push-to-test LED type with lens and LED lamp colors as specified below.
 - 1. Red: stopped, off, or closed
 - 2. Green: running, on, or opened
 - 3. Amber: fault, alarm, or warning
 - 4. White: generic non-alarm status
 - 5. Blue: control power on
- D. Control operators shall have legend plates as specified herein, indicated on the Drawings, or otherwise directed by the Engineer. Legend plates shall be plastic, black field (background) with white lettering. Engraved nameplates shall be securely fastened above each control operator. If adequate space is not available, the nameplate shall be mounted below the operator.
- E. Control operators for all equipment under this Contract shall be of the same type and manufacturer unless otherwise indicated. Control operators such as pushbuttons (PB), selector switches (SS), and pilot lights (PL) shall be Cutler-Hammer/Westinghouse Type E34, Square D Company Type SK, or equal

2.02 ELECTRONIC INDICATORS

- A. Electronic indicators shall be 3.5 or 6 digit, as appropriate, with 0.56" high red LED display. Indicators shall be provided with nameplate and scale calibrated to match the calibration of the primary element. The unit shall be designed primarily for use with 4-20 mA current loop signal circuits. Indicator operating voltage shall be 115 VAC 10%, 60 Hz. Indicator controls shall include three (3) front-panel pushbuttons for modifying alarm values and other indicator setup. Two (2) form-C relays shall be provided for each indicator. Relay contact outputs shall be rated 5A, 120/240 VAC, resistive load. Where required, a regulated and isolated 24 V excitation power supply shall be provided. Indicators shall be suitable for indoor or outdoor service as required and shall have the same NEMA enclosure rating as the associated enclosure.
- B. Indicators shall be Red Lion Model IMP or APLCL, Precision Digital, or equal.

2.03 RELAYS

- A. Interposing control relays (CR)
 - 1. Where required to interface between motor control centers, equipment controls, and control panels, interposing relays and associated control wiring circuitry shall be furnished and installed to provide the monitoring and/or control functions specified herein.

2. Interposing relays shall be small format type, DPDT, minimum 10 amp, 120 VAC contact rating.
3. Relay coils shall be 120 VAC or 24 VDC as required to interface with equipment.
4. Relays shall have a flag indicator to show relay status, a pushbutton to allow manual operation of the relay, and an internal pilot light to indicate power to the coil.
5. Relays shall be as manufactured by Square D, Potter & Brumfield, Allen-Bradley, or equal.

B. Timing Relays (TR)

1. Timing relays shall be electronic type with 120 VAC coils unless otherwise specified or indicated on the Drawings. Timers shall be provided with a minimum of two SPDT timed output contacts and instantaneous contacts where required. Contact ratings shall be the same as for interposing relays.
2. Timing relays shall be the general purpose plug-in type, Type JCK as manufactured by Square D Company, equivalent by Eaton/Cutler-Hammer, equivalent by Allen-Bradley, or equal.

PART 3 – EXECUTION

3.01 REQUIREMENTS

- A. Refer to Section 40 67 00 – Control System Equipment Panels and Racks, for additional requirements.

END OF SECTION

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SECTION 40 79 00
MISCELLANEOUS INSTRUMENTS, VALVES, AND FITTINGS

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, test, install and place in satisfactory operation, the instrumentation and control system accessories with all spare parts, and appurtenances as herein specified and as shown on the Drawings.
- B. Accessories include various items of equipment that may be required in the system but are not scheduled. Accessories are shown on details, flow sheets or plans. Accessories are also called out in specifications for scheduled instruments and in the installation specifications. It is not intended, however, that each piece of hardware required will be specifically described herein. This Specification shall be used as a guide to qualify requirements for miscellaneous hardware whether the specific item is described or not.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 40 61 13 – Process Control System General Provisions
- B. Section 40 70 00 – Instrumentation for Process Systems

1.03 SUBMITTALS

- A. Per Section 40 61 15 – Process Control System Submittals
- B. Impulse piping layout and routing drawings
- C. Complete instrument assembly drawings showing orientation to installed process piping.

PART 2 – PRODUCTS

2.01 PROCESS TUBING

- A. Process, impulse, or capillary tubing shall be 1/2 x 0.065-inch seamless, annealed, ASTM A-269 Type 316L stainless steel with 37 degrees Type 316 stainless steel flared fittings or Swagelock or Parker-CPI flareless fittings.
- B. Piping for closely coupling instruments to process seals shall be standard stainless steel NPT threaded piping or NPT tapped mounting blocks.
- C. A nickel-based lubricant shall be used on threaded stainless steel piping connections to prevent galling.

2.02 POWER, CONTROL, AND SIGNAL CABLES

- A. Power, control and signal wiring shall be provided under Division 26 of the Specifications, unless otherwise indicated.

2.03 CHEMICAL DIAPHRAGM SEALS

- A. Diaphragm seals shall be provided for isolation of pressure gauges, switches and transmitters attached to systems containing chemical solutions or corrosive fluids. As a minimum, seals shall be of all 316 stainless steel construction. In general, diaphragms shall be 316L stainless steel for operating pressures at or above 15 psi and elastomers for operating pressures below 15 psi. However, all components shall be non-reactive with the process fluid in all cases. Refer to the Process Control System Instrument Lists for specific materials requirements.
- B. Seal shall have fill connection, 1/4-inch NPT valved flush port and capable of disassembly without loss of filler fluid. Where specified, diaphragm seals shall comply with the above requirements and shall be provided with 316 SS factory filled capillaries.
- C. Seals shall be Helicoid Type 100 HA, Mansfield & Green, Ashcroft, or equal.

2.04 FILLING MEDIUM:

- A. The filling medium between instruments, isolating ring seals and diaphragm seals shall be a liquid suitable for operation in an ambient temperature ranging from -10 degrees F to +150 degrees F.
- B. Filling medium shall be silicone unless oxidizing agents, such as sodium hypochlorite, are present, then halocarbon shall be used.

2.05 TAMPER EVIDENT PAINT

- A. Piping and screwed/bolted connections of instrumentation containing the filling medium shall be marked with a small continuous tick mark of tamper evident paint over each piping/instrument joint. Tamper evident paint shall be applied prior to instrument assemblies arriving on the job site. Disturbance of the joint shall break the paint.
- B. Instrument assemblies with broken paint or missing paint shall not be accepted and shall be repaired or replaced at no additional cost to Owner. Paint shall be Dykem Cross-Check or equal.

2.06 ISOLATION VALVES

- A. Isolation valves shall be 1/2 inch diameter ball valves, unless otherwise indicated, with a Type 316 stainless steel body, Type 316 stainless steel ball. Where 316 stainless steel is not compatible with the process fluid, materials of construction shall be suitable for the associated process fluid (e.g., PVC for chemical service).

PART 3 – EXECUTION

3.01 REQUIREMENTS

- A. Refer to Section 40 70 00 – Instrumentation for Process Systems.

END OF SECTION

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SECTION 46 00 00
EQUIPMENT GENERAL PROVISIONS

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, install, test, and place in acceptable operation all mechanical equipment and all accessories as specified herein, as shown on the Drawings, and as required for a complete and operable system.
- B. The mechanical equipment shall be provided complete with all accessories, special tools, spare parts, mountings, shims, sheaves, couplings, and other appurtenances as specified, and as may be required for a complete and operating installation.
- C. The Contractor shall provide the Owner complete and operational equipment/systems. To this end, it is the responsibility of the Contractor to coordinate all interfaces with related mechanical, structural, electrical, instrumentation, and control work and to provide necessary ancillary items such as controls, wiring, etc., to make each piece of equipment operational as shown and specified.
- D. The complete installation shall be free from excessive vibration, cavitation, noise, and oil or water leaks.
- E. The requirements of this section shall apply to equipment furnished under Divisions 40 and 46.

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. All equipment, materials, and installations shall conform to the requirements of the most recent editions with latest revisions, supplements, and amendments of the specifications, codes, and standards listed in Section 01 42 00 – References.

1.03 ACTION/INFORMATIONAL SUBMITTALS

- A. Product Data: Comply with Section 01 33 00 – Submittals Procedures
- B. Shop Drawings shall be submitted to the Engineer for all equipment in accordance with Section 01 33 00 – Submittal Procedures and shall include the following additional information:
 - 1. Equipment name, identification number and specification number.
 - 2. Performance characteristics and descriptive data.
 - 3. Detailed equipment dimensional drawings and setting plans.

4. Drive and motor data as required by Division 26 – Electrical. Where pump and motor speeds are to be regulated by variable speed drives, the CONTRACTOR shall coordinate, furnish and exchange all necessary requirements with the respective equipment manufacturers to ensure compatibility and shall submit pump, motor and variable speed drive shop drawings together as a complete system.
5. Information on bearing types and bearing life.
6. Gear box design and performance criteria and AGMA service factor.
7. Piping schematics.
8. Equipment protective device details and connection diagrams.
9. Panel layout drawings, schematic wiring diagrams, and component product data sheets for control panels.
10. A list of spare parts and special tools to be provided.
11. Any additional information required to demonstrate conformance with the equipment specifications.
12. Warranty documentation including statement of duration of warranty period and contact phone numbers and addresses for warranty issues.
13. Shipment, delivery, handling, and storage instructions.

1.04 CLOSEOUT SUBMITTALS

- A. Submit warranty documentation in compliance with:
 1. Section 01 33 00 – Submittal Procedures
 2. Section 01 61 00 – Product Requirements and Options
- B. Operation and Maintenance (O&M) manuals shall be submitted in accordance with Section 01 33 00 – Submittal Procedures and Section 01 78 23 Operation and Maintenance Data.

1.05 MAINTENANCE MATERIALS SUBMITTALS

- A. Operation and Maintenance (O&M) manuals shall be submitted in accordance with:
 1. Section 01 33 00 – Submittal Procedures
 2. Section 01 78 23 – Operation and Maintenance Data
- B. Comply with Section 01 78 43 – Spare Parts and Extra Materials:

1. For spare parts, extra stock materials, and tools, submit quantity of items specified in associated Specification Section.
 2. Submit complete list of spare parts, extra stock materials, maintenance supplies and special tools required for maintenance for one year with unit prices and source of supply. Indicate number/quantity specified and furnished, manufacturer, part number, description,
- C. Comply with Section 01 79 00 – Instructions to Owner’s Personnel.

1.06 QUALITY ASSURANCE SUBMITTALS

- A. Factory testing plan.
- B. Factory Test Results shall be submitted and approved prior to shipment of equipment.
- C. Field testing plan.
- D. Comply with Section 01 75 00 – Check Out and Start Up Procedures.
- E. Preliminary field test data
- F. Final field test data

1.07 GENERAL INFORMATION AND DESCRIPTION

- A. All parts of the equipment furnished shall, be designed and constructed for the maximum stresses occurring during fabrication, transportation, installation, testing, and all conditions of operation. All materials shall be new and shall conform to all applicable Sections of these Specifications.
- B. All parts of duplicate equipment shall be interchangeable without modification. Manufacturer's design shall accommodate all the requirements of these Specifications.
- C. Equipment and appurtenances shall be designed in conformity with specifications, codes and reference standards.
- D. All bearings and moving parts shall be protected by bushings or other Engineer approved means against wear, and provision shall be made for accessible lubrication by extending lubrication lines and fittings to approximately 30 inches above finished floor elevation.
- E. Details shall be designed for appearance as well as utility. Protruding members, joints, corners, gear covers, etc., shall be finished in appearance. All exposed welds on machinery shall be ground smooth and the corners of structural shapes shall be rounded or chamfered.
- F. Machinery parts shall conform within allowable tolerances to the dimensions shown on the working drawings.

- G. All machinery and equipment shall be safeguarded in accordance with the specifications, codes, and reference standards.
- H. All rotating shafts, couplings, or other moving pieces of equipment shall be provided with protective guards of sheet metal or wire mesh, neatly and rigidly supported. Guards shall be removable as required to provide access for repairs.
- I. All equipment greater than 100 pounds shall have lifting lugs, eyebolts, etc., for ease of lifting, without damage or undue stress exerted on its components.
- J. All manufactured items provided under this Section shall be of current manufacture and shall be the products of manufacturers specializing in the manufacture of such products.

1.08 EQUIPMENT WARRANTIES

- A. Warranty requirements shall be as specified in General Conditions, 4. 4 and General Conditions, Section 4.9. Warranty requirements are supplementary to the individual equipment specifications.

PART 2 – PRODUCTS

2.01 ANCHORS AND SUPPORTS

- A. The Contractor shall furnish, install, and protect all necessary guides, bearing plates, anchor and attachment bolts, and all other appurtenances required for the installation of the devices included in the equipment specified. Working Drawings for installation shall be furnished by the equipment manufacturer, and suitable templates shall be used by the Contractor when required in the detailed equipment Specifications.
- B. Anchor bolts and fasteners shall be furnished in accordance with Section 05 05 23 – Metal Fastening, and with the individual equipment Specifications. All anchor bolts shall be a minimum of 1/2-inch diameter. All anchor bolts, guard bolts, washers, clips, clamps, and fasteners of any type shall be constructed of 316 stainless steel, unless otherwise specified the individual equipment Specifications.
- C. The Contractor shall provide all concrete pads or pedestals required for equipment furnished. All concrete equipment pads shall be a minimum of 6" high, unless otherwise shown on the Drawings and shall be doweled.
- D. Pipe sleeves or other means of adjusting anchor bolts shall be provided where indicated or required. Equipment shall be leveled by first using sitting nuts on the anchor bolts, and then filling the space between the equipment base and concrete pedestal with non-shrink grout, unless alternate methods are recommended by the manufacturer and are acceptable to the Engineer (such as shim leveling pumps, or chemical grout). Non-shrink grout shall be as specified in Section 03 60 00 – Grout.

2.02 DISSIMILAR METALS

- A. All dissimilar metals shall be isolated in accordance with Section 05 10 00 – Metal Materials and to the satisfaction of the Engineer.

2.03 GALVANIZING

- A. Where required by the equipment specifications, galvanizing shall be performed in accordance with Section 05 05 13 – Galvanizing.

2.04 STANDARDIZATION OF GREASE FITTINGS

- A. The grease fittings on all mechanical equipment shall be such that they can be serviced with a single type of grease gun. Fittings shall be “Zerk” type.

2.05 ELECTRICAL REQUIREMENTS

- A. All electrical equipment and appurtenances, including but not limited to motors, panels, conduit, and wiring, etc., specified in the equipment specifications shall comply with the applicable requirements of the Division 26 specifications and the latest National Electric Code. Motor starters and controls shall be furnished and installed under Division 26 and Division 40 unless otherwise specified in the individual pump specifications.
- B. In the individual equipment specifications, specified motor horsepower is intended to be the minimum size motor to be provided. If a larger motor is required to meet the specified operating conditions and performance requirements, the Contractor shall furnish the larger sized motor and shall upgrade the electrical service (conduit, wires, starters, etc.) at no additional cost to the Owner.
- C. Where variable frequency drives (VFDs) are specified, the Contractor shall be responsible for coordinating between equipment supplier and VFD supplier to ensure a complete and operational system. VFDs shall be furnished under Division 26 unless otherwise specified in the equipment specification.
- D. Motor starters and controls shall be furnished and installed under Division 26 and Division 40 unless otherwise specified in the individual equipment specifications.

2.06 ACCESSORIES, SPARE PARTS, AND SPECIAL TOOLS

- A. Accessories, spare parts, and special tools shall be provided in accordance with each appropriate Section herein.

2.07 EQUIPMENT IDENTIFICATION

- A. All mechanical equipment shall be provided with a substantial stainless-steel nameplate, mechanically fastened with stainless steel hardware in a conspicuous place, and clearly inscribed with the manufacturer's name, year of manufacture, serial number, and principal rating data.

- B. Each pump and other piece of mechanical equipment shall also be identified as to name and number by a suitable laminated plastic or stainless-steel nameplate mechanically fastened with stainless steel hardware; for example, "Raw Water Pump #1". Coordinate name and number with same on remotely located controls, control panel, and other related equipment.
- C. Nameplates shall not be painted over.

PART 3 – EXECUTION

3.01 SHOP TESTING

- A. All equipment shall be tested in the shop of the manufacturer in a manner which shall conclusively prove that its characteristics comply fully with the requirements of the Contract Documents and that it will operate in the manner specified or implied.
- B. No equipment shall be shipped to the project until the Engineer has been furnished a certified copy of test results and has notified the Contractor, in writing, that the results of such tests are acceptable.
- C. A certified copy of the manufacturer's actual test data and interpreted results thereof shall be forwarded to the Engineer for review.
- D. If required by the individual equipment Specifications, arrangements shall be made for the Owner/Engineer to witness performance tests in the manufacturer's shop. The Engineer shall be notified ten working days before shop testing commences. Expenses are to be paid by Owner.
- E. Shop testing of electric motors shall conform to:
 - 1. Section 26 05 60 – Low-Voltage Electric Motors
 - 2. Section 26 05 00 – Basic Electrical Requirements.

3.02 SHIPMENT, DELIVERY, HANDLING AND STORAGE

- A. Shipment, delivery, and handling of equipment and materials shall be in accordance with General Conditions, Section 4.7.
- B. Storage of equipment and materials shall be in accordance with General Conditions, Section 16.2 – Ordering and Processing Procedures for Job Orders and General Conditions, Section 16.4 – Construction Services.

3.03 MANUFACTURER'S FIELD SERVICES

- A. Manufacturer's field services shall be in accordance with General Conditions, Section 4.4

- B. The Contractor shall arrange for a qualified factory trained Technical Representative from each manufacturer or supplier of equipment who is regularly involved in the inspection, installation, start-up, troubleshooting, testing, maintenance, and operation of the specified equipment. Qualification of the Technical Representative shall be appropriate to the type of equipment furnished and subject to the approval of the Engineer and the Owner. Where equipment furnished has significant process complexity, furnish the services of engineering personnel knowledgeable in the process involved and the function of the equipment. When necessary, the Contractor shall schedule multiple Technical Representatives to be present at the same time for the purpose of coordinating the operation of multiple pieces of related equipment.
- C. Services of the Technical Representative will require a minimum of two (2) site visits, one for installation and testing and one for startup and training, and will be for the minimum number of days recommended by the manufacturer and approved by the Engineer but will not be less than the number of days specified in individual equipment sections. Additional site visits may be required as described below and in the equipment specifications.
- D. For each site visit, the Technical Representative shall submit jointly to the Owner, the Engineer, and the Contractor a complete signed report of the results of his inspection, operation, adjustments, and testing. The report shall include detailed descriptions of the points inspected, tests and adjustments made, quantitative results obtained if such are specified.
- E. The manufacturer's Technical Representative shall provide the following services.
 - 1. Installation: The Technical Representative shall inspect the installed equipment to verify that installation is in accordance with the manufacturer's requirements. Where required by individual equipment specifications, the Technical Representative shall also supervise the installation of the equipment.
 - 2. Testing: After installation of the equipment has been completed and the equipment is presumably ready for operation, but before it is operated by others, the Technical Representative shall inspect, operate, test, and adjust the equipment as required to prove that the equipment is in proper condition for satisfactory operation under the conditions specified. Unless otherwise noted in the signed site visit report, the report shall constitute a certification that the equipment conforms to the requirements of the Contract and is ready for startup and that nothing in the installation will render the manufacturer's warranty null and void. The report shall include date of final acceptance field test, as well as a listing of all persons present during tests.
 - 3. Startup: The Technical Representative shall start up the equipment for actual service with the help of the Contractor. If equipment or installation problems are experienced, the Contractor and the representative shall provide the necessary services until the equipment is operating satisfactorily and performing according to the specifications at no additional cost to the Owner. Unless otherwise noted in the

signed site visit report, the report shall constitute a certification that the equipment conforms to the requirements of the Contract and is ready for permanent operation and that nothing in the installation will render the manufacturer's warranty null and void.

4. Training: Training shall be provided in accordance with requirements specified in Section 01 79 00 – Instruction of Owner's Personnel.
 5. Services after Startup: Where required by the individual equipment specifications, the Technical Representative shall return to the project site thirty (30) days after the startup date to review the equipment performance, correct any equipment problems, and conduct operation and maintenance classes as required by the Owner. This follow-up trip is required in addition to the specified services of Technical Representative prior to and during equipment startup. At this time, if there are no equipment problems, each manufacturer shall certify to the Owner in writing that his equipment is fully operational and capable of meeting operating requirements. If the equipment is operating incorrectly, the Technical Representative will make no certification to the Owner until the problems are corrected and the equipment demonstrates a successful thirty (30) days operating period.
- F. The Contract amount shall include the cost of furnishing the Technical Representative for the minimum number of days specified, and any additional time required to achieve successful installation and operation. The times specified for services by the Technical Representative in the equipment Specifications are exclusive of travel time to and from the facility and shall not be construed as to relieve the manufacturer of any additional visits to provide sufficient service to place the equipment in satisfactory operation.
- G. The Contractor shall notify the Engineer at least 14 days in advance of each equipment test or Owner training session.
- H. The Technical Representative shall sign in and out at the office of the Engineer's Resident Project Representative on each day the Technical Representative is at the project.

3.04 INSTALLATION

- A. The Contractor shall obtain written installation manuals from the equipment manufacturer prior to installation. Equipment shall be installed strictly in accordance with recommendations of the manufacturer. A copy of all installation instructions shall be furnished the Engineer's field representative one week prior to installation.
- B. The Contractor shall have on hand sufficient personnel, proper construction equipment, and machinery of ample capacity to facilitate the work and to handle all emergencies normally encountered in work of this character. To minimize field erection problems, mechanical units shall be factory-assembled insofar as practical.

- C. Equipment shall be erected in a neat and workmanlike manner on the foundations at the locations and elevations shown on the Drawings.
- D. All equipment sections and loose items shall be match-marked prior to shipping.
- E. For equipment that requires field alignment and connections, the Contractor shall provide the services of the manufacturer's qualified mechanic, millwright, or machinist, to align the equipment and motor prior to making piping connections or anchoring the equipment base. Alignment shall be as specified herein.
- F. The Contractor shall furnish oil and grease for initial operation and testing. The manufacturer and grades of oil and grease shall be in accordance with the recommendations of the equipment manufacturer.

3.05 ALIGNMENT

- A. Set equipment to dimensions shown on drawings. Dimensions shall be accurate to $\pm 1/16$ inch unless otherwise noted on the drawings. Wedges shall not be used for leveling, aligning, or supporting equipment.
- B. General Equipment Leveling: Non-rotating equipment shall be set level to $\pm 1/16$ inch per 10-foot length (.005 inch per foot) unless otherwise noted on the drawings. Shims shall be used unless equipment is furnished with leveling feet. Set shims flush with equipment baseplate edges. When grouting is required, equipment shall be shimmed to allow a minimum of one-inch grout thickness. Grout shall cover shims at least 3 inches. Final level check shall be held for inspection and approval by Engineer before proceeding.
- C. Grouting
 - 1. Fill anchor bolt holes or sleeves with grout, after bolt alignment is proven, and prior to placing grout under equipment bases.
 - 2. Surface Preparation. Roughen surface by chipping, removing laitance, and unsound concrete. Clean area of all foreign material such as oil, grease, and scale. Saturate area with water at least 4 hours prior to grouting, removing excess water ponds.
 - 3. Application. Place grout after the equipment base has been set and its alignment and level have been approved. Form around the base, mix grout, and place in accordance with the grout manufacturers published instructions. Eliminate all air or water pockets beneath the base using a drag chain or rope.
 - 4. Finishing. Point the edges of the grout to form a smooth 45-degree slope.
 - 5. After grout has cured (not before 3 days after placement) paint exposed surfaces of grout with shellac.

6. Level Verification. After grout has cured, and immediately prior to drive alignment, recheck equipment for level and plumb. Re-level and square as necessary. Hold final checks for inspection and approval by Engineer.
- D. Inspect for and remove all machining burrs or thread pulls in female holes on mating surfaces of mounting frame and machine feet.
- E. Inspect and clean equipment mounting base pads, feet, and frames to remove all grease, rust, paint, and dirt.
- F. Assembled equipment shafts shall be set level to .0015 inches per foot of shaft length (+/- .0005 inches) up to a maximum of 0.015 inches for any length shaft unless the manufacturers requirements are more stringent or unless otherwise noted in the equipment specifications. Use the machined surfaces on which the equipment sets for the base/mounting frame leveling plane. Use the machined shaft surface for equipment leveling plane.
- G. Sprocket and Sheave Alignment. Check shaft mounted components for face runout and eccentricity (outside diameter) runout by magnetically mounting a dial indicator on a stationary base and indicating over 360 degrees on a continuous machined surface at the outside diameter of the component. Maximum allowable total indicated face runout and eccentricity for sprockets and sheaves will be per ANSI Standard B29.1-1975.
- H. Belt tensioning. Set drive belt tension to manufacturer's specification for the belt type. Recheck alignment after drive tensioning.
- I. Thermal/Mechanical Growth. Thermal/mechanical growth corrections for driver and driven machines will be used in vertical and horizontal alignment where applicable. The equipment manufacturer will determine thermal/mechanical growth applicability for any machine and provide the correction offsets to be used.
- J. Rotating Shaft Alignment
 1. Fixtures will be set up on the driver and driven machine, machines shaft surfaces. Machined coupling hubs may be used only if there is no clearance to mount fixtures directly on the shafts.
 2. Primary alignment method for direct drive machines is when coupled. Uncoupled alignment will be used only when approved by the Engineer.
 3. Account for possible coupling flex by always rotating coupled machines in the same direction during alignment.
 4. Uncoupled machines must be connected so that both shafts turn together without relative motion during alignment.
 5. Indicator bar sag will be measured and included for each reverse indicator alignment setup.

6. Reverse Dial Indicator. The final maximum allowable misalignment: vertical and horizontal from the desired targets of .000 inches (for a non-thermal growth machine) or from the given target readings (for a thermal growth machine) must meet BOTH of the following conditions simultaneously: 1/2 the final total indicator reading at each indicator will be no more than shown in the table below AND the final remaining correction at each machine foot be no more than .001 inches of required movement.

Machine Speed (RPM)	Total Misalignment* (inches)
Up to 1800	.002
1800 and greater	.001

* 1/2 indicator reading

3.06 FIELD TESTING

- A. Field testing shall be in accordance with General Conditions, Section 4.4.
- B. All equipment shall be set, aligned, and assembled in conformance with the manufacturer's drawings and instructions. Provide all necessary calibrated instruments to execute performance tests. Submit report certified by the pump manufacturer's representative.
- C. Preliminary Field Tests, Yellow Tag
1. As soon as conditions permit, after the equipment has been secured in its permanent position, the Contractor shall:
 - a. Verify that the equipment is free from defects.
 - b. Check for alignment as specified herein.
 - c. Check for direction of rotation.
 - d. Check motor for no load current draw.
 2. Contractor shall flush all bearings, gear housings, etc., in accordance with the manufacturer's recommendations, to remove any foreign matter accumulated during shipment, storage or erection. Lubricants shall be added as required by the manufacturer's instructions.
 3. When the Contractor has demonstrated to the Engineer that the equipment is ready for operation, a yellow tag will be issued. The tag will be signed by the Engineer, or his assigned representative and attached to the equipment. The tag shall not be removed.

4. Preliminary field tests, yellow tag, must be completed before equipment is subjected to final field tests, blue tag.

D. Final Field Tests, Blue Tag

1. Upon completion of the above, and at a time approved by the Engineer, the equipment will be tested by operating it as a unit with all related piping, ducting, electrical and controls, and other ancillary facilities.
2. The equipment will be placed in continuous operation as prescribed or required and witnessed by the Engineer or his assigned representative and the Owner or his assigned representative.
3. The tests shall prove that the equipment and appurtenances are properly installed, meet their operating cycles and are free from defects such as overheating, overloading, and undue vibration and noise. Operating field tests shall consist of the following:
 - a. Check equipment for excessive vibration and noise as specified herein.
 - b. Check motor current draw under load conditions. The rated motor nameplate current shall not be exceeded.
 - c. Recheck alignment with dial indicators where applicable, after unit has run under load for a minimum of 24 hours.

E. Additional field testing recommended by the manufacturer shall be performed at no cost to Owner.

F. Until final field tests are acceptable to the Engineer, the Contractor shall make all necessary changes, readjustments, and replacements at no additional cost to the Owner.

G. Upon acceptance of the field tests, a blue tag will be issued. The tag will be signed by the Engineer and attached to the unit. The tag shall not be removed, and no further construction work will be performed on the unit, except as required during start-up operations and directed by the Engineer.

H. Defects which cannot be corrected by installation adjustments will be sufficient grounds for rejection of any equipment.

I. All costs in connection with field testing of equipment such as lubricants, temporary instruments, labor, equipment, etc., shall be borne by the Contractor. Power, fuel, chemicals, water, etc. normally consumed by specific equipment shall be supplied by the Owner unless otherwise specified in the individual equipment specifications.

J. The Contractor shall be fully responsible for the proper operation of equipment during tests and instruction periods and shall neither have nor make any claim for damage

which may occur to equipment prior to the time when the Owner formally takes over the operation thereof.

- K. Field testing of electric motors shall be in accordance with Section 26 05 60 – Low-Voltage Electric Motors and Section 26 05 00, Basic Electrical Requirements.

3.07 FAILURE OF EQUIPMENT TO PERFORM

- A. Any defects in the equipment, or failure to meet the guarantees or performance requirements of the Specifications shall be promptly corrected by the Contractor by replacements or otherwise.
- B. If the Contractor fails to make these corrections, or if the improved equipment shall fail again to meet the guarantees or specified requirements, the Owner, notwithstanding his having made partial payment for work and materials which have entered into the manufacture of said equipment, may reject said equipment and order the Contractor to remove it from the premises at the Contractor's expense.
- C. The Contractor shall then obtain specified equipment to meet the contract requirements or upon mutual agreement with the Owner, adjust the contract price to reflect not supplying the specific equipment item.
- D. In case the Owner rejects said equipment, then the Contractor hereby agrees to repay to the Owner all sums of money paid to him for said rejected equipment on progress certificates or otherwise on account of the lump sum prices herein specified.
- E. Upon receipt of said sums of money, the Owner will execute and deliver to the Contractor a bill of sale of all his rights, title, and interest in and to said rejected equipment; provided, however, that said equipment shall not be removed from the premises until the Owner obtains from other sources other equipment to take the place of that rejected.
- F. Said bill of sale shall not abrogate Owner's right to recover damages for delays, losses, or other conditions arising out of the basic contract.

3.08 PAINTING

- A. All surface preparation, shop painting, field repairs, finish painting, and other pertinent detailed painting specifications shall conform to applicable paragraphs of Section 09 90 00 – Painting.
- B. All shop coatings shall be compatible with proposed field coatings.
- C. All inaccessible surfaces of the equipment, which normally require painting, shall be finished painted by the manufacturer. The equipment and motor shall be painted with a high-quality epoxy polyamide semi-gloss coating specifically resistant to chemical, solvent, moisture, and acid environmental conditions, unless otherwise specified.

- D. Gears, bearing surfaces, and other unpainted surfaces shall be protected prior to shipment by a heavy covering of rust-preventive compound sprayed or hand applied which shall be maintained until the equipment is placed in operation. This coating shall be easily removable by a solvent.

3.09 WELDING

- A. The Equipment Manufacturer's shop welding procedures, welders, and welding operators shall be qualified and certified in accordance with the requirement of AWS D1.1 "Structural Welding Code - Steel" or AWS D1.2 "Structural Welding Code - Aluminum" of the American Welding Society, as applicable.
- B. The Contractor's welding procedures, welders, and welding operators shall be qualified and certified in accordance with the requirements of AWS D1.1 "Structural Welding Code - Steel" or AWS D1.2 "Structural Welding Code - Aluminum" of the American Welding Society, as applicable.
- C. The Contractor shall perform all field welding in conformance with the information shown on the Equipment Manufacturer's drawings regarding location, type, size, and length of all welds in accordance with "Standard Welding Symbols" AWS A2.0 of the American Welding Society, and special conditions, as shown by notes and details.

END OF SECTION

VASECTION 46 33 44
PERISTALTIC TUBE METERING PUMPS

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, install, adjust, and place in satisfactory operation positive displacement peristaltic tube-type pumps for chemical metering as specified herein and as shown on the Drawings. All pumps shall be supplied by the same manufacturer. The manufacturer shall have sole responsibility for the satisfactory manufacture and performance of the system.
- B. The complete installation shall be free from excessive vibration, cavitation, noise, and oil or water leaks.
- C. Each metering pump shall include pump head, motor, self-contained variable speed drive, flexible tube, and all accessories and appurtenances as specified herein and as indicated on the Drawings.
- D. Equipment shall be provided in accordance with the requirements of Section 46 00 00 – Equipment General Provisions.

1.02 OPERATING CONDITIONS AND PERFORMANCE REQUIREMENTS

- A. Pumps and pump components shall be suitable for use in the chemical service specified herein. The equipment manufacturer is responsible for the coordination and selection of corrosion resistant materials for the chemical solutions specified herein and shall guarantee the suitability of the materials used in manufacturing the equipment.
- B. Chemical Properties

	Liquid Emulsified Polymer
Concentration	0.3%
Specific Gravity	1.1
Viscosity	5.4 cPs
Freezing Point	32 °F
pH	7 - 9

- C. Pump Performance Requirements
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	Liquid Emulsified Polymer
No. of Units	1
Tag Numbers	PWTP-PLY- PMP-3505
Application Point	Filter Influent
Total Pumped Flow Range	0.5 – 41.2 gph
Maximum Pump Speed	125 rpm
Required Discharge Pressure	16.1 psig
Suction and Discharge Connections	½" Threaded
Tubing Material	Norprene
Minimum Acceptable Tube Life	66 days at 40 gph
Motor HP	½ HP
Power	115VAC, 60 Hz, 1 Phase

1.03 SUBMITTALS

- A. The following items shall be submitted with the Shop Drawings in accordance with, or in addition to the submittal requirements specified in Section 01 33 00 – Submittal Procedures and Section 46 00 00 – Equipment General Provisions:
1. A pump characteristic performance curve showing flow rate as a function of RPM and pressure
 2. Details on materials of construction of all components including applicable ASTM designations
 3. Chemical resistance data for all wetted parts of pumps and accessories
 4. The total uncrated weight of the equipment plus the approximate weight of shipped materials. Support locations and loads that will be transmitted to bases and foundations. Exact size, placement, and embedment requirements of all anchor bolts.
 5. Dimensional drawings
 6. Control panel wiring diagrams
 7. Motor data sheet indicating motor horsepower; enclosure type; voltage; insulation class; temperature rise and results of dielectric tests; service-rating; rotative speed; motor speed-torque relationship; efficiency and power factor at ½, ¾, and full load; running, full load, and locked rotor current values; and safe running time-current curves

8. Equipment and motor protective device details. Connection diagrams for motor and all protective devices.
 9. Complete wiring diagrams
 10. Complete control descriptions for pump operation
 11. Complete erection, installation, and adjustment instructions and recommendations
 12. Warranty documentation including statement of duration of warranty period and contact phone numbers and addresses for warranty issues
 13. Complete lubricant schedule, including manufacturers of recommended lubricant and a cross reference table of alternative lubricant manufacturers and brand names for each lubricant recommended. Schedule shall include frequency of lubricant application, type of lubricant, and comments / remarks regarding lubricant application.
 14. Tube design information (chemical resistance, life cycle, wall thickness, pressure rating, etc.) and recommended tube replacement schedule
- B. Shop drawings shall include all pumps and accessories and shall be submitted as a complete system. Partial submittals will be unacceptable.

1.04 WARRANTY

- A. Warranty and Guarantee shall be as specified in Section 46 00 00 – Equipment General Provisions with the exception that the warranty period shall be for two (2) years.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. The Manufacturer shall be a company specializing in manufacture, assembly, and field performance of positive displacement peristaltic pumps. Manufacturer of pumps must have at least 20 operating installations in domestic water or wastewater treatment plants located in the United States over a period of at least seven years pumping the same fluid as specified.
- B. Tube-type metering pumps shall be ProSeries M, Models M3 or M4, as manufactured by Blue-White Industries.

2.02 GENERAL

- A. The pump supplier is responsible for the coordination of corrosion-resistant materials for the chemical solutions specified. The manufacturer shall include all features as necessary

for satisfactory operation of the pumping systems for chemical solutions specified. All pumps shall be capable of handling the designated process fluids in their full commercial strengths. Pumps, motors and accessories shall be non-metallic or shall be coated with a heavy-duty protective epoxy coating resistant to the specified chemical to prevent corrosion.

2.03 PERISTALTIC TUBE-TYPE METERING PUMPS

A. Materials and Equipment

1. The metering pumps shall be motor-operated chemical metering pumps of the positive displacement, peristaltic tube type. Pumps shall be furnished complete with roller assembly, direct coupled motor, DC motor controller, integral tube failure detection system, tube life roller revolution counter with alarm setpoint, and flexible tubing with connection fittings as specified herein. Peristaltic pumping action shall be created by compression of the hose between the pump head rollers and track creating a vacuum that draws fluid in and subsequently displaces the fluid forward. Flow shall be in the direction of the rotor rotation, which can be reversed and shall be proportional to rotor speed. The pumps shall be self-priming to 95% vacuum and shall be capable of indefinite operation without pumped fluid without damage to pump or hose. Metering accuracy shall be $\pm 1\%$. Pumps shall be capable of suction lift of 30 feet of water. Drive and pump heads shall be 24-hour continuous duty rated.

B. Pump Head

2. Pump head consisting of an enclosed housing with bolted clear polycarbonate cover and roller compressor mechanism designed for operation with tube shall be provided. Alternately, cartridge-style pump head shall be provided, allowing pump head to be serviceable as a single replaceable component.
3. Pump head and tubing compression surface shall be corrosion-resistant, impact-resistant thermoplastic.
4. Suction and discharge connections shall be 180 degrees apart with bottom suction and top discharge.
5. Rotor shall be glass-filled Nylon.
6. Roller shaft shall be 316 stainless steel.
7. Two polymeric rollers with encapsulated ball bearings shall be provided for compression of the hose against the housing, and two guide rollers shall be provided. One roller shall at all times be fully engaged with hose, providing complete compression to prevent back flow or siphoning. Spring-loaded or hinged rollers shall not be used. Roller diameters and occlusion gap shall be factory set to provide the optimum tubing compression.

8. Rotor and housing shall be bolted directly to the output flange of the gearmotor, which serves to support the rotor and center the rotor assembly within the pump housing. Pump to gearbox connection shall be close coupled and self-aligning requiring no flexible couplings.
9. An integral tube failure detection system shall be provided to shut the pump down immediately upon leak detection.
10. Pump output capacity shall be adjustable over a minimum 1000:1 turndown when using a variable speed motor for pump speed adjustment.

C. Tube and Connections

11. Tube shall be designed specifically for use with peristaltic pumps, with working pressures as specified above. Tube shall be constructed from materials completely compatible with the specified chemicals. Tube life shall be a minimum of 2 months, assuming continuous service at specified feed rate and pressure.
12. Pump tube shall be assembled to polypropylene connection fittings which shall connect to reinforced transparent PVC interface hose. Polypropylene compression by NPT adaptors shall connect interface hose to the process line.

D. Electrical and Control Requirements

13. Motors shall comply with Section 26 05 60, Low Voltage Electric Motors and shall be as specified below.
14. Drive system shall be factory installed and totally enclosed in a NEMA 4X, wash-down enclosure. Drive system shall be capable of operating on any input power from 110 VAC to 240 VAC, 60 Hz, single phase supply.
15. Motor shall be reversible, brushless DC gear motor rated for continuous duty. Motor shall include overload protection. Maximum pump rpm shall be 125.
16. Enclosure shall be NEMA 4X constructed out of corrosion and impact resistant engineered plastic. A wiring compartment shall be provided for connection of input/output signal wires and alarm output loads to un-pluggable type terminal block connectors.
17. Local Control Interface
 - a. Display: Backlit graphical TFT Display capable of up to 8 lines of text with up to 26 characters per line to display pump tag number, flow rate, and programming instructions. Display shall also provide visual indication of running status via screen color: Blue = Running, White = Stopped and Red = Warning.

- b. Keypad: Keypad for start, stop, speed increment, speed decrement, rapid prime, and programming.
- c. Flow units: Programmable in either ml/min or gallons/hour.
- d. Security: Programmable keypad lock and PIN security for optional lockout of all keys except emergency start/stop.
- e. Auto Restart: Feature to resume pump status in the event of power outage interruption.
- f. Fluid level monitor: Programmable flow totalization to advise operator when supply tank is low.

18. Remote Control

- a. Running: Digital output
- b. Fault: Digital output
- c. Start/Stop: Digital input
- d. In Remote: Digital output
- e. Speed: Analog 4-20mA speed output
- f. Speed Control Input: Analog 4-20mA speed input

2.04 PUMP ACCESSORIES

- A. The metering pump supplier shall furnish accessory equipment as specified herein and as shown on the Drawings including but not limited to the following:
 - 1. Pressure gauges shall be provided on the discharge of metering pumps in the quantities and locations as shown on the Drawings. Gauges shall be as specified in Section 40 73 13 – Pressure and Differential Pressure Gauges. Each gauge shall have a range of zero to 100 psi. Each gauge shall be provided with a diaphragm seal as specified in Section 40 79 00 – Miscellaneous Instruments, Valves, and Fittings, constructed of materials which are completely resistant to corrosion by the chemicals referred to in this Section. Each pressure gauge shall also be provided with an isolation valve. Isolation valves shall be PVC with seals that are resistant to the chemical applications.
 - 2. Pressure switches shall be supplied by the pump manufacturer in the quantities and locations as shown in the Drawings. Pressure switch shall be as specified in Section 40 73 36 – Pressure and Differential Pressure Switches. The pressure switch shall be calibrated according to Section 40 61 91 – Process Control System Instrument List.

- B. Piping on the suction and discharge of each metering pump shall be as specified in the Piping System Schedule in Section 40 06 20 – Process Pipe, Valve, and Gate Schedules. Materials of construction shall be completely compatible with the specified chemical. Contractor shall provide transition fittings for metal pipe connected to PVC accessories or for PVC pipe connected to metal accessories.

2.05 TOOLS, SUPPLIES AND SPARE PARTS

- A. The equipment manufacturer shall furnish all special tools necessary to disassemble, service, repair and adjust the equipment.
- B. The manufacturer shall furnish the following:
1. Two (2) spare tube assemblies or cartridge assemblies for each pump
 2. One (1) spare pump head assembly for each model pump

2.06 EQUIPMENT IDENTIFICATION

- A. The equipment shall be provided with a substantial stainless steel nameplate, securely fastened in a conspicuous place, and clearly inscribed with the manufacturer's name, year of manufacture, serial number, and principal rating data.

PART 3 – EXECUTION

3.01 MANUFACTURER’S FIELD SERVICES

The services of a qualified manufacturer's technical representative shall be provided in accordance with Section 46 00 00 – Equipment General Provisions. For each series of pumps, field services shall include the following site visits:

Service	Number of Trips	Number of Days/Trip
Installation and Testing	1	1
Startup and Training	1	1
Services after Startup	1	1

3.02 INSTALLATION

- A. The Contractor shall furnish and install the metering pumps and all associated equipment and accessories as required and specified herein in accordance with manufacturer's instructions and in accordance with Section 46 00 00 - Equipment General Provisions. The Contractor shall install the pumps on FRP equipment tables as indicated on the Drawings. FRP equipment tables shall be built to the required elevation, dimensions, level, and finish.

- B. All metallic fasteners, brackets, mounting hardware, and accessories located in the storage and feed areas shall be constructed of materials completely resistant to the specified chemicals.
- C. Contractor shall supply hose barb-to-process line adapters for connection of pump tubing to process lines. Hose barbs shall be secured to the pump tubing via a hose clamp tightened around the OD of the tubing. Barb material shall be completely resistant to corrosion by the specified chemicals. Contractor shall submit materials of construction of barbs and hose clamps. Contractor shall submit Drawings to Engineers for approval prior to execution.
- D. The Contractor shall be fully informed and shall be responsible to ensure that all Contractor's employees, agents, and/or subcontractors are fully informed as to the hazards and proper procedures associated with working with and around the specified chemicals.

3.03 TESTING, CLEANING, AND START-UP

- A. Testing shall be in accordance with Section 46 00 00 – Equipment General Provisions.
- B. All pumps shall be shop tested for capacity at rated pressure prior to shipment, with documented results provided.
- C. After installation of piping and accessories but before connection of piping to the storage tank and pumps, the Contractor shall completely flush the system to clean and remove all foreign matter from the piping system.
- D. After chemical storage tanks are hydrostatically tested and the tanks and piping system are cleaned, complete system hydrostatic tests and operational tests shall be completed with potable water. The functioning of all pump accessories, valves, and feed points shall be checked, and all malfunctioning or unsatisfactory components shall be repaired or replaced.
- E. After all pumps have been completely installed, conduct in the presence of the Engineer tests to indicate that each item of equipment conforms to this Section. The manufacturer's representative shall oversee field testing:
 - 1. Functional Test: Check for proper alignment, rotation, excessive or unusual noises, overheating, lubrication, and satisfactory performance, demonstrating the pumps' ability to deliver the rated capacity and operating pressure. Testing of the pumps will be at 0.5%, 2%, 4%, 50% and 100% of rated speeds. The functioning of all system components including pump accessories shall be checked.
 - 2. Vibration test: Check and verify that each operating pump does not have excessive vibration or movement during operation over the specified speed range.

3. If the performance of any item of equipment does not meet the specified requirements, take corrective measures or remove the unit and replace with one which satisfies the conditions specified.

END OF SECTION

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SECTION 46 61 16
GAC FILTER MEDIA

PART 1 – GENERAL

1.01 WORK INCLUDED

- A. This specification covers virgin Granular Activated Carbon (GAC) for use as filter media in a drinking water application. Contractor shall be responsible for coordination of all interfaces with Media supplier to achieve the required operation.
- B. Contractor furnish, install, test, and place into satisfactory operation granular activated carbon (GAC) filter media in Filters 9, 10, 11, and 12 at the Pecos Surface Water Treatment Plant, as specified herein.

1.02 RELATED SECTIONS

- A. Section 46 61 17 – Filter Media Sand

1.03 REFERENCES

- A. American Water Works Association (AWWA)
 - 1. AWWA Standard B100-16 – Granular Filter Material
 - 2. AWWA Standard B604 -18 – Granular Activated Carbon
 - 3. AWWA Standard C653 – Disinfection of Water Treatment Plants
- B. National Sanitation Foundation (NSF)
 - 1. NSF 61 – Drinking Water System Components – Health Effects
- C. American Society for Testing and Materials (ASTM)
 - 1. ASTM E11 – Specifications For Wire Cloth and Sieves For Testing Purposes
 - 2. ASTM D2862-97 – Standard Test Method for Particle Size Distribution of Granular Activated Carbon

1.04 SYSTEM DESCRIPTION

- A. Each of the four filters consists of a bed having two cells and plan dimensions of 14 feet by 27 feet per cell. The filter media shall consist of 72 inches of 8 x 20 mesh GAC filter media installed on top of 12 inches of sand media as specified in 46 61 17 Filter Sand Media.

1.05 DESIGN REQUIREMENTS

- A. The design requirements in this specification are to be used as a supplement to the Service Contract for the Supply, Placement, Removal and Thermal Reactivation of Granular Activated Carbon (Service Contract). Requirements of this specification supersedes requirements of Service Contract if there is conflict or duplication between the documents.
- B. Filter media shall conform to the design criteria listed in Section 2.03.

The depths shows are after installation, backwashing, and any scraping to remove fines. Excess media shall be installed to allow for scraping and for voidage changes.

1.06 SUBMITTALS

- A. The contractor shall obtain from the media manufacturer and submit the following:
 - 1. Working Drawings.
 - 2. Operation and Maintenance Manuals, electronic version.
 - 3. Lists of Spare Parts, Special Tools and Supplies.
 - 4. Reports of Certified Shop Tests.
 - 5. Reports of Field Tests.
 - 6. Reports of Manufacturer's Representative Site Visits.
 - 7. Valid ISO 9001: 2000 certification for the plant of manufacture for the GAC.
 - 8. Samples. Submit to Engineer two 1-pound samples representative of the media to be supplied.
- B. Working drawings shall include, but not be limited to, the following:
 - 1. Filter media specifications and data sheets, with identification of all materials used and methods of fabrication. Media sizes will be shown in millimeters.
 - 2. Complete installation drawings with clearly marked dimensions and approaches for staging, storage, etc.
 - 3. Manufacturer's delivery, storage, and handling requirements.
 - 4. Manufacturer's installation instructions and recommendations.
 - 5. Expansion curves for the filter media, showing backwash rate versus percent bed expansion for temperatures between 1°C and 40°C in 10°C increments, minimum.

6. Certification of compatibility of the filter media with the existing filter underdrain system, Leopold Type S with IMS Cap, when operating in either adsorption or biological mode.
 7. Certified test reports for acid solubility, friability and sieve analysis and samples of the filter media tested as specified in AWWA B100-16 and AWWA B604-18.
 8. Evidence of manufacturer experience and of the successful operation in other facilities of media similar to that proposed for this project, as specified herein.
 9. Affidavit of Compliance of GAC filter media as defined AWWA B604-18 and in NSF Standard No. 61.
- C. Reports of certified shop tests shall be submitted as specified herein. No filter media shall be shipped from its place of manufacture before the certified shop test reports have been approved by the Engineer. Prior notification of shop tests for media shall be submitted for approval and shall include, but not be limited to, a description of the proposed testing facilities and procedures.
- D. Reports of field tests shall be submitted as specified herein.
- E. Reports of manufacturer's representative Site visits shall be submitted as specified herein.
- F. GAC filter media samples shall be submitted, as specified herein.
- G. Other applicable submittals, as required elsewhere in the Contract Documents.
- H. Manufacturer's Certificate of Proper Installation.

1.07 QUALITY ASSURANCE AND QUALIFICATIONS

- A. Manufacturer/Supplier's Qualifications.
1. Only named manufacturers will be accepted.
 2. All filter media provided under this Specification shall be the product of a single manufacturer/supplier.
 3. The filter media manufacturer/supplier shall supervise the transportation, handling, on-site storage, and placement of the filter media. The filter media manufacturer/supplier shall also supervise the field preparation of the media for sampling, including backwashing the media prior to sampling.
 4. An Affidavit of Compliance shall be furnished certifying that the media is shipped in containers free from harmful contaminants as defined in NSF Standard No. 61.

5. Each package and container shall have legibly marked on it the name of the material, the gradation, filling date, the net weight of the contents, the name of the manufacturer/supplier, the lot number, and the brand name (if any). These markings shall be ineffaceably stenciled on the bag.
6. Bag or semi-bulk truck of media shipment will be accepted. Placement in the filters shall be accomplished using hydraulic slurry transfer only. Dry media placement will not be accepted.
7. The Contractor shall provide the services of an independent testing laboratory to perform the field tests specified herein below. The laboratory shall be experienced in the type of testing to be performed, and the suitability of the laboratory to provide these services shall be approved by the Engineer prior to testing.

1.08 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

- A. The Contractor shall supply, on wrapped pallets, 50 cubic feet of spare GAC filter media. The media shall be supplied in labeled bags on pallets and delivered to the Owner prior to Substantial Completion. The bags shall not exceed 80 lb. in weight and shall be manufactured from a strong, UV-resistant, waterproof and contamination-free woven fabric. Sisal, paper or unreinforced polyethylene bag materials will not be accepted. This spare media shall not be used for making good any losses of media during the installation, field testing, start up or warranty periods.
- B. The Contractor shall provide such special tools and appliances as may be needed to test, place or replace the filter media (such as rakes or screens) furnished under this specification.

1.09 SHOP TESTS

- A. Certified shop tests shall be performed by an independent lab for all filter media provided under this specification.
- B. Shop tests shall confirm, via samples taken from the point of distribution, that the filter media proposed for supply under this Specification conforms to the design requirements in Article 1.05 herein, and to the product specification requirements in Article 2.03 herein.

1.10 WARRANTY

- A. Carbon shall conform to the specifications herein for a period of one year after final completion.

PART 2 – PRODUCTS

2.01 MANUFACTURERS/SUPPLIERS

- A. The filter media shall be as purchased by Calgon Carbon Corporation. No other suppliers will be accepted.

2.02 GENERAL

- A. All filters shall be provided with GAC filter media as specified. No support gravel shall be provided for the media. The media shall be compatible with Leopold Type S filter underdrain with IMS Cap when operating either in adsorption or biological mode

2.03 GRANULAR ACTIVATED CARBON

- A. GAC Product Specifications.

Iodine Number	900 mg/g (min)
Real Density	2.1 g/cc
Typical Apparent Density	0.56 g/cc
Typical Backwashed and Drained	0.46 to 0.65 g/cc
Particle Density, Wetted in Water	1.3 to 1.4 g/cc
Pore Volume	0.75 to 0.85 cc/g
Moisture, wt %	2 % (Max)
Effective Size	1.05 – 1.15 mm
Uniformity Coefficient	<1.5
Abrasion No. (ROTAP	80 (min)
Surface Area	900 sq m/g (min)
Water Soluble Ash Content	0.5% (max)
Total Ash Content	9% (max)
Mesh Size	US Sieve Series 8 x 20
Screen Size (US Sieve), wt%	
On 8 mesh (2.36 mm)	5% (max)

Through 20 mesh (0.85 mm) 4% (max)

B. GAC Product Qualifications

1. The GAC shall be clean, hard, durable particles in conformance with AWWA B604-16.
2. The GAC shall be ANSI/NSF Standard 61 certified virgin quality.
3. The GAC shall be manufactured in the United States of America.
4. GAC shall be a re-agglomerated bituminous coal-based product with petroleum or coal-based pitch binders sized to a granular form prior to baking and activation. Lignite based GAC, peat, wood, coconut, recycled, used GAC media or broken pellets will not be accepted. Direct activated GAC will not be accepted.
5. GAC shall be thermally activated by steam under rigidly controlled conditions.
6. The GAC must possess superior hardness and abrasion characteristics to withstand repeated backwashes, transfers, and handling without significant change in physical size or loss of GAC volume.
7. The GAC shall contain no soluble inorganic or organic substances in quantities capable of producing deleterious or injurious effects upon the health of those consuming the water or that would otherwise render the water treated by the GAC unfit for public use. The GAC shall not impart to the water any contaminant that exceeds the maximum limits as defined by the Safe Drinking Water Act Public Law 93-523 or any of its amendments, or NSF 61 standards.

C. GAC Media Testing

1. Sampling shall be performed by the Media Supplier. Sampling shall be in accordance with the latest revision of AWWA B100 and AWWA B604, and results shall be submitted to the Engineer for approval prior to shipment. Test results shall include a statement certifying that the material for shipment is equal in quality to the sample submitted. Analyses shall be performed to document and confirm gradation, effective size, uniformity coefficient, iodine number, ash content, abrasion number, and apparent density. No plus tolerance shall be allowed on uniformity coefficients. The materials testing cost shall be borne by the Contractor.
2. Samples after arrival to site. Each of the semi-bulk truckloads of media delivered to site shall be sampled. For media in semi-bulk trucks, a composite sample will be obtained by taking a vertical cross section sample at each access hatch to result in at least 10 pound gross sample of each. For media in supersacks, a composite sample will be taken of 16 supersacks by taking a vertical cross section sample in

each of the bags to results in at least 10 pound gross sample of each. The gross sample, weighing at least 10 pounds, shall be mixed thoroughly and divided to provide three 1 pound samples, one sample shall be sent to the lab for initial testing. All samples shall be sealed in airtight, moisture proof glass containers and delivered as described above. Each sample container shall be labeled to identify it, and the label shall be signed by the sampler. Analyses shall be performed to confirm gradation, effective size, uniformity coefficient, iodine number, ash content, abrasion number, and apparent density. The materials testing cost shall be born by the Contractor.

3. If the GAC does not meet the requirements of this specification or of AWWA B100 and AWWA B604, a notice of nonconformance will be provided to the Contractor within five days after receipt of results from the independent lab. The results of the test shall prevail unless the Contractor requests a re-test to the Owner within five (5) working days of the notice. Upon receipt of the request for a retest, the Owner shall forward to the Contractor one of the duplicate sealed samples taken. The Contractor must notify the Owner within 12 days after receipt of the duplicate sealed sample if Contractor retesting reveals that the material complies with specifications. In the event that the retest indicates compliance of the media with the specifications and AWWA B604, then the other sealed sample shall be forwarded, unopened, to a neutral laboratory agreed upon by both parties for analysis. The results of the neutral laboratory analysis shall be accepted as final. The cost of the neutral laboratory analysis shall be paid by the Contractor if the neutral laboratory analysis shows that the material does not meet this standard and by the Owner if it does meet this standard.

- D. If the material does not meet the requirements specified in this standard AWWA B100 and AWWA B604, the Contractor shall remove it from the plant site when so ordered by the Owner.

PART 3 – EXECUTION

3.01 COORDINATION WITH PLANT OPERATIONS

- A. Contractor shall coordinate all activities with plant operations. Drinking water supply shall not be interrupted. Plant operations and maintenance activities shall not be interrupted. Lockout-tagout procedures must be documented and followed. Work in filters will be near filters that are in the production of drinking water and must be protected from contamination.
- B. Construction may occur on all four filters simultaneously after contractor schedule has been approved.

3.02 MEDIA REMOVAL AND DISPOSAL

- A. The existing anthracite media removal and disposal shall accord per Section 02 41 00 – Demolition and Section 02 41 16 – Removal of Filter Media.
- B. GAC Manufacturer shall remove approximately 84” depth of existing anthracite media. Existing media shall be transferred out of filter cells as water slurry only. Only potable water shall be used for the slurry transfer. Care shall be taken as to prevent damage to Owner’s property and filter boxes, filter troughs, filter underdrains and other appurtenances.
- C. GAC Manufacturer shall dispose of spent anthracite at proper solids waste disposal facility (i.e., landfill). Full chain of custody shall be provided to Owner as proof of disposal for record-keeping for the entire quantity of anthracite media removed from the site.

3.03 DELIVERY, STORAGE AND HANDLING

- A. Media shall be transported, delivered, and placed in a careful manner to prevent contamination or physical damage to the GAC Media particles and to the existing filter underdrain system.
- B. Delivery
 - 1. Media. All shipping and delivery charges shall be included and be paid by the GAC Media supplier. All deliveries shall be accompanied by a legible bill of lading or other evidence suitable to the Contractor, indicating the gross, tare and net weight of shipment, the name of carrier, and other pertinent information. This evidence shall be presented to the Contractor before or at the time of delivery.
 - 2. Bulk Shipment: Shipment shall be delivered to the Pecos Surface Water Treatment Plant.
 - 3. Prior to shipment, Contractor shall inspect and shall coordinate with the Media Supplier the Pecos Surface Water Treatment Plant site and facilities for unloading to make certain that these facilities will accommodate the type of trucks intended to be used.
 - 4. The Contractor shall provide all equipment, connections, hoses, piping and adapters necessary to utilize existing plant potable water supply. The GAC is to be transferred in slurry form to the filters.
 - 5. GAC Media supplier shall furnish equipment and accessories as required to transfer the GAC from the tanker to the filters or shall furnish hopper system to hydraulically educt media from bags or semi-bulk truckloads to the filters.
- C. Handling

C. Handling

1. It shall be the Contractor's responsibility to clean up, to the Owner's satisfaction, any GAC spills at the site and to repair any damage resulting from the GAC delivery or unloading operations.
2. Handle the GAC Media at all times in a safe manner and as recommended by the manufacturer and AWWA B100 and AWWA B604 standards. GAC depletes oxygen from air and can be hazardous in a confined situation. Contractor shall be responsible for worker's safety and follow all pertinent GAC media manufacturer, local, state, and federal guidelines.
3. Any media that becomes contaminated or dirty (i.e., contains more than 0.5% of foreign material by weight) either before or after it has been placed in the GAC Containers shall be removed and replaced with clean media at no cost to the Owner.

3.04 INSTALLATION

- A. General: Installation of materials provided under this Specification shall be in accordance with the manufacturer/supplier's recommendations and the approved by the Engineer.
1. Preparation of the filter, after media removal, for GAC media installation shall be in accordance with the AWWA B100-16 and AWWA B604-18 Standards unless specifically noted otherwise herein.
 2. The Contractor shall install the GAC media over the sand filter media only after confirmation that the sand filter media material and its installation is accepted by Owner and Engineer.
 3. The Contractor shall exercise caution in installing media to avoid damage to the filter underdrain system. Any damage resulting from work by the Contractor shall be repaired at the Contractor's expense. Each layer shall be completed before the layer above is started. Workmen shall not stand or walk directly upon the media, but upon boards or staging so that the weight of the workmen will not displace the media as indicated in ANSI/AWWA B100 and B604.
 4. The Contractor shall not support any staging equipment or personnel from the filter wash water troughs at any time.
- B. Method of Installation
1. The Contractor shall provide potable water supply connection for GAC transfer and flushing/rinse water. Contractor shall coordinate with Manufacturer to provide all necessary hoses, site glasses, piping, and appurtenances for installing GAC

Media into concrete filter cells. Hoses shall be carefully positioned to reduce headloss and to provide a smooth hydraulic flow path for GAC transport from the truck to the GAC Contactor(s).

2. GAC Media shall be transferred into GAC Contactor(s) as water slurry only, using air pressure via compressed air system or a hydraulic eductor as the motive force. GAC Media supplier shall coordinate for the rental or acquisition of required air compressor for transferring GAC Media.
3. Contractor shall be responsible for cleanup of all GAC Media and slurry spills that may occur during the GAC transfer operation.
4. A continuous chain of custody shall be maintained between the manufacturer and the Owner during GAC production, storage, loading, shipment, and installation of GAC Media into GAC Contactor(s).

C. Placing GAC Filter Media

1. Cleaning and Testing. Keep each filter cell clean throughout installation operations. All equipment used in placing GAC Media shall be cleaned and disinfected in accordance with AWWA C653. All workers shall use boots and gloves which have been disinfected in accordance with AWWA C653.
2. Placement
 - a. Caution in Installing Material. Carefully place GAC Media to avoid damage to the filter cells, troughs, and underdrain system.
 - b. The filter cells shall be filled with a minimum of 1.0 feet of water prior to adding GAC Media, as recommended by the GAC Media supplier.
 - c. Before media is placed, Contractor shall carefully measure and mark top of all layers on side of the filter cell.
 - d. Level filter media by hand to within plus or minus 6 inches of the appropriate mark prior to backwashing.
 - e. Place GAC media in 3 lifts. No lift shall be more than 30 inches in depth.
 - f. Place first lift plus adequate allowance for scrapings of GAC media and finish off smooth to proper elevation.
 - g. Backwash bed three times as described in 3.03 C. 3. below, and remove a minimum of ½ inch of surface fines by scraping after each washing.
 - h. Place second lift following procedures outlined in Items f and g above.

- i. Place third lift following procedures outlined in Items f and g above.
 - j. After the final scraping of fines of the third lift, the top 1 inch must meet gradation requirements (effective size and uniformity coefficient).
- 3. GAC Filter Media Washing.
 - a. After ensuring the GAC Media is completely wetted as recommended by the Manufacturer and approved by the Contractor, the filter media shall be backwashed at a rate that provides greater than 25% and less than 30% media expansion to remove fines. See Appendix A for backwash rates.
 - b. Owner shall perform all backwashes. Estimated number of backwashes required per day shall be supplied to Owner 5 working days in advance.
 - c. The backwash water flow rate may be increased in 5 gpm/sf increments while then holding for approximately 1 minute before increasing another 5 gpm/sf or until the desired bed expansion has been achieved. Backwash for sufficient duration to remove fines.
- 4. Following backwashing, final total depth of sand media and GAC media after washing and scraping shall be no less than 84 inches.

D. Cleaning and Disposal

- 1. Water for Testing and Backwashing. The Contractor shall supply all water for testing from potable water onsite to be supplied by Owner.
- 2. Disposal. The Contractor shall remove from the job site, and if necessary safely dispose of, all excess material and debris as a result of the work completed under this Section, including testing procedures.
- 3. The filters shall be maintained completely clean and free of any debris or other foreign materials at all times. Filters shall be cleaned to the satisfaction of the Engineer prior to disinfection.
- 4. Filter cells shall be disinfected prior to GAC media placement as specified in AWWA C653, and as directed and supervised by the Engineer. Disinfected filter cells shall be maintained to preserve disinfection during media placement and scrapings.
- 5. The Contractor shall remove from the job site and dispose of all excess or rejected filter media and the area around the filters shall be cleaned at the end of each working day.
- 6. Contractor shall tighten all anchor bolts in filter troughs, check level of filter trough weir plates and reset these to elevations shown in original Contract Drawings.

3.05 FIELD TESTING

- A. Samples shall be taken from the materials received at the site. An independent testing laboratory engaged by the Contractor shall prepare the samples in accordance with ASTM D2862-97 and shall then test the samples for compliance with the requirements of this Specification.
- B. After the final scraping of fines of the third lift for each filter cell, the top 1 inch must meet gradation requirements (effective size and uniformity coefficient). A composite sample of the top 1 inch of media shall be gathered from a minimum of 5 locations in each cell. This composite shall include each of the four corners at approximately 2' distance from each wall, and one center location.
- C. Upon receipt of the samples, the independent testing laboratory shall prepare the samples in accordance with ASTM D2862-97. The tests conducted shall determine the conformance of the media with the acid solubility, gradation, uniformity coefficient and sieve requirements specified herein above and with the other requirements of this Specification.
- D. Sieve analysis of samples taken shall include additional sieves such that there are two sieve measurements smaller than the effective size.

3.06 MANUFACTURER/SUPPLIER'S REPRESENTATIVE

- A. The Contractor shall provide the services of a qualified manufacturer/supplier's representative to: assist in the installation of the filter media; check the installation before the media is placed into operation and assist in the performance of field tests.
- B. The Contractor shall provide the services of the manufacturer/supplier's representative at such times and for such durations of time as are needed to perform the tasks required of the representative. At a minimum, the services of the manufacturer/supplier's representative shall be provided as indicated herein below. The number of visits and person-days per visit indicated below shall be understood as referring to the total required services for the lot of filter media provided under this Specification.
 - 1. Installation 1 visit of 3 days per visit.
 - 2. Field testing 1 visit of 2 days per visit.
- C. Unless otherwise authorized by the Engineer, the manufacturer/supplier's representative shall be a direct employee of the filter media manufacturer/supplier, with at least three (3) years experience in the installation, testing and start-up of filter media of the type provided under this Specification. The manufacturer/supplier's sales and marketing personnel will not be accepted as manufacturer/supplier's representatives.

- D. The manufacturer/supplier's representative shall have full knowledge and experience in the installation of the filter media in filter systems of the type to be provided under this Contract.
- E. Reports: The Contractor shall submit a report from the manufacturer/supplier for each visit to the Site of the manufacturer/supplier's representative. The report shall provide complete information regarding the visit, including, but not limited to, dates, times, subject media, tasks performed, persons contacted, problems corrected, test results, training provided, and other pertinent information.
- F. In addition to the above, the Contractor shall provide the services of person(s) authorized by the manufacturer/supplier to witness the unloading at the Site of the filter media provided under this Specification, and to ascertain the condition of said media. Manufacturer/supplier's sales and marketing personnel may be accepted as authorized person(s) to perform these specific tasks. The Contractor shall submit to the Engineer a report, completed by the authorized person(s) and certified by the filter media manufacturer, documenting the findings of the authorized person(s).
- G. Qualified engineers of the manufacturer/supplier shall inspect the filters before placement of the filter media.

APPENDIX A

FLUDIZATION BACKWASH RATE SCHEDULE

<u>Water Temperature</u>		<u>Backwash Rate (gmp/ft²)</u>	
(°C)	(°F)	(25% Expansion GAC)	(30% Expansion GAC)
1	34	11.7	13.3
5	41	13.0	14.7
10	50	14.7	16.5
15	59	16.1	18.2
20	68	17.8	20.0
25	77	19.8	22.0
30	86	21.3	23.8
35	95	23.2	25.8

END OF SECTION

SECTION 46 61 17

SAND FILTER MEDIA

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. The Contractor shall furnish, install, test, and place into satisfactory operation sand filter media in four (4) filters (Filters 9, 10, 11, and 12), as shown on the Contract Drawings and as specified herein.

1.02 RELATED SECTIONS

- A. General Conditions
- B. Section 01 11 40 – Coordination with Owner's Operations
- C. Section 46 00 00 - Equipment General Provisions
- D. Section 46 61 16 – GAC Filter Media

1.03 REFERENCES

- A. American Water Works Association (AWWA)
- B. AWWA Standard B100-16 – Granular Filter Material
- C. AWWA Standard C653 – Disinfection of Water Treatment Plants
- D. National Sanitation Foundation (NSF)
- E. NSF 61 – Drinking Water System Components – Health Effects
- F. American Society for Testing and Materials (ASTM)
- G. ASTM E11 – Specifications for Wire Cloth and Sieves For Testing Purposes
- H. ASTM D4371-84 – Methods for Determining the Washability Characteristics of Anthracite

1.04 SYSTEM DESCRIPTION

- A. Each of the four (4) filters consists of two cells, whose bed each has plan dimensions of 14 feet by 27 feet. The filter media shall consist of 12 inches of sand overlaid by 72 inches of GAC, as specified in Section 46 61 16 – GAC Filter Media.

1.05 DESIGN REQUIREMENTS

- A. Filter media shall conform to the following:

Layers	Material	Depth after installation (inches)	Average Specific Gravity	Effective Size (mm)	Uniformity Coefficient
One (1)	Sand	12.0	2.60 to 2.70	0.50 to 0.60	1.40 or less

The depths shown are after installation and any scraping to remove fines. Excess media shall be installed to allow for scraping and for voidage changes.

1.06 SUBMITTALS

- A. The contractor shall obtain from the media manufacturer and submit the following:
 1. Working Drawings.
 2. Operation and Maintenance Manuals, including an electronic version.
 3. Lists of Spare Parts, Special Tools and Supplies.
 4. Reports of Certified Shop Tests.
 5. Reports of Field Tests.
 6. Reports of Manufacturer's Representative Site Visits.
 7. Samples
- B. Working drawings shall include, but not be limited to, the following:
 1. Filter media specifications and data sheets, with identification of all materials used and methods of fabrication.
 2. Complete installation drawings with clearly marked dimensions.
 3. Manufacturer's delivery, storage, and handling requirements.
 4. Manufacturer's installation instructions and recommendations.
 5. Expansion curves for the filter media, showing backwash rate versus percent bed expansion for temperatures between 33°F and 95°F. Fluidization velocity versus headloss for sand shall be provided for temperatures between 33°F and 95°F.
 6. Certification of compatibility of the filter media with the existing filter underdrain systems: Leopold Type S with IMS Media retaining cap.
 7. Certified test reports for acid solubility and sieve analysis and samples of the filter media tested as specified in AWWA B100-16.

8. Certification that the sand satisfies the requirements in Articles 1.05 and 2.04 of this specification. Certificates of conformance shall accompany the filter media deliveries to the site.
 9. A detailed description of the procedures for filter media placement.
 10. Evidence of manufacturer experience and of the successful operation in other facilities of media similar to that proposed for this project, as specified herein and in General Conditions.
 11. Affidavit of Compliance as defined in NSF Standard No. 61.
- C. Spare parts lists shall indicate sizes, quantities, and part numbers of the items to be furnished. Terms such as “1 lot of packing material” shall not be acceptable.
- D. Reports of certified shop tests shall be submitted as specified herein and in General Conditions. No filter media shall be shipped from its place of manufacture before the certified shop test reports have been approved by the Engineer. Prior notification of shop tests shall be submitted for all equipment; shall be as specified in General Conditions; and shall include, but not be limited to, a description of the proposed testing facilities and procedures.
- E. Reports of field tests shall be submitted as specified herein and in General Conditions.
- F. Reports of manufacturer’s representative Site visits shall be submitted as specified herein and in applicable provisions of Division 1 – General Requirements.
- G. Samples shall be submitted, as specified herein and in General Conditions.
- H. Other applicable submittals, as required elsewhere in the Contract Documents.

1.07 QUALITY ASSURANCE AND QUALIFICATIONS

- A. Manufacturer/Supplier’s Qualifications.
1. The Contractor shall provide evidence to the Engineer that the manufacturer/supplier has a minimum of five (5) years’ experience, within the last seven (7) years in the design, manufacture, and supervision of installation of filter media of the type required under this Specification.
 2. The Contractor shall provide evidence to the Engineer that filter media which was designed and manufactured by the manufacturer, and which is similar to the filter media required under this Specification, has been in continuous and successful operation in at least five (5) separate facilities for the past five (5) years.
 3. The filter media manufacturer/supplier shall supervise the transportation, handling, on-site storage, and placement of the filter media. The filter media

manufacturer/supplier shall also supervise the field preparation of the media for sampling, including backwashing the media prior to sampling.

4. An Affidavit of Compliance shall be furnished certifying that the media is shipped in containers free from harmful contaminants as defined in NSF Standard No. 61.
5. Each package and container shall have legibly marked on it the name of the material, the gradation, filling date, the net weight of the contents, the name of the manufacturer/supplier, the lot number, and the brand name (if any). These markings shall be ineffaceably stenciled on the bag.
6. Bag or semi-bulk container shipment of media will be accepted. Semi-bulk containers shall not exceed 4,000 lbs in weight. Semi-bulk containers shall include a crane loop and rope locks for lifting by a crane. Bulk media shipment will not be allowed. Placement in the filters shall be accomplished using hydraulic slurry transfer or directly from bags or semi-bulk containers.
7. The Contractor shall provide the services of an independent testing laboratory to perform the field tests specified herein below. The laboratory shall be experienced in the type of testing to be performed, and the suitability of the laboratory to provide these services shall be subject to the approval of the Engineer.

1.08 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

- A. The Contractor shall supply, on wrapped pallets, 50 cubic feet of spare sand filter media. The media shall be supplied in labeled bags on pallets and delivered to the Owner at the time of the delivery with the bulk of the media. The bags shall not exceed 80 lb. in weight and shall be manufactured from a strong, UV-resistant, waterproof and contamination-free woven fabric. Sisal, paper or unreinforced polyethylene bag materials will not be accepted. This spare media shall not to be used for making good any losses of media during the installation, field testing, start up or warranty periods.
- B. The Contractor shall provide such special tools and appliances as may be needed to test, place or replace the filter media (such as rakes or screens) furnished under this Specification, and General Conditions.

1.09 SHOP TESTS

- A. Certified shop tests shall be performed by an independent lab for all filter media provided under this Specification and as specified in General Conditions.
- B. Shop tests shall confirm, via samples taken from the point of distribution, that the filter media proposed for supply under this Specification conforms to the design requirements in Article 1.05 herein, and to the product specification requirements in Article 2.03 and Article 2.04 herein.

PART 2 - PRODUCTS

2.01 MANUFACTURERS/SUPPLIERS

- A. The filter media shall be as purchased by Unifilt Corporation, Red Flint Sand and Gravel; or equal. Only suppliers who regularly furnish sand filtration media for the municipal water treatment industry will be considered for approval.

2.02 GENERAL

- A. All filters shall be provided with sand media as specified and as shown on the Drawings. No support gravel shall be provided for the media.

2.03 SAND

- A. The filter sand shall be high grade silica sand complying with the Standard Specifications for Granular Filter Material (AWWA B100-16). It shall be well graded. Material showing abnormal grading shall be rejected. The sand shall be washed silica and completely free from mica, dust, dirt, and foreign substances of any kind and shall meet the design criteria listed in Section 1.05. Sand shall have an acid solubility less than 5 percent.

PART 3 – EXECUTION

3.01 MEDIA REMOVAL AND DISPOSAL COORDINATION

- A. Contractor shall assist with the media removal and disposal as specified in Section 46 61 16 3.01 and 3.02. Contractor shall coordinate all activities with planter operations.
- B. After removal of the existing anthracite is complete, the filter underdrains shall be inspected by a Leopold technician with at least five (5) years' experience. Any defects in the filter underdrain grouting shall be repaired according to Section 03 60 00 – Grout. Any defective caps or blocks shall be replaced as required.

3.02 INSTALLATION

- A. Installation of materials provided under this Specification shall be in accordance with the manufacturer/supplier's recommendations and the approved working drawings.
- B. Additional instructions for the installation of materials provided under this Specification are as follows:
 - 1. Installation and the preparation of the filter for service shall be in accordance with the AWWA B100-16 unless specifically noted otherwise herein.
 - 2. The Contractor shall take measures to control dust during installation. If the filter media is bagged or in semi-bulk containers, the media shall be wetted to control dust as it is placed. The underdrain in each filter cell shall be inspected by the Contractor for any defects and/or damages, prior to installation of the new filter media.
 - 3. The underdrain in each filter cell shall be inspected and repaired by the Contractor for any defects and/or damages, prior to installation of the new filter media.

4. The filter box shall be thoroughly cleaned by brooming and vacuuming before any media is placed and shall be kept clean throughout the operation.
5. Media shall be placed in the filters hydraulically as a slurry or manually from bags or semi-bulk containers. Media shall not be discharged from the operating level.
6. The Contractor shall exercise caution in installing media to avoid damage to the filter underdrain system. Any damage resulting from work by the Contractor shall be repaired at the Contractor's expense. Each layer shall be completed before the layer above is started. The bottom layer shall be placed carefully by hand to avoid damage to the underdrain system and to ensure a free passage of water from the orifices. Workmen shall not stand or walk directly upon the media, but upon boards or staging so that the weight of the workmen will not displace the media as indicated in ANSI/AWWA B100.
7. The Contractor shall not support any staging equipment or personnel from the filter washwater troughs at any time.
8. Filter sand shall be installed in a uniform thickness with the top surface brought to a true level plane. Bulk media may be placed dry or wet as specified in AWWA B100-16. When shipped in bags, filter media may be placed by scattering material directly from the bags. The elevation of the top surface of each filter media layer shall be checked by filling the filter with water to the level line previously marked on the inside of the filter.
9. After the sand has been placed, the media shall be washed and scraped or skimmed to remove excess fine material. Wash water shall be slowly admitted upward through the underdrain system until the entire bed is flooded. The bed shall be allowed to stand for as long a period as deemed necessary before initial wash. The wash rate shall be increased gradually during the initial wash to remove air from the bed. During each backwash, the water shall be applied at an initial rate of not more than 2 gpm/ft² of filter area. The backwash rate shall then be increased gradually over a period of 3 minutes, at the rate as defined in Appendix A – Fluidization Backwash Rate Schedule. The filter bed shall be backwashed for a total period of not less than 30 minutes in order to stratify the bed and to wash out dirt. This process will require several separate backwashes, but not less than 3 backwashes at 10 minutes each at an expansion of not less than 25 percent followed by a slow closing of the wash water valve. Following each backwash, the top layer of media shall be removed such that after the last backwash a total of 2-inch of media shall be removed and discarded, and the final surface leveled. The depth of media, as specified herein, shall be measured in place after backwashing.
10. The field tests specified in Section 3.03 below shall then be conducted.
11. After the sand has been placed, leveled, washed, and scraped, the filters shall be disinfected by chlorination as specified in AWWA C653, and as directed and supervised by the Engineer

12. The filters shall be maintained completely clean and free of any debris or other foreign materials at all times. Filters shall be cleaned to the satisfaction of the Engineer prior to disinfection.
13. After disinfection, the GAC shall be placed, leveled, and scraped as described in Section 41 61 16 – GAC Filter Media.
14. The Contractor shall remove from the job site and dispose of all excess or rejected filter media and the area around the filters shall be cleaned at the end of each working day.
15. All tanks, channels, etc., used in the course of the placement of the media into the filters shall be completely cleaned of media and fines after all media is placed.

3.03 FIELD TESTING

- A. Preliminary and final field tests shall be performed for all material provided under this Specification, Section 46 0000 Equipment General Provisions and as specified in the General Conditions.
- B. Additional requirements for the field testing of the materials provided under this Specification are as follows:
 1. Samples shall be taken from the materials received at the site. An independent testing laboratory engaged by the Contractor shall prepare the samples in accordance with ASTM D4371-84 and shall then test the samples for compliance with the requirements of this Specification.
 2. Upon completion of the backwashing procedure specified in Article 3.01 above for sand, a sieve analysis shall be made of composite samples of the sand to determine the gradation. Sufficient material shall be removed from the top of the bed so that the uniformity coefficient shall be less than 1.40 after the sand is scraped. Further backwashing and scraping shall be carried out until the requirements specified in this Article are satisfied. After completion of field testing for sand filter media, placement of anthracite filter media may commence.
 3. After filter materials have been placed, soaked and initially backwashed, each filter shall be backwashed three times, for at least ten minutes each time, at a rate as defined in Appendix A. After each backwashing the filter media shall be allowed to compact by slowly reducing the washwater flow.
 4. A minimum of four composite samples of the filter media shall be taken for sieve analysis from each filter. Each composite sample shall consist of equal portions from a minimum of five cores. Four cores shall be taken at the corners approximately 2 feet from the walls, and one core shall be taken near the center-line of the filter surface and under a trough. These cores shall be taken using a core sampler of 2-inch empty tubing. The core sampler shall be inserted to the elevation of the underdrain and then removed by excavating around it in order to extract a complete profile of the material found above that elevation.

5. Upon receipt of the samples, the independent testing laboratory shall prepare the samples in accordance with ASTM D4371-84. The tests conducted shall determine the conformance of the media with the acid solubility, gradation, uniformity coefficient and sieve requirements specified herein above and with the other requirements of this Specification.
6. Sieve analysis of samples taken shall include additional sieves such that there are two sieve measurements smaller than the effective size.

3.04 MANUFACTURER/SUPPLIER'S REPRESENTATIVE

- A. The Contractor shall provide the services of a qualified manufacturer/supplier's representative to: assist in the installation of the filter media; check the installation before the media is placed into operation and assist in the performance of field tests. The services provided shall be in accordance with the requirements of General Conditions.
- B. The Contractor shall provide the services of the manufacturer/supplier's representative at such times and for such durations of time as are needed to perform the tasks required of the representative. At a minimum, the services of the manufacturer/supplier's representative shall be provided as indicated herein below. The number of visits and person-days per visit indicated below shall be understood as referring to the total required services for the lot of filter media provided under this Specification.
 1. Installation 1 visit of 1 day per visit.
 2. Field Testing 1 visit of 1 day per visit.
- C. Unless otherwise authorized by the Engineer, the manufacturer/supplier's representative shall be a direct employee of the filter media manufacturer/supplier, with at least three (3) years' experience in the installation, testing and start-up of filter media of the type provided under this Specification. The manufacturer/supplier's sales and marketing personnel will not be accepted as manufacturer/supplier's representatives.
- D. The manufacturer/supplier's representative shall have full knowledge and experience in the installation of the filter media in filter systems of the type to be provided under this Contract.
- E. Reports: The Contractor shall submit a report from the manufacturer/supplier for each visit to the Site of the manufacturer/supplier's representative. The report shall provide complete information regarding the visit, including, but not limited to, dates, times, subject media, tasks performed, persons contacted, problems corrected, test results, training provided, and other pertinent information.
- F. In addition to the above, the Contractor shall provide the services of person(s) authorized by the manufacturer/supplier to witness the unloading at the Site of the filter media provided under this Specification, and to ascertain the condition of said media. Manufacturer/supplier's sales and marketing personnel may be accepted as authorized person(s) to perform these specific tasks. The Contractor shall submit to the Engineer a report, completed by the authorized person(s) and certified by the filter media manufacturer, documenting the findings of the authorized person(s).

- G. Qualified engineers of the manufacturer/supplier shall inspect the filters before placement of the filter media.

APPENDIX A

FLUIDIZATION BACKWASH RATE SCHEDULE

<u>Water Temperature</u>		<u>Backwash Rate (gpm/ft²)</u>	
(°C)	(°F)	(25% Expansion Sand)	(30% Expansion Sand)
1	34	11.8	13.4
5	41	13.0	14.8
10	50	14.5	16.4
15	59	15.9	18.1
20	68	17.8	19.9
25	77	19.4	22.0
30	86	21.0	23.4
35	95	22.8	25.5

END OF SECTION

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EXHIBIT D

ACCEPTED GMP/PRICE PROPOSAL

SUBMITTAL

CITY OF CHANDLER
WATER SYSTEMS UPGRADE PROGRAM
WA2100.251

SUBMITTAL TASK #17.7
GMP-1



SUBMITTED BY: ARCHER WESTERN CONSTRUCTION, LLC
PHOENIX, AZ

DATE SUBMITTED: OCTOBER 10, 2024
REVISION #1

SECTION A

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SECTION B

PROJECT DESCRIPTION



1. PROJECT DESCRIPTION

The Pecos Surface Water Treatment Plant Improvement project will include preconstruction services and construction services to implement identified improvement projects for the liquid and solid treatment process at the PSWTP, as well as water quality and operational efficiency throughout Chandler's water system. Projects may include GAC media replacement, concrete repair and rehabilitation of existing filters, installation of new post-filter GAC contactors or ozone contactors, new dewatering equipment and associated building, submersible pump replacement and reconfiguration, and miscellaneous yard piping improvements.

Projects Identified to Meet Program Goals:

- 42.1 – Filter 9-12 Rehab
- 43.1 – Post Filter GAC Contactors
- 86.1 – Chlorine Dioxide (Final decision will depend on Pilot Results)
- 65.1A – EQ Pumps
- 75.1D – Dewatering Building

Projects are anticipated to be delivered in multiple separate designs and construction packages over the timeline of Quarter 3 of 2024 through Quarter 4 of 2027. Pre-construction services are tentatively scheduled to begin in Quarter 3 of 2024 and construction tentatively scheduled to begin Quarter 4 of 2024 through Quarter 4 of 2027.

The overall project has been broken into 3 GMPs:

1. Filters 9 to 12 construction
2. Long Lead Procurement
3. Remaining Construction and ClO₂ Construction

2. SCOPE OF WORK

This GMP cover the work related to Filters 9 to 12. The work under this project will address new and/or rehabilitated tertiary granular filters, concrete repair and rehabilitation of existing Filters 9-12.

The scope of work includes the following:

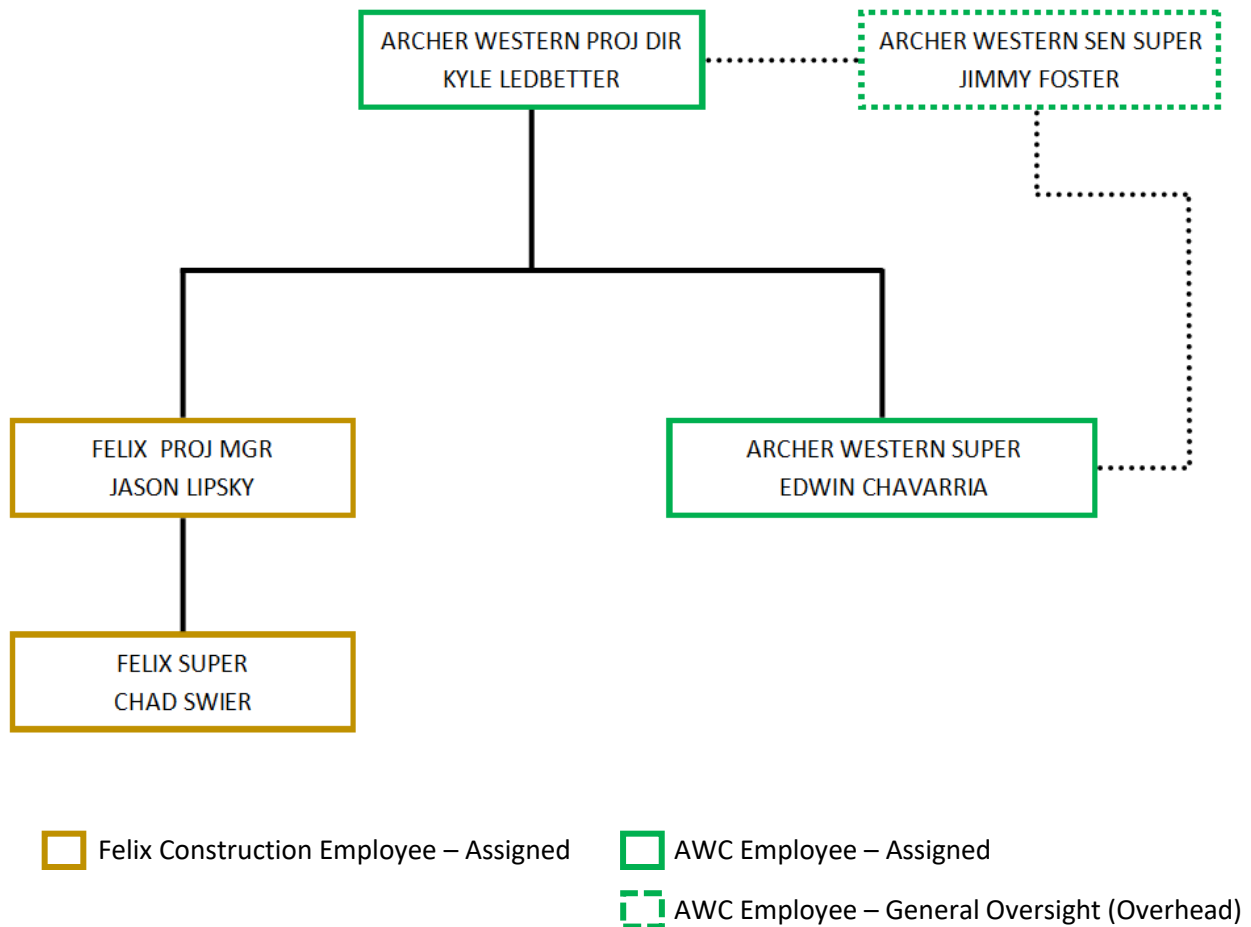
- Media Replacement & Underdrain Inspection
 - Remove 84" anthracite media
 - Inspect filter underdrains and filters
 - Install 12 inches of sand media
 - Install 72 inches of GAC media
- Structural Rehabilitation
 - Waterproof Crystalline Coating
 - Hydrophillic Crack injection after coating
- Process Mechanical
 - Extend piping at Filters 9-12 from existing polymer piping from Phase 1, includes flow meters and control valves



- 1 peristaltic metering pump, 1 pressure gauge, and 1 pressure switch in the disinfection building

3. ORGANIZATIONAL CHART

The following individuals and their reporting system will be used during the construction phase of the project:



4. ROLES & RESPONSIBILITIES

Several supervision staff are included in the project. Descriptions of their roles and responsibilities are provided below.



4.1 Project Director

4.1.1 Purpose:

Responsible for the overall direction, completion, financial outcome, technical success and quality of a very large, complex construction project or multiple projects simultaneously. The Project Director also establishes and manages strategic client relationships. Identifies opportunities to expand company relationships and business opportunities.

4.1.2 Major Responsibilities:

- Plans, organizes, coordinates and controls projects in accordance with established policies, procedures, systems and requirements approved by the Company. Creates and manages processes for tracking projects and associated deliverables, collects and analyzes data, and works closely with field personnel, designers, engineers, vendors and subcontractors to manage various programmatic and project processes.
- Leads interdisciplinary teams, such as preconstruction, to deliver projects that reside within a major business group or function. Determines staffing needs, personnel development, performance management and training for the project team. Provides leadership, guidance and direction to the project team members. Ensures projects are completed, tracked and reported on in accordance with all compliance regulations and goals. Completes and/or approves Performance Reviews for subordinates.
- Maintains exceptional relationships with owners, subcontractors, design partners and unions. Responsible for day-to-day contact as well as contact of a multifaceted nature.
- Assists with bid package development, pre-qualification activities and budget preparation. May draft budget/estimate documents and provide oversight for the estimating process.
- Leads efforts to analyze risk and define schedule-related issues, including analysis of long lead materials or equipment which may impact project cost or scheduled delivery.
- Analyzes and presents project delivery approaches, develops alternative approaches and facilitates implementation, ensuring compliance with corporate, federal and state regulations.
- Serves as the primary contact for senior department managers relative to critical business issues. Helps allocate regional assets and resources to projects within business group. Maintains vehicle/equipment database in online management tool in conjunction with EOG/Project Engineer. Assists with obtaining vehicle registrations and vehicle repairs. Tracks and monitors vehicle assignments to ensure vehicle availability and mitigate risk.
- Participates in the design and execution of project safety planning activities to ensure that projects are completed within established safety goals.

4.2 Assistant Project Manager

4.2.1 Purpose:

Responsible for assisting the Project Manager with the overall direction, completion and financial outcome of a construction project.



4.2.2 Major Responsibilities:

- Prepare, review and negotiate project contracts, subcontractor agreements, subcontractor services agreements, purchase orders, quality acceptance agreements, etc.
- Responsible for procurement of materials. From contract execution, through submittal phase, release for fabrication, and tracking of deliveries to ensure schedule of the project is maintained.
- Review owner contracts. Draft and articulate argument/positions on owner contracts. Negotiate owner change orders and claims for extra work. Develop change management and allowance/contingency controls. Review and prepare time and material allowance/contingency usage for execution. Aid in preparation of revenue forecasts.
- Records equipment and material deliveries to ensure accuracy and to ensure that project remains on schedule.
- Coordinate the purchase/renewal of insurance policies on the project. Pursue or aid in pursuing insurance claims on the projects.
- Establish and administer document control procedures.
- Work with Operations team on a daily basis on risk management, and contractual and commercial issues.
- Plans, organizes, coordinates and controls project(s) in accordance with established policies, procedures, systems and requirements approved by the Company.
- Supervises work of project administration, superintendents, and engineers to ensure that work is accomplished in an efficient, effective, profitable and safe manner and meets all quality standards.
- Reviews cost-coding of timesheets and invoices, reviews daily production reports and supervises forecasted final cost/revenue reporting to ensure that profitability goals are met.
- Reviews submittal of change orders and analyzes impact on project schedules. Participates in work planning of self-performed activities.
- Gathers and records subcontractor log and weather conditions and makes recommendations accordingly. May coordinate and schedule subcontractors.
- May coordinate with owners and engineers for project scheduling and issue resolution.
- Assists with the development and review of detailed MOPO plans.
- Manages allowance and contingency tracking and gathering supporting documentation.
- Attend weekly owner progress meetings and support the Project Manager as required.

4.3 Project Superintendent

4.3.1 Purpose:

In conjunction with Project Management, responsible for the direct supervision of field forces, and the efficient scheduling of the physical completion of all project work.

4.3.2 Major Responsibilities:

- The superintendent will be the day-to-day contact on the project for any site activities taking place under the contract.



- Coordinates subcontracts, drawings, and specifications to ensure conformity. Examines drawings and specifications for various work tasks and ensures current information is passed down to front line supervision and trades personnel. Carries out inspections as needed.
- Responsible for daily planning, creation and maintenance of project schedules, including subcontractor specialty schedules and short interval schedules. Involved in creating work plans for each specific work activity.
- Supervises and organizes workers; ensures workers are available and fully qualified to perform assigned duties. Reports on labor and materials. Schedules crews according to available work packages for the project and all required equipment and materials necessary to complete tasks. Monitors timely delivery of necessary materials to assure continued productivity.
- Responsible for controlling costs, adhering to budgets and managing equipment-related expenses. Ensures staff is aware of production rates for assigned items of work.
- Conducts regular safety meetings; maintains a safe work environment with the goal of keeping accidents and injuries to a minimum and complying with company and regulatory safety procedures. Complies with EPA requirements for hazardous materials.
- Coordinates subcontractors through a regular and disciplined series of meetings, questioning and verifying their plans and efforts, changing or augmenting as needed.
- Assists project management team ensuring compliance with the legal and regulatory requirements of the city, state and federal government applicable to the project. Alerts management to any potential concerns.
- Participates in the development and implementation of appropriate portions of the jobsite quality, safety and production plans; ensures maintenance of all records in accordance with project standards.
- Coordinates with internal staff to build professional and productive relationships with owners, architects, engineers and subcontractors.

SECTION C

GMP PROPOSAL

EXHIBIT D

CM@RISK GMP SUMMARY

EXHIBIT D **CMAR GMP SUMMARY**

Project Name: Pecos Surface Water Treatment Plant Improvements		Date: 10/7/2024
Project Location: 1475 E Pecos Rd		
City of Chandler Project No WA2100.251		
GMP 1 Rev 1 - 90% Design		
A. Cost of Work		
A.1 Cost of Work (self-perform, no mark-ups)		\$225,045
A.2. Cost of Work - Subcontracts		\$1,060,686
TOTAL COST OF WORK:		\$1,285,731
B. General Conditions		\$247,442
<i>SUBTOTAL 1 (Cost of Work) (A+B)</i>		<i>\$1,533,173</i>
C. CMAR's Fee (8.0%)		\$122,654
<i>SUBTOTAL 2 (A+B+C):</i>		<i>\$1,655,827</i>
D. Bonds and Insurance		
D.1. Bonds (Payment and Performance)		\$14,305
D.2. Insurance		\$28,485
TOTAL BONDS & INSURANCE:		\$42,790
<i>SUBTOTAL 3 (SUBTOTAL 2 + BONDS & INS):</i>		<i>\$1,698,617</i>
E. Sales Tax		
E.1. Sales Tax (5.07%)		\$92,448
E.2. Tax Credits		
TOTAL SALES TAX:		\$92,448
TOTAL GMP WITHOUT ALLOWANCES/CONTINGENCIES:		\$1,791,065
F. Approved Allowances		
F.1. Cofferdam Allowance (Cost + Fee (8.0%))		\$24,377
F.2. Concrete Repairs (Cost + Fee (8.0%))		\$35,640
F.3. Electrical Allowance (Cost + Fee (8.0%))		\$54,000
F.4. Under Drain Repair (Cost + Fee (8.0%))		\$10,800
TOTAL ALLOWANCES:		\$124,817
G. Contingencies		
G. 1. Construction Contingency		\$50,000
G. 2. Owner Contingency (10% of total cost of work)		\$128,573
TOTAL CONTINGENCIES:		\$178,573
<i>TOTAL GMP PROPOSAL:</i>		<i>\$2,094,455</i>
<u>Establishment of Values:</u>		
a. Cost of Work (A) and Allowances (F) to be submitted with GMP Proposal.		
b. General Conditions Cost (B) to be established in Baseline Cost Model.		
c. CMAR Fee as set forth in Section 3.7.3. of this Agreement.		



EXHIBIT D: ALLOWANCE DESCRIPTIONS

F.1 Cofferdam Allowance

This allowance is used to pay for installing angle, steel plates, anchors, gaskets, stand by pumps and sandbags as necessary for the cofferdam.

F.2 Concrete Repairs

This allowance is used to pay for structural crack repair. The crack repair will be an epoxy injection crack repair and waterproof injection grout per drawing S02.

F.3 Electrical Allowance

This allowance is used to pay for removing the boxes from the wall and replacing any electrical boxes or conduit as deemed necessary. Instruments and panels are not included in the allowance.

F.4 Filter Underdrain Repair

This allowance is used to pay for replacing any damaged filter underdrain boxes or grout fillets.

EXHIBIT D: CONTINGENCY DESCRIPTIONS

G.1. Construction Contingency

This contingency will be set at \$50,000 and will be used as directed by General Conditions 15.4.1.

G.1. Owner Contingency

This contingency will be set at 10% of the total cost of work and will be used as directed by General Conditions 15.4.2.

1. GENERAL NOTE

The GMP Worksheet includes bonds, insurance, and taxes for the full value of the project. Any allowance and contingency usage will only have fee added beyond the cost of work shown.

DETAILED COST ESTIMATE

CITY OF CHANDLER- PECOS SWTP IMPROVEMENTS									
PROJECT NO. WA2100.251									
GMP 1-90% DESIGN REV 1									
AREA	BID ITEM	DESCRIPTION	TAKEOFF QTY		LABOR AMOUNT	MATERIAL AMOUNT	SUB AMOUNT	EQUIPMENT AMOUNT	TOTAL AMOUNT
A. COST OF WORK									\$ 1,285,731
100		Filter Improvements	1	LS	\$ 53,091	\$ 7,136	\$ 785,094	\$ 2,000	\$ 847,321
		Site Development	1	LS	\$ 8,607	\$ 1,168	\$ -	\$ -	\$ 9,775
	02.100.100	Remove GAC Filter Media	18,309	CF	\$ 8,607	\$ 1,168			\$ 9,775
		Painting & Coatings	1	LS	\$ 8,681	\$ 1,280	\$ 686,289	\$ -	\$ 696,250
	09.100.100	Paint Inspections-Subcontractor	36,287	SF	\$ 8,681	\$ 1,280	\$ 8,400		\$ 18,361
	09.100.105	Painting Subcontract	18,144	SF	\$ -	\$ -	\$ 677,889		\$ 677,889
		Equipment General	1	LS	\$ 7,500	\$ 4,688	\$ 98,805	\$ -	\$ 110,993
	46.100.100	Sand Install	3,050	CF	\$ 4,564	\$ 2,464	\$ 700		\$ 7,728
	46.100.103	Sand Install Subcontract	3,050	CF	\$ -	\$ -	\$ 93,205		\$ 93,205
	46.100.105	GAC Install	18,309	CF	\$ 2,936	\$ 2,224	\$ 1,400		\$ 6,560
	46.100.110	Disinfection Subcontract	1	LS			\$ 3,500		\$ 3,500
		Construction Manager	1	LS	\$ 28,303	\$ -	\$ -	\$ 2,000	\$ 30,303
	99.995.900	Field Salary Staff	1	LS	\$ 28,303			\$ 2,000	\$ 30,303
110		Polymer Improvements	1	LS	\$ 36,741	\$ 61,302	\$ 1,000	\$ 1,000	\$ 100,043
		Process Piping	1	LS	\$ 24,738	\$ 49,640	\$ 1,000	\$ -	\$ 75,378
	40.110.100	Polymer Piping and Valves	400	LF	\$ 24,738	\$ 8,880	\$ 1,000		\$ 34,618
	40.110.105	Pipe and MOV Supplier Lump Sum	1	LS		\$ 35,391			\$ 35,391
	40.110.110	Pipe Support Supplier Lump Sum	1	LS		\$ 5,369			\$ 5,369
		Equipment General	1	LS	\$ 1,793	\$ 11,662	\$ -	\$ -	\$ 13,455
	46.110.100	Polymer Metering Pump	1	LS	\$ 1,793	\$ 712			\$ 2,505
	46.110.105	Polymer Metering Pump Supplier Lump Sum	1	LS		\$ 10,950			\$ 10,950
		Construction Manager	1	LS	\$ 10,210	\$ -	\$ -	\$ 1,000	\$ 11,210
	99.995.900	Field Salary Staff	1	LS	\$ 10,210			\$ 1,000	\$ 11,210
610		Process Equipment Commissioning	1	LS	\$ 13,275	\$ 500	\$ -	\$ 500	\$ 14,275
		Process Equipment	1	LS	\$ 13,275	\$ 500	\$ -	\$ 500	\$ 14,275
	43.610.220	Equipment Commissioning	1	wk	\$ 13,275	\$ 500		\$ 500	\$ 14,275
800		Electrical Work	1	LS	\$ -	\$ -	\$ 274,592	\$ -	\$ 274,592
		Electrical	1	LS	\$ -	\$ -	\$ 274,592	\$ -	\$ 274,592
	26.800.500	Electrical Work-Full Project	1	LS			\$ 274,592		\$ 274,592
998		Construction Equipment	1	LS	\$ -	\$ -	\$ -	\$ 49,500	\$ 49,500
		Construction Manager	1	LS	\$ -	\$ -	\$ -	\$ 49,500	\$ 49,500
	99.998.900	Construction Equipment-Site Wide (GC)	1	LS				\$ 49,500	\$ 49,500
B. GENERAL CONDITIONS									\$ 247,442
997		General Requirements	1	LS	\$ 2,046	\$ 11,846	\$ 4,075	\$ -	\$ 17,967
		Construction Manager	1	LS	\$ 2,046	\$ 11,846	\$ 4,075	\$ -	\$ 17,967
	99.997.900	General Requirements-Site Wide (GC)	1	LS	\$ 2,046	\$ 11,846	\$ 4,075		\$ 17,967
999		Salaried Staff	1	LS	\$ 229,475	\$ -	\$ -	\$ -	\$ 229,475
		Construction Manager	1	LS	\$ 229,475	\$ -	\$ -	\$ -	\$ 229,475
	99.999.900	Salaried Staff-Site Wide (GC)	1	LS	\$ 229,475				\$ 229,475
SUBTOTAL 1 (COST OF WORK)					\$ 334,628	\$ 80,784	\$ 1,064,761	\$ 53,000	\$ 1,533,173

CITY OF CHANDLER- PECOS SWTP IMPROVEMENTS									
PROJECT NO. WA2100.251									
GMP 1-90% DESIGN REV 1									
AREA	BID ITEM	DESCRIPTION	TAKEOFF QTY		LABOR AMOUNT	MATERIAL AMOUNT	SUB AMOUNT	EQUIPMENT AMOUNT	TOTAL AMOUNT
AREA	BID ITEM	DESCRIPTION	TAKEOFF QTY		LABOR AMOUNT	MATERIAL AMOUNT	SUB AMOUNT	EQUIPMENT AMOUNT	TOTAL AMOUNT
F. APPROVED ALLOWANCES (EXLUDING FEE)									\$ 115,571
120		Allowances	1	LS	\$ 7,747	\$ 11,024	\$ 96,800	\$ -	\$ 115,571
		Site Development	1	LS	\$ 7,747	\$ 11,024	\$ 3,800	\$ -	\$ 22,571
	02.100.105	Coffer Dam - Dewatering	1	LS	\$ 7,747	\$ 11,024	\$ 3,800		\$ 22,571
		Concrete Repair	1	LS	\$ -	\$ -	\$ 33,000	\$ -	\$ 33,000
	03.120.100	Filter Walls Crack Repair	1	LS			\$ 23,000		\$ 23,000
	03.120.120	Interior Basin Wall Repairs	1	LS			\$ 10,000		\$ 10,000
		Electrical	1	LS	\$ -	\$ -	\$ 50,000	\$ -	\$ 50,000
	26.120.100	Electrical Allowance	1	LS			\$ 50,000		\$ 50,000
		Equipment General	1	LS	\$ -	\$ -	\$ 10,000	\$ -	\$ 10,000
	46.120.100	Underdrain Repair Allowance	1	LS			\$ 10,000		\$ 10,000

QUOTE PACKAGE

COATING QUOTES

SECTION 07 16 16
CRYSTALLINE WATERPROOFING

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. Furnishing all labor, materials, services and equipment necessary for the supply and installation of topical cementitious crystalline waterproofing to concrete substrates, above-grade or below-grade, on either dry or wet side of substrates, as indicated on drawings and as specified herein.

- B. Principal items of work include:

Filters 9 through 12 located on the interior of the filter cells, center gullet between filter cells, and settled water channels.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 03 01 30 – Concrete Repairs

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Without limiting the generality of these specifications Work shall conform to the applicable requirements of the following documents:

1. American Society for Testing and Materials (ASTM)
2. Army Corps of Engineers (CRD)
3. NSF International (NSF)

1.04 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in Section 01 33 00 – Submittal Procedures, submit the following:

1. Submit product data, including manufacturer's specifications, installation instructions, and general recommendations for waterproofing applications. Include manufacturer's certification or other data substantiating that products comply with requirements of the Contract Documents.
2. Submit complete test reports from approved independent testing laboratories certifying that waterproofing system conforms to performance characteristics and testing requirements specified herein.

3. Provide certificates signed by manufacturer or manufacturer's representative certifying that the materials to be installed comply in all respects with the requirements of this specification, and that the applicator is qualified and approved to install the materials in accordance with manufacturer's product data.

1.05 SYSTEM PERFORMANCE REQUIREMENTS

- A. Testing Requirements: Crystalline waterproofing system shall be tested in accordance with the following standards and conditions, and the testing results shall meet or exceed the performance requirements as specified herein.
- B. Independent Laboratory: Testing shall be performed by an independent laboratory meeting the requirements of ASTM E 329 and certified by the United States Bureau of Standards. Testing laboratory shall obtain all concrete samples and waterproofing product samples.
- C. Crystalline Penetration: Crystallizing capability of waterproofing material shall be evidenced by independent SEM (Scanning Electron Microscope) photographs documenting penetration of crystal-forming waterproofing material to a depth of 2 inches.
- D. Permeability: Independent testing shall be performed according to U.S. Army Corps of Engineers CRD C48-73 "Permeability of Concrete".
 1. Concrete samples (treated and untreated) to have design strength of 2000 psi and thickness of 2 inches. No admixtures permitted.
 2. Coatings to have maximum thickness of 0.05 inches per coat with up to two coats permitted.
 3. Samples to be pressure tested to 175 psi (405 feet head of water).
 4. Treated samples, after crystalline growth has occurred, shall exhibit no measurable leakage.
- E. Chemical Resistance: Independent testing shall be performed according to ASTM C 267 "Chemical Resistance of Mortars" and ASTM C 39 "Compressive Strength of Cylindrical Concrete Specimens".
 1. Concrete samples (treated and untreated) to have design strength of 4000 psi. No admixtures permitted.
 2. Coatings to have maximum thickness of 0.05 inches per coat with up to two coats permitted.
 3. Untreated and treated specimens to be immersed for a minimum of 84 days in following chemical solutions: hydrochloric acid (3.5pH), brake fluid, transformer oil, ethylene glycol, toluene, caustic soda.

4. Treated specimens shall exhibit no detrimental effects after exposure, and shall have a minimum of 14% increase in compressive strength versus untreated control specimens.
- F. Potable Water Approval: Independent testing shall be performed according to NSF Standard 61/600 and approval for use of waterproofing material on structures holding potable water shall be evidenced by NSF certification.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials in manufacturer's unopened containers identified with name, brand, type, grade, class, and all other qualifying information.
- B. Store materials in dry location, in such manner as to prevent damage or intrusion of foreign matter. Conspicuously mark "Rejected" on materials which have been damaged and remove from the job site.

PART 2 – PRODUCTS

2.01 SYSTEM DESCRIPTION

- A. Cementitious Crystalline Waterproofing: Blend of portland cement, fine treated silica sand and active proprietary chemicals. When mixed with water and applied as a cementitious coating, the active chemicals cause a catalytic reaction which generates a non-soluble crystalline formation of dendritic fibers within the pores and capillary tracts of concrete. This process causes concrete to become permanently sealed against the penetration of liquids from either direction.

2.02 ACCEPTABLE MANUFACTURERS

- A. Subject to compliance with the Specifications provide products manufactured by one of the following:
 1. Xypex Chemical
 2. Tamms (Euclid)
 3. Vandex (Euclid)
 4. Kryton International

2.03 PRODUCTS

- A. Crystalline Waterproofing Materials as follows:
 1. Xypex Concentrate
 2. Tamms Hey'Di K-11

3. Vandex Super

4. Krystol T1

2.04 SOURCE QUALITY

- A. Obtain proprietary crystalline waterproofing products from a single manufacturer.

PART 3 – EXECUTION

3.01 EXAMINATION OF SURFACES

- A. Verify that the concrete surfaces are sound and clean, and that form release agents and materials used to cure the concrete are compatible with waterproofing treatment.
- B. Examine surfaces to be waterproofed for form tie holes and structural defects such as honeycombing, rock pockets, faulty construction joints and cracks. Such defects to be repaired in accordance with manufacturer's product data and Section 3.02 below.
- C. Coordinate all work under this Section with contiguous work of other trades.

3.02 PREPARATION Surface prep per manufacturers instructions (ICRI CSP3)

- A. Concrete Finish: Concrete surfaces to receive waterproofing treatment shall have an open capillary system to provide tooth and suction, and shall be free from scale, excess form oil, laitance, curing compounds and foreign matter. Horizontal surfaces shall have a rough wood float or broom finish. Where a smooth trowel finish is required on horizontal surface, crystalline waterproofing material shall be applied by dry shake method at time of concrete finishing in accordance with manufacturer's product data.
- B. Surface Preparation: Existing smooth surfaces (e.g. where steel forms are used) or surfaces covered with excess form oil or other contaminants shall be washed, lightly sand-blasted, water-blasted, or acid etched with muriatic acid as necessary. Surfaces to be acid-etched shall be saturated with water prior to application of acid. Procedures for preparing surface profile to receive waterproofing treatment shall be in accordance with the manufacturer's recommendations and instructions.
- C. Repair of Defects: Surface defects shall be repaired in accordance with Specification Section 03 01 30 – Concrete Repairs.
- D. Wetting Concrete: Prior to application of waterproofing treatment, thoroughly saturate concrete surfaces with clean water as required to ensure migration of crystalline chemicals into voids and capillary tracts of the concrete. Remove free surface water before application.

3.03 APPLICATION

Per manufacturers instructions.

- A. Surface Application: After repairs, surface preparation, treatment of construction joints, and sealing strip placement have been completed in accordance with manufacturer's product data and as specified herein, apply crystalline waterproofing treatment uniformly to concrete surfaces with semi-stiff bristle brush or broom, or suitable spray equipment. Application rates and locations shall be in accordance with manufacturer's product data, unless otherwise indicated on the Drawings. When brushing, work slurry well into surface of the concrete, filling surface pores and hairline cracks. When spraying, hold nozzle close enough to ensure that slurry is forced into pores and hairline cracks.
 - 1. First Coat (of one or two coat applications): Apply crystalline waterproofing slurry coat to specified locations and as indicated on the drawings in accordance with manufacturer's product data. **1/16" coat**
 - 2. Second Coat (of two coat applications): Where indicated on drawings or as required by manufacturer's product data, apply crystalline waterproofing slurry coat while first coat of crystalline waterproofing is still "green" but after it has reached an initial set. Use light pre-watering between coats. Contractor shall ensure that all curing requirements are met prior to application. If curing requirements are not met, contractor shall follow manufacturer recommendations to remediate.

3.04 CURING

- A. Begin curing as soon as crystalline waterproofing has hardened sufficiently so as not to be damaged by a fine spray. Cure with a mist fog spray of clean water at a frequency and duration as recommended by the waterproofing manufacturer, or cover treated surfaces with damp burlap for the prescribed period. In warm climates, more than three sprayings per day may be necessary to prevent excessive drying of coating.
- B. Do not lay plastic sheeting directly on the waterproofing coating as air contact is required for proper curing. If poor circulation exists in treated areas, it may be necessary to provide fans or blown air to aid in curing of waterproofing treatment.
- C. For concrete holding structures such as reservoirs, water treatment tanks and wet wells, cure for three days and allow treatment to set (air cure) for 12 days before filling structure with liquid. For structures holding hot or corrosive liquids, cure waterproofing treatment for three days and allow to set for 18 days before filling.
- D. During the curing period, protect treated surfaces from damage by wind, sun, rain and temperatures below 36°F. If plastic sheeting is used for protection, sheets must be elevated above waterproofing coating to allow sufficient air circulation.

3.05 FIELD QUALITY CONTROL

- A. Do not conceal installed waterproofing system before installation has been observed by Architect/Engineer and other designated entities.

- B. For watertightness testing after concrete repairs and coating are complete, refer to specification 01 88 16 – Watertightness Testing of Concrete Structures.

Existing structure. No hydrostatic test required.

3.06 CLEANING AND PROTECTION

1. Clean spillage and soiling from adjacent surfaces using appropriate cleaning agents and procedures.
2. Take measures to protect completed coating from damage after application. Do not permit traffic on unprotected coating.

END OF SECTION

<i>Interior Filter Cells</i>			<i>Interior Filter Gullet</i>			<i>South Settled Water Channel</i>			<i>North Settled Water Channel</i>		
TOW EL (ft)	1241		TOW EL (ft)	1241		TOW EL (ft)	1241		TOW EL (ft)	1241	
Max WSEL (ft)	1237.5		Max WSEL (ft)	1237.5		Max WSEL	1237.76		Max WSEL	1237.76	
+Safety Factor (ft)	1		+Safety Factor (ft)	1		+Safety Factor (ft)	1		+Safety Factor (ft)	1	
Wall Height (ft)	16.22		Wall Height (ft)	16.33		Wall Height - 1 (ft)	13		Wall Height - 1 (ft)	13	
Water Height (ft)	13.72		Water Height (ft)	13.83		Wall Height - 2 (ft)	31.5		Wall Height - 2 (ft)	23.5	
Cell Width (ft)	14		Gullet Width (ft)	5.5		Water Height - 1 (ft)	10.76		Water Height - 1 (ft)	10.76	
Cell Length (ft)	27		Gullet Length (ft)	27		Water Height - 2 (ft)	29.26		Water Height - 2 (ft)	21.26	
Cells per Filter	2		# of Gulleets	4		Width - 1 (ft)	4		Width - 1 (ft)	4	
# of Filters	4					Width - 2 (ft)	4.5		Width - 2 (ft)	4	
						Length - 1 (ft)	93		Length - 1 (ft)	93	
						Length - 2 (ft)	7		Length - 2 (ft)	7	
Surface Area Water (sq. ft)	9,000		Surface Area (sq. ft)	3,596		Surface Area (sq. ft)	2,908		Surface Area (sq. ft)	2,639	
Wall Surface Area (sq. ft)	9,560		Wall Surface Area (sq. ft)	3,706		Wall Surface Area (sq. ft)	3,395		Wall Surface Area (sq. ft)	3,123	

Parameter	Work	Scenario 1 (Selected)	Scenario 2 (Not slected for)
TOTAL SURFACE AREA (SQ. FT)	CRYSTALLINE COATING	18,144	19,784
	SURFACE PREP ON WALLS W/ EXISTING COATING	9,000	9,560
	SURFACE PREP ON WALLS W/OUT EXISTING COATING	9,143	10,223
	OTHER COATING	0	0

Scenario 1

Crystaline coat only what is in contact with water (+1-ft above water surface), assumes surface prep in filter gullet is w/out existing coating

Sceanrio 2

Crystaline coat all wall surfaces to top of wall, assumes surface prep in filter gullet is w/out existing coating

PROJECT NAME

BID DATE

OWNER

ENGINEER

SCOPE

ESTIMATOR INITIALS

PECOS SURFACE WATER TREATMENT PLANT FILTER IMPROVEMENTS - PHASE III

10/4/2024

CITY OF CHANDLER

HAZEN & SAWYER

COATINGS

TJ



BID QUANTITIES					PPS		AO PAINTING		RILEY INDUSTRIAL		JPCI	
AREA	BID ITEM NO.	ITEM DESCRIPTION	QTY	UNIT	UNIT AMOUNT	BID	UNIT AMOUNT	BID	UNIT AMOUNT	BID	UNIT AMOUNT	BID
100	09.100.105	XYPEX COATING	18144	SF	\$ 54.99	\$ 997,770.00	\$ 35.59	\$ 645,777.00	\$ 99.40	\$ 1,803,515.00	NO BID/TIME	
		ABOVE GRADE PIPE	1	LS	\$ 10,965.00	\$ 10,965.00	\$ 10,965.00	\$ 10,965.00	\$ 10,965.00	\$ 10,965.00		
		SURFACE PREP TO ICRI CSP3	1	LS	INCLUDED		INCLUDED		INCLUDED			
		PROTECTION OF FILTER UNDERDRAIN	1	LS	INCLUDED		INCLUDED		INCLUDED			
		CURING AND PROTECTION REQUIREMENTS (COVERING)	1	LS	INCLUDED		INCLUDED		INCLUDED			
SUBTOTAL						\$ 1,008,735.00		\$ 656,742.00		\$ 1,814,480.00		\$ -
BOND TOTAL					2.00%	\$ 20,174.70	3.00%	\$ 19,702.26	1.20%	\$ 21,773.76	2.00%	\$ -
TEXTURA TOTAL					0.22%	\$ 2,219.22	0.22%	\$ 1,444.83	0.22%	\$ 3,750.00	0.22%	\$ -
BID AMOUNT TOTAL						\$ 1,031,128.92		\$ 677,889.09		\$ 1,840,003.76		\$ -



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319 E Pioneer Street
Phoenix, AZ 85040
602-497-4997
gilles@ppscoatings.com
www.ppsphx.com
10-04-24

Archer-Western Contractors
4710 East Elwood Street, Suite 6
Phoenix, AZ 85040

Attention: Tony Jennaro, Estimating Department

ATTACHMENT 1
PROPOSED PRICING

Professional Piping Systems, LLC submits its Firm Lump sum pricing below.
Taxes are not Included.
Add 2% For Payment / Performance Bonds

Reference: PPS24-300
Pecos WTP Filter Improvements
Chandler, AZ

The following is PPS Coatings scope of work and pricing per the plans and specifications:

- Xypex Application per Section 07 16 16 Crystalline Waterproofing per quantity provided

- | | |
|---|---------------|
| - Surface Preparation to remove existing Coating: | 9,560 Sq.F. |
| - Surface Preparation of bare concrete: | 10,223 Sq.F. |
| - Application of Xypex | 19,784 Sq. F. |

Pricing includes containment as needed, sub-floors protection and water curing of Xypex.

Note:

We are assuming that the existing concrete is in stable and in sound condition in order to achieve the specified CSPI 3 to 5 Profile. Unforeseen excessive deterioration of the concrete beyond this understanding will need negotiation for its remedy.

Time for Completion: 2 Months

Please call me if you have any questions regarding this Proposal.

Gilles Bussieres,
Estimator/Project Manager
602-576-2740



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10-04-24

ATTACHMENT 2
Scope of work

PPS has **INCLUDED** in this proposal the following:

Inclusions					
Bid Item	Qty.	Unit	Description	Unit Price	Total
		LS	Xypex Application at Filter Structure		\$997,770.00



ATTACHMENT 3

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10-04-24

EXCLUSIONS

PPS has specifically **EXCLUDED** from this proposal the following:

- **Third Party Inspection of any kind**
- **Concrete Repairs**
- **Decommissioning of the Filter Structure**
- **Taxes**



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ATTACHMENT 4
Terms & Conditions

The following terms and conditions (these "Terms & Conditions") apply to the sale of goods, materials or products (collectively, "Products") or provision of services (collectively, "Services") by Professional Piping Systems, LLC, an Arizona limited liability company ("PPS"), to the customer identified on the Purchase Order to which these Terms & Conditions are attached (the "Customer") and all purchase orders and the provision of all Products or Services by PPS are subject to the Terms & Conditions.

1. Prices. Except as provided herein, prices offered by PPS for Services or Products in any written quote or estimate ("Quote") will remain in effect for a period of fifteen (15) days after the date of the Quote (the "Quote Date"). After said fifteen (15) day period, prices are subject to change. Prices for Products to be used in any Work (hereafter defined) which are obtained by PPS from a third party, are subject to change at any time to account for any fluctuations in the market price after the Quote Date.
2. Purchase Orders. All Services or Products to be provided by PPS to Customer shall be pursuant to a written purchase order executed by PPS and the Customer (a "Purchase Order"), referencing the scope of work described on the Quote, which will, at a minimum, include a description of the Services or Products to be provided by PPS (collectively, the "Work"), and the compensation to PPS therefor. PPS shall have no obligation to proceed with any Work until such time that it has received a fully executed Purchase Order and any initial deposit required there under.
3. Change Orders. The parties may only modify or add to the Work described in the Purchase Order by executing a written change order describing in reasonable detail the modified or additional Work to be completed and any adjustments to the schedule or the compensation to PPS therefore (a "Change Order"). PPS shall have no obligation whatsoever to commence or complete any additional or modified Work unless and until Customer and PPS have executed a Change Order.
4. Plans and Specifications; Scheduling. PPS shall complete or provide all Work in substantial conformity with written specifications, drawings and descriptions provided by Customer to PPS (collectively, "Customer Specifications"). PPS shall have no liability to Customer for any delays, damages or claims of any kind arising from defects, omissions, errors or deficiencies in the Customer Specifications and Customer shall defend, indemnify and hold PPS harmless for, from and against any and all liability, damages, claims, losses and expenses, including attorneys' fees and costs, arising therefrom or related thereto. PPS will furnish detailed joint design, pipeline layouts and manufacturing drawings for Customers' approval prior to commencing pipe manufacture at no extra cost. Drawings will be provided one (1) week after receipt of the approved layout.
5. Shipping. Shipping rate and delivery date will be arranged by mutual written agreement between PPS and Customer upon receipt of approved drawings. Any revised delivery schedule will be negotiated between PPS and Customer and will take into account PPS' current schedules of work on hand as well as current availability and prices of materials. Any delays on the project resulting in production or delivery delays longer than thirty (30) days may result in an escalation charge in an amount determined by PPS in its sole discretion. Prices are based on delivers in full truckload lots. Deliveries requested for material in quantities less than truckload lots will be billed to Customer at the full truck load rate. Internal bracing,

319 E. Pioneer Street Phoenix, AZ 85040 Phone 602.497.4997 Fax 602.497.4907



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stulling, and shoring are placed in pipe at the time of manufacture for the purpose of limited pipe deflection during hauling and handling. PPS is not responsible for internal bracing required for the installation or grouting of the pipe. Any special requirements, i.e. vertical elongation etc., will be the sole responsibility of Customer. Shipping Cradles and stull are the property of PPS and are to be grouped and reloaded on trucks, at Customer's expense, for reuse by PPS, if requested. Any bunks or stulls not returned in reusable condition will be billed to the Customer's account at full replacement cost. Risk of loss or damage shall pass to Customer when Products are delivered to Customer or delivered to or picked up by the shipping company.

6. Payment Terms. Payment terms are net thirty (30) days from the date that PPS sends an invoice to Customer for the amounts due. Any amounts not paid within such thirty (30) day period shall accrue interest thereafter until paid in full at a rate which is the lesser of eighteen percent (18%) per annum or the highest rate allowed under applicable laws, computed on a 365/360 day year basis. In addition, in the event that the Customer fails to pay the full amount due within thirty (30) days after PPS has sent Customer an invoice, PPS shall be entitled to exercise any of its available remedies under applicable law, which include suspension of any further work by PPS and retention of any equipment or other personal property owned by the Customer and in PPS' possession, until all past due amounts owing to PPS have been paid in full. PPS will invoice Customer for 100% of raw material (no retention) upon its arrival at PPS' facility. PPS will invoice Customer monthly for progress payments (less retention) per a PPS supplied schedule of values. PPS will invoice for all final amounts including retention amounts, after completion of the Work.

6. Warranty. PPS warrants that Products and Services provided by PPS to Customers are free from defects in material and workmanship. PPS' obligation under this warranty is limited to correction of defects in Products or Services which were provided by PPS. Within ten (10) calendar days after discovery of any defective Services or Products provided by PPS, Customer shall provide PPS written notice of such defect. This warranty does not cover any repairs or replacement required due to a Customer or third parties' accident, abuse, misuse, failure to maintain, disassembly, repair, modification, negligence, fault, or natural or man-made disaster. PPS shall have no liability to Customer for any: (a) consequential, special, indirect, incidental, punitive, or liquidated damages; or, (b) damages to or from products or services not furnished by PPS; or, (c) repair, replacement or other expenses incurred by Customer in correcting defective Products or Services provided by PPS. PPS' warranty will remain in effect for a period of twelve (12) months from the date the Products or Services were provided or completed. Notwithstanding the foregoing, with respect to new equipment, PPS' warranty will remain in effect until the earlier of: (i) twelve (12) months from the time the new equipment is placed into service; or, (ii) eighteen (18) months from the date of delivery to the Customer. PPS' warranty for new equipment shall apply only if Customer properly stores, maintains and operates said equipment in accordance with the original equipment manufacturer's procedures and specifications. EXCEPT FOR PPS' EXPRESS WARRANTY CONTAINED HEREIN, PPS IS NOT MAKING AND HEREBY EXPRESSLY DISCLAIMS ANY OTHER IMPLIED OR EXPRESS WARRANTIES WITH RESPECT TO THE SERVICES AND PRODUCTS. WITHOUT LIMITING THE FOREGOING, PPS EXPRESSLY DISCLAIMS ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

7. Indemnification. PPS will indemnify and hold Customer harmless for, from and against any and all claims, damages, liability, losses, or expenses, including reasonable attorneys' fees and costs pursuant



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to Arizona statutes, arising from or relating to PPS' breach of the Purchase Order or the Terms & Conditions. Customer will indemnify and hold PPS harmless for, from, and against any and all claims, damages, liability, losses or expenses, including reasonable attorneys' fees and costs pursuant to Arizona statutes, arising from or relating to Customer's breach of the Purchase Order or the Terms & Conditions. Notwithstanding anything to the contrary, under no circumstances will either party be liable to the other party for consequential, special, indirect, incidental, punitive, or liquidated damages.

8. Shortages, Defects or Errors. Customer shall give prompt written notice to PPS of any shortages, defects or errors in any Products or Services, which notice shall be given to PPS no later than ten (10) business days of Customer's receipt of the Product or the provision of Services.

9. Title. Title to Products provided by PPS shall not pass to Customer until PPS has received full payment of all amounts due for all Services performed and Products provided by PPS.

10. Cancellation. Customer may cancel a Purchase Order by providing written notice to PPS, provided, however, Customer will be obligated for all unpaid Work completed up to and including the date that PPS receives written notice of cancellation, plus PPS' reasonable profit for uncompleted Work under the Purchase Order.

11. Force Majeure. Neither PPS nor the Customer shall be liable for any damages, claims or liability of any kind arising from delay in performance caused by a "Force Majeure Event". As used herein, "Force Majeure Event" shall mean acts of God; acts of terrorism; explosion; fire; extreme weather conditions; flood; drought; epidemic; pandemic; earthquake; riot; insurrection; blockade; war or other hostilities; strike, lockout or other industrial disturbance; act or restraint of governmental authority whether valid or invalid; the refusal or failure of any governmental authority to promptly issue or grant any necessary governmental authorizations, permits, licenses, certificates or approvals or the action or inaction of any governmental authority which causes the lapse or expiration of any of the foregoing; shortages of materials or Products to be incorporated in the Work, and any other cause or event which is reasonably beyond the control of the party and which the party is not able to overcome by the exercise of reasonable diligence, provided, however, that neither party shall be required to settle any strike, work stoppage or other labor dispute on terms which, in its opinion, are unsatisfactory. If any delay in PPS' performance is attributable to a Force Majeure Event, the time for performance shall be extended for a period equal to the time of the delay caused by the Force Majeure Event. Notwithstanding the foregoing, the occurrence of a Force Majeure Event shall not excuse or delay any payment obligation under the Purchase Order or the Terms & Conditions.

12. Access and Cooperation. Customer shall provide PPS access to the Work site at all times during PPS' normal hours of business to enable PPS to complete the Work and shall otherwise cooperate with PPS so that the Work may be completed on a timely and efficient basis. Such cooperation shall include providing information to PPS necessary to obtain permits or other required governmental approvals for the Work and coordination with Customer's other contractors or employees to enable PPS to complete the Work without interference or interruption.

13. Jurisdiction, Venue and Waiver of Jury Trial. These Terms & Conditions and all Purchase Orders between PPS and Customer shall be interpreted and enforced according to Arizona substantive laws, without regard to Arizona's choice of law provisions. Any disputes between the parties arising from these Terms & Conditions or the Purchase Order shall be brought and maintained in a court of competent jurisdiction in Maricopa County, Arizona. PPS and Customer hereby irrevocably waive any and all rights they have to demand that any action, proceeding or counterclaim arising out of or in any way related to these Terms & Conditions or any Purchase Order be tried by jury.

14. Attorney Fees. In the event that either party hereto institutes an action or other proceeding to enforce any rights arising under these Terms & Conditions or any Purchase Order, the party prevailing in



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such action or other proceeding shall be paid all reasonable costs and reasonable attorneys' fees by the other party pursuant to Arizona statutes.

15. **Entire Agreement. Incorporation and Modification.** These Terms & Conditions and the applicable Purchase Order contain the entire agreement between the parties. These Terms & Conditions and the Purchase Order have been negotiated among the parties and, if there is any ambiguity, no presumption construing these Terms & Conditions or the Purchase Order shall be imposed because the same were prepared by such party or its attorney. These Terms & Conditions are hereby incorporated in and as a part of all Purchase Orders. To the extent that there is any conflict in the terms of these Terms & Conditions and the terms of a Purchase Order, these Terms & Conditions shall control, unless the Purchase Order, by its express terms, supersedes these Terms & Conditions by specific reference to the provision of these Terms & Conditions so modified. No modification of these Terms & Conditions or any Purchase Order shall be of any force or effect unless such modification is in writing and executed by both of the parties. These Terms & Conditions shall control over all additional or conflicting terms and conditions that may appear on Customer written documents, including purchase orders, delivery tickets, service order tickets, invoices or any other document and PPS' signature on any Customer written document shall not constitute PPS' consent to any terms and conditions set forth in such document. Notwithstanding the foregoing, the terms of the Purchase Order shall control over any conflicting Customer Specifications.

16. **Notices.** All notices or other communications required or provided to be given by either party shall be in writing and shall be hand delivered, transmitted by email or by United States first class mail, postage prepaid. Notices shall be deemed given upon hand delivery, or if sent via email, upon transmission provided the same is also sent on the date of transmission by first class mail, postage prepaid, or if mailed, three (3) calendar days after such notice is deposited in the mail, in each case, addressed to the parties to the addresses set forth in the Purchase Order. Any party may change the address to which notice shall be delivered or mailed or emailed by written notice duly given.

17. **Severability and Waiver.** The invalidity or unenforceability of any provision hereof shall in no way affect the validity or enforceability of any other provision hereof. Any waivers must be in writing and signed by the party sought to be charged. The waiver by any party of a right provided thereunder shall not be deemed to be a continuing waiver of that right or a waiver of any other right.

18. **Miscellaneous.** In these Term & Conditions: (i) the singular includes the plural and vice versa and reference to any gender includes each other gender; (ii) reference to any person includes such person's successors and assigns but only if such successors and assigns are not prohibited by these Term & Conditions; (iii) "hereunder," "hereof," "hereto," and words of similar import shall be deemed references to these Terms and Conditions as a whole; (iv) reference to any agreement, document or instrument means such agreement, document or instrument as amended or modified and in effect from time to time in accordance with the terms thereof; (v) references to documents, instruments or agreements shall be deemed to refer as well to all addenda, exhibits, schedules, restatement, supplements or amendments thereto; (vi) references to "day" or "days" mean calendar days; (vii) "including" (and with correlative meaning "include") means including without limiting the generality of any description preceding the word "including"; (viii) where specific language is used to clarify by example a general statement contained herein, such specific language shall not be deemed to modify, limit or restrict in any manner; (ix) "or" is used in the inclusive sense of "and/or"; (x) with respect to the determination of any period of time, "from" means "from and including" and "to" means "to but excluding"; (xi) references to amounts of money expressed in Dollars are references to United States Dollars; and (xii) any action required hereunder to be taken within a certain number of days shall, except as may otherwise be expressly provided herein, be taken within that number of days excluding the day on which the counting is initiated and including the final day of the period.



October 4, 2024

Archer Western
Tony Jennaro
4710 East Elwood Street
Suite 6
Phoenix, AZ 85040

RE: City of Chandler- Pecos Surface Water Treatment Plant Filter Improvements

Tony,

Below, please find the updated price to prepare and coat submerged concrete surfaces as outlined in project documents for the above-mentioned project. As discussed during our meeting this week, the coating limits have been better defined. Since coating will terminate approximately One (1) Foot above the water line, a termination line will be cut to allow coating to terminate inside newly cut void. This ensures that there is no leading edge of Xypex Coating Material. As mentioned, AO intends to erect scaffolding to access elevated surfaces safely. This scaffold will protect the under-drain system from spent abrasive and Xypex Material during rehabilitation. AO will contract a scaffold builder to evaluate under-drain conditions and develop a scaffold system that will focus on disbursing the weight of the scaffold as well as protecting under-drain. Also shown is the price to coat new small-diameter piping.

Care will be taken to properly cure Xypex Material, which includes misting the surface a minimum of three (3) times a day for three (3) days following installation. Along with erecting scaffolding, tarps will be used to cover basins to allow for proper curing of Xypex. Depending on environmental conditions, the shade created will help ensure Xypex Cures at the required rate. AO will coordinate with the Xypex Technical Representative before application to ensure that the coating approach is acceptable to the Xypex Representative.

Concrete Waterproofing

- Abrasive Blast Concrete to ICRI CSP 3 Surface Profile
- Two (2) Coats of Xypex Concentrate @ 1/16 inch Per Coat

Project Approach

- Mobilize equipment before shutdown begins
- Coordinate scaffold sub-contractor to develop a preliminary design of proposed scaffold towers and have materials onsite before shut-down to minimize downtime.
- Develop a workflow to ensure work begins immediately on North and South Settled Water Channels since these do not have any under-drains to protect.
- As surface preparation begins, another crew will begin to cover the first portion of the channels ready to receive coating.
- Once the surface has been inspected and approved, termination lines will be cut in preparation for the coating application; this will also include masking surfaces above the termination line to protect from over-spray.
- Multiple crews will be used to complete multiple tasks simultaneously, completing the project within the allowed time.



3237 E. President St. ▪ Tucson, AZ 85714 ▪ 520-573-0051 ▪ Fax 520-294-8353
ROC-095603 L-34 ▪ ROC-129492 L-05 ▪ Website: www.aopaintinginc.com



Page 37

- Once the Coating is applied, a quality control crew will ensure that the coated surface maintains the correct amount of moisture to cure properly. This includes misting the surfaces three (3) times daily for three (3) days.
- A Quality Control Manager on site will oversee the daily activities and electronically document environmental conditions and progress, including pictures and other important information. These daily logs will be submitted to Archer Western at the end of each shift.
- Special equipment will be used to ensure that work is being completed most efficiently. 12,000 CFM dust collector will minimize the dust created during the abrasive blast process and allow work to continue in neighboring basins. A Hurricane Vac will be used to remove spent abrasive. This will allow for a smaller clean-up crew, thus utilizing other crew members to help with the coating application

Proposed Schedule

November 18-26

- Mobilize equipment and coordinate with the scaffold subcontractor to ensure the majority of scaffold components are on site and ready to start on December 2.

December 2-13

- Scaffold erection to being in North and South Settled Water Channels then continuing to basins and filter gullets

December 5-13

- Surface Preparation and Termination Line in North and South Settled Water Channel

December 16-20

- Coating Application in North Settled Water Channel

December 23-January 3

- Surface Preparation begins in basins

January 6-10

- Surface Preparation begins in filter gullets

January 13-17

- Coating application in South Settled Water Channel

January 20- February 28

- Coating Application in basins and filter gullets

March 3-14

- Scaffold demobilization and clean up

March 17-19

- Final Inspection and clean up

Breakdown

Description	Price
Submerged Concrete Surfaces-Xypex	\$645,777.00
Above Grade Small Diameter Pipe	\$ 10,965.00
Bond Rate	3%

Above Prices Include

- Labor
- Material
- Equipment
- Confine Space Equipment
- Scaffold
- Supervision
- Quality Control Manager
- Disposal

Exclusions

- Existing Mechanical Surfaces
- Architectural Coating
- Caulking
- Sealers
- Taxes and Bonds
- 3rd Party Inspection

If you have any questions, please feel free to contact me.

Best Regards,

Alex "Bruiser" Ortega

Alex "Bruiser" Ortega
Secretary-Treasurer



PLANT LOCATION
2615 SAN JUAN BLVD FARMINGTON, NM 87401
PHONE (505) 327-4947

MAILING ADDRESS
P.O. BOX 2014 FARMINGTON, NM 87499
FAX (505) 326-0305

October 4, 2024

Archer Western

Attention: Tony Jennaro

Re: City of Chandler – Pecos WTP – Xypex lining of concrete filter Basins

We hereby submit our proposal for the above referenced project. Our figures include the supervision, labor, equipment, and materials to complete the following scope of work based on 18,144 sf of concrete surface to coated; to include Basin walls up to 1' above water level.

Basic Scope:

- Mobilize men and equipment to the job site.
- Vapor abrasive and water blasting to prepare the concrete surfaces to achieve a surface profile of ICRI CSP3.
- Application of Xypex:
 - Apply the first coat of Concentrate at a rate of 6-7.2 sf per pound as a cementitious slurry coat per manufacturer's data sheet recommendations.
 - Apply a second coat of Modified at a rate of 6-7.2 sf per pound to reinforce the Concentrate per manufacturer's data sheet recommendations.
- Wet curing per manufacturer's data sheet recommendations.
- Rig down and remove equipment from site.

PRICE **\$1,803,515.00** (see note 3)

Notes:

1. No taxes have been added; if there are applicable taxes, they will be added to the billing invoice.
2. Pricing does not include bonding; our bonding rate is 1.2%.
3. If it is decided to coat all the way to the top (Scenario 2) of the wall, please add \$163,116.00 to the above price.
4. Archer Western to provide:
 - Sanitary facilities
 - Clean water source
 - Draining of water and removal of any media.
 - Protecting underdrains using plywood.
5. Exclusions:
 - Tenting or heating
 - Removal of any media
 - Patching of deteriorated concrete to level the surface
 - Epoxy injection of large cracks

6. We anticipate 2-3 weeks' notice for a scheduled start up

Anticipated project duration: *

Task	Number of Days
Mobilize equipment to the site	1
Side #1: Set up scaffolding and equipment	2
Surface prep (abrasive vapor / water blasting)	5-7
Application of Xypex Concentrate slurry coat	8-10
Application of Xypex Modified top coat	8-10
Water curing	3-4
Side #2: Set up scaffolding and equipment	1
Surface prep (abrasive vapor / water blasting)	5-7
Application of Xypex Concentrate slurry coat	8-10
Application of Xypex Modified top coat	8-10
Water curing	3-4
Rig down, load up and demobilize from site	1
Total	53-67

(*) Based on having access to half of the facility at the same time.

Client Acceptance and Award

Authorized Signature

Printed Name

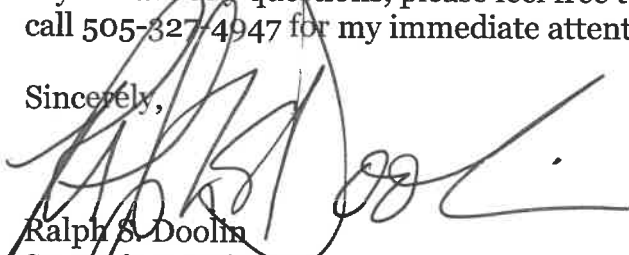
Title

Date

Note: By signing, client agrees to pay quoted amount and agrees to the terms explained in the work notes; see also our "Terms and Conditions" and initial the page. Acceptance needs to be returned before scheduling and performance of said work.

If you have any questions, please feel free to E-mail me at ralphd@rileyindustrial.com or call 505-327-4947 for my immediate attention.

Sincerely,


Ralph S. Doolin
Sr. Project Estimator



ELECTRICAL QUOTES

Project

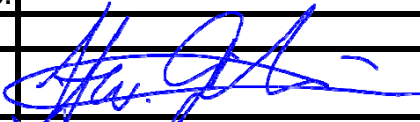
Chandler Pecos WTP Filter Improvements

Date

2024.10.03

Quoted Scope of Work

Number	Description	By Felix E/I&C	By Others
1	NOTE 1: This bid is based on the Chandler Pecos WTP Filter Improvements - Phase III City Project NO. PW3-925-4631 (Hazen) NOTE 2: Commodities, such as Copper Wire, are quoted based on 2024.10.03 pricing.	NOTE	NOTE
2	CIVIL (100) - N/A		All Civil/Site Work By OTHERS
3	CONDUIT (200) - Felix EI&C to Provide and Install PVC-CTD GRC Conduit in Above Ground Applications, and Anaconda Flex Conduit (UA) for Above Ground Applications. AG (1"): PVC-CTD GRC Conduit, PVC-CTD GRC Couplings, PVC-CTD GRC 90-Degree Elbows, PVC-CTD GRC LB Form 8, PVC-CTD GRC Myers Hubs w/ Ground, GRC Conduit, GRC Coupling, GRC 90-Degree Elbows, GRC Myers Hub w/ Ground, Anaconda Flex Conduit (UA), Flex Conduit 45-Degree Connector, Flex Conduit Straight Connector, Sealing Washer & Locknut, and PVC-CTD GRC and/or SS316 Conduit Strut Straps.	Provided and Installed by Felix E/I&C	N/A
4	CABLE & WIRE (300) - Felix EI&C to Provide and Install XHHW-2 for all Power and Non-Signal Control Wire, Belden TSP and Belden CAT6 for All Signal Wire. Branch Circuits: #12 AWG XHHW CU (STR), #14 AWG XHHW CU (STR), Belden 9318 (#18AWG/2 + Shield), and Machine Coded Sleeves for All Cables.	Provided and Installed by Felix E/I&C	N/A
5	LIGHTING (400) - N/A	N/A	N/A
6	GEAR (500) - Felix EI&C to Provide and Install Eight (8) 20A, 22kAIC, Bolt-On Branch Circuit Breakers in Panel: PP-FCP and One (1) 20A, 22kAIC, Bolt-On Branch Circuit Breaker in Panel: LP-DIS-1.	Provided and Installed by Felix E/I&C	N/A
7	GENERATOR (500) - N/A	N/A	N/A
8	INSTRUMENTATION (600) - Felix EI&C to Provide and ELECTRICALLY Install Four (4) 1" Flow Meters w/ Grounding Rings, One (1) Pressure Gauge w/ Ball Valve, Snubber, One (1) Pressure Switch, and One (1) 316SS Process Tree, One (1) Flow Switch. Spare Flow Meter - Felix EI&C to Provide One (1) Spare Flow Meter Electrical Installation Only: One (1) Metering Pump, Four (4) MOV's, One (1) Pressure Switch.	Provided and Electrically Installed by Felix E/I&C	Instruments and Field Devices Installed by Others. Valves Procured by Others.
9	CONTROL AND PUMP PANELS (600) - N/A	N/A	N/A

Number	Description	By Felix E/I&C	By Others
10	FABRICATION (700) - Felix E/I&C to Provide and Install 316 SS Strut and Hardware As-Required to Complete Electrical Installation.	Provided and Installed by Felix E/I&C	N/A
11	OTHER MISC. (800) - Felix E/I&C to Provide Contractor Testing and Owner/Engineer Start-Up, Electronic Submittals for All Felix E/I&C Provided Equipment, As-Built, and Field Reports.	Provided by Felix E/I&C	N/A
12	Programming - Not Included in Bid	N/A	√
13	Spare Parts - Included in bid (Flow Meter Only).	√	
14	Private Locating and Blue Stake	N/A	N/A
15	Painting and Coatings	N/A	N/A
16	Shade Structures SES or other Exterior Locations	N/A	N/A
17	Coordination / Arc Flash Study	N/A	N/A
18	As-Built / Red Lines	√	
19	Start-up/Calibrate Felix supplied Controls and Instruments	√	
20	Testing and Commissioning	√	
21	Plant MOPO's	N/A	N/A
22	Owner Site Training	√	
23	Concrete Pad's, Foundations, Curb's	N/A	N/A
24	Concrete embed sill's and custom specialty items	N/A	N/A
25	Concrete Coring, Saw cutting and Surface Restoration	N/A	N/A
26	Painting and Surface Restorations	N/A	N/A
27	Accelerated Schedules / Off Shift and Overtime Work	Excluded	Excluded
28	Trash Receptacles	N/A	N/A
29	Sanitary Facilities	N/A	N/A
30	Temporary Power	N/A	N/A
31	Construction Water	N/A	N/A
32	Permits / Permit Fees	N/A	N/A
33	Utility & Utility Fees	N/A	N/A
34	Taxes	N/A	N/A
NOTE: This Bid/Scope excludes the Power Study/Test called out on in the notes on SHEET E-08			
NOTE: This Bid/Scope excludes the Fiber Network, Ethernet Network, and PLC Programming on SHEET 1-02			
	Per Bid Scope, Construction Plans & Specifications.	\$ 273,989.78	
Signature:		Date:	
			
Estimator:	Trent Gillespie 602.618.2620		
	trentg@felixconstruction.com		

Proposal Clarifications

Project: Chandler Pecos WTP Filter Improvements
Date: 2024.10.03
Revision: Rev 0

Includes:

- 1 **AG (1"):** PVC-CTD GRC Conduit, PVC-CTD GRC Couplings, PVC-CTD GRC 90-Degree Elbows, PVC-CTD GRC LB Form 8, PVC-CTD GRC Myers Hubs w/ Ground, GRC Conduit, GRC Coupling, GRC 90-Degree Elbows, GRC Myers Hub w/ Ground, Anaconda Flex Conduit (UA), Flex Conduit 45-Degree Connector, Flex Conduit Straight Connector, Sealing Washer & Locknut, and PVC-CTD GRC and/or SS316 Conduit Strut Straps.
- 2 **Branch Circuits:** #12 AWG XHHW CU (STR), #14 AWG XHHW CU (STR), Belden 9318 (#18AWG/2 + Shield), and Machine Coded Sleeves for All Cables.
- 3 Felix EI&C to Provide and Install Eight (8) 20A, 22kAIC, Bolt-On Branch Circuit Breakers in Panel: PP-FCP and One (1) 20A, 22kAIC, Bolt-On Branch Circuit Breaker in Panel: LP-DIS-1.
- 4 Felix EI&C to Provide and ELECTRICALLY Install Four (4) 1" Flow Meters w/ Grounding Rings, One (1) Pressure Gauge w/ Ball Valve, Snubber , One (1) Pressure Switch, and One (1) 316SS Process Tree, One (1) Flow Switch.
Spare Flow Meter - Felix EI&C to Provide One (1) Spare Flow Meter
Electrical Installation Only: One (1) Metering Pump, Four (4) MOV's, One (1) Pressure Switch.
- 5 Felix EI&C to Provide and Install 316 SS Strut and Hardware As-Required to Complete Electrical Installation.
- 6 Felix EI&C to Provide Contractor Testing and Owner/Engineer Start-Up, Electronic Submittals for All Felix EI&C Provided Equipment, As-Built, and Field Reports.

Excludes:

- 1 All Civil Requirements - **Provided by OTHERS**
- 2 Any General Conditions - **Provided by OTHERS**
- 3 All Mechanical Requirements - **Provided by OTHERS**
- 4 All Structural Requirements - **Provided by OTHERS**
- 5 Valves & Motors/Pumps - **Provided by OTHERS**
- 6 **Power Study/Test called out on in the notes on SHEET E-08**
- 7 **Fiber Network, Ethernet Network, and PLC Programming on SHEET I-02**
- 8 Concrete Encased Duct Banks.
- 10 Pressure Switch or Pressure Transmitter
- 11 Temporary Power or Controls.
- 12 Conduit, Conductors, Wiring Devices, Trim Devices - Not Indicated on Construction Plans
- 13 ALL PLC/OIT/SCADA Software and Licenses
- 14 **ALL Spare Parts - EXCEPTION for One (1) Flow Meter as called out on in SPEC: 40 71 13.13.1.03.A**
- 15 Anything Not Listed Includes or Quoted Scope of Work.

Clarifications:

- 1 Due to current market volatility, material pricing is subject to the terms stated on the included material quotes, some of which may establish that final pricing will be determined at the time of shipment.
- 2 OTHERS TO INSTALL PROCESS DEVICES SUCH AS FLOW METER(S), PSH, FSL

Price Assumes:

- 1 Normal Working Hours

Assumes Owner to Provide:

- 1 Access to Site.

Project Contingency Usage:

- 1 N/A

Project Allowance Details:

- 1 N/A

PIPE & PIPE SUPPORT QUOTES

PROJECT NAME	PECOS SURFACE WATER TREATMENT PLANT FILTER IMPROVEMENTS - PHASE III
BID DATE	10/24/2024
OWNER	CITY OF CHANDLER
ENGINEER	HAZEN & SAWYER
SCOPE	PIPE AND PIPE SUPPORTS
ESTIMATOR INITIALS	TJ



BID QUANTITIES					FERGUSON		CAP FLOW		COPPER STATE NUT AND BOLT	
AREA	BID ITEM NO.	ITEM DESCRIPTION	QTY	UNIT	UNIT AMOUNT	BID	UNIT AMOUNT	BID	UNIT AMOUNT	BID
110	40.110.105	1" FAP CHEMICAL CPVC	420	LF	\$ 3.16	\$ 1,327.20	\$ 2.69	\$ 1,128.00		
		1" FTG 90, FAP CHEMICAL CPVC	50	EA	\$ 4.44	\$ 222.00	\$ 6.00	\$ 300.00		
		1" FTG CAP, FAP CHEMICAL CPVC	10	EA	\$ 8.53	\$ 85.30	\$ 9.00	\$ 90.00		
		1" FTG T, FAP CHEMICAL CPVC	9	EA	\$ 6.01	\$ 54.09	\$ 10.84	\$ 97.56		
		1" FTG UNION, FAP CHEMICAL CPVC	14	EA	\$ 12.27	\$ 171.78	\$ 10.00	\$ 140.00		
		1" BALL V-PORT BALL VALVE, FAP CHEMICAL - MANUAL	2	EA	\$ 179.16	\$ 358.32	\$ 900.00	\$ 1,800.00		
		1" BALL V-PORT BALL VALVE, FAP CHEMICAL - EMO	4	EA	\$ 7,993.00	\$ 31,972.00	\$ 7,086.84	\$ 28,347.34		
		1" CPVC VANSTONE FLANGE	16	EA	\$ 13.00	\$ 208.00	\$ 10.00	\$ 160.00		
		REMOTE STATION	4	EA	\$ 812.50	\$ 3,250.00	\$ 812.50	\$ 3,250.00		
110	40.110.110	1 5/8 X 1 5/8 X 10' 12 GA SINGLE HALF SLOT STRUT 304 S/S 10FT	100	LF	NOT INCLUDED		\$ 12.50	\$ 1,250.00	\$ 9.59	\$ 958.53
		1" RIGID PIPE CUSHION CLAMP 304 S/S	99	EA	NOT INCLUDED		\$ 12.00	\$ 1,188.00	\$ 11.12	\$ 1,100.88
		3 HOLE (1 5/8 DEPTH X 3 1/2 LENGTH) Z FITTING 304 S/S	198	EA	NOT INCLUDED		\$ 25.00	\$ 4,950.00	\$ 10.92	\$ 2,162.48
		1/2" X 4 1/4" WEDGE ANCHOR 316 S/S	198	EA	NOT INCLUDED		\$ 10.00	\$ 1,980.00	\$ 5.74	\$ 1,135.53
SUBTOTAL						\$ 37,648.69		\$ 35,312.90		\$ 5,357.42
BOND TOTAL					0.00%	\$ -	0.00%	\$ -	0.00%	\$ -
TEXTURA TOTAL					0.22%	\$ 82.83	0.22%	\$ 77.69	0.22%	\$ 11.79
BID AMOUNT TOTAL						\$ 37,731.52		\$ 35,390.59		\$ 5,369.20



Mrs. Jamie Germann
Outside Sales, AZ-NM-El Paso
Strategic Infrastructure Group (Plant Division)

Ferguson Waterworks
1324 S. 3rd Street # 140 Phoenix, AZ 85004
Office (602) 495-8420
Direct Mobile (480) 619-3382
E: jamie.germann@ferguson.com

Pricing valid for 30 days - 9/27/24
Quoting import materials - no specifications provided - pricing subject to change if specs do

Line	Description	QTY	UOM	SELL	EXT	Notes	Lead time
Chemical	1" FAP CHEMICAL	380	LF	\$ 3.16	\$ 1,201.05	QUOTING 380LF V/ 377LF PER 20' SOLD	
Chemical	1" FTG 90, FAP CHEMICAL	48	EA	\$ 4.44	\$ 213.12		
Chemical	1" FTG CAP, FAP CHEMICAL	8	EA	\$ 8.53	\$ 68.27		
Chemical	1" FTG T, FAP CHEMICAL	7	EA	\$ 6.01	\$ 42.09		
Chemical	1" FTG UNION, FAP CHEMICAL	12	EA	\$ 12.27	\$ 147.20	QUOTING 1" CPVC S80 SW EPDM UNION	
Chemical	1" BALL V-PORT BALL VALVE, FAP CHEMICAL - MANUAL	2	EA	\$ 179.16	\$ 358.32	QUOTING CPVC/EPDM SST BALL WITH INDICATOR	APPRX 6-8 WEEKS ARO
Chemical	1" BALL V-PORT BALL VALVE, FAP CHEMICAL - EMO	4	EA	\$ 7,993.00	\$ 31,972.00	QUOTING CPVC/EPDM SST BALL WITH INDICATOR	APPRX 14-16 WEEKS ARO
Chemical	1" BALL MAGNETIC FLOW METER, FAP CHEMICAL	4	EA	\$ -	\$ -	AND 120VAC EMO	
Chemical	10' FEET OF 1/2" REINFORCED FLEX TUBE FOR CHEMICAL PUMP + 4 CLAMPS SEE PICTURES	1	EA	\$ -	\$ -	No bid	
				\$ -	\$ -	No bid	
	Add for waste			\$ -	\$ -		
				\$ -	\$ -		
Chemical	1" FAP CHEMICAL	420	LF	\$ 3.16	\$ 1,327.20		
Chemical	1" FTG 90, FAP CHEMICAL	50	EA	\$ 4.44	\$ 222.00		
Chemical	1" FTG CAP, FAP CHEMICAL	10	EA	\$ 8.53	\$ 85.33		
Chemical	1" FTG T, FAP CHEMICAL	9	EA	\$ 6.01	\$ 54.12		
Chemical	1" FTG UNION, FAP CHEMICAL	14	EA	\$ 12.27	\$ 171.73	QUOTING 1" CPVC S80 SW EPDM UNION	
				\$ 35,862.44			



PHX
3602 N 35th Ave
Phoenix, AZ 85017-4408
USA

Quotation



Quotation

QT04400509-1

Page 1 of 1

9/25/2024 1:9:32 pm

Ordered by: Javier Acosta Order Date: 9/25/2024 Expiry Date: 10/2/2024 Mode of delivery: Delivery notes: Delivery terms: FOB Origin, PPD & Add Carrier account number: Weight (estimated): 0.00 Tax Group: AVATAX Cash Discount: 0% 0 Days Payment Days: 0	Customer: ARC02500 Archer Western Contractors, LLC. 4710 E Elwood St Ste 6 PHOENIX, AZ 85040 USA Delivery Address: Archer Western Contractors, LLC. 3625 S. Winchester Rd Apache Junction, AZ 85119 USA	Cust P.O.: Cust Ref: Contact: Phone: Mobile: Email: Notes: <table><tr><td># Boxes</td><td># Bundles</td><td># Other</td><td>Stage Area</td></tr></table>	# Boxes	# Bundles	# Other	Stage Area																																															
# Boxes	# Bundles	# Other	Stage Area																																																		
<table><tr><th>Item Number/Customer</th><th>Config/Source</th><th>Description</th><th>Quantity</th><th>Unit</th><th>Availability</th><th>Unit Price</th><th>Ext. Price</th><th>Sales Tax</th></tr><tr><td>1 23STA1201H3-10</td><td>Bundle .</td><td>1 5/8 x 1 5/8 x 10' 12 Ga Single Half Slot Strut 304 S/S</td><td>100</td><td>Ft</td><td>Stock</td><td>9.5853</td><td>958.53</td><td>82.44</td></tr><tr><td>2 23PC113-100</td><td>. .</td><td>1" Rigid Pipe Cushion Clamp 304 S/S</td><td>99</td><td>Ea</td><td>5-7 Days</td><td>11.1200</td><td>1,100.88</td><td>94.68</td></tr><tr><td>3 23ZF043</td><td>. .</td><td>3 Hole (1 5/8 Depth x 3 1/2 Length) Z Fitting 304 S/S</td><td>198</td><td>Ea</td><td>5-7 Days</td><td>10.9216</td><td>2,162.48</td><td>185.98</td></tr><tr><td>4 21SW-0500425</td><td>. .</td><td>1/2" X 4 1/4" Wedge Anchor 316 S/S</td><td>198</td><td>Ea</td><td>Stock</td><td>5.7350</td><td>1,135.53</td><td>97.66</td></tr></table>	Item Number/Customer	Config/Source	Description	Quantity	Unit	Availability	Unit Price	Ext. Price	Sales Tax	1 23STA1201H3-10	Bundle .	1 5/8 x 1 5/8 x 10' 12 Ga Single Half Slot Strut 304 S/S	100	Ft	Stock	9.5853	958.53	82.44	2 23PC113-100	. .	1" Rigid Pipe Cushion Clamp 304 S/S	99	Ea	5-7 Days	11.1200	1,100.88	94.68	3 23ZF043	. .	3 Hole (1 5/8 Depth x 3 1/2 Length) Z Fitting 304 S/S	198	Ea	5-7 Days	10.9216	2,162.48	185.98	4 21SW-0500425	. .	1/2" X 4 1/4" Wedge Anchor 316 S/S	198	Ea	Stock	5.7350	1,135.53	97.66								
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For a complete copy of our Terms & Conditions, please visit our website at www.copperstate.com:
It is the policy of Copper State Bolt & Nut Co. to offer only the highest quality products supplied by established and approved vendors. We assume no liability beyond replacing defective merchandise and refunding the purchase price, providing a claim is processed within a reasonable amount of time. We will not allow claims for consequential damage, transportation charges or for labor or other expenses incurred in removing defective products or installing replacement material. Any product manufactured by Copper State is manufactured per applicable specifications and tested per those specifications in accredited laboratories.

We hereby disclaim all warranties of fitness, fitness for purpose, and/or merchantability, express or implied, other than the limited return and replacement right set forth above and any warranties which the manufacturer may supply.

Sub Total

Freight:

Order Total USD

5,357.42	460.76
0.00	
5,818.18	



Capital Flow Arizona LLC

304 S Price Rd
Tempe, AZ 85281

Estimate

Date	Estimate No.
9/20/2024	1469

Name/Address

ARCHER WESTERN
4710 E ELWOOD ST, STE 6
PHOENIX, AZ 85040
USA

Ship To

WILL CALL

Payment Method	FOB
Net 30	JOBSITE

Project

Qty	U/M	Description	Unit Cost	Total
		****PECOS SWTP FILTER IMPROVEMENTS****		
420	ft	01"x20'-0" SCH80 CPVC PIPE (PE)	2.68571	1,128.00
50	ea	01" SCH80 CPVC 90° BEND - SxS	6.00	300.00
10	ea	01" SCH80 CPVC SLIP CAP	9.00	90.00
9	ea	01"x01" SCH80 CPVC TEE - SxSxS	10.84	97.56
16	ea	01" SCH80 CPVC VANSTONE FLANGE	10.00	160.00
14	ea	01" SCH80 CPVC SxS UNION w/EPDM SEALS	10.00	140.00
4		01" 150lb. FLG'd SS V-PORT BALL VALVE w/ADCWX150UL2Y1Z-UP EMO	7,086.835	28,347.34
4	ea	REMOTE STATION REBUILD	812.50	3,250.00
2	ea	01" 150lb FLG'd SS V-PORT BALL VALVE w/LEVER HANDLE	900.00	1,800.00
1	ea	BLUE WHITE PERISTALTIC PUMP - PWTP-PLY-PMP-3505	9,923.75	9,923.75
100	ft	1-5/8"x1-5/8" 304ss STRUT w/ELONG HOLES	12.50	1,250.00
99	ea	01" 304ss STRUT 'CUSH CLAMP' [1.315od]	12.00	1,188.00
100	ea	1-5/8" 304ss Z-FITTING	25.00	2,500.00
200	ea	1/2"x4-1/4" 316ss WEDGE ANCHOR	10.00	2,000.00
			Total	\$52,174.65

Phone #
4803772838

E-mail
eric@capfloww.com

PERISTALTIC METERING PUMP QUOTES

PROJECT NAME	PECOS SURFACE WATER TREATMENT PLANT FILTER IMPROVEMENTS - PHASE III
BID DATE	10/4/2024
OWNER	CITY OF CHANDLER
ENGINEER	HAZEN & SAWYER
SCOPE	METERING PUMP
ESTIMATOR INITIALS	TJ



BID QUANTITIES					CAP FLOW		PRECISION INSTRUMENTS	
AREA	BID ITEM NO.	ITEM DESCRIPTION	QTY	UNIT	UNIT AMOUNT	BID	UNIT AMOUNT	BID
	46.110.105	BLUE WHITE PERISTALTIC PUMP PWTP-PLY-PMP-3505	1	LS	\$ 9,923.75	\$ 9,923.75	\$ 8,586.03	\$ 8,586.03
		NSF 61	1	LS	INCLUDED		INCLUDED	
		5 YEAR WARRANTY	1	LS	INCLUDED		INCLUDED	
		A4 TUBING	2	LS	\$ 161.14	\$ 322.28	\$ 161.14	\$ 322.28
		ROLLER ASSEMBLY	1	LS	\$ 680.26	\$ 680.26	\$ 680.26	\$ 680.26
		FIELD SERVICES	1	LS	INCLUDED		\$ 1,750.00	\$ 1,750.00
		SHIPPING	1	LS	INCLUDED		\$ 150.00	\$ 150.00
SUBTOTAL						\$ 10,926.29		\$ 11,488.57
BOND TOTAL					0.00%	\$ -	0.00%	\$ -
TEXTURA TOTAL					0.22%	\$ 24.04	0.22%	\$ 25.27
BID AMOUNT TOTAL						\$ 10,950.33		\$ 11,513.84



Capital Flow Arizona LLC

304 S Price Rd
Tempe, AZ 85281

Estimate

Date	Estimate No.
9/20/2024	1469

Name/Address

ARCHER WESTERN
4710 E ELWOOD ST, STE 6
PHOENIX, AZ 85040
USA

Ship To

WILL CALL

Payment Method	FOB
Net 30	JOBSITE

Project

Qty	U/M	Description	Unit Cost	Total
		****PECOS SWTP FILTER IMPROVEMENTS****		
420	ft	01"x20'-0" SCH80 CPVC PIPE (PE)	2.68571	1,128.00
50	ea	01" SCH80 CPVC 90° BEND - SxS	6.00	300.00
10	ea	01" SCH80 CPVC SLIP CAP	9.00	90.00
9	ea	01"x01" SCH80 CPVC TEE - SxSxS	10.84	97.56
16	ea	01" SCH80 CPVC VANSTONE FLANGE	10.00	160.00
14	ea	01" SCH80 CPVC SxS UNION w/EPDM SEALS	10.00	140.00
4		01" 150lb. FLG'd SS V-PORT BALL VALVE w/ADCWX150UL2Y1Z-UP EMO	7,086.835	28,347.34
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1	ea	BLUE WHITE PERISTALTIC PUMP - PWTP-PLY-PMP-3505	9,923.75	9,923.75
100	ft	1-5/8"x1-5/8" 304ss STRUT w/ELONG HOLES	12.50	1,250.00
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200	ea	1/2"x4-1/4" 316ss WEDGE ANCHOR	10.00	2,000.00
			Total	\$52,174.65

Phone #
4803772838

E-mail
eric@capfloww.com

Precision Integrated Systems

PO Box 147

Wickenburg, AZ 85358

+1 9286845560

robbie@chemfeed.net

**Estimate****ADDRESS**

Archer Western Construction, LLC
 1830 N. 95th Avenue, Ste 114
 Phoenix, AZ 85037 US

SHIP TO

Archer Western Construction, LLC
 1830 N. 95th Avenue, Ste 114
 Phoenix, AZ 85037 US

ESTIMATE #	DATE	
7945	09/23/2024	

ITEM	DESCRIPTION	QTY	RATE	AMOUNT
M4S24-BNL	Blue-White M4S Series Peristaltic Pump- a. Design Capacity: 0.01 – 100 GPH (Flex-A-Prene Tubing) b. Design Pressure: 50 PSIG. c. Power Requirements: 120 Vac, 60 Hz, Single Phase. d. Inlet/Outlet Connections: 1/2" Barb d. Signal Inputs: i. Discrete: Run Command. ii. Analog: 4 – 20 mADC. e. Signal Outputs: i. Discrete: In Remote. ii. Discrete: Fail. iii. Discrete: On Status. iv. Analog: 4 – 20 mADC. b. Warranty: 5-Year c. NSF-61: Yes	1	8,586.03	8,586.03T
A4-BNL-T	A4 Tubing, 1/2" Tubing barb fitting, Flex-A-Prene 0.500 ID	2	161.14	322.28T
A4-MNL-R	Complete roller assembly, A4	1	680.26	680.26T
Service Call	Service Call - (one day onsite)	3 1	1,750.00	5,250.00

Lead time: 3-4 weeks ARO

FOB: Origin

Terms: Net 30 on established account. Credit cards
 accepted with 3.5% transaction fee.

SUBTOTAL	14,838.57
TAX	0.00
SHIPPING	150.00
TOTAL	

\$14,988.57**-\$3,500****\$11,488.57**

SAND INSTALLATION QUOTE



Pecos Surface Water Treatment Plant Filter Improvements – Phase III

Calgon Carbon Corporation

3000 GSK Drive,

Moon Township, PA 15108

Date: October 2, 2024

Spec Section: Section 46 61 17

Product	Quantity	Unit Price	Total Price
Sand Installation + Disinfection	3,050 cubic feet	N/A	\$93,000
Total			\$93,000

✓ Items Included

- Installation and disinfection of sand as per specification 3.02.
- Disinfection shall be followed in accordance with AWWA C653
- All related labor and equipment (trucks, hoppers, hoses, etc), except utilities detailed below.
- Manufacturer installation instructions to be submitted 2 weeks following executed contract, all other submittals documented in 1.06 do not apply to CCC

✗ Items NOT Included

- Owner to provide clean water source for movement of GAC to and from filter via eduction
- Sand to be provided by the owner
- Filter box to be thoroughly cleaned by the contractor (3.02.4)

- Field Testing (3.03) to be completed by the contractor
- Any applicable taxes not included.



Schedule

- Installation: 8-10 weeks after receipt of approved purchase order

8-10 Days for installation per email.



Special Terms & Conditions

1. Unless otherwise noted, or until other Terms and Conditions are provided, this offer is made only under Calgon Carbon Corporation's Terms and Conditions for the Sale of Carbon and Media.
2. Pricing provided is exclusive of any sales tax.
3. Scope of Supply/Pricing does not include any payment or performance bonds. Costs for any such bond (if necessary or requested by the buyer) will be added to the quoted pricing.
4. Upon acknowledgement of any purchase order, the buyer will be requested to complete a Credit Application and provide Tax Exemption Documentation.
5. The quoted price is valid until March 31st, 2024

For more information or to place an order, contact:

James Gray

Calgon Carbon Corporation - A Kuraray Company

Director of Sales - Drinking Water Solutions

james.pgray@kuraray.com

412-956-7885



Terms and Conditions for the Sale of Carbon and Media

1) DEFINITIONS:

- (a) Seller: Calgon Carbon Corporation or its applicable subsidiary or affiliate
- (b) Buyer: The buyer named in the Documentation
- (c) Documentation: The proposal, confirmation, acknowledgement or other contract, as applicable, for the sale of the Products to which these Terms and Conditions are attached
- (d) Goods: Any carbon cloth, carbon, resin, diatomaceous earth, and/or perlites sold pursuant to the terms of the Documentation
- (e) Products: The Goods and services, collectively, described in the Documentation
- (f) Agreement: The Documentation, these Terms and Conditions and any attachments referenced in the Documentation

2) GENERAL: Seller hereby offers for sale to Buyer the Products on the express condition that Buyer agrees to accept and be bound by the terms and conditions set forth herein. To the extent of a conflict between these Terms and Conditions and the express terms set forth in the Documentation, the terms set forth in the Documentation shall control. Any provisions contained in any document issued by Buyer are expressly rejected and if the terms and conditions set forth herein differ from the terms in any document issued by Buyer, this document shall be construed as a counter offer and shall not be effective as an acceptance of Buyer's document. In ordering and delivery of the Products, the parties may employ their standard forms; provided, however, that nothing in those forms shall be construed to modify or amend the terms of this Agreement. In the event of a conflict between this Agreement and either party's standard forms, this Agreement shall govern.

3) PRICE AND PAYMENT: The price shall be as stated in the Documentation. Unless otherwise stated in the Documentation: (a) The price is exclusive of any taxes, tariff, and duties of any kind which either party may be required to pay with respect to the sale of goods described in the Documentation, and Buyer shall be responsible for the payment of all taxes, tariffs and duties related hereto, except for income taxes imposed on Seller; (b) Sales tax will be added to the price based upon the Product destination unless tax exemption or direct pay documentation is provided; (c) Products will be billed for at the time of delivery; and (d) Payment terms shall be net thirty (30) days, or net forty-five (45) days if paid by Electronic Funds Transfer (EFT). A late payment fee of 1.25% per month, or the highest lawful rate, whichever is less, will apply to all amounts past due, and will be prorated per day. Retainage may only be applied on the final invoice. Buyer agrees that Seller, at its discretion, may accelerate and make due and payable all remaining payments if Buyer shall fail to perform any of its obligations hereunder or under the Documentation, including without limitation Buyer's failure to pay any amount when due, subject to any applicable cure periods provided for herein.

4) PRICING CONDITIONS:

(a) Unless otherwise indicated within the Documentation, all pricing quoted in connection with the Documentation is valid for purchase for a sixty (60) day period beginning with the date of the Documentation.

(b) If this Agreement shall continue into the next calendar year, the fees payable pursuant hereto will be adjusted on January 1st of such calendar year as outlined in the Documentation; provided that if the Documentation is silent, the mechanism set forth in Section 4(c) below will apply.

(c) If the Documentation is silent regarding the mechanism for adjustment of fees, the fees will be adjusted on January 1st of such calendar year by the annual percentage change in the combined average of two Producer Price Indices, as published by the United States Department of Labor: (i) Producer Price Index of other Petroleum and Coal Products Manufacturing, and (ii) Producer Price Index of Basic Organic Chemicals. The percent adjustment shall be calculated by taking the percent difference for each index during the twelve month period from January 1st through December 31st of the last completed calendar year as compared to the twelve month period from January 1st through December 31st of the calendar year immediately preceding the last completed calendar year. These two percentages will then be averaged for calculating the final percent increase to which all Goods will be subject. If the calculation would result in a negative adjustment, no changes shall be made for such year.

5) SALE AND DELIVERY: Sale terms and pricing, unless otherwise specified in the Documentation, are F.O.B. Seller's point of shipment (Incoterms® 2020). If freight is to be prepaid by Seller and added to the amount due, Seller shall add up to a thirty-five percent (35%) surcharge to the freight charges. Seller will have the right, at its election, to make partial shipments of the Products and to invoice each shipment separately. Seller reserves the right to stop delivery of

any Product in transit and to withhold shipments in whole or in part if Buyer fails to make any payment to Seller when due or otherwise fails to perform its obligations hereunder or under any other outstanding payment obligations of Buyer to Seller, whether related to the Documentation or otherwise.

6) TITLE AND RISK OF LOSS: Notwithstanding the trade terms indicated above and subject to Seller's right to stop delivery of any Goods in transit pursuant to Section 5 above, title to and risk of loss of the Goods will pass to Buyer upon delivery of the Goods by Seller to the carrier at Seller's point of shipment. Notwithstanding the foregoing or the provisions of the Uniform Commercial Code or Incoterms® 2020, if Buyer is located outside of the United States of America, title to the Goods, and all accessions to or products of the Goods, shall remain with Seller until the later of (a) payment in full of the purchase price and of other amounts owing by Buyer and (b) delivery to Buyer.

7) AVAILABILITY: Shipment dates (and delivery and installation dates, if included in the scope of work) are not guaranteed, and Seller will not be liable for any loss or damage resulting from any delay in delivery or failure to deliver which is due to any cause beyond Seller's reasonable control. In the event of a delay due to any cause beyond Seller's reasonable control, Seller reserves the right to reschedule the shipment within a reasonable period of time, and Buyer will not be entitled to refuse delivery or otherwise be relieved of any obligations as the result of such delay. If any delivery is delayed for more than thirty (30) days beyond the originally scheduled delivery date and such delay is caused by Buyer, Buyer will be subject to storage charges from the scheduled shipment date of two percent (2%) of the sale price per month; and such storage charge shall be due monthly on the first day of each month. Storage by Seller shall be at Buyer's risk and expense.

8) SERVICES:

(a) All orders which include services (including installation, supervision, startup, training, testing, etc.) as stated in the Documentation will require the completion of the Pre-Visit Checklist and Service Request Form prior to scheduling the visit. If there are delays, cancellations, or failures by Buyer to meet service personnel at designated times, then fees will be assessed to the customer at Seller's then-applicable per hour rate for each hour of delay for each person. For domestic or international travel, additional fees will apply.

(b) Buyer shall make the premises, where services are to be performed (the "Premises"), available to Seller at all reasonable times as Seller may request, such that Seller shall be able to perform the services in a timely manner. Buyer shall bear all risk and liability associated with its inability to make the Premises available to Seller to perform the services. Prior to the commencement of services, Buyer shall ensure that the Premises are in good repair and in safe condition, and shall notify Seller of any dangerous, unsafe or hazardous conditions associated with the Premises, such that Seller can take the appropriate safeguards. Prior to the commencement of any work, Buyer shall notify Seller of any special workplace requirements, safety standards, operating procedures or other conditions imposed on persons performing work at the Premises.

(c) Any spent activated carbon covered by this Agreement will be subjected to reactivation acceptance testing by Seller as described in Seller's Guidelines for Return for Reactivation of Granular Activated Carbon, which Seller may update from time to time in its sole discretion. Buyer will provide any information required by Seller relative to evaluating carbon acceptance. Seller reserves the right to reject any and all activated carbon if, in its judgment, it is unsuitable for reactivation. Further, Seller will periodically retest the spent activated carbon to assure it remains acceptable for reactivation and that it does not contain constituents that were not in the carbon acceptance sample and/or Adsorbate Profile Document. Seller reserves the right to apply a surcharge for reactivation of spent carbon with quality that creates excessive corrosion, slagging,

exothermic reactions, or other operational problems including lower furnace operating rates. If the spent activated carbon becomes unacceptable for reactivation, disposal of the carbon will be the responsibility of Buyer. Seller reserves the right to reactivate the spent carbon at any of its reactivation facilities where carbon acceptance exists.

9) PERMITS, LICENSES AND FEES: Buyer shall be responsible, at its sole expense, for all environmental permits, applications, regulatory approvals, and other permits or licenses that may be required for installation and/or operation of the Products.

10) TERMINATION: Seller may cancel this Agreement if any of the following occurs: (a) Buyer becomes insolvent; (b) Buyer ceases to conduct its operations in the normal course of business; (c) Buyer is unable to meet its obligations as they mature, or admit in writing such inability or fails to provide adequate assurances of its ability to perform its obligations hereunder; (d) Buyer files a voluntary petition in bankruptcy; (e) Buyer suffers the filing of an involuntary petition in bankruptcy and the same is not dismissed within thirty (30) days after filing; (f) a receiver, custodian or trustee is appointed for Buyer or for a substantial part of its property; (g) Buyer fails to make payment on the terms and within the time specified in this Agreement, or breaches any other obligations under this Agreement; or (h) Buyer executes an assignment for the benefit of its creditors. In the event of such cancellation, Seller shall have all rights and remedies set forth in the Uniform Commercial Code of any applicable jurisdiction and all other remedies available at law or in equity. Sections 2, 10, 11, 12, 14, 15, 16, 18, 19 and 20 shall survive termination or expiration of this Agreement.

11) LIMITED WARRANTIES:

(a) Unless otherwise specifically provided for in the Documentation, Seller warrants that all Products provided under this Agreement shall, at the time of delivery, conform to Seller's then-applicable specifications for such Products. Seller shall correct (by replacement of Goods or reperformance of services) any failure to conform to the foregoing warranty of which it is notified in writing within ninety (90) days from delivery. Any Goods removed in connection with such replacement may be reactivated or disposed of at Seller's sole discretion.

(b) THE OBLIGATIONS CREATED BY THIS WARRANTY TO REPAIR OR REPLACE DEFECTIVE GOODS OR TO PROVIDE CORRECTIVE SERVICES SHALL BE THE SOLE REMEDY OF BUYER IN THE EVENT OF DEFECTIVE GOODS OR SERVICES. THERE ARE NO WARRANTIES MADE WITH REGARD TO THE PRODUCTS OTHER THAN THOSE CONTAINED IN THIS SECTION. ALL OTHER WARRANTIES, EITHER EXPRESS OR IMPLIED, ARE HEREBY DISCLAIMED, INCLUDING, WITHOUT LIMITATION, THE WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE AND ALL WARRANTIES ARISING FROM COURSE OF DEALING OR USAGE OF TRADE.

(c) The sale of any Products pursuant to this Agreement does not include any license, express or implied, to practice any intellectual property owned or licensed by any third party. Buyer agrees not to use the Products for any patented use not set forth expressly in this Agreement, absent a separate license from the holder of such patent. Additionally, Buyer agrees not to resell or sublicense the use of Products for any use not expressly granted hereunder. Any warranty obligations do not apply to any specific use of the Products, application of the Products, modification of the Products, or combination of the Products with any product manufactured by any third party. Seller, except as noted herein, does not and will not warrant, indemnify, or in any other way share responsibility for Buyer's use, application, modification, or combination of the Products.

12) LIMITATION OF LIABILITY: Notwithstanding any provision to the contrary herein, except with respect to a breach of the confidentiality obligations set forth in Section 15 hereof, the parties hereto agree that in no event shall either party be liable to the other party for any indirect, special, consequential, incidental or punitive damages, or lost profits, as a result of a breach of any provision of this Agreement or for any other claim of any kind arising out of or relating to this Agreement, whether in contract, in tort or otherwise. Notwithstanding any provision to the contrary herein, for all losses, damages, liabilities or expenses (including attorney's fees and costs), whether for indemnity or negligence, including errors, omissions or other acts, or willful misconduct, or based in contract, warranty (including any costs and fees for repairing, replacing or re-

performing services or curing a breach hereof), or for any other cause of action (individually, a "Claim"; collectively, "Claims"), Seller's liability, including the liability of its insurers, employees, agents, directors, and officers and all other persons for whom Seller is legally responsible, shall not, to the maximum extent permitted by law, exceed in the cumulative aggregate with respect to all Claims arising out of or related to this Agreement, the lesser of (a) the total amount of compensation paid to Seller hereunder, and (b) One Million Dollars (\$1,000,000). All Claims of whatsoever nature shall be deemed waived unless made in writing within ninety (90) days of the occurrence giving rise to the Claim. Moreover, any failure of Buyer to notify Seller of unsatisfactory operation or any improper or unauthorized installation, maintenance, use, repair, or adjustment shall relieve Seller of any further responsibilities hereunder.

13) FORCE MAJEURE: Notwithstanding any provision to the contrary herein, Seller shall have no liability to Buyer or its affiliates, and shall have the right to suspend performance (including, without limitation, shipments) hereunder, in the event of war, riot, terrorism, accident, explosion, sabotage, flood, acts of God, fire, court order, strike, labor disturbance, work stoppage, national defense requirements, act of governmental authority, pandemic, epidemic, extraordinary failure of equipment or apparatus, inability to obtain electricity or other type of energy, raw material, labor, equipment or transportation, or other causes beyond Seller's reasonable control. It is understood and agreed that settlement of strikes, lockouts and other labor disputes shall be entirely within the discretion of Seller and that nothing in this Agreement shall require the settlement of strikes, lockouts and labor disputes when such course is inadvisable in the sole discretion of Seller.

14) EXPORT CONTROLS: Buyer acknowledges that the Products and related technology are subject to U.S. export control and economic sanctions laws and regulations, which may include the International Traffic in Arms Regulations (ITAR), the Export Administration Regulations (EAR) and regulations promulgated by the U.S. Department of the Treasury Office of Foreign Assets Control (OFAC). Buyer further acknowledges that the re-export of the Products and/or related technology to a third country or retransfer to an unapproved end user may require a license or other authorization from the Government of the United States. Such licenses or other authorizations may impose further restrictions on the re-export or retransfer of the Products and/or related technology. U.S. law also restricts the re-export or retransfer of U.S.-origin goods, technology, or services to countries or persons subject to U.S. sanctions or embargoes. Buyer represents and warrants that it is in compliance with and agrees to comply with all such applicable export control and economic sanctions laws and regulations. It is the sole responsibility of Buyer to apply for and obtain any necessary licenses or other authorizations prior to any re-export or retransfer of the Products and/or related technology. Seller makes no warranty that any such licenses or other authorizations will be granted, and shall have no liability for Buyer's inability to obtain such licenses or other authorization or for any violation by Buyer of any applicable export control and/or economic sanctions laws and regulations. Buyer will indemnify Seller and hold it harmless from any liability resulting from Buyer's violation of this provision or applicable export laws or regulations. Notwithstanding any other provision in this Agreement, Seller shall have the right to terminate this Agreement immediately upon the determination by Seller, in Seller's sole discretion, that Buyer has breached, intends to breach, or insists upon breaching any of the provisions in the above clauses.

15) CONFIDENTIALITY: Other than in the performance of the terms of this Agreement, neither Buyer nor its agents, employees, or subcontractors shall use or disclose to any person or entity any confidential information of Seller (whether written, oral, electronic or other form) that is obtained or otherwise prepared or discovered in connection with this Agreement. Buyer agrees that all pricing, discounts, design drawings and technical information that Seller provides to Buyer are the confidential and proprietary information of Seller, whether or not otherwise identified as such. The obligations under this section continue perpetually and survive the termination or expiration of any underlying agreement between the parties. The provisions of this section relating to use and disclosure shall not apply to any information that: (a) is or becomes generally available to the public other than as a result of a disclosure by Buyer under this Agreement; (b) becomes available to Buyer from a source other than Seller without breach of any obligation of confidentiality; (c) was independently developed by Buyer without violation of Seller's rights and without reference to the confidential information, as evidenced by written records, maintained in the ordinary course of business by Buyer; (d) is used or disclosed with the prior written approval of Seller; (e) is information previously known to Buyer as

evidenced by written records maintained by Buyer in the ordinary course of business, and not otherwise subject to any confidentiality restrictions; or (f) Buyer becomes legally compelled (by oral questions, interrogatories, requests for information or documents, subpoenas, investigative demands or similar process) to disclose. The burden of proof that the information resides within one of the exceptions set forth above shall be on Buyer. If Buyer becomes legally compelled (by oral questions, interrogatories, requests for information or documents, subpoenas, investigative demands or similar process) to disclose any of the confidential information, Buyer shall provide Seller with prompt written notice so that Seller may seek a protective order or other appropriate remedy or waive compliance with the provisions of this Agreement. If such protective order or other remedy is not obtained, or if Seller waives compliance with the provisions of this Agreement, Buyer shall furnish only that portion of the confidential information which Buyer is legally required to disclose and shall exercise its reasonable efforts to obtain reliable assurance that confidential treatment shall be accorded the confidential information. Buyer shall not undertake any qualitative or quantitative analysis, reverse engineering or replication of any of Seller's products, samples or prototypes without Seller's specific written authorization.

16) SECURITY INTEREST: Buyer hereby grants Seller a security interest in the Goods to secure the payment of the purchase price, and shall not sell, lease, transfer or encumber the Goods and will keep the Goods free from any and all liens and security interests until Seller has been paid in full. Buyer shall execute any and all documents reasonably requested by Seller to protect such security interests.

17) MANAGEMENT OF CHANGE: Seller is constantly striving to improve its products and capabilities and to provide the best product to its customers. Seller may from time to time develop product improvements or alterations with respect to the Products hereunder (the "Product Improvements"), and Seller may implement such Product Improvements without notice to Buyer so long as the performance of the Products will not be materially diminished, as determined in Seller's sole discretion, and so long as Seller has not separately agreed in writing to provide such notification to Buyer. In the event that Seller has agreed in writing to provide notice of Product Improvements to Buyer (the "Notice"), then Seller shall provide such Notice in accordance with the terms set forth in the separate writing.

18) APPLICABLE LAW AND JURISDICTION: This Agreement shall be governed by, construed and enforced in accordance with the laws of the Commonwealth of Pennsylvania, without regard to its conflict of law principles. The UN Convention on Contracts for the International Sale of Goods shall not apply to the transaction(s) represented hereby. The parties consent and submit to the exclusive jurisdiction and service of process of any state or federal court located in Allegheny County, Pennsylvania.

19) MISCELLANEOUS:

(a) Neither party may assign this Agreement, including without limitation any of its rights or obligations hereunder, without the express written consent of the other party hereto; provided that Seller may, without Buyer's consent, assign this Agreement, including without limitation any of its rights or obligations hereunder, to any of its parents, subsidiaries or affiliates or to any third party which merges with Seller or acquires all or substantially all of its business and assets or a substantial part of its assets or business relating to the Products. Seller may use subcontractors to fulfill its obligations pursuant to this Agreement.

(b) In the event of any legal proceeding between Seller and Buyer relating to this Agreement, neither party may claim the right to a trial by jury, and both parties waive any right they may have under applicable law or otherwise to a trial by jury.

(c) In the event that any one or more provisions (or portions thereof) contained herein shall be held by a court of competent jurisdiction to be invalid, illegal or unenforceable in any respect, the validity, legality and enforceability of the remaining provisions (or portions thereof) contained herein shall remain in full force and effect, unless the revision materially changes the bargain.

(d) Seller's failure to enforce, or Seller's waiver of a breach of, any provision contained in this Agreement shall not constitute a waiver of any other breach or of such provision.

(e) Seller reserves the right to correct clerical, arithmetical, or stenographic errors or omissions in this Agreement, invoices or other documents.

(f) Any notice or communication required or permitted hereunder shall be in writing and shall be deemed received when personally delivered or three (3) business days after being sent by certified mail, postage prepaid, to a party at the address specified in this Agreement, or at such other address as either party may from time to time designate in writing to the other.

(g) Buyer agrees that it will not use Seller's name(s), logo(s) or mark(s) in any public communication or press release, or for any other marketing or promotional purpose, without Seller's prior written consent.

(h) Terms used in this Agreement which are not defined herein and which are defined by the Uniform Commercial Code of the Commonwealth of Pennsylvania shall have the meanings contained therein.

20) ENTIRE AGREEMENT: With respect to the subject matter hereof, this Agreement constitutes the complete and exclusive statement of the contract between Seller and Buyer. No waiver, consent, modification, amendment or change of the terms contained in this Agreement shall be binding unless made in writing and signed by Seller and Buyer. Seller's failure to object to terms contained in any subsequent communication from Buyer (whether in a purchase order or other communication) will not be a waiver or modification of the terms set forth herein.

YARD SET UP

Chandler Pecos Improvements - Site Access



Chandler Pecos Improvements - Site Access



LIST OF SUBCONTRACTORS



2. LIST OF SUBCONTRACTORS

Archer Western will utilize the following subcontractors:

- Electrical material supply and installation: Felix Construction Company
- Sand Install: Calgon Carbon
- Peristaltic Pump: Capital Flow Arizona
- Pipe: Capital Flow Arizona
- Pipe Supports: Copper State Bolt & Nut Co Inc
- Coatings inside Filters: AO Painting

SECTION D

SCHEDULE OF VALUES

Archer Western Construction
 Chandler Pecos Water System Upgrades Program
 City Project Number: WA2100.251
 Schedule of Values
 Pay Application No 1 - Date TBD

Item #	Task No.	Description	Total To Date	Total Previous Qty	GMP Qty	Unit	Total Unit Price	Original Contract Amount	Current Cost	Previous Cost	Total to Date	Notes
1.0		Cost of Work										
	1.01	Remove Assistance and Clean of Filter Basins	\$ -	0.0	1.0	LS	\$ 9,775.00	\$ 9,775	\$ -	\$ -	\$ -	
	1.02	Painting Support and Inspections	\$ -	0.0	1.0	LS	\$ 18,361.00	\$ 18,361	\$ -	\$ -	\$ -	
	1.03	Painting Subcontractor - AO Painting	\$ -	0.0	1.0	LS	\$ 677,889.00	\$ 677,889	\$ -	\$ -	\$ -	
	1.04	Sand Install Support	\$ -	0.0	1.0	LS	\$ 7,728.00	\$ 7,728	\$ -	\$ -	\$ -	
	1.05	Sand Install Subcontractor	\$ -	0.0	1.0	LS	\$ 93,205.00	\$ 93,205	\$ -	\$ -	\$ -	
	1.06	GAC Install Support	\$ -	0.0	1.0	LS	\$ 6,560.00	\$ 6,560	\$ -	\$ -	\$ -	
	1.07	Disinfection Subcontractor	\$ -	0.0	1.0	LS	\$ 3,500.00	\$ 3,500	\$ -	\$ -	\$ -	
	1.08	Polymer Piping and Valves	\$ -	0.0	400.0	LF	\$ 86.55	\$ 34,618	\$ -	\$ -	\$ -	
	1.09	Piping and MOV Materials	\$ -	0.0	1.0	LS	\$ 35,391.00	\$ 35,391	\$ -	\$ -	\$ -	
	1.10	Pipe Support Material	\$ -	0.0	1.0	LS	\$ 5,369.00	\$ 5,369	\$ -	\$ -	\$ -	
	1.11	Polymer Metering Pump Install	\$ -	0.0	1.0	EA	\$ 2,505.00	\$ 2,505	\$ -	\$ -	\$ -	
	1.12	Polymer Metering Pump Purchase	\$ -	0.0	1.0	EA	\$ 10,950.00	\$ 10,950	\$ -	\$ -	\$ -	
	1.13	Electrical Subcontract - Felix Electric	\$ -	0.0	1.0	LS	\$ 274,592.00	\$ 274,592	\$ -	\$ -	\$ -	
	1.14	Commissioning	\$ -	0.0	1.0	LS	\$ 14,275.00	\$ 14,275	\$ -	\$ -	\$ -	
	1.15	Supervision	\$ -	0.0	1.0	LS	\$ 41,513.00	\$ 41,513	\$ -	\$ -	\$ -	
	1.16	Construction Equipment	\$ -	0.0	1.0	LS	\$ 49,500.00	\$ 49,500	\$ -	\$ -	\$ -	
2.0		Indirect Costs										
	2.01	General Conditions	\$ -	0.0	1.0	LS	\$ 247,442.00	\$ 247,442	\$ -	\$ -	\$ -	
	2.02	CMAR Fee	\$ -	0.0	1.0	LS	\$ 122,654.00	\$ 122,654	\$ -	\$ -	\$ -	
	2.03	Bonds	\$ -	0.0	1.0	LS	\$ 14,305.00	\$ 14,305	\$ -	\$ -	\$ -	
	2.04	Insurance	\$ -	0.0	1.0	LS	\$ 28,485.00	\$ 28,485	\$ -	\$ -	\$ -	
	2.05	Tax	\$ -	0.0	1.0	LS	\$ 92,448.00	\$ 92,448	\$ -	\$ -	\$ -	
3.0		Allowances										
	3.01	Coffer Dam and Dewatering Allowance	\$ -	0.0	1.0	LS	\$ 24,377.00	\$ 24,377	\$ -	\$ -	\$ -	
	3.02	Concrete Repairs	\$ -	0.0	1.0	LS	\$ 35,640.00	\$ 35,640	\$ -	\$ -	\$ -	
	3.04	Electrical Allowance	\$ -	0.0	1.0	LS	\$ 54,000.00	\$ 54,000	\$ -	\$ -	\$ -	
	3.05	Underdrain Repairs Allowance	\$ -	0.0	1.0	LS	\$ 10,800.00	\$ 10,800	\$ -	\$ -	\$ -	
4.0		Contingencies										
	4.01	Construction Contingency	\$ -	0.0	1.0	LS	\$ 50,000.00	\$ 50,000	\$ -	\$ -	\$ -	
	4.02	Owner Contingency	\$ -	0.0	1.0	LS	\$ 128,573.00	\$ 128,573	\$ -	\$ -	\$ -	
		Chandler Pecos Total	\$ -					\$ 2,094,455	\$ -	\$ -	\$ -	

SECTION E

PROJECT SCHEDULE

Chanderl Pecos Water Plant Improvements - GMP 1							09-Oct-24 20:26							
Activity ID	Activity Name	Original Duration	Remaining Duration	Start	Finish	Total Float	2024		2025					
							Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Chanderl Pecos Water Plant Improvements - GMP 1		164	164	07-Nov-24	30-Jun-25	0								
General		164	164	07-Nov-24	30-Jun-25	0								
Gen 1000	Council Approval	0	0	07-Nov-24		0	Council Approval							
Gen 1010	Notice to Proceed	18	18	07-Nov-24	03-Dec-24	24	Notice to Proceed							
Gen 1020	Mobilization	10	10	07-Nov-24	20-Nov-24	32	Mobilization							
Gen 1030	Demobilization	10	10	30-Apr-25	13-May-25	33	Demobilization							
Gen 1040	Substantial Completion	1	1	16-Jun-25	16-Jun-25	0	Substantial Completion							
Gen 1050	Punchlist	10	10	17-Jun-25	30-Jun-25	0	Punchlist							
Gen 1060	Final Completion	0	0		30-Jun-25	0	Final Completion							
Contracts		10	10	07-Nov-24	20-Nov-24	48	Contracts							
Contract 1000	Electrical Contract	10	10	07-Nov-24	20-Nov-24	0	Electrical Contract							
Contract 1010	Painting Contract	5	5	07-Nov-24	13-Nov-24	33	Painting Contract							
Contract 1020	Media Removal/Installation Contract	10	10	07-Nov-24	20-Nov-24	15	Media Removal/Installation Contract							
Contract 1030	Piping and Valves Contract	10	10	07-Nov-24	20-Nov-24	30	Piping and Valves Contract							
Contract 1040	Polymer Pump Contract	10	10	07-Nov-24	20-Nov-24	48	Polymer Pump Contract							
Contract 1050	Coffer Dam Contract	5	5	07-Nov-24	13-Nov-24	12	Coffer Dam Contract							
Submittal		33	33	14-Nov-24	02-Jan-25	65	Submittal							
Submittal 1010	Paint Submittal	5	5	14-Nov-24	20-Nov-24	33	Paint Submittal							
Submittal 1080	Coffer Dam Submittal	10	10	14-Nov-24	27-Nov-24	12	Coffer Dam Submittal							
Submittal 1000	Electrical Commodity Submittal	5	5	21-Nov-24	27-Nov-24	82	Electrical Commodity Submittal							
Submittal 1020	Motor Operated Valves Submittal	10	10	21-Nov-24	05-Dec-24	55	Motor Operated Valves Submittal							
Submittal 1030	Pipe Material Submittal	5	5	21-Nov-24	27-Nov-24	60	Pipe Material Submittal							
Submittal 1040	Pipe Support Material Submittal	10	10	21-Nov-24	05-Dec-24	30	Pipe Support Material Submittal							
Submittal 1050	Pressure Switch and Gage Submittal	10	10	21-Nov-24	05-Dec-24	57	Pressure Switch and Gage Submittal							
Submittal 1060	Flow Meter Submittal	15	15	21-Nov-24	12-Dec-24	0	Flow Meter Submittal							
Submittal 1070	Polymer Pump Submittal	15	15	21-Nov-24	12-Dec-24	48	Polymer Pump Submittal							
Submittal 1090	Sand/GAC Install Procedure Submittal	20	20	21-Nov-24	19-Dec-24	15	Sand/GAC Install Procedure Submittal							
Submittal 1100	Disinfection Plan Submittal	20	20	04-Dec-24	02-Jan-25	24	Disinfection Plan Submittal							
Submittal 1110	Concrete Repair Materials (If Necessary)	10	10	04-Dec-24	17-Dec-24	75	Concrete Repair Materials (If Necessary)							
Submittal Review		48	48	21-Nov-24	30-Jan-25	65	Submittal Review							
Review 1010	Paint Submittal Review	20	20	21-Nov-24	19-Dec-24	33	Paint Submittal Review							
Review 1000	Electrical Commodity Submittal Review	20	20	29-Nov-24	27-Dec-24	82	Electrical Commodity Submittal Review							
Review 1030	Pipe Material Submittal Review	20	20	29-Nov-24	27-Dec-24	60	Pipe Material Submittal Review							
Review 1080	Coffer Dam Submittal Review	5	5	29-Nov-24	05-Dec-24	12	Coffer Dam Submittal Review							
Review 1020	Motor Operated Valves Submittal Review	20	20	06-Dec-24	06-Jan-25	55	Motor Operated Valves Submittal Review							
Review 1040	Pipe Support Material Submittal Review	20	20	06-Dec-24	06-Jan-25	30	Pipe Support Material Submittal Review							
Review 1050	Pressure Switch and Gage Submittal Review	20	20	06-Dec-24	06-Jan-25	57	Pressure Switch and Gage Submittal Review							
Review 1060	Flow Meter Submittal Review	20	20	13-Dec-24	13-Jan-25	0	Flow Meter Submittal Review							
Review 1070	Polymer Pump Submittal Review	20	20	13-Dec-24	13-Jan-25	48	Polymer Pump Submittal Review							
Review 1110	Concrete Repair Materials (If Necessary) Submittal Review	20	20	18-Dec-24	16-Jan-25	75	Concrete Repair Materials (If Necessary) Submittal Review							
Review 1090	Sand/GAC Install Procedure Submittal Review	20	20	20-Dec-24	20-Jan-25	15	Sand/GAC Install Procedure Submittal Review							
Review 1100	Disinfection Plan Submittal Review	20	20	03-Jan-25	30-Jan-25	24	Disinfection Plan Submittal Review							
Lead Time		95	95	06-Dec-24	21-Apr-25	18	Lead Time							
Lead 1080	Coffer Dam Lead Time	10	10	06-Dec-24	19-Dec-24	12	Coffer Dam Lead Time							
Lead 1010	Paint Lead Time	10	10	20-Dec-24	06-Jan-25	33	Paint Lead Time							

Chanderl Pecos Water Plant Improvements - GMP 1								09-Oct-24 20:26							
Activity ID	Activity Name	Original Duration	Remaining Duration	Start	Finish	Total Float	2024		2025						
							Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	
	Lead 1000	Electrical Commodity Lead Time	10	10	30-Dec-24	13-Jan-25	82			Electrical Commodity Lead Time					
	Lead 1030	Pipe Material Lead Time	10	10	30-Dec-24	13-Jan-25	60			Pipe Material Lead Time					
	Lead 1020	Motor Operated Valves Lead Time	20	20	07-Jan-25	03-Feb-25	55			Motor Operated Valves Lead Time					
	Lead 1040	Pipe Support Material Lead Time	15	15	07-Jan-25	27-Jan-25	30			Pipe Support Material Lead Time					
	Lead 1050	Pressure Switch and Gage Lead Time	30	30	07-Jan-25	17-Feb-25	57			Pressure Switch and Gage Lead Time					
	Lead 1060	Flow Meter Lead Time	70	70	14-Jan-25	21-Apr-25	0			Flow Meter Lead Time					
	Lead 1070	Polymer Pump Lead Time	30	30	14-Jan-25	24-Feb-25	48			Polymer Pump Lead Time					
	Lead 1110	Concrete Repair Materials (If Necessary) Lead Time	10	10	17-Jan-25	30-Jan-25	75			Concrete Repair Materials (If Necessary) Lead Time					
	Lead 1090	Sand/GAC Material Lead Time	25	25	21-Jan-25	24-Feb-25	15			Sand/GAC Material Lead Time					
	Lead 1100	Disinfection Material Lead Time	10	10	31-Jan-25	13-Feb-25	24			Disinfection Material Lead Time					
	Filter Improvements		66	66	20-Dec-24	25-Mar-25	29			Filter Improvements					
	Filter 1330	Install Cofferdam at Filters	5	5	20-Dec-24	27-Dec-24	12			Install Cofferdam at Filters					
	Filter 1340	Drain Water from Entire Structure	2	2	30-Dec-24	31-Dec-24	12			Drain Water from Entire Structure					
	Filter 1010	Remove Existing Filter Media	5	5	02-Jan-25	08-Jan-25	12			Remove Existing Filter Media					
	Filter 1030	Clean and Prep Settled Water Channels South Side	5	5	02-Jan-25	08-Jan-25	36			Clean and Prep Settled Water Channels South Side					
	Filter 1020	Clean Filter Basins	2	2	09-Jan-25	10-Jan-25	12			Clean Filter Basins					
	Filter 1040	Coat Settled Water Channel South Side	5	5	09-Jan-25	15-Jan-25	36			Coat Settled Water Channel South Side					
	Filter 1260	Inspect Filters Underdrain South Side	1	1	13-Jan-25	13-Jan-25	12			Inspect Filters Underdrain South Side					
	Filter 1170	Erect Scaffolding on South Side Filters	5	5	14-Jan-25	20-Jan-25	12			Erect Scaffolding on South Side Filters					
	Filter 1050	Clean and Prep Settled Water Channel North Side	5	5	16-Jan-25	22-Jan-25	36			Clean and Prep Settled Water Channel North Side					
	Filter 1150	Cure Filter Basins South Side	3	3	16-Jan-25	20-Jan-25	37			Cure Filter Basins South Side					
	Filter 1070	Cut Termination Lines in Filter Basins South Side	5	5	21-Jan-25	27-Jan-25	12			Cut Termination Lines in Filter Basins South Side					
	Filter 1060	Coat Settled Water Channel North Side	5	5	23-Jan-25	29-Jan-25	36			Coat Settled Water Channel North Side					
	Filter 1080	Prep Filters Basins South Side	5	5	28-Jan-25	03-Feb-25	12			Prep Filters Basins South Side					
	Filter 1160	Cure Filter Basins North Side	3	3	30-Jan-25	03-Feb-25	36			Cure Filter Basins North Side					
	Filter 1190	Erect Scaffolding at Gullets	5	5	30-Jan-25	05-Feb-25	52			Erect Scaffolding at Gullets					
	Filter 1090	Coat Filters Basins South Side	5	5	04-Feb-25	10-Feb-25	13			Coat Filters Basins South Side					
	Filter 1290	Inspect Filters Underdrain North Side	1	1	04-Feb-25	04-Feb-25	12			Inspect Filters Underdrain North Side					
	Filter 1180	Erect Scaffolding on North Side Filters	5	5	05-Feb-25	11-Feb-25	12			Erect Scaffolding on North Side Filters					
	Filter 1200	Prep Gullets	3	3	06-Feb-25	10-Feb-25	52			Prep Gullets					
	Filter 1130	Cure Settled Water Channel South Side	3	3	11-Feb-25	13-Feb-25	19			Cure Settled Water Channel South Side					
	Filter 1210	Coat Gullets	5	5	11-Feb-25	17-Feb-25	52			Coat Gullets					
	Filter 1100	Cut Termination Lines in Filter Basins North Side	5	5	12-Feb-25	18-Feb-25	12			Cut Termination Lines in Filter Basins North Side					
	Filter 1220	Cure Gullets	3	3	18-Feb-25	20-Feb-25	52			Cure Gullets					
	Filter 1110	Prep Filter Basins North Side	5	5	19-Feb-25	25-Feb-25	12			Prep Filter Basins North Side					
	Filter 1230	Sand Install South Side	2	2	25-Feb-25	26-Feb-25	15			Sand Install South Side					
	Filter 1120	Coat Filter Basins North Side	5	5	26-Feb-25	04-Mar-25	12			Coat Filter Basins North Side					
	Filter 1240	Disinfect South Side	2	2	27-Feb-25	28-Feb-25	15			Disinfect South Side					
	Filter 1250	GAC Media Install South Side	5	5	03-Mar-25	07-Mar-25	15			GAC Media Install South Side					
	Filter 1140	Cure Settled Water Channel North Side	3	3	05-Mar-25	07-Mar-25	12			Cure Settled Water Channel North Side					
	Filter 1300	Sand Install North Side	2	2	13-Mar-25	14-Mar-25	12			Sand Install North Side					
	Filter 1310	Disinfect North Side	2	2	17-Mar-25	18-Mar-25	12			Disinfect North Side					
	Filter 1320	GAC Media Install North Side	5	5	19-Mar-25	25-Mar-25	12			GAC Media Install North Side					
	Polymer Improvements		78	78	28-Jan-25	15-May-25	0			Polymer Improvements					
	Polymer 1040	Install Pipe Supports at North Side Filters	10	10	28-Jan-25	10-Feb-25	30			Install Pipe Supports at North Side Filters					
	Polymer 1050	Install Pipe Supports at South Side Filters	10	10	11-Feb-25	24-Feb-25	30			Install Pipe Supports at South Side Filters					

Chanderl Pecos Water Plant Improvements - GMP 1							09-Oct-24 20:26							
Activity ID	Activity Name	Original Duration	Remaining Duration	Start	Finish	Total Float	2024		2025					
							Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
	Polymer 1000	Install Polymer Pump	3	3	25-Feb-25	27-Feb-25	48				Install Polymer Pump			
	Polymer 1060	Install Piping on North Side of Filters	5	5	25-Feb-25	03-Mar-25	30				Install Piping on North Side of Filters			
	Polymer 1010	Install Piping at Polymer Pump	1	1	28-Feb-25	28-Feb-25	48				Install Piping at Polymer Pump			
	Polymer 1020	Install Instruments at Polymer Pump	1	1	03-Mar-25	03-Mar-25	48				Install Instruments at Polymer Pump			
	Polymer 1030	Install Conduit and Electrical at Polymer Pump	2	2	04-Mar-25	05-Mar-25	48				Install Conduit and Electrical at Polymer Pump			
	Polymer 1070	Install Piping on South Side of Filters	5	5	04-Mar-25	10-Mar-25	30				Install Piping on South Side of Filters			
	Polymer 1080	Install Piping and Flow Meter above the Deck to Discharge at Filters	12	12	22-Apr-25	07-May-25	0					Install Piping and Flow Meter above the Deck to Discharge at Filters		
	Polymer 1090	Install Conduit and Electrical at Filters for Polymer Lines	6	6	08-May-25	15-May-25	0					Install Conduit and Electrical at Filters for Polymer Lines		
	Start-Up and Commissioning		103	103	21-Jan-25	13-Jun-25	0				Start-Up and Commissioning			
	Filter 1350	Final Inspection of Coatings at Filter Basins South Side	3	3	21-Jan-25	23-Jan-25	37				Final Inspection of Coatings at Filter Basins South Side			
	Filter 1360	Final Inspection of Coatings at Filter Basins North Side	3	3	04-Feb-25	06-Feb-25	36				Final Inspection of Coatings at Filter Basins North Side			
	Filter 1270	Final Inspection of Coatings at Settled Water Basins South Side	3	3	14-Feb-25	18-Feb-25	19				Final Inspection of Coatings at Settled Water Basins South Side			
	Filter 1370	Final Inspection of Coatings at Gulleys	3	3	21-Feb-25	25-Feb-25	52				Final Inspection of Coatings at Gulleys			
	Polymer 1100	Start Up Polymer Pump	2	2	06-Mar-25	07-Mar-25	48				Start Up Polymer Pump			
	Filter 1280	Final Inspection of Coatings at Settled Water Basins North Side	3	3	10-Mar-25	12-Mar-25	12				Final Inspection of Coatings at Settled Water Basins North Side			
	Polymer 1110	Test Polymer Pump	1	1	10-Mar-25	10-Mar-25	48				Test Polymer Pump			
	Commish 1010	Post Media Install Inspection/Testing (Hazen)	15	15	26-Mar-25	15-Apr-25	12				Post Media Install Inspection/Testing (Hazen)			
	Commish 1020	Receive Approval to Commence Operations (Hazen)	5	5	16-Apr-25	22-Apr-25	12				Receive Approval to Commence Operations (Hazen)			
	Filters 1380	Start Up Filters	5	5	23-Apr-25	29-Apr-25	12				Start Up Filters			
	Commish 1000	Commission Filters	20	20	16-May-25	13-Jun-25	0					Commission Filters		

SECTION F

CONSTRUCTION PHASING



1. CONSTRUCTION PHASING

Please see schedule for detailed sequence of work. A high level overview is provided below.

Phase 1: December 2024 – April 2025

- Install angle and temporary plate in the interconnect channel to isolate filters
- Waterproof Crystalline Coating
- Additional crack injections will be performed as time allows
- Media Replacement & Underdrain Inspection
 - Remove 84" anthracite media
 - Inspect filter underdrains and filters
- Reinstall media
 - Install 12 inches of sand media
 - Install 72 inches of GAC media
- Process Mechanical
 - Extend piping at Filters 9-12 from existing polymer piping from Phase 1 including flow meters and control valves
 - 1 peristaltic metering pump, 1 pressure gauge, and 1 pressure switch in the disinfection building

SECTION G

LIST OF GMP PLANS & SPECIFICATIONS



1. LIST OF PLANS AND SPECIFICATIONS

Archer Western utilized the following plans and specifications issued by Hazen to complete this GMP Proposal. All files reside on the ACC site uploaded on September 17, 2024.

- 46 61 17-01.1 – Sand Media Resub
- Chandler Pecos SWTP F820 Submittal
- Pecos SWTP – Filter Improvements Phase III Drawing Set
- Pecos SWTP Filter Improvements Phase III Technical Specs

Additional documents were provided on September 20, 2024, which included previous project submittals, quotes and product sheets. These documents can also be found on the ACC site.

SECTION H

ASSUMPTIONS AND CLARIFICATIONS



1. ASSUMPTIONS AND CLARIFICATIONS

We recognize the desire to receive unclarified proposals for greater cost certainty. As such, Archer Western has attempted to minimize the assumptions and clarifying information in this GMP Proposal. However, at this time we do have the following assumptions and clarifications to qualify our Proposal. The potential cost impact of these items has largely been captured in the recommended allowances and contingencies and will only be applied for unplanned and unmitigated events with cost impacts to the project.

Item	Description
1	Procurement, delivery, unloading and storage of the sand and GAC material is by others.
2	Actuated valves do not include a local control panel.
3	Crack injections are assumed to be performed with a basin full of water so hydrophilic water stop can be used. This is likely due to happen during the second shutdown due to time constraints during the first shutdown/low flow.
4	Plant operators will be required to perform back flushing and draining.
5	Filters 9-12 power and controls will be isolated from the rest of the plant operations by city staff for each operation of work.
6	Disinfection will be completed by Archer Western. BAC-T sampling and testing to be completed by City staff.
7	Water is being carried for install of sand and media. All other water (backwashing, disinfection, and flushing) will be supplied by City.
8	Spec 099000-14 Table 1 calls for two coats of acrylic epoxy. This is not included per discussions with Hazen.
9	City will need to provide non-chlorinated water for start-up and commissioning.
10	Xypex coating will only be applied on inlet channels and interior walls of Filters 9-12 per plans and specifications.
11	Calgon is responsible for hauling spent media from the filters and site and installing GAC media, per Section 46 61 16 and paid for by the City as shown in the 2024.09.13 CMAR Scoping Meeting Presentation.
12	CMAR is excluding any work in Section 46 61 16 GAC Filter Media. The City and Calgon will have a separate contract to perform the work in that Section. CMAR is only quoting the sand installation from Calgon per Section 46 61 17 Sand Filter Media.
13	Leopold inspection is included as an allowance. Major repairs or damage has not been carried.
14	Reference Felix quote from October 3, 2024 for exclusions and additional clarifications.
15	Per AO Painting quote from October 4, 2024, mechanical surfaces (including pipe) are excluded from the scope of work. Reference AO Painting quote for additional clarifications.



Item	Description																																																																																																																																
16	CMAR is following the redline Specification 07 16 16 Crystalline Waterproofing and takeoff quantities that were provided by Hazen. These documents can be found in the Quote Package																																																																																																																																
17	CMAR is only responsible for the column presented in the 2024.09.13 CMAR Scoping Meeting Presentation, shown below. Filters 9-12 Media Removal, Furnishing, & Installation Coordination <table><tr><th>Topic</th><th>Work</th><th>Reference Document</th><th>The City (Owner)</th><th>Hazen (CM)</th><th>CMAR (Contractor)</th><th>Calgon Carbon Co.</th><th>Red Flint Sand & Gravel, LLC</th></tr><tr><td>General</td><td>LOTO Procedures</td><td>46 61 16 (3.01)</td><td>X</td><td></td><td>X</td><td></td><td></td></tr><tr><td rowspan="2">Structural</td><td>Structural Inspection</td><td>-</td><td></td><td>X</td><td></td><td></td><td></td></tr><tr><td>Isolation of Filters 9-12 Settled Water Channel (MOPO)</td><td>-</td><td></td><td></td><td>X</td><td></td><td></td></tr><tr><td>Anthracite</td><td>Removal and Disposal of Existing Anthracite</td><td>46 61 16 (3.02, A) 02 41 00 02 41 16</td><td></td><td></td><td></td><td>X</td><td></td></tr><tr><td>Underdrain</td><td>Underdrain Inspection Coordination</td><td>46 61 17 (3.01)</td><td></td><td></td><td>X</td><td></td><td></td></tr><tr><td rowspan="2">Disinfection</td><td>Filter Cell Disinfection</td><td>46 61 16 (3.04, D)</td><td></td><td></td><td>X</td><td></td><td></td></tr><tr><td>BAC-T Test</td><td>-</td><td>X</td><td></td><td></td><td></td><td></td></tr><tr><td rowspan="4">Sand Media</td><td>Manufacture and furnish Sand Media</td><td>46 61 17 (1.05 -1.09, 2.03)</td><td></td><td></td><td></td><td></td><td>X</td></tr><tr><td>Installation of Sand Media (per specified installation and skimming procedures)</td><td>46 61 17 (3.02)</td><td></td><td></td><td>X</td><td></td><td></td></tr><tr><td>Pre-shipment Sand Media Testing</td><td>46 61 17 (1.09)</td><td></td><td></td><td></td><td></td><td>X</td></tr><tr><td>Post-shipment Sand Media Testing</td><td>46 61 17 (3.03)</td><td></td><td>X</td><td></td><td></td><td></td></tr><tr><td rowspan="4">GAC Media</td><td>Pre-shipment GAC Media Testing</td><td>46 61 16 (1.09)</td><td></td><td></td><td></td><td>X</td><td></td></tr><tr><td>Post-shipment GAC Media Testing</td><td>46 61 16 (3.05)</td><td></td><td>X</td><td></td><td></td><td></td></tr><tr><td>Delivery of GAC Media</td><td>46 61 16 (3.03)</td><td></td><td></td><td></td><td>X</td><td></td></tr><tr><td>Installation of GAC Media</td><td>46 61 16 (3.04)</td><td></td><td></td><td></td><td>X</td><td></td></tr><tr><td></td><td>Skimming of GAC Media</td><td>46 61 16 (3.04)</td><td></td><td></td><td>X</td><td></td><td></td></tr></table>	Topic	Work	Reference Document	The City (Owner)	Hazen (CM)	CMAR (Contractor)	Calgon Carbon Co.	Red Flint Sand & Gravel, LLC	General	LOTO Procedures	46 61 16 (3.01)	X		X			Structural	Structural Inspection	-		X				Isolation of Filters 9-12 Settled Water Channel (MOPO)	-			X			Anthracite	Removal and Disposal of Existing Anthracite	46 61 16 (3.02, A) 02 41 00 02 41 16				X		Underdrain	Underdrain Inspection Coordination	46 61 17 (3.01)			X			Disinfection	Filter Cell Disinfection	46 61 16 (3.04, D)			X			BAC-T Test	-	X					Sand Media	Manufacture and furnish Sand Media	46 61 17 (1.05 -1.09, 2.03)					X	Installation of Sand Media (per specified installation and skimming procedures)	46 61 17 (3.02)			X			Pre-shipment Sand Media Testing	46 61 17 (1.09)					X	Post-shipment Sand Media Testing	46 61 17 (3.03)		X				GAC Media	Pre-shipment GAC Media Testing	46 61 16 (1.09)				X		Post-shipment GAC Media Testing	46 61 16 (3.05)		X				Delivery of GAC Media	46 61 16 (3.03)				X		Installation of GAC Media	46 61 16 (3.04)				X			Skimming of GAC Media	46 61 16 (3.04)			X		
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Hazen

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EXHIBIT E

SUBCONTRACTOR DOCUMENTS WITH CM@RISK

Any subcontractor assumptions, clarifications, exclusions, terms & conditions, signature blocks, etc. included are strictly between the CM@RISK and their subcontractors, and do not apply to the Agreement between the CM@RISK and the City.

SUBCONTRACTOR'S LIST FORM

If CM@Risk intends to subcontract any portion of this Agreement, the CM@Risk must submit the name, address, and contractor's license number (if applicable) of each subcontractor, including the work component of such subcontracting. Include the form with the bid submittal documents. CM@Risk may make multiple copies of this form as needed.

Company Name:	
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:	
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:	

EXHIBIT F

**GIS / GPS DATA DELIVERY REQUIREMENTS
(IF APPLICABLE)**

N/A

EXHIBIT G

SUBCONTRACTOR DOCUMENTS WITH CM@RISK

Any subcontractor assumptions, clarifications, exclusions, terms & conditions, signature blocks, etc. included are strictly between the CM@Risk and their subcontractors, and do not apply to the Agreement between the CM@Risk and the City.