



CITY OF CHANDLER, ARIZONA

RECLAIMED WATER INTERCONNECT FACILITY – GMP 1

CITY PROJECT NO. WW1901.402

CONSTRUCTION SERVICES CONTRACT (CONSTRUCTION MANAGER AT RISK)

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

CITY OF CHANDLER, ARIZONA

**RECLAIMED WATER INTERCONNECT FACILITY – GMP 1
CITY PROJECT NO.: WW1901.402**

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**CONSTRUCTION MANAGER AT RISK
CONSTRUCTION SERVICES CONTRACT
PROJECT NO.: WW1901.402**

THIS CONTRACT is made and entered into on the ____ day of _____, 2021, ("Effective Date") by and between City of Chandler, an Arizona municipal corporation, hereinafter called "City" and the "Construction Manager at Risk" or "CM@Risk" designated below (City and CM@Risk may individually be referred to as "Party" and collectively referred to as "Parties").

City and CM@Risk agree as follows:

ARTICLE 1 - PARTICIPANTS AND PROJECT

CITY: **CIP City Engineer:**
 Andrew Goh, P.E.
 Public Works & Utilities Department
 P.O. Box 4008, Mail Stop 407
 Chandler, AZ 85244-4008
 Phone: 480-782-3343
 Email: andrew.goh@chandleraz.gov

CITY: **Construction Project Manager:**
 Russ Slotnick
 Public Works & Utilities Department
 P.O. Box 4008, Mail Stop 407
 Chandler, AZ 85244-4008
 Phone: 480-782-3411
 Email: russ.slotnick@chandleraz.gov

CM@RISK: **McCarthy Building Companies, Inc.**
 6225 N. 24th Street, Suite 200 Phoenix, Arizona 85016
 Arizona ROC No.: A 080910, B-1 080911
 Federal Tax ID No.: 43-1136212
 Business Organization: Corporation
 State Where Organized: Missouri
 Statutory Agent Name: Joseph Brunsman
 Statutory Agent Mailing Address: 6225 N. 24th Street, Suite 200
 Phoenix, Arizona 85016
 CM@Risk's Authorized Project Representative:
 Name: Shane D. Banks, PE
 Title: Project Director
 Phone: 480-386-7912
 Email: sbanks@mccarthy.com

PROJECT DESCRIPTION:

The project is for construction of the Reclaimed Water Interconnect Facility (RWIF), a membrane water treatment facility to be located at the Airport Water Reclamation Facility. This contract is for GMP1 - early procurement package for long lead items.

PROJECT LOCATION:

905 E. Queen Creek Road

ARTICLE 2 - CONTRACT DOCUMENTS

2.1 CONTRACT DOCUMENTS

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

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

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

2.3 DEFINITIONS

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

ARTICLE 3 - PRE-CONSTRUCTION SERVICES

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

ARTICLE 4 - CONSTRUCTION SERVICES

4.1 GENERAL

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

- 4.1.2 CM@Risk must provide all of the labor and materials, and perform the Work in accordance with Section 4 of the General Conditions. Some, but not all, of the major components of the Construction Services and the corresponding subsections of Section 4 of the General Conditions are set forth below.
- 4.1.3 This is a contract for complete construction services in accordance with the Construction Manager at Risk method of delivery of construction services. CM@RISK has participated in the design process and been an active member of the Project Design Team and is fully aware of any issues and constraints involved in this Construction Project.
- 4.1.4 CM@RISK is the CITY's fiduciary responsible for undertaking all necessary action contemplated under the contract documents to construct the Project and ensure timely and quality completion of the Project at a cost within the Guaranteed Maximum Price (GMP).
- 4.1.5 At all times relevant to this Contract and performance of the Work, the CM@Risk must fully comply with all Laws, Regulations, or Legal Requirements applicable to City, the Project and the Contract, including, without limitation, those set forth on attached **Exhibit A**.
- 4.1.6 CM@Risk must perform the Work under this Contract using only those firms, team members and individuals designated by CM@Risk consistent with the Statement of Qualifications dated December 12, 2019, the GMP Proposal, or otherwise approved by City pursuant to the General Conditions. No other entities or individuals may be used without prior approval of the Project Manager
- 4.1.7 CM@Risk will comply with all terms and conditions of the General Conditions.
- 4.1.8 In the event of a conflict between this Contract and the General Conditions or an exhibit hereto or appendix thereto, the terms of this Contract will control.
- 4.1.9 Ownership of Work Product. Notwithstanding anything to the contrary in this Contract, all Work Product prepared or otherwise created in connection with the performance of this Contract, including the Work, are to be and remain the property of City. For purposes of this provision, "Work Product" will include all designs, drawings, plans, specifications, ideas, renderings and other information or matter, in whatever form created (e.g., electronic or printed) and in all media now known or hereinafter created. All Work Product will be considered Work Made for Hire as defined in the United States Copyright Act 17 U.S.C. § 101 (Copyright Act). If for any reason, any such Work is found not to be a Work Made for Hire, CM@Risk hereby transfers and assigns ownership of the copyright in such Work to City. The rights in this Section are exclusive to City in perpetuity.

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

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

6.1 GENERAL

- 6.1.1 The Contract Duration is **440** Calendar Days.
- 6.1.2 The Contract Time will start with the Notice to Proceed (NTP) and end with Final Acceptance, as set forth in Article 6.4 below. The Notice to Proceed cannot be issued until approval and acceptance by City of the GMP or Fixed Price.

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

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

6.2 PROJECT SCHEDULE

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

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

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

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

6.3 SUBSTANTIAL COMPLETION

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

6.4 FINAL ACCEPTANCE

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

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

6.5 LIQUIDATED DAMAGES

6.5.1 Substantial Completion Liquidated Damages. CM@Risk acknowledges and agrees that if CM@Risk fails to obtain Substantial Completion of the Work within the Contract Time, City will sustain extensive damages and serious loss as a result of such failure. The exact amount of such damages will be extremely difficult to ascertain. Therefore, City and CM@Risk agree that if CM@Risk fails to achieve Substantial Completion of the Work within the Contract Time, City will be entitled to retain or recover from CM@Risk, as

liquidated damages and not as a penalty, the sum per calendar day as indicated in MAG § 108.9.

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

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

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

6.6 **MUTUAL WAIVER OF CONSEQUENTIAL DAMAGES ONLY**

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

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

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

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

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

ARTICLE 7 - CONTRACT PRICE

7.1 CONTRACT PRICE

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

The sum of the CM@Risk's Fee and reimbursable Cost of the Work, as defined in Section 15 of the General Conditions, which the CM@Risk guarantees will not exceed the GMP set forth in **Exhibit D** in the amount of **\$5,392,377**. Costs which would cause the GMP to be exceeded must be paid by CM@Risk without reimbursement from City.

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

7.2 COSTS

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

SIGNATURE PAGE TO FOLLOW

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

"CITY"

CITY OF CHANDLER

MAYOR

Date

Recommended By:

Andrew Goh, P.E.
CIP City Engineer

Date

APPROVED AS TO FORM:

City Attorney

ATTEST:

City Clerk

Seal

"CM@RISK"

McCarthy Building Companies, Inc.

Signature

Date

Joseph Brunzman

Name

Sr. Vice President

Title

jbrunzman@mccarthy.com

Signer Email Address

ATTEST: If Corporation

Secretary

STATE OF ARIZONA

)

)ss.

County of Maricopa

)

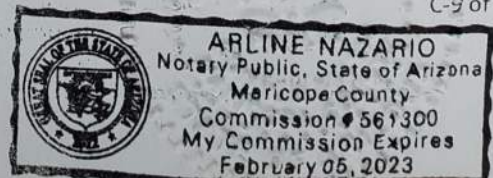
SUBSCRIBED AND SWORN TO before me, the undersigned notary public, by JOSEPH BRUNSMAN who was identified as the SVP of MCCARTHY BUILDING COMPANIES, INC. on this 19th day of NOVEMBER, 2021.

My commission expires:

FEBRUARY 5-2023

Notary Public

City of Chandler Construction Manager at Risk Construction Services
Public Works & Utilities Department, Capital Projects Division
Project Name: RECLAIMED WATER INTERCONNECT FACILITY - GMP 1
Project No.: WW1901.402
Rev. 7/16/2021



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EXHIBIT A

**PROJECT SPECIFIC
SPECIAL PROVISIONS**

EXHIBIT B

GENERAL CONDITIONS



GENERAL CONDITIONS

Approved date: April 27, 2021

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

SECTION 2 - GENERAL DEFINITIONS

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

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

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

Consultant: Person or firm that provides professional services.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

MAG: The Maricopa Association of Governments.

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

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

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

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

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

Project Manager: The Project Manager designated in Article 1 of the Contract, or any successor thereto designated by City. The Project Manager has the authority to act on behalf of City, as delineated and

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

SECTION 3 - STANDARD SPECIFICATIONS AND DETAILS

- 3.1 City operates under the latest revision of the MAG Specifications and MAG Standard Details as amended by City. City's current amendment to the MAG Specifications, part of the City's Unified Development Manual, may be found in the downloaded from City's website at <http://www.chandleraz.gov>.
- 3.2 Copies of the MAG Specifications and MAG Standard Details are available at the Maricopa Association of Governments office, 302 N. 1st Avenue, Suite 300, Phoenix,

Arizona. They may also be downloaded from their website at: <http://www.azmag.gov/Newsroom/Publications>

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

SECTION 4 - CONTRACTOR'S RESPONSIBILITIES FOR CONSTRUCTION SERVICES

4.1 GENERAL

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

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

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

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

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

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

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

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

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

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

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

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

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

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

4.2.5.3 Schedule of Values in a form specified by City reflecting the subcontracts and other categories that will be used to submit Pay Applications for the Work. The total amount of the Schedule of Values must not be greater than the Contract Price. The Schedule of Values will be reviewed at the Pre-Construction Conference and revised by Contractor within 10 Days after Pre-Construction Conference in response to comments and questions from City. Once accepted by City in writing, the Schedule of Values for the Project must not be changed without the prior written approval of City.

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

4.2.7 Aerial Drone Construction Photography.

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

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

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

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

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

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

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

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

4.2.7.7 Airspace Authorizations. Operations in Class G airspace are allowed without air traffic control (ATC) permission. Operations in Class B, C, D and E airspace need ATC authorization. Drone

pilots to schedule each flight in advance and based on airspace if required will notify nearby airports/control towers, etc.

4.2.8 Government Approvals and Permits.

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

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

4.3 **PRE-CONSTRUCTION CONFERENCE**

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

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

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

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

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

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

4.4.3 Contractor's Superintendent must be present at the Site at all times that material Work under this Contract is taking place. Contractor's Superintendent or designee must be present at the Site at all times any other Work under this Contract is taking place.

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

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

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

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

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

4.4.8 Before ordering materials or doing Work, Contractor and each Subcontractor must verify

measurements at the Site and will be responsible for the correctness of such measurements. No extra charge or compensation will be allowed because of differences between actual dimensions and the dimensions indicated on the Contract Documents, including the Drawings.

4.4.9 Ground Level Construction Photography.

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

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

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

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

4.4.10 Underground Facilities.

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

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

4.4.11 Relocation of Existing Water Meters. When a service line has been extended and a line setter installed in a meter box, City forces will re-install meter. No compression fittings will

be utilized.

4.4.12 Water Turn-On or Turn-Off.

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

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

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

4.4.13 Tests and Inspections.

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

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

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

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

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

approved in writing by City.

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

4.5 **CONTROL OF THE PROJECT SITE**

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

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

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

4.6 **PROJECT SAFETY**

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

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

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

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

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

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

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

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

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

- 4.6.9 Contractor's responsibility for safety under this Section is not intended in any way to relieve Subcontractors and Sub-Subcontractors of their own contractual and legal obligations and responsibility for (i) complying with all Legal Requirements, including those related to health and safety matters, and (ii) taking all necessary measures to implement and monitor all safety precautions and programs to guard against injury, losses, damages or accidents resulting from their performance of the Work.
- 4.6.10 As between City and Contractor, Contractor is responsible to City for any and all the safety issues relating to the Work on the Project. Contractor must administer and manage the safety program. This will include, but not necessarily be limited to review of the safety programs of each Subcontractor. Contractor must monitor the establishment and execution of compliance with all applicable regulatory and advisory agency construction safety standards. Contractor's responsibility for review, monitoring, and coordination of the Subcontractor's safety programs will not extend to direct control over execution of the Subcontractors' safety programs. Notwithstanding Contractor's safety obligations to City, it is agreed and understood that each individual Subcontractor will remain controlling employer responsible for the safety programs and precautions applicable to its own work and the activities of other's work in areas designated to be controlled by such Subcontractor for purposes of workers compensation insurance coverage.
- 4.6.11 Nothing in this agreement will relieve Contractor of his responsibility to maintain traffic, structures, etc., as noted on the Plans, Specifications, and Project Specific Conditions. Contractor is responsible to provide all necessary shoring, bracing and trench support as is necessary to maintain traffic structures, etc., as stipulated in the Plans, Specifications, and Special Provisions. If the stability of adjoining building, walls, roadways, etc., is endangered by Contractor's excavation, shoring, bracing, or under pinning must be provided as necessary to ensure project safety. Cost for shoring, bracing, underpinning, and trench support will be included in the appropriate items listed in the Contract Price, and no additional payment will be made for this work.
- 4.7 **MATERIALS QUALITY, SUBSTITUTIONS, AND SHOP DRAWINGS**
- 4.7.1 **Quality Control and Quality Assurance Testing.**
- 4.7.1.1 All construction materials to be used or incorporated in the Project are subject to inspection, Quality Control & Quality Assurance Testing, and approval or rejection by City. Any material rejected by City must be removed immediately and replaced in an acceptable manner to City at no additional cost to City. When QC/QA tests indicate noncompliance with the Contract Documents, retesting must be performed by the same testing laboratory that performed the tests that indicated noncompliance.
- 4.7.1.2 The Contractor must establish, provide, and maintain an effective Quality Control Testing Program (QCTP). The Contractor must develop his own program or procure the services of a consultant. In either case, the party performing the tests must be currently certified by the National Bureau of Standards in the National Voluntary Laboratory Accreditation Program (NVLAP) for construction services or the AASHTO Accreditation Plan (AAP) for Soils, Asphalt and Concrete. The Contractor must provide all support necessary to perform QC and QA testing and sampling (i.e. shoring for testing trench backfill, backhoes, motor graders, loaders, etc. to facilitate testing and sampling). The City will perform the QA testing.
- 4.7.1.3 The Contractor must submit a written QCTP to the City as a required submittal. The Contractor must not begin Work until the Quality Control Program has been reviewed and

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

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

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

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

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

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

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

4.7.2 Trade Names and Substitutions.

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

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

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

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

4.7.3 Shop Drawings.

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

- 4.7.3.2 Contractor must submit a schedule of Shop Drawing submissions, which avoids bulk submissions to the extent reasonably possible, with the Project Schedule for City approval. The schedule of Shop Drawing submissions must include all of the items for which Shop Drawings are required by the Contract Documents, including the Specifications. Unless otherwise noted, Shop Drawings will not be required for items specified or detailed in the Uniform Standard Specifications and Details or the Technical Specifications.
- 4.7.3.3 Shop Drawings must be numbered consecutively for each Specification section and must accurately and distinctly present the following:
- a. All working and erection dimensions.
 - b. Arrangements and sectional views.
 - c. Necessary details, including complete information for making connections between work under this Contract and work under other Contracts.
 - d. Kinds of materials and finishes.
 - e. Parts list and description thereof.
- 4.7.3.4 Each Drawing or page must include:
- a. Project Name, City of Chandler Project Number and descriptions.
 - b. Submittal date and space for revision dates.
 - c. Identification of equipment, product or material.
 - d. Name of Contractor and Subcontractor.
 - e. Name of Supplier and Manufacturer.
 - f. Relation to adjacent structure of material.
 - g. Physical dimensions clearly identified.
 - h. ASTM and Federal Specifications references.
 - i. Identification of and justification for deviations from the Contract Documents.
 - j. Contractor's stamp, initialed or signed, dated and certifying the review of submittal, certification of field measurements and compliance with Contract.
 - k. Location at which the equipment or materials are to be installed.
- 4.7.3.5 Location will mean both physical location and location relative to other connected or attached material. City will return unchecked any submittal, which does not contain complete data on the Work and full information on related matters.
- 4.7.3.6 Stock or standard drawings will not be accepted for review unless full identification and supplementary information is shown thereon in ink or typewritten form.
- 4.7.3.7 Contractor must schedule, prepare and submit all Shop Drawings in accordance with a timetable that will allow its suppliers and manufacturers sufficient time to fabricate, manufacture, inspect, test and deliver their respective products to the project Site in a timely manner so as to not delay the complete performance of the Work.
- 4.7.3.8 If the Shop Drawings show departures from the Contract requirements, Contractor must

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

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

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

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

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

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

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

4.8 **PROJECT RECORD DOCUMENTS**

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

4.8.2 Contractor must mark these Drawings to indicate the actual installation where the installation

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

- a. Dimensional changes to the Drawings.
- b. Revisions to details shown on Drawings.
- c. Locations and depths of underground utilities.
- d. Revisions to routing of piping and conduits.
- e. Actual equipment locations.
- f. Changes made by Change Order or Addendum.
- g. Details not on original Contract Drawings.

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

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

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

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

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

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

4.9 **WARRANTY AND CORRECTION OF DEFECTIVE WORK**

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

4.9.2 City May Stop the Work. If the Work is defective, or Contractor fails to supply sufficient skilled workmen or suitable materials or equipment, City may order Contractor to stop the Work without cost to City, or any portion thereof, until the cause for such order has been

eliminated; however, this right of City to stop the Work will not give rise to any duty on the part of City to exercise this right for the benefit of Contractor or any other party.

4.9.3 Correction or Removal of Defective Work.

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

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

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

4.9.5 Correction or Removal of Unauthorized Work.

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

4.9.5.2 Upon failure on the part of the Contractor to comply promptly with any order of the City, City will have authority to cause unauthorized Work to be remedied, removed, or replaced

at the Contractor's expense and to deduct the costs from any moneys due or to become due the Contractor.

4.9.6 Correction Period - One Year Guarantee.

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

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

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

4.9.7 Acceptance of Defective Work.

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

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

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

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

SECTION 5 - CITY RESPONSIBILITIES

5.1 CITY PROJECT MANAGER AND INSPECTORS

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

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

5.2 **DESIGN PROFESSIONAL SERVICES**

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

5.3 **CITY'S SEPARATE CONTRACTORS**

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

5.4 **PERMIT REVIEW AND INSPECTIONS**

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

5.5 **PLANS AND SPECIFICATIONS TO THE CONTRACTOR**

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

at the cost of reproduction.

SECTION 6 - CONTRACT TIME

6.1 CONTRACT TIME

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

6.2 PROJECT SCHEDULE

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

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

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

the Project completion date.

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

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

6.3.3 Certificate of Substantial Completion.

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

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

Project Manager's Punch List.

6.4 **PARTIAL UTILIZATION**

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

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

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

6.5 **FINAL ACCEPTANCE**

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

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

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

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

6.6 **CONTINUATION OF WORK**

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

6.6.2 Furthermore, the timely completion of the Work being of the utmost importance under this Contract, notwithstanding the existence of one or more disputes between the parties concerning the scope of the Work, the Project Schedule, Contract Time, payments or any

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

SECTION 7 - CONTRACT PRICE

7.1 UNIT PRICE CONTRACTS

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

7.2 CHANGE ORDERS

- 7.2.1 Unit Price Change Orders. The Change Order Price for all Unit Price Change Orders will be the amount set forth in the Change Order multiplied by the verified quantity provided.
- 7.2.2 Measurements of quantities to determine the total Change Order Price must be in accordance with MAG Specifications §§ 109.1 and 109.2.
- 7.2.3 The Unit Price may only be changed as set forth in Section 9 below.
- 7.2.4 MAG Specification § 109.4.1 is modified as follows: Before § 109.4.1, the following is added: Any deduction or increase in the Contract Price must be supported by a signed, written Change Order fully executed by City, and supported by such backup as the Project Manager may require. No adjustments in any Unit Prices will be allowed. Sections 109.4.1(A) and (B) and 109.4.2(A) are deleted in their entirety.

7.3 SALES TAX

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

SECTION 8 - PAYMENT

8.1 PAYMENT FOR CONSTRUCTION SERVICES

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

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

- 8.1.3 Except for Work performed under a JOC contract, the Contracting Agency will retain 10 percent of all estimates as a guarantee for complete performance of the Contract in accordance with Arizona Revised Statutes Section 34-221 or 34-607. 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 Contract.
- 8.1.6 City reserves the right under A.R.S. § 34-609(B)(3) to reinstate the ten percent (10%) retention if City determines that satisfactory progress is not being made.
- 8.1.7 Contractor's Warranty of Title.
 - 8.1.7.1 Contractor warrants and guarantees that title to all Work, materials and equipment covered by any Contractor Payment Request, whether incorporated in the Project or not, will pass to City at the time of payment, free and clear of all liens, claims, security interests, and encumbrances, provided that this will not preclude the Contractor from installing metering devices or other equipment of utility companies or municipalities, the title of which is commonly retained by the utility company or municipality.
 - 8.1.7.2 No materials, supplies, or equipment for the Work under this Contract will be purchased subject to any chattel mortgage or under a conditional sale contract or other agreement by which an interest therein, or any part thereof, is retained by the seller or supplier.
 - 8.1.7.3 Nothing contained in this Section will defeat or impair the right of such persons furnishing materials or labor under any bond given by the Contractor for their protection, or any right under any law permitting such persons to look to funds due the Contractor in the hands of the City. The provisions of this Section must be inserted in all subcontracts and material contracts, and notices of its provision must be given to all persons furnishing materials for the Work when no formal contract is entered into for such materials.

8.2 **PAYMENT UPON SUBSTANTIAL COMPLETION**

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

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

8.3 **FINAL PAYMENT**

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

- a. Work has been fully completed (including completion of all incorrect or incomplete work items) and the written Final Acceptance has been issued by City;
- b. Necessary operating manuals, any excess materials and supplies necessary for matching materials and supplies incorporated into the Work, acceptable sewer video results (if applicable), and complete "as-built" Drawings (including the Building Information Model, if required by the Contract Documents) have been delivered to City, as specified in this Section 8.3;
- 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 Contract Price;
- e. Damage to City or another Contractor;
- f. Reasonable evidence that the Work will not be completed within the Contract Time, and that the unpaid balance would not be adequate to cover actual or liquidated damages for the anticipated delay;
- g. Failure to carry out the Work in accordance with the Contract Documents; or
- h. Contractor is in default of any of its other obligations under the Contract Documents.

8.5 **JOINT/DIRECT CHECKS**

To promote the timely completion and progress of the Work or when appropriate and necessary, payments to Contractor may be made jointly to Contractor and its employees, agents, Subcontractors and suppliers, or any of them. For federally funded contracts, 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 Contract for which a lien may be filed either against the real estate or leasehold interest of City, or against payments due from City to Contractor, or for which a claim may be made against any payment or performance bond or both. To the fullest extent permitted by law, Contractor agrees that no liens or other claims in the nature of a lien against the real estate, leasehold, or other interest of City, against payment due from City to Contractor, or against any payment or performance

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

8.8 FINANCIAL RECORDKEEPING AND CITY'S AUDIT RIGHT

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

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

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

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

SECTION 9 - CHANGES TO THE CONTRACT

9.1 FIELD ORDERS

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

9.2 EXTRA WORK/CHANGES IN THE WORK

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

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

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

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

- a. By mutual acceptance of a lump sum properly itemized in a form acceptable to City;
- b. By unit prices stated in the Contract Documents;
- c. When the City determines that a Unit Price Book Job Order associated with a Job Order Contract requires a Change Order, by using the same Total Cost Data and CCI that are in effect when the Change Order is anticipated to be issued; or
- d. By actual cost and a percentage fee covering overhead and profit, as follows:
 - (i) Contractor will perform the extra work and be compensated for actual cost of labor, materials and equipment.
 - (ii) Contractor will have the right to add the fee percentage applicable to the Work under the Contract, or if no such fee has been agreed to by the parties, not more than five percent (5%) to the Subcontractor's prices for authorized extra work performed solely by Subcontractors. Such percentage will include all of Contractor's charges for overhead, profit, administration and supervision.
 - (iii) Contractor or Subcontractor will have the right to add the fee percentage applicable to Work under the Contract for self-performed extra work, or if no such fee has been agreed to by the parties, Contractor's or Subcontractor's maximum total allowable additions for overhead, profit, administration and supervision will not exceed ten percent (10%) of actual verifiable labor, materials and equipment for such self-performed extra work.

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

9.3 **ACCURACY OF CHANGE ORDER PRICING INFORMATION**

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

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

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

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

9.4 **EMERGENCIES**

In any emergency affecting the safety of persons or property, Contractor will act, at its

discretion, to prevent threatened damage, injury or loss. Any change in the Contract Price or Contract Time resulting from emergency work will be determined as provided in this Section.

9.5 **DIFFERING SITE CONDITIONS**

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

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

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

SECTION 10 -SUSPENSION AND TERMINATION

10.1 **SUSPENSION**

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

10.2 **TERMINATION BY THE CITY FOR CAUSE**

10.2.1 MAG Specifications § 108.11 applies to the Contract.

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

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

- g. Appointed a trustee or receiver for itself or any of its property;
- h. Filed a petition to take advantage of any debtor's act, or to reorganize under the bankruptcy or similar laws; or
- i. Otherwise breached a provision of the Contract Documents or any other contract between City and Contractor.

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

10.3 **TERMINATION BY CITY FOR CONVENIENCE**

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

10.4 **A.R.S. § 38-511**

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

SECTION 11 -INSURANCE AND BONDS

11.1 **INSURANCE REQUIREMENTS**

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

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

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

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

of the Contract services under this Contract by Contractor, its agents, representatives, employees, or Subcontractors and the Contractor is free to purchase any additional insurance as may be determined necessary.

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

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

11.2 **MINIMUM SCOPE AND LIMITS OF INSURANCE**

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

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

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

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

11.2.1.4 Builders' Risk/Installation Floater Insurance. The Contractor bears all responsibility for loss to all equipment or Work under construction. Unless waived in writing by the City the Contractor will purchase and maintain in force Builders' Risk/Installation Floater insurance on the entire Work until completed and accepted by the City. This insurance will be Special Causes of Loss policy form, (minimally including perils of fire, flood, lightning, explosion, windstorm and hail, smoke, aircraft and vehicles, riot and civil commotion, theft, vandalism, malicious mischief, and collapse), completed value, replacement cost policy form equal to the contract price and all subsequent modifications. The Contractor's Builders' Risk/Installation Floater insurance must be primary and not contributory.

a. Builders' Risk/Installation Floater insurance must cover the entire Work

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

- b. The Contractor must also purchase and maintain Boiler and Machinery insurance with the same requirements as Builders' Risk/Installation Floater insurance cited above if the Work to be performed involves any exposures or insurable property normally covered under a Boiler and Machinery insurance policy or made necessary as required by law or testing requirements in the performance of this Contract/Agreement. The Contractor will be responsible for any and all deductibles under these policies and the Contractor waives all rights of recovery and subrogation against the City under the Contractor- Builders' Risk/Installation Floater insurance described herein.
- c. Builders' Risk/Installation Floater Insurance must be maintained until whichever of the following first occurs: (i) final payment has been made; or, (ii) until no person or entity, other than the City, has an insurable interest in the property required to be covered.
- d. The Builders' Risk/Installation Floater insurance must be endorsed so that the insurance will not be canceled or lapse because of any partial use or occupancy by the City.
- e. The Builders Risk/Installation Floater insurance must include as named insureds, the City, the Contractor, and all tiers of Subcontractors and others with an insurable interest in the Work who will be named as additional insureds unless they are able to provide the same level of coverage with the City and Contractor named as additional insureds. Certificates must contain a provision that the insurance will not be canceled or materially altered without at least 30 Days advance notice to the City. The City must also be named as a Loss Payee under the Builders' Risk/Installation Floater coverage.
- f. The Builders Risk/Installation Floater insurance must be written using the Special Causes of Loss policy form, replacement cost basis.
- g. All rights of subrogation under the Builders Risk/Installation Floater insurance are, by this Contract/Agreement, waived against the City, its officers, officials, agents and employees.
- h. The Contractor is responsible for payment of all deductibles under the Builders' Risk/Installation Floater insurance policy.

11.2.1.5 Pollution Liability Insurance (Including Errors and Omissions). For Job Orders, Pollution Liability Insurance is only required if applicable and determined on a project specific basis.

Contractor must maintain Pollution Liability Insurance with a limit of not less than \$5,000,000 per loss, \$5,000,000 aggregate for losses caused by pollution conditions including coverage for bodily injury, property damage, defense costs, clean-up costs, and completed operations that arise from the operations of Contractor as described in this Contract.

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

11.3 ADDITIONAL POLICY PROVISIONS REQUIRED

- 11.3.1 Self-Insured Retentions or Deductibles. Any self-insured retentions and deductibles must be declared and approved by the City. If not approved, the City may require that the insurer reduce or eliminate any deductible or self-insured retentions with respect to the City, its officers, officials, agents, employees, and volunteers.
- 11.3.2 The Contractor's insurance must contain broad form contractual liability coverage.
- 11.3.3 The Contractor's insurance coverage must be primary insurance with respect to the City, its officers, officials, agents, and employees. Any insurance or self-insurance maintained by the City, its officers, officials, agents, and employees will be in excess of the coverage provided by the Contractor and must not contribute to it.
- 11.3.4 The Contractor's insurance must apply separately to each insured against whom claim is made or suit is brought, except with respect to the limits of the insurer's liability.
- 11.3.5 Coverage provided by the Contractor must not be limited to the liability assumed under the indemnification provisions of this Contract.

- 11.3.6 The policies must contain a severability of interest clause and waiver of subrogation against the City, its officers, officials, agents, and employees, for losses arising from Work performed by the Contractor for the City.
- 11.3.7 The Contractor, its successors and or assigns, are required to maintain Commercial General Liability insurance as specified in this Contract for a minimum period of 3 years following completion and acceptance of the Work. The Contractor must submit a Certificate of Insurance evidencing Commercial General Liability insurance during this 3 year period containing all the Contract insurance requirements, including naming the required Additional Insureds set forth herein.
- 11.3.8 If a Certificate of Insurance is submitted as verification of coverage, the City will reasonably rely upon the Certificate of Insurance as evidence of coverage but this acceptance and reliance will not waive or alter in any way the insurance requirements or obligations of this Contract.
- 11.3.9 Insurance Cancellation During Contract Term.
- 11.3.9.1 If any of the required policies expire during the life of this Contract, the Contractor must forward renewal or replacement Certificates to the City within 10 Days after the renewal date containing all the required insurance provisions.
- 11.3.9.2 Each insurance policy required by the insurance provisions of this Contract must provide the required coverage and must not be suspended, voided or canceled except after 30 Days prior written notice has been given to the City, except when cancellation is for non-payment of premium, then 10 Days prior notice may be given. Such notice must be sent directly to Chandler Law-Risk Management Department, Post Office Box 4008, Mailstop 628, Chandler, Arizona 85225. If any insurance company refuses to provide the 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 Contract.
- 11.4 **BONDS AND OTHER PERFORMANCE SECURITY**
- 11.4.1 After Contract award, Contractor must provide a Performance Bond and a Payment Bond, each in an amount equal to the full amount of the Contract Price.
- 11.4.2 Each such bond must be executed by a surety company or companies holding a Certificate of Authority to transact surety business in the State of Arizona, issued by the Director of the Arizona Department of Insurance and must be named in the current list of "Companies

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

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

SECTION 12 - INDEMNIFICATION

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

SECTION 13 -DISPUTE RESOLUTION

- 13.1 All disputes arising out of or relating to the Contract, the Work or the Project, other than termination under Section 10, will be resolved pursuant to the Dispute Resolution

process set forth in Appendix 6 of these General Conditions, and not pursuant to MAG Specifications § 110.

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

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

SECTION 14 - MISCELLANEOUS PROVISIONS

14.1 CONTRACT DOCUMENTS

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

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

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

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

14.1.5 On the Drawings, given dimensions will take precedence over scaled measurements and

large scale drawings over small-scale drawings.

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

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

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

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

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

14.2 **REFERENCE STANDARDS**

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

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

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

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

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

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

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

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

14.4 **HAZARDOUS ENVIRONMENTAL CONDITIONS**

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

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

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

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

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

14.5 **COOPERATION AND FURTHER DOCUMENTATION**

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

14.6 **ASSIGNMENT**

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

14.7 **SUCCESSORS**

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

14.8 **LAWFUL PRESENCE**

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

14.9 **NO BOYCOTT OF ISRAEL CERTIFICATION**

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

14.10 **NO THIRD PARTY BENEFICIARY**

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

14.11 **GOVERNING LAW AND VENUE**

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

14.12 **SEVERABILITY**

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

14.13 **LEGAL REQUIREMENTS**

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

forth on Exhibit C of the Contract.

14.14 **PARTIAL INVALIDITY**

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

14.15 **ATTORNEYS' FEES**

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

14.16 **CONFLICT OF INTEREST**

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

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

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

14.17 **INDEPENDENT CONTRACTOR**

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

14.18 **NOTICE OF INJURY**

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

14.19 **CONFIDENTIALITY**

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

14.20 **DATA CONFIDENTIALITY**

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

without notice.

14.21 **SURVIVAL**

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

14.22 **COVENANTS AGAINST CONTINGENT FEES**

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

14.23 **NO WAIVER**

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

14.24 **NONEXCLUSIVE REMEDIES**

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

14.25 **PROJECT COMMUNICATIONS**

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

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

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

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

14.26 **DRUG FREE WORKPLACE PROGRAM**

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

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

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

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

15.1 **ADDITIONAL DEFINITIONS**

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

Baseline Cost Model –

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

CM@Risk or Construction Manager at Risk –

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

CM@Risk Fee or Contractor's Fee –

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

Contract Documents –

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

Contract Price –

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

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

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

Cost of the Work –

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

Deliverables –

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

Pre-Construction Services Contract –

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

Pre-Construction Services –

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

Detailed Project Schedule –

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

General Conditions Costs –

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

GMP Plans and Specifications –

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

GMP Proposal –

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

Guaranteed Maximum Price or GMP –

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

15.2 CONTRACT PRICE

- 15.2.1 The Contract Price for all Contracts, Change Orders, and Job Orders based upon payment of the Cost of the Work plus a Fee with a GMP, time and materials, or cost-plus a fee will be the Cost of the Work incurred plus the Fee agreed to in writing by City, limited to the amount of the GMP, if agreed to. Unless otherwise expressly provided in the Contract, Change Order, or Job Order, all Cost Based pricing will be subject to and limited to GMP.
- 15.2.2 The Contract Price may only be changed as set forth in Section 9 above.
- 15.2.3 Only costs specifically designated as reimbursable costs are eligible for payment by City or may be charged against the Contract Price. All other costs will not be paid by City and will

not be chargeable against the Contract Price.

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

15.3 **ALLOWANCES**

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

- 15.3.2 Unless otherwise provided in the Contract Documents:

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

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

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

15.4 **CONTINGENCY**

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

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

GMP.

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

15.5 **REDUCTION IN RETENTION**

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

15.6 **FINAL PAYMENT**

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

15.7 **OPEN BOOK**

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

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

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

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

16.1 **ADDITIONAL DEFINITIONS**

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

Contract –

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

JOC Contractor's Coefficient –

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

Job Order Request for Proposal (RFP) –

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

Job Order Cost Proposal –

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

Guaranteed Maximum Price (GMP) Job Order –

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

Job Order Project Agreement (Job Order) –

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

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

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

16.2.2 RFP's For Job Orders

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

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

16.2.3 JOC Contractor's Job Order Cost Proposal

16.2.3.1 JOC Contractor must respond within ten (10) calendar days of the RFP date or site visit,

whichever is later or as otherwise indicated on a case-by-case basis, by submitting JOC Contractor's Job Order Cost Proposal to the City representative.

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

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

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

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

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

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

16.2.4 Issuance of Job Order

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

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

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

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

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

16.3 **INCIDENTAL DESIGN SERVICES**

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

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

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

Requirements, and the common law.

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

16.4 **CONSTRUCTION SERVICES**

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

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

16.4.3 Construction Phasing

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

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

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

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

- 16.4.5 Ownership of Work Product. Work Product prepared or otherwise created in connection with the performance of this Contract, including the Work, are to be and remain the property of City. For purposes of this provision, "Work Product" will include all designs,

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

16.5 OPTIONAL LIQUIDATED DAMAGES

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

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

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

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

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

16.6 PERFORMANCE MEASUREMENT

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

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

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

17.1 **ADDITIONAL DEFINITIONS**

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

17.2 **GENERAL**

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

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

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

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

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

17.2.6 Ownership of Work Product. All Work Product prepared or otherwise created in connection with the performance of this Contract, including the Work, are to be and remain the property

of City. For purposes of this provision, "Work Product" will include all designs, drawings, plans, specifications, ideas, renderings and other information or material, in whatever form created (e.g., electronic or printed) and in all media now 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, Contractor hereby transfers and assigns ownership of the copyright in such Work to City. The rights in this Section are exclusive to City in perpetuity.

- 17.2.7 CM@Risk represents to City in completing Pre-Construction Services and providing the reports and analysis required thereunder, that Work can be properly and timely constructed within the GMP Proposal, if accepted. CM@Risk does not assume any design responsibilities unless specifically called for in the scope of work, but CM@Risk will be responsible for their errors, omissions or inconsistencies included in the Work.

17.3 **DETAILED PROJECT SCHEDULE**

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

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

extent authorized by City, relationships between the activities, City's occupancy requirements showing portions of the Project having occupancy priority, and proposed dates for Final Acceptance.

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

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

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

- 17.4.6 The Project Team will routinely identify and evaluate using value analysis principles and alternate systems, approaches, design changes that have the potential to reduce Project costs while still delivering a high quality and fully functional Project consistent with the Project Program. If the Project Team agrees, CM@Risk in cooperation with the Design Professional, will perform a cost/benefit analysis of the alternatives and submit such in writing to the Project Team. City, through the Project Manager, will direct which alternatives will be incorporated into the Project. The Design Professional will have full design responsibility for the review and incorporation of CM@Risk suggested alternatives into the Drawings and Specifications. CM@Risk must analyze the costs and schedule impacts of the alternatives against the Baseline Cost Model and Schedule and provide a recommendation for the Project Team's consideration and City's approval prior to the establishment of the GMP.

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

- 17.5.1 At the conclusion of the Master Planning and Programming, if required, CM@Risk will review all available information regarding the design and scope of the Project using CM@Risk's experience in performing similar work, knowledge of similar projects and current and projected construction costs and, based upon that review, must develop a Baseline Cost Model for review by the Project Team and approval by City. Once approved by City, the Baseline Cost Model will be continually referenced as detailed estimates are created as the design progresses throughout Pre-Construction until the final GMP for the entire Project is established. A final GMP for the entire Project must be established and approved by City prior to the start of construction. It is the responsibility of CM@Risk to ensure City has sufficient information to evaluate and approve a final GMP prior to the time necessary to start construction so construction can be completed within the Contract Time. The Project Detailed Cost Estimate will be the best representation from CM@Risk of what the complete functional Project's construction costs will be as indicated by the most current available documents and will be constantly checked against the Baseline Cost Model. CM@Risk must communicate to the Project Team and assumptions made in preparing the Baseline Cost Model. The Baseline Cost Model must support CM@Risk's Detailed Cost Estimates and may be broken down initially as dictated by the available information, as required by City.
- 17.5.2 After receipt of the Design Professional's most current documents from certain specified pre- construction milestones, CM@Risk must provide a draft Detailed Cost Estimate including a detailed written report detailing any variances to the Baseline Cost Model and Baseline Project Schedule. The Design Professional and CM@Risk will reconcile any disagreements on the estimate to arrive at an agreed upon Detailed Cost Estimate for the construction costs based on the scope of the Project through that specified pre-construction milestone. Pre-Construction milestones applicable to this paragraph are: Master Planning and Programming, Schematic Design, 50% Design Development, 100% Design Development, and 50% Construction Drawings, If no consensus is reached, City will

make the final determination. If the Project Team requires additional updates of the Detailed Cost Estimate beyond that specified in this paragraph, CM@Risk must provide the requested information in a timely manner.

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

17.6 **SUBCONTRACTOR AND MAJOR SUPPLIER SELECTIONS**

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

- submitted with its Statement of Qualifications.
- 17.6.2 City may approve the selection of a Subcontractor(s) or 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 Contract Price until acceptance of ALL Pre-Construction Services and award of the final approved Construction Services Contract for the entire Project by City Council. If CM@Risk does not prepare a GMP Proposal that is acceptable to City, or the GMP Proposal exceeds the City's Construction Budget, then CM@Risk understands and acknowledges that it will forfeit any right to

receive the 25% of the Contract Price being retained by City.

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

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

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

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

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

General Conditions Appendices

SECTION 15 – APPENDICES

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

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

CALCULATING DELAYS AND DAMAGES

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

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

I. TYPES OF DELAYS:

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

A. Excusable/Compensable:

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

B. Excusable/Non-compensable:

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

C. Non-excusable/Non-compensable:

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

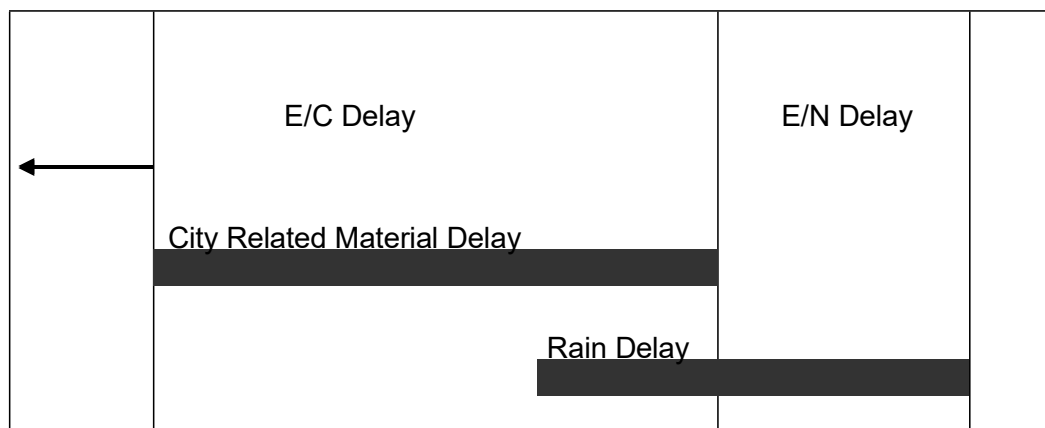
D. Concurrent:

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

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

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

Example of a Concurrent Delay:



II. ANALYZING THE DELAY:

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

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

As a minimum the Contractor must provide the following materials to the Engineer:

- A. As-Planned Schedule. The initial construction schedule, required by the Contract Documents, will be considered the baseline schedule. It is to the Contractor's advantage that the As-Planned (baseline) Schedule be as detailed as possible in order for delays, as they occur, to be incorporated into the schedule in representative locations. It is also to the Contractor's advantage to use a computer software program to generate the schedule since updated schedules are required monthly by the Contract Documents and since updated schedules are required to support delays and requests for additional compensation for delays. The As-Planned (baseline) Schedule must be presented in network format which clearly shows the interrelationships of the activities. The Contractor must also provide a printout of the activities showing early start, early finish, late start, late finish, duration and float. The activity list printout must also indicate predecessor and successor activities.
- B. As-Built Schedules. The as planned (baseline) schedule must be updated with complete progress-to-date information (actualized) up to the date of the start of the alleged delay. Each updated schedule will serve as the as-built schedule for analyzing the alleged delay and provide a new baseline as-planned schedule for the next delay. This process must be repeated for each alleged delay as it occurs. In updating the baseline schedule, the alleged delay must be treated as an activity and inserted into the schedule as a predecessor to the impacted activity (ies). When an activity that has already started is impacted, it is preferable to divide this activity into two parts and show the impact affecting the second part. For schedules which incorporate a time line (or data date), the delay activity must be inserted at the time it actually occurred. Some software scheduling programs have a PAUSE-RESUME feature that can be used to facilitate the requirements. The updated schedule must also be accompanied by a listing of activities as with the baseline schedule. This activities list must contain the alleged delay as an activity showing the duration and the activities which are predecessors and successors to it. When computer generated schedules are used, the Contractor must provide, in electronic media format, the complete data files for the updated schedule that included the delay activity, preferably either in Suretrak or in Microsoft Project. Each electronic media must contain a label identifying the Project name, Contractor's name, program name and version number, data date and project finish date.
- C. Other Documents: In order to determine the amount of the alleged delay and if it is compensable, the Contractor must provide all backup documentation relevant to the issue and as required by the Engineer. This documentation must include copies of such items as: purchase orders; delivery schedules; correspondence; memoranda of telephone calls; force account daily worksheets (initialed by the Inspector); payroll data; estimating (bid) worksheets; and any other materials which may be requested by the Engineer.
- D. Procedure: Only after receipt of sufficient documentation will the Engineer analyze each alleged delay and determine if it is supported or refuted. If supported, the Engineer will determine if it is excusable or non-excusable, compensable or non-compensable. If the Engineer determines that the delay did not affect the Project Completion, the as-planned schedule, which has been updated to the date of the alleged delay, must be revised to indicate this. If the Engineer determines the delay

did occur but was N/N, then no time extension will be granted. It is imperative that an actualized schedule be submitted as soon as the occurrence of the alleged delay is known. In no event will the Contractor submit an actualized updated schedule later than 60 days after the occurrence of the alleged delay becomes known.

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

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

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

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

III. CALCULATING MONETARY DELAY DAMAGES:

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

- A. No additional compensation or other monetary damages will be awarded or paid for any loss of anticipated profits by the Contractor, Subcontractors or Suppliers.
- B. No additional compensation or other monetary damages will be awarded for home office overhead or non-project general conditions of the Contractor, Subcontractors or Suppliers.
- C. Equipment:

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

In no event will compensation be paid for delay at more than 8 hours per day or 40 hours per week.
3. Except for vehicles used by supervisory personnel, all equipment will be paid at the "standby" rate during the delay period.
4. Equipment brought solely to mitigate the delay (such as pumps, light plants, etc.) may be paid in accordance with ADOT section 109.04(D) (3).
5. The Blue Book regional adjustment will apply in determining rental rates.

D. Material:

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

E. Labor:

1. Except for Supervisory Personnel (Superintendent, Project Engineer, and Foremen), labor wages will not be paid after the first one-half day of

claimed delay or impact. It is expected the Contractor will reassign or layoff unneeded employees.

2. For Foreman wages to be included, that Foreman must have been actively employed on the project prior to the commencement of the delay and be directly responsible for the activity being delayed.
3. Labor burden must be actual amounts incurred but must not exceed the ADOT approved rate.

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

IV. DOCUMENT REQUIRED FOR CLAIM ANALYSIS:

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

A. Labor:

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

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

B. Materials:

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

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

C. Equipment:

For all equipment, the Contractor must provide the Engineer with the designation, dates and hours of usage, dates and hours of standby, if any, daily hours, total hours,

rental rates and extension for each unit of equipment and machinery. Rental rates will be as established in Section III. Further, the Contractor must make available for inspection and copying to the Engineer the following listed documentation.

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

D. Subcontractors/Owner-Operators:

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

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

E. Miscellaneous:

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

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

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

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

COST REDUCTION INCENTIVE PROPOSALS FOR DESIGN BID BUILD CONTRACTS

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

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

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

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

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

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

General Conditions

Appendix 2

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

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

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

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

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

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

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

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

Upon acceptance of a Cost Reduction Incentive Proposal, any restrictions imposed by the

General Conditions Appendix 2

Contractor on its use or on disclosure of the information will become void, and the City thereafter will have the right to use all or any part of the Proposal without obligation or compensation of any kind to the Contractor.

COST REDUCTION INCENTIVE PROPOSAL FORM

TO: CIP City Engineer

FROM:

PROJECT NAME: RECLAIMED WATER INTERCONNECT FACILITY - GMP 1

PROJECT NUMBER: WW1901.402

DATE:

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

ESTIMATED COST SUMMARY (Attached detailed estimate):

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

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

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

CONTRACTOR'S AFFIDAVIT REGARDING SETTLEMENT OF CLAIMS

_____, Arizona
Date _____

Project Name: RECLAIMED WATER INTERCONNECT FACILITY - GMP 1
City Project No.: WW1901.402

To the City of Chandler, Arizona

Gentlemen:

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

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

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

CONTRACTOR

By _____

STATE OF ARIZONA)
) SS
COUNTY OF MARICOPA)

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

Notary Public

My Commission Expires

PERFORMANCE BOND

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

KNOW ALL MEN BY THESE PRESENTS THAT:_____

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

WHEREAS, the Principal has entered into a certain written contract with the Obligee, dated the _____ day of _____, 20__ for construction of **RECLAIMED WATER INTERCONNECT FACILITY - GMP 1, WW1901.402** which contract is hereby referred to and made a part hereof as fully and to the same extent as if copies at length herein.

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

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

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

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

AGENT OF RECORD

PRINCIPAL SEAL

By _____

SURETY SEAL

AGENT ADDRESS

PAYMENT BOND

ARIZONA STATUTORY PAYMENT BOND
PURSUANT TO TITLES 28, 34, AND 41, OF THE ARIZONA REVISED STATUTES
(Penalty of this Bond must be 100% of the Contract amount)

KNOW ALL MEN BY THESE PRESENTS THAT:_____

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

WHEREAS, the Principal has entered into a certain written contract with the Obligee, dated the _____ day of _____, 20__ for construction of **RECLAIMED WATER INTERCONNECT FACILITY - GMP 1, WW1901.402** which contract is hereby referred to and made a part hereof as fully and to the same extent as if copied at length herein.

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

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

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

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

PRINCIPAL

SEAL

AGENT OF RECORD

By _____

SURETY

SEAL

AGENT ADDRESS

DISPUTE RESOLUTION

A. INFORMAL DISPUTE RESOLUTION

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

B. DISPUTE RESOLUTION REPRESENTATIVE ("DRR") PROCESS

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

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

C. MEDIATION

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

mediator may request, and in the form and at such times, as the mediator may direct.

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

D. LITIGATION

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



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

CERTIFICATE OF COMPLETION

PROJECT NAME:	RECLAIMED WATER INTERCONNECT FACILITY - GMP 1		
CITY PROJECT NO.:	WW1901.402		
<i>If Federally Funded:</i>			
FEDERAL NO.:	WW1901.402	TRACS NO:	WW1901.402

(This section to be completed by Prime)
I HEREBY CERTIFY THAT ALL GOODS AND/OR SERVICES REQUIRED BY CITY OF CHANDLER FOR THIS PROJECT HAVE BEEN DELIVERED IN ACCORDANCE WITH THE CONTRACT DOCUMENTS AND BID SPECIFICATIONS AND ALL ACTIVITIES REQUIRED BY THE CONTRACTOR UNDER THE CONTRACT HAVE BEEN COMPLETED AS OF THE COMPLETION DATE LISTED HERE:

<u>COMPLETION DATE:</u>	

PRIME

FIRM NAME:			
PRINCIPAL:			
TITLE:			
SIGNATURE:		DATE:	

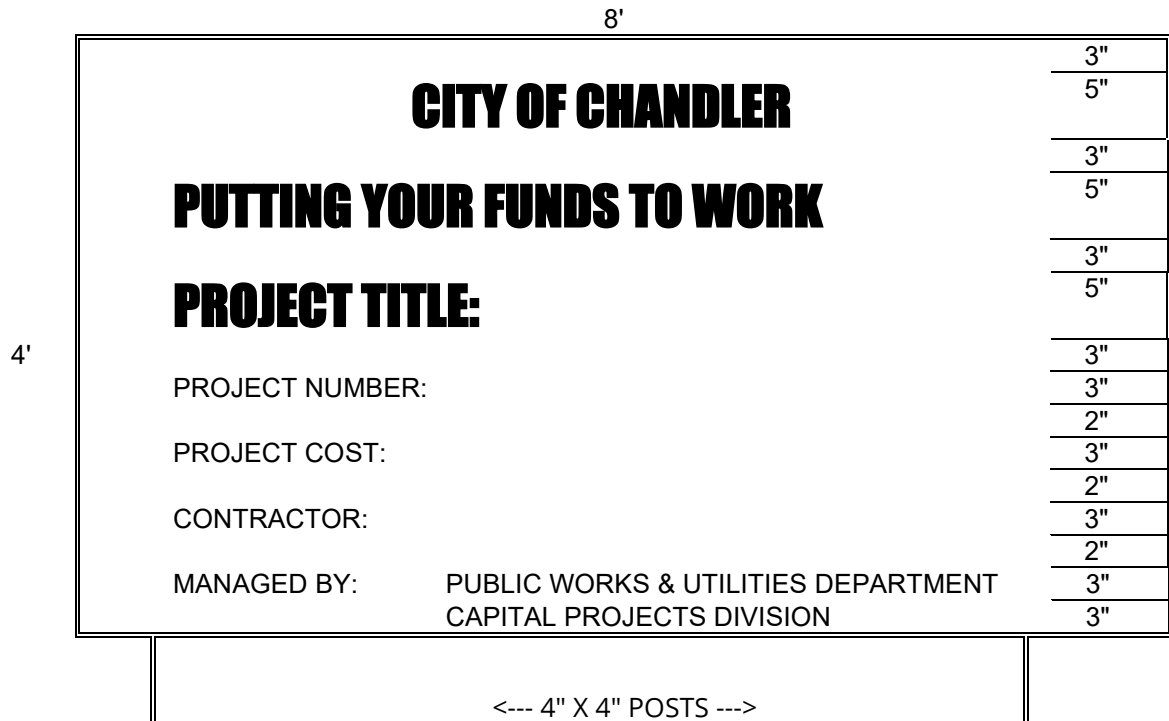
CERTIFIED BY ENGINEER/CONSULTANT:

FIRM NAME:			
SIGNATURE:		DATE:	

PROJECT ACCEPTED BY CITY OF CHANDLER:

FIRM NAME:			
SIGNATURE:		DATE:	

CONSTRUCTION SIGN DETAIL



NOTES:

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

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

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

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

COST OF THE WORK

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

SECTION 1 – COSTS TO BE REIMBURSED

1.1 Cost of the Work

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

1.2 Labor Costs

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

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

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

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

1.3 Subcontract Costs

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

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

- 1.3.3 Contractor (with respect to its Suppliers, Subcontractors and all lower tier Subcontractors) must provide City advance written notice and must obtain City's approval for any proposed Subcontract Change Order, Material Purchase Order, or other financial commitment in an amount in excess of \$5,000 prior to placing such order or entering into such agreement (regardless of whether or not any such commitment will affect the prime contract Guaranteed Maximum Cost). It is agreed that sums applicable to any Subcontract Change Order, Purchase Order or other financial commitment entered into in violation of the above notice and approval requirement will not be included in the amounts owing to Contractor, Subcontractors or Suppliers whether as Costs of the Work or as reasonable termination costs in the event of termination.

1.4 Costs of Material and Equipment Incorporated in the Completed Construction

- 1.4.1 Costs, including transportation and storage, of materials and equipment incorporated or to be incorporated in the completed construction.
- 1.4.2 Costs of materials described in the preceding Subparagraph 1.4.1 in excess of those actually installed to allow for reasonable waste and spoilage. Unused excess materials, in any, will become City's property at the completion of the Work or, at City's option, may be sold by the Contractor. Any amounts realized from such sales must be credited to City as a deduction from the Cost of Work.
- 1.4.3 Proceeds from the sale of recyclable materials, scrap, waste, etc. will be credited to job cost.

1.5 Costs of Other materials and Equipment, Temporary Facilities and Related Items

- 1.5.1 Costs, including transportation and storage, installation, maintenance, dismantling and removal of materials, supplies, temporary facilities, machinery, equipment and hand tools not customarily owned by construction workers, that are provided by the Contractor at the site and fully consumed in the performance of the Work; and cost (less salvage value) of such items if not fully consumed, whether sold to others or retained by Contractor. Cost for items previously used by Contractor will mean fair market value.
- 1.5.2 Rental charges for temporary facilities, machinery, equipment, and hand tools not customarily owned by construction workers that are provided by Contractor at the site, whether rented from Contractor or others, and costs of transportation, installation, minor repairs and replacements, dismantling and removal thereof. Rates and quantities of equipment rented will be subject to City's prior written approval.
- 1.5.2.1 The Projected usage for each piece of equipment to be rented for use on the Project and the estimated total rentals must be considered by Contractor before the piece of equipment is rented so that an appropriate rent versus buy decision can be made. Purchased equipment must be considered “job owned”. At the completion of the Project, Contractor must transfer title and possession of all remaining job-owned equipment to City, or Contractor may keep any such equipment for an appropriate fair market value credit to job cost, which will be mutually agreed to by City and Contractor.

1.5.2.2 Each piece of equipment to be rented must have hourly, daily, weekly and monthly rates and the most economical rate available will be reimbursed based on the circumstances of actual need and usage of the piece of equipment while it is stationed at the jobsite. When the piece of equipment is no longer needed for the work, no rental charges will be reimbursed if the piece of equipment remains at the jobsite for the convenience of Contractor.

1.5.2.3 Equipment Rental Rates

1.5.2.3.1 Compensation for equipment used on the Project will be paid in accordance with the Equipment Plan submitted by Contractor in the accepted GMP Proposal and no payments will be made in excess of the rates set forth in the Equipment Plan, or actual documented costs, whichever is less.

1.5.2.3.2 All equipment rental rates and costs are subject to City's right to audit when submitted as part of Equipment Plan and/or at any time during the Project.

1.5.2.4 The aggregate rentals chargeable for each piece of Contractor owned tools or equipment must not exceed 50% of the fair market value of such equipment at the time of its commitment to the Work. The original purchase price and date of purchase of the equipment will be documented with a copy of the purchase invoice for the piece of equipment. Such aggregate limitations will apply and no further rentals will be charged even if a piece of equipment is taken off the job and is later replaced by a similar piece of equipment. For purposes of computing the aggregate rentals applicable to aggregate rental limitations, rental charges for similar pieces of equipment will be combined if the pieces of equipment were not used at the same time.

1.5.2.5 Fair market value for used material and equipment as referred to in the Contract Documents will mean the estimated price a reasonable purchaser would pay to purchase the used material or equipment at the time it was initially needed for the job. Note: This is usually lower than the price a reasonable purchaser would pay for similar new construction material or construction equipment.

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

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

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

rates.

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

1.6 Miscellaneous Costs

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

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

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

1.7 Other Costs and Emergencies

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

advance in writing by City.

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

1.8 Related Party Transactions

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

SECTION 2 – COSTS NOT TO BE REIMBURSED

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

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

SECTION 3 – DISCOUNTS, REBATES, REFUNDS AND SAVINGS

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

SECTION 4 – GENERAL CONDITIONS COSTS

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

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

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

LANDSCAPE ESTABLISHMENT PERIOD

Section 1 – Description and General

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

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

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

1.1 Time and Schedule

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

1.2 Planted Stock and Seeding Establishment

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

1.3 Pre-Emergent Herbicide and Weed Control

- 1.3.1 Contractor will provide three applications of an approved pre-emergent herbicide on all unpaved areas of the project, as directed by City Representatives, to control weed growth in all areas of the project. The number of applications may be increased as directed by the City Representative, and at no additional cost to City, if the City Representative deems additional applications are required to control weed growth.
- 1.3.2 Application sequence will be approved in advance by City. The first application of pre-emergent will be completed prior to the application of Decomposed Granite and will be included with the cost of the Decomposed Granite as specified and part of the Construction Phase portion of work. The second application of pre-emergent will be completed after installation of the Decomposed Granite and no later than half-way through the Landscape Establishment Period. The third and final application of pre-emergent will be applied 15 days prior to completion of the Landscape Establishment portion of the project. The second and third pre-emergent applications will be included with the cost of Landscape Establishment. Watering will be completed in accordance with the manufacturer's recommendations, as included and as related to each application.
- 1.3.3 The pre-emergent herbicide will be applied in accordance with the Technical Specifications and the recommendations of the pre-emergent herbicide manufacturer, as approved by City Representatives.

- 1.3.4 The control of weeds will be accomplished by the use of herbicides. Manual removal of weeds will be required, after herbicides have taken affect.
- 1.3.5 Contractor is responsible for the removal and disposal of all trash and debris that during the Landscape Establishment Period. Contractor will keep the project in a neat and orderly manner during the duration of the Landscape Establishment Period.

1.4 Water

The water used during Landscape Establishment to properly maintain the plant material will be furnished by City, at designated sources from within the project limits, at no charge to Contractor. Contractor will be responsible for all equipment, materials and labor necessary to load, transport and unload water for watering purposes.

1.5 Plant Material Replacements

The plant material replacement will be considered as included in the work for Landscape Establishment, and will be made at no charge to the City.

- 1.5.1 Shrub and Plant Replacement - During the second half of the Landscaping Establishment period, Contractor will provide, where required, plant replacements as follows:

<u>Original Size</u>	<u>Replacement Size</u>
1 gallon	5 gallon
5 gallon	15 gallon
15 gallon	24-inch box
36-inch box	48-inch box

- 1.5.2 Tree Replacement – During the second half of the Landscape Establishment Period, Contractor will provide plant material replacements for existing plants that die as follows:

<u>Existing Plant Material Sizes</u>	<u>Replacement Size</u>
Trees:	
2-inch Caliper	24-inch box
4-inch Caliper	36-inch box
6-inch Caliper and greater	54-inch box
Shrubs:	
All Existing Shrubs	15 gallon

1.6 Measurement and Payment

See Technical Specifications for Measurement Payment provisions.

EXHIBIT C
TECHNICAL SPECIFICATIONS



CITY OF CHANDLER

PUBLIC WORKS & UTILITIES

Reclaimed Water Interconnect Facility

Project No. WW1901.203

GUARANTEED MAXIMUM PRICE (GMP) 1

August 11, 2021



**SPECIFICATIONS
FOR
RECLAIMED WATER INTERCONNECT FACILITY
GUARANTEED MAXIMUM PRICE (GMP) 1
CITY OF CHANDLER PUBLIC WORKS AND UTILITIES
DEPARTMENT
August 11, 2021**

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

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

I. CONTRACT AND SPECIFICATIONS

SECTION 01010 – Summary of Work

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

SECTION 01300 – Submittals

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

SECTION 01640 – Materials and Equipment

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

SECTION 01650 – Starting of Systems

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

SECTION 01660 – Field Tests of Equipment

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

SECTION 01730 – Operation and Maintenance Data

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

SECTION 01750 – Spare Parts and Maintenance Materials

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

SECTION 01821 – Instruction of Operations and Maintenance Personnel

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

SECTION 09900 – Painting

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

SECTION 11295 – Hydraulic Valves

Include Section 11295 – Hydraulic Valves attached as Attachment One of this Procurement Package.

SECTION 11314 – End Suction Centrifugal Pumps

Include Section 11314 – End Suction Centrifugal Pumps attached as Attachment One of this Procurement Package.

SECTION 11371 – Positive Displacement Blowers

Include Section 11371 – Positive Displacement Blowers attached as Attachment One of this Procurement Package.

SECTION 11372 – Air Compressors

Include Section 11372 – Air Compressors attached as Attachment One of this Procurement Package.

SECTION 11500.1 – Membrane Equipment System

Include Section 11500.1 – Membrane Equipment System attached as Attachment One of this Procurement Package.

SECTION 13127 – Extruded Flat Panel Covers

Include Section 13127 – Extruded Flat Panel Covers attached as Attachment One of this Procurement Package.

SECTION 13445 – Pneumatic Controllers and Control Valves

Include Section 13445 – Pneumatic Controllers and Control Valves attached as Attachment One of this Procurement Package.

SECTION 13447 – Electric Motor Actuators

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

SECTION 15062 – Steel Pipe

Include Section 15062 – Steel Pipe attached as Attachment One of this Procurement Package.

SECTION 16160 – Enclosures

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

SECTION 16161 – Control Panels

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

SECTION 16225 – Electric Motors 250 HP or Less

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

SECTION 16481 – Motor Control Centers

Include Section 16481 – Motor Control Centers attached as Attachment One of this Procurement Package.

SECTION 16485 – Variable Frequency Drives Low Voltage

Include Section 16485 – Variable Frequency Drives Low Voltage attached as Attachment One of this Procurement Package.

SECTION 17137 – Magnetic Flow Meters

Include Section 17137 – Magnetic Flow Meters attached as Attachment One of this Procurement Package.

SECTION 17451 – Programmable Logic Controller Hardware

Include Section 17451 – Programmable Logic Controller Hardware attached as Attachment One of this Procurement Package.

SECTION 17452 – Programmable Logic Controller System Software and Accessories

Include Section 17452 – Programmable Logic Controller System Software and Accessories attached as Attachment One of this Procurement Package.

SECTION 17455 – Operator Interface Terminal Software and Hardware

Include Section 17455 – Operator Interface and Terminal Software and Hardware attached as Attachment One of this Procurement Package.

II. FIGURES (PRELIMINARY – FOR REFERENCE ONLY)

I-0.00 – Instrumentation Standard Symbol and Legend

I-0.00 – Instrumentation Standard Symbols and Legend attached as Attachment Two of this Procurement Package.

I-1.04 – Membrane Filtration System Train No. 1 P&ID

I-1.04 – Membrane Filtration System Train No. 1 P&ID attached as Attachment Two of this Procurement Package.

I-1.08 – Membrane Filtration System Train Permeate Pump No. 1 P&ID

I-1.08 – Membrane Filtration System Permeate Pump No. 1 P&ID attached as Attachment Two of this Procurement Package.

I-1.12 – Membrane Filtration System Backpulse Tank P&ID

I-1.12 – Membrane Filtration System Backpulse Tank P&ID attached as Attachment Two of this Procurement Package.

I-1.13 – Membrane Filtration System CIP Tank P&ID

I-1.13 – Membrane Filtration System CIP Tank P&ID attached as Attachment Two of this Procurement Package.

I-1.14 – Membrane Filtration System CIP Pumps P&ID

I-1.14 – Membrane Filtration System CIP Pumps P&ID attached as Attachment Two of this Procurement Package.

I-1.15 – Membrane Filtration System CIP System P&ID

I-1.15 – Membrane Filtration System CIP System P&ID attached as Attachment Two of this Procurement Package.

I-1.17 – Membrane Filtration System Air Scour Blowers P&ID

I-1.17 – Membrane Filtration System Air Scour Blowers P&ID attached as Attachment Two of this Procurement Package.

ATTACHMENT ONE

GMP 1 - Specifications

SECTION 01010

SUMMARY OF WORK

PART 1 - GENERAL

1.1 SUMMARY

- A. The Work to be accomplished under the GMP 1 (Membrane Pre-Procurement) Contract Documents includes, but is not limited to procuring the following equipment required to install and provide a fully functional Membrane Filtration System:
 - 1. Four Membrane Filtration System Treatment Trains and all accessories at the Reclaimed Water Interconnect Facility (RWIF) located at the Chandler Airport WRF.
 - 2. Four Permeate Pumps, two CIP Pumps, Two Positive Displacement Blowers, and two Air Compressor Units essential to operate the Membrane Filtration System.
 - 3. MCCs, VFDs, and Control Panels for operation of the above equipment.
- B. The following work/notes pertains to all equipment related to the membrane Filtration System at the RWIF:
 - a. Provide minimum of one year warranty, starting upon substantial completion of work, on all warranted materials and labor.
 - b. Provide one year warranty on start-up assistance.
 - c. Provide on-site, hands-on operator training.
 - d. All other miscellaneous work as specified in the Contract Documents.
- C. A subsequent package of Contract Documents will include the remainder of the Work for the Chandler RWIF Project including installation of equipment procured as part of this package.

1.2 ACCESS TO AND FROM THE SITE

- A. The address for the Chandler Airport WRF is 905 East Queen Creek Road.
 - 1. The CONTRACTOR'S personnel shall ingress and egress the site utilizing the existing west entrance to the site.

1.3 DESCRIPTION OF SITE

- A. The Airport WRF site is located southwest of the Chandler Airport. The property is bounded by Queen Creek Road on the north, McQueen Road on the east, and Appleby Road (a dirt road) on the south. The Consolidated Canal passes through the southeast corner of the property.

1.4 PROXIMITY TO CHANDLER MUNICIPAL AIRPORT

- A. The proximity of the Airport WRF site to the Chandler Municipal Airport, as a minimum, can create the following concerns:
 - 1. Aircraft noise levels.
 - 2. Obstructions to air navigation.
 - 3. Radio Telemetry Interference.
 - 4. Bird strike hazards to aircraft.
- B. Obstructions to Air Navigation:
 - 1. Part 77 of the Federal Aviation Regulations (FAR) relates to potential obstructions to air navigation. Due to this Project's proximity to an airport, the FAR requires that a Notice of Proposed Construction be filed with the Federal Aviation Administration (FAA) for this Project. The FAA may require obstruction marking or lighting on construction equipment or may limit the height of construction equipment that can be used on this site.
 - 2. The CONTRACTOR shall be responsible for notifying the appropriate agencies, obtaining all required permits, and complying with applicable regulations.
- C. Radio Telemetry Interference:
 - 1. The CONTRACTOR shall be responsible for coordination of construction site communications to prevent interference with aircraft communications and navigation.
- D. Bird Strike Hazards to Aircraft:
 - 1. There is a potential for serious damage to an aircraft if the aircraft strikes a bird. The potential for bird strikes is increased by open bodies of water, refuse piles, or other activities which may attract birds.
 - 2. The CONTRACTOR shall be responsible for mitigation of all such activities associated with the Project.
- E. The CONTRACTOR shall be responsible for public safety related to all Work at the WRF site.
- F. CONTRACTOR shall provide copies of all documentation/correspondence referenced in this section to the ENGINEER for reference.

1.5 PROXIMITY TO CHANDLER MUNICIPAL TRANSFER STATION

- A. The City of Chandler Municipal Transfer Station is located adjacent to the Airport WRF. Construction activities shall not interfere with operation of the transfer station.
- B. City of Chandler Solid Waste Management Department utilizes the northwest portion of the site for storage and as a work yard. Construction activities shall not hinder normal operations.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01300

SUBMITTALS

PART 1 - GENERAL

1.1 SUMMARY

- A. The CONTRACTOR shall include a completed transmittal form for all submittals. Transmittal forms will be furnished to CONTRACTOR by ENGINEER at the pre-construction conference. Submittals shall be sent to the ENGINEER. CONTRACTOR shall deliver and pick up submittals from ENGINEER'S office located at 1620 W. Fountainhead Pkwy, Suite 501, Tempe, AZ 85282, between the hours of 7:00 a.m. and 4:00 p.m. All submittals shall be addressed to Sreeram Rengaraj.

1.2 SECTION INCLUDES

- A. Shop Drawings.
- B. Material and equipment record.
- C. Samples.
- D. Operation and Maintenance (O&M) Manuals.
- E. Progress Schedule.
- F. Progress reports.
- G. Daily reports.
- H. Testing results.
- I. Pre-construction video.
- J. Construction photographs.
- K. Record Drawings.
- L. Spare parts lists.
- M. List of spare parts furnished.

1.3 DATA REFERENCE SYMBOLS AND DESCRIPTIONS

- A. The submittal data required for Shop Drawings and operations manuals shall contain, but not necessarily be limited to, that data and material as defined by the coded legend set forth below. The submittal data required shall be as indicated and specified under various headings of the Specifications.
1. Letters of Certification of Compliance on materials, equipment, etc.
 2. Samples.
 3. Final Certified Drawings showing outline dimensions, foundation layout or mounting information, and other pertinent dimensions.
 4. Field erection instructions, assembly drawings and/or diagrams, detailed reference drawing lists, lists of erection details, and list of spare parts supplied with equipment.
 5. Shop Detail Drawings showing individual sub- assemblies and fabricated pieces with material specifications and other applicable data.
 6. Installation instructions, operating and/or service manuals, and all other data pertinent to operating or servicing the complete apparatus. Preventative maintenance instructions and recommended frequency.
 7. Schematic and wiring diagrams of power, control, and piping systems. A detailed description of operation shall be included for each diagram to describe all modes of operation of the system indicated. Where the integrated system requires interlocking and control of other components in normal operation, these components shall be included in the description of operation.
 8. General bulletins and catalog cuts describing complete apparatus, including operating principles and fundamentals.
 9. Service data sheets showing design performance, utility requirements, etc., as applicable to the specific duty for which the equipment is furnished.
 10. Certified head and capacity curves for pumps. Impeller size furnished and maximum size available shall be noted on these data sheets.
 11. Curves and/or data for overall range of operation from minimum to maximum capacity or load, showing capacity or load, utilities motive medium required, total or incremental differential head, and other pertinent information applicable to the equipment or its component assemblies.
 12. Materials of construction of all components.
 13. Renewal parts list with diagrammatic or cross-section drawings showing part identification. Material analysis or trades designation for each significant part is to be noted on parts lists or on a separate sheet.
 14. Stuffing box sizes; packing sizes; specifications and arrangement; and mechanical seal details, specifications, etc., if furnished in equipment.
 15. Bearing manufacturer's standard identification and/or interchangeable number for all anti-friction bearings in the equipment proper and its accessory items.
 16. Material gradation, design mix, job mix formula, and/or material analysis.
 17. Concrete reinforcement drawings, details, and calculations. Reinforcement drawings shall be redrawn by the CONTRACTOR to allow for clarity and scale necessary for easy review by the ENGINEER.

18. Completed equipment data sheets.

- B. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
- C. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**

1.4 SHOP DRAWINGS

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

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

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

- C. One copy of returned Shop Drawings shall be marked with red line comments.
- D. Only one copy of "Revise and Resubmit", "Rejected", and "No Action Taken" Shop Drawings will be stamped.
- E. If the CONTRACTOR requires additional copies of "No Exceptions Noted", "Exceptions Noted", or "No Action Taken" Shop Drawings, additional copies shall be included in original submittal.
- F. The CONTRACTOR may request submittals be reviewed up to two times for each equipment or construction material item, regardless of manufacturer or supplier, by the ENGINEER. For additional reviews, CONTRACTOR will reimburse the ENGINEER for additional labor as specified in Section 01013, Engineering Services.
- G. The CONTRACTOR will be held responsible for any delay in progress of the Work due to resubmittal of Shop Drawings. Time for completion of the Contract will not be extended due to the CONTRACTOR'S failure to promptly submit complete and acceptable Shop Drawings, product data, and samples.
- H. Do not execute Work required by Shop Drawings until accepted Shop Drawings are received from the ENGINEER.
- I. Before submitting Shop Drawings for review, the CONTRACTOR shall check Shop Drawings for accuracy, ascertain that all Work contiguous with and having bearing on other Work shown on Shop Drawings is accurately drawn, and that Work shown is in conformity with Contract requirements. The CONTRACTOR is responsible for all submittals from subcontractors and suppliers.
- J. All such Drawings and details, when submitted, must bear the stamp of approval of the CONTRACTOR, bearing checked data, as evidence that such Drawings and details have been checked by him. Said "stamp" shall clearly state that the CONTRACTOR has checked the Drawings and, by his signature, he so certifies. Any Drawings submitted without such executed stamp of approval, or whenever it is evident (despite the stamp) that the Drawings have not been checked, they will be returned to the CONTRACTOR for resubmission and will not be considered. In such event, it will be deemed that the CONTRACTOR has not complied with this provision and the CONTRACTOR shall bear risk of all delays to the same extent as if no Drawings or details had been submitted.
- K. The CONTRACTOR shall prepare composite Drawings and installation layouts, when required to solve tight field conditions. Such Drawings shall consist of dimensioned plans and elevations, and must give complete information particularly as to size and location of sleeves, inserts, attachments, openings, conduits, ducts, boxes, structural interferences, etc. These composite Drawings and installation layouts shall be coordinated in the field by the CONTRACTOR

- and his subcontractors for proper relationship to the work of other trades, based on field conditions, and shall be checked and approved by them before submission to the ENGINEER for his final review. The CONTRACTOR shall have competent technical personnel readily available for such coordinating and checking, as well as for supervision of field installation of work as per the Drawings and installation layouts, which have been previously determined by him to be correct and carry the ENGINEER'S review stamp.
- L. Submission of Shop Drawings (in either original submission or when resubmitted with corrections) constitute evidence that the CONTRACTOR has checked all information thereon, and that he accepts and is willing to perform the Work as shown in a workmanlike manner and in accordance with best standard practice.
 - M. Cost of any changes in construction due to improper checking and coordination by the CONTRACTOR shall be paid for by the CONTRACTOR, and the CONTRACTOR shall be responsible for all additional costs, including coordination.
 - N. Shop Drawings shall clearly delineate the following information:
 - 1. ENGINEER'S name and Project number; Project name and address.
 - 2. Drawing title, number, date, and scale.
 - 3. Names of CONTRACTOR, Subcontractor, and fabricator.
 - 4. Working and erection dimensions.
 - 5. Arrangements and sectional views.
 - 6. Necessary details, including complete information for making connections with other work.
 - 7. Kinds of materials and finishes.
 - 8. Show descriptive names of materials and equipment, classified item numbers, and locations at which materials or equipment are to be installed in the Work. Use same reference identification as shown on Contract Drawings.
 - O. If Shop Drawings show variations from Contract Documents because of standard shop practice or other reasons, make specific mention of such variations in a separate memo attached to information listed in Paragraph 1.3.B of this Section.
 - P. Shop drawing review will be general. It shall not relieve the CONTRACTOR of responsibility for accuracy of such Shop Drawings, nor proper fitting, construction of Work, furnishing of materials, or Work required by Contract Documents and not indicated on Shop Drawings. Shop drawing review shall not be construed as approving departures from Contract Documents.
 - Q. Review of Shop Drawings and schedules shall not relieve the CONTRACTOR from responsibility for any violation indicated on such Drawings or schedules of local, County, State, or Federal laws, rules, ordinances, or rules and regulations of commissions, boards, or other authorities or utilities having jurisdiction.

- R. When product data, consisting of manufacturer's printed literature, is required to be submitted to the ENGINEER, it shall be submitted in original form. Any fading type of reproduction will not be accepted. Pertinent information shall be indicated and irrelevant information shall be crossed out.
- S. Action taken by ENGINEER shall apply to entire submittal. ENGINEER shall not approve portions of a submittal while disapproving other portions.
- T. Resubmitted submittal shall contain entirety of information to review.
- U. The following is a list of anticipated submittals for this project, however it may not be a complete list. This list does not alleviate Contractor from obligations of requirements of each individual Technical Specification that may require additional information. See individual Technical Specification Sections for additional requirements.

CHANDLER RWIF – PROCUREMENT SUBMITTAL LISTING		
ITEM NO.	SPEC SECT	DESCRIPTION OF SUBMITTAL
1	01650	STARTING OF SYSTEMS
2	01730	OPERATION AND MAINTENANCE DATA
3	01750	SPARE PARTS AND MAINTENANCE MATERIALS
4	01821	INSTRUCTION OF O & M PERSONNEL
5	09900	PAINTING
6	11314	END SUCION CENTRIFUGAL PUMPS
7	11371	POSITIVE DISPLACEMENT BLOWERS
8	11372	AIR COMPRESSORS
9	11500	MEMBRANE EQUIPMENT SYSTEM
10	16160	ENCLOSURES
11	16161	CONTROL PANELS
12	16225	ELECTRIC MOTORS 250 HORSEPOWER OR LESS
13	16481	MOTOR CONTROL CENTERS
14	16485	VARIABLE FREQUENCY DRIVES LOW VOLTAGE
15	17137	MAGNETIC FLOW METERS

1.5 PROCEDURE

- A. A letter of transmittal shall accompany each submittal. If data for more than one Section of the Specifications is submitted, a separate transmittal letter shall accompany the data submitted for each Section.
- B. All letters of transmittal shall be submitted in duplicate.

- C. At the beginning of each letter of transmittal, provide a reference heading indicating the following:
1. OWNER'S Name City of Chandler
 2. Project Name RWIF
 3. Contract No. _____
 4. Transmittal No. _____
 5. Section No. _____
- D. If any portion of a Shop Drawing deviates from the requirements of the Contract Documents, CONTRACTOR shall specifically note each variation in his letter of transmittal.
- E. All Shop Drawings submitted for approval shall have a title block with complete identifying information satisfactory to ENGINEER.
- F. All Shop Drawings submitted shall bear the stamp of approval and signature of CONTRACTOR as evidence that they have been reviewed and verified to the completeness of the submittal by CONTRACTOR. Submittal without this stamp of approval will not be reviewed by ENGINEER and will be returned to CONTRACTOR. CONTRACTOR'S stamp shall contain the following minimum information:

Project Name: RWIF

CONTRACTOR'S Name: _____

Date: _____

-----Reference-----

Item: _____

Specifications:

Section: _____

Page No.: _____

Para. No.: _____

Drawing No.: _____ of _____

Location: _____

Submittal No.: _____

Approved By: _____

- G. In order to identify and track all submittals as separate and unique items, CONTRACTOR shall utilize the submittal identification numbering system as follows:
1. The Submittal Number shall be a separate and unique number correlating to each individual submittal that is required to be tracked as a separate and unique

item. The Submittal Number shall be a two part, nine character, alpha/numeric number assigned by CONTRACTOR in the following manner:

- a. The first part of the Submittal Number shall consist of five characters that pertain to the applicable Specification Section number.
- b. The second part of the Submittal Number shall consist of three numbers. The first digit identifies the Submittal type as follows:
 - 1) 0 - Shop Drawing.
 - 2) 1 - Operations and Maintenance Manual.
 - 3) 2 - Training Manual.
- c. The second and third digits (numbers 01 to 99) number each separate and unique Submittal submitted under each Specification Section.
- d. A dash shall separate the two parts of the Submittal Number.
- e. A typical Submittal Number for the third Working Shop Drawing submitted under Section 11400, Disc Filter System, would be 11400-0.03.
- f. A typical Submittal Number for the first Working Operations and Maintenance Manual submitted under Section 11285, Hydraulic Gates, would be 11285-1.01.

1.6 MATERIAL AND EQUIPMENT RECORD

- A. The CONTRACTOR shall maintain an up-to-date record of all materials and equipment furnished by him and any subcontractors to be incorporated in the Work.
 1. The ENGINEER will furnish the CONTRACTOR a master of the materials and equipment form. The CONTRACTOR shall maintain the records on reproductions of this form in the field office.
- B. The CONTRACTOR shall provide the following information on these forms:
 1. The Specification Paragraph and Section Number where material or equipment are called for.
 2. Date ordered.
 3. Date required.
 4. The CONTRACTOR'S purchase order number.
 5. Supplier's purchase order number.
 6. Date promised.
 7. Date received.
 8. Supplier's name and address.
 9. Remarks.
 10. Shop Drawings and samples with approval date.
 11. Physical dimensions and ratings.
 12. Where submittal sheet describes items in addition to that item being submitted, the submitted item shall be clearly marked on the sheet and superfluous information shall be crossed out.

- C. Three copies of the materials and equipment record shall be submitted to the ENGINEER with each Application for Payment. If the current record has not been submitted, the Application shall not be reviewed and shall be returned to the CONTRACTOR as incomplete.
- D. The CONTRACTOR shall permit free access to these records, including information on items recently received and not yet posted to the record by the ENGINEER or authorized representative of the OWNER at any time.

1.7 SAMPLES

- A. Deliver no material to the building site prior to receipt of the ENGINEER'S written approval. Furnish materials equal in every respect to approved samples and execute Work in conformity therewith. Samples shall be provided with respective Shop Drawings.
- B. The approval or acceptance of samples will not preclude the rejection of any material upon the discovery of defects in same prior to the Final Acceptance of the completed Work.
- C. After a material has been approved, no change in brand or make will be permitted unless satisfactory written evidence is presented to and approved by the ENGINEER that the manufacturer cannot make scheduled delivery of approved material, or that material delivered has been rejected and substitution of suitable material is an urgent necessity, or that other conditions are apparent which indicate approval of such substitute materials to be in best interest of the OWNER. CONTRACTOR shall provide complete Shop Drawings for replacement product.
- D. All samples of materials requiring laboratory tests shall be submitted to laboratory for testing not less than 90 days before such materials are required to be used in the work. Submit all other samples for approval within 30 days after signing of the Contract.
- E. Submit samples in duplicate, except where greater or lesser number is specifically required by these Specifications. Submittal shall be made only by the CONTRACTOR, unless he has authorized his subcontractor to submit them and has notified the ENGINEER to this effect.
- F. Each sample shall be accompanied by a Shop Drawing form and an itemized transmittal form. The transmittal shall contain list of samples, Project, CONTRACTOR, manufacturer, brand, quarry, quality, etc.; also Project number, Specifications reference, ASTM number (if any), and material being furnished. Enclose copies of transmittal with samples. Any deviation from Contract requirements shall be so stated in the transmittal.

- G. Label each sample by a securely attached label giving the Project, CONTRACTOR, subcontractor or supplier, manufacturer's name, product trade name and number, material type, Specification Section and Paragraph reference etc.; also Project name and number and ASTM number (if any).
- H. Samples shall be of adequate size to permit proper evaluation. The samples submitted shall show the full range of colors, textures and dimensions, and other variable characteristics expected. Samples of different items that must match or whose finish relates shall be delivered at the same time to facilitate coordination.

Samples which are rejected by the ENGINEER must be resubmitted as soon as possible after notification of rejection, and shall be marked "Resubmitted Sample" in addition to other information required.

- I. The right is reserved to require submission of samples of any material, any material lists, or any information whether or not specifically specified in the Specifications.

1.8 OPERATION AND MAINTENANCE MANUALS

- A. One hard copy and one electronic copy in PDF format of an Operations and Maintenance (O&M) Manual containing the following items, in addition to any instructions packed with the equipment, are required for each individual item of equipment:
 - 1. Specifications.
 - 2. Drawings.
 - 3. Description of each individual item of equipment.
 - 4. Manufacturer name, model number, and serial numbers.
 - 5. Name address and phone number of both the manufacturer's customer service department and the local manufacturer's representative.
 - 6. Installation instructions.
 - 7. Operation and maintenance instructions, including lubrication schedule and lubricant specification.
 - 8. Parts list and part numbers.
 - 9. Additional data to be included in the manual shall be as required in these Specifications.
 - 10. Temporary storage recommendations.
 - 11. Warranty information.
- B. O&M Manuals are to be submitted to the ENGINEER upon delivery of the equipment to the site. Overall Project substantial completion will not be scheduled until all manuals are approved. Training shall not be scheduled until O&M Manuals are approved. Training shall not be scheduled until 30 days following delivery of approved O&M Manuals to the OWNER. Training shall be scheduled based on draft O&M Manuals upon approval of ENGINEER.

- C. The respective manuals for the individual items of equipment shall be combined into bound volumes covering the complete operating installation with individual equipment items tabled separately. Information for equipment subassemblies not manufactured by the major supplier shall also be included with the respective equipment item.
- D. Manuals for particular items of equipment which are in the same area (i.e., Permeate Pumps and Pneumatic Valves) should be bound in the same volume where practicable.
- E. Upon completion of the installation of each item of equipment, the CONTRACTOR shall provide As-Built Drawings of the local control panel to be added to the O&M Manual, as well as set-up parameters such as those required for VFDs, instrumentation, calibration, etc. Manuals for particular items of equipment which are in the same area (i.e., belt press, belt press feed pumps, and conveyors) should be bound in the same volume where practicable.
- F. O&M Manuals shall be submitted in 3-ring binders meeting the following criteria:
 - 1. Binders shall be Wilson Jones Custom View Organization, D-Ring, white, non-stick, back mounted, binder models 362-13W, 386-14W, 386-34W, 386-44W, 386-49W, or 386-54W; or approved equal.
 - 2. Binder cover insert shall be created using a Microsoft word template supplied by ENGINEER. Modifications to the template shall be approved by the ENGINEER prior to submission of the O&M Manuals. The binder cover insert shall include the Specification number and title as presented within the Contract Documents, manufacturer name, year of purchase, year and month that equipment was placed into operation.
 - 3. Binder spine insert shall be created using a Microsoft word template supplied by ENGINEER. Modifications to the template shall be approved by the ENGINEER prior to submission of the O&M Manuals. The spine insert shall include the Specification number and title as presented within the Contract Documents, manufacturer name, year of purchase, year and month that equipment was placed into operation. Spine insert shall read top to bottom.

1.9 PROGRESS SCHEDULE

- A. Progress Schedule as defined in Section 01310, Progress Schedule.

1.10 DAILY REPORTS

- A. The CONTRACTOR will provide to the ENGINEER a daily report on a form provided by the ENGINEER indicating the Work in progress, Work completed, equipment used, numbers and category of personnel, and such other pertinent information as applicable. The daily reports shall be compiled and submitted monthly with the Application for Payment. The Application for Payment will not

be reviewed and shall be returned to the CONTRACTOR as incomplete if the reports do not accompany it.

1.11 TESTING RESULTS

- A. CONTRACTOR shall furnish to the ENGINEER copies of all testing results for all tests required in the Specifications.

1.12 CONSTRUCTION PHOTOGRAPHS

- A. Construction photographs as defined in Section 01380, Construction Photographs.

1.13 RECORD DRAWINGS

- A. Record Drawings as defined in Section 01700, Contract Closeout. The CONTRACTOR shall update Record Drawings Monthly and make available for review to the ENGINEER monthly one week prior to the Application for Payment submittal. Failure of the CONTRACTOR to maintain updated Record Drawings can be justification for refusal of Application for Payment.

1.14 UNIT RESPONSIBILITY

- A. This Section contains the required Unit Responsibility Form for the CONTRACTOR to use in documenting Work required under this Contract.
- B. The Unit Responsibility Form provided in Appendix A to this Section is referenced from other Sections in the Contract Documents. The CONTRACTOR shall submit it with the applicable equipment as required in those Sections.

1.15 CONTRACTOR'S FORMS

- A. This Section contains the required forms for CONTRACTOR use in documenting testing Work and other Work required under this Contract. This Section supplements, but does not supersede, specific testing requirements found elsewhere in the Contract Documents.
- B. The forms listed below are included in this Section are referenced from other Sections in the Contract Documents. CONTRACTOR may utilize standard forms when authorized by ENGINEER. Forms will include, but will not necessarily be limited to, the following.

<u>Form Designation</u>	<u>Title</u>

A	Schedule of Values
B	Shop Drawings, Product Data and Sample Transmittal Schedule

C	Request for Change Order Proposal
D	Change Order Proposal
E	Request for Information
F	Request for Alteration
G	CONTRACTOR'S Daily Construction Report
H	Equipment Information Form
I	Manufacturer's Installation Certification Form
J	Equipment Test Report Form
K	Operation and Maintenance Transmittal Form
L	Manufacturer's Instruction Certification Form
M	Motor Data Form
N	Wire and Cable Resistance Test Data Form
O	Installed Motor Test Data Form
P	Dry Transformer Test Data Form
Q	Motor Control Center Test Form
R	Medium Voltage Motor Starter Test Form
S	Medium Voltage Switchgear Test Form
T	Protective Relay Test Form
U	Low Voltage Switchgear Test Form
V	Medium Voltage Load Interrupter Switch Test Form
W	Liquid-Filled Transformer Test Form
X	Automatic Transfer Switch Test Form
Y	Neutral Grounding Resistor Test
Z	Conduit and Wire Termination Sheet (not included)
AA	Loop Wiring and Insulation Resistance Test Data Form
BB	Control Circuit Piping Leak Test Form
CC	Controller Calibration Test Data Form
DD	Panel Indicator Calibration Test Data Form
EE	Recorder Calibration Test Data Form
FF	Signal Trip Calibration Test Data Form
GG	Field Switch Calibration Test Data Form
HH	Transmitter Calibration Test Data Form
II	Miscellaneous Instrument Calibration Test Data Form
JJ	Individual Loop Test Data Form
KK	Loop Commissioning Test Data Form
LL	Pipe Test Report

- C. CONTRACTOR shall complete the above referenced forms prior to start-up of each piece of equipment, as listed in the Equipment and Valve Schedule. Each form shall pertain to each equipment number.
- D. The CONTRACTOR shall submit to ENGINEER for approval one month after completion of start-up, 3-ring binders with tabs for each process area and include all the forms completed prior to start-up. The forms shall be further tabbed within each process area of each form designation as listed above. For example, the

Chemical Facilities tab (22) shall include separate tabs for forms H, J, K, and etc.
The CONTRACTOR shall submit five copies of all 3-ring binders to the
ENGINEER for approval.

- E. All forms are provided in Appendix B of this Section.

1.16 ADDITIONAL SUBMITTALS

- A. All additional submittals as required by the Contract Documents.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

APPENDIX A - Unit Responsibility Form

(Job Title)

CERTIFICATE OF UNIT RESPONSIBILITY
for Specification Section _____

(Section title)

In accordance with Paragraph 01600.1.2.B of the Contract Documents, the undersigned manufacturer accepts unit responsibility for all components of equipment furnished under specification Section _____. We hereby certify that these components are compatible and comprise a functional unit suitable for the specified performance and design requirements.

Notary Public

Name of Corporation

Commission expiration date

Address

Seal:

By: _____
Duly Authorized Official

Legal Title of Official

Date: _____

SECTION 01640

MATERIALS AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. The CONTRACTOR shall furnish all materials and equipment and perform all operations required to completely install and place in operation the various mechanical apparatus and systems indicated on the Drawings and as specified herein. It is not the intention to mention herein each and every item required. However, all installations shall be complete and operable in the methods intended. These general equipment requirements apply, in general, to all equipment. They shall supplement the detailed Equipment Specifications, but in case of conflict, the Equipment Specifications shall govern.

1.2 RELATED SECTIONS

- A. Section 01300, Submittals.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Materials and equipment shall be of new, of first quality and best grade, essentially the standard catalog products of reputable manufacturers, and shall be of the type, size, and capacity, and for the type of service specified. It is the intent of these Specifications that the highest quality equipment shall be provided for the intended service. Units proposed shall be carefully matched to the particular hydraulic and mechanical requirements for each installation, and the CONTRACTOR shall submit complete hydraulic and mechanical data for approval of the ENGINEER. Where two or more units of the same class of equipment are required, these units shall be the products of a single manufacturer; however, the component parts of the system need not be the products of the same manufacturer unless otherwise specified.
 - 1. Materials and Workmanship. Materials used in the manufacture of the equipment shall be of the best quality used for the purpose in commercial practice. Materials shall be suitable for service conditions. Iron castings shall be tough, close-grained gray iron free from blowholes, flaws, or excessive shrinkage, and shall conform to ASTM A48. Except where otherwise specified, structural and miscellaneous fabricated steel used in items of equipment shall conform to the Standards of the American Institute of Steel Construction. All structural members shall be considered as subject to shock or vibratory loads. Unless otherwise specified, all steel which will

be submerged, all or in part, during normal operation of the equipment shall have a minimum nominal thickness of 1/4-inch. Equipment shall be installed in accordance with the recommendations of the manufacturer and the best standard practice for each type of equipment.

2. Approval of Materials, Equipment, and Shop Drawings. Detailed Shop Drawings shall be prepared for the equipment to be furnished under this Project. General Drawings for equipment will not be acceptable. Approval of equipment under this provision shall not be construed as authorizing any deviations from the Specification unless the attention of the ENGINEER has been directed to the specific deviation.
 - a. The decision of the ENGINEER on any questions concerning the acceptability of materials, equipment, or installation shall be final and binding. The Shop Drawing material required for the various submittals shall be in accordance with the coded legend set forth in Section 01300, Submittals, and as indicated and specified under various headings of these specifications.
3. Nameplates: Equipment shall be furnished with nameplates of bronze, monel, or stainless steel. Aluminum will not be acceptable. Each nameplate shall include pertinent hydraulic and mechanical data. Information shown shall be permanently stamped or cast into each nameplate and shall include the manufacturer's name and model number.
4. ASME Stamp: Where materials and equipment are specified to be constructed in accordance with the standard of the American Society of Mechanical Engineers Code for Unfired Pressure Vessels, the CONTRACTOR shall submit proof that the items furnished under this Section of the Specifications conform to such requirements. The ASME stamp, label, or listing will be acceptable as sufficient evidence that the items conform to these requirements and shall be provided on all pressure vessels falling within the ASME Code jurisdiction.

B. Electric Motors:

1. General: Unless otherwise required by the detailed equipment specifications, motors furnished with equipment shall be rated for continuous duty at 50° C ambient temperature with a 1.15 service factor. Motors designated for use with variable speed drives and where indicated shall be derated to accommodate the application. Where frequent starting occurs, motors shall be designed for frequent starting duty equivalent to the duty service required by the driven equipment. The horsepower rating of each motor shall be as required to drive the equipment under full load, including all losses in speed reducers and power transmission, and to be non-overloading over the entire range of equipment head capacity curves without the use of motor service factors. It is the intent of this general specification to allow the manufacturer's standard motor on integrally constructed motor driven equipment such as appliances, hand tools, etc., that is specified by model number in which a redesign of the complete unit would be required for a motor with other features as may be specified herein. All motors furnished

under these Specifications shall be of recognized manufacture, of adequate capacity for the loads involved, and wound to the current characteristics noted. All motors shall conform to the standards of manufacture and performance of the National Electrical Manufacturers Association as shown in their latest publications.

2. Enclosures: Unless otherwise required by the detailed equipment specifications, the enclosures for motors shall be as indicated below:
 - a. Motors installed outdoors shall be totally enclosed or totally enclosed fan-cooled except that vertically mounted motors may be weather protected Type I.
 - b. Motors installed indoors may be open drip-proof unless otherwise indicated.
3. Motor horsepower requirements in the equipment specifications are estimated. If the horsepower requirements for the equipment furnished vary from the estimated horsepower, the CONTRACTOR shall be responsible for making all necessary revisions to wiring, conduit, motor starters, circuit breaker, and other electrical equipment at no additional cost to OWNER.
4. Anchor Bolts: Equipment suppliers shall furnish suitable anchor bolts of specified metallurgy for each item of equipment. Anchor bolts, together with templates or setting drawings, shall be delivered sufficiently early to permit setting the anchor bolts when the structural concrete is placed. Two nuts shall be furnished for each bolt. Unless otherwise shown or specified, anchor bolts for items of equipment mounted on baseplates shall be long enough to permit 1-1/2-inch of grout beneath the base plate and to provide adequate anchorage into structural concrete.
5. Equipment Bases: A cast iron or welded steel baseplate shall be provided for each pump and other item of equipment which is to be installed on a concrete base. Each baseplate shall support the unit and its drive assembly, and shall be of a neat design with pads for anchoring the units. Baseplates shall be anchored to the concrete base with suitable anchor bolts and grouted in place.
6. Equipment Guards: All belts or chain drives, fan blades, couplings, and other moving or rotating parts shall be covered on all sides by a safety guard. All safety guards in outdoor locations shall be designed to prevent the entrance of rain and dripping water.
7. Special Tools and Accessories: Equipment requiring periodic repair and adjustment shall be furnished complete with all special tools, instruments, and accessories required for proper maintenance. Equipment requiring special devices for lifting or handling shall be furnished complete with those devices.
8. Standard specifications prepared by recognized organizations mentioned elsewhere shall govern except as provided otherwise by these specifications and/or its accompanying drawings. Special care shall be exercised in requests for quotations and in orders, to refer to the standard specifications and to all modifications thereof.
9. Standard Codes, Regulations, and Specifications: Unless indicated or specified otherwise, all materials and workmanship for the mechanical trades

shall conform to the editions of the various standards, codes, manuals, and specifications in effect on the date of advertisement for bids, which are referred to in the various sections herein.

PART 3 - EXECUTION

3.1 PROTECTION OF EQUIPMENT

- A. General. All equipment shall be boxed, crated, or otherwise completely enclosed and protected during shipment, handling, and storage. All equipment shall be protected from exposure to the elements and shall be kept thoroughly dry at all times.
- B. Painted surfaces shall be protected against impact, abrasion, discoloration, and other damage. All painted surfaces which are damaged prior to acceptance of equipment shall be repainted to the satisfaction of the ENGINEER.
- C. Electrical equipment, controls, and insulation shall be protected against dust, moisture, or water damage.

3.2 INSTALLATION

- A. Installation of materials and equipment specified herein shall be performed in a workmanlike manner by mechanics skilled in their particular trade. Piping and equipment shall be installed square and plumb and accessible for proper operation and service. Installations shall be consistent in completeness and appearance whether enclosed or exposed. Any item which does not present a neat and workmanlike appearance shall be replaced without additional cost to OWNER.

3.3 ELECTRIC WIRING

- A. The CONTRACTOR shall do all electric wiring of every type for both power supply and for instrumentation and control in accordance with the provisions specified herein, except for such items as are normally wired at their point of manufacture and so delivered, and unless specifically noted to the contrary herein. The CONTRACTOR shall erect all motors and shall mount all starters and controls, furnishing the supporting structures.

3.4 GUARANTEE

- A. The CONTRACTOR shall guarantee all equipment against:
 - 1. Faulty or inadequate design.
 - 2. Improper assembly or erection.
 - 3. Defective workmanship or materials.
 - 4. Leakage, breakage, or other failure.
 - 5. The guarantee period shall be as defined in the General Conditions.

END OF SECTION

SECTION 01650
STARTING OF SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Description:

1. This Section contains requirements for CONTRACTOR'S performance in documenting testing work required under this Contract. In addition, this Section contains requirements for CONTRACTOR'S starting of systems, performance testing during startup, performance testing of all mechanical, electrical, instrumentation, HVAC equipment and systems, and training. This Section supplements, but does not supersede specific testing requirements, found elsewhere in the Contract Documents.

1.2 RELATED SECTIONS

- A. Section 01300, Submittals.

1.3 SUBMITTALS

- A. Descriptive submittals shall be made in accordance with Section 01300, Submittals. Submit for approval the following:

1. A complete description of CONTRACTOR'S plan for documenting the results from the test program in conformance with the requirements of Paragraph 2.1.A., below, including:
 - a. Proposed plan for documenting the calibration of all test instruments.
 - b. Proposed plan for calibration of all instrument systems, including flow/level meters and all temperature, pressure, weight, and analysis systems.
 - c. Sample forms for documenting the results of field pressure and performance tests.
2. The credentials and certification of the testing laboratory proposed by CONTRACTOR for calibration of all test equipment.
3. Pre-start-up check-out procedures reviewed and approved by the respective equipment manufacturers.
4. Detailed testing plans, setting forth step-by-step descriptions of the procedures proposed by CONTRACTOR for the systematic startup and performance testing of all equipment and systems installed under this Contract.
5. A schedule and subsequent updates, presenting CONTRACTOR'S plan for startup and performance testing the equipment and systems installed under this Contract.
6. A schedule establishing the expected time period (calendar dates) when CONTRACTOR plans to commence performance testing of the completed

systems, along with a description of the temporary systems and installations planned to allow operational testing to take place.

7. All records produced during the startup and testing program.
8. Systems or unit process or any piece of equipment shall not be started up without the approved Operation and Maintenance Manuals being turned over to the OWNER.
9. Written notice to ENGINEER a minimum of 72 hours prior to beginning of any test.

B. Shop Drawings: Submit for approval the following:

1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
2. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**

PART 2 - PRODUCTS

2.1 DOCUMENTATION

A. Documentation Plans

1. CONTRACTOR shall develop a records keeping system to document compliance with the requirements of this Section. Calibration documentation shall include identification (by make, manufacturer, model, and serial number) of all test equipment, date of original calibration, subsequent calibrations, calibration method, and test laboratory.
2. Equipment and system documentation shall include date of test, equipment number or system name, nature of test, test objectives, test results, test

instruments employed for the test and signature spaces for the OWNER'S and ENGINEER'S witnesses. A separate file shall be established for each system and item of equipment. These files shall include the following information as a minimum:

- a. Metallurgical tests, if required in detailed Specification Section.
 - b. Factory performance tests.
 - c. Accelerometer recordings made during shipment, if required in detailed Specification Section.
 - d. Field calibration tests¹.
 - e. Field pressure tests¹.
 - f. Field performance tests¹.
 - g. Field operational tests¹.
- (¹ Each of these tests are required even though not specifically noted in detailed Specification Section.)

B. Test Plans:

1. CONTRACTOR shall develop test plans detailing the coordinated, sequential testing of each item of equipment and system installed under this Contract. Each test plan shall be specific to the item of equipment or system to be tested. Test plans shall identify by specific equipment or tag number each device or control station to be manipulated or observed during the test procedure and the specific results to be observed or obtained. Test plans shall also be specific as to support systems required to complete the test work, temporary systems required during the test work, subcontractors and manufacturers' representatives to be present and expected test duration. As a minimum, the test plans shall include the following features:
 - a. Step-by-step proving procedure for all control and electrical circuits by imposing low voltage currents and using appropriate indicators to affirm that the circuit is properly identified and connected to the proper device.
 - b. Calibration of all analysis instruments and control sensors.
 - c. Performance testing of each individual item of mechanical, electrical, and instrumentation equipment. Performance tests shall be selected to duplicate the operating conditions described in the Contract Documents.
 - d. System performance tests designed to duplicate, as closely as possible, operating conditions described in the Contract Documents.
2. Test plans shall contain a complete description of the procedures to be employed to achieve the desired test environment.
3. As a condition precedent to receiving progress payments in excess of 75% of the Contract amount, or in any event, progress payments due to CONTRACTOR eight weeks in advance of the proposed date the CONTRACTOR intends to begin any testing work (whichever occurs earliest in the Project Schedule), CONTRACTOR shall have submitted all test plans required for the systematic field performance and operational tests for all equipment and systems installed under this Contract. Once the ENGINEER has reviewed and approved CONTRACTOR'S test plans, CONTRACTOR shall reproduce the plans in sufficient number for CONTRACTOR'S purposes and an additional 10 copies for delivery to the ENGINEER. No test

work shall begin until the CONTRACTOR has delivered the specified number of final test plans to the ENGINEER.

- C. Testing Schedule: CONTRACTOR shall provide a startup and testing schedule setting forth the sequence contemplated for performing the test work. The schedule shall be a CPM format, plotted against calendar time, shall detail the equipment and systems to be tested, and shall be coordinated with CONTRACTOR'S Progress Schedule specified in Section 01310, Progress Schedule. The schedule shall show the contemplated start date, duration of the test and completion of each test. The test schedule shall be submitted no later than four weeks in advance of the date testing is to begin. The ENGINEER will not witness any testing work for the purpose of acceptance until CONTRACTOR has submitted a test schedule and the ENGINEER approves. The test schedule shall be updated weekly, showing actual dates of test work, indicating systems and equipment testing completed satisfactorily and meeting the requirements of the Contract Documents.

2.2 SYSTEM AND EQUIPMENT PERFORMANCE TESTS

- A. Each item of mechanical, electrical, instrumentation and HVAC equipment installed under this Contract shall be tested to demonstrate compliance with the performance requirements of the Contract Documents. Each electrical, instrumentation, mechanical, piping, and HVAC system installed or modified under this Contract shall be tested in accordance with the requirements of this Section.
- B. Once all equipment and systems have been tested individually, CONTRACTOR shall proceed with performance testing in accordance with the requirements of Paragraph 3.3, below, simulating actual operating conditions to the greatest extent possible. CONTRACTOR shall install temporary connections, bulkheads and make other provisions to re-circulate process fluids or otherwise simulate anticipated operating conditions. During the operational testing period, CONTRACTOR'S Quality Assurance Manager and testing team shall monitor the characteristics of each machine and system and report any unusual conditions to the ENGINEER.

PART 3 - EXECUTION

3.1 GENERAL

- A. CONTRACTOR shall organize teams made up of qualified representatives of equipment suppliers, subcontractors, CONTRACTOR'S independent testing laboratory, and others, as appropriate, to efficiently and expeditiously calibrate and test the equipment and systems installed and constructed under this Contract. The objective of the testing program shall be to demonstrate, to the OWNER'S and ENGINEER'S complete satisfaction, that the structures, systems, and equipment constructed and installed under this Contract meets all performance

requirements and the facility is Substantially Complete and ready for the commissioning process to commence. In addition, the testing program shall produce baseline-operating conditions for the OWNER to use in a Preventive Maintenance Program. The Preventive Maintenance Program shall be provided as part of the vendor supplied equipment Operations and Maintenance Manual as required by Specification Section 01300 Submittals.

3.2 CALIBRATION OF FIXED INSTRUMENTS

- A. Calibration of analysis instruments, sensors, gauges, and meters installed under this Contract shall proceed on a system-by-system basis. No equipment or system performance test shall be performed until all instruments, gauges, and meters to be installed in that particular system have been calibrated and the calibration work has been witnessed by the OWNER and ENGINEER.

3.3 PERFORMANCE TESTS

- A. General: Performance tests shall consists of the following:
 - 1. Pressure or leakage tests.
 - 2. Electrical testing as specified in Division 16, Electrical.
 - 3. Wiring and piping, individual component, loop, loop commissioning and tuning testing, as specified in Division 17, Instrumentation.
 - 4. Pre-startup check out for all mechanical and HVAC equipment specified in Division 15, Mechanical. Pre-startup check out procedures shall be reviewed and accepted by the respective equipment manufacturer.
 - 5. Individual and system tests of all mechanical, electrical, HVAC, and instrumentation equipment and systems shall demonstrate compliance with the performance requirements of the Contract Documents.
- B. Performance tests for any individual system shall be performed in the order listed above. The order may be altered only on the specific written authorization of the ENGINEER after receipt of a written request, complete with justification for the change in sequence.
- C. Pressure and Leakage Tests: Pressure and leakage tests shall be conducted in accordance with applicable Sections. All acceptance tests shall be witnessed by the ENGINEER. Evidence of successful completion of the pressure and leakage tests shall be the ENGINEER'S signature on the test forms prepared by CONTRACTOR.
- D. Equipment Checkout: Prior to energization (in the case of electrical systems and equipment), all circuits shall be rung out and tested for continuity and shielding in accordance with the requirements of Division 16, Electrical.
- E. Component Calibration and Loop Testing: Prior to energization (in the case of instrumentation system and equipment), all loops and associated instruments shall be calibrated and tested, as specified in Division 17, Instrumentation.

- F. Electrical Resistance: Electrical resistance testing shall be in accordance with the requirements of Division 16, Electrical.
- G. Pre-Start-up Tests: Pre-start-up tests shall include the following
 1. Alignment of equipment using reverse dial indicator method.
 2. Pre-operation lubrication.
 3. Tests in accordance with the manufacturers' recommendations for pre-start preparation and pre-operational check out procedures.

3.4 DISINFECTION

- A. CONTRACTOR shall disinfect all new portions of the plant that are located downstream of, and including, reclaimed water pump station, backwash piping, non-potable water system, potable water system, and reclaimed water system. Disinfection shall be completed prior to bringing the specific process or component on-line. All disinfection shall be done in accordance with AWWA C-653.
- B. The CONTRACTOR shall provide all chemicals, materials, equipment, and utilities to perform the disinfection.

3.5 EQUIPMENT START-UP

- A. The CONTRACTOR in the presence of OWNER and ENGINEER shall place the newly installed equipment and facilities into operation and test, observe, and adjust all items until the units are properly adjusted and operating in accordance with the requirements of the manufacturer's data and the Contract Documents. After the new equipment has been put into operation, CONTRACTOR, ENGINEER, and Plant Operator shall go over in detail the standard operating procedures of the equipment. The work performed by CONTRACTOR shall include, but not be limited to, the following items:
 1. Marking and numbering all valves, gates, and equipment which have been numbered in the Contract Documents. All valves and gates shall be labeled with the appropriate equipment identification tag as shown on the Drawings and specified in Section 10400, Equipment Identification Plates.
 2. Labeling switches.
 3. Testing of pumps and equipment for proper operation and verifying alignment and capacity.
 4. Checking all electrical, electronic, and remotely controlled equipment for proper operation as specified under Section 01400, Quality Control.
 5. Marking all new and existing exposed pipelines for identification as specified in Section 09900, Painting, and as labeled on the Drawings for pipe material, size, service, and direction of flow.
 6. Testing of unit processes for proper operations.
 7. Making all equipment adjustments required.

3.6 SUPERVISION OF INSTALLATION AND START-UP BY MANUFACTURER

- A. An experienced, competent, and factory-employed representative of the equipment manufacturer shall visit the site of the work and inspect, check, adjust if necessary, and approve the equipment installation and shall be present when the equipment is placed in operation. The equipment manufacturer's representative shall revisit the job site as often as necessary until any trouble is corrected and the equipment installation and operation is satisfactory to the OWNER. The equipment manufacturer's representative shall furnish to OWNER a written report certifying that the equipment:
 - 1. Has been properly installed and lubricated.
 - 2. Is in accurate alignment.
 - 3. Is free from any undue stress imposed by connecting piping or anchor bolts.
 - 4. Has been operated under full load conditions and that it operated satisfactorily.
- B. A resume of each factory personnel assigned to supervise installation and train OWNER'S personnel shall be submitted to the ENGINEER for approval prior to scheduling training and installing the equipment.

3.7 SYSTEM PERFORMANCE TESTS

- A. General: Once all affected equipment has been subjected to the required pre-operational check out procedures and the ENGINEER has witnessed and has not found deficiencies in that portion of the Work, individual items of equipment and systems may be started and operated under simulated operating conditions to determine, as nearly as possible, whether the equipment and systems meet the requirements of these Specifications.
- B. For each system performance test phase, the equipment shall be operated a sufficient period of time to determine machine operating characteristics, including noise, temperatures and vibration; to observe performance characteristics; and to permit initial adjustment of operating controls and shall last no less than seven continuous days. When testing requires the availability of auxiliary systems such as looped piping, electrical power, compressed air, control air, or instrumentation which have not yet been placed in service, CONTRACTOR shall provide acceptable substitute sources, capable of meeting the requirements of the machine, device, or system, at no additional cost to the OWNER. Disposal methods for test media shall be subject to review and approval by the OWNER and ENGINEER. During the performance test period, CONTRACTOR shall obtain baseline-operating data on all equipment with motors greater than one horsepower to include amperage, bearing temperatures, and vibration. The baseline data shall be collected for the OWNER to enter in a Preventive Maintenance Program.

- C. Test results shall be within the tolerances set forth in the detailed Specification Sections of the Contract Documents. If no tolerances have been specified, test results shall conform to tolerances established by recognized industry practice. Where, in the case of an otherwise satisfactory performance test, any doubt, dispute, or difference should arise between the ENGINEER and CONTRACTOR regarding the test results or the methods or equipment used in the performance of such test, then the ENGINEER may order the test to be repeated. If the repeat test, using such modified methods or equipment as the ENGINEER may require, confirms the previous test, then all costs in connection with the repeat test will be paid by the OWNER. Otherwise, the costs shall be borne by CONTRACTOR. Where the results of any performance test fail to comply with the contract requirements for such test, then such repeat tests as may be necessary to achieve the contract requirements shall be made by CONTRACTOR at his expense.
- D. CONTRACTOR shall provide, at no expense to the OWNER, all power, fuel, compressed air supplies, water, and chemicals, all labor, temporary piping, heating, ventilating, and air conditioning for any areas where permanent facilities are not complete and operable at the time of functional tests, and all other items and work required to complete the functional tests. Temporary facilities shall be maintained until permanent systems are in service.
- E. Should the testing period be halted for any reason, the operational testing program shall be repeated, until the specified continuous period has been accomplished without interruption. All process units shall be brought to full operating conditions, including temperature, pressure, flow and level.
- F. Record Documents shall conform to the requirements of Section 01300, Submittals, of facilities involved shall be accepted and ready for turnover to the OWNER 72 hours prior to operational testing.
- G. Phase Retesting: If under test, any portion of the Work should fail to fulfill the Contract requirements and is adjusted, altered, renewed, or replaced, tests on that portion when so adjusted, altered, removed, or replaced, together with all other portions of the Work as are affected thereby, shall, unless otherwise directed by the ENGINEER, be repeated within reasonable time and in accordance with the specified conditions. CONTRACTOR shall pay to the OWNER all reasonable expenses incurred by the OWNER, including the costs of the ENGINEER, as a result of repeating such tests.
- H. Post-Test Inspection: Once testing has been completed, all machines shall be rechecked for proper alignment and realigned, as required. All equipment shall be checked for loose connections, unusual movement, or other indications of improper operating characteristics. Any deficiencies shall be corrected to the satisfaction of the ENGINEER. All machines or devices which exhibit unusual or unacceptable operating characteristics shall be disassembled and inspected. Any defects found during the course of the inspection shall be repaired or the specific

part or entire equipment item shall be replaced to the complete satisfaction of the ENGINEER, at no additional cost to the OWNER.

3.8 TRAINING

- A. Provide training per requirements of specification Section 01821, Instruction of Operations and Maintenance Personnel.

END OF SECTION

SECTION 01660

FIELD TESTS OF EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION

- A. In addition to testing required by this Section, CONTRACTOR shall perform all other tests required by detailed Equipment Specifications.
- B. No system or subsystem shall be started up for continuous operation unless all components, including instrumentation and monitoring systems, of that system or subsystem has been tested and proven to be operable as intended by the Contract Documents.

1.2 PRELIMINARY TESTS

- A. CONTRACTOR shall make preliminary field tests of all equipment as soon as conditions permit.
- B. Purpose of tests is to determine if equipment is:
 - 1. Properly installed.
 - 2. In compliance with operating cycles.
 - 3. Operational and free from overheating, overloading, vibration, or other operating problems.
- C. CONTRACTOR shall furnish all labor, materials, instruments, fuel, incidentals, and expendables required, unless otherwise provided.
- D. CONTRACTOR shall make all changes, adjustments, and replacements required to place equipment in service and test it.
- E. ENGINEER and OWNER shall be given sufficient notice prior to witness tests. A minimum 48 hour notice shall be given.

1.3 FINAL TESTS

- A. To the maximum extent possible, CONTRACTOR shall perform final field tests of equipment prior to initial start-up and operation of the Project.
- B. Purpose of the tests is to demonstrate that equipment is:
 - 1. Properly installed.
 - 2. Completely ready for operation by the OWNER.
 - 3. In compliance with design conditions, material specifications, and all other requirements of the Contract Documents.

- C. CONTRACTOR shall furnish all fuel and energy, labor, materials, instruments, chemicals, lubricants, and expendables required for the tests, where permanent facilities are not complete and operable at the time of testing, except where otherwise specified.
- D. Until final field tests are completed and approved, CONTRACTOR shall make all necessary changes, adjustments, and replacements.
- E. Systems or unit process, or any piece of equipment, shall not be started up without the approved Operation and Maintenance Manuals being turned over to the OWNER.
- F. CONTRACTOR shall notify ENGINEER at least 48 hours prior to beginning of tests. CONTRACTOR shall keep notes and data on tests, and submit copy to the ENGINEER. ENGINEER and OWNER'S operating personnel shall witness all tests.

1.4 MANUFACTURERS' AND SUPPLIERS' FIELD AND TEST DATA

- A. An experienced, competent, and authorized representative of the manufacturer or supplier of each item of equipment, as required in these Specifications, shall visit the site of the Work and inspect, check, and approve the equipment installation. In each case, the equipment supplier's representative shall be present when the equipment is placed in operation. The equipment supplier's representative shall revisit the job site as often as necessary until all trouble is corrected and the equipment installation and operation is satisfactory to the ENGINEER. Sales representatives shall not be acceptable to perform start-up and training functions.
- B. One hard copy and electronic copies of all test and field data collected by the manufacturers/suppliers of equipment during installation supervision and start-up services shall be submitted to the ENGINEER within 14 calendar days after the start-up services are complete. The test and field data shall be submitted, whether specified or not, in the detailed Equipment Specifications and shall include, but are not limited to, tolerance and alignment measurements where applicable to verify equipment has been satisfactorily installed, and all other information collected by the manufacturers/suppliers to satisfy themselves that equipment has been properly installed. The manufacturer shall submit to the ENGINEER a certification on the manufacturer's letterhead stating that the equipment has been properly installed and lubricated, is in accurate alignment, is free from any undue stress imposed by connecting piping or anchor bolts; and has been operated under full load conditions and it operated satisfactorily. In cases where the manufacturer/supplier's representative believes equipment is not properly installed he shall include with this submittal a punch list detailing the problems noted which require correction. The information required under this Section shall be furnished for all equipment and devices requiring installation and start-up services, as specified in these Specifications, including the detailed Mechanical, Electrical, and Instrumentation Specifications.

- C. The costs for this Work shall be included in the prices quoted by equipment suppliers. CONTRACTOR shall perform all Work required to install and place into operation the equipment in accordance with the manufacturer's recommendations.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01730

OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Provide Operation and Maintenance Data in the form of instructional manuals for use by the OWNER'S personnel for:
 - 1. All equipment and systems.
 - 2. All valves, pumps, and related accessories.
 - 3. All instruments and control devices.
 - 4. All electrical gear.
- B. Training or start-up on any system, process, or piece of equipment shall not be allowed until Operation and Maintenance Manuals and Lesson Training Plans are approved by the ENGINEER, and the approved Operation and Maintenance Manuals have been turned over to the OWNER.
- C. Definitions:
 - 1. Operation and Maintenance Data:
 - a. The term "Operation and Maintenance Data" includes all product related information and documents which are required for preparation of the station Operation and Maintenance Manual. It also includes all data which shall accompany said manual as directed by current regulations of any participating government agency.
 - b. Required Operation and Maintenance Data includes, but is not limited to, the following:
 - 1) Complete, detailed written operating instructions for each product or piece of equipment including equipment function; operating characteristics; limiting conditions; operating instructions for start up, normal, and emergency conditions; regulation and control; and shut down.
 - 2) Complete, detailed written preventive maintenance instructions as defined below.
 - 3) Recommended spare parts lists, by generic title and identification number, and local sources of supply for parts.
 - 4) Written explanations of all safety considerations relating to operation and maintenance procedures.
 - 5) Name, address, and phone number of manufacturer, manufacturer's local service representative, and subcontractor or installer.

- 6) Copy of all approved Shop Drawings, and a copy of the warranty bond and service contract as applicable, including circuit diagrams, schematics, and functional Drawings.
 - 7) Control Diagrams: Internal and connection wiring, including logic diagrams, wiring diagrams for control panels, ladder logic for computer based systems, and connections between existing systems and new additions, and adjustments such as calibrations and set points for relays, and control or alarm contact settings. Provide all programming/wiring documentation needed for "in-house" troubleshooting and customizing.
 - 8) Final test data, where applicable, shall be submitted as an appendix when completed.
 - 9) Disassembly, reassembly, installation, alignment, adjustment, and checking instructions.
2. Preventive Maintenance Instructions:
- a. The term "Preventive Maintenance Instructions" includes all information and instructions required to keep a product or piece of equipment properly lubricated, adjusted, and maintained so that the item functions economically throughout its full design life.
 - b. Preventive Maintenance Instructions include, but are not limited to, the following:
 - 1) A written explanation with illustrations for each preventive maintenance task.
 - 2) Recommended schedule for execution of preventive maintenance tasks.
 - 3) Lubrication charts.
 - 4) Table of alternative lubricants.
 - 5) Trouble shooting instructions.
 - 6) List of required maintenance tools and equipment.

D. Submittals:

1. General: Submit operations and maintenance data to the ENGINEER within 60 days after approval of Shop Drawings, unless noted otherwise.
2. Number of Copies: One hard copy of each item.
 - a. One preliminary copy of each O&M Manual shall be submitted to the ENGINEER for approval within 30 days of the approval of the Shop Drawing, which indicated further submittals are not required. The O&M Manual shall conform to the requirements as specified herein.
 - b. 60 days prior to placing the equipment into service, submit one hard copies and one soft copy of the approved O&M Manual (except for field test data) to the ENGINEER.
 - c. Soft copy shall be in CD format and shall include all information provided in hard copy. Text shall be in ".pdf" format. Drawings and figures shall be in AutoCAD ".dwg", or bitmap ".bmp", tiff ".tif", jpeg ".jpg", gif ".gif", or pc paint brush ".pcx".

3. Letter of Transmittal: Provide a letter of transmittal with each submittal and include the following in the letter:
 - a. Date of submittal.
 - b. Contract title and number.
 - c. CONTRACTOR'S name and address.
 - d. A list of the attachments and the Specification Sections to which they relate.
 - e. Reference to or explanation of related submittals already made or to be made at a future date.
4. Format Requirements:
 - a. Use 8-1/2-inch by 11-inch paper of high rag content and quality. Larger Drawings or illustrations are acceptable if neatly folded to the specified size in a manner which will permit easy unfolding without removal from the binder. Provide reinforced punched binder tab, or provide flyleaf for each product.
 - b. All text must be legible typewritten or machine printed originals or high quality copies of same.
 - c. Each page shall have a binding margin of approximately 1-1/2-inches and be punched for placement in a 3-ring loose-leaf binder. Provide binders. Identify each binder with the following:
 - 1) Title "OPERATING AND MAINTENANCE INSTRUCTIONS".
 - 2) Title of Project.
 - 3) Identity of building or structure as applicable.
 - 4) Identity of general subject matter covered.
 - d. Use dividers and indexed tabs between major categories of information such as operating instructions, preventive maintenance instructions, or other. When necessary, place each major category in a separate binder.
 - e. Provide a Table of Contents for each binder.
 - f. Identify products by their functional names in the table of contents and at least once in each Chapter or Section. Thereafter, abbreviations and acronyms may be used if their meaning is explained in a table in the back of each binder. Use of model or catalog numbers or letters for identification is not acceptable.
 - g. Upon completion of the installation of each item of equipment, the CONTRACTOR shall provide Drawings of the local control panel to be added to the O&M Manual.
 - h. Indicate all components of the equipment on catalog pages by highlighting or some other clearly definable medium for ease of identification.
 - i. Final test data determined after installation of the equipment shall be submitted as an appendix to the Operations and Maintenance Manuals.
- E. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to

indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

- F. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01750

SPARE PARTS AND MAINTENANCE MATERIALS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. 60 days after approval of the Shop Drawing of the equipment specified in the individual Sections, CONTRACTOR shall furnish spare parts data and maintenance material for equipment. The data shall include a complete list of parts and supplies, with current unit prices and source or sources of supply.
- B. Spare parts and materials required to be supplied in the Contract Documents shall be furnished in manufacturer's unopened cartons, boxes, crates or other protective covering suitable for preventing corrosion or deterioration for the maximum length of storage that may be normally anticipated. They shall be clearly marked and identified as to the name of manufacturer or supplier, applicable equipment, part number, description and location in the equipment. All parts shall be protected and packaged for a shelf life of at least 10 years.
- C. During construction, store parts in buildings or trailers with floor, roof, and closed sides and in accordance with manufacturers' recommendations. Protect from weather, condensation, and humidity.
- D. Parts and materials shall be delivered to the OWNER upon Substantial Completion of the Work or start-up. CONTRACTOR shall then place them in permanent storage rooms or areas approved by the OWNER. The turnover procedures shall be developed by the ENGINEER.
- E. Provide a Letter of Transmittal and Spare Parts Receiver Form including the following:
 - 1. Date of letter and transfer of parts and material.
 - 2. Contract title and number.
 - 3. CONTRACTOR'S name and address.
 - 4. Transmittal should list applicable Specification Sections for each set of spare parts supplied.
 - 5. Spare Parts Receiver Form.
- F. CONTRACTOR shall be fully responsible for loss or damage to parts and materials until they are transmitted to the OWNER.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

(The remainder of this page left intentionally blank).

SPARE PARTS RECEIVER

SPECIFICATION SECTION 01750

CONTRACTOR PLEASE FILL OUT:

MANUFACTURER:_____

ITEM DESCRIPTION:_____

COST:_____

MANUFACTURER PART NUMBER:_____

SUPPLIER:_____

CROSS REFERENCE NUMBER:_____

VENDOR INFORMATION:_____

VENDOR ORDER PART NUMBER:_____

PART TO BE USED ON
WHAT EQUIPMENT:_____

EQUIPMENT NUMBER:_____

SPECIFICATION SECTION:_____

CITY PERSONNEL FILL IN:

BIN NUMBER:_____

AIMS NUMBER:_____

LOCATION IN STORES:_____

RECEIVED BY:_____

END OF SECTION

SECTION 01821

INSTRUCTION OF OPERATIONS AND MAINTENANCE PERSONNEL

PART 1 - GENERAL

1.1 DESCRIPTION

- A. CONTRACTOR shall provide the services of factory-trained maintenance specialists to instruct OWNER'S operations and maintenance personnel in the recommended operation and the preventive maintenance procedures for equipment specified in the equipment Sections.
- B. The qualifications of specialists shall be subject to approval by ENGINEER.
- C. CONTRACTOR shall coordinate these services at times acceptable to OWNER and ENGINEER, with a minimum of 14 days prior notice.
- D. Manufacturer shall provide a combination of classroom and field training. All training shall be conducted at the facility, unless otherwise stated in the Equipment Sections. Class size shall be limited to no more than 15 trainees. Manufacturer shall provide training for all plant shifts, or as approved by OWNER.
- E. Manufacturer shall allow any and all training sessions to be videotaped by OWNER.
- F. Section 01640, Materials and Equipment; Section 01650, Starting of Systems; Section 01660, Field Tests of Equipment; and, additional requirements for manufacturer's and supplier's field and test data.
- G. Instruction of OWNER'S personnel shall commence only after the equipment has been started, approved Operation and Maintenance Manuals have been turned over to the OWNER, and acceptance tests have been completed according to the provisions in Section 01650, Starting of Systems.
- H. CONTRACTOR shall submit a copy of this Section 01821, Instruction of Operations and Maintenance Personnel, to all manufacturers of equipment for this Contract.

1.2 SUBMITTALS

- A. Manufacturer shall submit for approval the following:
 - 1. Proposed Lesson Plan for each scheduled instruction 28 days prior to commencement of training. Lesson plans shall be approved a minimum of 14 days prior to scheduled instruction.

2. Credentials of their designated operations and maintenance instructor. Credentials shall include a brief resume and specific details of the instructor's experience pertaining to operation of, maintenance of, and training for the equipment specified.
3. Training Request Form: CONTRACTOR shall submit the Training Request Form to the ENGINEER 28 days prior to the requested training date.
4. There shall be separate "Operations" and "Maintenance" staff training.

1.3 INSTRUCTION LESSON PLAN

- A. Manufacturer's proposed Lesson Plan shall include the elements presented in the outline of Instruction Lesson Plan in Paragraph 1.3.D., below, of this Section. Specific components and procedures shall be identified in the proposed Lesson Plan.
- B. Manufacturer's proposed Lesson Plan shall detail specific instruction topics. Training aids to be utilized in the instruction shall be referenced and attached where applicable to the proposed Lesson Plan. "Hands-On" demonstrations planned for the instruction shall be described in the Lesson Plan.
- C. The manufacturer shall indicate the estimated duration of each segment of the training Lesson Plan.
- D. Instruction Lesson Plan shall include the following as a minimum:
 1. Equipment Operation:
 - a. Describe equipment's operating (process) function.
 - b. Describe equipment's fundamental operating principals and dynamics.
 - c. Identify equipment's mechanical, electrical and electronic components and features.
 - d. Identify all support equipment associated with the operation of subject equipment (e.g., air intake filters, valve actuators, motors).
 - e. Recommend standard operating procedures to cover start-up, routine monitoring and shutdown of the equipment.
 2. Detailed Component Description:
 - a. Identify and describe in detail each component's function.
 - b. Where applicable, group related components into subsystems. Describe subsystem functions and their interaction with other subsystems.
 - c. Identify and describe in detail equipment safeties and control interlocks.
 3. Equipment Preventive Maintenance (PM):
 - a. Describe PM inspection procedures required to:
 - 1) Perform an inspection of the equipment in operation.
 - 2) Spot potential trouble symptoms and anticipate breakdowns.
 - 3) Forecast maintenance requirements (predictive maintenance).
 - b. Define the recommended PM intervals for each component.
 - c. Provide lubricant and replacement part recommendations and limitations.

- d. Describe appropriate cleaning practices and recommend intervals.
 - e. Identify and describe the use of special tools required for maintenance of the equipment.
 - f. Describe component removal/installation and disassembly/assembly procedures.
 - g. Perform at least two "hands-on" demonstrations of preventive maintenance procedures.
 - h. Describe recommended measuring instruments and procedures, and provide instruction on interpreting alignment measurements, as appropriate.
 - i. Define recommended torquing, mounting, calibration and/or alignment procedures and settings, as appropriate.
 - j. Describe recommended procedures to check/test equipment following a corrective repair.
4. Equipment Troubleshooting:
- a. Define recommended systematic troubleshooting procedures.
 - b. Provide component specific troubleshooting checklists.
 - c. Describe applicable equipment testing and diagnostic procedures to facilitate troubleshooting.

1.4 TRAINING AIDS

- A. The manufacturer's instructor shall incorporate training aids as appropriate to assist in the instruction. As a minimum, the training aids shall include text and figure handouts. Other appropriate training aids are:
- 1. Audio-Visual Aids (e.g., films, slides, videotapes, overhead transparencies, posters, blueprints, diagrams, catalogue sheets).
 - 2. Equipment cutaways and samples (e.g., spare parts and damaged equipment).
 - 3. Tools (e.g., repair tools, customized tools, measuring and calibrating instruments).
- B. The manufacturer's instructor shall utilize descriptive class handouts during the instruction. Photocopied class handouts shall be good quality reproductions. Class handouts should accompany the instruction with frequent reference made to them. Customized handouts developed especially for the instruction are encouraged. Handouts planned for the instruction shall be attached with the manufacturer's proposed Lesson Plan.

1.5 "HANDS-ON" DEMONSTRATIONS

- A. The manufacturer's instructor shall present "hands-on" demonstrations of operations and maintenance of the equipment for each scheduled group. The proposed "hands-on" demonstrations should be described in the manufacturer's proposed Lesson Plan.

1.6 TRAINING SCHEDULE

- A. Each manufacturer shall provide as a minimum the following hours of training. Travel time and expenses are responsibility of manufacturer and are not included in training schedule time.
- B. The CONTRACTOR shall provide experienced, competent manufacturers' representatives to train OWNER'S personnel in operation and maintenance procedures for equipment items specified below during the start-up period at no additional cost to OWNER. The Lesson Plans for these sessions shall be reviewed with the OWNER and the ENGINEER in one meeting prior to initiating training. Lesson Plans shall be submitted to the ENGINEER not less than one week prior to this meeting. CONTRACTOR will video tape the manufacturers' training sessions and provide OWNER with DVD format professional quality discs of the training sessions. The representatives shall present training programs and on-site demonstrations designed to fully acquaint plant personnel with all equipment features, routine scheduled maintenance procedures, alternative operational modes, emergency procedures, spare parts inventories, and demonstrate performance requirements of the Specifications. Representatives shall remain on-site to observe operation of the equipment and further advise plant personnel for a minimum number of hours as specified below:

Equipment	Additional Training Days (Day = 8 hrs minimum)
Membrane Filtration System	2
Positive Displacement Blowers	1
Actuators	½
Turbidity Instrument	½

- C. A complete schedule of representatives and dates for operator training shall be submitted to OWNER prior to commencement of the start-up period. This schedule shall be prepared to accommodate the plant staff's work schedules, including training on all three shifts and staff flex time.
- D. The plant operators work on a shift schedule. Develop the training schedule to account for training classes for each shift.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

TRAINING REQUEST FORM
CITY OF CHANDLER
WRF IMPROVEMENTS PROJECT

SPECIFICATION SECTION 01821
INSTRUCTION OF OPERATIONS AND MAINTENANCE PERSONNEL

Equipment Name: _____

Equipment Tag Number: _____

Equipment Description: _____

Specification Section: _____

Operations and Maintenance Data Submitted/Approved: _____

Start-up and Testing Complete/Date: _____

Lesson Plan Submitted/Approved: _____

Training Aids Submitted/Approved: _____

Hands-on Demonstration: _____

Training Schedule (Dates, Time, No. of Sessions): _____

END OF SECTION

SECTION 09900

PAINTING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes surface preparation and field painting of the following:
 - 1. Exposed exterior items and surfaces.
 - 2. Exposed interior items and surfaces.
 - 3. Surface preparation, priming, and finish coats specified in this Section are in addition to shop priming and surface treatment specified in other Sections.
- B. Paint exposed surfaces, except where the paint schedules indicate that a surface or material is not to be painted or is to remain natural. If the paint schedules do not specifically mention an item or a surface, paint the item or surface the same as similar adjacent materials or surfaces, whether or not schedules indicate colors. If the schedules do not indicate color or finish that is mentioned, the ENGINEER will select from standard colors and finishes available.
 - 1. Painting includes field painting of exposed bare and covered pipes and ducts (including color coding), hangers, exposed steel and iron work, and primed metal surfaces of mechanical and electrical equipment.
- C. Unless indicated otherwise, do not paint prefinished items, concealed surfaces, finished metal surfaces, operating parts, and labels.
 - 1. Prefinished items include, but are not limited to, the following factory-finished components:
 - a. Architectural woodwork and casework.
 - b. Motor nameplates.
 - c. Instrumentation and electrical mounting hardware such as nuts, bolts, screws, U-bolts, handles, latches, and hinges.
 - d. Analyzers, probes, nuts, bolts, and screws or any mounting hardware.
 - e. Metal toilet enclosures.
 - f. Acoustical ceiling panels.
 - g. Metal lockers.
 - h. Ceramic tile, windows, glass, resilient flooring; other architectural features, such as "finish" hardware, furnished in aluminum, bronze or plated ferrous metal, prefinished panels, or other items installed prefinished.
 - i. Finished mechanical and electrical equipment, except as indicated in the Specifications or on the Plans.
 - j. Light fixtures.
 - k. Interior distribution cabinets and switch gear, except as indicated.
 - 2. Concealed surfaces include walls or ceilings in the following generally inaccessible spaces:

- a. Foundation spaces, unless noted otherwise.
- b. Surfaces behind furred areas.
- c. Ceiling plenums.
- d. Utility tunnels.
- e. Pipe spaces.
- f. Duct shafts.
- 3. Finished metal surfaces include the following:
 - a. Stainless steel or chromium plated items.
 - b. Chromium plate.
 - c. Copper.
 - d. Bronze and brass.
 - e. Buried cast and ductile iron pipe encased with a protective polyethylene sleeve.
 - f. Anodized aluminum, aluminum gratings, and floor plates.
 - 1) Paint aluminum surfaces in contact with concrete, grout, masonry, wood, or dissimilar materials as described below:
 - a) Surface must be clean, dry, and free of oil, grease, and other contaminants. Surface preparation with SSPC-SP7 brush-off abrasive blast cleaning. Apply two coats of Tnemec Series 20 Pota-Pox or approved equal; each coat shall be 3-5 mils. Coating must be NSF 61 approved.
 - g. Prefinished louvers, except those in doors, unless otherwise noted and acoustical ceiling panels.
- 4. Operating parts include moving parts of operating equipment and the following:
 - a. Valve and damper operators or handles.
 - b. Linkages.
 - c. Sensing devices.
 - d. Motor and fan shafts.
- 5. Labels: Do not paint over Underwriters Laboratories (UL), Factory Mutual (FM), fire rating labels, equipment serial number and capacity labels, or other code-required labels or equipment name, identification, performance rating, nomenclature plates, and equipment identification plates.

1.2 RELATED SECTIONS

- A. Division 1, General Requirements, Specification Sections, apply to this Section.

1.3 SECTION INCLUDES

- A. Surface preparation.
- B. Field application of paints and other coatings.
- C. Pipe identification markers.

- D. Surfaces to Be Finished are provided in the schedule at end of Section and in the Contract Documents.

1.4 REFERENCES

- A. ANSI A13.1, Scheme for the Identification of Piping Systems; 1981 (revised 1993).
- B. ASTM D16, Standard Terminology Relating to Paint, Varnish, Lacquer, and Related Products; 1995.
- C. OSHA 1910.144, Code of Federal Regulations (CFR) Title 29.
- D. SSPC (PM2), Steel Structures Painting Manual, Vol. 2, Systems and Specifications; Steel Structures Painting Council; 1995.

1.5 DEFINITIONS

- A. General: Standard coating terms defined in ASTM D16 apply to this Section.
 - 1. Flat refers to a lusterless or matte finish with a gloss range below 15 when measured at an 85 degree meter.
 - 2. Eggshell refers to low-sheen finish with a gloss range between 5 and 20 when measured at a 60-degree meter.
 - 3. Satin refers to low-sheen finish with a gloss range between 15 and 35 when measured at a 60 degree meter.
 - 4. Semi-gloss refers to medium-sheen finish with a gloss range between 30 and 65 when measured at a 60 degree meter.
 - 5. Full gloss refers to high-sheen finish with a gloss range more than 65 when measured at a 60 degree meter.
 - 6. Buried refers to covered with earth.
 - 7. Exposed or exposed surfaces refers to areas visible when permanent or built-in fixtures, grilles, and similar components are in place. Extend coatings in these areas, as required, to maintain the system integrity and provide desired protection.
 - 8. Submerged refers to materials which are permanently or intermittently below the maximum water or liquid surface elevation in open top structures, unless otherwise noted or otherwise shown; materials within liquid or residual solids carrying structures that are covered, including materials on the underside of the covers, whether in contact with liquids or not, unless otherwise noted or otherwise shown; materials within an enclosed process structure, whether in contact with liquids or not.

1.6 SUBMITTALS

- A. See Section 01300, Submittals, for submittal procedures.
- B. Product Data: For each paint system specified. Include block fillers and primers.

1. **Material List:** Provide an inclusive list of required coating materials. Indicate each material and cross-reference specific coating, finish system, and application. Identify each material by manufacturer's catalog number and general classification.
 2. **Manufacturer's Information:** Provide manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each coating material proposed for use.
 - a. Identify manufacturer's recommended, published spreading rate, and dry film thickness of each coating material proposed for use.
 - b. Indicate manufacturer's instructions on surface and special surface preparation procedures.
 - c. Include the following: Mixing instructions, shelf life, method of application, recommended number of coats, drying time of each coat including prime coat, required prime coat, compatible and non-compatible prime coats, and recommended thinners when required.
- C. **Pipe Identification Markers:** Submit product data and marker sample for each type of pipe identification required.
- D. **Maintenance Data:** Submit data on cleaning, touch-up, and repair of painted and coated surfaces.
- E. **Samples for Initial Selection:** Manufacturer's color charts showing the full range of colors available for each type of finish-coat material indicated. Submit two paper chip samples, 3-inch by 3-inch in size.
- F. Before supplying any material to the site, the painting subcontractor and the paint manufacturer's area representative shall prepare a complete schedule showing the materials proposed to be used for each treatment specified, and submit same to ARCHITECT and ENGINEER for review/approval.
- G. Paint colors will be specified by the ARCHITECT for the architectural paint system specified herein, who, before any Work is done, will furnish color chips and schedule showing where the various colors shall go.
- H. **Qualification Data:** For firms and persons specified in Paragraph 1.9 to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of Engineers or Architects and Owners, and other information specified.
- I. **Manufacturer's Certification:** Submit in accordance with Paragraph 3.8 at the completion of the Work.
- J. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓)

shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

1.7 REGULATORY REQUIREMENTS

- A. Conform to applicable code for flame and smoke rating and VOC requirements for products and finishes.
- B. Lead, heavy metals, cadmium, and chromate content of painting materials shall not exceed amount permitted by Federal, State, and local authorities.
- C. Coatings for surfaces in contact with potable water or water being treated for potable use shall not impart any taste or odor to the water or result in any organic or inorganic content in excess of the maximum contaminant level established by applicable laws or regulations.
- D. Comply with governing code requirements for air quality and material disposal regulations.

1.8 MOCK-UP

- A. Provide stepped-down job mock-ups for all painting and coating systems showing all components of the preparation and installation before any Work shall commence. Verify all dry film thicknesses, surface preparations, and methods of installation in addition to color and texture of the finished work.
- B. Provide mock-ups for each of the following substrates, illustrating painting and coating colors and finishes:
 - 1. Ferrous Metal: Provide panel equal to 4 square feet in size for each color and finish.
 - 2. Provide door and frame assembly for each paint coating color and finish.
- C. Locate where directed by ENGINEER.
- D. Mock-up(s) may remain as part of the Work.

- E. Work advanced without approved job mock-ups shall be completely removed and re-installed without additional compensation to the OWNER.

1.9 QUALITY ASSURANCE

- A. Applicator Qualifications: Engage an experienced applicator who has completed painting system applications similar in material and extent to that indicated for this Project with a record of successful in-service performance.
- B. Source Limitations: Obtain block fillers, primers, and undercoat materials for each coating system from the same manufacturer as the finish coats.
- C. Products shall be of best grade or first line.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to the Project site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label, and the following information:
 - 1. Product name or title of material.
 - 2. Product description (generic classification or binder type).
 - 3. Manufacturer's stock number, lot number, brand code, and date of manufacture.
 - 4. Contents by volume for pigment and vehicle constituents.
 - 5. Thinning instructions.
 - 6. Application instructions.
 - 7. Coverage and surface preparation.
 - 8. Drying time.
 - 9. Cleanup requirements.
 - 10. Instructions for mixing and reducing.
 - 11. Color name and number.
 - 12. Material Safety Data Sheets.
- B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45° F (7° C). Maintain containers used in storage in a clean condition, free of foreign materials and residue.
 - 1. Protect from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily. Take necessary measures to ensure that workers and work areas are protected from fire and health hazards resulting from handling, mixing, and application.
 - 2. Provide fire extinguishers and post caution signs warning against smoking and open flame when working with flammable materials.
- C. Protect work of other trades, whether being painted or not, against damage by painting. Correct damage by cleaning, repairing, or replacing and repainting, as approved by the ENGINEER. Provide "Wet Paint" signs to protect newly painted

finishes. Remove temporary protective wrappings provided by others to protect their work after completing painting operations.

1.11 PROJECT CONDITIONS

- A. Apply water-based paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 50° F and 120° F (10° C and 48.9° C).
- B. Apply solvent-thinned paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 45° F and 120° F (7.2° C and 48.9° C).
- C. Provide lighting level of 80 foot candles measured mid-height at substrate surface.
- D. Do not apply paint in snow, rain, fog, or mist; or when the relative humidity exceeds 85%; or at temperatures less than 5° F (3° C) above the dew point; or to damp or wet surfaces.
 - 1. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by manufacturer during application and drying periods.

1.12 UNUSED MATERIALS

- A. Furnish unused materials in unopened or opened and resealed containers for storage and identify with labels describing contents. Deliver materials to the OWNER.

1.13 EXTRA MATERIALS

- A. Supply one gallon of each color; store where directed.
- B. Label each container with color in addition to the manufacturer's label.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products listed in the paint schedules.
- B. Manufacturers Names: The following manufacturers are referred to in the paint schedules by use of shortened versions of their names, which are shown in parentheses:
 - 1. Benjamin Moore & Co. (Moore).
 - 2. PPG Industries, Inc. (PPG).
 - 3. Tnemec Co. (Tnemec).

4. Frazee Paint.
5. Ameron.
6. Valspar.

2.2 PAINT MATERIALS, GENERAL

- A. Paint exposed surfaces, except as indicated in Paragraph 1.4 and/or in Drawings/Specifications. If an item or surface is not specifically mentioned, paint the item or surface the same as similar adjacent materials of surfaces whether or not the schedule indicates color(s). If the schedule does not indicate color(s) or finish(es), the ENGINEER will select from standard colors and finishes available.
- B. Equipment supplied with a finished coat by the manufacturers shall be touched-up by the CONTRACTOR.
- C. Paints and Coatings: Ready mixed, except field-catalyzed coatings. Prepare pigments:
 1. To a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating.
 2. For good flow and brushing properties.
 3. Capable of drying or curing free of streaks or sags.
- D. Metals encased in concrete shall only receive a primer compatible with the covering material.
- E. All items under and around the metal canopies shall be considered exterior and painted with materials conforming to those specified in this Specification.
- F. Material Compatibility: Provide block fillers, primers, undercoats, and finish coat materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
- G. Material Quality: Provide manufacturer's best-quality paint material of the various coating types specified. Paint-material containers not displaying manufacturer's product identification will not be acceptable.
 1. Proprietary Names: Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Furnish manufacturer's material data and certificates of performance for proposed substitutions.
- H. Color Coding: Unless otherwise specified, all color coding of piping, ducts, and equipment shall comply with applicable standards of the following:
 1. ANSI A13.1.
 2. OSHA 1910.144.

- I. At completion of construction activities of other trades, touch-up and restore damaged or defaced painted surfaces.
- J. Architectural Color Schedule: Colors indicated are by Tnemec Company, Inc.: www.tnemec.com.
 - 1. Shading Devices: Match existing colors at existing Administration Building located on site.
 - 2. Exterior Hollow Metal Doors and Frames: Match existing colors at existing Administration Building located on site.
 - 3. Exposed CMU, Interior: 11WH White.
 - 4. Interior Hollow Metal Doors and Frames: 33GR Grey.
 - 5. Exposed Gypsum Board, Interior: 07WH Winter Mist.
- K. Colors: All colors as selected by ENGINEER from manufacturer's standards except as follows:
 - 1. Color of safety stripe at bollards match PPG 6-330 Safety Yellow.

2.3 PAINT SYSTEMS - INTERIOR AND EXTERIOR

- A. Field Primed Steel and Ferrous Metal:
 - 1. Exterior Exposure:
 - a. Surface Preparation: SSPC SP6 Commercial Abrasive Blast Cleaning.
 - b. Prime Coat: Series 69-1255 (beige) H.B. Epoxoline II; one coat; 4-6 mils DFT (dry film thickness).
 - c. Finish Coat: Series 73 Endura-Shield; one coat; 3-4 mils DFT.
 - 2. Interior Exposure:
 - a. Surface Preparation: SSPC SP6 Commercial Abrasive Blast Cleaning.
 - b. Prime Coat: Series 69-1255 (beige) H.B. Epoxoline II; one coat; 3-5 mils DFT.
 - c. Finish Coat: Series 69 H.B. Epoxoline; one coat; 4-6 mils DFT.
 - 3. Immersion or Partial Immersion Exposure:
 - a. Surface Preparation: SSPC SP10 Near-White Metal Abrasive Blast Cleaning.
 - b. Prime Coat: Series 66 H.B. Epoxoline; one coat; 4-6 mils DFT.
 - c. Finish Coat: Series 69 H.B. Epoxoline II; one coat; 4-6 mils DFT.
- B. Shop and Factory Primed Steel:
 - 1. Exterior Exposure:
 - a. Field Prime Coat (over factory prime coat): Series 135 (beige) Chembuild; one coat; 3-4 mils DFT.
 - b. Finish Coat: Series 73 Endura-Shield; one coat; 3-4 mils DFT.
 - 2. Interior Exposure:
 - a. Field Prime Coat (over factory prime coat): Series 135 (beige) Chembuild; one coat; 3-4 mils DFT.
 - b. Finish Coat: Series 69 H.B. Epoxoline; one coat; 4-6 mils DFT.
 - 3. Immersion or Partial Immersion Exposure:

- a. Surface Preparation: Brush off abrasive blast cleaning if required for recoat of the shop primer. Coating surface to be clean, dry, and free of contaminants prior to application of the field coats.
 - b. Prime Coat: Series 66 H.B. Epoxoline; one coat; 2.5-3 mils DFT.
 - c. Finish Coat: Series 69 H.B. Epoxoline II; one coat; 4-6 mils DFT.
- C. Galvanized Steel and Non-Ferrous Metals:
 - 1. Exterior Exposure:
 - a. Surface Preparation: Brush-off abrasive blast cleaning.
 - b. Prime Coat: Series 69-1255 (beige) H.B. Epoxoline II; one coat; 3-4 mils DFT.
 - c. Finish Coat: Series 73 Endure-Shield; one coat; 3-4 mils DFT.
 - 2. Interior Exposure:
 - a. Surface Preparation: Clean, dry and free of contaminants.
 - b. Prime Coat: Series 135 (beige) Chembuild; one coat; 3-4 mils.
 - c. Finish Coat: Series 69 H.B. Epoxoline II; one coat; 4-6 mils DFT.
 - 3. Immersion or Partial Immersion Exposure:
 - a. Surface Preparation: Brush-off abrasive blast cleaning.
 - b. Prime Coat: Series 66 H.B. Epoxoline; one coat; 4-6 mils DFT.
 - c. Finish Coat: Series 69 H.B. Epoxoline II; one coat; 4-6 mils DFT.
- D. Ductile and Cast Iron:
 - 1. Exterior Exposure:
 - a. Surface Preparation: Solvent scrub with stiff bristle brush, followed by brush-off abrasive blast cleaning to a minimum surface profile depth of 1.5 mils DFT.
 - b. Prime Coat: Series 69-1255 (beige) H.B. Epoxoline II; one coat; 3-5 mils DFT.
 - c. Finish Coat: Series 73 Endura-Shield; one coat; 3-4 mils DFT.
 - 2. Interior Exposure:
 - a. Surface Preparation: Clean, dry, and free of contaminants.
 - b. Prime Coat: Series 135 Chembuild; one coat; 4-6 mils DFT.
 - c. Finish Coat: Series 69 H.B. Epoxoline II; one coat; 4-6 mils DFT.
 - 3. Buried:
 - a. Surface Preparation: Solvent scrub with stiff bristle brush followed by brush-off abrasive blast cleaning to a minimum surface profile depth of 1.5 mils DFT.
 - b. Prime Coat: Series 69-1255 (beige) H.B. Epoxoline II; one coat; 3-5 mils DFT.
 - c. Finish Coat: Series 69 H.B. Epoxoline II; one coat; 4-6 mils DFT.
 - 4. Immersion:
 - a. Surface Preparation: Solvent scrub with stiff bristle brush, followed by brush-off abrasive blast cleaning to a minimum surface profile depth of 1.5 mils.
 - b. Prime Coat: Series 66 H.B. Epoxoline; one coat; 4-6 mils DFT.
 - c. Finish Coat: Series 69 H.B. Epoxoline II; one coat; 4-6 mils DFT.

- E. PVC:
 - 1. Exterior Exposure:
 - a. Surface Preparation: Clean, dry, and free of contaminants.
 - b. Prime Coat: Series 66 H.B. Epoxoline; one coat; 3-5 mils DFT.
 - c. Finish Coat: Series 73 Endure-Shield; one coat; 3-4 mils DFT.
 - 2. Interior Exposure:
 - a. Surface Preparation: Clean, dry, and free of contaminants.
 - b. Finish Coat: Series 66 H.B. Epoxoline; two coats; 3-5 mils DFT per coat.

2.4 PIPE IDENTIFICATION MARKERS

- A. Manufacturers: Provide products by one of the following:
 - 1. Seton Name Plate Company.
 - 2. W.H. Brady Company.
 - 3. Or equal.
- B. General: The size of lettering and marker shall conform to ANSI A13.1.
- C. Provide brass tags for pipes under 3/4-inch outside diameter. Provide plastic pipe markers for pipes over 3/4-inch.
- D. Plastic Pipe Markers: Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.
 - 1. Markers for piping up to 6-inch diameter shall be preformed to completely wrap around the pipe requiring no adhesive. Markers for pipes over 6-inch diameter shall be preformed to the contour of the pipe and attached with stainless steel spring fasteners.
- E. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2-inch diameter with smooth edges.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Inspect substrates, areas, and conditions, with the applicator present, under which painting will be performed for compliance with paint application requirements. Verify that surfaces are ready to receive work as instructed by the product manufacturer.
 - 1. Do not begin to apply paint until unsatisfactory conditions have been corrected and surfaces receiving paint are thoroughly dry.
 - 2. Start of painting will be construed as the applicator's acceptance of surfaces and conditions within a particular area.

- B. Coordination of Work: Review other Sections in which primers are provided to ensure compatibility of the total system for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.
 - 1. Notify the ENGINEER about anticipated problems using the materials specified over substrates primed by others.

3.2 PREPARATION

- A. Perform all preparation and cleaning procedures as specified herein and in strict accordance with the paint manufacturer's instructions for each particular substrate and atmospheric condition.
- B. Clean surfaces to be painted before applying paint or surface treatments. Remove oil and grease with clean cloths and cleaning solvents prior to mechanical cleaning. Program the cleaning and painting so that dust and other contaminants from the cleaning process will not fall in wet, newly painted surfaces.
- C. Furnish sufficient drop cloths, shields, and protective equipment to prevent spray or droppings from fouling surfaces not being painted and, in particular, surfaces within storage and preparation area.
- D. Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted. If removal is impractical or impossible because of the size or weight of the item, provide surface-applied protection before surface preparation and painting.
 - 1. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved.
- E. Surfaces: Correct defects and clean surfaces which affect Work of this Section. Remove or repair existing coatings that exhibit surface defects.
- F. Marks: Seal marks which may bleed through surface finishes with barrier coat compatible with paint.
- G. Impervious Surfaces: Remove mildew in accordance with paint manufacturer's recommendations.
- H. Cleaning: Before applying paint or other surface treatments, clean the substrates of substances that could impair the bond of the various coatings. Remove oil and grease before cleaning.
 - 1. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.
- I. Surface Preparation: Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition and as specified.

1. Provide barrier coats over incompatible primers or remove and reprime.
2. Cementitious Materials: Prepare concrete, concrete masonry block, cement plaster, and mineral fiber-reinforced cement panel surfaces to be painted. Remove stains, loose mortar, scale, salt, efflorescence, chalk, dust, dirt, grease, oils, release agents, and other foreign matter in accordance with paint manufacturers's recommendations. Do not use wire brushes for preparation or cleaning. Roughen as required to remove glaze. If hardeners or sealers have been used to improve curing, use mechanical methods of surface preparation.
 - a. Use abrasive blast cleaning methods if recommended by paint manufacturer.
 - b. Determine alkalinity and moisture content of surfaces by performing appropriate tests. If surfaces are sufficiently alkaline to cause the finish paint to blister and burn, correct this condition before application. Do not paint surfaces where moisture content exceeds that permitted in manufacturer's written instructions.
 - c. Clean concrete floors to be painted with a 5% solution of muriatic acid or other etching cleaner. Flush the floor with clean water to remove acid, neutralize with ammonia, rinse, allow to dry, and vacuum before painting.
3. Wood: Clean surfaces of dirt, oil, and other foreign substances with scrapers, mineral spirits, and sandpaper, as required. Sand surfaces exposed-to-view smooth and dust off.
 - a. Scrape and clean small, dry, seasoned knots, and apply a thin coat of white shellac or other recommended knot sealer before applying primer. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood filler. Sand smooth when dried.
 - b. Seal pitch streaks and sappy sections with sealer. Seal cracks, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks with caulking compound after prime coat has been applied; sand between coats. Back prime concealed surfaces before installation.
 - c. Prime, stain, or seal wood to be painted immediately on delivery. Prime edges, ends, faces, undersides, and backsides of wood, including cabinets, counters, cases, and paneling.
 - d. When transparent finish is required, back prime with spar varnish.
 - e. Seal tops, bottoms, and cutouts of unprimed wood doors with a heavy coat of varnish or sealer immediately on delivery.
4. Gypsum Board Surfaces to Be Painted: Fill minor defects with filler compound. Spot prime defects after repair.
5. Zinc Coated Surfaces: Remove surface contamination and oils and prepare for priming in accordance with metal manufacturer's recommendations.
6. Plaster Surfaces to Be Painted: Allow new plaster surfaces to cure 28 days. Remove grease, dirt, loose mortar, scale or alkali powder, high alkali surfaces, and other foreign matter in accordance with paint manufacturer's recommendation. Fill hairline cracks, small holes, and imperfections with

patching plaster that is compatible with paint. Make smooth and flush with adjacent surfaces. Do not use wire brushes for preparation or cleaning.

7. Aluminum: Remove surface contamination by steam or high pressure water. Remove oxidation with acid etch and solvent washing.
 8. Copper: Remove surface contamination by steam or high pressure water.
 9. Ferrous Metals: Clean and remove oil, grease, dirt, loose mill scale, and other foreign substances from ungalvanized ferrous metal surfaces that have not been shop coated as outlined in Paragraph 2.3. Use solvent or mechanical cleaning methods that comply with the Steel Structures Painting Council's (SSPC) recommendations.
 - a. Blast steel surfaces clean, as recommended by paint system manufacturer.
 - b. Touch-up bare areas and shop applied prime coats that have been damaged. Wire brush, clean with solvents recommended by paint manufacturer, and touch-up with the same primer as the shop coat.
 - c. For shop-primed ferrous metal surfaces, clean and prepare in accordance with manufacturer's recommendations. Feather edges to make touch-up patches inconspicuous. Prime bare steel surfaces. Provide barrier coat over entire shop primed items.
 10. Galvanized Surfaces: Clean galvanized surfaces with nonpetroleum-based solvents so surface is free of oil and surface contaminants. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods.
 11. Ductile Iron Pipe: All new ductile iron pipe (DIP) intended for immersion service shall be prepared per coating manufacturer's specifications and as specified herein.
 - a. Remove grease, rust scale, rust and touch-up any chipped or abraded areas on items that have been shop coated. Items intended for immersion service that have not been shop coated shall be sandblasted to "Near White Blast Cleaning" condition per SSPC SP-10 prior to receiving coating.
 - b. All new DIP intended for non-immersion service shall be sandblasted to "Commercial Blast Cleaning" condition per SSPC SP-6 prior to receiving coating.
- J. Materials Preparation: Mix and prepare paint materials according to manufacturer's written instructions.
1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.
 2. Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.
 3. Use only thinners approved by paint manufacturer and only within recommended limits.

- K. Tinting: Tint each undercoat a lighter shade to simplify identification of each coat when multiple coats of the same material are applied. Tint undercoats to match the color of the finish coat, but provide sufficient differences in shade of undercoats to distinguish each separate coat.

3.3 APPLICATION

- A. General: Apply paint according to manufacturer's written instructions. Use applicators and techniques best suited for substrate and type of material being applied.
1. Any spot measurement found below the required minimum dry film thickness shall be repainted by the CONTRACTOR in accordance with the manufacturer's instructions, at no additional cost to the OWNER.
 2. Do not apply finishes on surfaces that are not sufficiently dry. Allow each coat of finish to dry before following coat is applied, unless directed otherwise by the manufacturer.
 3. Where adjacent sealant is to be painted, do not apply finish coats until sealant is applied.
 4. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.
 5. Install piping identification markers after painting has been completed according to the color coding schedule indicated.
 6. Paint colors, surface treatments, and finishes are indicated in the schedules located at the end of this Section.
 7. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.
 8. Provide finish coats that are compatible with primers used.
 9. Finish edges, tops and bottoms of all doors the same as door faces. Both sides and all edges of doors to be finished simultaneously.
 10. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, convactor covers, covers for finned-tube radiation, grilles, and similar components are in place. Extend coatings in these areas, as required, to maintain the system integrity and provide desired protection.
 11. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before the final installation of movable equipment, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 12. Paint interior surfaces of ducts with a flat, nonspecular black paint where visible through registers or grilles.
 13. Finish exterior doors on tops, bottoms, and side edges the same as exterior faces.
 14. Finish interior of wall and base cabinets and similar field-finished casework to match exterior.
 15. Sand lightly between each succeeding enamel or varnish coat.

- B. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pre-treated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.
1. The number of coats required are the same regardless of application method. Do not apply succeeding coats until the previous coat has cured, as recommended by the manufacturer. If sanding is required to produce a smooth, even surface according to manufacturer's written instructions, sand between applications.
 - a. Apply each coat in film thicknesses as recommended by the manufacturer.
 2. Unless recommended by the manufacturer, omit primer on factory finished metal surfaces indicated to be field painted or metal surfaces that have been shop primed and touch-up painted.
 3. If undercoats, stains, or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance. Give special attention to ensure edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.
 4. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until paint has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure, and where application of another coat of paint does not cause the undercoat to lift or lose adhesion.
- C. Application Procedures: Apply paints and coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions.
1. Brushes: Use brushes best suited for the type of material applied. Use brush of appropriate size for the surface or item being painted.
 2. Rollers: Use rollers of carpet, velvet back, or high-pile sheep's wool, as recommended by the manufacturer for the material and texture required.
 3. Spray Equipment: Use airless spray equipment with orifice size and pressure, as recommended by the manufacturer for the material and texture required.
- D. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate. Provide the total dry film thickness of each coat and of the entire system as recommended by the manufacturer.

3.4 FINISHING MECHANICAL AND ELECTRICAL EQUIPMENT

- A. Electrical and mechanical items to be painted include the following, whether factory prefinished or not, with color selected by the ENGINEER:
1. Exterior mechanical and electrical equipment and accessories including, but not limited to, the following:
 - a. Electrical and instrument panels, motor control centers, and switch gear.
 - b. Electrical conduit and accessories.
 - c. Transformers.

- d. Brackets.
 - e. Meter enclosures.
 - f. Conduit.
 - g. Components that are visible or exposed to the weather.
 - h. Exhaust fans and blowers.
 - 2. Exterior roof mounted mechanical and electrical equipment, any component of which is above adjacent parapets, including but not limited to, the following:
 - a. Roof mounted HVAC units.
 - b. Exhaust stacks, blowers, vents, etc.
 - c. Miscellaneous steel support components for mechanical equipment screens.
- B. Paint interior factory finished mechanical and electrical components selected by the ENGINEER from the manufacturer's standards, including, but not limited to, the following:
- 1. Piping (per color code and schedule), pipe hangers, and supports.
 - 2. Duct work.
 - 3. Duct throats behind grilles, registers, louvers, baffles, etc., shall be given one coat of flat acrylic latex (copolymer) black paint wherever visibility of the interior of the duct is allowed.
 - 4. Switchboards.
 - 5. Disconnect switches.
 - 6. Pumps, motors, and mechanical equipment.
 - 7. Gear reducers.
 - 8. Accessory items.
 - 9. Conduit and fittings (per color code and schedule).
 - 10. Switchgear.
 - 11. Panelboards.
- C. Block Fillers: Apply block fillers to concrete masonry block at a rate to ensure complete coverage with pores filled.
- D. Prime Coats: Before applying finish coats, apply a prime coat of material, as recommended by the manufacturer, to material that is required to be painted or finished and that has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn through or other defects due to insufficient sealing.
- E. Pigmented (Opaque) Finishes: Completely cover surfaces as necessary to provide a smooth, opaque surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.

- F. Transparent (Clear) Finishes: Use multiple coats to produce a glass smooth surface film of even luster. Provide a finish free of laps, runs, cloudiness, color irregularity, brush marks, orange peel, nail holes, or other surface imperfections.
- G. Provide satin finish for final coats.
- H. Stipple Enamel Finish: Roll and redistribute paint to an even and fine texture. Leave no evidence of rolling, such as laps, irregularity in texture, skid marks, or other surface imperfections.
- I. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
- J. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.
- K. Paint both sides and edges of plywood backboards for electrical equipment before installing backboards and mounting equipment on them.
- L. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with requirements.

3.5 FINISHING PROCESS EQUIPMENT AND FACILITIES

- A. The following process equipment and facilities shall be painted according to this Specification, including, but not limited to, the following:
 - 1. Headworks Building: Paint control panels, disconnects, transmitters, all new above ground, buried, and immersed piping and fittings, all new valves, pipe supports, exposed ductwork, interior CMU walls, gypsum board walls and ceilings, ladders, hollow metal doors and frames, etc.
 - 2. Headworks odor control scrubber: Paint all new above ground, buried, and immersed piping and fittings, all new valves, and pipe supports, etc.
 - 3. Chemical storage and containment area: Paint new above ground, buried and immersed piping and fittings, all new valves and pipe supports, chemical metering pumps and appurtenances, etc.

3.6 CLEANING

- A. Cleanup: At the end of each workday, remove empty cans, rags, rubbish, and other discarded paint materials from the site.
 - 1. After completing painting, clean glass and paint-spattered surfaces. Remove spattered paint by washing and scraping. Be careful not to scratch or damage adjacent finished surfaces.

3.7 PROTECTION

- A. Protect work of other trades, whether being painted or not, against damage by painting. Correct damage by cleaning, repairing, or replacing and repainting, as approved by ENGINEER.
- B. Provide "Wet Paint" signs to protect newly painted finishes. Remove temporary protective wrappings provided by others to protect their work after completing painting operations.
 - 1. At completion of construction activities of other trades, touch-up and restore damaged or defaced painted surfaces. Comply with procedures specified in PDCA P1.

3.8 FIELD QUALITY CONTROL

- A. CONTRACTOR shall provide a written report from the manufacturer certifying that paint has been applied in accordance with the manufacturer's requirements
- B. Provide ENGINEER with suitable testing materials in order for ENGINEER to carry out alkalinity and moisture tests prior to preparation and application.
- C. Provide ENGINEER with the following testing equipment, accurately calibrated, for use by the ENGINEER prior to surface preparation and application.
 - 1. Tinker and Razor Model M-1, K-D "Bird Dog", or equal, holiday detector, complete with necessary accessories.
 - 2. Microtest, Elcometer, or equal, magnetic dry film thickness gauge.
 - 3. Wet mil paint gauge for use during application.
- D. The ENGINEER reserves the right to test surfaces, film thicknesses, and paint products at any time and as often as the ENGINEER deems necessary during the period when paint is being applied.
 - 1. Any spot measurement found below the required minimum dry film thickness shall be repainted by the CONTRACTOR in accordance with the manufacturer's instructions, at no additional cost to the OWNER.
 - 2. Do not paint unsatisfactory surfaces until they have been corrected and are in accordance with paint manufacturer's recommendations.

3.9 PIPE COLOR CODING AND IDENTIFICATION SCHEDULE

- A. Install plastic pipe markers in accordance with manufacturer's instructions.
- B. Install tags with corrosion resistance chain.
- C. Locate identification markers and tags at the following locations:
 - 1. At each branch and riser takeoff.
 - a. At each pipe passage through a wall, floor, or ceiling.
 - b. On each horizontal and vertical pipe run at 25 foot intervals.

- D. Exposed, non-submerged, interior piping shall be color coded and provided with identification markers as follows, unless directed otherwise by the ENGINEER:

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

- E. Exposed piping, as defined earlier in this Specification, shall be color coded as listed above, except submerged pipes and pipes less than 3/8-inch diameter shall be painted the same as the wall or piece of equipment to which it is attached.
- F. Positive identification of the contents of a piping system shall be lettered legibly, giving the name of the contents in full or abbreviated form at no greater than 25 foot intervals between markings. Arrows shall be used to indicate direction of flow at no greater than 10 foot intervals. Contents shall be identified by additional details required by the ENGINEER, such as temperature, pressure, etc., as necessary to identify the hazard.
- G. Legend shall be brief and applied close to valves or flanges and adjacent to changes in direction, branches, and where pipes pass through walls or floors.
- H. Where two or more pipes run parallel, markings shall be applied in the same relative location on each as to be in vertical or horizontal line and present a neat appearance.

- I. In case a pipe is in such location that it can be seen only from one direction, such as pipes near a wall, two sets of the code designation shall be applied at each location, placed in two visible quadrants with respect to normal viewing positions.

Minimum Letter Sizes	
O.D. of Pipe (inches)	Height of Letters (inches)
3/4 - 1-1/4	1/2
1-1/2 - 2	3/4
2-1/2 - 6	1-1/4
8 - 10	2-1/2
Over 10	3-1/2

END OF SECTION

SECTION 11295
HYDRAULIC VALVES

PART 1 - GENERAL

1.1 SUMMARY

- A. Furnish and install all valves and valve accessories for water, non-potable water, wastewater, air, as indicated in the Drawings, as listed at the end of this Section, and as specified herein, including all appurtenances required for a complete and operational installation.

1.2 SECTION INCLUDES

- A. Gate valves.
- B. Butterfly valves.
- C. Check valves.
- D. Ball valves.
- E. Mud Valves
- F. Air/Vacuum Relief Valves
- G. Solenoid Valves
- H. Pressure Reducing Valves
- I. Globe Valves
- J. Valve appurtenances.

1.3 RELATED SECTIONS

- A. Section 01300, Submittals.
- B. Section 01640, Materials and Equipment.
- C. Section 01650, Starting of Systems.
- D. Section 09900, Painting.
- E. Section 13447, Electric Motor Actuators.
- F. Section 15050, Piping Systems.

1.4 REFERENCES

- A. AWWA C500, Metal Seated Gate Valves For Water Supply Service.
- B. AWWA C504, Rubber Seated Butterfly Valves.
- C. AWWA C510, Double Check Valve Backflow Prevention Assembly.
- D. ASME B16.1, Gray Iron Pipe Flanges and Flanged Fittings.
- E. ASME B46.1, Surface Texture (Surface Roughness, Waviness, and Lay).
- F. ASME A126, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
- G. ASTM A269, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
- H. ASTM A48, Standard Specification for Gray Iron Castings.
- I. ASTM A536, Standard Specification for Ductile Iron Castings.
- J. ASTM A582, Standard Specification for Free-Machining Stainless Steel Bars.
- K. ASTM B271, Standard Specification for Copper-Base Alloy Centrifugal Castings.
- L. ASTM D429, Standard Test Methods for Rubber Property—Adhesion to Rigid Substrates.
- M. ASTM D1784, Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.
- N. ASTM F439, Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.
- O. All other applicable ASTM and ANSI Standards.

1.5 SUBMITTALS

- A. Descriptive submittals shall be made in accordance with the Data Reference Symbols defined in Section 01300, Submittals.
 - 1. All Valves: Shop Drawings and O&M Manuals:
 - a. Final Certified Drawings showing outline dimensions, foundation layout or mounting information, and other pertinent dimensions.
 - b. Field erection instructions, assembly drawings and/or diagrams, detailed reference drawing lists, lists of erection details, and list of spare parts supplied with equipment.
 - c. Shop Detail Drawings showing individual sub- assemblies and fabricated pieces with material specifications and other applicable data.

- d. Installation instructions, operating and/or service manuals, and all other data pertinent to operating or servicing the complete apparatus. Preventative maintenance instructions and recommended frequency.
 - e. General bulletins and catalog cuts describing complete apparatus, including operating principles and fundamentals.
 - f. Service data sheets showing design performance, utility requirements, etc., as applicable to the specific duty for which the equipment is furnished.
 - g. Materials of construction of all components.
 - h. Renewal parts list with diagrammatic or cross-section drawings showing part identification. Material analysis or trades designation for each significant part is to be noted on parts lists or on a separate sheet.
 - i. Stuffing box sizes; packing sizes; specifications and arrangement; and mechanical seal details, specifications, etc., if furnished in equipment.
 - j. Bearing manufacturer's standard identification and/or interchangeable number for all anti-friction bearings in the equipment proper and its accessory items.
- B. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
- C. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**

PART 2 - PRODUCTS

2.1 GENERAL

- A. All buried valves shall be provided with a valve box and extension stem.

2.2 GATE VALVES

A. Cast Iron Gate Valves:

1. Gate valves shall conform to AWWA C509, 200 psi working pressure, resilient seated, iron body, bronze mounted, non-rising stem. All valves shall have an opening direction of counter-clockwise. All gate valves shall be as manufactured by Mueller Company, American Flow Control; or approved equal.
2. All above ground gate valves shall have handwheel/lever/t-handle geared operators or electric actuators as specified in the Equipment Schedule or as shown on the Drawings. All buried valves shall be equipped with valve box and extension stem per City of Chandler standard details and either a handwheel and pedestal, actuator and pedestal, or with operating nut as specified in the Equipment Schedule or as shown on the Drawings. Valves specified with an operating nut shall be installed with a ground level valve position indicator. Valves with actuators shall have sealed geared actuators with extension stems and torque tubes.
3. Valves will be provided with torque tube pedestal assemblies where pedestals are indicated on the Plans. Assemblies shall consist of a torque tube and a pedestal. Torque tubes shall be designed for a maximum deflection of no more than 0.75 degrees when measured at the disc edge. The pedestal shall be made of high strength cast iron and shall support the full weight of the torque tube by use of corrosion resistant thrust bearings located in the pedestal. Design of a torque tube shall allow ± 2 -inches of free movement along the tube longitudinal axis. Pedestal shall have a height of 3 feet above the operating floor. Torque tube floorstand assemblies shall be factory assembled and shipped as integral units. For buried valves with actuators, the actuators shall be located on pedestals with overriding handwheel. See Section 13447, Electric Motor Actuators, for Actuator Specifications.

2.3 BUTTERFLY VALVES

A. Butterfly valves – AWWA C504

1. Butterfly valves shall be tight-closing, rubber-seat type with rubber seats that are securely fastened to the valve body or valve disc. No metal-to-metal seating surfaces shall be permitted. Valves shall be bubble-tight at rated pressures with flow in either direction and shall be satisfactory for applications involving valve operation after long periods of inactivity. Valve disc shall rotate 90 degrees from the full open position to the tight shut position. The handwheel operators shall be traveling nut, self-locking type and shall be designed to hold the valve in any intermediate position between fully open and fully closed without creeping or fluttering. Valve operators shall be equipped with mechanical stop-limiting devices to prevent over-travel of the disc in the open and closed positions. Valves shall close with a clockwise rotation. Operators shall conform to the requirements of AWWA C504.

2. Valve bodies shall be constructed of cast iron ASTM A48, Class 40, or ASTM A126, Class B. Two trunnions for shaft bearings shall be integral with each valve body. Minimum body shell thicknesses shall be in strict accordance with AWWA Standard C504.
3. Valve disc shall be constructed of ductile iron ASTM A536, Grade 65-45-12, or cast iron ASTM A48, Class C.
4. Shafts of all valves shall be turned, ground, and polished. Valve shafts shall be constructed of 18-8 Type 316 stainless steel. Shaft diameters must meet minimum requirements established by AWWA Standard C504 for Class 150B.
5. Valve seats shall be Buna-N for water and EPDM for air service at conditions up to 250° F. Valves shall have seats that are bonded or mechanically retained to the valve body or valve disc.
6. Valves shall be fitted with sleeve-type bearings. Bearings shall be corrosion resistant and self-lubricating. Bearing load shall not exceed 20% of the compressive strength of the bearing or shaft material. Bearings shall be high temperature for air valves.
7. Packing shall be Chevron V-type adjustable for above ground service and non-adjustable wear compensating for submerged or buried service.
8. Valves will be provided with torque tube pedestal assemblies where indicated on the Plans. Assemblies shall consist of a torque tube extension or a pedestal. Torque tubes shall be designed for a maximum deflection of no more than 0.75 degrees when measured at the disc edge. The pedestal shall be made of high strength cast iron and shall support the full weight of the extension rod by use of corrosion resistant thrust bearings located in the pedestal. Torque tube shall be made of carbon steel. Design of a torque tube shall allow ± 2 -inches of free movement along the tube longitudinal axis. Pedestal or torque tube extension shall have a height of 3 feet above the operating floor. Torque tube or pedestal assemblies shall be factory assembled as integral units where applicable.
9. All above ground butterfly valves shall have handwheel/lever/t-handle geared operators or electric actuators as specified in the Equipment Schedule or as shown on the Drawings. All buried valves shall be equipped with valve box and extension stem per City of Chandler standard details and either a handwheel and pedestal, actuator and pedestal, or with operating nut, as specified in the Equipment Schedule or as shown on the Drawings. Valves specified with an operating nut shall be installed with a ground level valve position indicator.
10. All buried butterfly valves shall be side mounted with a buried service gear operator and extended nut as specified in this Section.
11. Certified Drawing and Material Specifications shall be furnished by the manufacturer through the CONTRACTOR covering all items included in Sections 1 and 2 of AWWA C504. Butterfly valves shall be as manufactured by Bray, DeZurik, Henry Pratt Company, Mueller, Val-Matic, or equal.

2.4 CHECK VALVES

A. CPVC and PVC Ball Check Valves (CKB):

1. Ball check valves shall be self-contained, straight-through designed, automatic valves which prevent reversal of flow direction. Ball check valves shall ensure a positive seal to prevent reversal of flow, with extremely low back pressure.
 2. Ball shall be supported by a system of guide ribs to full flow with minimum turbulence and chatter.
 3. Valves shall be able to operate in horizontal and vertical position and shall be thermoplastic construction in PVC. Valves shall contain Viton O-ring seals. Valves shall be 150 psi at 75° F.
 4. Ball check valves shall be as manufactured by Watts Regulator or approved equal.
- B. CPVC Spring Loaded Ball Check Valves (SCKB):
1. Spring loaded ball check valves shall be self-contained, straight-through designed, automatic valves which prevent reversal of flow direction. Spring loaded ball check valves shall ensure a positive seal to prevent reversal of flow, with extremely low back pressure.
 2. Ball shall be supported by a system of guide ribs to full flow with minimum turbulence and chatter.
 3. Valves shall be able to operate in horizontal and vertical position and shall be thermoplastic construction in PVC. Valves shall contain Viton O-ring seals. Valves shall be 150 psi at 75° F.
 4. Product and Manufacturer (Manufacturers listed in alphabetical order):
 - a. Heflin-Harrington,
 - b. Ryan Herco.,
 - c. Or approved equal.
- C. Swing Check Valves (CKS):
1. Swing check valves shall be of the spring-loaded, non-slamming type. Swing check valves for wastewater or sludge pumping shall be designed to operate in the horizontal position. Valves shall have manual spring-loaded operators outside the valve body for backflushing.
 2. All materials of construction shall be certified in writing to conform to ASTM Specifications as follows:
 - a. Body, Cover: Cast iron, ASTM A126, Grade B.
 - b. Disc, Disc Arm: Ductile iron, ASTM A536.
 - c. Seat: Stainless steel, ASTM B148.
 - d. Disc Seat: Buna-N.
 - e. Pivot Shaft: Stainless steel, Type 17-4 PH.
 3. Product and Manufacturer (Manufacturers listed in alphabetical order):
 - a. Series 6000 CLS, as manufactured by APCO,
 - b. Or approved equal.

2.5 BALL VALVES

A. CPVC Ball Valves:

1. Ball valves shall be constructed of chlorinated polyvinyl chloride conforming to ASTM F439 and ASTM D1784. Valves shall be true union with Viton seals and locked in Teflon seat carrier. Operation shall be 1/4 turn from full open to full closed with the hand lever parallel to flow in the full open position. Valves shall be rated at 200 psi at 70° F.
2. Product and Manufacturer (Manufacturers listed in alphabetical order):
 - a. Heflin-Harrington,
 - b. Ryan Herco.,
 - c. Spears
 - d. Or approved equal.

2.6 AIR/VACUUM RELIEF VALVES

- A. The air/vacuum valve allows large volumes of air to escape out the large orifice when filling a pipeline and closes when liquid enters the air and vacuum valve. During the large orifice closure, the small air release orifice will open to allow small pockets of air to escape automatically and independently of the large orifice through an attached air release valve.
- B. The large orifice shall also allow large volumes of air to enter during pipeline drainage to break the vacuum. The body inlet must be dampened to protect the lower float from direct forces of rushing air and water and to prevent premature valve shut-off causing water hammer in the air and vacuum valve. The floats shall be heavy stainless steel, hermetically sealed, designed to withstand 1,000 psi. The top plug or float shall be center guided through hex bushings for positive shut-off.
- C. The main valve parts shall be a body, cover, baffle, float, and seat. The baffle shall shield the float from direct impact of air and water to prevent premature float closure. The seat shall slip fit into the baffle or cover and lock in place without any distortion.
- D. The entire float and baffle assembly must be shrouded with a water diffuser to prevent water from slamming the float shut. Outlets shall be threaded.
- E. Materials of Construction shall be as follows:
 1. Air and Vacuum Valve Body, Cover: 316 SST.
 2. Float: Polypropylene.
 3. Seat: Buna-N.
- F. Product and Manufacturer (Manufacturers listed in alphabetical order):
 1. ARI Model D-26 (with low pressure seal option) for RAS pumps,
 2. ARI Model D-025 L NS for WAS pumps,
 3. Or approved equal.

2.7 SOLENOID VALVES

- A. 2-way solenoid valves:
 - 1. Manufacturers: One of the following or equal (manufacturers listed in alphabetical order)
 - a. Automatic Switch Company, Series 8210.
 - b. Skinner Electric Valve Division, Series C.
- B. Design:
 - 1. Valves: Suitable for service under the following conditions:
 - a. Fluid: Reclaimed water.
 - b. Temperature of fluid: 80 degrees Fahrenheit.
 - c. Piping test pressure: 100 pounds per square inch gauge.
 - 2. Unless otherwise indicated on the Drawings, provide valves that:
 - a. Minimum NEMA Type 4 enclosure.
 - b. 120 VAC operation.
 - c. Suitable for use as indicated on the Drawings.
 - d. Minimum Class F coil insulation.
 - e. Normally closed
 - 3. 2-way valves: Furnish with openings of size equal to or larger than the nominal size designation of the valve.
 - 4. Furnish with manual/bypass operators.
- C. Materials:
 - 1. Body: Type 316 Stainless Steel.
 - 2. Seats: Resilient material.

2.8 PRESSURE REDUCING VALVES

- A. Manufacturers: One of the following or equal (manufacturers listed in alphabetical order)
 - 1. Watts Regulator, Series 223.
 - 2. Wilkins, 500 Series.
- B. Direct operated, single seat type pressure reducing valve.
- C. Materials:
 - 1. Body and spring cover: Bronze.
 - 2. Valve seat: Series 300 stainless steel.
 - 3. Diaphragm: Buna Nitrile.
 - 4. Disk: Buna Nitrile.

2.9 GLOBE VALVES

- A. Manufacturers: One of the following or equal (manufacturers listed in alphabetical order)
 - 1. Crane, No. 1 Globe.
 - 2. Lunkenheim Company, Figure 2140 Globe.

- B. Design:
1. Size and configuration: Indicated in the Drawings.
 2. Valves: Class 125 threaded ends, rated for 250 degrees Fahrenheit at pressure of 170 psi

2.10 VALVE APPURTENANCES

- A. Extension Stems, Stem Guides, Wrenches, and Keys:
1. Provide intermediate stem guide for extensions more than 7 feet long.
 2. Stem brackets and guides shall be made of cast iron and have fully adjustable bronzed bushed guide block. Fasten brackets to walls with approved expansion bolts.
 3. Operating nuts about 2-inches square shall be included with each extension stem and located in floor box or grating recess, as required.
 4. Provide operating key or wrench of suitable length and size for each valve that is not readily accessible to direct operation.
- B. Floor Boxes: Provide cast iron floor boxes for all valves which are to be operated from floor above valve. Boxes shall be equal in depth to floor slab. Boxes shall have cast iron covers and shall be fitted with bronze bushing.
- C. Valve Boxes: Provide each buried valve with a valve box as follows:
1. Made of heavy pattern cast iron construction with two-piece adjustable telescoping type.
 2. Lower section shall enclose operating nut and stuffing box and rest on bonnet.
 3. Inside diameter shall be at least 4-1/2-inches.
 4. Provide extension stem and operating nut.
 5. Cover shall be heavy-duty cast iron with direction to open arrow cast in.
 6. Provide ground level valve position indicator for all buried valves.

2.11 SHOP PAINTING

- A. The manufacturer shall paint all PVC valves to be installed in exterior exposure as follows:
1. Surface Preparation: Clean, dry, and free of contaminants.
 2. Prime Coat: Series 66 H.B Epoxoline; one coat, 3-5 mils DFT.
 3. CONTRACTOR shall determine the quantity of each type of valve to the manufacturer.
 4. CONTRACTOR shall provide finished coat per Section 09900, Painting. Final color selection shall be approved by ENGINEER prior to application.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Workmanship shall be of the highest grade throughout and in accordance with the best standard practice for this type of equipment.
- B. Valves of the various types and pattern shall be installed at the respective locations as shown on the Drawings, listed in the Equipment Schedule, and specified herein. All appurtenances required for operation and control of the valves shall be included. Joints and connections shall be made in accordance with applicable requirements for pipe line or pipe joints. Valve stems shall be plumb and vertical unless otherwise specifically shown. Each valve shall be adjusted for smooth and easy operation and shall be watertight when placed in operation under maximum working pressure.

3.2 MANUFACTURER'S FIELD SERVICE

- A. Equipment Start-up: A factory trained representative of the manufacturer shall visit the site and provide installation and start-up services as specified in Section 01650, Starting of Systems. Sales representatives shall not be acceptable to perform start-up and training functions.
- B. Training: A factory employed representative of the manufacturer shall visit the site and provide operator training services, in addition to equipment start-up services, as specified in Section 01650, Starting of Systems.

END OF SECTION

SECTION 11314

END SUCTION CENTRIFUGAL PUMPS

PART 1 - GENERAL

1.1 SUMMARY

- A. The CONTRACTOR shall provide all labor, materials, equipment, and incidentals required to furnish and install end suction centrifugal pumps complete and operational with motors, control equipment, and accessories as shown on the Drawings and as specified. The pumps furnished and installed in accordance with this Section, shall include five end suction centrifugal pumps for the membrane system Permeate Pumps and two end suction centrifugal pumps for the membrane system Clean-In-Place (CIP) Pumps. The Process and CIP Pumps shall have NSF certification.

1.2 REFERENCES

- A. Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
 - 1. Antifriction Bearing Manufacturers Association (AFBMA).
 - 2. National Electric Code (NEC).
 - 3. American National Standards Institute (ANSI).
 - 4. American Society for Testing and Materials (ASTM).
 - 5. Underwriters Laboratories, Inc. (UL).
 - 6. American National Standards Institute/Hydraulic Institute (ANSI/HI).

1.3 SYSTEM DESCRIPTION

- A. Five Permeate pumps and two CIP pumps shall be installed as shown in the Drawings. Each pump shall be mounted on a structural steel horizontal base atop a concrete equipment pad and secured with anchor bolts in accordance with the manufacturer's recommendations and as shown on the Drawings.
- B. Pumps shall be heavy-duty, end suction centrifugal pump units designed, constructed, and installed for the service intended.
- C. Provide reducers as necessary to ensure pump locations, pipe locations, and pipe sizes are as shown on the Drawings. If reducers affect pump locations, pipe locations, or pipe sizes, the CONTRACTOR shall notify the ENGINEER before construction of the pump station proceeds.

1.4 PUMP DESIGN CRITERIA

A. All end suction centrifugal pumps shall meet the below criteria:

Service	Permeate Pump	CIP Pump
Quantity	5	2
Rated Design Flow (gpm)	3,407	3,079
Rated Design Head (feet)	50	11
Minimum Overall Efficiency (%)	81	80
Maximum Motor Horsepower	60	15
Maximum Speed	900	900
Voltage	460	460
Power Phases	3	3
Power Frequency (Hz)	60	60
Discharge Flow Diameters	12	14
Suction Flow Diameter	14	14

1.5 SUBMITTALS

- A. Shop Drawings: Submit for approval the following:
1. Letters of Certification of Compliance on materials, equipment, etc.
 2. Final Certified Drawings showing outline dimensions, foundation layout, or mounting information, and other pertinent dimensions.
 3. Assembly drawings and/or diagrams, detailed reference drawing lists, and lists of erection details.
 4. Shop Detail Drawings showing individual sub-assemblies and fabricated pieces with material specifications and other applicable data.
 5. Installation instructions, operating and/or service manuals, and all other data pertinent to operating or servicing the complete apparatus. Preventative maintenance instructions and recommended frequency.
 6. Schematic and wiring diagrams of power, control, and piping systems. A detailed description of operation shall be included for each diagram to describe all modes of operation of the system indicated. Where the integrated system requires interlocking and control of other components in

normal operation, these components shall be included in the description of operation.

7. General bulletins and product literature describing complete apparatus including operating principles and fundamentals.
8. Service data sheets showing design performance, utility requirements, etc., as applicable to the specific duty for which the equipment is furnished.
9. Head capacity curves for pumps. Impeller size furnished and maximum size available shall be noted on these data sheets.
10. Curves and/or data for overall range of operation from minimum to maximum capacity or load, showing capacity or load, utilities motive medium required, total or incremental differential head, and other pertinent information applicable to the equipment or its component assemblies.
11. Materials of construction of all components.
12. Renewal parts list with diagrammatic or cross-section drawings showing part identification. Material analysis or trades designation for each significant part is to be noted on parts lists or on a separate sheet.
13. Mechanical seal details, specifications, etc., bearing manufacturer's standard identification and/or interchangeable number for all anti-friction bearings in the equipment proper and its accessory items.

B. Shop Tests: Submit for approval:

1. Pump casings shall be hydrostatically tested to twice the discharge head or 1-1/2 times the shutoff head, whichever is greater.
2. Running Test: Pump assembly shall be operated from zero to maximum capacity as shown on the approved curve. Results of the test shall be shown in a plot of test curves showing head, flow, horsepower, efficiency, and current. Readings shall be taken at rated speed capacity points including shut-off, design point, and minimum head for which pump is designed to operate.
3. Each test shall be witnessed by the Factory Registered Engineer, who is an employee of the pump manufacturer. Engineer shall sign and seal all copies of curves and shall certify that hydrostatic tests were performed. Tests shall be conducted in conformance with applicable Hydraulic Institute Standards.
4. Pumps shall not be shipped until the ENGINEER has approved the test reports.

C. Field Test Results:

1. Submit a written report giving the results of the required field tests.

D. Manufacturer's Reports:

1. Submit written report of the results of each visit by a manufacturer's serviceman, including purpose and time of visit, tasks performed, and results obtained.

E. Operation and Maintenance Manuals: Submit complete Operation and Maintenance Manuals, including field erection instructions, in conformance with the Operation and Maintenance Manuals Section of Section 01300, Submittals.

- F. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
- G. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**

1.6 QUALITY ASSURANCE

- A. Manufacturers regularly engaged in the manufacture of the centrifugal pump equipment, as specified herein, and who can demonstrate equipment of this specified design, in actual service for not less than five years will be considered as acceptable manufacturers. All like items shall be furnished by one manufacturer to ensure uniformity and interchangeability of parts. Manufacturer shall guarantee all equipment furnished as per the warranty stated below; however, this shall not be construed as relieving the CONTRACTOR from his responsibility for the proper installation and functioning of the Work.
- B. Require pump manufacturer to furnish and coordinate pump, driver, drive, and pump components as specified and scheduled below and to provide written installation and check out requirements.
- C. Manufacturer shall have five installations of same size equipment in same application within the last five years in the United States. Manufacturer to submit installation information, including size, location, and a total of three operator contact names and operator phone numbers with the Submittals.
- D. Complete assemblies, including motor, all accessories shall be listed and approved by OSHA, UL, and NSF where applicable.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to the site to ensure uninterrupted progress of the Work. Deliver anchor bolts and anchorage devices, which are to be embedded in cast-in-place concrete, in ample time so as not to delay that Work.
- B. Store materials to permit easy access for inspection and identification. Keep steel members off the ground using pallets, platforms, and other supports. Protect steel members and packaged materials from corrosion and deterioration.
- C. Store mechanical equipment in covered storage off the ground and prevent condensation.

1.8 WARRANTY

- A. The pump manufacturer shall warrant the units being supplied to the OWNER against defects in workmanship and material for a period of 12 months from substantial completion. The warranty shall cover parts and labor and shall be in printed form. The warranty shall apply to all similar units.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Pumps (listed in alphabetical order):
 - 1. Flowserve
 - 2. ITT Goulds
 - 3. Or approved equal.
- B. The naming of a manufacturer in this Specification is not an indication that the manufacturer's standard equipment is acceptable in lieu of the specified component features. Naming is only an indication that the manufacturer may have the capability of engineering and supplying a system as specified.

2.2 PUMP COMPONENTS

- A. Pump Construction:
 - 1. Each pump shall be designed for clockwise rotation when viewed from motor end and include the following design features.
 - a. Pump End Components:
 - 1) Casing: The pump casing shall be concentric volute, diffuser, type, back pull-out design with flanged suction and discharge connections. The Permeate Pump casing shall be constructed of cast iron. The CIP Pump casing shall be Duplex stainless steel type CD4MCuN. The pump discharge shall be center line oriented to allow simplified system design and installation. Pump casing

vent/fill and drain shall be provided with stainless steel plugs. Wetted pump materials shall be NSF certified.

- 2) Floating Suction O-ring: The pump shall be provided with easily replaceable suction O-ring and be lubricated and self-aligning to maintain maximum pump efficiency without adjustments of impeller clearances.
- 3) Impeller: The impeller shall be of the balanced non-clogging type made of Duplex stainless steel (CD4MCuN). It shall be of one-piece construction, single suction, enclosed or open taper cut, radial flow design with well-rounded leading vanes.
- 4) Seal Housing: The seal housing shall be a self-flushing design, and shall hold the stationary seat of the mechanical shaft seal. The Permeate Pump stuffing box shall be cast iron and the CIP Pump stuffing box shall be Duplex stainless steel. The seal housing shall be clamped in place over a machined fit on the motor adapter to maintain component alignment and O-ring sealed to insure against leakage.
- 5) Mechanical Seal: The pump shaft seal shall be a John Crane Type 21 as standard, constructed of the following materials:
 - a) Seal Type: Standard.
 - b) Stationary Face: Sil-Carb.
 - c) Rotary: Carbon.
 - d) Elastomers: Viton.
 - e) Metal Components: 316 stainless steel.

B. Motor:

1. The motor shall be TEFC premium efficiency, designed for continuous duty at 50° C, capable of sustaining a minimum of 15 starts per hour with a minimum service factor of 1.15. The close coupled motor shall be a wash down type. Overload protection must be provided. See Section 16225, Electric Motors 250 Horsepower or Less, for motor specifications.

C. Control:

1. Provide the necessary control devices and equipment for the control of each pump in accordance with Section 17454, Operations and Control Descriptions. The CONTRACTOR shall be responsible for control panels as shown on the Drawings.

2.3 SPARE PARTS

A. Each type and size of pump shall be furnished with the following spare parts, carefully boxed or packaged and plainly marked for reordering:

1. One set of gaskets.
2. One set of special tools required for maintenance or operation.
3. One set of mechanical seals.

- B. CONTRACTOR shall store and safeguard spare parts until completion of the Work, at which time they shall be inventoried, delivered, and placed in an area designated by the OWNER.

2.4 PUMP SHOP PAINTING

- A. The manufacturer shall paint the pumps as follows:
 - 1. Pumps, motors, drives, frames, baseplates, appurtenances, etc., shall receive shop primer and shop finish coating conforming to the requirements of Section 09900, Painting. If any damage to the paint system occurs, the equipment shall be repainted as directed by the ENGINEER.
 - 2. All gears, bearing surfaces, machined surfaces, and other surfaces which are to remain unpainted shall receive a heavy application of grease or other rust-resistant coating. This coating shall be maintained during storage and until the equipment is placed into operation.
 - 3. CONTRACTOR shall provide finished coat per Section 09900, Painting. Final color selection shall be approved by ENGINEER prior to application.
 - 4. CONTRACTOR shall certify, in writing, that the shop primer and shop finish coating system conforms to the requirements of Section 09900, Painting.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. The pumps and accessories shall be installed in accordance with the manufacturer's recommendations and approved Shop Drawings.
- B. All pumps shall be installed on concrete equipment pads and secured with anchor bolts in accordance with the manufacturer's recommendations and as shown on the Drawings. Supplier shall design anchor bolts and shall provide location for anchor bolts. Anchor bolts for equipment will be provided and installed by CMAR. Pump bases shall be grout-filled for vibration and noise control.
- C. Piping shall be supported independent of the pumps.
- D. Using laser alignment, check and align all pump, motor, and flexible shafting.

3.2 MANUFACTURERS' FIELD SERVICE

- A. Equipment Start-up: A factory employed representative of the manufacturer shall visit the site and provide installation and start-up services as specified in Section 01650, Starting of Systems.
- B. Training: A factory employed representative of the manufacturer shall visit the site and provide eight hours of operator training services, in addition to equipment start-up services, as specified in Section 01650, Starting of Systems.

END OF SECTION

SECTION 11371

POSITIVE DISPLACEMENT BLOWERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Furnish and install two (2) skid-mounted positive displacement blowers for the Membrane Air Scour System. The skid mounted units shall have integral piping for all equipment, discharge isolation butterfly valves, check valves, relief valves, silencers, expansion joints, air filters, and all appurtenances required to construct complete and operable positive displacement blower systems, as shown on the Plans and specified herein.
- B. Furnish and install two acoustical noise enclosures.

1.2 SECTION INCLUDES

- A. Membrane Air Scour System Blowers: Two units.

1.3 RELATED SECTIONS

- A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions, apply to this Section.
- B. Section 01300, Submittals.
- C. Section 01640, Materials and Equipment.
- D. Section 01650, Starting of Systems.
- E. Section 09900 - Painting.
- F. Section 11295 – Hydraulic Valves.
- G. Section 15260 - Piping Insulation.
- H. Section 16195 - Electrical Identification.
- I. Section 16161 - Control Panels.
- J. Section 16225 - Electric Motors 250 Horsepower or Less.
- K. Section 16485 - Variable Frequency Drives - Low Voltage.

1.4 REFERENCES

- A. American Iron and Steel Institute (AISI).
- B. American National Standards Institute (ANSI).
- C. American Society for Testing Materials (ASTM).
 - 1. A48, Standard Specification for Gray Iron Casting.

1.5 SUBMITTALS

- A. Submit for approval the following:
 - 1. Letters of Certification of Compliance on materials, equipment, etc.
 - 2. Field erection instructions, diagrams, lists of erection details, and list of items to be repaired. The formal test protocol for use during performance testing, if required.
 - 3. Schematic and wiring diagrams of power, control, and piping systems with all devices, terminals, and wires uniquely numbered. Clearly indicate between factory and field wiring. All field wiring shall be terminated on labeled terminal blocks. A detailed description of operation shall be included for each diagram to describe all modes of operation of the system indicated. Where the integrated system requires interlocking and control of other components in normal operation, these components shall be included in the description of operation.
 - 4. General bulletins and catalog cuts describing complete apparatus, including operating principles and fundamentals.
 - 5. Renewal parts list with diagrammatic or cross-section drawings showing part identification. Material analysis or trades designation for each significant part is to be noted on parts lists or on a separate sheet.
 - 6. Recommended list of spare parts and safety equipment along with price and ordering information. Spare parts and safety equipment at a minimum shall include the equipment listed in Paragraph 2.3 of this Specification.
 - 7. Positive displacement blowers manufacturer on-site factory-trained representative's complete signed report of results of the inspection, operation, adjustments, and tests. Include the manufacturer's certificate that equipment is ready for permanent operation, and that nothing in installation will render manufacturer's warranty null and void.
 - 8. Operation and Maintenance data shall be submitted per Section 01300, Submittals.
 - 9. All equipment manufacturers shall submit evidence of conformance with the Specifications as required by the individual Specification Sections.
- B. Shop Drawings: Submit for approval the following:
 - 1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked

to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

2. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to the site to insure uninterrupted progress of the Work.
- B. Handle all blowers and associated equipment properly, in accordance with Manufacturer's recommendations. Equipment that is in anyway damaged will not be acceptable.
- C. Store materials to permit easy access for inspection and identification.
- D. Each blower must be stored and maintained in accordance with Manufacturer recommendation. CONTRACTOR is required to show proof of the proper storage and maintenance, which must be approved and verified by ENGINEER. Improper storage will result in replacement and service of the equipment at CONTRACTOR'S expense.

1.7 WARRANTY

- A. The manufacturer shall warrant, in writing that all equipment supplied by them shall be free from defects in material and workmanship, for a period of 12 months from the date of substantial completion, unless noted otherwise within the Specifications.

1.8 QUALITY ASSURANCE

- A. Manufacturer shall have a minimum of 5 years of experience manufacturing blower systems and shall show evidence of at least 5 installations in satisfactory operation for 5 years in similar environments and operating conditions.
- B. Supplies all accessories including motor.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. AERZEN.
- B. Naming of a manufacturer in the Specifications is not an indication that the manufacturer's proposed or standard equipment is acceptable in lieu of the specified components and features. Naming is only an indication that the manufacturer may have the capability of engineering and supplying a system as specified

2.2 DESIGN CRITERIA

- A. Positive Displacement Blower:
 - 1. Number of Blowers: 2 (1 duty, 1 standby).
 - 2. Rated Speed: 1,800 rpm, maximum.
 - 3. Rated Air Flow at Rated Speed: 3,000 scfm.
 - 4. Required Air Flow Range: 801 to 3,000 scfm.
 - 5. Inlet Piping Pressure: 0.20 pound per square inch.
 - 6. Rated Discharge Pressure: 2.8 to 5.7 psig.
 - 7. Rated Inlet Pressure: 14.1 psia
 - 8. Inlet Temperature: 25° to 110° Fahrenheit
 - 9. Inlet Humidity: 0% to 36%.
 - 10. Approximate Site Elevation: 1,190 feet above sea level.
- B. Motor: As specified in Section 16225, Electric Motors 250 Horsepower or Less, except as otherwise specified or supplemented below:
 - 1. Motor Power Supply: 480 volts, 3 phase, 60 hertz.
 - 2. Motor Horsepower: 150.
 - 3. Motor Speed, Maximum: 1,800 rpm.
 - 4. Motor Enclosure: TEFC.
 - 5. Motor Service Factor: 1.15 at altitude.
- C. Drive: Belt type automatic tension designed with a minimum 1.4 service factor based on motor horsepower.

- D. Noise control: Sound pressure levels radiated from equipment furnished shall not exceed 80 dBA (mean, A-weighted) at 3 feet (RE 2×10^{-5} N/m²) for free field condition when unit is in operation at the rated flow with the sound enclosure is in place.
- E. Provide control panel, instrumentation, and alarms as indicated on the P&ID Drawings and as specified in Section 17454.
- F. System operation: System operation shall be manual through a vendor supplied control panel.
- G. All components listed in this Section shall be mounted and piped (including instrument tubing and acoustical enclosure), by the blower equipment supplier.

2.3 MATERIALS

- A. General:
 - 1. Blower package: Complete with blower, motor, inlet and discharge silencers, valves, inlet filters, acoustic enclosure, instrumentation, controller, and appurtenances. Manufacturer to furnish all required lubrication and anchor bolts, including anchorage for acoustical enclosure.
 - 2. Blower rating: As specified above.
 - 3. Rotation direction of blower shall match requirements of piping.
- B. Blower and Drive:
 - 1. General:
 - a. Blower shall deliver oil-free air.
 - b. Blower and Motor Mounting: On common base.
 - c. Lifting Provisions: Lifting eyes on blowers, motors, and base so each major component or entire unit can be lifted.
 - d. Piping Connections: 125 pound class flanges meeting ANSI B16.1.
 - 2. Type: Positive displacement rotary blowers using 3 lobes to pressurize a trapped volume of air at a controlled rate prior to exposing it to a discharge pressure.
 - 3. Casing and head plates:
 - a. Blower casing: One piece with separate head plates and end covers.
 - b. Casing and head plates: Made of close-grained, machined cast iron.
 - c. End covers and head plates: Reinforced with bosses at penetrations with cast, machined support feet as required.
 - 4. Impellers:
 - a. Material: Ductile iron or cast iron.
 - b. Design: Straight, 3-lobe, involute type.
 - c. Balance: Statically and dynamically, by removing metal from impeller body.
 - d. Operation: Free of rubbing without need for liquid seals or lubrication.

- e. Timing: Positively by a pair of accurately machined, heat treated, alloy steel timing gears.
 - f. Shafts: Alloy steel forgings, pressed into each end of each impeller and pinned or one piece design.
 - g. Impeller assembly support: Anti-friction type bearings, sized for a minimum ABMA L-10 life of 100,000 hours.
 - h. Each impeller shall be of the stiff design with first lateral critical speed at least 120 percent of the maximum allowable operating speed.
5. Lubrication:
- a. Positive Oil Seal: Provided at each bearing.
 - b. Seal Design: Capable of preventing lubricant from leaking into air stream.
 - c. Vent Provisions: Capable of venting impeller side of oil seal to atmosphere while eliminating possible carryover of lubricant into air stream.
 - d. Drive-end bearings: Oil lubricated.
 - e. Timing gears and gear-end bearings: Splash oil lubricated.
 - f. Blowers shipment: With openings sealed after injection of rust inhibitor.

2.4 APPURTENANCES

- A. Inlet filter: 2-stage pleated media type, using replaceable pleated lofted fiber elements with final media efficiency of not less than 45 percent per ASHRAE Standard 52-76, or integral cleanable filter/silencer. Inlet filter to include resettable tell-tale Replace Filter indicator.
- B. Inlet and discharge silencers:
 - 1. Manufacturers: One of the following or equal:
 - a. Aerzen, equivalent product.
 - 2. Construction: Welded steel.
 - 3. Discharge silencer: Sized for flow and furnished with absorption material or other noise cancellation techniques as required.
 - 4. Silencers sizing: For design conditions and specifically designed for use with positive displacement blowers, size as indicated on the Drawings unless the manufacturer recommends a larger size.
 - 5. Mounting of silencers: Within acoustic enclosure and per manufacturer.
- C. Acoustic enclosure:
 - 1. General: Each blower shall be supplied with a sound enclosure covering the entire blower package including the drive motor. The sound enclosure must be designed for easy inspection and maintenance of all blower package components. The sound enclosure shall not interfere with this requirement and shall not require disassembly of the piping or use of tools to meet the aforementioned requirements. Operator shall not be required to reach over any component of the blower package to perform oil filling and draining. Panels shall be internally and externally powder coated. Sound enclosure acoustic material, as a minimum, shall comply with UL 94-HF1 for fire retardant, self-extinguishing, non-dripping materials. Materials with a lesser

rating are not acceptable. If used, non-flammable packing materials such as compressed mineral fibers are only acceptable if lined with appropriate retaining mat and supported by galvanized perforated sheet. The enclosure shall provide suitable protection for outdoor installation under the specified site conditions (seismic, wind load, and snow load). The enclosure and the blower package must both be mounted on a skid / oil-drip pan designed for meeting environment protection standards and for easy transportation and installation. A grounding strap shall be installed between the blower base and the package skid to bypass any vibration isolating mounts. Electrical components, instrumentation and instrument connections shall not be mounted or interface with moving panels of the sound enclosure.

2. Galvanized sheet-metal sandwich construction.
3. With noise attenuating walls and with ventilation openings ported, ducted, shielded, and lined with acoustic absorptive material as required to achieve specified noise levels.
4. Seismic structural calculations:
Submit seismic structural calculations in conformance with the following requirements:
 - a. Design spectral acceleration at short periods. $S_{DS} = 0.19$.
 - b. Design spectral acceleration at period of 1-second, $S_{D1} = 0.09$.
 - c. Risk Category: III
 - d. Component amplification factor, a_p = in accordance with ASCE 7, Tables 13.5-1 and 13.6-1.
 - e. Component response modification factor, R_p = in accordance with ASCE 7, Tables 13.5-1 and 13.6-1.
 - f. Component importance factor, I_p = in accordance with ASCE 7 Chapter 13.
 - g. Seismic Design Category: Category B.
 - h. The calculations shall be prepared and stamped by a structural engineer registered in the State of Arizona.
5. With ventilation system designed for not more than 10 degrees Fahrenheit air temperature rise with blower operating at maximum load.
6. With an enclosure ventilation air intake filter:
 - a. Of disposable, dry type, pleated lofted cotton and polyester fiber media construction, securely bonded to a welded galvanized wire backing, with a frame of heavy duty paperboard.
 - b. Sized for not more than 400 feet per minute face velocity.
 - c. With ASHRAE 52.2 cleaning efficiency of not less than 25 percent.
 - d. With thickness not less than 2 inches.
 - e. With an easily visible and resettable "replace filter" indicator with retained indication independent of blower on/off status.
7. With removable access panels located for maintenance and inspection access to the housed equipment, each weighing not more than 40 pounds, or hinge if weight exceeds 40 pounds.

D. Pressure relief valve:

1. Provide each blower with a pressure-relief valve sized to receive full blower capacity with 10 percent accumulation.
2. Suitable for use in the specified service and under specified conditions.
3. Field adjustable spring loaded and sized for full blower capacity.

E. Check valves:

1. Provide each blower with line-sized (minimum), heavy-duty, low-pressure drop, tight shutoff valve designed to prevent damage due to reverse rotation in the case of system pressure surge.
2. Suitable for use in the service specified and capable of providing a gastight seal upon closure with minimum pressure loss when opened.
3. Valve plates of aluminum, bronze, or other anti corrosion material and an EPDM flat full-contact seal. The valve shall be removable without disturbing the piping. Check valve performance losses shall be included by the blower vendor in the blower performance calculation and shall be factory assembled.
4. Sealing element: Suitable for use with air temperatures as great as 275 degrees Fahrenheit.

F. Switches:

1. High inlet differential air pressure switch:
 - a. Adjustable and as recommended by blower manufacturer. Initial setting as recommended by blower manufacturer.
 - b. Activation shuts down unit and activates an alarm condition.
2. Low oil level switch:
 - a. As recommended by blower manufacturer.
 - b. Activation shuts down unit and activates an alarm condition.
3. High motor temperature switch:
 - a. As recommended by motor manufacturer.
 - b. Activation shuts down unit and activates an alarm condition.
4. High discharge air temperature switch:
 - a. Adjustable and as recommended by blower manufacturer. Initial setting as recommended by blower manufacturer.
 - b. Activation shuts down unit and activates an alarm condition.
5. High discharge pressure switch:
 - a. Adjustable and as recommended by blower manufacturer.
 - b. Initial setting as recommended by blower manufacturer.
 - c. Activation shuts down unit and activates an alarm condition

G. Sensors:

1. Discharge air temperature elements:
 - a. With thermowell, suitable for mounting in discharge piping of enclosure.
 - b. Range of 0 to 300 degrees Fahrenheit or as recommended by blower manufacturer.
 - c. With local and remote indication of temperature.

H. Other safety devices and controls: As recommended by blower manufacturer.

- I. Piping pressure gauges:
 - 1. Type on Discharge Side of Blower Piping: Pressure gauge calibrated in psig with a range of 0 to 30 psig.
 - 2. A suitable tee handled corporation stop or ball valve and snubber shall be installed between each gauge and connection to air piping.
 - 3. Pressure gauges outside acoustic enclosure shall be supplied by Contractor.
- J. Rubber expansion joints:
 - 1. Provided at discharge flange of blower enclosure.
 - 2. Includes split backing plates for mounting.
 - 3. Suitable for pressures up to 30 inches mercury vacuum, 15 psig pressure and temperature up to 300 degrees Fahrenheit.
 - 4. Manufacturers: One of the following or equal:
 - a. General Rubber, or equal.
 - 5. Expansion joints outside acoustic enclosure shall be supplied by Contractor.
- K. Discharge piping insulation: As specified in Section 15082, and as indicated on the Drawings. Insulation outside acoustic enclosure shall be supplied by Contractor.
- L. Supports and bracing: As required to support blower, associated equipment, and piping, and to prevent excessive or harmful vibration or movement of equipment or piping shall be supplied by Contractor.

2.5 SHOP PRIMING AND FINISHING

- A. Prepare and shop paint surfaces as specified in Sections 09900, Painting.
- B. Acoustic enclosure shall be powder coated.

PART 3 - EXECUTION

3.1 INSPECTION

- A. The manufacturer shall furnish experienced startup service personnel to inspect the final installation and supervise the field startup tests of the equipment and software. The services of the representative shall be provided for a minimum of two 8 hour days for each blower and two 8 hour days for the blower control system adjustment and optimization. If there are difficulties in operation of the equipment due to the manufacturer's fabrication and programming or Contractor's installation, additional service shall be provided at no extra cost to Owner.
 - 1. Provide, as a minimum, the following field services: Provide written documentation for check out including who performed the work, when performed, what was final setting or tolerance, and who witnessed the final settings.
 - a. Verify proper connection of piping and installation of accessories.

- b. Check leveling of blower enclosure.
 - c. Confirm proper wiring of all instruments and field wired items.
 - 2. A minimum 8 hour, for each blower, field acceptance test shall demonstrate that, under all conditions of operation, each unit:
 - a. Has not been damaged by transportation or installation.
 - b. Has been properly installed.
 - c. Has no mechanical defects.
 - d. Has fully functional instrumentation that are properly calibrated and set.
 - e. Will start, run, and stop in the prescribed manner.
 - f. Will run through the entire range of specified pressure and flow.
 - g. Has the proper shutdown sequence of standard stop, soft stop, and emergency stop.
 - h. Is free of overheating of any parts.
 - i. Is free of objectionable vibration and noise.
 - j. Is free of overloading of any parts.
 - 3. Conduct a minimum of 8 hour field acceptance test of each blower's instrumentation, controls, and valves. The test shall demonstrate the following:
 - a. The air flow control loop will automatically control online blower without hunting.
 - b. The entire blower system and instrumentation operates in a stable fashion, without hunting, maintains air flow setpoint.
 - 4. Field acceptance testing shall be conducted after the installation of all equipment has been completed, all instrumentation has been calibrated and is working as intended, and the equipment has operated for a sufficient period to make all desirable corrections and adjustments. Contractor shall schedule testing with the full knowledge and consent of Owner and shall ensure no adverse effect on the operation of plant facilities.
- B. The manufacturer shall furnish the services of the programmer responsible for programming and integrating the blower control system described in this Section. The services of the programmer shall be provided for a minimum of two 8 hour days to assist Owner's programmer with integrating the blower system software programs with the plant DCS system as well as coordinate with monitoring for the plant DCS system. The programmer must have complete knowledge of proper blower operation and of the blower system software programs supplied in this Section. The programmer must be involved with the submittal preparation process and certifies that the product will meet the control system design intent.

3.2 INSTALLATION

- A. Each blower skid unit shall be mounted on a flat and level concrete surface in accordance with the recommendations of the manufacturer.

3.3 TESTING

- A. After installation of equipment, approval of installation by manufacturer's representative, and operation equipment for sufficient period to make corrections and adjustments, test blower system in the presence of Engineer.
- B. The process startup shall be executed in conjunction with Owner's personnel to coordinate loop-tuning activities so that the entire system works in harmony.
- C. During test period, take and record readings of essential data at 30 minute intervals, including but not limited to noise, vibration, and air temperature, and operating pressures.

3.4 MANUFACTURER'S FIELD SERVICE

- A. Employ and pay for services of equipment manufacturer's field service representative(s) to:
 - 1. Inspect equipment covered by these Specifications.
 - 2. Supervise pre-start adjustments and installation checks.
 - 3. Conduct initial start-up of equipment and perform operational checks.
 - 4. Provide a written statement that manufacturer's equipment has been installed properly, started up, and is ready for operation.
 - 5. Installation/start-up shall conform to Specification Section 01650, Starting of Systems.
- B. The services of the representative shall be provided for a minimum of two 8 hour days for each blower and two 8 hour days for the blower control system adjustment and optimization.
- C. A minimum of a eight hour time period is required for training services.
- D. Sales representatives shall not be acceptable to perform start-up and training functions.

END OF SECTION

SECTION 11372
AIR COMPRESSORS

PART 1 - GENERAL

1.1 SUMMARY

- A. The CONTRACTOR shall provide all labor, materials, equipment, and incidentals required to furnish and install two (2) Air Compressors for the Membrane System valves, instrumentation, and Membrane Integrity Test. The Air Compressor units shall have integral piping for all equipment, discharge isolation valves, check valves, relief valves, silencers, expansion joints, air filters, and all appurtenances required to construct complete and operable air compressor systems, as shown on the Plans and specified herein. This Section describes the requirements for providing the following:
1. Air Compressors.
 2. Receiver.
 3. Accessories.

1.2 RELATED SECTIONS

- B. Drawings and General Provisions of the Contract, including General and Supplementary Conditions, apply to this Section.
- C. Section 01300, Submittals.
- D. Section 01640, Materials and Equipment.
- E. Section 01650, Starting of Systems.
- F. Section 09900 - Painting.
- G. Section 11295 – Hydraulic Valves.
- H. Section 15260 - Piping Insulation.
- I. Section 16195 - Electrical Identification.
- J. Section 16161 - Control Panels.
- K. Section 16225 - Electric Motors 250 Horsepower or Less.
- L. Section 16485 - Variable Frequency Drives - Low Voltage.

1.3 REFERENCES

- A. Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
 - 1. American Society of Mechanical Engineers (ASME):
 - a. B16.11 - Forge Fittings, Socket-Welding and Threaded.
 - b. B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
 - c. B31.1 - Power Piping.
 - 2. ASTM International (ASTM):
 - a. A 53 - Standard Specification For Pipe, Steel, Black And Hot-Dipped, Zinc-Coated, Welded And Seamless.
 - b. A 269 - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
 - c. B 88 - Standard Specification for Seamless Copper Water Tube.
 - 3. National Electrical Manufacturers Association (NEMA):
 - a. NEMA MG-1 - Motors and Generators.

1.4 SUBMITTALS

- A. Submit for approval the following:
 - 1. Letters of Certification of Compliance on materials, equipment, etc.
 - 4. Field erection instructions, diagrams, lists of erection details, and list of items to be repaired. The formal test protocol for use during performance testing, if required.
 - 2. Schematic and wiring diagrams of power, control, and piping systems with all devices, terminals, and wires uniquely numbered. Clearly indicate between factory and field wiring. All field wiring shall be terminated on labeled terminal blocks. A detailed description of operation shall be included for each diagram to describe all modes of operation of the system indicated. Where the integrated system requires interlocking and control of other components in normal operation, these components shall be included in the description of operation.
 - 3. General bulletins and catalog cuts describing complete apparatus, including operating principles and fundamentals.
 - 4. Renewal parts list with diagrammatic or cross-section drawings showing part identification. Material analysis or trades designation for each significant part is to be noted on parts lists or on a separate sheet.
 - 5. Recommended list of spare parts and safety equipment along with price and ordering information. Spare parts and safety equipment at a minimum shall include the equipment listed in Paragraph 2.3 of this Specification.
 - 6. Air Compressor manufacturer on-site representative's complete signed report of results of the inspection, operation, adjustments, and tests. Include the manufacturer's certificate that equipment is ready for permanent operation, and that nothing in installation will render manufacturer's warranty null and void.
 - 7. Operation and Maintenance data shall be submitted per Section 01300, Submittals.
 - 8. All equipment manufacturers shall submit evidence of conformance with the Specifications as required by the individual Specification Sections.

- B. Shop Drawings: Submit for approval the following:
1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
 2. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**

1.5 QUALITY ASSURANCE

- A. Manufacturers regularly engaged in the manufacture of the air compressor equipment, as specified herein, and who can demonstrate equipment of this specified design, in actual service for not less than five years will be considered as acceptable manufacturers. All like items shall be furnished by one manufacturer to ensure uniformity and interchangeability of parts. Manufacturer shall guarantee all equipment furnished as per the warranty stated below; however, this shall not be construed as relieving the CONTRACTOR from his responsibility for the proper installation and functioning of the Work.
- B. Require air compressor manufacturer to furnish and coordinate all compressor components as specified and scheduled below and to provide written installation and check out requirements.
- C. Manufacturer shall have five installations of same size equipment in same application within the last five years in the United States. Manufacturer to submit installation information, including size, location, and a total of three operator contact names and operator phone numbers with the Submittals.
- D. Complete assemblies, including motor, all accessories shall be listed and approved by OSHA and NSF where applicable.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to the site to insure uninterrupted progress of the Work.
- B. Handle all air compressors and associated equipment properly, in accordance with Manufacturer's recommendations. Equipment that is in anyway damaged will not be acceptable.
- C. Store materials to permit easy access for inspection and identification. Keep steel members off the ground using pallets, platforms, and other supports. Protect steel members and packaged materials from corrosion and deterioration.
- D. Store mechanical equipment in covered storage off the ground and prevent condensation.
- E. Each air compressor must be stored and maintained in accordance with Manufacturer recommendation. CONTRACTOR is required to show proof of the proper storage and maintenance, which must be approved and verified by ENGINEER. Improper storage will result in replacement and service of the equipment at CONTRACTOR'S expense.

1.7 WARRANTY

- A. The manufacturer shall warrant, in writing that all equipment supplied by them shall be free from defects in material and workmanship, for a period of 12 months from the date of substantial completion, unless noted otherwise within the Specifications.

1.8 QUALITY ASSURANCE

- A. Manufacturer shall have a minimum of 5 years of experience manufacturing air compressor systems and shall show evidence of at least 5 installations in satisfactory operation for 5 years in similar environments and operating conditions.
- B. Supplies all accessories including motor.

1.9 ENVIRONMENTAL CONDITIONS

- A. As specified in Section 15050.
- B. The equipment to be provided under this Section shall be suitable for installation and operation under the following conditions:
 - 1. Project site elevation at Airport Water Reclamation Facility: 1220 feet above sea level.
- C. Air compressors will be designed for indoor operation at wastewater treatment facilities within Maricopa County, Arizona. Air handling units will be used to maintain an ambient temperature in the space where the air compressors are located that will not to exceed 95 degrees Fahrenheit.

1.10 MAINTENANCE

- A. Spare parts:
 - 1. Supply to the Owner spare parts, any specialized tools required in the manufacturer's maintenance procedures, and 3 air filters. Submit spare parts in accordance with Section 01750.

PART 2 - PRODUCTS

2.1 AIR COMPRESSOR

- A. Manufacturers: One of the following or equal:
 - 1. Quincy, PLT.
 - 2. Ingersoll Rand.
 - 3. Or approved equal.
- B. Type: The air compressors shall be reciprocating, 2-stage, V-belt driven compressor mounted on a horizontal air receiver, meeting the requirements of the membrane system Supplier.
- C. Two compressor units shall be mounted on one receiver. Each compressor shall be capable of independently meeting the design requirements to provide full redundancy. Refer to the Drawings for layout.
 - 1. Compressor unit, including crankshaft, cylinders, flywheel, and motor shall be 2 stage, and shall be air cooled, splash lube, completely sealed against dirt, and providing a large oil sump.
 - 2. A finned, multi-tube intercooler shall be provided between stages and shall include a safety valve to prevent over pressurization. A dry-type 10 micron filter silencer shall be provided on the air inlet.
 - 3. A low oil level switch shall be provided to automatically stop the compressor if the oil level gets too low.
 - 4. An air-cooled aftercooler shall lower the discharge air temperature to within 25 degrees Fahrenheit of the ambient air temperature.
 - 5. Compressor bearings shall be oil lubricated.
 - 6. Each compressor shall be driven by an electric motor integral with the compressor.
 - 7. Compressor shall include all anchor bolts required for anchorage.
- D. Receiver:
 - 1. Air receiver shall be ASME, National Board coded, and tested to 1.5 times the design working pressure of 200 pounds per square inch.
 - 2. Receiver shall be provided with pressure gauge, safety valve, and automatic condensate drain trap.
 - 3. All taps shall be NPT threaded, and receivers shall be provided with sturdy, steel mounting feet.

- E. Motor: As specified in Section 16225, Electric Motors 250 Horsepower or Less, except as otherwise specified or supplemented below:
 - 1. Compressor motor: 460 VAC, 3 phase, 60 hertz, TEFC, 1.15 service factor, severe duty, energy efficient, with self-lubricated ball bearings.
 - 2. Designed, manufactured, and tested in accordance with NEMA MG-1.
- F. Equipment identification plates:
 - 1. A 16 gauge stainless steel identification plate shall be securely mounted on the compressors and receivers in a readily visible location. The plate shall bear the 1/4 inch die-stamped equipment number indicated in this Section.

2.2 COALESCING FILTER

- A. Manufacturers:
 - 1. Finite Filter Division, Parker Hannifin Corp. H-Series.
 - 2. Or approved equal.
- B. Materials:
 - 1. Housing: Metallic.
 - 2. Element, Coalescing Type: Glass fiber.
- C. Components:
 - 1. Filter to be sized for same capacity as compressor.
 - 2. Housing: Two-piece, with threaded bowl to head.
 - 3. Elements: Replaceable with resilient end seals.
- D. Accessories:
 - 1. Drain Trap: Internally mounted automatic mechanical type.
 - 2. Air Dryer or Desiccator

2.3 PIPING

- A. General:
 - 1. All interconnecting piping and tubing between components of the equipment package shall be shop installed.
 - 2. Piping from the compressor discharges to the receiver shall be sized not less than the compressor discharge connection size and shall be ASTM A 53, seamless, Grade B, Schedule 40 black steel pipe with ASME B16.11, Class 3000, forged steel socket-welding fittings or Schedule 80 black steel pipe with Class 3000 forged steel threaded fittings. "Close" nipples will not be acceptable.
- B. Pneumatic control and instrument tubing:
 - 1. In accordance with ASTM A 269, Type 316, stainless steel tubing with Parker-Hannifin "Ferulok," Crawford "Swagelock," or equal, Type 316 stainless steel flareless double ferrule compression fittings.
 - 2. Tubing shall not be less than 1/4 inch OD with a wall thickness of 0.028 inch.

- C. Piping between the package receiver and the air dryer shall be ASTM B 88, Type K, hard drawn copper tubing with ASME B16.18 solder-joint fittings.
- D. All piping and tubing shall be run in vertical and horizontal planes. Piping shall be arranged to ensure that undue stresses, from thermal expansion, are not transmitted to equipment components.
- E. All control and instrument tubing shall be continuously supported.

2.4 CONTROL EQUIPMENT

- A. All control equipment for each compressor shall be furnished as required for a complete installation, requiring only field connection of the electrical power supply and discrete inputs to plant SCADA system.
- B. Equipment shall include the following:
 - 1. All control switches, pressure switches, timing relays, auxiliary relays, elapsed time meters, circuit breaker combination magnetic motor starters, and other accessories required for control of each compressor.
 - 2. Each starter shall include a thermal magnetic circuit breaker with external operating handle.
 - 3. Starter overloads shall be matched to motor current and shall be provided with a reset pushbutton.
- C. All control equipment for each compressor package shall be housed in a control panel mounted on the receiver.
- D. All system wiring shall be shop installed to terminal blocks in the control panel. Wiring from the panel to system components shall be completely enclosed in liquidtight flexible conduit.
- E. All pneumatic tubing shall be shop installed to bulkhead fittings at the control panel. All field connections shall be made to the fittings at the panel.
- F. Control panel enclosure:
 - 1. The control panel shall be NEMA 12 construction, fabricated from 14 USS gauge or heavier steel and shall be equipped with a full size gasketed door with chromium-plated or stainless steel three point latch and hinges.
 - 2. A screened vent shall be provided in the bottom of the control panel.
 - 3. All control devices shall be rigidly mounted within the enclosure except for breaker handles, selector switches, pushbuttons, and indicating lights, which shall be mounted on the panel door.
- G. Internal panel tubing shall be run in horizontal and vertical planes and shall be rigidly supported to withstand handling and shipping without damage. Compression type bulkhead fittings shall be provided through the panel for all connections.

- H. Panel wiring:
 - 1. Internal panel wiring shall be neatly bundled and tied and identified with suitable wire markers.
 - 2. Terminal blocks for external connections shall be furnished complete with marking strips, covers, and pressure connectors.
 - 3. A terminal shall be provided for each conductor of external circuits.
 - 4. All wiring shall be grouped or cabled and securely attached to the panel.
 - 5. Clearance for field wiring shall be provided between the terminal strips and base.
- I. Compressor control:
 - 1. General: The compressed air package shall be furnished with a control system which shall start and stop the compressors as required. The control system shall unload the compressors on shutdown and while coming up to speed during startup. Unloading shall be accomplished by inlet valve control.
 - 2. The compressor control package shall include a dual control system that is operator selected to be either Start/Stop operation with a pressure switch or constant speed control with unloading.
- J. Protection controls:
 - 1. A protection control system shall be provided for each compressor. The control system shall stop the compressor on either motor overload or low oil level.
- K. A mechanical latching relay circuit with a common "Reset" pushbutton shall be provided.
- L. Provide running and fail contacts. Contacts shall be dry, rated 120 VAC, 10 amp.

2.5 ACCESSORIES

- A. The compressed air equipment package shall be provided with the following accessory equipment:
 - 1. Safety valves:
 - a. Safety valves with manual lifting levers shall be installed in the compressor discharge piping and on the receiver.
 - b. Valves in the compressor discharge piping shall be capable of protecting the compressors from damage when operating against a closed discharge valve and shall be suitable for the maximum compressor discharge air temperature.
 - c. The safety valve on the receiver shall be capable of protecting the receiver from excessive pressure.
 - 2. Safety guards: All compressor cooling fans shall be provided with safety guards.
 - 3. Intake filter muffler:
 - a. Provide each compressor with a dry type intake filter muffler supported by the suction pipe and close coupled to the compressor intake connection.
 - b. Intake filter muffler shall have an outer cover and replaceable filter element.
 - 4. Discharge check valves:
 - a. A line-mounted check valve shall be provided in the discharge piping leading from each compressor.

- b. Check valves shall be sized in accordance with the manufacturer's recommendations and shall be suitable for service with reciprocating compressors at the maximum compressor discharge air temperature.
- 5. Shutoff valves:
 - a. Type: All shutoff valves shall be ball valves.
 - b. Valves in steel piping shall have carbon steel bodies, chrome-plated or stainless steel balls, and reinforced Teflon seals and seats.
 - c. Valves in the compressor discharge piping shall be suitable for the maximum compressor discharge air temperature.
- 6. Receiver vent valve:
 - a. Provide a globe type vent valve with bronze body and brass stem on each receiver.
- 7. Pressure gauges:
 - a. As specified in Section 17121.
- 8. Pressure switches:
 - a. Each pressure switch shall have SPDT contacts rated 10 amperes at 120 volts alternating currents and shall be complete with shutoff valve.
 - b. Pressure switches mounted inside the control panel shall have NEMA 1 housings.
- B. Finishes:
 - 1. Shop and field painting of piping and equipment shall be as specified in Section 09900.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install equipment in accordance with these Specifications and the manufacturer's installation instructions.
- B. Install piping in such manner as not to place a strain on any part of the equipment.
- C. Complete installation, testing, start-up, and certification in accordance with Sections 01756, 15050, 15958.
- D. All lubricants shall be per Section 01600 and provided by the compressor manufacturer.

3.2 FIELD TESTS AND INSPECTION

- A. Provide equipment and apparatus required for performing inspections and tests.
- B. Correct defects and repeat the respective inspections and tests. Pressure test gauges shall be currently certified as being accurate to within 1 percent of their full scale. Use gauges with maximum scale between 1-1/2 and 2 times the test pressure.

END OF SECTION

SECTION 11500.1
MEMBRANE FILTRATION SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section outlines the furnishing of a complete and operable Membrane Filtration System and provides the Scope of Work that shall be performed by the Membrane System Supplier (MSS) for the City of Chandler's Airport Water Reclamation Facility located in Maricopa County, Arizona.
- B. The Membrane Filtration System to be installed as shown on the Preliminary Drawings and/or specified within include , but not be limited to the following major components:
 - 1. Low pressure membrane air scour blower system with associated valves and instrumentation.
 - 2. Membrane modules, cassettes, frames and all hardware required to support membranes within concrete membrane tanks.
 - 3. Piping and valves internal to the membrane tanks with termination points at or near the edge of the tanks.
 - 4. Membrane Tank covers, and all beams and support structure required to support covers within concrete tanks.
 - 5. Permeate pumping and backpulse system, including loose-shipped valves, instruments, controls, backpulse tankage, and air extraction system.
 - 6. All instruments, controls and pumps required for CIP cleaning (CIP tank to be concrete by construction contractor).
 - 7. Filters and instruments required to regulate compressed air for the membrane system operation.
 - 8. Membrane integrity test system.
 - 9. UF/MF system process instrumentation and control (I&C) system including PLC system panel.

1.2 RELATED SECTIONS

- A. Section 01010, Summary of Work.
- B. Section 01300, Submittals.
- C. Section 01640, Materials and Equipment.
- D. Section 01650, Starting of Systems.
- E. Section 01660, Field Tests of Equipment.
- F. Section 11295 – Hydraulic Valves.
- G. Section 13447, Electric Motor Actuators.
- H. Division 16, Electrical.

- I. Division 17, Instrumentation.
- J. Section 17454, Operation and Control Description.

1.3 WORK BY OTHERS

A. The following items are supplied by CMAR and will include:

- 1. Structural:
 - a. Building of concrete tanks, structure and pads for housing the supplied membrane equipment including permeate pumps, blowers, etc. (please note that the membrane basins will not be located within a building).
 - b. Protective coatings for concrete, if required.
 - c. Anchor bolts; anchor bolt design by Supplier in accordance with IBC 2006 and available software programs, such as Hilti Profis. Use stainless steel epoxy anchor bolts for submerged anchors.
- 2. Mechanical:
 - a. Pipe supports and hangers, as needed and as shown.
 - b. Hoist equipment above the membrane basins for installation and removal of the membrane cassettes.
 - c. Single connection points will be provided by CMAR, unless otherwise noted, for each membrane basin for the following:
 - 1) Membrane Effluent (Permeate)
 - 2) Air scour supply
 - 3) Chemical valves and feed lines for Maintenance Clean/Recovery Clean:
 - a) Sodium hypochlorite.
 - b) Citric acid.
 - c) Caustic Soda
 - d) Sodium bisulfite
 - e) Hydrochloric acid
 - d. Backpulse storage tank for backpulse cleaning cycles.
 - e. Installation materials for instrumentation and automatic valves including but not limited to air/sample line tubing, fittings, and mountings.
- 3. Electrical and Instrumentation:
 - a. Motor control centers and variable frequency drives.
 - b. Electrical wiring interconnections (including wiring, conduit, and other appurtenances required to provide power connections as needed) from the electrical power source to the membrane system MCC and PLC.
 - c. Ethernet communications connection to the Owner's Plant Control System.
- 4. Other:
 - a. Receiving, unloading, and safe storage of equipment at site or a storage facility until ready for installation.
 - b. Equipment and membrane cassette installation.
 - c. Raw materials, chemicals, and utilities during equipment testing.
 - d. Any onsite painting or touch-up painting of equipment supplied (shop prime by the Supplier).
 - e. Removal and disposal of glycerin or other compounds used to preserve membranes during shipment.

B. The following items are supplied by Owner and will include:

- 1. Laboratory services, operating and maintenance personnel during equipment checkout,

startup, and operations.

1.4 SUBMITTALS

- A. Shop Drawings: Submit for approval the following (one hardcopy and one softcopy):
1. Letters of Certification of Compliance on materials, equipment, etc.
 2. Detailed specifications and drawings as specified in Section 01300 containing complete piping and flow diagrams of the proposed installation, including dimensions, weights, and complete parts lists. Drawings shall show proposed anchorage of equipment and appurtenances and equipment relationship to other parts of the work including clearances for installation.
 3. Field assembly instructions, assembly drawings and/or diagrams, detailed reference drawing lists, and lists of assembly details.
 4. List of materials, list of equipment (with model number, size, weight), including a complete list of parts and supplies with current unit prices and sources of supply. List of parts recommended by the Manufacturer to be replaced after 1 and 3 year(s) service. List of special tools for each type of equipment furnished including special tools necessary for adjustment, operation, maintenance, and disassembly.
 5. Installation instructions, operating and/or service manuals, and all other data pertinent to operating or servicing the complete apparatus. Preventative maintenance instructions and recommended frequency.
 6. Wiring and control schematics and control logic diagrams for all electrical and control components furnished.
 7. A complete process description detailing all process parameters.
 8. Documentation that the manufacturer has produced, supplied, and placed into satisfactory service, equipment similar to that specified herein.
 9. Recommended list of spare parts and safety equipment, along with price and ordering information.
 10. Complete data sheet (ISA data sheet) for each instrument supplied.
 11. Process and instrumentation diagrams (P&IDs) of the Membrane Filtration System.
 12. CONTRACTOR shall submit specification section with check marks next to each section denoting submittal complies with section, or an "X" next to the section denoting a deviation from the specification. Justification for any deviations must also be included.
- B. Seismic structural calculations:
1. Submit seismic structural calculations in conformance with the following requirements:
 - a. Design spectral acceleration at short periods, $S_{DS} = 0.19$.
 - b. Design spectral acceleration at period of 1-second, $S_{D1} = 0.09$.
 - c. Risk Category: III
 - d. Component amplification factor, a_p = in accordance with ASCE 7, Tables 13.5-1 and 13.6-1.
 - e. Component response modification factor, R_p = in accordance with ASCE 7, Tables 13.5-1 and 13.6-1.
 - f. Component importance factor, I_p = in accordance with ASCE 7 Chapter 13.
 - g. Seismic Design Category: Category B.
 - h. The calculations shall be prepared and stamped by a structural engineer registered in the State of Arizona.
- C. Manufacturer's installation instructions:

1. Installation and checkout instructions including lubrication and initial start-up procedures.
 2. Do not install equipment until all installation instructions have been supplied.
- D. No equipment shall be shipped until the ENGINEER approves the Shop Drawings.
- E. Shop Test Results: Submit results of routine factory motor tests.
- F. Field Test Results: Submit a written report giving the results of the required field tests.
- G. Manufacturer's Reports: Submit written report of the results of each visit by a manufacturer's serviceman, including purpose and time of visit, personnel present, tasks performed, and results obtained.
- H. Operation and Maintenance Manuals: Submit complete Operation and Maintenance Manuals in conformance with the Operation and Maintenance Manuals Section of Section 01300, Submittals.
- I. The MANUFACTURER shall provide a written guarantee detailing permeate quality. This guarantee shall be based upon laboratory test, and past operating experience. The guarantee is based on past operating experience; documentation of that experience shall be submitted with the proposal.
- J. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
- K. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**

1.5 QUALITY ASSURANCE

- A. Manufacturer: Company specializing in the manufacture of products specified in this Section with minimum five years documented experience and at least 15 similar-sized filtration installations in service.

- B. Inspection and Testing Requirement: The ENGINEER reserves the right to reject delivery of any or all pieces of equipment found, upon inspection, to have any or all of the following: tear, cracks, chips, rust, foreign matter, non-standard welding.
- C. Shop Tests:
 - 1. Motor Tests: Perform a routine test on each drive motor at the manufacturer's factory. The test shall consist of: Running Light Current; Locked Rotor Current; Winding Resistance; High Potential; and Bearing Inspection.
- D. Responsibility: To ensure that all the equipment required for the installation of the Membrane Filtration System is properly coordinated and will function as a unit in accordance with the intent of these Specifications, the CONTRACTOR shall obtain all the equipment specified under this Section, from a single supplier in whom the responsibility for the proper function of all the equipment, regardless of manufacturer, as an integrated and coordinated system shall be vested. The intent of this paragraph is to establish unit responsibility for all the equipment with the Membrane Filtration System equipment supplier. The use of the word "responsibility" relating to the equipment supplier is in no way intended to relieve the CONTRACTOR'S ultimate responsibility for equipment coordination, installation, operation, and guarantee.
- E. The CONTRACTOR shall guarantee the Membrane Filtration System as required under the General Conditions, and as specified herein. If, during the guarantee period, the Membrane Filtration System fails or does not meet any of the specified requirements or test criteria herein, the CONTRACTOR shall correct such deficiencies as may be necessary to meet these requirements and criteria, and at no additional cost to the OWNER. The ENGINEER must first review any proposed remedial measures before any work is done.

1.6 WARRANTY

- A. Supplier shall provide a guaranteed membrane replacement or additional purchase price, as a cost per module and as a cost for the total system.
- B. Supplier shall warrant membranes for a minimum of 5 years. The warranty shall not be prorated. All warranty and support shall be provided directly by the Supplier and not the local representative.
- C. Membrane modules shall be warranted on a pro-rated basis for an additional period of 5 years following the 5-year non-pro-rated warranty period. Membranes replaced under warranty shall assume the balance of the remaining original warranty.
- D. Supplier shall warrant membrane modules under the following terms:
 - 1. Supplier shall repair, replace, or add at no cost to the Owner, any membrane modules that fail before the end of the full replacement (i.e., non-prorated warranty) warranty period which shall commence after successful completion of the Operational Test. Failure is defined as any of the following:
 - a. Inability of membrane to pass direct integrity test as specified within this Section.
 - b. Inability to meet production capacity requirements as specified.
 - c. Inability to meet membrane cleaning frequency requirements as specified.
 - d. Inability to meet membrane permeate quality requirements as specified.
 - 2. The Supplier shall further warrant all system components, including pumps, valves, and ancillary equipment for a minimum period of 12 months following the date of successful completion of the Operational Test.

3. If Supplier is unable to modify the system through addition of membranes or other elements, and cannot satisfy requirements of Operational Test, or system fails to meet specified performance criteria during the warranty period following the date of successful completion of the Operational Test, then Supplier shall be responsible for complete removal of nonconforming system and subsequent installation of membrane products that are capable of meeting specified performance conditions.
- E. The warranty period, membrane equipment system components found to be defective shall be replaced as follows:
1. Any membrane equipment system component found to be defective within the first 12 months of the warranty period (5 years for membrane modules) shall be repaired or replaced with new components at no cost to the Owner.
 2. If membrane modules are found to be defective past the fifth year and up to, and including the final month during the pro-rated 5-year warranty period, the cost for replacement shall be determined as follows:
- Pro Rated Module Price = (Module Price x applicable CPI adjustment x
Months of Beneficial Use) / Membrane Module Warranty Period in Months
3. Owner shall be responsible for shipping and handling of components for membrane components defective past the second year.
- F. The Supplier shall guarantee that for components manufactured by the Supplier, replacement parts shall continue to be available to the Owner for a minimum of 20 years from date of successful completion of Operational Test. Supplier shall guarantee that, if Supplier or Supplier's product line is sold, Supplier shall make provisions such that all guarantees, warranties, and bonds will remain in effect and that replacement parts and operational support continue to be available to the Owner for the time period specified above.
- G. Warranty submittals:
1. Submit for approval prior to the shipment of the membrane modules, quality assurance/quality control (QA/QC) reports in letter format for membrane modules. As a minimum, the reports shall include:
 - a. The membrane module model and part number, manufacturing lot number and serial number. Indicate the nominal or absolute pore size, inside and outside fiber diameter, effective fiber length, and effective feed side surface area of the membrane module.
 - b. The membrane module normalized specific flux (permeability, gpm/psi at 20°C).
 - c. A certification by the membrane module supplier that each membrane module has passed the membrane module suppliers' QA/QC (integrity) tests.
 - d. Certification of wet testing for each membrane module conducted at the membrane module supplier's facilities. The membrane module supplier shall certify that each membrane module has passed the quality assurance/quality control tests for membrane element integrity.
 - e. Identify modules that have undergone pinning or repair for more than 0.1 percent of original fibers at the factory.
 2. Identification of operating parameters and limits required to satisfy and maintain membrane module warranty.
 3. Changes in the Supplier's established operational and maintenance guidelines cannot be applied retroactively to invalidate the membrane module warranty.

1.7 DELIVERY AND SCHEDULE

- A. Provide notification in writing to the Owner and CMAR of approximate delivery date(s) 12 weeks before delivery. Notify same of actual delivery date at least 7 days before delivery. Provide description and approximate weight of shipping container and required equipment for unloading. Supplier shall coordinate delivery, unloading, and storage with CMAR.
- B. Supplier shall coordinate with CMAR in delivery of equipment. Supplier shall revise schedule for delivering equipment packages if requested by CMAR without additional cost to CMAR.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Membrane equipment shall be provided complete, with all necessary components, accessories, and appurtenances required to make a complete and operable system. Interconnecting piping between membrane basins and ancillary systems, including air blowers, air compressors, chemical metering systems, and backwash volume will be provided by the CMAR.
- B. Membrane modules and equipment shall be prefabricated, preassembled, and tested before shipment to the site.
- C. Supplier shall provide the equipment as described in these Specifications:
 - 1. Items shall be new and unused, and shall be Supplier's most current product line at the time of product submittal.
 - 2. Designed to use latest generation membrane modules having greater membrane area or improved performance characteristics.
 - 3. Furnished as a complete and operable system including all piping and valves.
- D. Supplier shall design anchor bolts based on 4,000-psi concrete in accordance with paragraph 1.06 and shall provide location for anchor bolts. Anchor bolts for equipment will be provided and installed by CMAR.
- E. Any carbon steel components provided are to be for uses that do not come into contact with water or chemicals.

2.2 MANUFACTURER

- A. Suez.
- B. Alternate vendors shall comply with the alternate package documents.
- C. The naming of a manufacturer in this Specification is not an indication that the manufacturer's standard equipment is acceptable in lieu of the specified component features. Naming is only an indication that the manufacturer may have the capability of engineering and supplying a system as specified.

2.3 DESIGN CRITERIA & REQUIREMENTS

- A. Flow
 - 1. Membranes and related equipment are to be designed for the maximum net daily production year round, at the minimum raw water temperature specified.
 - 2. The production flow rate is to be based on the following feed water parameters to the MSS:

Table 1: Production Flow Design Criteria				
	Current Criteria		Future Criteria	
Total Permeate Flow (MGD)	10	10	12.5	12.5
Trains in Operation	4	3*	4	3*
Cassettes Installed / Train	4	4	5	5
Cassettes Spaces / Train	5	5	5	5
Recovery Rate	> 95%	> 95%	> 95%	> 95%

*During Backpulse (5 – 25 min./train, every 2 hours); During Maintenance Clean (15 -30 minutes/train, once per day); During Recovery Clean (6 - 24 hours/train, once per month).

Note:

- a. Design Net Production is based on daily average. Instantaneous production flow rates may vary during the day to meet average permeate flow of 10 MGD.
- b. During Recovery Clean of one Train, where three Trains are in operation, production shall meet 10 MGD. This applies even during Backpulse and Maintenance Clean cycles of one of the three operating trains.
- c. Recovery when feed water > 135 NTU, < 800 NTU 90%
- d. Maximum CIP/Maintenance Clean Frequency 1/day
- e. Maximum Recovery Clean Frequency 12 / year

B. Feed Water Quality

Table 2: Influent Water Quality		
Parameter	Annual Average Day	Maximum Month Average Day
TSS (mg/L)	33.7	185.0
Turbidity (NTU)	9.28	37.89
pH (SU)	8.20	8.53
Alkalinity (mg/L)	171	190
Temperature (°C)	16 (minimum) 32 (maximum)	

Note:

- a. Minimum design water temperature for design of MFS shall be 20 degrees C. Below this, treatment capacity may change according to the EPA MFGM temperature/flux adjustment calculation shown below, or cleaning frequency will be impacted.

Equation 2.11 (EPA MFGM, 2005): $TCF = \frac{\mu_T}{\mu_{20}}$

Where:

TCF = temperature correction factor (dimensionless)

City of Chandler

μ_T = viscosity of water at temperature T (cp)

μ_{20} = viscosity of water at 20° C (cp)

Equation 2.12 (EPA MFGM, 2005): $J_{20} = J_T \times TCF$

C. Permeate Water Quality

1. Permeate from the MFS shall meet the following requirements:

- a. Turbidity (NTU) ≤ 0.5 100% of the time¹
- b. Turbidity (NTU) ≤ 0.1 95% of the time¹
- c. LRV: ≥ 3.0 log

Note 1: Based on readings taken on 15-minute intervals over any continuous period of at least 24 hours in length. Low range, laser type turbidity monitors shall be provided on the permeate of each membrane train to measure permeate turbidity.

D. Membrane modules shall house hollow fiber type membranes. All the modules in each membrane tank shall be connected to a common permeate header, which shall be connected to the permeate pump. The permeate shall move through the membranes by applying a suction force with the permeate pump to the inside of the membrane fibers. The permeate flow during normal operation shall be from the outside of the membrane fibers to the inside. Operating Environment

1. The membranes shall be installed in new basins built by the Contractor.
2. The membrane basins will be located in a facility supplied by the Contractor.

E. The Supplier under this Contract shall provide the following in accordance with the appropriate Specification:

1. Permeate pumps (one pump furnished per membrane train and one uninstalled spare), vacuum system, air extraction system, and all valves, instrumentation and controls.
2. Membrane agitation air blowers including instrumentation and controls.
3. Membrane modules, cassettes/racks, process instrumentation and associated equipment.
4. Membrane backwash system, including valves, fittings, instrumentation, and controls. CMAR to provide backwash volume (tank) as a component of the reclaimed water pump station.
5. Instrumentation and controls for membrane maintenance/recovery cleaning feed and distribution system.
6. Air compressor system, including compressor (one duty, one standby), air dryers, valves, fittings, instrumentation, and controls.
7. Process control panels, PLC(s), Human Machine Interface(s), and associated software programming and graphical displays.
8. Membrane permeate piping and air scour supply piping within the limits of each membrane basin (above basin).
9. All in-basin piping for membrane effluent and air scour.
10. Membrane basin drain valves will be provided by the CMAR and controlled by the Supplier.
11. All supports for membrane cassettes/racks and plates.
12. Membrane basin covers will be provided by CMAR.

2.4 MEMBRANE FILTRATION SYSTEM

A. The membrane basins shall be constructed of reinforced concrete by the CMAR. Four basins shall

be provided for the membrane equipment system, complete with elevated walkways (grating and supports), handrail, stairs, and supports.

- B. See the Drawings for space available for the membrane equipment system including the membrane basins.
- C. Piping supports shall be provided by the CMAR to support the header pipes and associated valves and appurtenances on each basin, as indicated on the Drawings. Supports to be connected to each membrane basin in a configuration to match the requirements of the layout shown on the Drawings. Exact elevations and pipe header lengths to be determined by the Supplier. Pipe headers shall be factory assembled, and shipped and delivered as a single component. Provide appropriate connections to piping to be connected in the field.
- D. Basins shall be designed and equipped with covers on top of each basin. Support and configuration of covers to be determined and designed by Supplier. Decking and support configuration shall allow for the removal of membrane cassettes without removal of the entire deck. Submit proposed decking design and support details for review by Engineer.
- E. Stairways, elevated platform, and aluminum railing shall be provided by CMAR as indicated on the Drawings. Railing design shall meet all applicable OSHA and safety requirements. The railing layout shall allow operators to walk from the stairway and platform onto each tank. Submit proposed stairway, platform, and railing design and basin connection details for review by Engineer.
- F. The Supplier is responsible for configuring piping within the limits of the membrane basins to meet the basin size, connections, and configuration indicated on the Drawings.
- H. The membrane basins shall be equipped with a passive ventilation system to relieve pressure or vacuum conditions in the basins, such as may occur when the basins are being drained or filled. Supplier shall design the passive ventilation system and submit for Engineer's review. CMAR shall provide the passive and/or active ventilation system and install it.

2.5 MEMBRANE EQUIPMENT

A. Membranes

- 1. Use hollow fibers having a nominal pore size of 0.04 μm or less.
- 2. Flow shall be from the outside through the membrane fibers and filtered water (permeate) shall be collected from the inside of the fibers.
- 3. Membranes shall be constructed of chemically resistant material and shall be capable of being washed in high chlorine solutions (up to 1,500 mg/L) and low pH solutions for time periods required for maintenance and recovery cleans provided in this Specification.
- 4. Membranes shall be physically strong enough to withstand the operating conditions associated with water quality conditions specified in Table 1 and the peak design flow rate.
- 5. Membranes shall be able to withstand backwash flow from inside to outside, as proposed without any indication of damage.

B. Membrane Modules

- 1. The membranes shall be assembled into a housing called a membrane module.
- 2. Hollow fiber modules are to be constructed such that the fibers are arranged vertically, and permanently bonded in position at both ends. Hollow fibers shall be "reinforced". The

polymeric membrane surface shall be permanently bonded to a reinforcing material made of nylon or a similarly suitable material.

3. The materials used to hold the membrane fibers in place shall be chemical resistant to high concentrations of chlorine (maximum 1,000 mg/L) for 10 hours, and low pH (range 2 to 3) and high pH wash solutions (range 10 to 10.5) for 10 hours respectively.
4. Membrane modules are to be constructed of chemically resistant materials matching the immersed chemical resistance of the fibers.
5. The filtration area of each module is to be based on the wetted external surface area of the fibers.
6. The top and bottom sections of the module shall be connected with corrosion resistant materials and allow permeate to be withdrawn from the top of each module.
7. The base of each cassette shall contain diffusers or jets to allow compressed air to escape and travel upwards past and between the membrane fibers creating an agitation effect.
8. All non-steel components of the membrane modules shall be UV resistant and have a chemical resistance at least equal to that of the membranes.

C. Membrane Racks/Cassettes

1. Membrane modules shall be assembled into units called cassettes.
2. Each cassette shall be supported within a frame manufactured of Type 316L stainless steel.
3. Provide isolation valves for the permeate and agitation air to provide means of isolating and removing individual cassettes from the remainder of the system, without draining the basin, and enabling the system to produce permeate with one or more cassettes out of service.
4. Each frame shall be fitted with lifting eyes (one at each end) to allow the entire membrane cassette to be lifted into and out of the membrane basin and transported away from the basin.
5. All fasteners, including nuts, bolts, screws, cables, washers, and other appurtenances associated with the membrane cassette and housing shall be manufactured from Type 316 stainless steel.

2.6 PERMEATE SYSTEM

A. Permeate Suction Piping

1. Provide each membrane train with a permeate header for filtrate collection.
2. All cassettes in a membrane basin or train shall connect to the permeate header.
3. Each membrane train shall be in a separate, isolatable concrete basin.
4. The pipe connections between the membrane cassettes and the permeate header shall be capable of operating at the positive and negative pressures expected for this system.

B. Permeate / Backpulse Pumps

1. Provide a pumped permeate collection system including pumps, controls, isolation valves, check valves, flow meters, and pressure gauges.
2. Provide an individual permeate pumping system for each train. The Permeate Pumps shall meet the requirements of Specification 11314, End Suction Centrifugal Pumps.
3. Motors shall comply with the requirements of Specification Section 16225, Electric Motors 250 Horsepower or Less.
4. Each pump shall have sufficient capacity to operate one membrane train and meet the design flow rates per train resulting from the design flow and redundancy requirements specified herein. This requirement shall be met at the maximum transmembrane pressure and allow for all other system losses.
5. Each pump shall be able to maintain a constant permeate flow regardless of transmembrane pressure up to the maximum transmembrane pressure.

6. The permeate pump shall deliver sufficient total dynamic head to drive downstream processes.
7. Provide the following at a minimum as part of the Permeate Pump System.
 - a. Process Pump for each train
 - b. Feed flow control valve for each train
 - c. Backwash drain flow control valve for each train
 - d. Level transmitter and isolation valve for each train
 - e. Pressure transmitter for each train
 - f. Automated and manual valve for MIT air isolation for each train
 - g. A vacuum ejector and associated valves for each train to allow for periodic air removal
 - h. Permeate turbidity meter and associated valves for each train
 - i. Backpulse suction isolation valve for each train
 - j. Backpulse discharge isolation valve for each train
 - k. Air scour isolation valve for each train
8. All valves shall comply with the requirements of Specification Section 11295 – Hydraulic Valves.
9. Instrument air compressors and associated appurtenances to operate pneumatic valves and instrumentation shall comply with the requirements of Specification Section 11372 – Air Compressors.

2.7 CLEANING SYSTEMS

A. Agitation Air System

1. Provide membrane agitation air blower system including blowers, control panels, isolation valves, check valves, pressure gauges, discharge pressure safety valves, flow transmitters, low flow switches, high-pressure switches, flowmeters, and other associated appurtenances, as required to meet system performance requirements.
2. Provide air scour supply piping within the limits of each membrane basin and instrumentation and control functions to control the operation of the membrane agitation air blowers.
3. Membrane agitation air blowers shall provide airflow to scour the membranes for control of fouling, and to assist in keeping the solids in a membrane basin in suspension.
4. Provide a minimum of two membrane agitation air blowers per the requirements of Specification Section 11371.
5. Motors shall comply with the requirements of Specification Section 16225.
6. Control Panels shall comply with the requirements of Specification Section 16161.

B. Backwash or Backpulse System

1. Provide permeate pumps, valves, meters and control elements, and other components to provide an automated backwash system.
2. The backpulse system shall deliver the required backwash flow at worst-case hydraulic conditions (maximum system headloss and maximum transmembrane pressure). Backpulse system shall be capable of backpulse pressure up to 12 psi.
3. Backpulse volume will be provided by others.
4. Provide the backpulse system appurtenances, control elements (valves, pressure sensors, flowmeters, etc.), and instrumentation and control functions required to operate the backpulse system.
5. Initiation of all functions shall be automatically controlled by the vendor supplied PLC. Backwash shall be automatically initiated based on time, process water volume, or TMP. System shall also allow operator to initiate a backwash and control each piece of equipment

and valves manually.

C. Clean-In-Place (CIP) System

1. Provide two CIP Pumps (one duty+ one standby) to direct CIP water from a concrete CIP Tank (by others). Pumps shall comply with the requirements of Specification Section 11314.
2. Provide duty/stand-by configuration with all required instrumentation and controls required for fully automated operation including check valves, manual isolation valves, pressure gauges, and flow measurement.
3. Provide CIP tank isolation valves and all instrumentation for a functional CIP system.
4. Motors shall comply with Specification Section 16225 – Electric Motors 250 Horsepower or Less.

D. Chemical Feed System

1. Chemical Cleaning and Neutralization feed systems by others.

E. Compressed Air Filters and Instruments

1. Provide compressed air for membrane system pneumatic valve actuation and membrane integrity testing.
2. Provide air quality and flow requirements.
3. Provide air filter assemblies mounted on a panel which includes, air regulators, isolation valves, discharge pressure gauge, discharge pressure switch, and other related appurtenances to produce, deliver and monitor the compressed air for the pneumatically actuated valves on the MFS and for the membrane integrity tests.

F. Membrane Integrity Test System

1. The Membrane Filtration System shall include an air-hold integrity test to provide a positive means of monitoring the integrity of the membranes and membrane system. The test shall be conducted using pressure or vacuum and be designed in accordance with Chapter 4 and Appendices B through D of the U.S. EPA Membrane Filtration Guidance Manual (November 2005).
2. The membrane integrity test system shall detect membrane defects having a minimum size of 3 microns.
3. The membrane integrity test system shall operate automatically, controlled by the vendor supplied PLC. Operators shall have the ability to manually initiate a MIT from the HMI screen.
4. Integrity tests registering below the indicated LRV value will automatically alarm a failure and automatically shut down the specific membrane train.

G. Membrane Permeate Header/Air Scour Piping

1. Piping shall conform to requirements specified in Division 15.
2. Provide one (1) permeate header and one (1) air header per membrane train. Header sizes and material shall be as shown on the Drawings and as scheduled in Specification Sections 15050 and 15052. The permeate headers shall include tie points for:
 - a. A single finished permeate and backpulse tie point per train
 - b. A single air removal / ejector tie point per train
 - c. A single compressed air for membrane integrity test tie point per train.
3. The air headers shall include tie points for:
 - a. A single backwash air scour tie point per train.

H. Membrane Tank Feed Header

1. Piping shall conform to requirements specified in Division 15.
2. Provide one (1) feed water header per membrane train. Header size shall be as shown on the Drawings and as scheduled in Specification Sections 15050 and 15052. Header will include a minimum of six (6) laterals to distribute feed water evenly throughout the membrane tank.

I. Valves and Actuators

1. Provide all check valves, control valves, solenoid valves, isolation valves and actuators required for a completely functional system.
2. Check Valves: Provide per Specification Section 11295.
3. Ball Valves, (PVC) 2-Inch and Smaller: Provide per Specification Section 15065.
4. Ball Valves, (SS): Provide per Specification Section 11295.
5. General Purpose AWWA Butterfly Valves:
 - a. Service conditions: General service and manual and automated isolation.
 - b. Supplier-supplied butterfly valves shall be supplied in accordance with Section 11295. Valve discs shall be Type 316 stainless steel.
 - c. CMAR-supplied butterfly valves shall be in accordance with Section 11295. Valve discs shall be Type 316 stainless steel.
 - d. Provide Pneumatic Actuators used for OPEN/CLOSE application where fast action is required in accordance with Section 13445 – Pneumatic Controllers and Control Valves.
6. Industrial Class Butterfly Valves:
 - a. Service conditions: Modulating aeration for membrane equipment system.
 - b. Supplier-supplied butterfly valves shall be supplied in accordance with Section 11295. Valve discs shall be Type 316 stainless steel.
 - c. CMAR-supplied butterfly valves shall be in accordance with Section 11295. Valve discs shall be Type 316 stainless steel.
 - d. Provide Pneumatic Actuators used for OPEN/CLOSE application where fast action is required in accordance with Section 13445 – Pneumatic Controllers and Control Valves.
7. Solenoid Valves: Provide per Specification Section 11295.
8. Electric Motor Actuators: Provide per Specification Section 13447.

J. Electrical

1. Electrical components shall be provided in accordance with the requirements of Division 16, Electrical.
2. Three-phase, 60-Hz, 480 V ac power will be available for the membrane equipment.
3. Notwithstanding anything to the contrary in this specification, all variable frequency drives and motor control center equipment will be provided by the installation CMAR.
4. Each membrane train shall have its own remote input/output panel and control equipment independent from each other.
5. Electrical material and equipment shall have UL listing wherever standards have been established by that agency.
6. Complete electrical assembly shall meet all requirements of the National Electrical Code, the National Electrical Manufacturers Association (NEMA), the National Fire Protection Association (NFPA), all applicable state and local codes.

K. Instrumentation

1. Provide the following field instrumentation components in accordance with the requirements of Division 17.
 - e. Transmembrane pressure transmitters (1 per tank)

- f. Membrane tank level transmitters (1 per tank)
- g. Permeate turbidimeter panels (1 per tank)
- h. High pressure switches (1 per permeate pump)
- i. Suction pressure gauges (1 per permeate pump, 1 on CIP suction manifold)
- j. Discharge pressure gauges (1 per permeate pump)
- k. Magnetic flowmeter (1 per permeate pump, 1 on permeate manifold)
- l. Backpulse tank level transmitter (1 per backpulse tank)
- m. CIP tank level transmitter (1)
- n. CIP pump suction pressure gauge (1)
- o. CIP pump discharge pressure gauge (1)
- p. CIP pump magnetic flowmeter (1)
- q. CIP temperature transmitter (1)
- r. CIP chlorine and pH analyzer panel (1)
- s. Compressed air cleaning system panel that includes the following instruments:
 - (i) Pressure switch for MIT operation
 - (ii) Pressure gauge for MIT operation

L. Control System

- 1) The control system shall allow for complete automation of the Membrane Filtration System.
- 2) Provide control panels, PLC and Human Machine Interface hardware and software, Membrane Control System software package, data links with the Owner's Plant Control System, graphic display and configuration, instruments, and instrumentation and control components in accordance with Division 16 and 17.
- 3) Control system shall be provided for the functionality described in Specification Section 17454.

2.8 SPECIAL TOOLS

- A. The MSS shall furnish all special tools required for routine operation of the MFS. Special tools include the following:
- 1. Hand tools used for cassette and module removal (if required).
 - 2. Repair vessel and means to repair the membrane fibers/flat plate.
 - 3. Instrumentation and means to identify any required membrane repairs.

2.9 SPARE PARTS

- A. Procedures: See Section 01750 – Spare Parts and Maintenance Materials.
- B. Provide a "standard" spare parts list, including prices for all replaceable parts associated with the membrane equipment system, including the following at a minimum:
- 1. One spare set of expendable material such as gaskets, seals, and packing.
 - 2. One set of new and unused special tools required for installation, operation, and maintenance.
 - 3. One repair kit for sealing off damaged membrane fibers within the membrane module.
 - 4. All jigs, fixtures, clamps, lifting beams, hooks, and other instruments required facilitating the removal, disassembly, re-assembly, and installation of each item of equipment within the system.
 - 5. Reagents/chemicals, calibration sets, and spare parts as specified for individual equipment

- items or instruments.
6. Spare parts for instruments, PLC hardware and control devices as specified in Divisions 16 and 17.
- C. Provide recommendations for spare parts and materials for the first 12 months of facility specific system operation. Cross-reference with the spare parts list and provide a total cost for all recommended spare parts.
- D. Guarantee availability of "appropriate" spare parts as listed above or equivalent alternatives for a period no less than 20 years.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Supplier shall furnish installation instructions and recommendations to CMAR.
- B. The Supplier shall provide training to the CMAR for installation of membrane equipment. The training shall be conducted on-site by an authorized, experienced, employee of the Supplier.
- C. CMAR will install the membrane equipment system membrane cassettes, pumps, valves, and piping in accordance with Supplier's instructions and recommendations.
- D. An employee of the Supplier shall be present at the site to oversee the proper placement and installation of all equipment supplied by the Supplier for at least 2 weeks.
- E. The representative of the Supplier shall also be present to oversee the assembly installation of the associated anchor bolts for Supplier furnished equipment.
- F. The Supplier shall be responsible for identification of the volume and concentration of the membrane module storage solution and rinsing requirements for membrane modules.
- G. The CMAR shall be responsible for making any adjustments and/or modifications to the installation process that may become necessary to ensure that all equipment is properly installed and stored.
- H. The CMAR shall be responsible for rinsing and disposing of the membrane storage solution. CMAR shall be responsible for keeping the membranes wetted after removing the membranes from the storage solution.
- I. Supplier shall record location of each membrane module in each membrane tank with their respective serial numbers.
- J. CMAR shall clean all tanks and piping of construction debris prior to installing the membranes.
- K. After the installation is complete, the Supplier, CMAR, and Engineer shall jointly perform a

pre-commissioning inspection of the membrane equipment system. The inspection shall identify the following:

1. Mechanical:
 - a. Membrane units shall be completely installed and unit and interconnecting piping pressure tested.
 - b. The cleaning system shall be completely installed and pressure tested.
 - c. The compressed air system shall be completely installed and the piping pressure tested.
 - d. The air scour system piping shall be completely installed and the piping pressure tested.
 2. Electrical:
 - a. All local control panels shall be installed and terminations completed.
 - b. All 480, 120, and 24 VDC power supplies shall be connected and verified.
 - c. The documentation associated with the inspection of electrical terminations shall be provided by the CMAR to the Supplier.
 3. Instrumentation:
 - a. Instruments shall be properly installed and calibrated.
- L. The CMAR shall be responsible for making any adjustments and/or modifications to the installation process that may become necessary to ensure that all equipment is properly installed.
1. The inspection shall identify any equipment that has not been properly installed, detailing the outstanding installation issues on a "punch list" and noting the party who shall be responsible for each correction and identify the items that require correction before commissioning can begin.
 2. Once the corrections identified have been made, a "Notice of Completed. Installation" shall be issued by the Engineer and testing and commissioning shall commence.

3.2 TESTING AND COMMISSIONING

- A. Procedures: See Section 01650 – Starting of Systems and Section 01660 – Field Tests of Equipment.
- B. Following the Engineer's issuance of a "Notice of Completed Installation", the Supplier shall perform Component, System, and Operational Tests, on the membrane equipment system. It will be the responsibility of the Supplier and CMAR to communicate to arrange the times for testing and startup activities; however, the CMAR must confirm that these times are acceptable to the Owner.
- C. Component and System Tests:
1. Once written "Notice of Completed Installation" has been issued, Supplier shall coordinate with CMAR to perform Component and System testing of the membrane equipment system.
 2. To perform the Component and System Tests, the Supplier shall operate all valves, controls, and other devices to ensure they are functional and ready for performance testing.
 3. Purpose of the Component and System Test shall be to demonstrate the effectiveness of the following system components and features:
 - a. Automatic START/STOP and flow control of membrane trains using Plant Control System.
 - b. Manual flow control using membrane HMI and PLC.
 - c. Automatic backwashing at various time intervals.

- d. Automatic shutoff and alarm for various failure modes for each membrane train and for entire membrane equipment system.
- e. START and STOP of air system.
- f. Determination of clean water permeability of each membrane train and temperature correction of the clean water permeability for each train.
- g. Monitoring and recovery of operating data.
- h. Monitoring and control from remote workstation. (Remote workstations and connectivity to be provided by CMAR.)
- i. Automatic switchover from normal power to emergency power, and emergency power to normal power (if emergency power is provided, otherwise automatic restart from power fail).
- j. All control functions, both at local system and remote workstation.
- k. Operation of systems for Maintenance Cleans and Recovery Cleans.
- l. Operation of all monitoring instruments.
- m. Bubble point testing of the membrane modules.

D. Operational Test:

1. Following the Component and System Tests, the Supplier, CMAR, and Owner shall complete a 30 day Operational Test. The Supplier shall be on-site for the first and last week of the 30-day Operational Test plus additional 7 days of site time. The 30-day Operational Test shall be initiated following membrane system stabilization and completed during the 90 day Commissioning Period. During the Operational Test, the Supplier shall take the lead and be responsible to test the membrane equipment system, the CMAR shall be responsible for testing all other equipment associated with the secondary process as part of the overall plant testing, and the Owner shall provide assistance with controlling ancillary facilities.
2. Supplier shall submit the Operational Test Report within 21 days of completion of the test period.
3. To perform the test, the Supplier shall assist the Owner in continuously operating the membrane equipment system over a 30-day test period, and collect and summarize data to demonstrate that the system meets the performance test requirements for the parameters listed below. In all cases, compliance with the requirements of this Specification shall be determined for each calendar day, and to successfully pass the test, membrane equipment system must comply with requirements for each of the 30 days of the Operational Test:
 - a. Production Capacity: System meets production capacity requirements under conditions specified in Performance Requirements specified in Paragraph 2.3.C of these specifications.
 - b. Pressure Limitations: System operates within the TMP limit that is specified by the Supplier.
 - c. Membrane Permeate Quality: Membrane permeate quality meets requirements under conditions specified in Performance Requirements specified in Paragraph 2.3.D of these specifications.
 - d. Maintenance Clean: Perform Maintenance Clean at the frequency equal to or less than specified in Performance Requirements in this Section.
 - e. Recovery Clean: Perform the recovery clean operation at the end of the 30-day test period on one membrane train. Using the TMP and temperature corrected permeability data from the 30 day operation, the recovery clean interval when averaged over one year, shall not exceed the minimum frequency specified in Performance Requirements in this Section.
 - f. Control System: Verify that the PLC, Process Control, SCADA and network communications systems operate as intended. Verify that automatic transfer to redundant or backup systems is permitted, with operator intervention to restart or to re-

establish normal operation during weekday periods between 8:00 a.m. and 4:00 p.m. Any other manual intervention to restart or to re-establish normal operation of the control system is considered a system failure.

4. Successful completion of the Operational Test will be defined as 30 continuous days of operation and demonstration that system meets all performance requirements established herein.
5. A major failure in the system is one that decreases system capacity below 75 percent of design capacity for more than 24 hours, or, for control systems, a major failure is any event that requires operator intervention to restart or to re-establish normal system operation beyond that described above.
6. If membrane equipment system fails to successfully complete Operational Test, Supplier shall have the option of repeating the test over a second 30-day period:
 - a. If the system fails to successfully complete the Operational Test during second test period, Supplier shall prepare a written plan for modifying the system to meet all test requirements.
 - b. Supplier shall submit the written plan within 7 days after the second unsuccessful test period ends.
 - c. If in the opinion of the Owner, Supplier cannot modify or supplement its system to meet performance requirements specified herein, the Supplier shall remove their system and install an alternate membrane system as required to meet performance requirements at sole cost of Supplier. This requirement shall be secured by the Performance Bond.
7. During the Operational Test, CMAR and Owner shall have the option of collecting samples for independent analyses to confirm measurements and analyses conducted by Supplier.
8. Owner shall have the option of witnessing all testing performed by the Supplier.

E. Commissioning Period:

1. Compliance with the requirements for production capacity, chemical cleaning interval, and membrane permeate quality shall be determined during the Commissioning Period.
2. The Commissioning Period shall begin and end at Owner's discretion, within the limits defined herein:
 - a. The 30-day Operational Test may be concurrent with the Commissioning period.
 - b. Duration: 90 days.
3. Owner shall operate the plant during the Commissioning Period; however, Supplier and CMAR shall provide onsite assistance and remote support.
4. Supplier is responsible for monitoring operating conditions and performance during the Commissioning Period for the purpose of demonstrating compliance with the specified membrane equipment system performance requirements.
5. Supplier shall summarize data at the end of the Commissioning Period and prepare report results in writing to the Owner.
6. The Commissioning Period Report shall include a narrative description, tables, and graphs of production capacity, TMP versus time, maintenance clean and recovery clean frequency, permeate turbidity, permeate TSS concentration, and other parameters necessary to document the performance of the system and demonstrate compliance with the specified membrane equipment system performance requirements.
7. Supplier shall submit the Commissioning Period report within 30 days following the end of the Commissioning Period.
8. Owner and Engineer may conduct their own monitoring and record keeping during the Commissioning Period.
9. The following parameters shall be evaluated to determine compliance with specified membrane

equipment system performance requirements:

- a. Membrane Permeate Quality: If the system fails to comply with requirements for membrane permeate quality, Supplier shall provide to Owner a written plan of modifications to the membrane system (such as repairing damaged fibers, replacing seals, complete replacement of membrane system) to achieve compliance with the requirements. Upon implementation of plan of modifications, the Commissioning tests shall re-commence in its entirety.
 - b. Chemical Cleaning Interval: If the interval for Maintenance Cleans and Recovery Cleans during the Commissioning tests is shorter than the Supplier's proposed interval (not more frequently than required in this specification), and/or chemical usage is greater than the Supplier's initial estimates, Supplier shall pay Owner for total costs of additional chemicals that will be needed per year in a one-time payment based on the 20-year present worth using a 6 percent interest rate and a 3 percent inflation rate, and the cost per gallon of each chemical.
 - c. Production Capacity: Production capacity shall be reported in units of million gallons per day (mgd).
10. Successful completion of Commissioning concludes the Supplier's obligation regarding performance guarantees.
- F. Training: Provide training to Owner personnel as required for complete understanding of process, mechanical, electrical, and control system relationships. Refer to Paragraph 3.3.B of these Specifications. Training to be provided prior to the Operational Test.
- G. Telephone:
1. Provide telephone support by means of a toll-free phone number for a minimum period of 3 years following installation and startup.
 2. Provide a list of three or more names of individuals qualified to support operation, and provide mobile phone contact numbers for these individuals, if available.
 3. At least one of the listed individuals shall be available at all times including nights, weekends, and holidays in the event of an emergency.
- H. Internet Monitoring:
1. Provide internet monitoring service and support for a minimum period of 2 years following installation and startup.

3.3 MANUFACTURER'S FIELD SERVICES

- A. Provide onsite services in accordance with Section See Section 01650 – Starting of Systems and Section 01660 – Field Tests of Equipment, and as described herein.
- B. In addition to the time necessary to complete the requirements established elsewhere within these documents, Supplier shall provide the following during construction and testing:
 1. Provide onsite services for the WRF site at times designated by the Owner and CMAR, for the minimum person-days listed below, travel time excluded. If the minimum person-days and trips listed below are insufficient in the opinion of the Supplier, the Supplier shall recommend an alternative number of person-days and trips.
 2. Provide qualified individual who has previously provided onsite services for the installation, testing, and startup of Supplier's identical system of similar size.
 3. 2 person-days (one trip) to provide training to the Owner regarding unloading and installation of membrane equipment system, including attendance at a one day pre-delivery site meeting with the CMAR.

4. 10 person-days (two trips) for providing installation assistance, pre-commissioning inspection for the membrane equipment system, and Component and System Testing.
5. 30 days on-site assistance during the Operational Test.
6. 10 person-days (three trips) for additional assistance during the Commissioning Period.
7. 8 person-days (4 trips) for training of the Owner's operators including attendance at a 1 day pre-startup site meeting with the CMAR and the Owner and a 2-day review of operations at the end of the first year of operation.
8. Service time spent remedying equipment deficiencies/problems shall not count toward the listed service days and trips.
9. MFS Manufacturer shall provide itemized costs for their Manufacturer's Field Services identified above.

** END OF SECTION **

SECTION 13127

EXTRUDED FLAT PANEL COVERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Furnish all labor, materials, and equipment required to design, fabricate, deliver, and install a new extruded flat aluminum cover structure with all appurtenances required for a complete and operational installation.
 - 1. Membrane Trains 1 thru 4.
 - 2. Membrane Facility Common Influent Channel.
 - 3. CIP Tank.
- B. The enclosure shall be a flat cover structure conforming to the dimensions indicated on the Drawings, a rectangle aluminum structure with stainless steel structure members.
- C. All metal components of the aluminum structure shall be aluminum with cold-formed stainless steel. No galvanized, painted, or plated steel shall be used.
- D. The structure shall be designed as a substantially airtight system under all design load and temperature conditions. All raw edges of the aluminum panels shall be covered and sealed.
- E. The cover manufacturer shall provide 4 access hatches each for each Membrane Train. Coordinate pipe support attachments and penetrations as shown in the Drawings.

1.2 RELATED SECTIONS

- A. Drawings and General Provisions of the Contract, including General Supplementary Conditions apply to this Section.
- B. Section 01300, Submittals.
- C. Section 01640, Materials and Equipment.
- D. Section 01650, Starting of Systems.
- E. Section 09900, Painting.
- F. Division 13, Special Construction.

G. Division 15, Mechanical.

H. Division 16, Electrical.

1.3 REFERENCES

- A. Aluminum Association Specifications for Aluminum Structures.
- B. Aluminum Association Aluminum Design Manual, Specification, and Guidelines for Aluminum Structures.
- C. ASCE 8-90, Specification for the Design of Cold-Formed Stainless Steel Structural Members.
- D. ASTM C864-90, Standard Specifications for Performed Gasket and Sealing Material.
- E. ASTM F593, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.

1.4 SUBMITTALS

- A. Drawings describing the completed structure and all its components shall be submitted, complete with materials of construction and typical details. Drawings shall be sealed and signed by a qualified Professional Engineer registered in the State of Arizona.
- B. Records certifying the satisfactory inspection of all structural welds of aluminum components shall be submitted prior to delivery of all fabricated materials.
- C. Design calculations verifying conformance to deflection limits shall be submitted. Deflection calculations are required for structural members as well as walking surfaces.
- D. Descriptive and Operation and Maintenance Data submittals shall be made in accordance with the Data Reference Symbols defined in Section 01300, Submittals.
 - 1. Covers: Shop Drawings and O&M Manuals:
 - a. Letters of Certification of Compliance on materials, equipment, etc.
 - b. Final Certified Drawings showing outline dimensions, foundation layout or mounting information, and other pertinent dimensions.
 - c. Field erection instructions, assembly drawings and/or diagrams, detailed reference drawing lists, lists of erection details, and list of spare parts supplied with equipment.

- d. Shop Detail Drawings showing individual sub- assemblies and fabricated pieces with material specifications and other applicable data.
 - e. General bulletins and catalog cuts describing complete apparatus, including operating principles and fundamentals.
 - f. Materials of construction of all components.
- E. All equipment manufactures shall submit evidence of conformance with the Specifications as required by the individual Specifications Sections. Naming of a manufacturer in the Specifications is not an indication that the manufacturer's proposed or standard equipment is acceptable in lieu of the specified components and features. Naming is only an indication that the manufacturer may have the capability of engineering and supplying a system as specified.
- F. Before executing any of the Work in this Section prints or Drawings shall be submitted to the ENGINEER showing dimensions, sizes, thickness, gauges, materials, finishes, joint attachments, erection procedure, and thermal expansion allowances.
- G. A complete set of design calculations for the covers shall be submitted. These calculations shall be signed by a Registered Professional Engineer. All Work shall be fabricated and erected in accordance with the approved Drawings.
- H. Certification that the specified material alloys, sizes, and quantities have been furnished shall be submitted upon completion of the Project.
- I. Unit responsibility form not required for extruded flat panel covers.
- J. Each Shop Drawing Submittal shall include a hard copy of the relevant Specification Section and shall be clearly marked to indicate whether the requirements for equipment and/or services in the Specification Section are met by writing "accept" or "deviate" next to each Paragraph. If clarifications are needed to any of the Paragraphs in the Specification Sections due to deviations, they shall be addressed next to the Paragraph as such and explained further with any additional information necessary. If any exceptions and/or deviations are proposed to any of the Specifications, they shall be clearly noted as such in the Submittal, and an explanation of any deviation and/or exception shall be provided. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

PART 2 - PRODUCTS

2.1 DESCRIPTION

- A. The flat cover shall be clear-span and self-supporting from the peripheral structure. The aluminum cover shall be composed of panels and beams. All panels shall interlock with the adjoining beam and panels without the use of threaded fasteners. Uplift of each panel will be resisted with the use of an integral latch system. The use of structural members in contact with the contents of the basin is expressly prohibited. The flat cover shall consist of removable panels each weighing no more than 150 lbs. The required lifting force per panel shall not exceed the dead weight of the panel. Each panel must be able to be removed without needing to remove more than the two adjacent panels. The need for removing flashing or "hold-down" extrusions longer than the width of the panel is prohibited. The flat cover shall have an integral aggressively non-skid surface. Raised surfaces without the use of texturing to achieve slip resistant is not acceptable. The use of checkered plate, paint, tape, sandblasting, or other applied systems to achieve the slip resistant surface is expressly prohibited.
- B. The design shall prevent water pooling which may result in over-stressing the flat cover.
- C. Cover manufacturer shall provide access hatches, gravity vents, and pipe penetrations as shown on the Drawings.
- D. The removable closure panels shall be attached continuously along their edges to the structural members using an interlocking joint. Elastomeric weather seal gasket shall form a substantially airtight seal along the panel edges. The gaskets shall be fully enclosed to prevent ultraviolet exposure.
- E. Access to any location under the cover shall be gained through integral gear hinged access hatches. The Access Hatch Panels shall have the identical properties as the rest of the aluminum cover including loads, deflection and slip resistance specifications. The hinged access panels shall be the full panel width. The length of the access panel shall be clearly indicated on drawings. Hinged panel components including hinges, decking and lifting handles shall be extruded 6061-T6. While in the closed position the hatches will be completely flush therefore posing no tripping hazard. In the open position the panel shall lie flat on the cover and will not need a hold open device.
- F. The cover system shall be mounted on aluminum angle attached to the inside face of the concrete to match existing aluminum cover systems in appearance and functionality. No portion of the cover system shall be mounted to the top surface of the concrete wall. The aluminum angle shall be mounted at an elevation that provides a zero transition between the cover system and the top of concrete.

2.2 MATERIALS

- A. The following is a summary of approved materials and/or material specifications. All aluminum alloys shall be defined by the Aluminum Association and published in the Aluminum Standards and Data:
1. Bolts and Fasteners: All bolts and fasteners shall be 2024-T4 or 7075-T73 aluminum or Series 300 stainless steel.
 2. Structural Shapes: Aluminum structural shapes shall be alloy 6061-T6, 6005A-T6, or 6063-T6. Load supporting surfaces shall be of sufficient thickness to meet or exceed all loading requirements specified in this Section.
 3. Miscellaneous Shapes: Miscellaneous aluminum shapes shall be alloy 6061-T6, 6005A-T6, or 6063-T6.
 4. Gaskets: All gaskets shall be Neoprene conforming to ASTM C864-90, resistant to ozone and shielded from exposure to ultraviolet light.
 5. Sealant: All sealants shall be resistant to ozone and ultraviolet light and conform with Federal Specification TT-S-00230C.
 6. Anchors shall be epoxy-type. Expansion-type anchors are not permitted.

2.3 EXPERIENCE

- A. No equipment shall be supplied by any manufacturer not regularly engaged in the manufacturing and production of flat covers in the size and character herein specified. The manufacturer must have designed, manufactured and installed at least one roof of the same type and of similar size as units specified herein. This roof must be in satisfactory use for a period not less than five years.

2.4 DESIGN LOADS

- A. The entire flat cover shall be designed to sustain the loads specified herein, within the stress limitations of the Aluminum Association Specifications for Aluminum Structures.
- B. The load cases to be considered shall be those described below, unless more severe loads are specified by the purchaser.
1. Dead Load: The dead load shall be defined as the weight of the structure and all material permanently attached to and supported by the structure.
 2. Live Load: The uniform live load shall be the greater of 30 psf or the live load specified by the purchaser.
 3. Wind Load: The wind load shall be obtained by ASCE 7-98.
 4. Vacuum/Pressure Load: The vacuum load shall not exceed 3 psf.
 5. Panel Design Load: In addition to the above mentioned loads, the aluminum panels shall be designed for a 400 lb load distributed over 1 square foot at any location. These loads are to be taken as acting separately from one another and not simultaneously with the other design loads.

6. Load Combinations: The loads described above shall be applied to the flat cover in the following combinations:
 - a. Dead Load.
 - b. Dead Load, Uniform Live Load, and Vacuum Load.
 - c. Dead Load, Unbalanced Live Load, and Vacuum Load.
 - d. Dead Load, Wind Load, and Pressure Load.
 - e. Dead Load, Uniform Live Load, and Wind Load.
 - f. Dead Load, Unbalanced Live Load, and Wind Load.
7. Deflections: For the above loads and load combinations, the deflection of all components (structural and cladding) shall not exceed $L/240$ with L equal to the short span of the component. This deflection limit applies not only to the flat cover as a whole, but also to the skin of the cover spanning between the supporting edges of each panel or module. Calculations stamped by a Registered Professional Engineer shall be provided at the time of submittal to ensure that this requirement has been met.
8. Temperature: The load combinations listed above shall be considered for a temperature change of 100°F below the installation temperature and 100°F above the installation temperature and for a material temperature range of 40°F below zero to 160°F above zero.

2.5 CONNECTIONS

- A. In no case shall a joint be designed to sustain a greater total resultant shear force than that which would be allowed by summing the allowable shear force of the individual fasteners, based on their net cross-section areas through the shear plane and the allowable shear stress of the material. The use of manufacturers' test data to rationalize an increase in assumed fastener strengths is prohibited. In no case shall values greater than those published by the Aluminum Association and ASTM F593 for aluminum and stainless steel fasteners, respectively, be used. The allowable stresses are as follows:

<u>Fastener Material</u>	<u>Allowable Shear Stress</u>
Series 300 Stainless Steel	20% of Minimum Tensile Strength as published in ASTM F593
6061-T6 Aluminum	11 ksi
7075-T73 Aluminum	18 ksi

2.6 MANUFACTURERS

- A. Ultraflote Corp., Houston, TX.
- B. Conservatek Industries, Inc., Conroe, TX.
- C. Hallsten Corporation.

- D. Or approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. All Work shall be executed by skilled mechanics with a supervisor experience in the erection of flat covers. The flat cover shall be erected plumb and level and in proper alignment.
- B. Field refabrication of structural components or panels will not be accepted. Forcing of the structure to achieve fit-up during construction is expressly forbidden and not acceptable.
- C. All sealant joints shall be tooled slightly concave after sealant is installed. Care shall be taken to keep sealant confined to joint area, and any outside of the joint shall be moved so that the panels will be free from misplaced sealant. All gasket materials shall be continuous; splices will not be allowed between right angles.

3.2 WARRANTY

- A. The flat cover manufacturer shall warrant that the work described herein shall be free from defects (workmanship and material). The flat cover manufacturer shall replace or repair only faulty workmanship or defective material furnished by it that is reported to it within one year from the date of completion of this scope of Work.

END OF SECTION

SECTION 13445

PNEUMATIC CONTROLLERS AND CONTROL VALVES

PART 1 - GENERAL

1.1 SUMMARY

- A. Furnish and install all valves and valve accessories for water, non-potable water, wastewater, air, as indicated in the Drawings, as listed at the end of this Section, and as specified herein, including all appurtenances required for a complete and operational installation.

1.2 SECTION INCLUDES

- A. 3-way control valves.

1.3 RELATED SECTIONS

- A. Section 01300, Submittals.
- B. Section 01640, Materials and Equipment.
- C. Section 01650, Starting of Systems.
- D. Section 09900, Painting.
- E. Section 15050, Piping Systems.

1.4 REFERENCES

- A. National Electrical Manufacturers Association (NEMA):
 - 1. 250-Enclosures for Electrical Equipment (1000 V Maximum).
- B. All other applicable ASTM and ANSI Standards.

1.5 SUBMITTALS

- A. Descriptive submittals shall be made in accordance with the Data Reference Symbols defined in Section 01300, Submittals.
 - 1. All Valves: Shop Drawings and O&M Manuals:
 - a. Final Certified Drawings showing outline dimensions, foundation layout or mounting information, and other pertinent dimensions.
 - b. Field erection instructions, assembly drawings and/or diagrams, detailed reference drawing lists, lists of erection details, and list of spare parts supplied with equipment.
 - c. Shop Detail Drawings showing individual sub- assemblies and fabricated pieces with material specifications and other applicable data.

- d. Installation instructions, operating and/or service manuals, and all other data pertinent to operating or servicing the complete apparatus. Preventative maintenance instructions and recommended frequency.
 - e. General bulletins and catalog cuts describing complete apparatus, including operating principles and fundamentals.
 - f. Service data sheets showing design performance, utility requirements, etc., as applicable to the specific duty for which the equipment is furnished.
 - g. Materials of construction of all components.
 - h. Renewal parts list with diagrammatic or cross-section drawings showing part identification. Material analysis or trades designation for each significant part is to be noted on parts lists or on a separate sheet.
 - i. Stuffing box sizes; packing sizes; specifications and arrangement; and mechanical seal details, specifications, etc., if furnished in equipment.
 - j. Bearing manufacturer's standard identification and/or interchangeable number for all anti-friction bearings in the equipment proper and its accessory items.
- B. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
- C. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**

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PART 2 - PRODUCTS

2.1 MATERIALS

- A. Pneumatic temperature controllers:
 - 1. Manufacturers: One of the following or equal:
 - a. Fisher & Porter Company, Model 51-1401-TC11.
 - b. Bray Controls, Series 92/93.
 - 2. Design:
 - a. Temperature controllers: Pneumatic proportional type.
 - b. Controller: Include Class 1A, liquid filled, temperature measuring system and the following capabilities:
 - 1) A span of 100 to 200 degrees Fahrenheit.
 - 2) Measurement to within plus or minus 1.0 percent of the measuring span.
 - 3) Repeatability within 0.2 percent per span.
 - 4) Air output signal of 3 to 15 pounds per square inch gauge.
 - 5) Proportional band adjustable from 4.0 to 400 percent.
 - c. Provide controllers with reset adjustable from 0.2 to 25 minutes per repeat.
 - 1) Provide with external reset feedback connection to the reset bellows to prevent reset “wind-up”.
 - d. Provide and external set-point knob.
 - e. Provide selector relay valve where two temperature controllers are used to control the output of 1, 3-way control valve.
 - 3. Materials:
 - a. Enclosure: NEMA Type 4X with shatterproof glass in the case door.
 - b. Connecting tubing: Type 316 stainless steel with Type 302 or Type 304 stainless steel armor.
 - c. Measuring bulbs: Provide a flexible extension and a fixed union with Type 316 stainless steel well.
- B. 3-way control valves:
 - 1. Manufacturers: One of the following or equal:
 - a. Fisher Controls Company , “YO” type design with a Type 657 actuators.
 - b. Hammed-Dahl Control and Instrument Division of ITT Corporation, Model V830 with Hammel-Dahl A40A actuators.
 - c. Bray Controls, Series 63 with Series 50 Status Monitors.
 - 2. Design:
 - a. 3-way control valves: Suitable for diverging service and for operation in response to a signal transmitted by pneumatic temperature controllers.
 - b. Valve: Suitable for service under pressures equal to and less than 125 pounds per square inch gauge, and under a maximum temperature of 350 degrees Fahrenheit.

- c. Valve and actuator: Capable of seating against an unbalanced pressure of 30 pounds per square inch gauge, with a 3 to 15 pounds per square inch gauge, air signal supplied from the temperature controllers.
 - 1) Diaphragm on the actuator: Sized to operate with a 3 to 15 pounds per square inch gauge, pressure without a booster.
- d. Valve: Furnish with a valve coefficient not less than 243 at full travel and a valve coefficient of not less than 122 at mid travel.
- e. Plug: For throttling service with a V-port.
- 3. Materials:
 - a. Body, bonnet, and bottom flange: Cast-iron.
 - b. Trim: Type 316 stainless steel.
 - c. Packing, Teflon V-ring.

2.2 SHOP PAINTING

- A. The manufacturer shall paint all PVC valves to be installed in exterior exposure as follows:
 - 1. Surface Preparation: Clean, dry, and free of contaminants.
 - 2. Prime Coat: Series 66 H.B Epoxoline; one coat, 3-5 mils DFT.
 - 3. CONTRACTOR shall determine the quantity of each type of valve to the manufacturer.
 - 4. CONTRACTOR shall provide finished coat per Section 09900, Painting. Final color selection shall be approved by ENGINEER prior to application.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Workmanship shall be of the highest grade throughout and in accordance with the best standard practice for this type of equipment.
- B. Valves of the various types and pattern shall be installed at the respective locations as shown on the Drawings, listed in the Equipment Schedule, and specified herein. All appurtenances required for operation and control of the valves shall be included. Joints and connections shall be made in accordance with applicable requirements for pipe line or pipe joints. Valve stems shall be plumb and vertical unless otherwise specifically shown. Each valve shall be adjusted for smooth and easy operation and shall be watertight when placed in operation under maximum working pressure.

3.2 MANUFACTURER'S FIELD SERVICE

- A. Equipment Start-up: A factory trained representative of the manufacturer shall visit the site and provide installation and start-up services as specified in Section 01650, Starting of Systems. Sales representatives shall not be acceptable to perform start-up and training functions.

- B. Training: A factory employed representative of the manufacturer shall visit the site and provide operator training services, in addition to equipment start-up services, as specified in Section 01650, Starting of Systems.

END OF SECTION

SECTION 13447

ELECTRIC MOTOR ACTUATORS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes: Electric motor-driven actuators for valves and gates as identified in the valves and gate schedule as MOV or EDR (Electric Discrete Run Open / Run Close Valve Actuator), except for specialty actuators specified with individual valves.
- B. Related sections:
 - 1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
 - 2. It is the Contractor's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of Contractor's Work.
 - 3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the Contractor to see that the completed Work complies accurately with the Contract Documents.
 - a. Section 11285 - Hydraulic Gates and Stop Logs.
 - b. Section 11295 - Hydraulic Valves.
 - c. Section 16225 - Electric Motors 250 Horsepower or Less.
 - d. Section 09900 - Painting.

1.2 REFERENCES

- A. American Water Works Association (AWWA):
 - 1. AWWA C504 - Rubber-Seated Butterfly Valves.
 - 2. AWWA C542 - Electric Motor Actuators for Valves and Slide Gates.
- B. FM Global (FM).
- C. National Electrical Manufacturers Association (NEMA):
 - 1. MG-1 Standard for Electrical motors.
- D. Underwriters Laboratories (UL) - UL 674, UL 1004.

1.3 DEFINITIONS

- A. NEMA:
 - 1. Type 4X enclosure in accordance with NEMA 250.
 - 2. Type 7 enclosure in accordance with NEMA 250.

1.4 SUBMITTALS

- A. Product data:
 - 1. Electrical ratings:
 - a. Voltage and number of phases.
 - b. Starting and running current.
 - c. Voltage levels and source for control and status.
 - 2. Description of integral control interface.
 - 3. Integral and remote control station components.
 - 4. Environmental ratings, including NEMA enclosure rating and submergence capabilities.
 - 5. Gear ratios for both manual and motorized actuation.
 - 6. Opening and closing directions.
 - 7. Allowable starts per hour.
 - 8. List of all included options and accessories.
 - 9. Full travel times.
 - 10. Gearbox data including gear ratio, and gearbox efficiency.
 - 11. Affidavit in accordance with AWWA C542.
- B. Shop drawings:
 - 1. Wiring diagrams:
 - a. Include all options and expansion cards furnished with each actuator.
 - 2. Dimensioned drawings of each valve and actuator combination.
 - 3. Dimensioned drawings of each valve gearbox.
 - 4. Electric motor data.
- C. Calculations: Submit the following for each valve/gate size and class:
 - 1. Operating torque calculations.
 - 2. Maximum torque calculations for seating and unseating.
 - 3. Maximum operating torque at starting and normal operation.
 - 4. Indicate factor of safety for all torque calculations.
- D. Test reports:
 - 1. Factory test report and certificate.
- E. Manufacturer's instructions:
 - 1. Include manufacturer's instructions, description of system operation, start-up data and troubleshooting check lists.
- F. Operations and maintenance data:
 - 1. Include manufacturer's literature; cleaning procedures, replacement part lists, wiring diagrams, and repair data.
 - 2. Include a list of all configurable parameters, and the final values for each.
 - 3. List of recommended spare parts.
 - 4. List of special tools necessary for proper operation and/or maintenance.
 - 5. Exploded view drawings that illustrate all assemblies, sub-assemblies, and components.

6. Routine test procedures for all electronic and electrical circuits.
 7. Troubleshooting chart covering the complete valve and controls/electrical power systems, showing description of trouble, probable cause, and suggested remedy.
 8. Certified factory and field-test results.
- G. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
- H. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**

1.5 QUALITY ASSURANCE

- A. Obtain required information from the valve/gate supplier, including but not limited to:
1. Interface to gate or valve.
 2. Operating range:
 - a. Quarter turn or multi-turn.
 - b. Required turns for full travel on multi-turn applications.
 3. Direction of rotation for opening and closing.
 4. Maximum and normal torque requirements.
- B. All motorized, intelligent actuators shall be the product of a single manufacturer for all valve and gate applications on this project, regardless of gate or valve type, manufacturer, or supplier.

1.6 WARRANTY

- A. Refer to Contract Document 01010 – Summary of Work.

1.7 SPARE PARTS

- A. Provide the following spare parts (minimum 10 percent of total number of actuators of each model type furnished, but not less than 1 for each model of actuator furnished):
 - 1. Stem nut.
 - 2. Worm shaft subassembly.
 - 3. Drive sleeve subassembly.
 - 4. Complete actuator seal kit.
 - 5. Actuator gearbox oil (sufficient quantity to fill 4 gearboxes).
 - 6. Encoder.
 - 7. Control module.
- B. Provide 1 spare motor for each size motor furnished.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable manufacturers for lines 3 inches and smaller:
 - 1. RCI:
 - a. RCEL-005L, with Receptacle (quarter-turn)
 - 2. Hayward:
 - a. Series EJM (quarter-turn).
 - 3. Rotork:
 - a. ROM Series (quarter turn).
 - 4. Rotork:
 - CVA Series (multi- turn).
- B. Acceptable Manufacturers for lines 4 inches and larger, and actuated gates:
 - 1. Rotork Controls, Inc.:
 - a. IQ (multi-turn).
 - b. IQT (quarter-turn).
 - 2. Limitorque Corporation:
 - a. Accutronix MX (multi-turn).
 - b. Accutronix QkX (quarter-turn).
 - 3. Or equal from EIM Corporation.

2.2 MANUFACTURED UNITS

- A. Actuators for valves 3 inches and smaller:
 - 1. Provide actuators complete and operable with all components and accessories required for operation.

2. Power supply:
 - a. 120 VAC.
 - b. Valve motion independent of power supply phase rotation.
3. Size actuator to move valves from full open to closed position within the time indicated in the Motorized Actuator Schedule:
 - a. If an operating time is not indicated on the Schedule, size the actuator to move valves at minimum 12 inches per minute under maximum load. Measure rate of closure for valves at maximum diameter of disc, plug, or ball.
4. Control inputs:
 - a. Capable of using discrete 120 VAC and 24VDC inputs, as shown on DRAWINGS.
 - b. Isolated inputs capable of operating from external control voltage source
 - c. Provide for the following control inputs:
 - 1) OPEN.
 - 2) CLOSE.
5. Status outputs:
 - a. Dry contact outputs configured for the functions indicated on the Drawings. Provide the following outputs for all actuators:
 - 1) FULLY CLOSED.
 - 2) FULLY OPEN.
 - b. All output contacts rated for minimum 3 amps, 120 VAC.
6. Analog input:
 - a. Provide a 4-20 milliamp analog input for analog modulating valves when indicated on the Drawings.
 - b. Modulate valve to maintain position based on analog input value.
 - c. Maximum input impedance 250 ohms.
7. Analog output:
 - a. Provide an isolated 4-20 milliamp analog output when indicated on the Drawings.
8. Materials:
 - a. Construct motorized actuators of materials suitable for the environment in which the valve or gate is to be installed.
9. Components:
 - a. Motors:
 - 1) Specifically designed for valve actuator service with high starting torque, totally enclosed non-ventilated construction.
 - 2) Torque ratings equal to or greater than that required for valve seating and dynamic torques with a 25 percent factor of safety.
 - 3) Rated for operating under the following conditions without exceeding temperature limits with ambient temperature of 40 degrees Celsius.
 - a) Continuous operation for 15 minutes or twice the open-to-close operating time (whichever is greater) at normal operating torque or 33 percent of maximum torque (whichever is greater).

- b) 60 starts per hour for open/close service or 1,200 starts per hour for modulating service.
 - b. Enclosures:
 - 1) Actuator housing ratings as indicated in the Motorized Actuator Schedule.
 - 2) Stainless steel external fasteners.
 - 3) Provide the following minimum enclosure ratings:
 - a) NEMA Type 4X for outdoor, wet or corrosive area applications.
 - b) NEMA Type 7 certified by FM for Class I, Division 1, Groups C, D, E, F and G, for actuators installed in Class I, Division 1 and 2 areas.
 - c. Manual Override:
 - 1) Allen key operation.
 - d. Gearing: Hardened alloy steel spur or helical gears and self-locking, alloy bronze worm gear set:
 - 1) Accurately cut to assure minimum backlash.
 - e. Bearings:
 - 1) Anti-friction bearing with caged balls or rollers throughout.
 - 2) Sealed-for-life type thrust bearings housed in a separate thrust base.
 - f. Drive bushing:
 - 1) Easily detachable for machining to suit the valve stem or gearbox input shaft.
 - 2) Positioned in a detachable base of the actuator.
- B. Actuators for valves 4 inch and larger, and actuated gates:
 - 1. Provide actuators complete and operable with all components and accessories required for operation.
 - 2. Power supply:
 - a. Voltage and phases as indicated on the DRAWINGS and/or Valve and Gate Actuator Schedule.
 - b. Valve or gate motion independent of power supply phase rotation.
 - 3. Size actuator to move gates or valves from full open to closed position within the time indicated in the Valve and Gate Actuator Schedule:
 - a. If an operating time is not indicated on the Schedule, size the actuator to move gates or valves at minimum 12 inches per minute under maximum load.
 - b. Measure rate of closure for valves at maximum diameter of disc, plug, or ball.

4. Control interface:
 - a. Configuration:
 - 1) Provide a non-intrusive, non-contacting interface for configuring all input and output settings, control values, ranges, torque switch settings, valve positions switch settings, and options.
 - a) Configurable from a hand-held configuring tool or input devices on the actuator.
 - b. Local interface, integral to actuator:
 - 1) Selector switches:
 - a) Local-Off-Remote:
 - i. Motor actuator operation is prevented with the switch in OFF.
 - b) Open-Close:
 - i. Controls the valve when Local-OFF-Remote is in LOCAL.
 - ii. Spring return to center.
 - iii. Configurable between maintained (actuator runs until end of travel, high torque, or a local-stop-remote is switched to STOP) and momentary (actuator stops when lever is released).
 - c. Control inputs:
 - 1) Capable of using 120 VAC or 24 VDC inputs, as shown on DRAWINGS.
 - 2) Controls the valve when Local-OFF-Remote is in REMOTE.
 - 3) Isolated inputs capable of operating from external control voltage source or internal power supply:
 - a) Furnish control power supplies within the actuator.
 - 4) Provide the following inputs:
 - a) OPEN.
 - b) CLOSE.
 - c) OFF.
 - d) OPEN and CLOSE inputs configurable between maintained (actuator runs until end of travel, high torque, or a OFF input) and momentary (actuator stops when command is removed).
 - d. Status outputs:
 - 1) Monitor relay output: Dry contact, normally closed, opens when actuator is not in REMOTE or in the event of any internal fault or alarm condition.
 - 2) Dry contact outputs configured for the functions indicated on the Drawings. Provide the following outputs for all actuators:
 - a) FULLY CLOSED.
 - b) FULLY OPEN.
 - c) Local-Off-Remote in REMOTE position.
 - 3) All output contacts rated for 5 amps, 120 VAC and 24 VDC.

- e. Analog input:
 - 1) Provide a 4-20 milliampere analog input for analog modulating valves when indicated on the Drawings.
 - 2) Modulate valve to maintain position based on analog input value.
 - 3) Maximum input impedance 250 ohms.
- f. Analog output(s):
 - 1) Provide an isolated 4-20 milliampere analog outputs when indicated on the Drawings:
 - a) Loop power sourced from the actuator power supply.
 - b) Capable of driving into a load up to 500 ohms.
 - c) Output proportional to process value(s) indicated on the Drawings.
 - d) Valve or gate position.
 - e) Operating torque.

2.3 FEATURES

- A. Time delay on reversal: Incorporate time delay between stopping actuator and starting in opposite direction to limit excessive current, torque, and heating from instantaneous reversal.

2.4 MATERIALS

- A. Construct motorized actuators of materials suitable for the environment in which the valve or gate is to be installed.

2.5 COMPONENTS

- A. Motors:
 - 1. Specifically designed for valve actuator service with high starting torque, totally enclosed non-ventilated construction.
 - 2. Torque ratings equal to or greater than that required for valve seating and dynamic torques with a minimum of 25 percent factor of safety:
 - a. Design requirements for rubber-seated AWWA butterfly valves:
 - 1) Design valves and actuators for maximum operating torque, in accordance with and using safety factors required in AWWA C504 and AWWA C542:
 - a) Valve actuator torque requirement for open-close service: Not less than the required valve-seating and dynamic torques under design operating conditions in accordance with AWWA C504.
 - b) Valve actuator torque requirement for modulating service: Not less than twice the required valve dynamic torque under design operating conditions in accordance with AWWA C504.
 - b. Design requirements for slide gates, gate valves, knife gate valves, globe valves, and diaphragm valves:
 - 1) Design valves and actuators for maximum operating torque, in accordance with and using safety factors required in AWWA C542.

- 2) Design for the maximum torque and thrust running load over the full cycle.
 - 3) Maximum torque or thrust rating: The actuator stall torque or maximum thrust output shall not exceed the torque or thrust capability of the valve or gate, as determined by the valve or gate manufacturer.
 3. Capable of being removed and replaced without draining the actuator gear case.
 4. Motor bearings shall be amply proportioned of the anti-friction type and permanently lubricated.
 5. Rated for operating under the following conditions without exceeding temperature limits with ambient temperature of 40 degrees Celsius:
 - a. Continuous operation for 15 minutes or twice the open-to-close operating time (whichever is greater) at normal operating torque or 33 percent of maximum torque (whichever is greater).
 - b. 60 starts per hour for open/close service or 1,200 starts per hour for modulating service.
 6. Provide the following motor protection features:
 - a. Jammed valve (no valve motion detected through a time delay).
 - b. High motor temperature (sensed by embedded thermostats).
 - c. High torque.
 - d. Single phasing protection for 3-phase motors.
- B. Enclosures:
1. Actuator housing ratings as indicated in the Valve and Gate Actuator Schedule.
 2. Stainless steel external fasteners.
 3. Provide seals for each of the following areas:
 - a. Between the terminal compartment and the internal electrical elements.
 - b. Between the mechanical and electrical portions to protect from the ingress of oil, and to protect the mechanical components of oil from dust and moisture when the electrical terminal is open.
 4. Provide the following minimum enclosure ratings:
 - a. NEMA Type 4X for general applications.
- C. Position sensing:
1. Integral with valve actuator.
 2. Gearing: Intermittent type; bronze or stainless steel; grease lubricated; totally enclosed.
 3. Contacts: Heavy duty and silver-plated with wiping action or encoder wheel.
 - a. Remote indication contacts: As indicated on the Drawings.
 4. Switches: Adjustable; allowing for trip points from fully open to closed positions of valve travel; not subject to breakage or slippage due to over travel; permits visible verification of switch position without disassembly.
 5. Capable of retaining position and monitoring valve or gate motion when valve is manually actuated and when main power is not present.

6. Valve range and position switch outputs field adjustable.
- D. Torque sensing:
1. Capable of interrupting control circuit in both opening and closing when valve torque overload occurs.
 2. Silver-plated contacts.
 3. Graduated dials for both open and close directions of travel, each independently adjustable or 0-100 LTD display.
 4. Positive means to limit adjustability to avoid exceeding actuator output torque capability with solid-state sensor embedded within the torque transducer.
 5. Permits visible verification of switch position without disassembly.
 6. Torque shutdown setting: 40 percent to 100 percent rated torque:
 - a. Adjustable in 1 percent increments.
 7. Capable of interrupting control circuit during both opening and closing and when valve torque overload occurs.
 8. Independent of variations in frequency, voltage, or temperature.
 9. Provide a temporary inhibit of the torque sensing system during unseating or during starting in mid-travel against high inertia loads.
- E. Manual actuators:
1. Hand wheel for manual operation:
 - a. Maximum 80-pound pull on rim when operating gate or valve under maximum load.
 - b. Provide pull chain when motorized actuator is located more than 6 feet above floor surface.
 - 1) Chain shall be of sufficient length to reach approximately 4 feet above the operating level.
 - 2) Where the chain obstructs an aisle or walkway, provide holdback or other means to ensure chain does not create a nuisance or hazard to operating personnel.
 2. Declutch lever: With padlock, capable of mechanically disengaging motor and related gearing and freeing hand wheel for manual operation.
- F. Gearing: Hardened alloy steel spur or helical gears and self-locking, alloy bronze worm gear set:
1. Accurately cut to assure minimum backlash.
- G. Bearings:
1. Anti-friction bearing with caged balls or rollers throughout.
 2. Sealed-for-life type thrust bearings housed in a separate thrust base.
- H. Drive bushing:
1. Easily detachable for machining to suit the valve stem or gearbox input shaft.
 2. Positioned in a detachable base of the actuator.

- I. Lubrication:
 - 1. Provide totally enclosed actuator gearing with oil filled gear case suitable for operation at any angle.
 - a. Suitable for standard SAE80EP gear oil.
 - 2. Actuators requiring special or exotic lubricants are not acceptable.
 - 3. Provide seals for all shafts.

2.6 ACCESSORIES

- A. Setting tool:
 - 1. If required for setting or configuring the actuator, provide a hand-held setting tool.
 - a. Furnish 1 setting tool for every 10 actuators.
 - b. Capable of communicating with PC-based configuration software, and transferring the following in either direction between the computer and programmer and setting tool, and between the setting tool and actuator.
 - c. Actuator configurations:
 - 1) Capable of storing up to ten different configurations.
 - d. Diagnostic data.
 - 1) Capable of storing 4 complete sets of diagnostic data.

2.7 SOURCE QUALITY CONTROL

- A. Factory test:
 - 1. Test each actuator in the factory, and submit an individual test certificate for each actuator.
 - 2. Perform a high potential test and record the following information:
 - a. Test voltage.
 - 3. Simulate a maximum and typical valve loads and record the following information:
 - a. Current and power factor at maximum and set torque values.
 - b. Torque as measured by the actuator.
 - c. Actuator output speed or operating time.
 - 4. Performance testing: Conduct performance test for each actuator simulating valve operating torque from full-open to full-close and from full-close to full-open. The following information shall be recorded during each performance test:
 - a. Torque at maximum torque setting.
 - b. Current at maximum torque setting.
 - c. Test voltage and frequency.
 - d. Actuator output speed and operating time for full-open to full-close.
 - e. Amperage draw on motors at breakaway and under normal operation.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install actuators in accordance with manufacturer's instructions.

3.2 MOTORIZED ACTUATOR SCHEDULE

- A. Provide all actuators required by the Drawings. Major process actuators are listed in the Valve and Gate Actuator Schedule. The schedule does not include all number and types of actuators required for the Project.
- B. Abbreviations relating to type:
 - 1. BFV = Butterfly Valve.
 - 2. BV = Ball Valve.
 - 3. PV = Plug Valve.
 - 4. SG = Slide Gate.
 - 5. KGV = Knife Gate Valve.
 - 6. TSV = Telescoping Valve.
- C. Abbreviations relating to actuator type:
 - 1. O/C = Open and Close Service.
- D. Abbreviations relating to controls:
 - 1. MB = Modbus RTU (RS-485).
 - 2. NET = Manufacturer's proprietary network.
 - 3. A = Analog (4-20 mA) control, modulating duty.
 - 4. D = Discrete control, modulating duty.
 - 5. D-O/C = Discrete Open/Close.

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SECTION 15062

STEEL PIPE

PART 1 - GENERAL

1.1 SUMMARY

- A. Scope:
 - 1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified, and required to furnish and install steel pipe and fittings.
 - 2. The extent of steel pipe to be provided is shown on the Drawings and in the Schedules included in Sections 15051, Buried Piping Installation, and 15052, Exposed Piping Installation.

1.2 RELATED SECTIONS

- A. Section 09900, Painting.
- B. Section 15050, Piping Systems.
- C. Section 15051, Buried Piping Installation.
- D. Section 15052, Exposed Piping Installation.
- E. Section 15066, Stainless Steel Pipe.
- F. Section 15120, Piping Specialties and Accessories.
- G. Section 15140, Supports and Anchors.

1.3 REFERENCES

- A. Manufacturer Qualifications:
 - 1. Manufacturer shall have a minimum of five years of experience in the production of steel pipe and fittings and shall show evidence of satisfactory service in at least five installations.
 - 2. Steel pipe and fittings shall be the product of one manufacturer.
- B. Reference Standards: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
 - 1. ASTM E96, Test Method for Water Vapor Transmission of Materials.
 - 2. ASME B16.5, Pipe Flanges and Flanged Fittings.
 - 3. ANSI B36.10, Welded and Seamless Wrought Steel Pipe.
 - 4. ASTM A53, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
 - 5. ASTM B209, Aluminum and Aluminum Alloy Sheet and Plate.

6. ASTM A194, Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature service.
 7. ASTM C921, Determining properties of Jacketing materials for Thermal Insulation.
 8. ASTM A234, Piping Fittings of Wrought Carbon steel and Alloy steel for moderate and high temperatures.
 9. ASTM C547, Mineral Fiber Pipe installation.
 10. ASTM A36, Carbon Structural Steel.
 11. ASTM C150, Portland cement.
 12. ASTM A193, Alloy-Steel and Stainless steel bolting for High Temperature or High Pressure service and other Special purpose applications.
 13. ASTM A307, Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
 14. AWWA C200, Steel Water Pipe 6-inches and Larger.
 15. AWWA C203, Coal-Tar Protective Coatings and Linings for Steel Water Pipelines-Enamel and Tape-Hot Applied.
 16. AWWA C205, Cement-Mortar Protective Lining and Coating for Steel Water Pipe - 4-inches and Larger - Shop Applied.
 17. AWWA C206, Field Welding of Steel Water Pipe.
 18. AWWA C207, Steel Pipe Flanges for Waterworks Service - Sizes 4-inches through 144-inches.
 19. AWWA C208, Dimensions for Fabricated Steel Water Pipe Fittings.
 20. AWWA C209, Cold-Applied Tape Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines.
 21. ASME B1.1, Unified Tech Screw Threads.
 22. ASME B16.21, Nonmetallic Flat Gaskets for Pipe Flanges.
- C. Verification of Field Conditions: Verify and, if required, correct indicated dimensions and sizes of pipe connections by field measurement prior to preparation of design drawings and fabrications of shop fabricated pipe.

1.4 SUBMITTALS

- A. Shop Drawings: Submit for approval the following:
1. Detailed Drawings and data on pipe, fittings, gaskets, and appurtenances. Submit these with Shop Drawings required under Section 15052, Exposed Piping Installation.
 2. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or

services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

3. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**

- B. Certificates: Submit Certificates of Compliance with referenced standard.
- C. Design calculations, including determination of wall thickness satisfactory for external loading, special loading, and internal pressure. The design calculations shall be signed and sealed by a Registered Professional ENGINEER licensed in the State of Arizona.
- D. Mill certificates for cement used in fabrication of piping.
- E. Test reports for rubber gaskets for the characteristics specified hereinafter.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Refer to Section 15052, Exposed Piping Installation.

PART 2 - PRODUCTS

2.1 DESIGN CONDITIONS FOR LIQUID SERVICE PIPE 24-INCHES AND LARGER

- A. Pipe and fittings shall be designed by CONTRACTOR.
- B. Design shall be in accordance with the recommended procedures in AWWA Manual M11, as complemented and modified herein. A design pressure of 150 psi for pipes larger than 16-inches and 200 psi for pipes 16-inches and smaller shall be used in equation 4-1 of AWWA Manual M11.
- C. Joints shall be welded by the CONTRACTOR per AWWA Manual M11.
- D. Thickness of pipe, fittings, and specials shall be the thicker of:
 1. The thickness designed in accordance with the design methods specified in the preceding Paragraph 2.1.B.
 2. The thickness specified in the following:
 - a. For pipes 26-inches and less in nominal diameter, not less than 3/8-inch.

- b. For pipes more than 26-inches and less than 38-inches in nominal diameter, not less than 0.5-inch.
 - c. For pipes 38-inches to and less than 56-inches in nominal diameter, not less than 5/8-inch.
 - d. For pipe 56-inches to and including 72-inches in nominal diameter, not less than 13/16-inch.
- 3. A D/t ratio (diameter over thickness) of 240.
- E. The working stress for steel used for fabrication of pipe shall not exceed 50% of the yield stress, or 18,000 psi, minimum.
- F. The laying lengths shall not be longer than 40 feet and not shorter than 20 feet, except as follows:
 - 1. Laying length of pipe shall be not longer than 40 feet.
 - 2. Short pieces shall be provided as necessary for curves, closures, and to locate fittings and specials.
- G. Longitudinal and girth seams for straight seam pipe shall be no greater in number than would be required for the fabrication of pipe with 96-inch by 120-inch steel plates.
 - 1. Longitudinal seams shall be offset at the girth seams.
- H. Where piping is designated to be flanged or welded in order to restrain thrust, the design of the cylinder and flange or welded joint shall take into account the effect of stresses caused by thrust loads.
- I. Steel cylinder shall be subjected to no more than 50% of the yield stress.
- J. Design steel pipe and welds between pipes for the axial thrust exerted by full working pressure. All joints shall be restrained.
- K. Nominal pipe diameter refers to the outside diameter for steel pipe smaller than 45-inches and the inside diameter for steel pipe 45-inches and larger. Nominal pipe diameters are prior to any coating or linings to be applied.

2.2 DETAILED REQUIREMENTS - LIQUID SERVICE

- A. Steel pipe shall be ASTM A36. Thickness class shall be as follows, except as shown on the piping schedule:
 - 1. Exposed Pipe:
 - 2. 12-inches and Smaller: Minimum 3/8-inch wall thickness.
 - 3. 24-inches and Larger: Refer to Paragraph 2.1.
- B. Material, manufacturing operations, testing and inspection of pipe shall be in conformance with applicable portions of AWWA C200.

- C. All special sections and fittings shall be made with component parts having the dimensions, ends, and other details as shown and as herein specified. All fittings shall have the same minimum wall thickness as the pipe.
- D. Galvanized steel pipe shall conform to ASTM A53, latest revision, Schedule 40 and shall be hot-dip galvanized. Fittings shall be hot-dip galvanized malleable iron.
- E. Mechanical Coupled Joints: Outside ends shall be free from surface defects and shall have welds ground to surface smooth for a sufficient distance from the end. Pipe shall be grooved for a segmental, clamp type, mechanical coupling, whose housing shall enclose a U-shaped rubber gasket. The housing shall lock pipe ends together to prevent end movement.
- F. Flanged Joints: Pipe ends shall be fitted with steel pipe flanges in accordance with AWWA C207. Flange shall be AWWA Standard steel ring type Class D. Flanges shall be attached to pipe by means of two fillet welds. Gasket shall have full face, one-piece construction of rubber, 1/16-inch thick for pipe 12-inches in diameter and smaller and 3/32-inch thick for pipe larger than 12-inches. Buried or submerged bolts and nuts shall be Type 316 stainless steel.
- G. Welded Joints: Joints shall be lap joints, unless otherwise specified. The field welding of the joints shall meet the applicable requirements of AWWAC206. Lugs shall be welded to the pipe where required for harnessing of flexible couplings. The lugs shall be as required by the manufacturer of the couplings.
- H. Threaded Joint: Steel pipe less than 4-inches in diameter shall be furnished, unless otherwise shown or specified, with threaded end and line couplings. Threads shall conform to ANSI B2.1, tapered threads 3/4-inch per foot. Use Teflon tape on threaded joints.
- I. Fittings: Fittings shall be fabricated of the same material as the pipeline of which they are a part. Unless otherwise shown or approved, all fittings shall conform to AWWA C208.
- J. Couplings:
 - 1. Sleeve Type, Flexible Couplings:
 - a. Pressure and service shall be the same as connected piping.
 - b. Materials: Steel.
 - c. Gaskets: Suitable for specified service.
 - d. Bolts and Nuts: Alloy steel, corrosion-resistant, prime coated. Buried couplings shall have Type 316 stainless steel bolts and nuts.
 - e. Harnessing:
 - 1) Harness all couplings to restrain all pressure piping.

- 2) Dimensions, sizes, spacing, and materials for lugs, tie bolts, washers, and nuts shall conform to the standards of the manufacturer for the pipe size, wall thickness, and working pressure required.
- 3) No less than two bolts shall be furnished for each coupling.
- 4) Flexible couplings for flanged steel pipe shall be harnessed with tie bolts and lugs conforming to AWWA Manual M11 "Steel Pipe Design and Installation".
- 5) Lugs shall be fabricated from steel equal to or better than that specified for the pipe to be harnessed. The lugs shall be shop welded to the pipe.
- 6) Lugs and tie bolts shall be designed for 150% of the piping system test pressure specified in Section 15051, Buried Piping Installation, and Section 15052, Exposed Piping Installation.
- 7) Tie bolts, nuts, and washers shall be ASTM A193, Grade B7, steel or better.
- f. Product and Manufacturer: Provide couplings as manufactured by one of the following:
 - 1) Dresser Industries, Style 38.
 - 2) Rockwell International Corporation.
 - 3) Or approved equal.
2. Flanged Adapters:
 - a. Pressure and service shall be the same as connected piping.
 - b. Materials: Steel.
 - c. Bolts and Nuts: Alloy steel, corrosion-resistant. Buried adapters shall have Type 316 stainless steel bolts and nuts.
 - d. Harnessing:
 - 1) Flanged coupling adapters for steel pipe shall be harnessed by using tie bolts and lugs as specified for flexible couplings.
 - e. Product and Manufacturer: Provide flanged adapters as manufactured by one of the following:
 - 1) Dresser Industries Style 128.
 - 2) Rockwell International Corporation.
 - 3) Or approved equal.
- K. Coatings and Linings:
 1. The exterior of exposed steel pipe shall receive a commercial blast cleaning according to Steel Structures Painting Council, SSPC-SP-6. Immediately after cleaning, the pipe surface shall be prime coated in the shop. Paint system shall be in accordance with the requirements of Section 09900, Painting.
 2. Where specified in Section 15052, Exposed Piping Installation, interior of pipe shall be cement mortar lined. The lining shall be shop applied and meet the applicable requirements of AWWA C205. Lining shall be twice the standard thickness.

2. Cement shall conform to ASTM C150, Type II Low Alkali.

2.3 STEEL PIPE AND FITTINGS FOR AIR SERVICE

- A. This Section of the Specification covers the steel pipe for air service. See Section 15052, Exposed Piping Installation, and Drawings locations.
- B. Steel pipe for air service (blower buildings) shall be welded Schedule 10S with standard thickness conforming to API 5LB, ANSI B36.10, and ASTM A53.
 1. Compound shall be suitable for the service and shall be provided maximum protection against corrosion and leakage. Steel pipe for air services shall not have any internal lining or coating. Steel pipe has been proposed for Centrifugal blower suction and discharge piping.
- C. Steel fittings shall conform to ASTM A234, shall be welded type, and shall be Schedule 10.
- D. Where flanged joints are required for steel pipe, faced slip-on or weld neck type flanges shall be furnished and shop welded to the pipe, special, or fittings. Flanges shall be 150 lb forged and rolled steel conforming to ASME B16.5. Flanges shall be back faced or spot faced on the back for bolt heads and nuts. Flanged bolts for use with steel flanges shall be of carbon steel conforming to ASTM A307, Grade B. Nuts shall be of the cold-pressed type conforming to ASTM A194, Grade 1. Bolts and nuts shall be threaded in accordance with ASME B1.1 for coarse thread series, Class 2 fit. Gaskets shall be 1/16-inch compressed ring conforming to ASME B16.21.
- E. The CONTRACTOR shall ensure coordination of dimensions and drilling patterns of all piping, fittings, specials, valves, and ancillary items. Nuts and bolts shall have hexagonal patterns. Diameters of flange bolts for each size of flange shall conform to ANSI Standard Specifications and the lengths shall be such that the installed projections are not less than 1/8-inch, nor greater than 3/8-inch beyond the outer nut face.
- F. Pipe and fittings shall be capable of withstanding a continuous working pressure of 150 psi at 200° F.
- G. Pipe Insulation:
 1. Glass fiber insulation shall conform to ASTM C547; rigid molded, non-combustible.
 - a. 'K' ('ksi') Value: ASTM C335, 0.23 at 75° F (0.035 at 24° C).
 - b. Minimum Service Temperature: -20° F (-28.9° C).
 - c. Maximum Service Temperature: 300° F (150° C).
 - d. Maximum Moisture Absorption: ASTM C553; 0.2% by volume maximum.
 - e. Micro-Lok manufactured by Manville, or approved equal.

2. All Service Vapor Barrier Jacket:
 - a. ASTM C921, white 35 lb Kraft paper reinforced with glass fiber yarn and bonded to aluminized film with flame resistant adhesive.
 - b. Moisture Vapor Transmission: ASTM E96; 0.02 perm.
 - c. Secure with self-sealing longitudinal laps and butt strips.
3. Fabrication Adhesive: Non-flammable, quick setting; Spark-Fas 85-20 manufactured by Foster Products Corp.; Drion 85-75 manufactured by Foster Products Corp., or approved equal.
4. Vapor Barrier Mastic Finish:
 - a. Piping Service At or Below Ambient Temperature: Single component, elastomeric coating containing Hypalon, white color, maximum 0.02 perm; Monolar 60-95 manufactured by Foster Products Corp.; or approved equal.
 - b. Piping Service Above Ambient Temperature: Water based mastic, white color, minimum 3.0 perm; Seal Fas G-P-M 3 5-00 manufactured by Foster Products Corp.; WC-5 manufactured by Vimasco Corp.; or approved equal.
5. All steel pipes to be insulated shall be wrapped with an aluminum jacket conforming to ASTM B209. Jacket shall be corrugated with a thickness of 0.016-inch sheet and fitting shall be 0.020-inch thick die shaped fitting covers with factory attached protective liner. Joining shall be longitudinal slip joints and 2-inch laps. Metal jacket bands shall be 3/8-inch wide, 0.020-inch thick aluminum. Aluminum jacket shall be manufactured by Childers or approved equal.

2.4 MARKING FOR IDENTIFICATION

- A. All pipeline materials shall be stamped, marked, or identified with the following:
 1. Name or trade mark of the manufacturer.
 2. Pipe class and specification designation.
 3. Size and length dimensions.
 4. Date and place of manufacture.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. For exposed piping installation, refer to Section 15052, Exposed Piping Installation.
- B. Buried steel piping will not be accepted.

END OF SECTION

SECTION 16160

ENCLOSURES

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. This Specification includes enclosures to house electrical controls, instruments, terminal blocks, and serve a junction boxes where shown on the Drawings.

1.2 SUBMITTALS

- A. Products shall be submitted in accordance with Section 16000, General Electrical Requirements, and elsewhere in the Contract Documents, prior to installation.
- B. Shop Drawings: Submit for approval the following:
 - 1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
 - 2. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**

1.3 MANUFACTURERS

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

PART 2 - PRODUCTS

2.1 STEEL

- A. Enclosures shall be fabricated from stainless steel with seams that are continuously welded. Doors shall have full length piano hinges with the door removable by pulling the hinge pin.
- B. A rolled lip shall be provided around three sides of the door and around all sides of the enclosure opening. The gasket shall be attached with oil-resistant adhesive and held in place with steel retaining strips. Exterior hardware, such as clamps, screws, and hinge pins, shall be of stainless steel for outdoor installations. A hasp and staple shall be provided for padlocking. Each enclosure shall have a print pocket. All wires entering or leaving the enclosure shall terminate on terminal strips. All wires and terminals shall be clearly identified as specified elsewhere in these Specifications.
- C. Finish shall be white enamel interior, light gray enamel, ANSI 61 exterior, over phosphatized surfaces. Special finishes and colors shall be furnished for wet locations. Drawings should be checked for special conditions.

2.2 NEMA RATING

- A. Unless otherwise indicated on the Drawings, enclosures shall be NEMA 12 for indoors and NEMA 4X for corrosive areas and outdoor installations. NEMA 4X enclosures shall be 316 stainless steel, unless noted otherwise. NEMA 4X enclosures shall also be used in wet or wash down areas.
- B. Hazardous locations as indicated on plans shall be Nema 7.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Enclosures shall be installed as indicated on the Drawings and according to manufacturer's instructions.
- B. Enclosures shall be properly grounded and shall include ground straps connected to hinged doors and accessories.

END OF SECTION

SECTION 16161
CONTROL PANELS

PART 1 - GENERAL

1.1 SCOPE

- A. Contract Documents illustrate and specify functional and general construction requirements of the panel components and do not necessarily show or specify all components, wiring, and accessories required for a completely integrated system.
- B. Provide all labor, materials, equipment, documentation including drawings and incidentals as shown on the Drawings, specified and required to design, furnish, install, calibrate, test, start-up, program, configure, commission and place into satisfactory operation all panels, intermediate termination panels and/or enclosures including panel components and instruments.
- C. Conform the design and construction of panels to the specifications herein.
- D. For vendor packages, markup this specification for proposed control panel components against the relevant sub-section.

1.2 COORDINATION

- A. Coordinate the installation of all items specified herein and required to ensure the complete and proper interfacing of all the components and systems.
- B. All control loops to function as described in Section 17, Control Descriptions and depicted on the CONTRACT DRAWINGS.

1.3 DEFINITIONS

- A. Intermediate Termination Panel (ITP): An Intermediate Termination Panel is any junction box that has terminals to terminate wires and no electrical or electronic powered devices. These panels act as interim termination points for field wiring to be connected to the control systems equipment. Please note that junction boxes and pull boxes are different. ITP's are sometimes referred to as junction boxes. However, pull boxes are not allowed to have any wire splicing devices, including terminal blocks.
- B. Local Control Panel (LCP): A Local Control Panel is an industrial piece of equipment that contains electrical or electronic devices, in addition to wire terminals. Typically, it is a local panel connected to a specific piece of equipment to provide control and/or monitoring of that equipment. A local control panel contains voltages of 120VAC or below.

- C. Motor Control Panel (MCP): A Motor Control Panel is an industrial piece of equipment that houses components for the power distribution and starting of motors. The components may include motor starters and variable frequency drives.

1.4 QUALITY ASSURANCE

- A. Reference Standards: Construction of panels and the installation and interconnection of all equipment and devices mounted within also comply with applicable provisions of the following, except where otherwise shown or specified.
1. National Fire Protection Association 79
 2. National Electrical Code (NEC) current adoption.
 3. National Electrical Manufacturer's Association Standards (NEMA).
 4. American Society for Testing and Materials (ASTM).
 5. Operational Safety and Health Administration (OSHA) Regulations.
 6. State and local code requirements.
 7. Where any conflict arises between codes or standards, the more stringent requirement applies.
 8. All panel devices shall bear the label of the Underwriters' Laboratory (UL), Inc. or be UL Recognized. Some products certified by UL are components that are intended to be used in the manufacture of a complete listed product. These components cannot bear the UL symbol, but may use a special Recognized Component Mark.
 - a. The UL/UR listed number shall be documented on the Bill of Materials on the drawings.
 9. The assembled LCP's and MCP's are to be conformed to meet UL 508A requirements and labeling.
- B. Panel to be designed, schematics drawn and assembled by the manufacturer. Utilize one of the following Panel Manufacturers:
1. Zak Controls, 4970 East Beverly Rd., Phoenix AZ 85044 – (602) 267-0100.
 2. RDC Electrical, 3411 South 44th St., Phoenix, AZ 85308 – (602) 437-0760.
 3. Keller Electrical Industries, Inc., 1881 East University Dr., Phoenix AZ 85034 (602) 437-3015.
 4. Vertech Industrial Systems, 4409 East Baseline Rd., Phoenix, AZ 85042, Tel: (480) 756-2300.
 5. Prime Controls LP, 1515 W University Dr #104, Tempe, AZ 85281, Tel: (480)-781-0220

1.5 SUBMITTALS

- A. General:
1. Reference Section 01330, Submittals Procedures.
 2. Panels shall be furnished in accordance with the requirements as shown on the Drawings, and as specified in Division 16, Section 16050 and Division 17000, Sections 17456, 17453, 17460 and 1761.

3. Generate drawing package utilizing AutoCAD versions 2004 through 2015. If utilizing a newer AutoCAD version, submit files saved at version 2015.
 4. Drawing package shall contain complete wiring and schematic diagrams, control diagrams loop drawings, a complete Bill of Material, and any other details required to demonstrate that the system has been coordinated and will properly function as a unit. Drawings shall show proposed layout, anchorage, support and appurtenances of equipment and equipment relationship to other parts of the work including clearances for maintenance and operations.
 5. Submit legible hard copies of the panel drawing package printed on 11" x 17" sheets.
 6. Submit manufacturer's technical data sheets and product literature for the panel and all components utilized. Clearly identify exact equipment and material that is being supplied on the manufacturer's data sheets.
 7. Submit a sample nameplate with the submittal.
 8. Identify general location of all conduit entry points on the Front Elevation drawing of the documentation package.
 9. Submit calculations and recommended cooling and heating load requirements.
 10. Utilize the Hoffman Temperature Calculation tool at: http://www.hoffmanonline.com/product_catalog/tools/index.aspx?cat_1=34&cat_2=375&SelectCatID=375&CatId=375.
 11. Submit location and tube routing details for air conditioner drain line. Coordinate drain location with ENGINEER.
- B. Shop Drawings: Submit for approval the following:
1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
 2. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE**

**WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF
PREVENTIVE MAINTENANCE INFORMATION.**

1.6 O&M MANUALS

- A. Comply with the requirements of Section 01730, Operation and Maintenance Data.
- B. Provide an electronic copy of the panel drawing package on a separate CD. Panel Drawings are to be provided electronically in AutoCAD version 2004 through 2015. If utilizing a newer AutoCAD version, submit files saved at version 2015.

1.7 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Comply with manufacturers requirements for Transportation and Handling of Materials and Equipment.
- B. Comply with manufacturers requirements for Storage of Materials and Equipment.
- C. Provide a hard copy of the panel drawings, size 11" x 17", inside the panel upon delivery.

PART 2 - PRODUCTS

2.1 PANEL ENCLOSURES

- A. General:
 - 1. Conform panels and enclosures to the NEMA requirements as stated in Specification 16160, Enclosures.
 - 2. All outdoor panels shall be provided with sunshade structures. Sunshade structures shall be constructed as shown on CONTRACT DRAWINGS.
 - 3. Sizes shown on contract drawings are estimates. Furnish panels and enclosures sized to house all equipment, instruments, front panel mounted devices, power supplies, power distribution panels, wiring and other components installed within.
 - 4. Size the panel to provide 20% spare free space capacity.
 - 5. Use stainless steel fasteners throughout.
 - 6. Provide interior mounting panels and shelves constructed of minimum 12 gage steel.
 - 7. Provide 12"x12' print pocket in panels with a 24" or larger door. Mount on inside door where no door mounted devices are located. If there is not enough room for a 12"x12" print pocket, provide a sized pocket to fit available room.
 - 8. Provide enclosure mounting supports as required for floor, frame, or wall mounting. Indoor wall mount panels utilizing stainless steel unistrut. Outdoor wall mount panels utilizing PVC-coated Unistrut.

B. Construction Features:

1. General Construction Features - Provide the following convenience accessories inside of each panel.
 - a. One or more 120 VAC light fixtures with a minimum 40 watt lamp or LEDs with a snap switch for on/off control.
 - b. Provide grounding studs or lugs for metal panels and doors.
 - c. Provide all electrical components and devices, support hardware, fasteners, and interconnecting wiring required to make the panels and/or enclosures complete and operational.
 - d. Provide oil resistant gasket completely around each door or opening.
 - e. For panels located in the field or outdoors that have door mounted devices which do not meet the NEMA rating for the area, provide a window kit that includes a hinged door with a clear plastic window and an oil resistant gasket to encompass all non-NEMA rated panel instruments for this area.
 - f. Provide full height doors.
 - g. Provide panels with no extra holes or knockouts unless shown on Contract DRAWINGS.

C. Environment:

1. General:
 - a. Provide the following panel(s) with an air conditioner, heat exchanger or ventilation fan based on the submitted calculations for cooling and/or heating load requirements.
 - 1) As Required by cooling and/or heating calculations.
 - b. Provide a heater for all panels located outdoors to maintain a minimum temperature of 68°F.
 - c. Provide a separate supplementary protector for the cooling or heating equipment.
 - d. Provide thermostats to automatically control heating and cooling requirements.
 - e. Provide a high temperature switch, for alarm purposes, in all panels that require air conditioners, heat exchangers or ventilation fans. The contact shall be wired to alarm to the Process Control Information System.
 - 1) Products and Manufacturers:
 - a) Hoffman ATEMNC.
 - b) Or Equal.
2. Air Conditioner:
 - a. Coordinate utilization of air conditioners with the ENGINEER.
 - b. Provide an automatically controlled closed loop air conditioner with filtered and adjustable air louvers to maintain temperature inside each enclosure below the maximum operating temperature rating of the lowest rated component.
 - c. Provide a condensation drain line for each air conditioner.
 - d. Coordinate space requirements for maintenance.
 - e. Provide NEMA 4X for outdoor locations.

- f. Coat heating and cooling elements including external housing that are in contact with Plant's ambient environment with Heresite, or equal, for protection from hydrogen sulfide corrosion with hydrogen sulfide levels up to seven ppm.
 - 1) Coordinate application of coating with the ENGINEER.
 - g. Product and Manufacturer:
 - 1) Hoffman (McClean).
 - 3. Heat Exchanger:
 - a. Coordinate utilization of heat exchangers with the ENGINEER.
 - b. Provide an automatically controlled heat exchanger to maintain temperature inside each enclosure below the maximum operating temperature rating of the lowest rated component.
 - c. Coordinate space requirements for maintenance.
 - d. Products and Manufacturers: 1) Hoffman.
 - 4. Ventilation Fan:
 - a. Coordinate utilization of ventilation fans with the ENGINEER.
 - b. Provide automatically controlled ventilation fans with filter to maintain temperature of indoor enclosures below the maximum operating temperature of the lowest rated component.
 - c. Products and Manufacturers: 1) Hoffman. 2) Or Equal.
 - 5. Heater:
 - a. Provide adequately sized automatically controlled 120 VAC heaters to maintain temperature inside each enclosure above 40°F to a maximum of 80°F when the outside temperature is 0°F through 40°F.
 - b. Maintain a minimum four inch clearance or minimum clearance recommendations from the manufacturers from any device.
 - c. Product and Manufacturer: 1) Hoffman. 2) Or Equal.
- D. Identification:
 - 1. Provide laminated plastic nameplates with a white background and black lettering for identification of panels and components.
 - 2. Construct nameplates with 1/16" plastic and with beveled edges.
 - 3. Nameplate Mounting:
 - a. Indoor panels: Mount nameplates to the panel utilizing glue.
 - b. Outdoor panels: Mount nameplates to the panel utilizing glue and with two self-sealing 1/4" stainless steel screws by APM Hexseal.
 - c. Glue Product and Manufacturer:
 - 1) Gorilla Glue.
 - 2) Or Equal.

- 3) Provide nameplates according to Table 2.1.C.5 and Section 3.1.B:

Nameplate Specifications			
Type	Size	Font	Font Size
Manufacturer Nameplate	*1½" x 6"	Arial	1/8"
Panel Nameplate	*2" x 7"	Arial	1/2"
Device Nameplate	*1½"x 2½"	Arial	3/16"

Table 2.1.C.5 Nameplate Specifications

* This is a minimum height size requirement. Size nameplates large enough to display the information required to clearly identify the panel.

2.2 PANEL DEVICES

A. General:

1. Provide DIN rail mounted devices where practical.
2. All devices mounted on the exterior of the panel shall match the NEMA rating of the panel.

B. Internal Component Labeling:

1. Provide a device label for devices mounted inside the panel that conforms to the criteria below:
 - a. Instruments: Provide label with the instrument loop number as shown on the CONTRACT DRAWINGS. Place label below the instrument on the backplane.
 - b. Supplementary Protector: Label each supplementary protector with CB and the number assigned in the supplementary protector schedule. Place label on the backplane.
 - c. Fuses: Label each fuse with FU and the number assigned in the fuse schedule. Place a label on the backplane that includes the fuse number and the fuse size.

- d. Control Relays: Label each relay with CR and the number assigned in the panel drawings. Place label below the relay on the backplane.
- e. Terminal Strips: Label each terminal strip with the terminal strip type. (ex. TB1, TB2, ATB). Place label above the terminal block or at first terminal on the backplane.
- f. Door Mounted Devices: Provide a label on the interior of the front panel door for every panel device. The label should contain the same information as shown on the front panel nameplate. Place the label below the device.
- g. Wireway Covers: Label wireways with the voltage that is being routed through it. For example; “24 VDC” for DC voltage or “120VAC” for AC voltage. Place label on wireway cover. Coordinate label size to fit on wireway cover.
- h. Identify internal components with permanent adhesive plastic labels.
 - 1) Product and Manufacturer:
 - a) Brady USA Inc.
 - b) Or Equal.
 - 2) Provide device label size and fonts per Table 2.2.B.1:

Device	Label Size	Font Size	# Points	Brady Part #
(Wireways) 24VDC	1”x 4”	Arial	48 Points	PTL-42-422
(Wireways) 120VAC	1”x 4”	Arial	48 Points	PTL-42-422
Misc. Device Labels	1”x 1”	Arial	16 Points	PTL-19-423
Panel Door Devices	1” x 1.5”	Arial	8 Points	PTL-31-423

Table 2.2.B.1 Panel Interior Device Label

C. DIN Rail:

1. General: DIN rail is the metal rail used to mount various electrical components in a panel.
2. Mount all internal components on DIN Rail.
3. DIN Rail for terminal blocks shall be raised DIN rail to match the height of the wireways.
4. Product and Manufacturer, Provide one of the following:
 - a. Phoenix Contact.
 - b. Or Equal.

D. Control Circuit – Supplementary Protectors:

1. Provide single pole supplementary circuit protectors with the following features, 120 Volt AC, DIN rail mounted and UL 1099 listed with auxiliary contacts.
2. Provide end caps, marking strips, insulated side jumpers and other accessories.

3. Product and Manufacturer, Provide one of the following models where “xx” is the appropriate rating.
 - a. Phoenix Contact, TMC 1-M1-xxA.
 - b. Allen-Bradley, 1492-SP1Bxxx.
 - c. Idec, NRC-11-0-L-xxA-AA.

- E. Air Conditioner or Heater Supplementary Protectors:
 1. Provide supplementary protectors with the following features, 120 Volt AC, DIN rail mounted and UL 489 listed with auxiliary contacts.
 2. Product and Manufacturer, Provide one of the following:
 - a. Allen-Bradley, Bulletin 1489.
 - b. Or Equal.

- F. Control Relays:
 1. Type: General purpose, plug-in socket base type rated for continuous duty.
 2. Construction Features:
 - a. Coil Voltages: 120 VAC.
 - b. Contacts:
 - 1) Silver cadmium oxide rated not less than ten amperes resistive at 120 VAC or 28 VDC continuous.
 - 2) For switching low energy circuits (less than 200 ma) fine silver, gold flashed contacts rated not less than three amperes resistive at 120 VAC or 28 VDC continuous shall be provided.
 - 3) Number of contacts:
 - a) Minimum: Two double pole/double throw contact sets
 - b) Maximum: Four double pole/double throw contact sets.
 - c) Socket type to be blade.
 - d) Relay Enclosure: Dust-proof plastic enclosure.
 - e) Relays shall have an LED indicating lamp to show energized state.
 3. Product and Manufacturer: Provide one of the following:
 - a. Type R and/or Type K, as manufactured by Square D Company.
 - b. Type RH and/or Type RY, as manufactured by IDEC.
 - c. Potter & Brumfield.

- G. Time Delay Relay:
 1. Type: Dial adjustable, plug-in type time delay relay providing delay-on-make, delay-on-break one shots or interval operation.
 2. Construction Features:
 - a. MOS digital circuit with transformer coupled power.
 - b. Switch selectable ranges.
 - c. Minimum Setting: Three percent of range; except 50 ms for one second range.
 - d. Contacts:
 - 1) Type: DPDT.
 - 2) Rating: Seven amps resistive at 120 VAC, seven amps at 24 VDC.
 - e. Housing:

- 1) Plug-in design with dust and moisture resistant molded plastic case.
 - f. Power Input: 120 VAC.
 3. Product and Manufacturer: Provide one of the following:
 - a. Manufactured by Automatic Timing and Controls Company.
 - b. Manufactured by IDEC.
- H. Selector Switches, Pushbuttons and Indicating Lights:
1. General:
 - a. Selector switches, pushbuttons and indicating lights shall be supplied by one manufacturer and be of the same series or model type.
 - b. Type: 30mm, Heavy duty industrial, oil tight, corrosion resistant, with interchangeable pilot lights, plug-in construction, double break silver contacts, chrome plated lock rings, and modular contacts.
 - c. Mounting: Flush mounted on panel front, unless otherwise noted.
 - d. NEMA rated to match panel in which mounted.
 - e. Provide individual legend plates for indication of switch, pushbutton, and light function (e.g., Open, Closed, Hand-Off-Auto). A list shall be submitted for review and approval.
 - I. Selector Switches:
 - a. Type: Provide selector switches with number of positions as required to perform intended functions as shown on the Drawings and as specified.
 - b. Contacts:
 - 1) Provide number and arrangement of contacts as required to perform intended functions specified, but not less than one double pole, double throw contact per switch.
 - 2) Type: Double break, silver contacts with movable contact blade providing scrubbing action.
 - 3) Rating: Compatible with AC or DC current with devices simultaneously operated by the switch contacts, but not less than ten amperes resistive at 120 volts AC or DC continuous.
 - c. Switch Operator: Standard black knob.
 2. Pushbuttons (Standard or Illuminated):
 - a. Momentary Type: Provide momentary, boot type pushbuttons as required to perform intended functions specified and shown on the Drawings. Boot color to be red for stop buttons and black for other functions.
 - 1) Provide extended head pushbuttons for all stop functions.
 - 2) Provide flush head pushbuttons for all other functions.
 - b. Maintained Type: Provide maintained, push/pull, "Mushroom" type, red in color, to perform intended functions as specified, and as shown on the drawings.
 - 1) Emergency Stop button shall be red and the base of the button shall be yellow.
 - c. Contacts: Comply with the requirements specified for selector switches.
 - d. Lock-out: Provide locking mechanism for all lock-out functions.
 3. Indicating Lights:

- a. Type: Compact, integral non-transformer type.
 - b. Lamps: 120 VAC, high-intensity LED type (20,000 hours minimum). Indicating lights shall have clear lenses and LED lamps colored as shown on the Drawings.
 - c. Common, push-to-test circuitry shall be provided for each panel to simultaneously test all indicating lights on the panel using a single pushbutton when there are 10 or more lights on the panel. Control panels with less than 10 lights shall utilize individual push-to-test lights and control circuitry.
 - d. Button and Lamp Colors:
 - 1) Red for indication of open, on, or running.
 - 2) Green for indication of closed, off (ready), or stopped.
 - 3) YELLOW for indication of equipment malfunction, process trouble or alarms.
 - 4) White for indication of electrical control power on.
4. Rotary Cam Switches:
- a. Provide rotary cam switches with number of positions and poles as required performing the signal switching function specified and shown on the Drawings.
 - b. Contacts:
 - 1) Gold-flashed contacts housed in mechanical contact blocks with number and arrangement of contacts as required performing intended function.
 - 2) Contact Rating: Compatible with AC or DC through-put current of signals and devices simultaneously operated by the switch contacts, but not less than 20 amperes at 600 VAC or 250 VDC continuous.
 - c. Switch Operator: Standard black knob.
5. Product and Manufacturer: Provide one of the following:
- a. Square D.
 - b. Allen-Bradley Co.
 - c. Eaton.
- J. Potentiometer:
- 1. Type: Industrial potentiometer operator, direct acting, 3/4 to full turn; and standard 3-wire potentiometer.
 - 2. Required Features:
 - a. NEMA rated to match panel in which mounted.
 - b. Resistance Range: 0 to 10,000 Ohms.
 - c. Resistance Element: Wire wound or conductive plastic.
 - d. Power Rating: Two watts.
 - e. Mounting: Flush mounted on panel front, unless otherwise noted.
 - f. Provide legend plate for indication of position (0 to 100 percent).
 - 3. Product and Manufacturer: Provide one of the following:
 - a. Square D.
 - b. Allen-Bradley Co.
 - c. Eaton.

K. Power Supply:

1. General:

- a. Panel power supply source, type, voltage, number of circuits and circuit ratings shall be as shown on the Contract Drawings.
- b. Panels shall be provided with an internal 120 VAC with number of circuits and separate supplementary protectors sized as required to distribute power to the panel components.

L. 24VDC Power Supplies:

1. General:

- a. Single unit and multiple unit power supplies, located in panels, as required.
- b. Single Unit Required Features:
 - 1) Solid state circuitry.
 - 2) Surface mounting.
 - 3) Input Power: 120 VAC, ± 10 percent, 60 Hz.
 - 4) Output Power: 24 VDC or as required.
 - 5) Line/Load Regulation: 0.05 percent.
 - 6) Ripple: 0.25 mv RMS.
 - 7) Overload Protection: Internal preset or fused.

2. Product and Manufacturer: Provide one of the following:

- a. Acopian Corporation.
- b. Power One.
- c. Lambda.
- d. Sola.

3. If redundant power supplies are required: Provide one of the following:

- a. Lambda DPL-PU/E.
- b. Phoenix Contact Quint-Diode/40.
- c. Puls.
- d. Or Equal.

M. Wire:

1. General:

- a. Provide internal wiring of Type MTW stranded copper wire with thermoplastic insulation with no nylon jacket rated for 600 V at 90°C for single conductors.
- b. No utilization of Type THHN for panel wiring.
- c. For DC panel signal wiring, use #16 AWG shielded minimum.
- d. For AC power wiring, use #14 AWG minimum. For AC signal and control wiring, use #16 AWG minimum. For wiring carrying more than 15 amps, use sizes required by NEC and NFPA 79 Standards.
- e. Identify wires at each end using heat shrink labels with permanent number codes using a Brady LS2000 Labeling System, or equal.
- f. Panels conform to the wire color code as shown in Table 2.2.K.1.f Wire Color Code and NFPA 79 Standards.

2. Product and Manufacturer: Provide one of the following:

- a. Carol.

- b. Belden.
- c. Anixter.

WIRE COLOR CODE TABLE (Inside Panels)			
TYPE	FUNCTION	INSULATION COLOR	WIRE SIZE
AC POWER - HOT	120VAC	**BLACK	#14
AC POWER - NEUTRAL	120VAC	WHITE	#14
AC GROUND	120VAC	GREEN	#14
AC CONTROL	120VAC	**RED	#16
ISOLATED DC GROUND	GROUND	GREEN W/YELLOW	#16
DC POWER	SOURCE	BLUE	#16
DC POWER	COMMON	WHITE /BLUE	#16
CONTROL	FOREIGN VOLTAGES	YELLOW	#16
LOW VOLTAGE AC	24 VAC SOURCE	BROWN	#16
LOW VOLTAGE AC	24 VAC COMMON	BROWN W/WHITE	#16
*AC POWER	480 VAC PHASE A	BROWN	Size to FLA
*AC POWER	480 VAC PHASE B	ORANGE	Size to FLA
*AC POWER	480 VAC PHASE C	YELLOW	Size to FLA
TEMPORARY	TEMPORARY	PURPLE	Size to FLA

Table 2.2.K.1.f Wire Color Code * - For Motor Control Panels (MCP's) that are permitted to contain 480 VAC

** - Black 120 VAC wires are hot unless powered down via supplementary circuit protector. Red 120 VAC wires are hot based on the control logic state.

N. Single Shielded Pair Cable:

1. Tinned copper, nineteen strand, PVC insulated conductors, No. 16 AWG minimum, twisted with aluminum-polyester shield, stranded tinned 16 AWG copper drain wire and PVC black or gray outer jacket. Wire conductor colors shall be black (-neg) and red (+pos). 600 Volt Tray Cable (TC) rated.
 2. Product and Manufacturer: Provide one of the following:
 - a. Belden Company (No. 9342).
 - b. Okonite Company.
 - c. Dekoron Wire and Cable Company.
- O. Wire Terminations:
1. Terminate all field and internal component wiring using insulated ferruled connectors attached with manufacturer's recommended tool.
 2. Excessive stripping of the wire so as to allow bare wire outside the insulated ferrule is not permitted.
 3. Utilize insulated double ferruled connectors wherever two wires terminate on the same terminal block connection.
 4. Product and Manufacturer: Provide one of the following:
 - a. Phoenix Contact – Cipline.
 - b. Thomas & Betts.
 - c. Weidmuller.
- P. Terminal Blocks:
1. General:
 - a. Numerically code terminals utilizing terminal block manufacturer's marking system. Information must be printed directly on the terminal label. Sticky back labels are not permitted.
 - b. Terminal blocks must be DIN rail mountable with screw clamp connections. Spring cage connections are not permitted.
 - c. Double level terminal blocks are permitted for use with signals on Analog Terminal Block (ATB) only.
 - d. Terminals used for analog signals on ATB shall be colored blue.
 - e. Terminal block jumpers must be connected via screw clamp. Screw clamped comb jumpers are permitted. Plug in jumpers are not permitted.
 2. Product and Manufacturer: For each terminal strip type provide one of the following:
 - a. Power Terminal Block (PTB).
 - 1) Phoenix Contact, Type UK 5 N, Color Gray, Model # 30 04 36 2.
 - 2) Allen Bradley, Type 1492-J4, Color Gray, Model # 1492-J4.
 - 3) Weidmuller, Type WSU 4, Color Dark Beige, Model # 1020100000.
 - b. Field Wiring Discrete Signal Terminal Blocks (TB1 and TB2).
 - 1) Phoenix Contact, Type UDK 3, Double Connection, Color Gray, Model # 27 75 37 5.
 - c. Weidmuller, Type WDK 2.5V, Double Connection, Double Level, Internal Connection, Color Dark Beige, Model # 1905060000.
 - d. Field Wiring Analog or Internal Wiring DC Power (ATB) - Single Level Terminal Blocks:

- 1) Phoenix Contact, Type UK 3N BU, Color Blue, Model # 30 01 51 4.
- 2) Allen Bradley, Type 1492-J3-B, Color Blue, Model # 1492-J3-B.
- 3) Weidmuller, Type WDU 2.5 BL, Color Blue, Model # 1020080000.
- e. Field Wiring Analog or Internal Wiring DC Power (ATB) - Double Level Terminal Blocks. Alternating double and single level ATB terminal blocks are permitted.
 - 1) Phoenix Contact, Type MBKKB 2,5 BU, Double Level, Color Blue, Model # 27 71 09 4.
 - 2) Allen Bradley, Type 1492-JD3-B, Double Level, Color Blue, 3) Model # 1492-JD3-B.
 - 3) Weidmuller, Type WDK 2.5 BL, Double Level, Color Blue, 5) Model # 1021580000.

Q. Surge Protection:

1. Provide DC surge protection with integrated varistor for all analog signal loops that are terminated to Programmable Logic Controllers.
2. Provide maintenance free, self-restoring surge protection to protect the electronic instrumentation system from surges propagating along the signal and power supply lines. Device shall be removable without interrupting the circuit.
3. Provide a separate surge protector for the positive and a separate surge protector for the negative polarity of each loop.
4. Mount the surge protectors on the ATB.
5. Ground the surge protectors to the panel DC ground bus.
6. Label the surge protectors in sequential order starting with the ATB signals.
7. Required Features:
 - a. Amp Rating: Compatible with working voltage and current of device being protected.
 - b. Voltage Rating: Compatible with the working voltage of protected device.
 - c. Reaction Time: nanosecond range.
8. Product and Manufacturer: Provide one of the following:
 - a. Phoenix Contact.
 - b. Advanced protection Technologies.
 - c. EDCO.
 - d. Or Equal.

R. Wireways:

1. General:
 - a. Mount wireways using stainless steel bolts. Drill and tap the sub-panel to accommodate the bolts.
 - b. Color to be Gray or White throughout the entire panel. Provide only one color.
 - c. All wireways to include cover.
 - d. Wireway covers to be labeled as per section 2.2.B.
2. Product and Manufacturer: Provide one of the following:

- a. Panduit.
- b. Thomas & Betts.
- c. Or Equal.

S. Alarms:

1. Audible alarms shall be UL listed, 120VAC, with solid state circuitry, vibrating horn, non-metallic corrosion resistant housing, with required mounting hardware, suitable for outdoor use capable of producing 100 dB at 10 feet. The audible alarm shall be manufactured by Federal Signal model 350, Edwards Model 870-EX, or equal.
2. Rotating beacons for interior and/or exterior locations shall be UL listed, 120VAC, with motor and cooling fan, rotating lights at 60 times per minute minimum, capable of producing 36,000 candlepower with required mounting hardware. Lens color shall be verified at the time of construction. The rotating beacons shall be manufactured by Federal Signal Model 371L or equal.
3. Rotating beacons for corrosive and/or hazardous locations shall be UL listed, 120VAC, with solid state circuitry, rotating lights at 60 times per minute minimum, suitable for outdoor use capable of producing 36,000 candlepower with required mounting hardware. Lens color shall be verified at the time of construction. The rotating beacons shall be manufactured by Edwards Model 52EX, or equal.
4. Strobe beacons shall be UL listed, NEMA 4X, 120VAC, flashing at 80 times per minute minimum, producing peak candlepower of 520,000, effective candlepower of 165, with required mounting hardware. Lens color shall be verified at the time of construction. The rotating beacons shall be manufactured by Federal Signal model 151XST, Edwards Model 92EX, or equal.

T. Intrinsically Safe Barriers:

1. Intrinsic safety barriers shall permit connection of devices located in a hazardous area to other devices located in a safe area. Intrinsic safety barriers shall be EMC compliant, 10 to 35VDC, 35mA output current, hazardous area terminals identified by blue labels, terminals accommodating conductors up to 12AWG, ambient temperature rating of -20° C to +60° C. The intrinsic safety barriers shall be manufactured by MTL Inc., Ronan Engineering Co., R. Stahl Inc., A.T.C., or equal.

U. Elapsed Time Meters and Time Clocks:

1. Elapsed time meters shall be self powered, non-reset, solid state counter which provides silent, accurate and noise immune operation. Elapsed time meters shall require no external power, five year minimum battery life, 120VAC power, accessories for panel mounting, nameplate below LCD display reading "HOURS", liquid crystal display with 6 digits approximately 2-inches high with 50,000 hour minimum display life and indication of sufficient battery power. The elapsed time meters shall be manufactured by Durant, Automatic Timing and Controls, a Division of Sycon Corp., or equal.

2. Time clocks shall be microprocessor based, have 24 hour time control, up to 24 operations per day, programmable from panel face keys, skip-a-day feature allowing schedule to be skipped for one to seven days, SPDT switch contact rated at 15 amps at 120VAC, with battery carryover to maintain time and program during power outage for 275 hours. The time clocks shall be manufactured by Tork, Paragon Electric Company, or equal.

V. Motor Starters and Overload Relays:

1. Refer to Specification Section 16480, Motor Controllers.

PART 3 - EXECUTION:

3.1 EXTERIOR PANEL:

A. Component Layout:

1. Arrange associated control and indication devices for a particular part of the process in close proximity to each other.
2. Mount indicating lights above control switches and push buttons.
3. Standard component spacing is 3 ½" center to center and 3 ½" above and below. It is acceptable to use more space if required, but spatial consistency must be maintained.
4. Maximum height for panel exterior-mounted devices is 6'-0" from the floor. Minimum height for panel exterior-mounted devices is 3'-0" from the floor.
5. Locate alarm horn at the top of the panel. The alarm horn may be located above 6'-0" device height limitation.
6. Unless otherwise noted; route field wiring through the bottom of the enclosure. Provide watertight conduit openings.

B. Exterior Panel Nameplates:

1. General:
 - a. Refer to Section 2.1.D for material and size requirements.
 - b. Provide specific panel identification on nameplates derived from the contract specifications and drawings.
 - c. Obtain ENGINEER approval for panel identification for panels that are not identified in the contract specifications and drawings.
2. Panel Manufacturer Identifier and Power Requirements Nameplate (NP-1):
 - a. Mount nameplate in the upper left corner of the panel front.
 - b. Provide the following information for each circuit feeding the panel:
 - 1) The first line indicates the name of the manufacturer, location and phone number of who assembled the panel.
 - 2) The following lines:
 - a) Include panel voltage, current, phase, frequency, short circuit current rating for each panel feed.
 - b) Provide switchboard name and circuit number for each circuit feeding the panel.

c) Refer to figure 3.1.B.2.

WILSON & Sons, CHANDLER, AZ 85226 - (480) 555-1234
120 VAC, 0.5 AMPS, 1Ø, 60HZ, SCCR 5KA, FED FROM LP-34, CIRCUIT 6
120 VAC, 7.5 AMPS, 1Ø, 60HZ, SCCR 8KA, FED FROM LP-34, CIRCUIT 8

Figure 3.1.B.2

Panel Manufacturer Identifier and Power Requirements Nameplate (NP-1)

3. Panel Identification Nameplate (NP-2)
 - a. Mount panel identification nameplate in the top, center of the panel.
 - b. Provide the following information:
 - 1) The first line of text is an abbreviation of the panel as shown on the CONTRACT drawings.
 - 2) The second line of text on the nameplate is used to spell out the process abbreviation.
 - 3) Refer to figure 3.1.B.3.

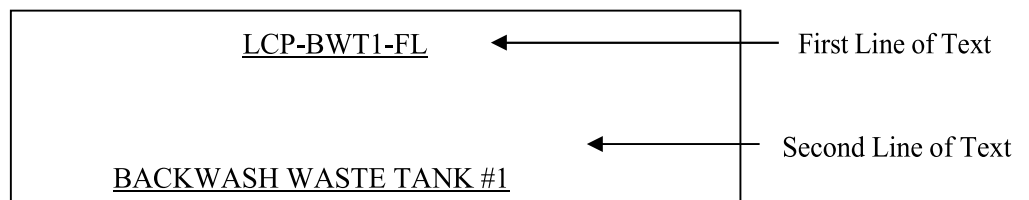


Figure 3.1.B.3

Panel Identification Nameplate (NP-2)

4. Panel Component Nameplates
 - a. Mount nameplates above all control and indicating devices.
 - b. Provide the following information:
 - 1) The first line indicates the instrument device loop identifier and number as shown on the DRAWINGS.
 - 2) The second line identifies the system equipment that the component is associated with.
 - 3) The third line identifies the control position, condition of the equipment or the alarm state being monitored.

- 4) Refer to figure 3.1.B.4.

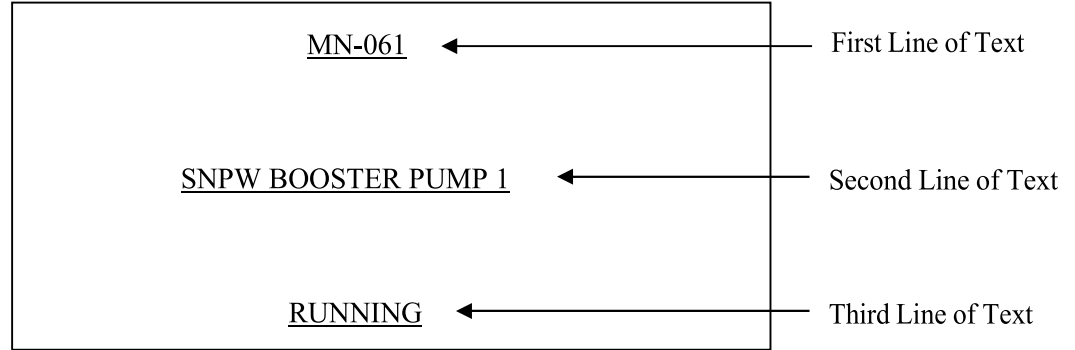


Figure 3.1.B.4
Panel Component Nameplates

3.2 INTERIOR PANEL

A. General:

1. All Wall Mounted Panels - Where conduit enters the panel, maintain a minimum of 4" clearance from any device or wireway to allow room for routing of field wiring.
2. Concrete Pad or Floor Mounted LCP's and MCP's – Where conduits enter the panel through the concrete pad, maintain a minimum of 6" clearance from any device or wireway to allow room for routing of field wiring. Where conduit enters the panel sides or top, maintain a minimum of 4" clearance from any device or wireway to allow room for routing of field wiring.
3. Elevated Floor Mounted LCP's and MCP's - Where conduit enters the panel, maintain a minimum of 4" clearance from any device or wireway to allow room for routing of field wiring.
4. Concrete Pad, Floor Mounted or Elevated Floor Mounted ITP's - Where conduits enter the panel through the top or bottom, maintain a minimum of 6" clearance from any device or wireway to allow room for routing of field wiring.
5. Locate and install all devices and components so that connections can be easily made and that there is ample room for servicing each item.
6. Maintain a minimum 2'0" clearance between components mounted on side panels and components mounted on the opposing side panel.
7. Components mounted on the back panel are to be unobstructed by any components mounted on side panels.
8. Adequately support and restrain all devices and components mounted on or within the panel to prevent any movement.

B. Panel Incoming Power:

1. Panel power fed from lighting panels, or other sources with fused or circuit breaker protection, shall be wired to the Power Terminal Blocks (PTBs). Power sources entering the panel are to be provided with a separate neutral and

ground. The PTBs shall have a separate terminal for the hot and neutral for each circuit. The ground to be terminated to the AC ground bar.

2. Mount the PTBs near the top left corner of the panel.
3. Multiple power sources may be required for each panel. Power requirements are identified on the CONTRACT DRAWINGS. The following additional power sources may be required for the panel.
 - a. Control Logic Power and Light Fixture.
 - b. Air Conditioning.
4. Arrange the terminal strip in an orderly manner with circuit conductors grouped together. For instance, terminate the hot and neutral conductors on consecutive terminals. Label terminals and internal wiring as H1 and N1 (Control Logic), H2 and N2 (Air Conditioning). Identify each additional source in sequential order beginning with H3 and N3.
5. Terminate all incoming power on one side of the terminal strip.

C. AC Power Distribution:

1. Identify the wire extending from the PTB to the supplementary protector as H1 and H2, etc. Using H1 as an example; the wire terminated to the line side of the supplementary protector is labeled H1, the wire terminated to the load side of the supplementary protector is labeled as L1-1.
2. If L1-1 passes through an additional supplementary protector to feed panel components, this supplementary protector can be shown on the drawings in a horizontal or vertical position on a schematic rung and the wire terminated to the line side of the supplementary protector is labeled L1-1. The wire terminated to the load side of the supplementary protector is labeled L1 – (the Supplementary Protector #) and the wire color is black.
3. If the panel controls multiple pieces of equipment, such as two pumps with separate control circuits, provide a supplementary protector for each control circuit.
4. Powering 120 VAC field 4-wire instruments from the panel is not permitted.

D. DC Power Distribution:

1. Mount DC power supplies near the top right of the panel. Mount fuses associated with the power supply in close proximity to the power supplies.
2. Identify terminals used for DC power distribution as PTB-DC.
3. Provide a fuse for each analog loop that loop power is provided by a power supply located in the panel.

E. Grounding:

1. AC Ground:
 - a. Provide the AC ground bus bar with cage type or screw terminals installed near the bottom of the back panel with extended mounting bolts.
 - b. Provide adequate metal to metal contact between the AC ground bus bar and the back plane.
 - c. Connect all AC power sources and devices to ground at this ground bus.
 - d. Connect all panel enclosure doors to the AC ground bus.
 - e. Connect all side panels to the AC ground bus.

- f. Provide a connection point on the ground bus for connection to the ground grid system.
2. DC Ground:
 - a. Install the isolated DC grounding bus bar with cage type or screw terminals installed near the bottom of the back panel at a minimum distance of 6" from the AC ground bus.
 - b. The isolated grounding bus bar consists of two non-conductive mounting blocks with a single copper grounding bar attached between them.
 - c. Connect all shields (SH) requiring loop grounding in the panel from the analog signal terminals to the DC grounding bus bar.
 - d. To avoid ground loops, connect analog cable signal shields to ground at one location only, preferably in the LCP, MCP or ITP; not in the field. Maintain consistency for the termination point of signal shield for all analog signals.
 - e. Provide a connection point on the ground bus for connection to the ground grid system.
 - f. Figure 3.2 illustrates a typical ground system within a panel. The illustration depicts the physical terminations of the ground wires in the panel. Ground Conductor AWG size to ground grid system shall be as stated in Specification 16170, Grounding and Bonding.

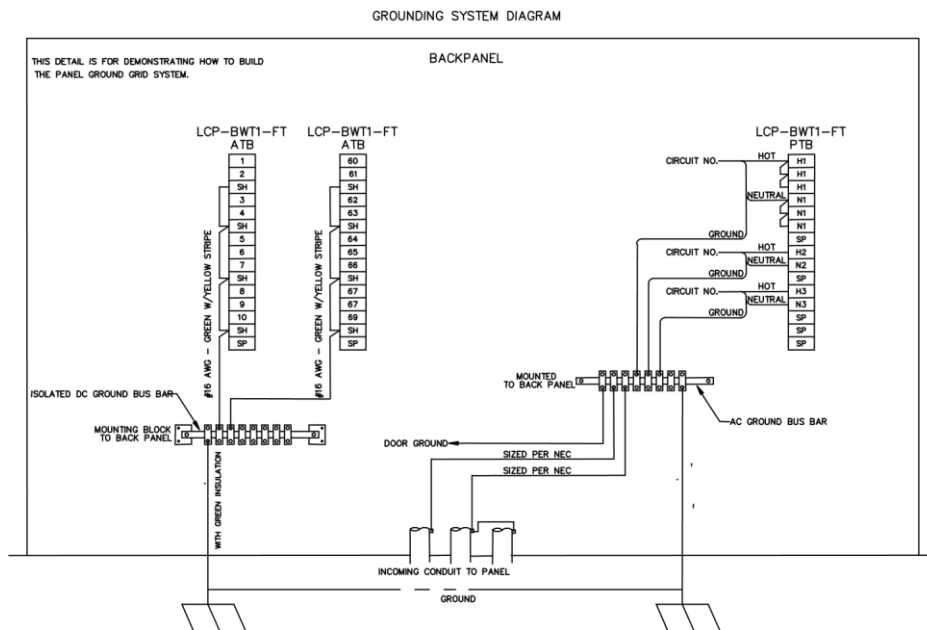


Figure 3.2 Typical Grounding Systems

F. Circuit Protection:

1. Provide an isolating supplementary protector for each group of control logic. For example: the start, stop and reset control circuit for Pump #1 has a dedicated supplementary protector supplying power to the control logic. Pump #2 requires a separate isolating supplementary protector for the control logic.

2. Provide an isolating supplementary protector for each component requiring 120 VAC power.
3. A supplementary protector is not required for control circuits powered from a fused control power transformer in an MCP.
4. Size supplementary protector to handle the connected load.
5. Mount supplementary protector next to the PTBs near the top left corner of the panel.
6. Provide an auxiliary contact for each supplementary protector. Wire each auxiliary contact from the supplementary protector in series to one "Power fail" relay. Send one Power Fail status to the Process Control Information System.

G. Internal Panel Wiring:

1. Route all internal wiring using wireways. Terminate all internal wires on one side of the terminal blocks. The opposite side of the terminal block shall remain available for field wires.
2. Where wires pass through panel walls, provide suitable bushings to prevent cutting or abrading of insulation.
3. Adequately support and restrain all wiring runs to prevent sagging or other movement. Wires extended from the control logic to the panel door devices are to be wrapped in plastic protective wire wrap designed for this purpose.
4. Wire splicing is not allowed at any time.
5. Utilize two wires (hot and return leg) with field wiring for each field input. It is not acceptable to utilize one common Hot for multiple field inputs.
6. Terminate wires with a non-insulated ferrule type crimp connector. Excessive stripping of the insulation to allow bare wire strands between the insulation and the ferrule is not permitted.
7. Orientate wire labels on the individual conductor or cable so that wire labels are legible without having to twist or move the connectors. Securely heat shrink the labels around the conductor. Label wires or cables with the number assigned in the panel documentation. Refer to Section 2.2.K.1.e for wire label materials.
8. DC wiring for analog and discrete field or Process Control Information System signals that enter or leave the panel are to be terminated on the Analog Terminal Block (ATB).
9. AC wiring for discrete field signals that enter or leave the panel are to be terminated on the Terminal Block 1 (TB1).
10. AC wiring for discrete Process Control Information System signals that enter or leave the panel are to be terminated on Terminal Block 2 (TB2).
11. The terminal blocks (TB1, TB2 or ATB) can be mounted on the left or right side panels.
12. Provide a minimum of 10% spare terminal DIN rail space per terminal strip.
13. Signals from the field that enter the panel and only pass through the panel from the field to the Process Control Information System require internal wiring from TB1 to TB2.
14. Arrange all control wiring associated with a particular piece of process equipment together on adjacent terminal blocks.

15. Identify wire number by the schematic rung numbers. Label TB1 and TB2 terminals with the rung number associated with the internal wire number connected to the terminal. Label ATB terminals in sequential order starting with the number 1. Identify analog shield terminations with an “SH” on the terminal block.
16. Multi-conductor cables of two pair or more shall have the outer cable insulation removed before entering the wireway.
17. Route all DC power and analog signals at a minimum of six inches from AC power and controls. When the six inch minimum distance is not available, provide a metallic barrier that extends 3” beyond the tallest wireway between the analog and discrete wireways.

H. Wireways:

1. Mount wireways from the internal panel components and terminal blocks with a minimum 2” spacing.
2. Arrange wireways to maintain a six inch minimum distance between analog and discrete circuit wiring.
3. Provide wireways for all field wiring. Arrange wireways to allow field wiring to enter from the top or bottom of the panel.
4. Align wireways between back and side panels.
5. Install a wireway on both sides of each terminal strip.
6. Size wireways to prevent conductor fill from exceeding 50% of the interior cross-sectional area of the wireway.
7. In addition to the above requirements, for ITP’s, wireways are not to be common for two terminal strips. Each terminal strip shall have a dedicated wireway on each side of the strip.

I. Control Logic:

1. The Start commands are to be designed utilizing normally open contacts from pushbuttons and/or the Process Control Information System and shall be of a momentary signal that will require a seal circuit to maintain operation. Constant signals from positions switches are not allowed unless noted on the CONTRACT DRAWINGS.
2. All system failure, safety logic control devices or normal operations that are intended to cause the equipment to stop are to be wired in series with the start seal circuit. The unsealing of the start command on any fault or normal operation that causes the equipment to stop will require another start command to reseal.
3. Provide interlocks for the control functions of Local and Computer Modes in series with the Start and Stop logic. Provide a closed switch or relay contact to the Process Control Information System to identify when the equipment is in Computer Mode.
4. Provide control logic of voltage 120 VAC.
5. Use power relays when control relay contacts are insufficient for the designated load.
6. Terminate the “Hot” conductor on the common of the switch or relay contact.

7. Control alarm logic shall be wired in a fail safe mode from the field device to the panel circuitry to alarm when a field wire has failed.

3.3 PANEL DRAWING DOCUMENTATION

A. General:

1. Files of the title block, panel symbols for front and internal sub-panel elevations, terminal strips, control schematics, analog loops, etc. are available in hard copy and AutoCAD .dwg format from the OWNER upon request through the ENGINEER via Example Panel Drawing Packages and Drawing Templates.
2. Provide drawing copies in the following format:
 - a. Hard Copy - B Size - 11" X 17".
 - b. Hard Copy - D Size - 22" X 34".
 - c. Soft Copy in .DWG.
3. The panel drawing documentation package consists of the following drawings types arranged in the following order.
 - a. Cover Sheet.
 - a. Symbols and Legends 1 – Exterior and Interior Panel Symbols.
 - b. Symbols and Legends 2 – Schematic Symbols.
 - c. Front Panel Elevation.
 - d. Interior/Sub Panel Layout.
 - e. Terminal Strip Drawings.
 - f. Control Schematics.
 - g. Analog Loop Diagrams.
 - h. Point to Point Discrete Wiring Diagrams.
4. Drawing Scale:
 - a. Provide Front Elevation and Interior/Sub Panel Layout Drawings proportionately correct and to scale. Create all drawings on a D Size layout.
5. Border and Title Block:
 - a. Provide each drawing with a border and title block information.
 - b. Utilize the border and title block as provided in the Drawing Templates referenced in Section 3.03.A.1.

B. Panel Drawing Types:

1. General:
 - a. Provide a complete documentation package for each panel consisting of the drawings in the order listed in Section 3.03.A.3.
2. Cover:
 - a. Cover sheet for the panel documentation shall include the following information.
 - 1) Located on the left half of the sheet to include the manufacturers name, address, phone number, web address, project reference number and ul508a certification number.
 - 2) On the right half of the sheet include the following, "customer name" "department" and the project title, project number, the panel

full title, the panel abbreviation, the facility area in which the panel exists, submittal date, volume number and sheet count.

3. Symbols & Legends:
 - a. Utilize the Symbols and Legend sheets as provided by the OWNER upon request from the ENGINEER.
 - b. Additional symbols may be added if an existing symbol on the Symbol and Legend sheets does not exist.
4. Front Elevation Drawing:
 - a. The Front Elevation drawing illustrates the arrangement of the panel and position of the devices on the front face of the panel.
 - b. Provide panel dimensions in inches. Provide dimensions for height, width, and depth. If the panel is small in size, the Front Elevation Drawing and Internal layout Drawing can be combined on one drawing.
 - c. Provide the nameplate schedule on the Front Elevation drawing.
 - d. Device Callouts:
 - 1) Device callout hexagons are utilized to reference a device to the bill of materials. Place the bill of material item number inside the hexagon.
 - 2) Provide a leader from the hexagon that will point to the device.
 - 3) For a typical of multiple devices of the same type, only one device callout is necessary.
 - e. Provide air conditioning heating and cooling information as provided by the Hoffman Temperature Calculation tool at:
http://www.hoffmanonline.com/product_catalog/tools/index.aspx?cat_1=34&cat_2=375&SelectCatID=375&CatId=375.
5. Interior Sub Panel Layout:
 - a. General:
 - 1) The Interior Sub Panel Layout drawing identifies the individual interior components and their physical location.
 - 2) Draw all components within the panel to scale.
 - 3) Include all interior sub panels if the panel has sub panels on the side walls.
 - b. Provide the following information on the Interior Sub Panel Layout Drawing. Utilize the formats provided on the Drawing Templates. The information can be shown on a second sheet if needed to drawing clutter.
 - 1) Bill of Materials:
 - a) Include the devices on the Front Panel Elevation and the Interior Sub Panel(s) Elevation.
 - b) Include items that are not specifically shown on the Front Panel Elevation or the Interior Sub Panel Layout drawing, such as wire size, color and type, on the bill of materials.
 - c) The utilization or insertion of Microsoft Excel files for the Bill of Materials is not allowed.
 - 2) Fuse Schedule.
 - 3) Supplementary Protector Schedule.

- c. Label and identify all devices, including terminal strips, relays, fuses, timers, power supplies and other special components on the drawing.
 - d. For unique devices not shown on the Symbols and Legend Sheets, use rectangles and squares with the appropriate dimensions of the device.
 - e. Device Callouts:
 - 1) Device callout hexagons are utilized to reference a device to the bill of materials. Place the bill of material item number inside the hexagon.
 - 2) Provide a leader from the hexagon that will point to the device.
 - 3) For a typical of multiple devices of the same type, only one device callout is necessary.
6. Terminal Strip Drawing:
- a. General:
 - 1) Terminal Strip Drawings provides locations for wiring terminations from field devices and other equipment external to the panel.
 - 2) Display the wiring connections exactly as they are physically installed. For example, if field wiring is terminated to the left side of the terminal strip, the terminal strip drawing displays the wiring connections to the left side of the terminal block.
 - 3) There are 5 different types of terminal strips and each has a specific function. The following is a brief description of each:
 - a) For LCP's and MCP's:
 - a) Power Terminal Block (PTB) – Power supply/supplies to the panel (120 VAC or higher). Identify terminal block number with the wire number assigned in the control logic drawings. Identify power sources with the originating panel, voltage and circuit number.
 - b) Field Wiring Discrete Signal Terminal Blocks (TB1) – Discrete field inputs and outputs to/from the panel. Identify terminal block number with the rung number assigned in the control logic drawings.
 - c) Field Wiring Discrete Signal Terminal Blocks (TB2) – Discrete inputs and outputs to/from the Process Control Information System. Identify terminal block number with the rung number assigned in the control logic drawings.
 - d) Field Wiring Analog (ATB) or Internal Wiring DC Power
 - e) Terminal Blocks - Field or Process Control Information System Analog inputs and outputs to/from the panel, including 4-20 mA, 1-5 VDC, thermocouple or Resistance Temperature Detectors (RTD's). Identify terminal block number with consecutive numbers starting with number 1.
 - f) The shield wire terminal block is to be label "SH".
 - g) For ITP's:
 - i. TB-A thru Z – Discrete field inputs and outputs to/from the panel.

- ii. ATB-A thru Z – Analog inputs and outputs to/from the panel.
- 4) It is acceptable, if space available, to combine TB1, TB2, ATB and PTB on a single terminal strip drawing.
- 5) Identify spare terminals with an “SP” inside the rectangle.
- 6) Display terminals in the order they appear in the panel.
- 7) Place field wire labels on each line extending toward the terminal. Obtain this information from the cable and conduit schedules. If wire labels are unavailable, place seven “X’s” where wire tag normally resides. Provide this information prior to final deliverable of the Operations & Maintenance Manuals.
- 8) Signal description consists of 3 lines of text. Center the text next to the terminals.
 - a) The 1st line of text lists the Equipment Name.
 - b) The 2nd line of text is for the Signal Function.
 - c) The 3rd line of text is the Signal Loop Number, if applicable.
- 7. Control Schematic:
 - a. General:
 - 1) Control Schematics show the controls associated with pieces of process equipment and provide a visual depiction of the majority of control wiring.
 - b. Control Schematic Components:
 - 1) Power Rail:
 - a) Represent the power rail with two parallel vertical lines that extend vertically down the schematic.
 - b) Each drawing includes two sets of power rails separated by 2.5”.
 - c) Identify each power rail with the wire number such as L1 at the top and bottom of each power rail.
 - d) The left power rail represents the “Hot” side of the power source. The right power rail represents the “Neutral” side of the power source.
 - 2) Power Source:
 - a) Identify power source(s) with the originating panel, voltage and circuit number between the “Hot” terminal and “Neutral” terminal on the first rung of the portion of the schematic for each source.
 - b) Indicate the terminals from the PTB providing the source and neutral powering the rail.
 - c) A supplementary protector or fuse is displayed in the power rail directly below the power source (Hot) terminal. Label the supplementary protector or fuse with the supplementary protector or fuse number and current rating.
 - d) Power layout for LCP’s:
 - i. In the first portion of the schematic, display power to the general purpose receptacle and panel light.

- ii. In the second portion of the schematic, display power to the air conditioner and/or heater.
 - iii. In the third portion of the schematic, display the power to the control logic.
 - iv. See Sections 3.2.B Panel Incoming Power and 3.2.C AC Power Distribution.
- e) Power layout for MCP's:
 - i. The first portion is for the typical 480 VAC motor control circuit with starter and disconnect, the next sections are the same as for the LCP's.
- f) Rung Number:
- 3) Rung Number:
 - a) Rung numbers are used to identify the location and cross referencing of devices within the schematic and provide a practical means of labeling conductors and terminals within the panel.
 - b) Rung numbers are a sequential series of numbers starting with number 1. Locate the numbers vertically along the left side of the "Hot" power rail.
 - c) Rungs are to be spaced on 0.5" centers based on a D Sized drawing.
- 4) Wire Numbering:
 - a) On the downstream side of the first device on a rung, the wire number takes the rung number appearing to the left of the power rail. If a second device is located in the circuit, the wire number to the right of the second device takes the rung number, but is appended with an "A". The wire number to the right of the third device is appended with a "B", and so on.
 - b) When the electrical connection originated on the previous rung, the wire numbers continue to use the previous rung number as the base.
 - c) Connections to the power neutral rail take on the power neutral rail's wire number N#.
- 5) Electrical Connections:
 - a) Represent electrical connections as a solid small circle where two or more wires interconnect.
 - b) Represent electrical connections as a hollow small circle where wires terminate to a device.
- 6) Electrical Wiring:
 - a) Electrical wires or circuits are represented by horizontal rungs that connect terminal blocks, relays, contacts and all other components used in the electrical schematic.
 - b) Space the schematic electrical wiring every other rung at a minimum.
 - c) Identify each wire with the rung number as the wire number.

- d) Label each wire with the conductor insulation color below each electrical wire. Refer to Table 2.2.K.1.f.
- e) Indicate electrical wiring that is external to the panel with dashed lines.
- 7) Device Labeling:
 - a) Symbols in the schematic for field devices, pilot lights, switches, push buttons etc. requires two lines of text above the device and one line of text below the device to describe the usage of the device.
 - i. The first line of text above the device is the name of the equipment with which the device is associated.
 - ii. The second line of text above the device is the control function of the device.
 - iii. The line of text under the device is the loop number.
 - b) Relay and timer symbol labels are to be identified with consecutive number starting with the number 1 or the rung number. For relay coils and contacts, identify the relay base terminal connection. Normally open or normally closed contacts refer to the de-energized or “off the shelf” state.
 - c) Symbols in the schematic for contacts of relays, timers, etc. require two lines of text above the contact and two lines of text below the contact to describe the usage and coil reference of the contact.
 - i. The first line of text above the contact is the name of the equipment the device is associated with.
 - ii. The second line of text above the device is the control function of the device.
 - iii. The first line of text under the device is the relay or timer number to reference the relay or timer in the schematic.
 - iv. The second line of text under the device is the rung number of the relay or timer to reference where the relay or timer is located in the schematic. If using the rung number for the relay or timer coil, the rung number under the contact is not required.
 - v. For relays and timer contact references, at the right of the neutral power rail, the schematic rung number location of all associated contacts is shown. If the contact is normally closed, underline the reference number. If a contact is unused, “SP” is shown.
- 8) Field Contacts:
 - a) Show Field Contacts connected to their respective TB1 or TB2 Terminals.
 - b) The connection lines from the contact to the terminal are dashed to designate they originate from outside the panel.
- 9) Selector Switches:

- a) Always show the switch in the far-left position, the switch contacts are shown as either opened or closed in this state. If they're in the closed state, the contact is shown closed, indicated by a line shown below and touching the two side small circles. If the contact is open in this position, a line is drawn above the two side small circles, but not touching them.
 - b) Show each position of the switch directly above its respective location on the switch. This indicates whether it is a two, three, four, or more position (pole) switch, and shows what the nameplate on each position will read.
 - c) To indicate which positions the contact is closed, show a contact legend in parenthesis below and to the right of the contact. If the contact is closed in a position, an "X" is shown in the order of the contact position in which it is closed. If the contact is open in a position, an "O" is shown.
 - d) When a selector switch is continued onto another sheet or further down on the same sheet, the continuation note is shown below the selector switch. Where the switch is continued, the same note appears, but on the top of the contact.
- 10) Push Buttons:
- a) Represent the push button contact in its "off the shelf" state.
- 11) Terminals:
- a) Terminal numbers are dependent upon the specific rung number that they appear in the schematic logic. As a horizontal electrical connection is followed from left to right, the first terminal number takes on the number of the rung. The second terminal number also takes the rung number but is appended by the letter A, the third by the letter B, and so on.
- 12) Programmable Logic Controller:
- a) Panels that contain a Programmable Logic Controller (PLC) require connection information for the PLC I/O modules.
 - i. Utilize the PLC drawings as provided in the Drawing Templates referenced in Section 3.03.A.1.
 - b) Module Layout:
 - i. Represent the module with a 1 1/2" wide vertical rectangle with a length suitable to encompass a maximum of 16 channels or 8 analog per section based on type of module.
 - ii. Two cards can be shown per sheet.
 - iii. Display field wiring (inputs) including TB1 and field device connections with a description on the left side of the module symbol.
 - iv. Label the module with model number, input voltage, rack number and slot number above the module symbol.
 - iv. Number each screw terminal per manufacturer's data.

- v. Display the associated PLC register address with each signal.
 - vi. Identify the positive and negative legs of the analog cable.
 - vii. Include all required jumpers for signal type and all 120VAC and 24VDC power requirements.
- 13) 480 Volt Equipment:
 - a) a) Provide the motor horsepower, full load amps and motor identification.
- 14) Contact Development:
 - a) The last sheet of the control schematic displays contacts for internal panel relay contacts that connect with external field equipment or the Process Control Information System (PCIS).
 - b) Organizes into two sections. The first section lists all contacts extending to the PCIS. Title this section "Contacts to PCIS". The second section lists all contacts extending into the field equipment external to the panel. Title this section "Contacts to Field". Group multiple contacts related to a single piece of equipment together.
 - c) Each contact includes a signal description and its associated relay number and relay rung number location. Device signals require the appropriate symbol from the Schematic Legend Sheet.
- 8. Analog Loop Diagrams:
 - a. General:
 - 1) The analog loop diagram only displays the portion of the instrument loop that passes through a particular panel.
 - 2) The analog loop diagram displays the connections between field instruments, panels and the PCIS.
 - 3) Analog loop diagrams are reserved for analog signals and control loops, but may be used to show complex connections for a particular instrument or device.
 - 4) Divide each loop into three different segments.
 - a) The left segment is "FIELD" connections. This segment provides information on terminations external to the panel (i.e., connected panels, instrument transmitters). If the first segment is another panel, the panel name replaces the "FIELD" label.
 - b) The center segment is the internal panel wiring and controls.
 - c) The right segment information represents output or input signals to downstream panels or the PCIS.
 - 5) Identify shield grounding location.
 - 6) Identify surge protection devices for each signal. Include surge protection for positive and negative leads. Utilize the surge protection block symbol from the legends and symbols sheet.
 - 7) Identify the cable number, wire color and polarity for each cable in the loop.

3.4 INSTALLATION

- A. Install equipment in conformance with NEC. Mounting panels on handrails is not allowed.
- B. Unless otherwise noted, install indoor free standing panels on 4-inch concrete pad. Extend pad 4-inches beyond outside dimensions of base, all sides. Lay grout after panel sills have been securely fastened down.
- C. Unless otherwise noted, install outdoor free standing panels on a reinforced concrete pedestal:
 - 1. Minimum Thickness: 8-inches with No. 4 steel reinforcing bars at 12-inches on centers, each way.
 - 2. Minimum Size: 4-inches larger than outer dimensions of base, all sides.
 - 3. Provide excavation and backfill work in conformance with Section 02260, Excavation Support and Protection.
 - 4. Provide concrete work in conformance with Section 03300, Cast-In-Place Concrete.
 - 5. Seal the contact surface between the panel base along the outside perimeter of the panel using RTV sealant.
 - 6. Install anchor bolts and anchor in accordance with Section 05190, Mechanically Anchoring and Fastening to Concrete and Masonry.
- D. Elevated Panels with floor stands:
 - 1. 1. When installing conduits through bottom, utilize bushings to retain the NEMA rating of the panel.
- E. Install each item in accordance with manufacturer's recommendations and in accordance with the Contract Documents.

3.5 RECORD DRAWINGS:

- A. Maintain a set of red-line panel drawings to reflect changes or deviations that occur during installation, start-up and commissioning and incorporates these deviations into the final Operation & Maintenance Manual.

3.6 SPARE PARTS AND TEST EQUIPMENT

- A. Furnish and deliver the spare parts and test equipment as outlined below, identical and interchangeable with similar parts furnished under this Specification.
- B. Pack spare parts in containers suitable for long term storage, bearing labels clearly designating the contents and the pieces of equipment for which they are intended.
- C. The following constitutes the minimum spare parts:
 - 1. Five of each type of control relay for each 40 or less furnished for this Contract.

2. One replacement power supply for each type and size furnished for this Contract.
 3. One per ten (two, if fewer than twenty) of each type of panel mounted instrument including lights and pushbuttons.
 4. One dozen of each type and size of fuse used in panels and instruments.
- D. The following constitutes the minimum test and calibration equipment:
1. All tooling required to insert, extract and connect any internal or external connector, including edge connectors.
 2. All special calibration equipment required for system calibration.

3.7 TESTING AND ADJUSTMENTS:

- A. Perform system testing and make any adjustments necessary in accordance with this Section and Section 17000, Instrumentation.
- B. Perform power supply, voltage adjustments to tolerances required by the appurtenant equipment.
- C. A Factory Acceptance Test shall be conducted before the panel is shipped to the site.
1. The Factory Acceptance test shall be witnessed by the ENGINEER and OWNER.
 2. The Factory Acceptance Test Report shall be utilized to document the test.
 3. All Control Panels require the Factory Acceptance Test to be witnessed by ENGINEER and OWNER:
 4. Provide all labor, materials, equipment and incidentals as shown on the Drawings, specified and required to perform factory testing, before shipment, at the manufacturer's facility to verify that system components are functioning properly and that they meet the functional and performance requirements of the Contract Documents.
 5. Submit information on factory testing procedures to verify that testing shall fulfill the requirements as specified herein. Submittal shall be made at least two months in advance of any scheduled testing and shall include dates of scheduled tests.
 6. Notify ENGINEER, in writing, at least four weeks before expected initiation of tests. OWNER and ENGINEER may elect to be present at CONTRACTOR'S facilities during operational test of system equipment, either for individual units or as an integrated system. Presence of OWNER and ENGINEER during testing does not relieve CONTRACTOR from conforming to the requirements of the Contract Documents and shall in no way imply acceptance of the equipment.
- D. System Hardware Operational Testing:
1. All input/output devices and components shall be tested to verify operability and basic calibration.

2. All system hardware components equipment shall be tested to verify proper operation of the equipment as stand alone units. Test shall include, but not be limited to, the following:
 - a. AC/DC power checks.
 - b. Power fail/restart tests.
 - c. Diagnostics checks.
 - d. Test demonstrating that all specified equipment functional capabilities are working properly.
 - e. All system components shall be tested to verify that communication between units is working properly.

3.8 MANUFACTURER'S SERVICE

- A. Provide the services of qualified factory-trained service representative to check and approve the installation of the panel(s).
- B. The factory trained service representative shall be provided for installation supervision, start-up and testing services. The representative shall make a minimum of 2 visits to the site to approve the completed installation and to perform start-up testing of the equipment. The representative shall coordinate each visit with the ENGINEER prior to arrival on the site. The representative shall test operate the system in the presence of the ENGINEER and verify that the equipment conforms to requirements. The representative shall revisit the job site as often as necessary until the installation and testing is entirely satisfactory.
- C. The factory trained service representative shall be provided for operation and maintenance personnel training services. The representative shall make a minimum of 1 visits to the site to perform the services as described under Section 01782, Operations and Maintenance Data. The representative shall coordinate each visit with the ENGINEER prior to arrival on the site.
- D. For the factory trained service representative, all costs, including travel, lodging, meals and incidentals, shall be considered as included in the bid price.
- E. Warranty: Standard Manufacturers and General Contractor Warranties.

END OF SECTION

SECTION 16225

ELECTRIC MOTORS 250 HORSEPOWER OR LESS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. This Section includes alternating current induction motors, 250 horsepower or less, to be provided with the driven equipment. Unless specified otherwise, electric motors shall be provided by the manufacturer of the driven equipment under an assumption of unit responsibility. This Section refers to motors by enclosure type as defined in NEMA MG 1, except as noted.

B. Horsepower Rating:

1. Motor horsepower ratings noted in individual equipment Specifications are estimates only and it is the responsibility of CONTRACTOR to furnish motors, electric circuits, and other equipment of ample horsepower capacity to operate the equipment furnished without exceeding the manufacturer's nameplate full-load current at rated manufacturer's nameplate voltage. Full-load current information shall be furnished with the individual submittals.

1.2 QUALITY ASSURANCE

A. General: Motors shall be built in accordance with UL 674, UL 1004, NEMA Standard MG 1, and to the requirements specified.

B. Reference Standards: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified. In case of conflict between the requirements of this Section and those of the listed documents, the requirements of this Section shall prevail.

1. AFBMA 9: Load Rating and Fatigue Life for Ball Bearings.
2. AFBMA 11: Load Ratings and Fatigue Life for Roller Bearings.
3. IEEE 112: Standard Test Procedures for Polyphase Induction Motors and Generators.
4. IEEE 841, Standard for Petroleum and Chemical Industry - Totally Enclosed Fan Cooled (TEFC) Squirrel Cage Induction Motors - Up to and Including 500 HP.
5. NEMA ICS 2: Industrial Control Devices, Controllers and Assemblies.
6. NEMA ICS 6: Enclosures for Industrial Controls and Systems.
7. NEMA 250, Enclosures for Electrical Equipment (1000 volts maximum).
8. NEMA MG 1: Motors and Generators.
9. NEMA MG1-31: Application Considerations for Constant Speed Motors Used on a Sinusoidal Bus with Harmonic Content and General Purpose Motors Used with Adjustable-Voltage or Adjustable- Frequency Controls or Both.
10. UL.674: Electric Motors and Generators for Use in Class I Division I Hazardous Locations
11. UL 1004: Electric Motors.

C. Factory Tests:

1. The manufacturer's factory motor Prototype Tests per IEEE Standard 112 Appendix-A on motors through 250 horsepower shall be submitted as Product Data for the motor, and actual factory tests for motors are not required:
 - a. Winding resistance in ohms and converted to 25 degree C.
 - b. Resistive Unbalance and Quarter Voltage Impedance, as applicable.
 - c. Locked-Rotor current (Single phase).
 - d. High Potential.
 - e. No-Load Excitation (volts, amperes, RPM).
 - f. Bearing vibration check.
 - g. Efficiency, Power Factor, Current at 115%, 100%, 75%, 50%, and no load.

D. Warranty:

1. Motors ½ horsepower and greater shall be warranted against defects in materials and workmanship for a period of 5 years under the specified uses and with normal operation and service. This warranty shall be delivered, in writing, to the Owner and shall include, as a minimum, 100 percent full payment coverage for parts and labor during the first 60 months of operation.

1.3 SUBMITTALS

A. Submittals shall include the following:

1. Shop Drawings: Submit for approval the following:
 - a. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
 - b. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**
2. Manufacture completed IEEE Standard 841 Date Sheet for AC Squirrel Cage Induction Motors with required factory data of motors supplied.
3. Speed-Torque curve per 1.2 C Factory Tests.

4. Factory Test Data: Including Guaranteed Minimum Efficiency for 115% load, 100% load, 75% load, 50% load, and no load.
5. Guaranteed vibration level when measured per MG 1, Figure 7-6:
 - a. Displacement: 0.0025 inch peak-to-peak
 - b. Velocity: 0.10 inches per second peak
 - c. Acceleration: 1g (gravity) peak.
6. Motor heating curve for motors per 1.2 C Factory Tests.
7. Motor outline, dimensions, and weight.
8. Manufacturer's descriptive information relative to motor features.
9. Response curve where a winding over-temperature device is required.
10. For all inverter duty motors: Manufacturer's certification that the motor is compatible with the adjustable frequency drive to be used.
11. Disassembly and repair documentation.

1.4 POWER SUPPLY VARIATIONS

- A. Motors shall operate successfully under running conditions at rated load with +/- 10-percent of rated voltage with rated frequency or +/- 5-percent of rated frequency with rated voltage.

1.5 AMBIENT CONDITIONS

- A. Unless specified otherwise, motors shall be suitable for continuous operation at an elevation of approximately 1,200 feet above mean sea level. Motors to be installed outdoors, exposed to the weather, shall be suitable for continuous operation in a 50° C ambient temperature; motors to be installed indoors shall be suitable for continuous operation in 50° C ambient temperature, unless otherwise noted.

1.6 NEMA WINDING TEMPERATURES

- A. NEMA MG 1 Table 12-7 motors insulation system maximum winding temperatures in degrees-Centigrade (C), with the degrees-Fahrenheit (F) insulation system class specified herein.
 1. Forty degree-C ambient (104 degree-F) is the basis for temperature rise.
 2. For 50 degree C ambient (122F) and above, refer to the driven equipment specifications for additional requirements.

Insulation System Class	Degrees C / F	Temperature Rise by Resistance
A	140 / 284	NA
B	165 / 329	B-rise: 40 + 80 = 120 Degrees C / 248 F
F	190 / 374	F-rise: 40 + 105 = 145 Degrees C / 293 F
H	215 / 419	H-rise: 40 + 125 = 165 Degrees C / 329 F

1.7 NEMA MOTOR TEMPERATURE PROTECTION TYPES

- A. The NEMA design shall limit the temperatures of the windings without using a thermal device:
 - 1. Type-1: Winding Running and Locked Rotor Over-temperature Protection.
 - 2. Type-2: Winding Running Over-temperature Protection.

PART 2 - PRODUCTS

2.1 MANUFACTURER'S NAMEPLATES

- A. Factory installed manufacturer's nameplates shall be stainless steel with embossed or pre-printed lettering and fastened to the motor frame with Type 316 stainless steel pins. Manufacturer's nameplates shall have stamped on them the motor manufacturer's name, design voltage; number of hertz and phase; horsepower rating; amperage and temperature rise at rated load, full load speed, NEMA code letter, service factor, minimum guaranteed efficiency, model number, AFBMA bearing number, serial number and maintenance manual number in accordance with NEMA MG1-10.40.1.
- B. A separate factory installed manufacturer's nameplate shall provide lubrication instructions and a separate manufacturer's nameplate connection diagram for dual voltage motors.
- C. Additionally, factory to provide the following information on manufacturer's nameplates or additional manufacturer's nameplates for:
 - 1. Motors 1/2 horsepower and larger: Indicate the ABMA L-10 rated life for the motor bearings.
 - 2. Motors 2 to 50 horsepower: Indicate the NEMA nominal efficiency.
 - 3. Motors 50 horsepower and larger: Indicate NEMA guaranteed minimum efficiency.
 - 4. Explosion-Proof motors: Indicate UL frame temperature limit code.
 - 5. Space heater information.
 - 6. NEMA MG 1 Over Temperature Protection Type Number.

2.2 CONSTRUCTION

- A. Unless specified otherwise, all motors provided under this Section shall have the following features of construction and operation:
 - 1. Motor voltage, speed and enclosures are specified in the detailed equipment Specifications. Motors furnished with equipment shall comply with this Section.
 - 2. All motors shall be of the motor manufacturer's premium energy-efficient design, different from manufacturer's standard product through the use of premium materials, design and improved manufacturing process that reduces motor losses approximately 40 percent from standard efficient designs.
 - 3. Motor efficiency shall be determined in accordance with NEMA Standard MG1-12.54.1 and guaranteed minimum full load efficiency labeled on manufacturer's motor nameplate in accordance with NEMA Standard MG1-12.54.2 or MG1-10.40.1 below.
 - 4. Minimum efficiencies shall not be less than those listed in Paragraph 2.4.E., below.

5. All motors shall successfully operate under power supply variations in accordance with NEMA MG1-14.30.
6. All motors shall be NEMA Design B with torque and starting currents in accordance with NEMA MG1-12.35 and 12.37, except in special applications requiring higher starting torques where NEMA Design C is permitted.
7. All motors shall have a 1.15 service factor. Polyphase integral horsepower motors shall be sized so that, under maximum load conditions imposed by the driven equipment, for the conditions specified, the manufacturer's motor nameplate rated horsepower and Class B temperature rise will not be exceeded. Motors with a service factor of 1.15 shall be selected for operation within their full load rating without applying the service factor.
8. Each motor shall be of the speed and horsepower specified or required to properly operate the driven equipment, torque characteristics as required by the drive load and suitable for direct coupling or V-belt drive, as shown on the Drawings and specified herein. Motors shall be designed for full voltage starting, unless otherwise specified.
9. Frames shall be of corrosion-resistant cast iron with integrally cast feet or bases. End bells, conduit box and cover and bases shall be cast iron, with precision machined bearing fits, ASTM Type A-48, Class 25 or better. UL approved automatic stainless steel breather drains shall be provided in the lowest part of front and back brackets to allow drainage of condensation on TEFC and explosion proof motors.
10. Each stator core assembly shall consist of stacked lamination made from specially selected electrical sheet silicon steel.
11. Insulation materials shall be non-hygroscopic and meet or exceed Class H definition, utilizing materials and insulation systems evaluated in accordance with IEEE 117 classification tests. Motor temperature rating shall not exceed Class F temperature limits as measured by resistance method when the motor is operated at full load at 1.0 service factor continuously in a maximum ambient temperature of 50° C. Windings shall be copper.
12. Rotor cages for motors 50 HP or less shall be die cast aluminum or fabricated copper. Shafts shall be made from carbon steel. Rotor cages for motors larger than 50 HP shall be copper only.
13. Rotors on frames 213T and above shall be keyed shrunk or welded to shaft and rotating assembly dynamically balanced to NEMA limits in accordance with MG1-12.06. Balance weights, if required, shall be secured to the rotor resistance ring or fan blades by rivets. Machine screws and nuts are prohibited. The entire rotating assembly between bearing inner caps shall be coated with a corrosion-resistant epoxy.
14. Bearings shall be ball, open, single row, deep groove, Conrad type, and shall have a Class 3 internal fit conforming to AFBMA Std. 20. For belted duty applications, drive end bearing may be cylindrical roller type. Bearings shall be selected to provide L-10 rating life of 100,000 hours minimum. Calculations shall be based on external loads using NEMA applications limits in accordance with MG1-14.41 and typical sheave weights and internal loads defined by the manufacturer, including magnetic pull and rotating assembly weight.
15. Bearing temperature rise at rated load shall not exceed 60° C. Temperature rise shall be measured by RTD or thermocouple at bearing outer race. Bearing AFBMA identification number shall be stamped on manufacturer's motor nameplate.

16. Motor lubrication system shall consist of a sealed bearing or a grease inlet on motor bracket with capped grease fitting on inlet, grease relief plug 180 degrees from inlet, grease reservoir in bracket and grease reservoir in cast inner cap. Motor shall be greased by manufacturer with a premium moisture resistant polyuria thickened grease containing rust inhibitors and suitable for operation over temperatures from -25° C to 120° C.
17. All bolt and cap screws shall be of high strength, SAE Grade 5 zinc-plated and chromatic steel. Screwdriver slot fasteners are unacceptable.
18. All motor parts including frame, brackets, fan cover and terminal box shall receive a minimum of two coats of high grade USDA accepted epoxy paint. Motor assembly shall successfully withstand salt spray tests for corrosion in accordance with ASTM B-117 for 96 hours.
19. All motors shall be painted the same color as the driven equipment.
20. Two-speed motors shall be two-winding motors. Two-speed, one-winding consequential-pole motors that require special motor starters are prohibited.

2.3 MOTORS LESS THAN 1/2 HORSEPOWER

A. General:

1. Unless otherwise specified, motors less than 1/2 horsepower shall be squirrel cage, single phase, capacitor start, induction run type. Construction features listed in Paragraph 2.2, above, shall be as normally supplied by the equipment manufacturer. Single phase motors shall have Class B insulation, minimum. Small fan motors may be split-phase or shaded pole type. Windings shall be copper.

B. Rating:

1. Unless otherwise specified, motors shall be rated for operation at 115 volts, single phase, 60 Hz, and shall be continuous-time rated in conformance with NEMA Standard MG 1, Paragraph 10.35. Dual voltage (115/230) rated motors are acceptable if all leads are brought out to the conduit box. Motors shall be non-overloading at all points of the equipment operation.

C. Enclosures:

1. Unless otherwise specified, motors shall have totally enclosed fan cooled or totally enclosed non-ventilated enclosures.

2.4 MOTORS 1/2 HORSEPOWER THROUGH 250 HORSEPOWER

A. General:

1. Unless otherwise specified, motors 1/2 horsepower through 250 horsepower shall be three phase, squirrel cage, full voltage start induction type. Unless otherwise specified, motors shall have a NEMA MG 1-1.16 design letter B or C torque characteristic as required by the driven equipment's starting torque requirements.

B. Rating:

1. Unless otherwise specified, motors shall be rated for operation at 460 volts, 3 phase, 60 Hz, and shall be continuous time rated in accordance with NEMA Standard MG 1, Paragraph 10.35.

2. Motors for variable frequency systems shall not be required to deliver more than 80 percent of the motor's service factor rating by any load imposed by the driven machine at any specified operating condition or any condition imposed by the driven machine's performance curve at maximum operating speed.

C. Enclosure and Insulation:

1. General: Motors shall be classified as Type 1 (Process) and Type 2 (Explosion proof). Enclosures and insulation systems shall be as specified in the following paragraphs. Temperature rise for all motor types shall not exceed that permitted by Note II, Paragraph 12.42, NEMA MG 1. The insulation shall be non-hygroscopic.
 - a. Type 1 Motors (Process): Type 1 motors shall be premium energy efficient motors, totally enclosed, fan cooled. All motors shall have Class H insulation with Class B temperature rise. Motors shall conform to IEEE 841. All internal surfaces shall be coated with an epoxy paint. Motors shall be rated for corrosive atmosphere duty.
 - b. Type 2 Motors (Explosion proof): Explosion proof motors shall be UL listed in accordance with UL 674 for Class I, Group D hazardous atmospheres. The motor shall have Class H insulation and shall conform to IEEE 841. Steel frame motors will not be permitted. A UL-approved Type 316 stainless steel breather/drain device shall be provided in the motor drain hole. The motor shall be provided with a frame temperature thermostat which meets the UL frame temperature limit code T2A (280°C). The thermostat shall contain an automatically reset, normally closed contact rated two amperes at 115 volts AC.

D. Motors for Variable Frequency Drives:

1. Motors intended for use with variable frequency drives shall be compatible with the characteristics of the intended variable frequency inverters. Motors shall be Type 1 or Type 2 as specified in the detailed Specification. Insulation for all motors operating with variable frequency drives shall be Class H with Class F temperature rise. Variable frequency drive motors shall be premium energy-efficient motors. Motors shall be capable of withstanding a pulse voltage of at least 1750 volts with a rate of rise up to 750V/micro second. The motors shall be certified by the manufacturer as suitable for inverter duty.
2. All motors connected to variable frequency drives shall be equipped with shaft grounding rings. Shaft grounding devices must be factory installed or installed by a reputable motor shop with the expertise in the proper installation of the devices. If the shaft grounding devices are not factory installed, a third party shall be engaged to test the installation to ensure no damaging shaft currents are present.

- E. Minimum Manufacturer's Nameplate Efficiency: Motor minimum manufacturer's nameplate efficiency, determined in accordance with IEEE 112B testing procedures, when operating on a sinusoidal power source shall conform to the following:

HORSEPOWER RANGE	SPEED, RPM		
	1200	1800	3600
1-2	82.5	84.5	82.5

3-5	89.5	88.5	86.5
7-25	90.2	90.2	89.5
30-60	92.4	92.4	89.8
75-250	94.1	93.7	91.7

F. Vertical Motors:

1. Unless otherwise specified, vertical motors shall be full voltage with a Type P base specifically designed for vertical installation. Universal position motors are not acceptable. Vertical motors shall have solid shafts, unless otherwise specified. Vertical motors shall conform to either Type 1 or Type 2 motor requirements as specified under Paragraph 2.4.C., above. Thrust bearing rating shall be compatible with the loads imposed by the driven equipment.

G. Conduit Boxes:

1. CAUTION: External conduit boxes on motors shall be sized to accommodate oversized feeder conductors and as shown on the Drawings shall, in any case, not be less than one size larger than NEMA standards. The conduit boxes shall be diagonally split and rotatable in 90 degree steps. A gasket shall be furnished between the conduit box and frame. Motor leads shall be stranded copper wire, Class H or better insulated, non-wicking, with permanent identifications spaced 1-1/2-inches maximum. Clamp type grounding terminals shall be provided in the conduit boxes.

H. Lifting Eyes:

1. Motors weighing more than 50 pounds shall be fitted with at least one lifting eye.

I. Current Imbalance:

1. Current imbalance shall not exceed the values tabulated below when the motor is operating at any load within its service factor rating and is supplied by a balanced voltage system.
 - a. Under five horsepower: Ten percent
 - b. Five horsepower and above: Ten percent
2. Imbalance criteria shall be based upon the lowest value measured.

2.5 MOTOR TYPES

A. The following Standard motor types shall conform to the following requirements:

1. Horizontal Dripproof: Provide horizontal motors with an enclosure that meets NEMA Standard MG 1 for open, dripproof construction. Provide screen over all air openings.
2. Horizontal Totally Enclosed Fan-Cooled: Provide totally enclosed fan-cooled (TEFC) motors with frame sizes 182 and larger with cast iron frames and end shields. Smaller frame sizes may be constructed of rolled steel with cast metal end shields. Provide motors with condensate drain holes. For frame size 286 and larger, provide automatic breather/drain device in drain hole.

3. Vertical Weather Protected Type I: Provide vertical motors with an enclosure that meets NEMA Standard MG 1 for weather protected Type I (WP-I) enclosure. Provide screens over all air openings.
4. Vertical Totally Enclosed Fan-Cooled: Provide vertical motor with an enclosure identical to the requirements for the horizontal TEFC motors.
5. Explosion proof: Provide all horizontal and vertical motors with TEFC explosion proof enclosures, UL listed for Class 1, Division 1, Group D hazardous atmosphere.
6. Submersible: Submersible motors UL listed for explosion proof atmospheres in accordance with subsequent sections of this specification. In addition, provide submersible motors with two mechanical seals; the lower one outside the motor and protecting the upper one, which is in an oil filled chamber. Provide moisture detector probes in the oil filled seal chamber to indicate the presence of moisture in the seal chamber. Provide a temperature detector and switch rated 3 amperes, 120 volts minimum, set to operate when the internal motor temperature exceeds a preset limit. Provide any relays or solid state controls for separate mounting.
7. Horizontal, Totally Enclosed, Fan-Cooled, Severe Duty: Provide horizontal (TEFC), severe duty motors suitable for contaminated environments, including gasketed conduit box, stainless steel drains, double-shielded bearings, and corrosion resistant paint. Provide motors manufactured by Reliance Electric SXT-XT-XE, Century Type SCE E-Plus, or equal.
8. Vertical, Totally Enclosed, Fan-Cooled, Severe Duty: Provide vertical (TEFC), severe duty motors with the requirements identical to horizontal (TEFC), severe duty motors, above.

2.6 PRODUCT DATA

- A. The following information shall be provided for each motor in accordance with the individual equipment specification.
 1. Motor outline, dimensions and weight.
 2. Manufacturer's general descriptive information relative to motor features.
 3. Where a winding over-temperature device is required, provide a response curve for the temperature device.
 4. Applicable operation and maintenance information specified in Section 01730, Operation and Maintenance Data. Provided overhaul instructions for each motor five HP and over.

2.7 ACCEPTABLE PRODUCTS

- A. The following manufacturer's motors generally meet the class and performance requirements of this specification when furnished with appropriate modifications and additional features as specified:
 1. General Electric Inc.
 2. Emerson US Motors.
 3. Siemens.

PART 3 - EXECUTION GROUNDING AND BONDING

- A. Verify the circuit ground cable (green) is identified and connected to the grounding lug terminal in the conduit box.
- B. Provide supplementary grounding by installing a bond from the motor frame to the grounding electrode system as indicated on the drawings.

4.2 FIELD TESTING

- A. Verify breather/drain fittings have been installed as specified herein.
- B. Provide winding insulation resistance testing for motors to be witnessed by owner or engineer before connection is complete. Winding insulation resistance shall be not less than 10-megohm measured with a 1000-VAC megohmmeter at 1-minute at or corrected to 40-degree C.
- C. Provide motor phases current imbalance testing to be witnessed by owner or engineer.
- D. Test motors in accordance with Specification 16920, Electrical Acceptance Testing.

END OF SECTION

SECTION 16481

MOTOR CONTROL CENTERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 1, General Requirements, Specification Sections apply to this Section.

1.2 SUMMARY

- A. This Section includes new motor control centers for use on AC circuits rated 600 VAC.
- B. This section also includes modifications to existing motor control centers rated 600VAC.

1.3 SUBMITTALS

- A. Product Data: For each type of controller and each type of motor control center. Include dimensions and manufacturer's technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each motor control center.
 - 1. Dimensioned Plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings. Include the following:
 - a. Each installed unit's type and details.
 - b. Nameplate legends.
 - c. Short circuit current ratings of buses and installed units.
 - d. Vertical and horizontal bus capacities.
 - e. UL listing for series rating of overcurrent protective devices in combination controllers.
 - f. Features, characteristics, ratings, and factory settings of each motor control center unit.
 - 2. Wiring Diagrams: Power, signal, and control wiring for class and type of motor control center. Differentiate between manufacturer-installed and field-installed wiring. Provide schematic wiring diagram for each type of controller.
 - 3. Submit for approval the following:
 - a. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification

compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

- b. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**
- C. Manufacturer Seismic Qualification Certification: Submit certification that motor control centers, accessories, and components will withstand seismic forces defined for the site.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event".
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- D. Qualification Data: For firms and persons specified in Paragraph 1.4 of this Specification.
- E. Field Test Reports: Written reports specified in Part 3 of this Specification.
- F. Manufacturer's field service report.
- G. Maintenance Data: For motor control centers, all installed devices, and components to include in maintenance manuals specified in Division 1, General

Requirements. In addition to requirements specified in Section 01700, Contract Closeout, include the following:

1. Routine maintenance requirements for motor control centers and all installed components.
 2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
- H. Load-Current and Overload-Relay List: Compile after motors have been installed and arrange to demonstrate that selection of heaters suits actual motor nameplate full-load currents.
- I. Arc Flash Hazard Survey and appropriate labeling shall be done on all circuits 300 volts and above.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Maintain, within 100 miles of Project site, a service center capable of providing training, parts, and emergency maintenance and repairs.
- B. Source Limitations: Obtain controllers of a single type through one source from a single manufacturer.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. Comply with NFPA 70.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver motor control centers in shipping splits of lengths that can be moved past obstructions in delivery path as indicated.
- B. Handle motor control centers according to NEMA ICS 2.3, "Instructions for the Handling, Installation, Operation, and Maintenance of Motor Control Centers", use factory-installed lifting provisions.
- C. Store motor control centers indoors in clean, dry space with uniform temperature to prevent condensation. Protect motor control centers from exposure to dirt, fumes, water, corrosive substances, and physical damage.
- D. If stored in areas subjected to weather, cover motor control centers to protect from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside controllers; install electric heating of sufficient wattage to prevent condensation.

1.6 PROJECT CONDITIONS

- A. Existing Utilities: Do not interrupt utilities serving facilities occupied by OWNER or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
 - 1. Notify construction manager at least two days in advance of proposed utility interruptions. Identify extent and duration of utility interruptions.
 - 2. Indicate method of providing temporary utilities.
 - 3. Do not proceed with utility interruptions without Construction Manager's written permission.

1.7 COORDINATION

- A. Coordinate layout and installation of motor control centers with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Section 03300, Cast-In-Place Concrete.
- C. Coordinate features of motor control centers, installed units, and accessory devices with pilot devices and control circuits to which they connect.
- D. Coordinate features, accessories, and functions of each motor control center, each controller, and each installed unit with ratings and characteristics of supply circuit, motor, required control sequence, and duty cycle of motor and load.

1.8 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Spare Fuses: Furnish one spare for every two installed, but not less than one set of three of each type and rating.
 - 2. Indicating Lights: Two of each type installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products from the following:
 - 1. Eaton.

2. Square D Company.
3. Allen-Bradley.

2.2 MOTOR CONTROL CENTERS

- A. Wiring: NEMA ICS 3, Class I, Type B.
- B. Enclosures: Flush- or surface-mounted cabinets as indicated.
 1. Outdoor Locations: NEMA 250, Type 3R, provide intrusion switches on all sectional doors.
 2. Indoor Locations: NEMA Type 1A enclosure.
 3. Compartments: Modular; individual doors with concealed hinges and quick-captive screw fasteners. Interlocks on combination controller units requiring disconnecting means in OFF position before door can be opened or closed, except by operating a permissive release device.
 4. Interchangeability: Compartments constructed to allow for removal of units without opening adjacent doors, disconnecting adjacent compartments, or disturbing operation of other units in motor control center. Interchangeability of units requiring the same size compartment and constructed to permit ready rearrangement of units, such as replacing three single units with a unit requiring three spaces, without cutting or welding.
 5. Wiring Spaces: Wiring channel in each vertical section for vertical and horizontal wiring to each unit compartment; supports to hold wiring in place.
- C. Short Circuit Current Rating for Each Section: Greater than indicated available fault current in symmetrical amperes at motor control center location or that required by power utility, whichever is greater.

2.3 BUSES

- A. Material: Tin-plated copper, 98% conductivity.
- B. Ampacity Ratings: As indicated on the Drawings for horizontal busses, 300 amperes minimum for vertical buses.
- C. Neutral Buses: Full size.
- D. Equipment Ground Bus: Non-insulated, horizontal copper bus, 2-inches by 1/4-inch, minimum.
- E. Horizontal Bus Arrangement: Main phase, neutral and ground buses extended with same capacity the entire length of motor control center, with provision for future extension at both ends by bolt holes and captive bus splice sections or equivalent.

2.4 FUNCTIONAL FEATURES

- A. Description: Modular arrangement of controllers, control devices, overcurrent protective devices, transformers, panelboards, instruments, indicating panels, blank panels, and other items mounted in compartments of motor control center.
- B. Controller Units:
 - 1. Provide Motor Controller units supplied by the same manufacturer as the motor control center.
 - 2. Provide units with short circuit current ratings equal to or greater than short circuit current rating of motor control center section.
 - 3. Equip units in Type B and Type C motor control centers with pull-apart terminal strips or drawout terminal boards for external control connections.
- C. Overcurrent Protective Devices: Individual feeder-tap units through 225 A rating shall have drawout mountings with connectors that automatically line up and connect with vertical-section buses while being racked into their normal, energized positions.
- D. Surge Protection Devices: Connect to motor control center bus. Provide surge protective devices in accordance with Section 16282, Surge Protective Devices.
- E. Transformer housing section for a transformer and a distribution panel with connections, as shown on the Drawings.
- F. Spaces and Blank Units: Compartments fully bused and equipped with guide rails or equivalent, ready for insertion of drawout units.
- G. Spare Units: Type, sizes, and ratings indicated; installed in compartments indicated "spare".
- H. Provide power quality metering.

2.5 MOTOR CONTROLLERS

- A. Description: NEMA ICS 2, Class A, full voltage, non-reversing, across-the-line, unless otherwise indicated.
- B. Control Circuit: 120 volt; obtained from integral control power transformer with a control power transformer of sufficient capacity to operate connected pilot, indicating and control devices, +100% spare capacity.
- C. Combination Controller: Factory-assembled combination controller and disconnect switch.
 - 1. Circuit Breaker Disconnecting Means: NEMA AB 1, motor-circuit protector with field-adjustable, short circuit trip coordinated with motor locked-rotor amperes.

- D. Adjustable Overload Relay: Dip switch selectable for motor running overload protection with NEMA ICS 2, Class 10 tripping characteristic, and selected to protect motor against voltage and current unbalance and single phasing. Provide relay with Class II ground-fault protection, with start and run delays to prevent nuisance trip on starting.
- E. Bypass Controller: NEMA ICS 2, full-voltage, non-reversing controller with across-the-line starting capability in manual bypass mode. Provide motor overload protection under both modes of operation with control logic that allows common start-stop capability in either mode.
- F. Solid-State, Reduced-Voltage Controller: Provide Solid State Motor Controllers internal to MCC bucket in accordance with Section 16482, Solid State Motor Controllers.
- G. Variable Frequency Drive: Provide Variable Frequency Drive motor controllers internal to MCC bucket in accordance with Section 16485, Variable Frequency Drives.

2.6 FEEDER OVERCURRENT PROTECTION

- A. Thermal-Magnetic Circuit Breakers: Provide as shown on DRAWINGS. Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger. All breakers 600 amp and larger shall be 100% rated.
 - 1. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
 - 2. Electronic Trip Unit Circuit Breakers: RMS sensing; field-replaceable rating plug; with the following field-adjustable settings:
 - a. Instantaneous trip.
 - b. Long- and short-time pickup levels.
 - c. Long- and short-time time adjustments.
 - d. Ground-fault pickup level, time delay, and I²t response.
 - 3. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
 - 4. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker; trip activation on fuse opening or on opening of fuse compartment door.
 - 5. GFCI Circuit Breakers: Single- and 2-pole configurations with 5 mA trip sensitivity.
 - 6. Molded-Case Switch: Molded-case circuit breaker without trip units.
- B. Molded-Case, Circuit-Breaker Features and Accessories: Provide as shown on DRAWINGS. Standard frame sizes, trip ratings, and number of poles.

1. Lugs: Mechanical style, suitable for number, size, trip ratings, and material of conductors.
2. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
3. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
4. Communication Capability: Circuit breaker-mounted communication module with functions and features compatible with power monitoring and control system.
5. Shunt Trip: 120 volt trip coil energized from separate circuit, set to trip at 75% of rated voltage.
6. Undervoltage Trip: Set to operate at 35% to 75% of rated voltage with field-adjustable 0.1 to 0.6 second time delay.

2.7 MOTOR CONTROL CENTER ACCESSORIES

- A. Devices shall be factory installed in controller enclosure and shall be of the same manufacturer as the motor control center, unless otherwise indicated.
- B. Pushbutton Stations, Pilot Lights, and Selector Switches: Provide pushbuttons, pilot lights, and selector switches in accordance with Section 16161, Control Panels.
- C. Stop and Lockout Pushbutton Station: Momentary-break, pushbutton station with a factory-applied hasp arranged so padlock can be used to lock pushbutton in depressed position with control circuit open.
- D. Control Relays: Provide auxiliary and adjustable time-delay relays in accordance with Section 16161, Control Panels.
- E. Elapsed Time Meters: Provide elapsed time meters in accordance with Section 16161, Control Panels.
- F. Meters: Panel-type, 2-1/2-inch minimum size with 90 degree or 120 degree scale, and $\pm 2\%$ accuracy. Where indicated, provide transfer device with an OFF position. Meters shall indicate the following:
 1. Ammeter: Output current, with current sensors rated to suit application.
 2. Voltmeter: Output voltage.
 3. Frequency Meter: Output frequency.
- G. Multifunction Digital-Metering Monitor: UL listed or recognized, microprocessor-based unit suitable for three- or four-wire systems and with the following features:

- H. Provide metering in accordance with Section 16430, Customer Power Metering System.
- I. Phase Failure and Undervoltage Relays: Solid-state sensing circuit with isolated output contacts for hardwired connection. Provide adjustable undervoltage setting.
- J. Current Sensing, Phase Failure Relays: Solid-state sensing circuit with isolated output contacts for hardwired connection; arranged to operate on phase failure, phase reversal, current unbalance of from 30% to 40%, or loss of supply voltage; with adjustable response delay.
- K. Spare Fuse Cabinet: Identified cabinet with hinged, lockable door.

2.8 FACTORY FINISHES

- A. Manufacturer's standard prime-coat finish ready for field painting.
- B. Finish: Manufacturer's standard paint applied to factory-assembled and -tested controllers before shipping.

2.9 ENVIROMENTAL CONTROL

- A. Environmental Controls:
 - 1. Furnish circulation fans near hot spots where required to prevent temperature from exceeding instrument and equipment ratings.
 - 2. Over-temperature switches shall be utilized to provide special cooling if required to maintain operating temperatures within the manufacturer's specified temperature range.
 - 3. Air conditioning cooling applications shall also include means of preventing moisture condensation inside the enclosure.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and surfaces to receive motor control centers for compliance with requirements, installation tolerances, and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

- A. Select features of each controller to coordinate with ratings and characteristics of supply circuit and motor; required control sequence; duty cycle of motor, drive, and load; and configuration of pilot device and control circuit affecting controller functions.

- B. Select horsepower rating of controllers to suit motor controlled.

3.3 INSTALLATION

- A. See Section 16050, Basic Materials and Methods, for general installation instructions.
- B. Anchor each motor control center assembly to steel-channel sills arranged and sized according to manufacturer's written instructions. Attach by bolting. Level and grout sills flush with motor control center mounting surface.
- C. Install motor control centers on concrete bases complying with Section 03300, Cast-In-Place Concrete.

3.4 IDENTIFICATION

- A. Identify motor control center, motor control center components, and control wiring according to Section 16195, Electrical Identification.
- B. Operating Instructions: Frame printed operating instructions for motor control centers, including control sequences and emergency procedures. Fabricate frame of finished metal and cover instructions with clear acrylic plastic. Mount on front of motor control centers.

3.5 CONTROL WIRING INSTALLATION

- A. Install wiring between motor control devices.
- B. Bundle, train, and support wiring in enclosures.
- C. Connect hand-off-automatic switch and other automatic control devices where available.
 - 1. Connect selector switches to bypass only manual and automatic control devices that have no safety functions when switch is in "hand" position.
 - 2. Connect selector switches with motor control circuit in both "hand" and "automatic" positions for safety-type control devices such as low and high pressure cutouts, high temperature cutouts, and motor overload protectors.

3.6 CONNECTIONS

- A. Conduit installation requirements are specified in other Division 16, Electrical, Sections. Drawings indicate general arrangement of conduit, fittings, and specialties.
- B. Ground equipment.

- C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.7 FIELD QUALITY CONTROL

- A. Prepare for Acceptance Tests as follows:
 - 1. Test insulation resistance for each motor control center element, bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- B. Testing: Perform the following field quality control testing:
 - 1. Perform each electrical test and visual and mechanical inspection indicated in NETA ATS, Sections 7.5, 7.6, and 7.16.
 - 2. Certify compliance with test parameters.
 - 3. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- C. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including pre-testing and adjusting solid-state controllers.
- D. Test Reports: Prepare a written report to record the following:
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

3.8 ADJUSTING

- A. Set field-adjustable switches and circuit breaker trip ranges.

3.9 CLEANING

- A. Clean controllers internally, on completion of installation, according to manufacturer's written instructions. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

3.10 START-UP SERVICE

- A. Engage a factory-authorized service representative to perform start-up service.
- B. Verify that motor control centers and components are installed and connected according to the Contract Documents.
- C. Verify that electrical wiring installation complies with manufacturer's submittal and installation requirements in Division 16, Electrical, Sections.

- D. Complete installation and start-up checks according to manufacturer's written instructions.

3.11 DEMONSTRATION

- A. Engage a factory-authorized service representative to train OWNER'S maintenance personnel to adjust, operate, and maintain motor control centers.
 - 1. Train OWNER'S maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining equipment and schedules.
 - 2. Review data in maintenance manuals. Refer to Section 01700, Contract Closeout.
 - 3. Schedule training with OWNER, through Construction Manager, with at least seven days advance notice.

END OF SECTION

SECTION 16485

VARIABLE FREQUENCY DRIVES - LOW VOLTAGE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Variable Frequency Drive (VFD) systems rated 480 VAC or lower.

1.2 VFD FEATURES

A. The VFDs shall be provided with the following features:

1. Fused control circuit transformer.
2. Provision for 4 to 20 mA input speed reference signal.
3. Electrically isolated auxiliary contacts for ready, running, and trouble status.
4. Adjustable minimum/maximum frequency limits.
5. Independent timed linear acceleration and deceleration.
6. Adjustable motor slip compensation based on motor current.
7. Terminal blocks for control and signal wires entering and leaving the controller.
8. Output transistors shall be insulated gate bipolar transistors (IGBT) type, or Darlington pair.
9. Current limit.
10. Programmable automatic restart.
11. 4 to 20 mA output signal proportional to VFD output frequency.
12. Digital keypad for configuration, programming, local control, and monitoring.
13. Microprocessor-based control for system logic sequencing functions.
14. VFD shall have a minimum 18-pulse input circuit (for VFD's rated 40 HP and above) designed to reduce harmonic distortion.
15. VFD's below 40 HP rating shall have a 6 pulse input circuit designed to reduce harmonic distortion.
16. Ethernet port for TCP/IP communications.

1.3 FUNCTIONAL REQUIREMENTS

- A. Supply Power: The VFD shall operate continuously with supply power of 480 volts $\pm 10\%$, 60 Hz $\pm 3\%$. The VFD shall remain on line and operate without damage to either the VFD or its connected load during a supply power variation of plus 50% lasting for a period of up to 0.01 seconds and minus 100% lasting for a period of up to 0.5 seconds.
- B. Ambient Conditions: The VFDs shall operate continuously as specified in an ambient temperature of 0° C to +40° C and an ambient humidity of 0% to 90%,

non-condensing. Provide air conditioning as required to maintain the VFD manufacturers' maximum ambient temperature rating.

- C. Load: The VFD system shall be capable of 110% continuous current overload. Variable torque inverters shall be capable of delivering 120% of the specified load for up to 60 seconds, and constant torque inverters shall deliver 150% overload current for 120 seconds.
- D. Power Factor: Displacement power factor shall be not less than 0.95 at rated full speed and load. Overall power factor, including harmonic distortion, shall be 0.85, or greater. CONTRACTOR shall provide power factor correction components as necessary to meet this requirement.
- E. Efficiency: Efficiency of VFD systems shall be at least 96% at 60 Hz output driving the specified maximum load.
- F. Frequency and Voltage Regulation: VFD output frequency shall be regulated to within 0.6 Hz of the frequency set point. VFD output voltage shall be regulated to within $\pm 1.0\%$ of that value which will produce minimum motor heating at any operating frequency within the specified range.
- G. Frequency Range: VFD shall be capable of continuous operation with the specified load at any frequency between 0.1 Hz and 60 Hz.
- H. Space: VFD system size shall not exceed the size allotments specified on the Drawings, nor shall any portion of the VFD system exceed a height of 90-inches. VFD system shall be front accessible and shall not require rear access. The VFD equipment shall be suitable for mounting directly against the wall without any clearance for ventilation or other purposes. VFD units shall be arranged as required for entry of incoming line cables and as required for entry of load cables.
- I. Ambient Noise: Free field noise generated by the VFD shall not exceed 85 dBA at 3 feet out from any point on the VFD cabinet under any normal operating condition.

1.4 PROTECTION AND ANNUNCIATION

- A. Overcurrent Protection: The VFD system shall provide electronic current limit at 150% of motor nameplate current. Current limit shall be accurate to within 1.0% and shall smoothly limit motor speed at whatever value is necessary to limit motor current to that value.
- B. The VFD shall also provide motor running overcurrent protection in compliance with NFPA 70.
- C. Short Circuit Protection: The VFD shall be fully protected against load faults. Bolted faults, phase-to-phase, or phase-to-ground shall not damage the unit. Any impedance or other current limiting necessary to meet this requirement shall be

provided as part of the VFD system, and any losses caused by current limiting devices shall be included in efficiency calculation for the VFD system.

- D. Line Voltage: The VFD shall be protected against high and low line voltage on one or more phases.
- E. Internal Faults: The VFD shall incorporate an internal fault monitoring system to detect malfunctions. This system shall be designed to protect the VFD from transient and sustained faults, and to limit damage that may be caused by these faults.
- F. Overtemperature: Overtemperature circuitry shall shut down the VFD upon overheating and display an overtemperature alarm, or message.
- G. Diagnostics: The VFD shall be provided with a fault diagnostics system that indicates the cause of any shutdown. The system shall store faults in memory and discard the oldest faults as new ones fill the memory. Faults shall be accessible via a digital keypad, also used for local control and programming.

1.5 EXTERNAL CONTROL AND MONITORING

- A. Speed Reference: The VFD shall accept a 4 to 20 milliampere direct current speed reference signal. Speed reference input shall be galvanically isolated and input resistance shall not exceed 250 ohms.
- B. Ready Signal: The VFD shall provide a contact closure that indicates that the controller line power supply is within acceptable tolerances, the control circuits are normal, and there are no internal or external fault conditions that have not been reset. Presence of this signal indicates that the controller should start normally.
- C. Running Signal: The VFD shall provide a contact closure which indicates that the controller is running.
- D. System Trouble: Isolated normally open contacts for remote fault annunciation shall be provided and wired to terminal blocks, which shall be labeled and identified. Contact shall close under fault conditions. Fault conditions that drive the outputs shall be selectable from the digital keypad.
- E. The VFD control circuitry shall shutdown the VFD if the motor overheats. Motor winding temperature switches, or RTDs shall be connected if provided by the motor manufacturer.

1.6 QUALITY ASSURANCE

- A. This Section contains references to the following documents. They are a part of this Section as specified and modified. In case of conflict between the

requirements of this Section and those of the listed documents, the requirements of this Section shall prevail.

1. IEEE 519-1992, Guide for Harmonic Control in Electric Power Systems.
 2. NEMA 250-85, Enclosures for Industrial Control and Systems.
 3. NEMA ICS 2-83, Industrial Control Devices, Controllers and Assemblies.
 4. NEMA ICS 3-83, Industrial Systems.
 5. NFPA 70-87, National Electrical Code (NEC).
 6. Underwriters Laboratories, UL 508.
- B. The VFD shall comply with the applicable requirements of NEMA ICS 3 and additional standards referenced by ICS 3.
- C. The VFDs specified in this Section shall be the product of a single vendor. The CONTRACTOR shall assign unit responsibility for the adjustable frequency drives in this section. The CONTRACTOR shall submit letters of certification with the Shop Drawings from the VFD manufacturer, the motor manufacturer, and the driven equipment manufacturer stating that they have reviewed each application and that the combination will satisfy the application duties required, for the actual motor sizes required, regardless of deviations from the scheduled "nominal horsepower".
- D. VFD manufacturing facility shall be ISO 9001 certified.

1.7 SUBMITTALS

- A. The following information shall be provided in accordance with the Contract Documents:
1. Catalog and technical data.
 2. Outline dimensions, shipping section dimensions, weight, and foundation requirements for all assemblies.
 3. External connection wiring diagram showing function and identification of all terminals requiring field connections.
 4. Line harmonic distortion calculations and filter design if applicable.
 5. Component fabrication drawings consisting of detailed circuit schematics, printed circuit board drawings, and chassis layouts for all electrical and electronic components.
 6. Manufacturer's certification that VFD can withstand fault conditions specified in Paragraph 1.4.
 7. Manufacturer's certification that VFD can withstand environmental conditions specified in Paragraph 1.4.
- B. Shop Drawings: Submit for approval the following:
1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If

deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

2. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**

1.8 COOLING REQUIREMENTS

- A. VFDs shall be supplied with air conditioning, where shown on the Drawings. The air conditioner shall be mounted and ducted to provide efficient cooling of the VFD. Where air conditioners are mounted on a NEMA 12, 3R, or 4 enclosure, the installation shall maintain the NEMA rating of the enclosure. Enclosure cooling shall be closed-loop, with no outside air entering the enclosure. The unit shall be mounted either on the door, or the side, of the enclosure. Size units to maintain a maximum 40° C operating temperature for the VFDs, based on a 50° C outdoor temperature.
- B. Air conditioners installed outdoors shall be supplied with outdoor packages and low operating temperature kits. Air conditioners shall be equipped with integral, or wall mounted thermostats.
- C. Air circulation shall be furnished by dual centrifugal blowers; one for the enclosure closed-loop circuit and one for the ambient air circuit.
- D. A hot-gas bypass valve shall regulate the air conditioner cooling and prevent freezing of the coils when operating in low ambient temperatures and low heat loads.
- E. Air filters shall be standard disposable-type furnace filters with a large surface area. Only half the filter surface area shall be used at one time, so that the filter can be inverted, exposing the unused half to the air flow.
- F. Air conditioner cabinets shall be constructed of cold rolled steel, with a phosphatized and baked enamel finish.

- G. The air conditioners shall be available in single phase voltages of 120 and 240 volts. Manufacturers shall be McLean Midwest, BARD, or equal.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. The VFDs shall be manufactured by one of the following:
1. Eaton.
 2. Allen Bradley.
 3. Square D.
 4. Toshiba.
- B. AC reactors shall be manufactured by one of the following:
1. TCI.
 2. MIRUS.
 3. Powersmiths.
 4. Or equal.

2.2 ENCLOSURES

- A. Enclosures shall be as shown on the Drawings, with force ventilated gasketed enclosures. UL approved Class 1 filters shall be provided on ventilation openings. Cabinets shall be fabricated from 14 gauge minimum thickness stainless steel. Cabinet shall be provided with an interior frame or otherwise formed so as to provide a rigid structure. Doors shall be hung on removable-pin hinges and equipped with vault-type latch capable of accepting a 3/8-inch shackle padlock. Three-point latch hardware shall be provided. Door width shall not exceed 30-inches.

2.3 INVERTER

- A. A door-interlocked, flange-mounted, through-the-door power disconnecting means shall be provided to protect the inverter against internal faults and as a backup for external load faults. Provide a thermal-magnetic circuit breaker as the main disconnecting means for each VFD enclosure as specified in Section 16481.2.06, Motor Control Centers—Feeder Overcurrent Protection. Load faults shall normally be cleared by the inverter assembly.
- B. Line reactors for harmonic filtering shall be provided on each VFD below 40 HP to reduce total harmonic distortion (THD) of the voltage and current power source. Total voltage and current harmonic distortion, including contribution of notching, and with all VFDs in operation shall not exceed the limits set forth for a general system in IEEE 519-1992, Tables 10.2 and 10.3. The voltage THD shall not exceed 5% and the current THD shall not exceed 10% as measured at the point of common coupling. The point of common coupling (PCC) is defined

herein as the circuit breakers feeding each VFD, or where each VFD connects to the bus.

- C. AC reactor coils in output circuitry of the VFD shall be provided to limit inductive switching surges such that the measured RMS voltage at the motor terminations does not exceed 480 VAC line to line, as shown on DRAWINGS.
- D. Provide EMI/RFI filtering to eliminate radio interference between 10 KHZ and 30 MHZ.
- E. Provide VFD manufacture's recommended inverter output dv/dt filters within VFD enclosure where conductor length from VFD to motor equals or exceeds 100 feet. Provide in submittal, the manufacture's recommended data for filters.

2.4 CONTROL DEVICES

- A. See Control Devices Schematic for requirements.
- B. Control devices and indicating lamps shall be provided in accordance with Section 16161, Control Panels.

PART 3 - EXECUTION

3.1 FIELD INSTALLATION

- A. Each VFD shall be installed and tested by the CONTRACTOR with the assistance of factory-trained engineers in accordance with the manufacturer's specifications and the Contract Documents. The installation shall be certified on forms provided in the Contract Documents.

3.2 TESTING

- A. Test in accordance with Specification 16920, Electrical Acceptance Testing.

3.3 TRAINING

- A. Provide four hours of VFD training for the OWNER'S operations and maintenance staff. Training shall be certified on forms provided in the Contract Documents. Training shall cover VFD theory of operation, features and functions available, normal operation, troubleshooting, and routine maintenance. The CONTRACTOR shall submit a syllabus for the training session for approval a minimum of three weeks prior to conducting the class. Provide each attendee with a class syllabus detailing each topic to be discussed.
- B. Provide VFD training in accordance with Section 01410, Testing.

3.4 SPARE PARTS

- A. The following spare parts shall be supplied with each type or frame size of VFD:
 - 1. Three sets of all replaceable fuses.
 - 2. One of each type of replaceable printed circuit board.
 - 3. Two of each type of output power transistor.
- B. Provide three spare air conditioner filters for each type and size of air conditioner installed.

END OF SECTION

SECTION 17137

MAGNETIC FLOW METERS

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. This Section covers the magnetic flow meters to be provided where indicated on the Drawings. The flow meters shall consist of two parts with manufacturer supplied interconnecting wiring, the field installed flow element and the flow indicating transmitter.
- B. Related Work specified elsewhere includes, but is not limited to Section 16000, General Electrical Requirements. Also, refer to requirements of Contract Documents for testing, adjusting, and balancing of systems.

1.2 QUALITY ASSURANCE

- A. Equipment to be furnished under this Section shall be the product of firms regularly engaged in the design and manufacture of this type of equipment. Manufacturer shall assume responsibility for, and guarantee performance of equipment furnished. However, this shall not be construed as relieving the CONTRACTOR from responsibility for the proper installation and functioning of the Work.

1.3 SUBMITTALS

- A. The following material shall be submitted to the ENGINEER prior to installation, in accordance with Section 16000, General Electrical Requirements, and as required elsewhere in the Contract Documents:
 - 1. Where applicable, provide complete manufacturer's part number, identifying scaling, operating range, housing and wetted parts materials, NEMA rating, product options, consumable materials, and other pertinent information.
 - 2. Prior to Final Acceptance of the Work, the CONTRACTOR shall provide Operations and Maintenance Manuals, in accordance with the Contract Documents.
- B. Shop Drawings: Submit for approval the following:
 - 1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a

detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

2. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**

PART 2 - PRODUCTS

2.1 MAGNETIC FLOW METERS

- A. Acceptable Manufacturers (Manufacturers listed in alphabetical order):
 1. Endress+Hauser model Pro-Mag W400
 2. Krohne
 3. Toshiba LF654
- B. Materials:
 1. All mounting hardware shall be 316 stainless steel, the instrument enclosure shall be rated NEMA 4X, the flow sensor liner shall be polyurethane lined, and the electrode material shall be 316 stainless steel.
- C. Design and Fabrication:
 1. Utilize characterized field principle of electromagnetic induction to produce signal directly proportional to flow rate.
 2. Provide flanged end connections, per ANSI B16, rated for piping system operating and test conditions.
 3. Operating Pressure: 100 psi.
 4. Operating Temperature: 122° F.
 5. Grounding Requirements:
 - a. Non-metallic or Lined Pipe:
 - 1) Inlet and outlet grounding rings of same material as electrode.
 - b. Conductive Piping:
 - 1) Conductive path between the meter and the piping flanges.
 6. Provide cable between magnetic flow meter and transmitter.
 7. Pulsed DC magnetic field excitation.
 8. Automatic zero.
 9. Adjustable low flow cutoff.

10. 16-character alphanumeric display shall indicate user-defined flow units and total flow. All menu advice and commands shall be viewed on this display.
11. Minimum signal lock (empty tube zero) to prevent false measurement when tube is empty.
12. Accuracy:
 - a. $\pm 0.5\%$ of rate above 1 fps.
 - b. ± 0.01 fps below 1.0 fps.
 - c. 4mA to 20 mA DC isolated output into maximum 800 ohms.
 - d. Scaled frequency output, 24 VDC.
 - e. Power supply: 117 V $\pm 10\%$, 60 HZ.
 - f. Meter operable as specified in liquids with 5.0 micro-ohm/cm or more conductivity.
13. Electrodes shall be self-cleaning.

2.2 MAGNETIC FLOW METERS FOR CHEMICAL SERVICE

A. Acceptable Manufacturers:

1. Endress+Hauser model Pro-Mag 53H.

B. Design and Fabrication:

1. The metering tube sensors shall be of the proper sizes to measure the design flow rate of the piping and shall be noted in the instrument schedule.
2. Materials:
 - a. Seals, Orings and Flange gaskets: Viton.
 - b. Tube: Stainless steel with PFA liner.
 - c. Electrodes: The two measuring electrodes and empty pipe electrode shall be constructed of a material compatible with the measured fluid.
 - d. 40% Aluminum Chlorohydrate: PTFE or PFA
 - e. 50% Citric Acid: Tantalum.
 - f. 12.5% Sodium Hypochlorite: Platinum.
 - g. 33% Hydrochloric Acid: PTFE, ETFE, or PFA
 - h. 50% Sodium Hydroxide: Type C22 Ni-Alloy
 - i. 38% Sodium Bisulfite: PTFE, ETFE, or PFA
 - j. Grounding rings: Inlet and outlet, same as electrodes.
 - k. Housing: Aluminum housing shall enclose the coil assemblies and internal wiring.
 - l. Process connections: PVDF flanges, rated NEMA 4X.
 - m. Transmitter housing: Powder coated cast aluminum with NEMA 4X rating.

C. Electrodes:

1. Meters 5/16 inches diameter and larger shall have a third electrode of the same material to serve as an empty pipe detector.
2. The electrode circuit shall have a minimum impedance of 1012 ohms to overcome moderate coating buildup.

D. Transmitter:

1. The transmitter shall be a microprocessor controller mounted remotely.
2. The flowmeter shall have a backlit LCD display used for programming as well as for simultaneous display of flow rate and total flow in user selectable engineering units, and readout of diagnostic error messages.
3. All programming parameters shall be access-code protected
4. The electronics shall include infinitely adjustable low flow cutoff.
5. The power supply to the transmitter shall be 117 V $\pm$ 10%, 60 Hz.
6. Upon any power failure, the unit shall retain all setup parameters and accumulated measurements internally in non-volatile memory. All units shall be protected against voltage spikes from the power source with internal transient protection.
7. The transmitter shall output a scaled 4 to 20 mA DC directly proportional to flow rate plus a scaled 24 VDC pulse or open collector frequency output. The analog output shall include an adjustable low flow cutoff.
8. The transmitter shall have an algorithm which recognizes pulsating flows from chemical metering pumps and allows for precise measurement of these irregular flow rates.

E. Accessories:

1. Grounding:
 - a. Tantalum electrodes: Provide inlet and outlet grounding rings.
 - b. Platinum electrodes: Provide grounding pins.
2. Provide a stainless steel tag labeled with the instrument tag number.
3. Provide a standard hand-held HART communicator with the current device drivers for every ten flow meters provided, with a minimum of two.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Equipment and materials specified in this Section shall be installed and connected as specified, and as shown on the Drawings. The CONTRACTOR shall coordinate the installation with the other trades, to insure proper installation of the flow element, transmitter, and associated conduit and cables.
- B. The CONTRACTOR shall calibrate the instruments to the proper ranges, as required by the OWNER and the ENGINEER. Where analog signals are connected to local, or remote monitoring equipment, the CONTRACTOR shall verify that the calibrated ranges and scaling of the local and remote indicators are correct.

3.2 ACCEPTANCE

- A. Prior to Final Acceptance of the Work, the CONTRACTOR shall certify the equipment and installation included under this Section to be free of defects, and suitable for trouble-free operation under the conditions set forth in these Specifications. This requirement is in addition to the manufacturer's guarantee.

3.3 SPARE PARTS

- A. Provide the OWNER with a list of the manufacturers' recommended spare parts.

END OF SECTION

SECTION 17451

PROGRAMMABLE LOGIC CONTROLLER HARDWARE

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. This Section covers the programmable logic controller (PLC) used for control and monitoring, as indicated on Drawings.
- B. Provide software support and debugging time for a period of 30 days after start-up of the equipment under PLC control.

1.2 SUBMITTALS

- A. Submittals shall include the following:
 - 1. Manufacturer's data on electrical characteristics, capabilities, and physical properties.
 - 2. Wiring diagrams showing connections to all devices; input and output (I/O), analog, and discrete. The wiring diagrams shall indicate the I/O address point to be used in the PLC programs.
 - 3. A tag database for each ladder logic element, timer, counter, and register.
- B. PLC ladder logic program complete with I/O memory map and addressing, I/O module physical slot locations, and cross-referenced list of program elements such as contacts, coils, timers, and other devices. The PLC program shall be documented with symbol names for each program element or device, and comments shall clearly describe the logic for each rung of the ladder logic. This Submittal shall be provided for review prior to field start-up of the equipment under PLC control. The CONTRACTOR shall make corrections to the program logic as requested by the OWNER or the ENGINEER, and resubmit the document for review and approval.

1.3 MANUFACTURERS

The PLC shall be a Control Logix L7X series with latest firmware manufactured by Allen-Bradley/Rockwell Automation.

PART 2 - PRODUCTS

2.1 PROGRAMMABLE LOGIC CONTROLLER

- A. PLCs shall be furnished with hardware and software necessary to monitor and control equipment as listed in the Specifications and shown on the Drawings. Each field input and output shown as an I/O point shall be connected as per manufacturer's recommendations. Additionally, the CONTRACTOR shall provide the hardware, software, and installation necessary for connecting additional future equipment as indicated on the Drawings. The type of field input and output shall be defined as follows:
1. Analog inputs Isolated (4 to 20 mA DC) 1756-IF8I.
 2. Analog outputs Isolated (4 to 20 mA DC) 1756-OF8I.
 3. Discrete inputs (120 VAC). 1756-IA16 or 1756-IA32
 4. Discrete outputs (24VDC) 1756-OB16D or 1756-OB32 in addition to interposing relays.
 5. Non-Volatile Flash Memory Card: 1784-SD1.
 6. Power Supply: 1769-PA75.
- B. The logic control programs shall reside in the PLCs. The program shall consist of software relay and attendant logic control. Control loop and logic flow diagrams shown on the Drawings, or control descriptions listed herein, shall be fully implemented.

2.2 INPUT/OUTPUT MODULES

- A. Analog inputs shall have a minimum of 24 bits resolution. Analog outputs shall have a minimum of 16 bits resolution. Analog input modules shall be configurable for 4 to 20 mA or 1 to 5 VDC signals. Analog output modules shall be selectable for 4 to 20 mA or 1 to 5 VDC signals. Provide external or user power as needed.
- B. Indicator lights shall also be provided on each I/O point to indicate status of each signal. Each individual input or output point shall be optically isolated to protect the controller I/O circuitry from high voltage transients. External wiring shall terminate on removable terminal blocks to allow quick installation or extraction of 16 or 32 point I/O modules without disconnecting field wiring. Labels shall be provided on modules that indicate the I/O address of each termination.
- C. The power supply shall provide power for the processor and I/O modules. The power supply shall have a hold-up time (the time the system is operational during a brief power loss), typically between 20 milliseconds and 3 seconds. Power requirement shall be 120 VAC or 24 VDC.
- D. Provide a minimum of 25% spare I/O of each type connected to terminals for future expansion.

2.3 STORAGE AND DOWNLOADING OF PLC PROGRAMS

- A. The PLC shall be programmable through an RS-232/USB port or Ethernet/IP connected to a personal computer through a standard cable. The PLC programming software shall be provided with the user's manuals, original diskettes, and licensing agreement for registration by the OWNER. Cables, adapters, connectors, or other hardware required to connect to the PLC shall be provided to the OWNER.
- B. The PLC programming software shall enable the user to write the PLC program on-line or off-line. The software shall include utilities to manage PLC program files, document and print the programs, configure the programming environment, monitor and force the PLC addresses while on-line, and configure the PLC memory and addressing structure.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. PLC shall be installed as indicated on the Drawings designed for the PLC enclosure and according to the manufacturer's instructions.

3.2 START-UP AND TESTING

- A. Upon completion of the installation, start-up shall be performed by a factory trained Controls Engineer. Operating and maintenance instruction books shall be supplied upon delivery of the unit and procedures explained to operating personnel.
- B. The PLC program and I/O shall be thoroughly tested. Each input and output signal shall be tested for correct indication and control function. The CONTRACTOR shall demonstrate operation of the PLC control logic with simulated inputs, before the entire system is started, and run in automatic mode.
- C. Program changes made as a result of start-up testing and debugging shall be fully documented. Submit the latest program changes to the logic for review, and update the Operation and Maintenance Manuals with the latest program printout and diskette.
- D. Proportional-Integral-Derivative (PID) loops shall be tested and tuned to provide a stable control over the process variable, with uniform internal analog range scaling.

3.3 TRAINING

- A. Provide eight hours of training on the control system. Instruction shall include a description of the control system operation. Teach the operators how to make control system parameter changes (set points, timer values, etc.) and show them how to enter passwords to make these changes.

3.4 SPARES

- A. Furnish a minimum of two spare I/O module of each type, and two power supply modules.
- B. Furnish 10 fuses of each type and size used in the power supply and I/O modules.

END OF SECTION

SECTION 17452

PROGRAMMABLE LOGIC CONTROLLER SYSTEM SOFTWARE AND ACCESSORIES

PART 1 - GENERAL

1.1 SCOPE

- A. This Section includes furnishing all programmable logic controllers (PLCs) as indicated on the Drawings and specified herein.
- B. Related Work specified elsewhere includes, but not limited to, Section 16000, General Electrical Requirements. Also refer to requirements of Contract Documents for testing, adjusting, and balancing of systems.

1.2 QUALITY ASSURANCE

- A. Use programmable logic controller system manufacturer approved hardware, such as cable, mounting hardware, connectors, enclosures, racks, communication cable, splitters, terminators, and taps.
- B. Programmable Logic Controller Installer Qualifications:
 - 1. Qualified by completion of the programmable logic controller manufacturer's training course.
 - 2. Experience of installing at least five installations equal to scope of Project.
- C. Provide a single source responsibility for programmable logic controller system mounting, installation, and wiring.
- D. Design and test the programmable logic controller system to operate in an industrial environment per NEMA Standard UCS 2-230 (Arc Test) and IEEE C37.90a CSWC.
- E. The CONTRACTOR shall ensure sufficient time for programming on-site, interfacing with other process equipment, and testing.

1.3 SUBMITTALS

- A. Shop Drawings and Product Data: Include description of components, methods of connecting components, and the following:

1. Hard copy of the programmable logic controller application program with full I/O documentation and explanation of conventions.
 2. Three copies of the programmable logic controller application program on CD-ROMS.
 3. System interconnection diagram drawing for PLCs, radios, antennas, Modbus Plus data highway, Ethernet data highway, and field instrumentation.
 4. Panel and enclosure plans, sections, and details.
 5. Access opening locations and required clearances for each panel and enclosure.
 6. Mounting plates and details for input and output chassis.
 7. Enclosure internal wiring and terminal blocks.
 8. Tabular Input and Output (I/O) Listing, Including the Following Data:
 - a. Each I/O point, chassis number, module number, module I/O point number, name of I/O device.
 - b. Instrumentation tag number of the I/O device in the Contract Documents.
 - c. Electrical characteristics of the I/O signal.
 - d. PLC internal address of each I/O.
 9. Hard copies and machine-readable copies of PLC programs and personal computer graphics, reports, and database configuration.
- B. Operating and Maintenance Manuals: Include the following:
1. Programming procedures.
 2. Operations manuals.
 3. Maintenance and troubleshooting manuals.
 4. Spare parts manuals.
 5. Configuration manuals.
 6. List of service personnel contacts, including 24 hour service hot lines.

1.4 PLC DIAGNOSTICS

- A. Configure the PLC programs to monitor the diagnostic registers in the PLC. Publish the status of these registers to SCADA for alarm of a PLC diagnostic failure. The following diagnostic status words shall be monitored:
1. Module status and module failures.
 2. Internal battery condition.
 3. Power supply status.

1.5 PLC APPLICATION PROGRAMMING SOFTWARE

- A. Refer to the Contract Documents and P&IDs for the process control descriptions and functional requirements to be implemented using the following application software packages.

1. Furnish and install complete packages of RSLOGIX 5000, version 20 or newer and RXLINX Version 3.8 or newer, using primarily Function Block Diagram (FBD).
2. PLC Programming:
 - a. Submit two copies of the PLC programs for review, prior to installation. The programs shall be fully documented with unique symbol names for each program element (coils, contacts, inputs, outputs, etc.), and comments for every three rungs of logic. The rung comments shall clearly describe the function of the logic so that another programmer can understand the logic and be able to debug and modify the programs at a later date.
 - b. Once the programs have been reviewed, comments and changes shall be incorporated into the programs and submitted for a final review. Upon final review of the programs, install the programs in the PLCs to test the control logic using simulated I/O.
 - c. Provide instruction, maintenance manuals, and diagrams for supplied programs, device drivers, and custom designed subprograms and device drivers developed for this Project. Provide all materials in one or more three-ring binders. Separate sections by laminated numbered or descriptive tabs, with a table of contents to aid the user in finding specific information. Three-ring binders shall have labels on the spine identifying the contents of each volume.
 - d. Submit a training schedule in accordance with these Specifications.
 - e. Submittals shall be complete, neat, and orderly.
 - f. Submit two CD-ROM copies of the PLC software programming in their final configuration. Also submit all original software registered in the OWNER'S name, and all original documentation that accompanies the original software diskettes.
 - g. All programming shall be coordinated with the OWNER, who will provide programming standards to be used.
 - h. OWNER and programmer will hold programming kick-off meeting to coordinate scope and requirements.

1.6 ON-SITE TRAINING

- A. Arrange for instruction of the OWNER'S designated personnel. The instruction shall commence within 30 days of OWNER request. Training shall include a minimum of eight hours of OWNER training.
- B. The OWNER reserves the right to split training periods to accommodate personnel schedules.

- C. The training sessions shall be structured to provide the OWNER'S personnel with a maximum of hands-on experience.
- D. Control System Overview Training Shall Consist of the Following Topics:
 - 1. Definition of control modes, such as HAND, AUTO, LOCAL, and REMOTE.
 - 2. Entering and changing setpoints.
- E. Provide the OWNER with the ability to program the PLCs, add new network components and PLCs as needed for future expansion of the system.

1.7 START-UP SUPPORT

- A. The CONTRACTOR shall have field service and programming personnel on-site to provide start-up and commissioning services for a period of at least five days. The start-up service shall be coordinated with the ENGINEER. The start-up service shall be required prior to starting the final acceptance test.

1.8 PROGRAMMING SUPPORT

- A. The CONTRACTOR shall be available to provide programming services for a period of at least 15 days. The start of this service shall commence after successful completion of the final acceptance test. This service shall consist of:
 - 1. Furnishing additional programming that may be required.
 - 2. Assisting OWNER'S personnel with additional technical support and training.

1.9 FACTORY WITNESS TESTING

- A. Hardware and software components of the PLC system shall be thoroughly tested and "burned in" at the factory by the CONTRACTOR. Inform the ENGINEER 10 working days prior to the testing of the equipment. The ENGINEER and OWNER shall witness these tests before shipment to the site. Provide copies of all test reports to the ENGINEER.
- B. The CONTRACTOR shall be responsible for all transportation, meals, and accommodation expenses for the OWNER'S and ENGINEER'S representative witnessing the factory test.

1.10 ON-SITE TESTING

- A. On-site testing of the PLC system shall be performed prior to the final acceptance test. Submit a testing schedule detailing the timing and extent of the proposed testing and the test procedures to be followed.
- B. Prior to the final acceptance test, the ENGINEER will review the status of the PLC system and determine if the final acceptance test can be performed. All primary elements shall be calibrated and all I/O signals shall be fully functional prior to the start of the final acceptance test.
- C. Perform the PLC system final acceptance test and confirm the operation of all control loops, primary elements, control functions and sequences, and monitoring functions required of the complete PLC system. The PLC shall be operated continuously throughout the test without software or hardware failure. In the event of a failure, the acceptance test shall be terminated, the hardware or software failure shall be corrected, and the acceptance test shall be restarted. The ENGINEER and the OWNER shall determine if it is necessary to restart the test at the first day of the test. The final acceptance test shall run uninterrupted for seven calendar days.

1.11 GENERAL PROGRAMMING REQUIREMENTS

- A. The software development and programming of the control functions described herein shall be completed by the date defined in the Contract Documents. PLC programs shall meet the performance requirements described herein, and the control needs of the OWNER.
- B. The control descriptions provided herein do not provide every programming detail such as timers, function blocks, coils, contacts, or other relay ladder logic elements that are required to write and implement complete PLC programs. The control descriptions are intended to describe the overall functional capability of the particular process being described. Communication with the OWNER and the ENGINEER shall be necessary to convey the additional information needed to produce the working PLC programs.
- C. Any discrepancies in these documents shall be brought to the attention of the ENGINEER, in writing. The ENGINEER will then issue further explanation. The decision of the ENGINEER will be final.
- D. Control logic shall be programmed, furnished, and installed as specified. The CONTRACTOR shall be required to test and demonstrate to the satisfaction of the ENGINEER that the control logic functions as specified.

- E. The PLC programs shall meet industry norms, and function in such a way as to maintain safe and reliable operation of the equipment they are designed to control. If the ENGINEER determines that the control logic and PLC programming fails to perform the functions described herein in a safe and reliable manner, the CONTRACTOR shall modify and correct the programs.
- F. The PLC shall not be able to control any equipment item that is not in the Auto or Remote mode.
- G. The PLCs shall be programmed to monitor each of their respective analog signal inputs for instrument failures. If the input signal falls below 4 milliamps due to a short circuit, or an open current loop, the PLC shall produce an alarm signal to SCADA.
- H. All motorized equipment (i.e., wells and pumps) will have Accumulation Runtime Counters associated with them.

PART 2 - PRODUCTS

2.1 APPLICATION SOFTWARE, PROGRAMMING HARDWARE, AND TRAINING

- A. Provide fully annotated software with Logic Flow Diagram, rung-by-rung description, register, and variable cross-referencing. Reference program to control descriptions by Logic Flow Diagram.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install the programmable logic controller system in accordance with the programmable logic controller manufacturer's instructions and recommendations, including grounding specifications.

3.2 DEMONSTRATION

- A. Establish a mutually agreed upon time for demonstrations with the ENGINEER.
- B. Deliver written notification of demonstrations to ENGINEER at least seven days before demonstrations. Include an agenda for the demonstration and testing procedures with notification.

- C. Demonstrate functional operation of programmable logic controller system hardware and logic program at system assembly location prior to shipment.
- D. Demonstrate full functional operation of programmable logic controller system hardware and logic program at the Project job site when fully integrated to the field I/Os.

END OF SECTION

SECTION 17455

OPERATOR INTERFACE TERMINAL SOFTWARE AND HARDWARE

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Supply and programming of Operator Interface Terminals (OIT) used to monitor and control electrical and process equipment.
- B. Startup and commissioning of control systems using OIT.
- C. Programming software supplied to owner.

1.2 SUBMITTALS

- D. Manufacturers literature showing:
 - 1. Physical characteristics, dimensions, and weights.
 - 2. Mounting and installation requirements.
 - 3. Wiring information including power requirements and communication capabilities and cabling information.
 - 4. Available memory and screen storage information.
 - 5. Recommended spare parts.
 - 6. OIT screen development software information including:
 - a. Minimum computer memory requirements for installation and use.
 - b. Communication ports and cables to download OIT programs.
- E. Proposed OIT screens showing the following:
 - 1. Number of proposed screens.
 - 2. Proposed color and graphics standards for OIT screen development.
 - 3. Menu tree showing how the operator will access all screens
 - 4. Description of each screen listing control and display points and indicating what actions the operator may perform on the screen.

1.3 GENERAL

- F. OIT's are to be new, the most current version, and compatible with PLCs provided for this project.
- G. Provide the latest version of the OIT programming software and use it to develop the OIT screens. License the software in the name of the owner. Deliver it to the Owner's programmer within 30 days of accepted plant startup or the stated date of project substantial completion.

PART 2 – PRODUCTS

2.1 OPERATOR INTERFACE TERMINAL

- H. Manufacturer shall be Allen Bradley PanelView Plus.
- I. Shall communicate directly with the PLC over Ethernet/IP or DF1, DH-485.
- J. Shall be minimum 10” diagonal screens, color, with touchscreen keys.
- K. Shall be capable of alarm detection and processing, discrete and analog display and control.

PART 3 - EXECUTION

3.1 OPERATOR INTERFACE TERMINAL

- L. Mount the OIT in the control panel at an elevation and location convenient for operator access.
- M. Program the OIT to perform all control and monitoring functions required by these specifications and the drawings.
- N. Test the programming to verify all required functions.
- O. Provide startup and commissioning assistance to make the plant operational.
- P. Deliver “As Built” OIT programs, documentation, and original programming disks, manuals, and literature to owner
- Q. Warranty OIT programming for a period of one year from date of substantial completion. Correct errors and software “bugs” at no cost to owner for that period of time.

END OF SECTION

ATTACHMENT TWO

GMP 1 – Figures (Preliminary – Not for Construction)

LINE SYMBOLS

MAJOR PROCESS PIPING OR FLOW CHANNEL

EXISTING PROCESS PIPING

SECONDARY PROCESS PIPING

EXISTING SECONDARY PROCESS PIPING

MISCELLANEOUS PIPING

EXISTING PIPING AND EQUIPMENT

FUTURE PIPING AND EQUIPMENT

ELECTRICAL SIGNAL

HYDRAULIC SIGNAL

PNEUMATIC SIGNAL

ELECTRICAL DIRECTION ARROW

FLOW ARROW FOR PROCESS PIPING

PROCESS OR SIGNAL LINE GOING TO ANOTHER SHEET (MATCH LETTERS)

PROCESS OR SIGNAL LINE FROM ANOTHER SHEET (MATCH LETTERS)

PROCESS LINES CROSSING

DATA COMMUNICATIONS LINK

VENDOR PACKAGE BOUNDARY

A

AMPERE

AFD

ADJUSTABLE FREQUENCY DRIVE

AI

ANALOG INPUT

AIC

AMPS INTERRUPTING CAPACITY

ARV

AIR RELIEF VALVE

AO

ANALOG OUTPUT

ABE

ANOXIC BASIN EFFLUENT

AS

AIR SUPPLY

ATS

AUTOMATIC TRANSFER SWITCH

AUTO

AUTOMATIC

CB

CIRCUIT BREAKER

CL2

CHLORINE

CON

CONTACTOR

CU

COPPER

CV

CONTROL VALVE

DCS

DISTRIBUTED CONTROL SYSTEM

DI

DISCRETE INPUT

DO

DISSOLVED OXYGEN, DISCRETE OUTPUT

DP

DIFFERENTIAL PRESSURE

DWG

DRAWING

EGO

EMERGENCY GAS OFF

ETM

ELAPSED TIME METER

ETMf

ELAPSED TIME METER (FAST SPEED)

ETMs

ELAPSED TIME METER (SLOW SPEED)

EOL

ELECTRONIC OVERLOAD

EXIST

EXISTING

FA

FOUL AIR

FC

FAIL CLOSED

FE

FINAL EFFLUENT

FR

FORWARD-REVERSE

FS

FLOAT SWITCH

FVNR

FULL VOLTAGE NON-REVERSING

FW

FINISHED WATER

GND

GROUND

GAL

GALLONS

GPD

GALLONS PER DAY

GPH

GALLONS PER HOUR

GPM

GALLONS PER MINUTE

H, HI

HIGH

H2S

HYDROGEN SULFIDE

HMI

HUMAN MACHINE INTERFACE

HS

HAND SWITCH

HMS

HAND SWITCH MAINTAINED

HOA

HAND-OFF-AUTO

I

CURRENT

IO

INPUT/OUTPUT

IOE

INTERNAL-OFF-EXTERNAL

JB

JUNCTION BOX

L, LO

LOW

LAN

LOCAL AREA NETWORK

LC

LOCAL CONTROL

LCP

LOCAL CONTROL PANEL

LOS

LOCK-OFF-STOP

LR

LOCAL/REMOTE

LS

LEVEL (i.e.. FLOAT) SWITCH

M

MOTOR

MA

MANUAL/AUTO

mA

MILLIAMPERE

MC

MANUFACTURE CABLE

MCC

MOTOR CONTROL CENTER

MCP

MOTOR CIRCUIT PROTECTOR

MFR(S)

MANUFACTURER(S)

MGD

MILLION GALLONS PER DAY

MGL

MILLIGRAMS PER LITER

MH

MANHOLE

MLR

MIXED LIQUOR RETURN

MO

MOISTURE

MOD

MODULATED

MTU

MASTER TELEMETRY UNIT

NPW

NON-POTABLE WATER

NS

NITROGEN SUPPLY

NTU

TURBIDITY

O/C

OPEN / CLOSE

OCA

OPEN-CLOSE-AUTO

OCR

OPEN-CLOSE-REMOTE

OIT

OPERATOR INTERFACE TERMINAL

OVER

OVERLOAD

OO

ON/OFF (MAINTAINED)

OOA

ON-OFF-AUTO

OOR

ON-OFF-REMOTE

OSC

OPEN-STOP-CLOSE

PAH

PRESSURE ALARM HIGH

PER

PERMISSIVE

PLC

PROGRAMMABLE LOGIC CONTROLLER

PNL

PANEL

PO

PULSE OUTPUT

POS

POSITION

POT

POTENTIOMETER

PPG

POUNDS PER GALLON

PPH

POUNDS PER HOUR

PPM

PARTS PER MILLION

PR

PAIR

PRES

PRESSURE

PS

PRESSURE SWITCH

PSI

POUNDS PER SQUARE INCH

PV

PROCESS VARIABLE

RAS

RETURN ACTIVATED SLUDGE

RAW

RAW WATER

REM

REMOTE

RF

RADIO FREQUENCY

RIO

REMOTE INPUT OUTPUT

RS

RAW SEWAGE

RSP

RAW SEWAGE PUMP

RST

RESET

RTD

RESISTANCE TEMPERATURE DETECTOR

RTU

REMOTE TELEMETRY UNIT

RUNf

RUN (FAST SPEED)

RUNs

RUN (SLOW SPEED)

SB

SLUDGE BLANKET

SEQ

SERVICE ENTRANCE EQUIPMENT

SES

SERVICE ENTRANCE SECTION

SLC

SINGLE LOOP CONTROLLER

SLOS

START-LOCK-OFF-STOP

SO2

SULFUR DIOXIDE

SOV

SOLENOID OPERATED VALVE

SP

SET POINT

SPD

SPEED

SPR

SPARE

SS

START/STOP (MAINTAINED)

SSS

SOLID STATE STARTER (SOFT START)

STR

MOTOR STARTER

TAH

TEMPERATURE ALARM HIGH

T/M

TEMPERATURE AND/OR MOISTURE

TEMP

TEMPERATURE

TS

TEMPERATURE SWITCH

TSS

TOTAL SUSPENDED SOLIDS

UG

UNDERGROUND

UP/STP/DOWN

VOLT

V

VARIABLE FREQUENCY DRIVE

W

WATER

WAS

WASTE ACTIVATED SLUDGE

WW

WASTEWATER

XMTR

TRANSMITTER

ZS

POSITION (i.e. LIMIT) SWITCH

ISA INSTRUMENT IDENTIFICATION TABLE

FIRST LETTERS		SUCCEEDING LETTERS		
MEASURED OR INITIATING VARIABLE	MODIFIER	READOUT OR PASSIVE FUNCTION	OUTPUT FUNCTION	MODIFIER
A ANALYZER		ALARM		AUTO
B BURNER, COMBUSTION				
C CONDUCTIVITY			CONTROL	CLOSED
D DENSITY	DIFFERENTIAL			
E VOLTAGE		ELEMENT		
F FLOW	RATIO			
G GAUGE		GLASS, VIEWING DEVICE		
H HAND				HIGH
I CURRENT		INDICATE		
J POWER	SCAN			
K TIME, TIME SCHED.	TIME RATE OF CHANGE		CONTROL STATION	
L LEVEL		LIGHT		LOW
M MOTION				MIDDLE
N INTRUSION				NORMAL
O TORQUE		ORIFICE, RESTRICTION		OPEN
P PRESSURE	INTEGRATE, TOTALIZE	POINT CONNECTION		STOP
Q QUANTITY				
R RADIATION		RECORD, OR PRINT		RUN OR REMOTE
S SPEED, FREQUENCY	SAFETY		SWITCH	START
T TEMPERATURE			TRANSMIT	
U MULTIVARIABLE		MULTIFUNCTION	MULTIFUNCTION	MULTIFUNCTION
V VIBRATION			VALVE, LOUVER	
W WEIGHT		WELL		
X MOTOR	X-AXIS	UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED
Y EVENT, STATE, OR PRESENCE	Y-AXIS		RELAY, COMPUTE, CONVERT	
Z POSITION	Z-AXIS		DRIVER, ACTUATOR, FINAL CONTROL ELEMENT	

FIRST LETTER

SUCCEEDING LETTER(S)

LOOP DESIGNATION NUMBER

ADDITIONAL IDENTIFICATION
SEE ABBREVIATIONS AND
HAND SWITCH DESIGNATIONS

HAND SWITCH DESIGNATIONS

ES

EMERGENCY STOP

HOA

HAND-OFF-AUTO

HOR

HAND-OFF-REMOTE

HORA

HAND-OFF-REMOTE-AUTO

JOA

JOG-OFF-AUTO

LOR

LOCAL-OFF-REMOTE

LR

LOCAL-REMOTE

OC

OPEN-CLOSE

OO

ON-OFF

S/S

START STOP PUSH BUTTONS

P&ID INTERFACE SYMBOLS

AAA

PILOT LIGHT

X

LENS COLOR, R=RED, G=GREEN, A=AMBER B=BLUE

AAA

FIELD DEVICE

CCC

AAA

PANEL DEVICE

CCC

AAA

DEVICE MOUNTED IN SUBPANEL

CCC

BBB

REMOTE I/O TERMINAL

XX

BBB

HMI OR OIT FUNCTION

CCC

I

INTERLOCK DEVICE

X

NOTE REF.

I/I

DUAL CHANNEL CURRENT ISOLATOR

Δ

DISCRETE INPUT

▽

DISCRETE OUTPUT

▲

ANALOG INPUT

▼

ANALOG OUTPUT

Δ

PULSE INPUT

R

RELAY

M

MOTOR ACTUATOR

PNEUMATIC ACTUATOR

S

SOLENOID

CHLORINE TANK

WEIGHT SCALE

AIR COMPRESSOR

VERTICAL TURBINE PUMP

FSL 100

FLOW SWITCH

FAN

METERING PUMP WITH MANUAL STROKE CONTROL

ROTARY LUBE PUMP

M

SUBMERSIBLE MIXER

AERATOR

S

SUBMERSIBLE PUMP

DIESEL GENERATOR

CENTRIFUGAL PUMP

BLOWER

LIFT PUMP

M

SUBMERSIBLE PUMP

ROTAMETER

AIR FILTER

EJECTOR

DIAPHRAGM SEAL

DIFFUSER

DIAPHRAGM

Y-TYPE STRAINER

IPS CORPORATION STOP

PVC DIFFUSER WITH IPS CORPORATION STOP

NTU

NEPHELOMETRIC TURBIDITY METER

MANUAL SLUICE GATE

CHEMICAL INJECTION QUILL

SAMPLER

PROPELLER FLOWMETER ELEMENT

M

MAGNETIC FLOWMETER ELEMENT

CL2 FLOWMETER

FIT 105

INSERTION TYPE MASS FLOW METER

FIT 100

MASS FLOW METER ANNUBAR TYPE

DRAIN

OUTLET SILENCER

INLET SILENCER

M

AGITATOR MIXER

F

INLET FILTER

P&ID EQUIPMENT AND PROCESS SYMBOLS

GATE VALVE

BUTTERFLY VALVE

ECCENTRIC PLUG VALVE

BALL VALVE

3 WAY VALVE

4 WAY VALVE

CHECK VALVE

SWING CHECK VALVE

STOP CHECK VALVE

BALL CHECK VALVE

AIR RELEASE VALVE

KNIFE VALVE

PRESSURE REGULATOR VALVE

BACKPRESSURE VALVE

PRESSURE RELIEF VALVE

RELIEF VALVE

VACUUM RELIEF VALVE

SURGE ANTICIPATOR VALVE

PLUG VALVE

M

MOTOR OPERATED PLUG VALVE

S

SOLENOID VALVE

M

MOTOR OPERATED PLUG VALVE

M

MOTOR OPERATED GATE VALVE

M

MOTOR OPERATED BUTTERFLY VALVE

M

MOTOR OPERATED SLEEVE VALVE

M

MOTOR OPERATED PINCH VALVE

NEEDLE VALVE

MUD VALVE

SENSING, AND INDICATION SYMBOLS

LS

FLOAT SWITCH

BEACON

BEACON

R

BEACON R=RED, A=AMBER, B=BLUE, G=GREEN

YL

STOP

G

INDICATING LIGHT

HOA

HAND SWITCH

ORP

ORP ANALYZER

AIT

pH ANALYZER

AE

ANALYZER ELEMENT

AE

DO SENSOR

AE

ORP SENSOR

AE

pH SENSOR

DO

DO ANALYZER

CL2

RESIDUAL CL2 CHLORINE SENSOR

CL2

RESIDUAL CL2 CHLORINE ANALYZER

VT

VIBRATION TRANSMITTER

LE

ULTRASONIC LEVEL TRANSDUCER

CITY OF CHANDLER

RECLAIMED WATER INTERCONNECT FACILITY

INSTRUMENTATION STANDARD SYMBOLS AND LEGEND

CITY PROJECT NO. WW1901.203

WILSON PROJECT NO. 21007

Design: ER

Drawn: ER

Checked: PKP

Date: 9/2021

Wilson Project No.: 21007

By

Description

Revision

Date

Verify Scales

Bar is one inch on original drawing

0 1"

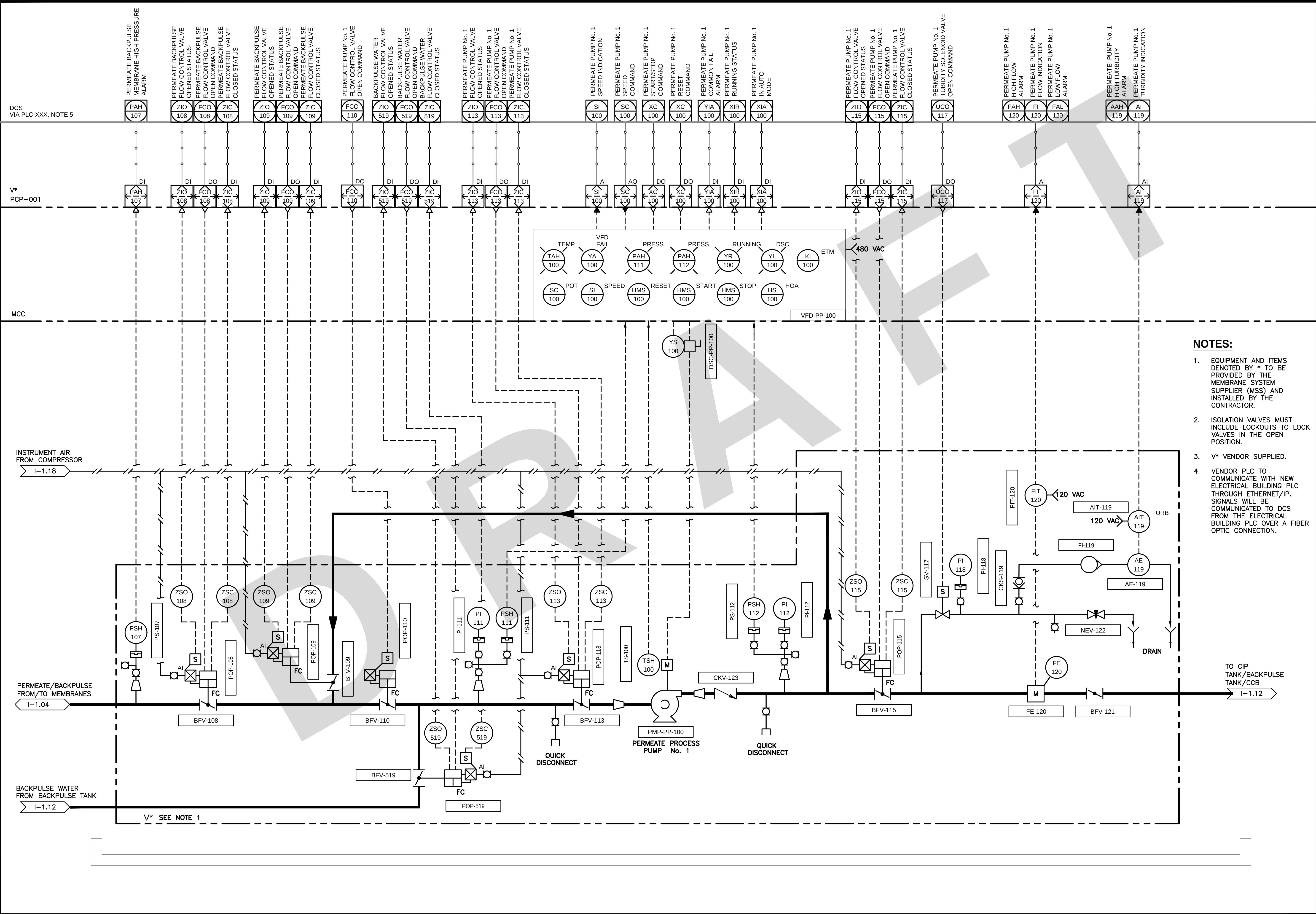
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ENGINEERS

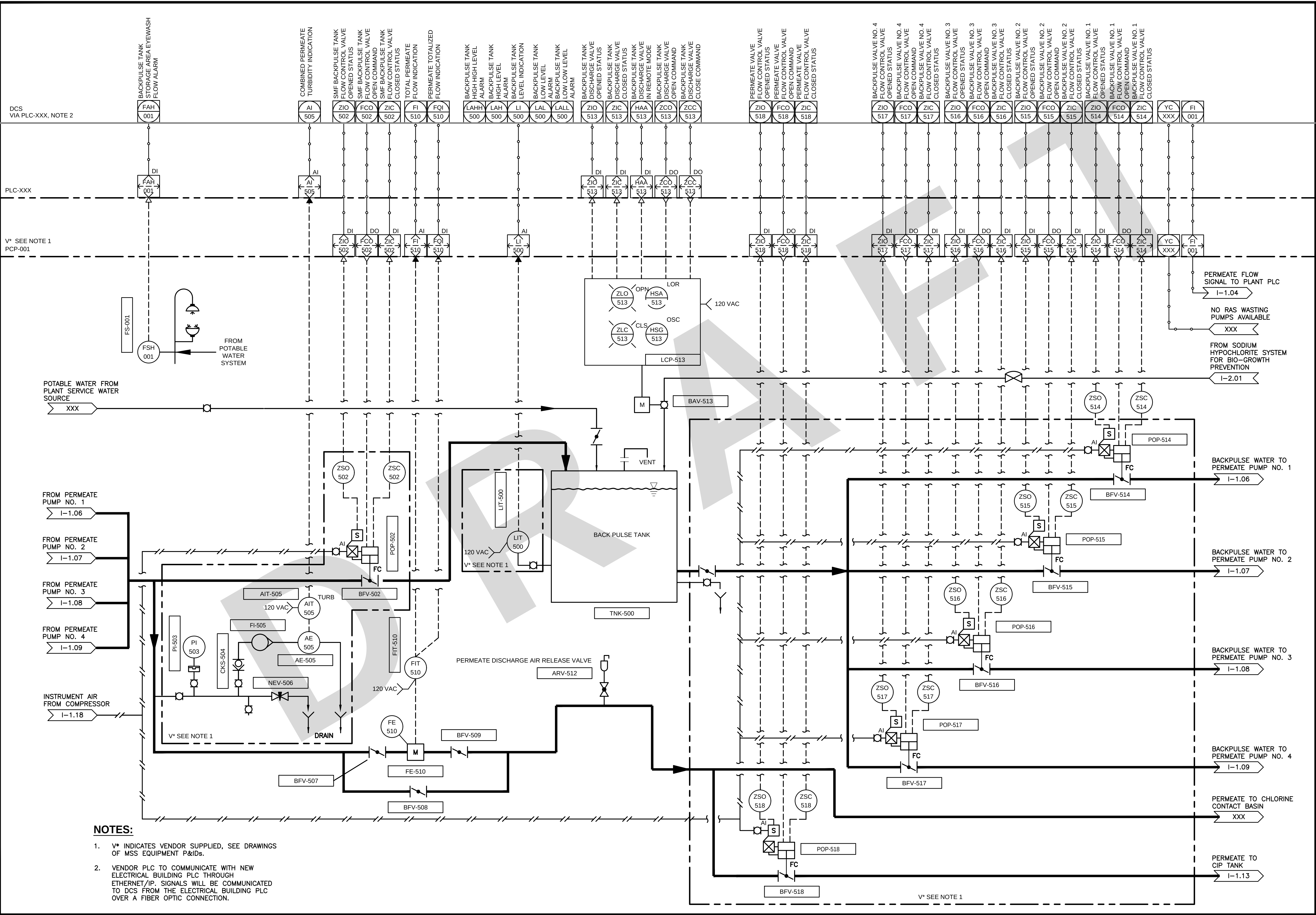
CITY OF CHANDLER
RECLAIMED WATER INTERCONNECT FACILITY

MEMBRANE FILTRATION SYSTEM
PERMEATE PUMP NO. 1 P&ID
CITY PROJECT NO. WW1901.203
WILSON PROJECT NO. 21007

Design: ER	Drawn: ER	Checked: PKP
Date: 9/2021	Wilson Project No.: 21007	
Revision	Date	Description
		By

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RECLAIMED WATER INTERCONNECT FACILITY

MEMBRANE FILTRATION SYSTEM
BACKPULSE TANK P&ID

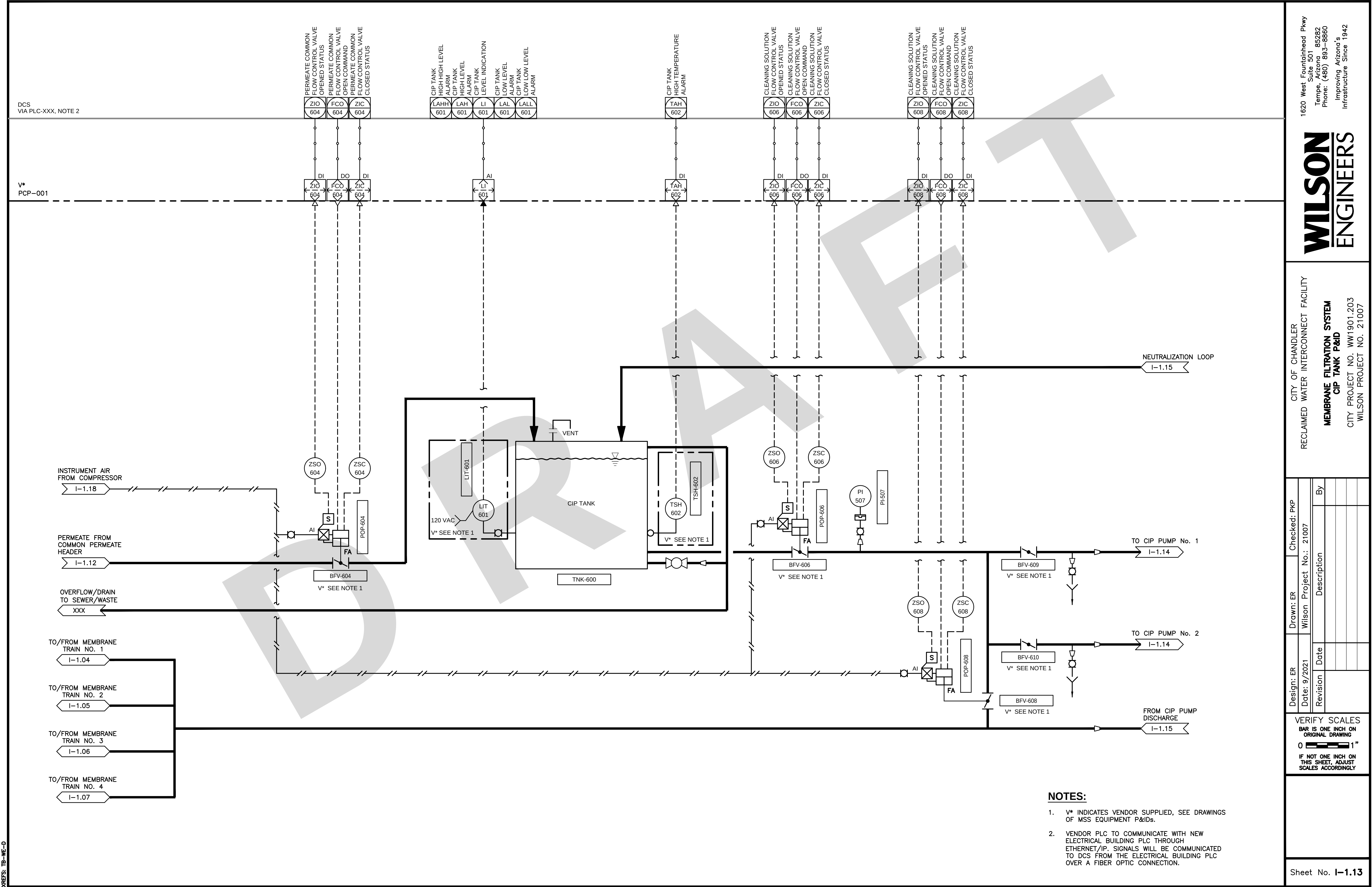
CITY PROJECT NO. WW1901.203
WILSON PROJECT NO. 21007

Design: ER	Date: 9/2021	Revision	Description	By
Project No.: 21007				

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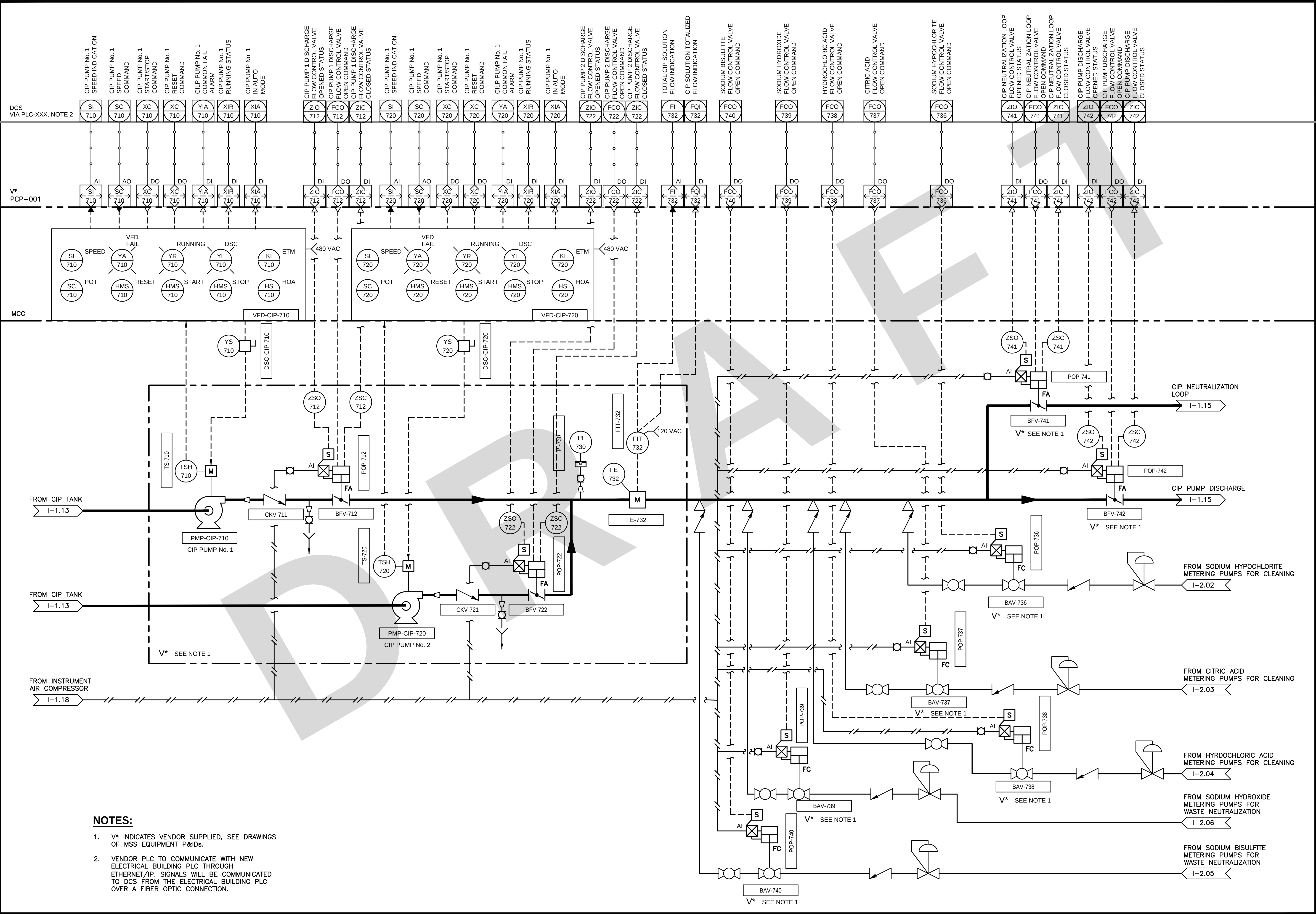
CITY OF CHANDLER
RECLAIMED WATER INTERCONNECT FACILITY
**MEMBRANE FILTRATION SYSTEM
CIP TANK P&ID**
CITY PROJECT NO. WW1901.203
WILSON PROJECT NO. 21007

Design: ER	Drawn: ER	Checked: PKP
Date: 9/2021	Wilson Project No.: 21007	
Revision	Date	Description

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CITY OF CHANDLER
RECLAIMED WATER INTERCONNECT FACILITY

**MEMBRANE FILTRATIONS SYSTEM
CIP PUMPS P&ID**

CITY PROJECT NO. WW1901.203
WILSON PROJECT NO. 21007

Design: SC	Drawn: SC	Checked: PKP
Date: 9/2021	Wilson Project No.: 21007	
Revision	Date	By

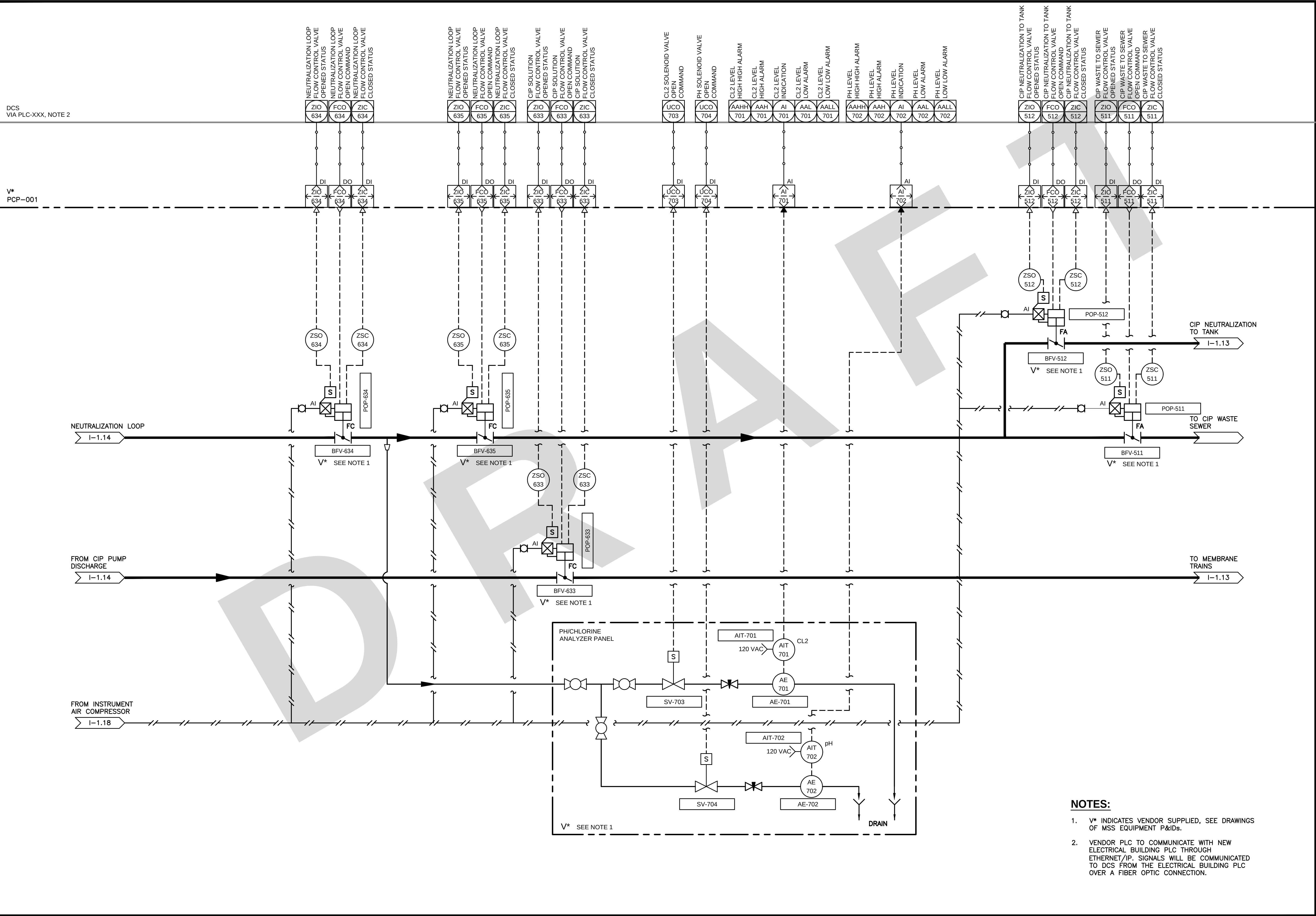
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CITY OF CHANDLER
RECLAIMED WATER INTERCONNECT FACILITY

MEMBRANE FILTRATION SYSTEM
CIP SYSTEM P&ID

CITY PROJECT NO. WW1901.203
WILSON PROJECT NO. 21007

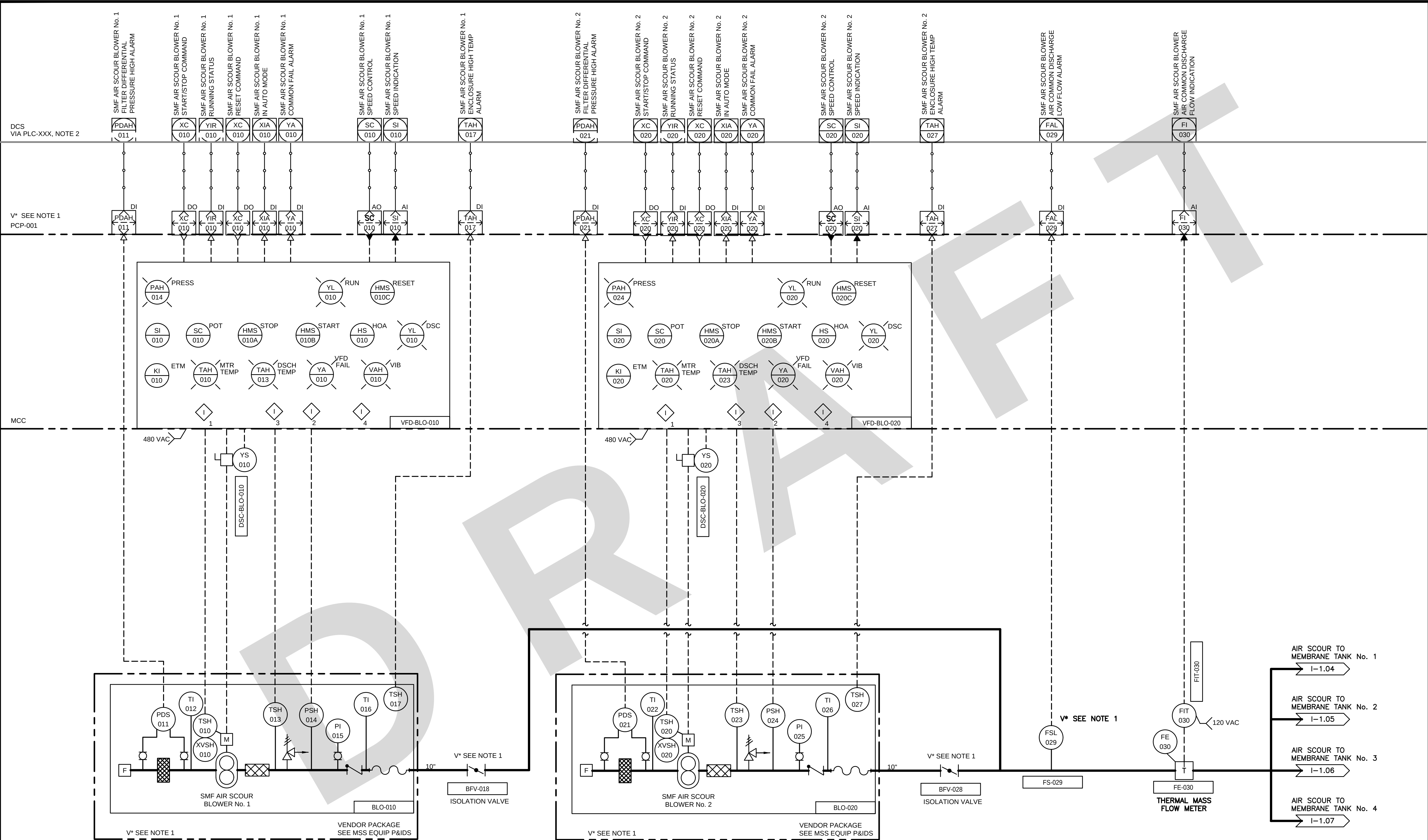
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Date: 9/2021	Wilson Project No.: 21007	
Revision	Description	By

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ELECTRICAL INTERLOCK LEGEND

- BLOWER STOPS ON HIGH TEMPERATURE OF BLOWER MOTOR , MANUAL RESET REQUIRED.
- BLOWER STOPS ON HIGH PRESSURE , MANUAL RESET REQUIRED.
- BLOWER STOPS HIGH TEMPERATURE OF DISCHARGE AIR, MANUAL RESET REQUIRED.
- BLOWER STOPS ON LOW FLOW. FSL IS A SOFTWARE INTERLOCK. A DCS MANUAL RESET IS REQUIRED.

NOTES:

- V* INDICATES VENDOR SUPPLIED, SEE DRAWINGS OF MSS EQUIPMENT P&IDs.
- VENDOR PLC TO COMMUNICATE WITH NEW ELECTRICAL BUILDING PLC THROUGH ETHERNET/IP. SIGNALS WILL BE COMMUNICATED TO DCS FROM THE ELECTRICAL BUILDING PLC OVER A FIBER OPTIC CONNECTION.

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CITY OF CHANDLER
RECLAIMED WATER INTERCONNECT FACILITY

**MEMBRANE FILTRATION SYSTEM
AIR SCOUR BLOWERS P&ID**

CITY PROJECT NO. WW1901.203
WILSON PROJECT NO. 21007

Design: ER	Drawn: ER	Checked: PKP
Date: 9/2021	Wilson Project No.: 21007	
Revision	Date	Description
		By

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EXHIBIT D

ACCEPTED GMP/PRICE PROPOSAL

N/A



**City of Chandler Reclaimed Water
Interconnect Facility**

Project No. WW1901.402

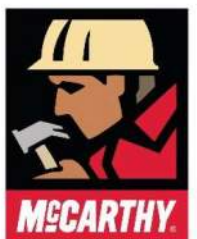
GMP #1 Proposal

**September 2, 2021
Rev. November 5, 2021**

City of Chandler Reclaimed Water Interconnect Facility

TABLE OF CONTENTS

SECTION 1	PROJECT DESCRIPTION
SECTION 2	GMP PROPOSAL SUMMARY - PROJECT COST SUMMARY - TAX EXEMPT SUMMARY - LIST OF SUBCONTRACTORS AND SUPPLIERS
SECTION 3	WORK CATEGORY SCHEDULE OF VALUES (“SOV”)
SECTION 4	GMP CLARIFICATIONS AND ASSUMPTIONS
SECTION 5	PRELIMINARY PROJECT SCHEDULE
SECTION 6	LIST OF GMP PLANS AND SPECIFICATIONS
SECTION 7	GENERAL CONDITIONS AND RATES
SECTION 8	SUEZ PROPOSAL AND CHECK SPECS



City of Chandler Reclaimed Water Interconnect Facility

PROJECT DESCRIPTION

The project is for the construction of the Reclaimed Water Interconnect Facility (RWIF) a membrane water treatment facility located at the Airport Water Reclamation Facility (AWRF). The new facility will optimize the use of the City's water resources by recharging the additional water into the groundwater aquifer beneath the City to enhance the sustainability of the aquifer and provide resilience of the City's water system in case of the drought.

This GMP only includes select early work for the project as follows:

The following includes the procurement of the membrane system from Suez including but not limited to:

- Membranes Modules
- Permeate Pumps + (1) One Spare
- Membrane Agitation Air Blowers
- Backwash system- valves, instrumentation, and controls
- Permeate piping and air scour supply piping
- Air Compressor System with 1 duty/ 1 standby with air dryers, valves, fittings, instrumentation, and controls.
- Process Control Panels, PLC, HMI and associated software programming and graphical display.

All general condition coordination efforts through design evolution of the 60% through the 100% contract drawings and specifications.

The installation of the membrane system is included in GMP 2.

Owner Allowance is included at \$1,000,000 for the following items in GMP 2:

- *Electrical gear early procurement* \$ 500,000
The electrical gear during the 30% cost model was quoted at \$1.52 million by Eaton to the electricians. The gear supplier requires a full contract from the electrician to start submittals and hold gear cost. At the city's request the amount as been reduced to \$500,000.
- *Early submittals and permitting* \$ 100,000
The Allowance is for early submittals such as shoring, concrete, process piping and other items that would have longer lead time such to affect the end date of the project. Permit cost and general condition cost associated with preparing permits, contracts and early submittals are also included here.
- *Changes/Unforeseen Scope* \$ 400,000

This would be for unforeseen changes and or scope required by the city. This allowance would also include items not in Suez's scope proposal dated September 24, 2021 but are required to be provided by Suez as the design evolves through the 60% to the 100% documents.

PROJECT COST SUMMARY

9/2/2021 Rev 11/5/2021

Project: Chandler Water Reclamation Interconnect Facility
GMP 1
Client: City of Chandler
Location: Chandler, AZ
City Project # WW1901.252

		Percentage	Amount
A. Direct Costs			
A1	Direct Cost		\$3,774,763
A2	Construction Contingency	3.00%	\$113,243
TOTAL DIRECT COSTS:			\$3,888,006
B. General Conditions on Direct Costs only			
B	General Conditions	2.2%	\$83,980
<i>SUBTOTAL 1 (Cost of the Work):</i>			\$3,971,986
C. CM@Risks's Fee on Cost of Work only			
	CMAR Construction Fee	7.0%	\$278,039
<i>SUBTOTAL 2</i>			\$4,250,025
D. Bonds and Insurance			
D1	Performance and Payment Bonds	0.7%	\$29,750
D2	Insurance (PL/PD, Builders Risk)	1.2%	\$52,700
<i>Bonds & Insurance Allowance Total</i>			\$82,450
<i>SUBTOTAL 3</i>			\$4,332,475
E. Sales Tax			
E1	Sales Tax (65% of 7.8%)	5.07%	\$219,656
E2	Tax Credits		(\$179,633)
TOTAL SALES TAX			\$40,023
F. Allowances			
F1	COVID/Force Majeure Allowance		\$19,880
F2	Owner Allowance		\$1,000,000
TOTAL GMP #1 PROPOSAL			\$5,392,377

TAX EXEMPT SUMMARY

9/2/2021 Rev 11/5/2021

Project: **Chandler Water Reclamation Interconnect Facility
GMP 1**

Client: **City of Chandler**

Location: **Chandler, AZ**

City Job # **WW1901.252**

DESCRIPTION		Total Tax Exempt Value
01A	General Requirements	\$0
11A	Membrane System	\$3,543,066
Total Tax Exempt Amount		\$3,543,066
Gross Receipts Tax Credit, 65% * 7.8%		5.07% \$ (179,633)

LIST OF SUBCONTRACTORS AND SUPPLIERS

9/2/2021 Rev 11/5/2021

Project: Chandler Water Reclamation Interconnect Facility

GMP 1

Client: City of Chandler

Location: Chandler, AZ

City Project # **WW1901.252**

Work Category	DESCRIPTION	Subcontractor / Supplier
<i>Recommended Subcontractors / Suppliers</i>		
11A	Membrane System	Suez

WORK CATEGORY SCHEDULE OF VALUES ("SOV")

9/2/2021 Rev 11/5/2021

Project: Chandler Water Reclamation Interconnect Facility

GMP 1

Client: City of Chandler

Location: Chandler, AZ

City Project # WW1901.252

Work Category	Description	Total
A. DIRECT COSTS		
01A	General Requirements	\$17,000
11A	Membrane System	\$3,757,763
Direct Cost Subtotal		\$3,774,763

City of Chandler Reclaimed Water Interconnect Facility

GMP #1 CLARIFICATIONS AND ASSUMPTIONS

9/2/2021 Rev. 11/5/2021

General

1. Liquidated damages have been assumed to be per MAG section 108.9.
2. The cost of reuse water, sewer, power, and chemical usage during construction and start-up is not included.
3. Transaction Privilege Tax has been included at 7.8% based on the projects being in the City of Chandler. Tax exemptions have also been included.
4. The following are City of Chandler project costs and have not been included in the cost model:
 - a. Temporary/construction/startup use and permanent utility hookup and usage costs including power, sewer, reuse water
 - b. Building and Environmental Permits, MCDES and ADEQ permitting fees, plan review fees and impact costs
 - c. Special Inspection Fees
 - d. Asbestos testing and Hazardous Waste removal
 - e. Furnishings, Fixtures, and Equipment (FFE) and design of FFE
5. Section 4.1.4 of the Construction Services Contract (Construction Manager at Risk) is rewritten as follows:
"4.1.4 CM@RISK is responsible for undertaking all necessary action contemplated under the contract documents to construct the Project and ensure timely and quality completion of the Project at a cost within the Guaranteed Maximum Price (GMP)."
6. General Conditions have been included for GMP 1 and do not include equipment check-in.
7. COVID-19/Force Majeure Allowance: This allowance to be used only under authorization by the City. This allowance is available if the parties agree conditions that directly arise out of or directly result from the COVID19 pandemic or other force majeure event as defined in General Conditions Article 6.2.14, which may excuse a party's performance under this clause. The party who seeks to invoke this clause must give the other party written notice 30 days after the occurrence of the event giving rise to such condition and the parties must agree in writing to the length of excused or suspended performance. An allowance has been established to cover increases in costs incurred by Contractor resulting from the COVID19 pandemic or force majeure event, which allowance may be used by Contractor subject to the prior written approval of the City, which approval shall not be unreasonably withheld.
8. The rate for the G/L insurance is .95% and meets the requirements of 11.2.1.1
9. This GMP is based on mutually agreed to contract terms.

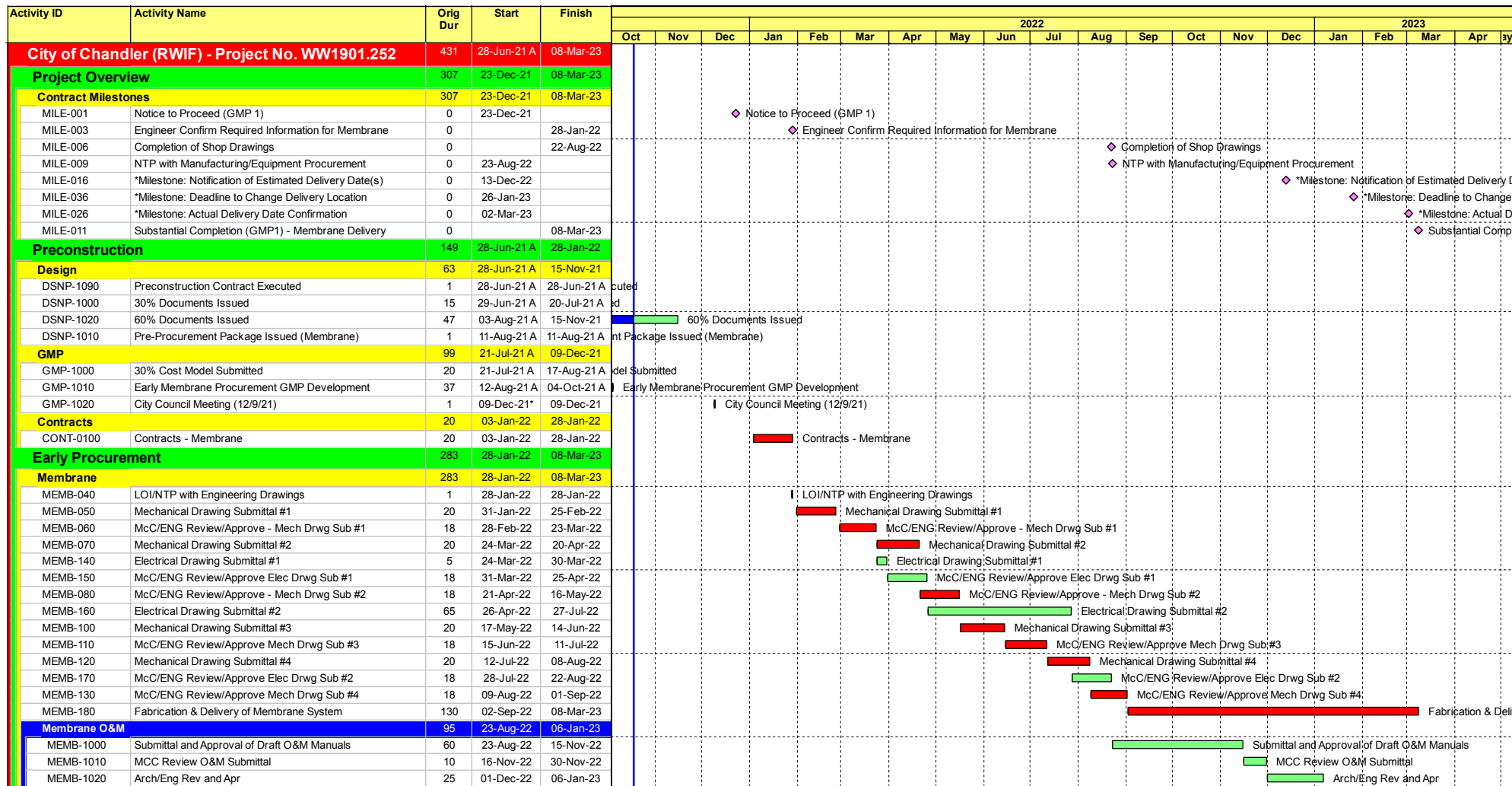
Work Category 11A – Membrane System

1. The design temperature is based on 20-degree C.
2. Influent water to the membrane system will flow at a consistent rate. Table 1 represents the maximum net permeate flow for the current project (Current Criteria) and in the future (Future Criteria).

Table 1: Production Flow Design Criteria				
	Current Criteria		Future Criteria	
Total Permeate Flow (MGD)	10	10	12.5	12.5
Trains in Operation	4	3*	4	3*
Cassettes Installed / Train	4	4	5	5
Cassettes Spaces / Train	5	5	5	5
Recovery Rate	> 95%	> 95%	> 95%	> 95%

3. The membrane system will be designed to increase flows through online trains to accommodate constant inlet feed flow to the membranes up to 10 MGD (net)/95% recovery = 7,310 gpm (net) during Maintenance Clean, Membrane Integrity Test, and Backwashing, with all other trains otherwise in service.

- i. Design Net Production is based on daily average. Instantaneous production flow rates may vary during the day to meet average permeate flow of 10 MGD.
 - ii. If a train is off-line for Recovery Clean or for any other equipment repair or maintenance, then influent flow will be decreased. The feed flow that can be accommodated with one train out of service for Recovery Clean or for any other equipment repair or maintenance is 7,310 gpm (net) $\times \frac{3}{4} = 5,482$ gpm (net).
 - iii. Recovery when feed water is > 135 NTU, < 800 NTU = 90%
 - iv. Maximum Maintenance Clean Frequency = 1/day
 - v. Maximum Recovery Clean Frequency = 12/year
 - vi. Cleaning protocols may be modified during raw water turbidity peak events to maintain membrane performance, particularly if the turbidity peak events extend to more than 72 hours.
- 4. Suez PLC is Allen-Bradley ControlLogix. I/O is Allen-Bradley FlexI/O.
- 5. Suez Butterfly Valves do not conform to AWWA C504 but are Bray Series 30/31 Butterfly Valves with Nylon 11 Coated Ductile Iron discs.
- 6. Suez proposal includes vendor's standard paint systems and may not fully comply with Spec Section 09900 – Painting requirements.
- 7. Suez's proposal includes Purchase Order markups and scope clarifications/exceptions that are not acceptable which we are in the process of negotiating. Should the parties be unable to reach mutually agreeable terms, any changes will be incorporated in GMP 2.
- 8. Items included are referenced in Suez's Proposal dated 9-24-2021 located in Section 8. Items that will be included in GMP-2 are as follows:
 - i. Supply and Installation of Spec Section 16481 – Motor Control Centers
 - ii. Supply and Installation of Spec Section 16485 – Variable Frequency Drives Low Voltage
 - iii. Supply and Installation of Spec Section 13127 – Extruded Flat Panel Covers
 - iv. Supply and Installation of passive ventilation system to relieve pressure or vacuum conditions in the membrane basins when draining or filling basins (If required).
 - v. Supply and Installation of Backwash Tank
 - vi. Overall SCADA system and integration.



Run Date - 05-Nov-21
 Start Date - 28-Jun-21
 Finish Date - 08-Mar-23
 Data Date - 18-Oct-21

- Remaining Level of Effort
- Actual Level of Effort
- Actual Work
- Remaining Work
- Critical Remaining Work

City of Chandler (RWIF) - Project No. WW1901.252



00 - All Act

City of Chandler Reclaimed Water Interconnect Facility

List of GMP Plans and Specifications

GMP 1 Specifications

<i>Specification Section</i>	<i># Pages</i>	<i>Date Issued</i>
Section 01010- Summary of Work	3	August 2021
Section 01300- Submittals	15	August 2021
Section 01640- Materials and Equipment	5	August 2021
Section 01650- Starting of Systems	9	August 2021
Section 01660- Field Tests of Equipment	3	August 2021
Section 01730- Operation and Maintenance Data	4	August 2021
Section 01750- Spare Parts and Maintenance Materials	4	August 2021
Section 01821- Instruction of Operations and Maintenance Personnel	6	August 2021
Section 09900- Painting	21	August 2021
Section 11295- Hydraulic Valves	10	August 2021
Section 11314- End Suction Centrifugal Pumps	8	August 2021
Section 11371- Positive Displacement Blowers	11	August 2021
Section 11372- Air Compressors	9	August 2021
Section 11500.1- Membrane Equipment System	21	August 2021
Section 13127- Extruded Flat Panel Covers	7	August 2021
Section 13445- Pneumatic Controllers and Control Valves	5	August 2021
Section 13447- Electric Motor Actuators	12	August 2021
Section 15062- Steel Pipe	8	August 2021
Section 16160- Enclosures	2	August 2021
Section 16161- Control Panels	34	August 2021
Section 16225- Electric Motors 250 HP or Less	10	August 2021
Section 16481- Motor Control Centers	12	August 2021
Section 16485- Variable Frequency Drives Low Voltage	8	August 2021
Section 17137- Magnetic Flow Meters	5	August 2021
Section 17451- Programmable Logic Controller Hardware	4	August 2021
Section 17452- Programmable Logic Controller System Software and Accessories	7	August 2021
Section 17455- Operator Interface Terminal Software and Hardware	2	August 2021

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

GMP 1 Plans

<i>Sheet #</i>	<i>Sheet Name</i>	<i>Date of Print</i>	<i>Date of Issuance</i>
I- 0.00	Instrumentation Standard Symbols and Legend	8/11/2021 @3:14:01 PM	8/12/2021
I-1.04	Membrane Filtration System Train No. 1 P&ID	8/11/2021 @3:14:03 PM	8/12/2021
I-1.08	Membrane Filtration System Permeate Pump No. 1 P&ID	8/11/2021 @3:14:05 PM	8/12/2021
I-1.12	Membrane Filtration System Back pulse Tank P&ID	8/11/2021 @3:14:07 PM	8/12/2021
I-1.13	Membrane Filtration System CIP Tank P&ID	8/11/2021 @3:14:09 PM	8/12/2021
I-1.14	Membrane Filtration System CIP Pumps P&ID	8/11/2021 @3:14:11 PM	8/12/2021
I-1.15	Membrane Filtration System CIP System P&ID	8/11/2021 @3:14:14 PM	8/12/2021
I-1.17	Membrane Filtration System Air Scour Blowers P&ID	8/11/2021 @3:14:15 PM	8/12/2021

City of Chandler Reclaimed Water Interconnect Facility

Project No. WW1901.252

9/2/2021 Rev. 11/5/2021

GENERAL CONDITIONS

Early Procurement

						TOTALS		
POSITION	QTY	UNIT	PRICE	TOTAL	Start	Hours	Wks	Months
Project Manager	9.2	WKS	\$ 5,168	\$ 47,546	12/23/2021	368	9.20	2.1
Project Engineer	9.3	WKS	\$ 3,673	\$ 34,159	12/23/2021	372	9.30	2.1
Project Administrator	0.9	WKS	\$ 2,600	\$ 2,275	12/23/2021	35	0.88	0.2
<i>Subtotal</i>				\$ 83,980				
TOTAL GENERAL CONDITIONS				\$ 83,980				

	Project Manager*	Project Engineer*	Project Administrator
	Teagan Crabb	Lain Geisler	Adrianne Coffinger
Task Description	Ting Chen	Wil Waldren	(Overtime as needed)
Concrete/Reinforcing/Structural Coordination	24	48	2
Mechanical Piping Coordination	52	104	4
Electrical Coordination	96	96	3
Membrane - Contract/Submittals/Checkin	184	120	16
Insurance/Bonds/Compliance	12	4	10
TOTAL HOURS	368	372	35
(MONTHS)	2.1	2.1	0.2

*Actual manager/engineer involved will depend on task (e.g., civil, concrete, mechanical or CMAR)

City of Chandler Reclaimed Water Interconnect Facility

Project No. WW1901.252

9/2/2021 Rev 11/5/2021

McCarthy Non-Staff Unit Rates

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

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

City of Chandler Reclaimed Water Interconnect Facility

Project No. WW1901.252

9/2/2021 Rev 11/5/2021

McCarthy Staff Unit Rates

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

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



Project Name: Chandler Reclaimed Water Interconnect Facility
Project No. WW1901.252

Work Category:

11A- Membrane Equipment System

Date:

9/2/2021 Rev. 11/5/2021

COMPANY INFORMATION		SUEZ				
		Grant MacInnis				
		(303) 396-9532				
		grant.macinnis@suez.com				
TOTAL WORK CATEGORY PACKAGE VALUE		\$3,757,763				
MCCARTHY SUBCONTRACT & FRONT END TERMS						
1	Compliant with McCarthy Front Ends	No				
2	Bid Submitted on McCarthy Bid Form	Yes				
3	Bid Bond Included with Bid (if over \$250k Sub/\$500k Supplier)	Yes				
4	Surety Company	Federal Insurance Company				
5	Surety AM Best Rating (Must be A- or Better)	A++				
6	AM Best Financial Size X(\$500M to \$750M) or higher	XV				
7	Anticipated contract amount is less than the Federal UW Limit as listed on the Treasury Listing	Yes				
8	Bond/CDI Cost	0.950%				
9	Included Insurance Requirements (Per Matrix)	No				
10	GL Insurance Company Name	Everest National Insurance Company				
11	GL Insurance Carrier AM Best Rating (Must be A- or Better)	A+				
12	PRL Insurance (If required by the Front Ends)	Yes				
13	Pollution Insurance (If required by the Front Ends)	N/A				
14	Tier 1 Approved	Not Current				
15	Tier 2 Approved	N/A				
16	Safety Items:					
17	OSHA Recordable Incident Rate (Current)	N/A				
18	Agrees to comply with PPE requirements including 100% glove policy	Yes				
19	Acknowledges updated ladder policy (platform ladders)	Yes				
20	Task Hazard Analysis included for all tasks	Yes				
21	Tie-off above 6' required	Yes				
22	Includes Hoisting for Sub's Own Work Scope	N/A				
23	Acknowledges Soils Report	N/A				
24	Acknowledges Addenda	Yes				
25	Hold Bid for 150 Days	Yes				
26	Pricing good for the duration of the project	Yes				
27	Sales Tax Included	No				
28	COVID-19 Market Questions					
29	How has your workprogram been impacted by the COVID-19 situation? % of work stopped or delayed by more than 2 weeks?	No				
30	Have you had any future work opportunities canceled or delayed? What % of your future sales are projected to be impacted by COVID-19?	No				
31	Are you suffering productivity loss that is impacting the ability to complete work on time?	No				
32	Have you had any difficulty with employees not wanting to come to work because of the risk of infection?	No				
33	Have you experienced any unusual voluntary turnover as a result of COVID-19?	No				
34	Have you had to furlough or make a reduction in staff or go to a reduced workweek as a result of COVID-19 market conditions?	No				
35	Have you experienced and/or do you anticipate any issues with existing suppliers or vendors?	No				
36	Do you have any overseas suppliers that may be impeding your supply chain?	No				
37						
38	Per Plans & Specifications					
39	Division 1 as it relates to this scope of work	Yes				
40	01010 - Summary of Work	Yes				
41	01300 - Submittals	Yes				



Project Name: Chandler Reclaimed Water Interconnect Facility
Project No. WW1901.252

Work Category:

11A- Membrane Equipment System

Date:

9/2/2021 Rev. 11/5/2021

COMPANY INFORMATION		SUEZ				
		Grant MacInnis				
		(303) 396-9532				
		grant.macinnis@suez.com				
TOTAL WORK CATEGORY PACKAGE VALUE		\$3,757,763				
42	01640 - Materials and Equipment	Yes				
43	01650 - Starting of Systems	Yes				
44	01660 - Field Tests of Equipment	Yes				
45	01730 - Operation and Maintenance Data	Yes				
46	01750 - Spare Parts and Maintenance Materials	No				
47	01821 Instruction of Operations and Maintenance Personnel	Yes				
48	09900 - Painting	Yes				
49	11295 - Hydraulic Valves	Yes				
50	11314 - End Suction Centrifugal Pumps	Yes				
51	11371 - Positive Displacement Blowers	Yes				
52	11372 - Air Compressors	Yes				
53	11500.1 - Membrane Equipment System	Yes				
54	13127 - Extruded Flat Panel Covers	No				
55	13445 - Pneumatic Controllers and Control Valves	Yes				
56	15062 - Steel Pipe	Yes				
57	16160 - Enclosures	Yes				
58	16161 - Control Panels	Yes				
59	16225 - Electric Motors 250 HP or Less	Yes				
60	16481 - Motor Control Centers	No				
61	16485 - Variable Frequency Drives Low Voltage	No				
62	17137 - Magnetic Flow Meters	Yes				
63	17451 - Programmable Logic Controller Hardware	Yes				
64	17452 - Programmable Logic Controller System Software and Accessories	Yes				
65	17455 - Operator Interface Terminal Software and Hardware	Yes				
Scope of Work						
Base Bid:		\$3,595,000				
67	Provide all labor, materials, tools, equipment and appurtenances as required to perform the Work Category - Membrane Equipment System, in accordance with and reasonably inferable from the Contract Documents, complete and without exception unless otherwise noted below, including, but not limited to the following:	Yes				
68	Check to Spec completed and submitted to McCarthy	Yes				
69	Membrane Warranty: 5 year warranty from Final Acceptance (July 2023), with additional pro-rated 5 year warranty. System Component Warranty (pumps, valves, ancillary equipment): 1 year warranty from Final Acceptance (July 2023).	Yes				
70	Four (4) UF Membrane Filtration Train System, four (4) cassettes installed per train, one (1) cassette spaces per train	Yes				
71	Design minimum temperature: 20 degrees C	Yes				
72	Design capacity (net): 10 MGD	Yes				
73	Design capacity (net) with one (1) train out of service: 9.5 MGD	Yes				
74	Future hydraulic capacity: 12.5 MGD	Yes				
75	Recovery (at design capacity) at turbidities up to 135NTU: 95%	Yes				
76	Recovery (at design capacity) at turbidities up to 800NTU: 90%	Yes				
77	Permeate water quality: ≤ 0.5 NTU 100% of the time, ≤ 0.1 NTU 95% of the time	≤ 0.1 NTU 95% of the time				
78	Log removal value (LRV): ≥ 3.0 log	Yes				



Project Name: Chandler Reclaimed Water Interconnect Facility
Project No. WW1901.252

Work Category:

11A- Membrane Equipment System

Date:

9/2/2021 Rev. 11/5/2021

COMPANY INFORMATION		SUEZ				
		Grant MacInnis				
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		grant.macinnis@suez.com				
TOTAL WORK CATEGORY PACKAGE VALUE		\$3,757,763				
79	Max CIP/Maintenance Clean Frequency: 1 per day	Yes				
80	Max Recovery Clean Frequency: 12 per year	Yes				
81	Membrane Modules: hollow fiber type membranes	Yes				
82	Permeate Pumps: One (1) pump per train plus one (1) uninstalled spare, with valves, instrumentation and controls	Yes				
83	Membrane Agitation Air Blowers: minimum of two (2) blowers, with valves, instrumentation and controls	Yes				
84	Clean-In-Place (CIP System): One (1) duty and one (1) standby CIP Pump, valves, instrumentation and controls	Yes				
85	Membrane modules, cassettes/racks, process instrumentation and associated equipment	Yes				
86	Membrane Backwash System: valves, instrumentation and controls	Yes				
87	Membrane Integrity Test System: valves, instrumentation and controls	Yes				
88	I&C for membrane maintenance/recovery cleaning feed and distribution system	Yes				
89	Air Compressor System: One (1) duty & one (1) standby, with air dryers, valves, fittings, instrumentation and controls.	Yes				
90	Process control panels, PLC(s), HMI(s), and associated software programming and graphical displays	Yes				
91	Membrane Permeate piping and Air Scour Supply piping within the limits of each membrane basin (above), with valves, instrumentation and controls	Yes				
92	All in-basin piping for membrane effluent and air scour.	Yes				
93	Additional Valves & Instruments not shown on Suez P&IDs, but are on Wilson P&IDs	\$25,000				
94	Steel Pipe Design Calculations: Stamped by Registered AZ Engineer	\$7,500				
95	All supports for membrane cassettes/racks and plates.	Yes				
96	Setting Tools for Electric Motor Operators	N/A				
97	Membrane Basin Covers	No				
98	Provide lifting lugs for proper installation	Yes				
99	Provide structural and anchorage calculation sealed by a registered structural engineer in the state of Arizona	\$7,500				
100	Provide all anchors and epoxy required for the installation of the equipment	\$30,000				
101	All metallic surfaces (including pipe, supports, and enclosure) shall be primed per the requirements of the 09900 - Painting	Yes				
102	Shipping shall be FOB jobsite	Yes				
103	Unloading & storage	N/A				
104	Temporary protection & enclosure	N/A				
105	Preventative maintenance	\$10,000				
106	O&M's per specification section 01781	Yes				
107	Training: minimum 4 trips - 8 person days	Yes				
108	Spare Parts per the Specifications	No- to be added later				
109	Manufactures Services: minimum 1 trip - 2 person days unloading and installation training, 2 trips - 10 person days installation assistance & inspection, 30 days onsite for operational testing, 3 trips - 10 person days durin commissioning period.	\$11,400				
110	Performance testing: Per Spec	Yes				
111	Testing days/trips included:	Yes				
112	Startup days/trips included:	Yes				
113	Professional Liability	\$36,000				
113	COVID-19 Scope Items					
114	Proposal includes CDC, Federal, State and Local OSHA guidelines for COVID-19.	Yes				
115	Your proposal shall include all productivity, schedule, and other impacts to cost and schedule.	Yes				



Project Name: Chandler Reclaimed Water Interconnect Facility
Project No. WW1901.252

Work Category:

11A- Membrane Equipment System

Date:

9/2/2021 Rev. 11/5/2021

COMPANY INFORMATION		SUEZ				
		Grant MacInnis				
		(303) 396-9532				
		grant.macinnis@suez.com				
TOTAL WORK CATEGORY PACKAGE VALUE		\$3,757,763				
116	All personnel onsite must maintain 6'0" spacing between personnel and shall have facemasks on at all times that align with CDC, Federal, State or Local OSHA guidelines for COVID-19.	Yes				
117	Work activities that require personnel to be closer than 6'0" must have a plan presented and approved by McCarthy before work activity commences. Work activities within 6'0" shall also include the appropriate masks and PPE while performing the work	Yes				
118	All tools and equipment used must be sanitized each day.	Yes				
119	Personnel must comply with all hand washing and sanitizing requirements set by McCarthy.	Yes				
120	Subcontractors with onsite trailers must sanitize trailer interior high contact areas and restroom facilities daily. Subcontractors must have a plan approved by McCarthy to maintain 6' social distancing within the trailer as required by the AHI.	N/A				
121	Personnel are not allowed to carpool to the site or while onsite.	Yes				
122	Any personnel reporting symptoms must be immediately reported to McCarthy and follow the appropriate testing and quarantine protocols.	Yes				
123						
124	End of Scope					
	Bond/CDI Cost	\$35,363				
TOTAL WORK CATEGORY PACKAGE VALUE		\$3,757,763				



PROPOSAL

City of Chandler Reclaimed Water Interconnect Facility GMP 1

Submitted To: McCarthy Building Companies, Inc.
6225 North 24th Street, Suite 200
Phoenix, Arizona 85016
Attention: Jason House
Nicole Azuri

Submitted By: SUEZ WTS Systems USA Inc.
SUEZ Proposal No.: 415261

Contact Person: Grant MacInnis
Senior Sales Manager
2913 Quitman Street
Denver, Colorado 80212
Cell: (303) 396 9532
E-mail: grant.macinnis@suez.com

Local Representation: Coombs-Hopkins Company
Jason Vernon
8950 S. 52nd Street, Suite 103
Tempe, Arizona 85284
Cell: (602) 363 6755
E-mail: jason@chcwater.com

SUEZ WTS Systems USA Inc.

3239 Dundas Street West
Oakville, Ontario L6M 4B2

www.suezwatertechnologies.com

Date: September 24, 2021

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Confidential and Proprietary Information**

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InSight and ZeeWeed

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Appendix A – Check-marked Specifications

Appendix B – SUEZ Supplemental Conditions

Appendix C – Piping and Instrumentation Diagrams

1 Bid Proposal Form and Bid Bond

Please find a signed copy of the Bid Proposal Form attached.

At the end of the document, please also find a sample certificate of insurance and current W9 form.

Last, please find a copy of the Bid Bond attached.

BID PROPOSAL

Date September 24, 2021

Bid Proposal of * SUEZ WTS Systems USA Inc. (hereinafter called "Bidder")

a ** corporation organized and existing under the laws of the State of Massachusetts

* Insert name of firm.

** Insert corporation, partnership, or individual, as applicable.

TO: McCarthy Building Companies, Inc.
6225 North 24th Street, Suite 200
Phoenix, Arizona 85016

The Bidder, in compliance with your Invitation for Bids for the construction of Chandler Reclaimed Water Interconnect Facility having examined the Contract Documents entitled City of Chandler, Chandler Reclaimed Water Interconnect Facility, and other related documents and being familiar with the site of the proposed work, and with all of the conditions surrounding the construction of the proposed project including the availability of materials and labor, and the progress of work to date, if any, hereby proposes to furnish all materials, transportation, perform all work, provide all services, and to construct all work in accordance with the Contract Documents set forth herein, and at the prices stated below. These prices are to cover all expenses incurred in performing the work required.

The Bidder shall attach a copy of Bidders' detailed proposal to its Bid Proposal. This proposal shall identify all quantities shown in the documents or anticipated along with corresponding material pricing.

After Bid Proposals are received, tabulated and evaluated by McCarthy, said Bidder agrees to meet with McCarthy for the purpose of determining any duplications, omissions, or mutually agreed bid adjustments. For these meetings, the Bidder agrees to provide a complete, detailed cost breakdown.

The Bidder, if awarded a Purchase Order, agrees to commence work and to fully complete its Work in accordance with a schedule to be established in collaboration with McCarthy under the provisions of the Additional Subcontractor Conditions of the Specifications.

The Bidder acknowledges receipt of the following Addenda: Not applicable

BASE BID:

The Bidder agrees to perform all Membrane Equipment System
 (herein insert the title of the Work Category as it appears in the Additional Subcontractor Conditions) Work for
 Work Category No. 11A, as described in the Contract Documents, for the Lump Sum of Three million six hundred thirty thousand nine hundred fifty
DOLLARS (\$ 3,630,950.00).

BID BREAKDOWN:

Base Bid Amount	\$ <u>3,595,000.00</u>
Performance & Payment Bond Cost (If Applicable)	\$ <u>35,950.00</u>
Total Subcontract Amount	\$ <u>3,630,950.00</u>

The name of the proposed Bonding Company is Federal Insurance Company

Bond rate 1.0 %

All applicable taxes, except sales and use taxes on materials and equipment which are affixed and made a part of the real estate of the Project, are included in the above Base Bid. Bidder agrees that this Bid Proposal shall be good and may not be withdrawn unless McCarthy does not send Bidder a Subcontract within one hundred twenty (120) calendar days after the opening date of Bid Proposals.

(Amounts shall be shown in both words and figures. In case of discrepancy, the amount shown in words will govern.)

ALTERNATES:

The Bidder further agrees that if any or all of the Alternates listed and described below are incorporated and accepted within sixty (60) calendar days after receipt of a Purchase Order from McCarthy, the Bidder will adjust its Subcontract by the amount indicated opposite the Alternates listed below.

ALTERNATE NO. 1:

ADD/DEDUCT the sum of \$ Not applicable

ALTERNATE NO. 2:

ADD/DEDUCT the sum of \$ Not applicable

SELECT AS APPROPRIATE

- ☒ The Bidder has completed the Prequalification Form together with all other required data for McCarthy's Contractor Default Insurance Program; OR Final completion is pending
- ☐ The Bidder has not completed the Prequalification Form together with all other required data for McCarthy's Contractor Default Insurance Program because the Bidder has provided the Form and all such information to McCarthy in the past 12 months for the following project:

_____ Project which bid on _____.

RESPONSIVE BID REQUIREMENTS:

DO NOT ENCLOSE YOUR STANDARD TERMS AND CONDITIONS

If any exceptions are taken to the requirements of this Proposal form, attach a separate sheet listing those exceptions, stating the sections and paragraphs and the specific exception.	B.M. (initials)
In submitting this proposal, the Bidder certifies that this bid is valid for 120 calendar days.	B.M. (initials)
In submitting this Proposal, the Bidder certifies that all cost for extended warranties to start on the date of Substantial Completion is included.	B.M. (initials)
In submitting this proposal as described herein, we confirm that we have received, reviewed and agree to all commercial terms stated in the McCarthy Subcontract and Purchase Order Agreement. Any exception taken to the commercial terms stated in these Agreements must be listed on a separate sheet noting the article or paragraph and the specific exception. <u>Bidders attached Standard Terms and Conditions will not be acknowledged or accepted as part of any given bid.</u>	B.M. (initials)
In submitting this proposal as described herein, the Bidder certifies that this bid is coordinated based on a complete set of documents and that there will be no claims for change order based on the assertion that the Bidder did not have a complete set of Bidding Documents.	B.M. (initials)
In submitting this proposal, the Bidder certifies that they have included all ~~spare parts~~ , training, O & M Manuals, shop drawings and administration costs as associated to comply with the requirements of the specifications and as listed for their scope of work. <u>Spare parts not included at this time</u>	B.M. (initials)
A bid will be considered non-responsive if the Subcontractor Pre-Qualification Form is not completed as part of the Bid Form (or on file at McCarthy office) .	B.M. (initials)
The Bidder, by submitting their bid, represents that they have read and understand the scope requirements of the Bidding Documents.	B.M. (initials)
The Bidder certifies that any proposed materials in this scope of work meet or exceeds the requirements stated in the specifications unless noted otherwise within this proposal.	B.M. (initials)
The bidder certifies that the price listed in this bid is a firm Price through the final delivery of the materials proposed herein, and that no material escalation will be accepted as part of this proposal.	(initials)

Within fifteen (15) days after receipt by the Bidder from McCarthy of the Purchase Order for "Furnish Only" Categories in excess of \$500,000.00, the Bidder will execute and return to McCarthy said Purchase Order, provide to McCarthy proof of the EMR and Incidence Rates listed above and if notified from McCarthy that Bidder is not to be enrolled in McCarthy's Contractor Default Insurance Program, deliver to McCarthy Supply Contract Bond for the Purchase Order, or the difference between the amount of the bid and such larger amount for which McCarthy may subcontract with another party to perform the work covered by said bid, together with all court costs, all attorney fees and all other expense of recovery, all of which shall not exceed the Bid Security attached in the amount of 15% of the bid, will become the property of McCarthy. The bonds shall name McCarthy as Obligor.

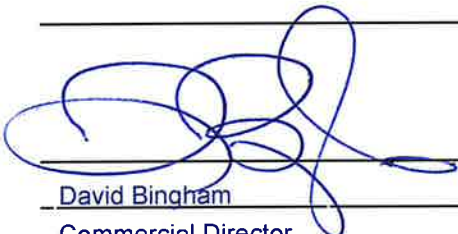
If an Individual:

Signature: _____
 Name (print): _____
 Business Address: _____

If a Partnership:

Signature: _____
 Name (print): _____
 Signature: _____
 Name (print): _____
 Business Address: _____

If a Corporation:

Signature:  _____
 Name (print): David Bingham
 Title: Commercial Director
 Business Address: 3239 Dundas Street West
Oakville, Ontario L6M 4B2
 Telephone Number: (905) 465 3030
 Contractor License Number: Not applicable
 General Liability Insurance Carrier (not the agent): Everest National Insurance Company

*Please attach a sample certificate of insurance and current W9 form to your bid.



CERTIFICATE OF LIABILITY INSURANCE

DATE (MM/DD/YYYY)
01/12/2021

THIS CERTIFICATE IS ISSUED AS A MATTER OF INFORMATION ONLY AND CONFERS NO RIGHTS UPON THE CERTIFICATE HOLDER. THIS CERTIFICATE DOES NOT AFFIRMATIVELY OR NEGATIVELY AMEND, EXTEND OR ALTER THE COVERAGE AFFORDED BY THE POLICIES BELOW. THIS CERTIFICATE OF INSURANCE DOES NOT CONSTITUTE A CONTRACT BETWEEN THE ISSUING INSURER(S), AUTHORIZED REPRESENTATIVE OR PRODUCER, AND THE CERTIFICATE HOLDER.

IMPORTANT: If the certificate holder is an ADDITIONAL INSURED, the policy(ies) must have ADDITIONAL INSURED provisions or be endorsed. If SUBROGATION IS WAIVED, subject to the terms and conditions of the policy, certain policies may require an endorsement. A statement on this certificate does not confer rights to the certificate holder in lieu of such endorsement(s).

PRODUCER MARSH USA, INC. 445 SOUTH STREET MORRISTOWN, NJ 07962-1966 Attn: Morristown.CertRequest@marsh.com Fax: 212-948-0979	CONTACT NAME:		
	PHONE (A/C, No, Ext):	FAX (A/C, No):	
CN102425067-STG-GAW-21-22 INSURED SUEZ WTS Systems USA, Inc. 4636 Somerton Road Trevose, PA 19053-6742	E-MAIL ADDRESS:		
	INSURER(S) AFFORDING COVERAGE		NAIC #
	INSURER A : Everest National Insurance Company		10120
	INSURER B : Everest Premier Insurance Company		16045
	INSURER C :		
	INSURER D :		
	INSURER E :		
INSURER F :			

COVERAGES **CERTIFICATE NUMBER:** NYC-010823304-14 **REVISION NUMBER:** 3

THIS IS TO CERTIFY THAT THE POLICIES OF INSURANCE LISTED BELOW HAVE BEEN ISSUED TO THE INSURED NAMED ABOVE FOR THE POLICY PERIOD INDICATED. NOTWITHSTANDING ANY REQUIREMENT, TERM OR CONDITION OF ANY CONTRACT OR OTHER DOCUMENT WITH RESPECT TO WHICH THIS CERTIFICATE MAY BE ISSUED OR MAY PERTAIN, THE INSURANCE AFFORDED BY THE POLICIES DESCRIBED HEREIN IS SUBJECT TO ALL THE TERMS, EXCLUSIONS AND CONDITIONS OF SUCH POLICIES. LIMITS SHOWN MAY HAVE BEEN REDUCED BY PAID CLAIMS.

INSR LTR	TYPE OF INSURANCE	ADDL SUBR INSD WVD	POLICY NUMBER	POLICY EFF (MM/DD/YYYY)	POLICY EXP (MM/DD/YYYY)	LIMITS
A	☒ COMMERCIAL GENERAL LIABILITY ☐ CLAIMS-MADE ☒ OCCUR GEN'L AGGREGATE LIMIT APPLIES PER: ☒ POLICY ☐ PRO-JECT ☐ LOC ☐ OTHER:		RM5GL00017-211	01/01/2021	01/01/2022	EACH OCCURRENCE \$ 5,000,000 DAMAGE TO RENTED PREMISES (Ea occurrence) \$ 5,000,000 MED EXP (Any one person) \$ 10,000 PERSONAL & ADV INJURY \$ 5,000,000 GENERAL AGGREGATE \$ 5,000,000 PRODUCTS - COMP/OP AGG \$ 5,000,000 \$
A	☒ AUTOMOBILE LIABILITY ☒ ANY AUTO ☐ OWNED AUTOS ONLY ☐ SCHEDULED AUTOS ☐ HIRED AUTOS ONLY ☐ NON-OWNED AUTOS ONLY		RM5CA00013-211 (AOS) FM5CA00025-211 (MA)	01/01/2021 01/01/2021	01/01/2022 01/01/2022	COMBINED SINGLE LIMIT (Ea accident) \$ 5,000,000 BODILY INJURY (Per person) \$ BODILY INJURY (Per accident) \$ PROPERTY DAMAGE (Per accident) \$ \$
	☐ UMBRELLA LIAB ☐ OCCUR ☐ EXCESS LIAB ☐ CLAIMS-MADE ☐ DED ☐ RETENTION \$					EACH OCCURRENCE \$ AGGREGATE \$ \$
B	☒ WORKERS COMPENSATION AND EMPLOYERS' LIABILITY ANY PROPRIETOR/PARTNER/EXECUTIVE OFFICER/MEMBER EXCLUDED? (Mandatory in NH) ☒ Y/N ☒ N/A If yes, describe under DESCRIPTION OF OPERATIONS below		RM5WC00021-211 (AOS) RM5WC00022-211 (MA, WI) RM5WC00047-211 (FL, ME, NJ)	01/01/2021 01/01/2021 01/01/2021	01/01/2022 01/01/2022 01/01/2022	☒ PER STATUTE ☐ OTH-ER E.L. EACH ACCIDENT \$ 5,000,000 E.L. DISEASE - EA EMPLOYEE \$ 5,000,000 E.L. DISEASE - POLICY LIMIT \$ 5,000,000

DESCRIPTION OF OPERATIONS / LOCATIONS / VEHICLES (ACORD 101, Additional Remarks Schedule, may be attached if more space is required)

Re: Evidence of Coverage

CERTIFICATE HOLDER

SUEZ WTS Systems USA, Inc. 4636 Somerton Rd. Trevose, PA 19053	SHOULD ANY OF THE ABOVE DESCRIBED POLICIES BE CANCELLED BEFORE THE EXPIRATION DATE THEREOF, NOTICE WILL BE DELIVERED IN ACCORDANCE WITH THE POLICY PROVISIONS.
	AUTHORIZED REPRESENTATIVE of Marsh USA Inc. Manashi Mukherjee <i>Manashi Mukherjee</i>

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Request for Taxpayer Identification Number and Certification

Give Form to the
requester. Do not
send to the IRS.

► Go to www.irs.gov/FormW9 for instructions and the latest information.

Print or type. See Specific Instructions on page 3.	1 Name (as shown on your income tax return). Name is required on this line; do not leave this line blank. SUEZ WTS SYSTEMS USA, INC.	
	2 Business name/disregarded entity name, if different from above	
	3 Check appropriate box for federal tax classification of the person whose name is entered on line 1. Check only one of the following seven boxes. ☐ Individual/sole proprietor or single-member LLC ☒ C Corporation ☐ S Corporation ☐ Partnership ☐ Trust/estate ☐ Limited liability company. Enter the tax classification (C=C corporation, S=S corporation, P=Partnership) ► Note: Check the appropriate box in the line above for the tax classification of the single-member owner. Do not check LLC if the LLC is classified as a single-member LLC that is disregarded from the owner unless the owner of the LLC is another LLC that is not disregarded from the owner for U.S. federal tax purposes. Otherwise, a single-member LLC that is disregarded from the owner should check the appropriate box for the tax classification of its owner. ☐ Other (see instructions) ►	
	4 Exemptions (codes apply only to certain entities, not individuals; see instructions on page 3): Exempt payee code (if any) 5 Exemption from FATCA reporting code (if any) _____ (Applies to accounts maintained outside the U.S.)	
	5 Address (number, street, and apt. or suite no.) See instructions. 4636 SOMERTON ROAD 6 City, state, and ZIP code TREVOSE, PA 19053	7 List account number(s) here (optional)

Requester's name and address (optional)

Part I Taxpayer Identification Number (TIN)

Enter your TIN in the appropriate box. The TIN provided must match the name given on line 1 to avoid backup withholding. For individuals, this is generally your social security number (SSN). However, for a resident alien, sole proprietor, or disregarded entity, see the instructions for Part I, later. For other entities, it is your employer identification number (EIN). If you do not have a number, see *How to get a TIN*, later.

Note: If the account is in more than one name, see the instructions for line 1. Also see *What Name and Number To Give the Requester* for guidelines on whose number to enter.

Social security number								
			-				-	
or								
Employer identification number								
0	4		-	2	0	6	8	5
								3
								0

Part II Certification

Under penalties of perjury, I certify that:

1. The number shown on this form is my correct taxpayer identification number (or I am waiting for a number to be issued to me); and
2. I am not subject to backup withholding because: (a) I am exempt from backup withholding, or (b) I have not been notified by the Internal Revenue Service (IRS) that I am subject to backup withholding as a result of a failure to report all interest or dividends, or (c) the IRS has notified me that I am no longer subject to backup withholding; and
3. I am a U.S. citizen or other U.S. person (defined below); and
4. The FATCA code(s) entered on this form (if any) indicating that I am exempt from FATCA reporting is correct.

Certification instructions. You must cross out item 2 above if you have been notified by the IRS that you are currently subject to backup withholding because you have failed to report all interest and dividends on your tax return. For real estate transactions, item 2 does not apply. For mortgage interest paid, acquisition or abandonment of secured property, cancellation of debt, contributions to an individual retirement arrangement (IRA), and generally, payments other than interest and dividends, you are not required to sign the certification, but you must provide your correct TIN. See the instructions for Part II, later.

Sign
Here

Signature of
U.S. person ►

Date ► 02/18/2020

General Instructions

Section references are to the Internal Revenue Code unless otherwise noted.

Future developments. For the latest information about developments related to Form W-9 and its instructions, such as legislation enacted after they were published, go to www.irs.gov/FormW9.

Purpose of Form

An individual or entity (Form W-9 requester) who is required to file an information return with the IRS must obtain your correct taxpayer identification number (TIN) which may be your social security number (SSN), individual taxpayer identification number (ITIN), adoption taxpayer identification number (ATIN), or employer identification number (EIN), to report on an information return the amount paid to you, or other amount reportable on an information return. Examples of information returns include, but are not limited to, the following.

- Form 1099-INT (interest earned or paid)

- Form 1099-DIV (dividends, including those from stocks or mutual funds)
- Form 1099-MISC (various types of income, prizes, awards, or gross proceeds)
- Form 1099-B (stock or mutual fund sales and certain other transactions by brokers)
- Form 1099-S (proceeds from real estate transactions)
- Form 1099-K (merchant card and third party network transactions)
- Form 1098 (home mortgage interest), 1098-E (student loan interest), 1098-T (tuition)
- Form 1099-C (canceled debt)
- Form 1099-A (acquisition or abandonment of secured property)

Use Form W-9 only if you are a U.S. person (including a resident alien), to provide your correct TIN.

If you do not return Form W-9 to the requester with a TIN, you might be subject to backup withholding. See What is backup withholding, later.

8/20/2021
Front Ends

BID BOND Number 82733-CHU-21-8

KNOW ALL MEN BY THESE PRESENTS, that we Suez WTS Systems USA, Inc.
4636 Somerton Road, Trevose PA 19053 (here
insert full name and address or legal title of Contractor) as Principal, hereinafter called the Principal, and Federal Insurance Company, 202B Halls Mill Road, Whitehouse Station NJ 08889-3454

(Here insert full name and address or legal title of Surety) a corporation duly organized under the laws of the State of IN as Surety, hereinafter called the Surety, are held and firmly bound unto McCARTHY, hereinafter called the Obligee, in the sum of Fifteen percent of the amount bid Fifteen Percent of Amount Bid

DOLLARS (\$ 15%), for the payment of which sum well and truly to be made, the said Principal and the said Surety, bind ourselves, our heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, the Principal has submitted a bid for Work Category/ Specification No. 11A - Membrane Equipment System, for Chandler Reclaimed Water Interconnect Facility, 955 E. Queen Creek Road, Chandler, Arizona 85286.

NOW, THEREFORE, if the Obligee shall accept the bid of the Principal and the Principal shall, within the specified period of time, enter into a formal contract and furnish a surety guaranteeing the full and faithful performance of the Work, all as provided in the Additional Subcontractor Conditions, Plans and Specifications and other Contract Documents, including addenda, of said Obligee, then this obligation shall become void; otherwise it shall remain in full force and effect.

In the event the Obligee determines the Principal has failed to comply with any requirement as set forth in the preceding paragraph, then the Principal and Surety shall be jointly and severally obligated to pay to the Obligee the difference, not to exceed the full penal sum set forth above, between the amount specified in the Principal's bid and such larger amount for which the Obligee may contract with another party to perform the work covered by said bid, together with all court costs, all attorney's fees and any other expense of recovery.

IN TESTIMONY WHEREOF, the said Principal and said Surety have caused this instrument to be signed by their respective officers and their corporate seals to be hereunto affixed this 13th day of September A.D. 2021.

[Signature]
(Witness)

[Signature]
(Witness) Annette Audinot

Suez WTS Systems USA, Inc.
(Principal) (Seal)
Gen. Director (Title)

Federal Insurance Company
(Surety) (Seal)

April D. Perez
April D. Perez, Attorney-In-Fact (Title)

Power of Attorney

Federal Insurance Company | Vigilant Insurance Company | Pacific Indemnity Company
Westchester Fire Insurance Company | ACE American Insurance Company

Know All by These Presents, that FEDERAL INSURANCE COMPANY, an Indiana corporation, VIGILANT INSURANCE COMPANY, a New York corporation, PACIFIC INDEMNITY COMPANY, a Wisconsin corporation, WESTCHESTER FIRE INSURANCE COMPANY and ACE AMERICAN INSURANCE COMPANY corporations of the Commonwealth of Pennsylvania, do each hereby constitute and appoint

April D. Perez

each as their true and lawful Attorney-in-Fact to execute under such designation in their names and to affix their corporate seals to and deliver for and on their behalf as surety thereon or otherwise, bonds and undertakings and other writings obligatory in the nature thereof (other than bail bonds) given or executed in the course of business, and any instruments amending or altering the same, and consents to the modification or alteration of any instrument referred to in said bonds or obligations.

In Witness Whereof, said FEDERAL INSURANCE COMPANY, VIGILANT INSURANCE COMPANY, PACIFIC INDEMNITY COMPANY, WESTCHESTER FIRE INSURANCE COMPANY and ACE AMERICAN INSURANCE COMPANY have each executed and attested these presents and affixed their corporate seals on this 10th day of March, 2020.

Dawn M. Chloros

Dawn M. Chloros, Assistant Secretary

Stephen M. Haney

Stephen M. Haney, Vice President



STATE OF NEW JERSEY

County of Hunterdon

ss.

On this 10th day of March, 2020 before me, a Notary Public of New Jersey, personally came Dawn M. Chloros and Stephen M. Haney, to me known to be Assistant Secretary and Vice President, respectively, of FEDERAL INSURANCE COMPANY, VIGILANT INSURANCE COMPANY, PACIFIC INDEMNITY COMPANY, WESTCHESTER FIRE INSURANCE COMPANY and ACE AMERICAN INSURANCE COMPANY, the companies which executed the foregoing Power of Attorney, and the said Dawn M. Chloros and Stephen M. Haney, being by me duly sworn, severally and each for herself and himself did depose and say that they are Assistant Secretary and Vice President, respectively, of FEDERAL INSURANCE COMPANY, VIGILANT INSURANCE COMPANY, PACIFIC INDEMNITY COMPANY, WESTCHESTER FIRE INSURANCE COMPANY and ACE AMERICAN INSURANCE COMPANY and know the corporate seals thereof, that the seals affixed to the foregoing Power of Attorney are such corporate seals and were thereto affixed by authority of said Companies; and that their signatures as such officers were duly affixed and subscribed by like authority.

Notarial Seal



KATHERINE J. ADELAAR
NOTARY PUBLIC OF NEW JERSEY
No. 2316685
Commission Expires July 16, 2024

Katherine J. Adelaar
Notary Public

CERTIFICATION

Resolutions adopted by the Boards of Directors of FEDERAL INSURANCE COMPANY, VIGILANT INSURANCE COMPANY, and PACIFIC INDEMNITY COMPANY on August 30, 2016; WESTCHESTER FIRE INSURANCE COMPANY on December 11, 2006; and ACE AMERICAN INSURANCE COMPANY on March 20, 2009:

"RESOLVED, that the following authorizations relate to the execution, for and on behalf of the Company, of bonds, undertakings, recognizances, contracts and other written commitments of the Company entered into in the ordinary course of business (each a "Written Commitment"):

- (1) Each of the Chairman, the President and the Vice Presidents of the Company is hereby authorized to execute any Written Commitment for and on behalf of the Company, under the seal of the Company or otherwise.
- (2) Each duly appointed attorney-in-fact of the Company is hereby authorized to execute any Written Commitment for and on behalf of the Company, under the seal of the Company or otherwise, to the extent that such action is authorized by the grant of powers provided for in such person's written appointment as such attorney-in-fact.
- (3) Each of the Chairman, the President and the Vice Presidents of the Company is hereby authorized, for and on behalf of the Company, to appoint in writing any person the attorney-in-fact of the Company with full power and authority to execute, for and on behalf of the Company, under the seal of the Company or otherwise, such Written Commitments of the Company as may be specified in such written appointment, which specification may be by general type or class of Written Commitments or by specification of one or more particular Written Commitments.
- (4) Each of the Chairman, the President and the Vice Presidents of the Company is hereby authorized, for and on behalf of the Company, to delegate in writing to any other officer of the Company the authority to execute, for and on behalf of the Company, under the Company's seal or otherwise, such Written Commitments of the Company as are specified in such written delegation, which specification may be by general type or class of Written Commitments or by specification of one or more particular Written Commitments.
- (5) The signature of any officer or other person executing any Written Commitment or appointment or delegation pursuant to this Resolution, and the seal of the Company, may be affixed by facsimile on such Written Commitment or written appointment or delegation.

FURTHER RESOLVED, that the foregoing Resolution shall not be deemed to be an exclusive statement of the powers and authority of officers, employees and other persons to act for and on behalf of the Company, and such Resolution shall not limit or otherwise affect the exercise of any such power or authority otherwise validly granted or vested."

I, Dawn M. Chloros, Assistant Secretary of FEDERAL INSURANCE COMPANY, VIGILANT INSURANCE COMPANY, PACIFIC INDEMNITY COMPANY, WESTCHESTER FIRE INSURANCE COMPANY and ACE AMERICAN INSURANCE COMPANY (the "Companies") do hereby certify that

- (i) the foregoing Resolutions adopted by the Board of Directors of the Companies are true, correct and in full force and effect,
- (ii) the foregoing Power of Attorney is true, correct and in full force and effect.

Given under my hand and seals of said Companies at Whitehouse Station, NJ, this September 13, 2021



Dawn M. Chloros

Dawn M. Chloros, Assistant Secretary

IN THE EVENT YOU WISH TO VERIFY THE AUTHENTICITY OF THIS BOND OR NOTIFY US OF ANY OTHER MATTER, PLEASE CONTACT US AT:
Telephone (908) 903-3493 Fax (908) 903-3656 e-mail: surety@chubb.com

FEDERAL INSURANCE COMPANY
STATEMENT OF ASSETS, LIABILITIES AND SURPLUS TO POLICYHOLDERS

Statutory Basis

December 31, 2020

(in thousands)

ASSETS		LIABILITIES AND SURPLUS TO POLICYHOLDERS	
Cash and Short Term Investments	\$ (247,647)	Outstanding Losses and Loss Expenses	\$ 7,823,012
United States Government, State and Municipal Bonds	4,277,332	Reinsurance Payable on Losses and Expenses	1,421,176
Other Bonds	5,455,272	Unearned Premiums	2,145,775
Stocks	567,832	Ceded Reinsurance Premiums Payable	261,276
Other Invested Assets	<u>1,207,053</u>	Other Liabilities	<u>551,641</u>
TOTAL INVESTMENTS	<u>11,259,842</u>	TOTAL LIABILITIES	<u>12,202,880</u>
Investments in Affiliates:		Capital Stock	20,980
Great Northern Ins. Co.	404,889	Paid-In Surplus	2,711,474
Vigilant Ins. Co.	349,615	Unassigned Funds	<u>1,591,718</u>
Chubb Indemnity Ins. Co.	182,191	SURPLUS TO POLICYHOLDERS	<u>4,324,172</u>
Chubb National Ins. Co.	186,189		
Other Affiliates	98,826		
Premiums Receivable	1,634,609		
Other Assets	<u>2,410,891</u>		
TOTAL ADMITTED ASSETS	<u>\$ 16,527,052</u>	TOTAL LIABILITIES AND SURPLUS	<u>\$ 16,527,052</u>

Investments are valued in accordance with requirements of the National Association of Insurance Commissioners. At December 31, 2020, investments with a carrying value of 507,794,700 were deposited with government authorities as required by law.

STATE OF PENNSYLVANIA

COUNTY OF PHILADELPHIA

John Taylor, being duly sworn, says that he is Senior Vice President of Federal Insurance Company and that to the best of his knowledge and belief the foregoing is a true and correct statement of the said Company's financial condition as of the 31 st day of December, 2020.

Sworn before me this April 7, 2021

3FB94DA7736415 Vice President

Diane Wright
Notary Public

August 8, 2023
My commission expires

Commonwealth of Pennsylvania - Notary Seal
Diane Wright, Notary Public
Philadelphia County
My commission expires August 8, 2023
Commission number 1235745
Member, Pennsylvania Association of Notaries

2 Commercial Terms

2.1 System Price

Pricing shall be as outlined on the **Bid Proposal** included in **Section 1** of this Proposal.

Please note that the presented pricing does not include any provision for any procurement restrictions imposed on Seller by Buyer's funding parties. Should these restrictions be required, such as "Buy America", Seller reserves the right to adjust the pricing herein upon review of the restrictions.

Also note the United States of America announced the imminent application of tariffs on most, if not all, aluminum and steel imports under Section 232 of the Trade Expansion Act of 1962, as amended (19 U.S.C. 1862) and Section 604 of the Trade Act of 1974, as amended (19 U.S.C. 2483). As such, the imposition and application of these tariffs may cause short-term market volatility, fluctuations, price adjustments, delays, and other unforeseen impacts on industries, such as ours, that substantially rely on the use of these commodities to varying degrees.

SUEZ is currently monitoring the situation as it develops and is constantly adjusting our current pricing and bidding to be reflective of market conditions as of the day of price or bid submission. However, to the degree the application and implementation of the aforementioned tariffs cause material impact, further market disruption, delay or price escalation, SUEZ reserves the right to adjust our pricing and bid submissions accordingly.

Please rest assured that SUEZ will continue to make every effort to be as accurate as possible in our pricing estimates and we will continue to keep all of our customers, clients, and partners apprised of any changes as they occur.

2.2 Price Validity

The quoted system price will be valid for **120 calendar days** from the date of this Proposal. If a formal Purchase Order or Procurement Agreement is not received and accepted within this Validity Period, both the pricing and delivery schedule are subject to review and adjustment.

The proposed system pricing is based upon receipt of a Notice to Proceed (NTP) with Manufacturing/Equipment Procurement being provided by **April 1, 2022**. In the event the NTP with Manufacturing/Equipment Procurement is not received before this date, the equipment and service prices contained herein will be subject to adjustment for any increase in the North American Consumer Price Index (CPI) + 1.0%. This adjustment will be from the end of the proposal validity date to the date of the NTP with Manufacturing/Equipment Procurement is received.

If a formal NTP with Manufacturing/Equipment Procurement is not received and accepted within **three (3) months** of the NTP date referenced above, Seller will be afforded the right to review and adjust the scope of supply, pricing and delivery schedule offered herein.

2.3 Taxes

Pricing provided herein does not include any taxes or duties, as specified in McCarthy's Front Ends, Article 16 – Sales Taxes.

Seller's price and schedule shall be based on applicable Federal and State laws, local ordinances, codes, and standards as well as duties, sales or use taxes in effect as of the date of Seller's Proposal. Should such laws, codes, taxes and standards change and increase the cost of performing the work or impact the schedule, Seller shall, upon notice to Buyer of such, be entitled to an equitable adjustment of price and /or schedule. Similarly, should such laws, codes, taxes and standards change and decrease the cost of performing the work, Buyer shall be entitled to an equitable adjustment of price.

2.4 Delivery

The following freight terms for delivery of equipment used are as defined by INCOTERMS 2020:

All pricing is **CIP designated Project Site**, Chandler Airport WRF, 905 East Queen Creek Road, Chandler, Arizona 85286. Delivery to the project site is conditional upon provision of access roads of a nature that will permit access by tractor-trailers. Off-loading and positioning of equipment at the job-site is not included.

2.5 Bonds

The price for Performance and Labor & Material Payment Bonds is included in the Bid Breakdown on the Bid Proposal Form included in **Section 1** of this Proposal.

2.6 Payment Terms

Upon approved credit for the Buyer, payment terms will be as outlined in Article 17 of McCarthy's Front Ends – Schedule of Values, with modifications in **bold** below:

- 5% on Approved Submittals
- 3% on Approval of Draft Operation and Maintenance Manuals
- **15% on Notice to Proceed with Manufacturing/Equipment Procurement**
- **65% on Equipment Delivery Including Spare Parts (partial shipments allowed)**
- 5% on Manufacturer Startup and Services, **or net ten (10) months from equipment delivery, whichever occurs first**
- 2% on Approval of Final O&M, **or net ten (10) months from equipment delivery, whichever occurs first**
- 5% on Owner Training, **or net ten (10) months from equipment delivery, whichever occurs first**

Provision has been made for a 10% statutory holdback.

Seller shall only proceed with preparation of Engineering Drawings upon receipt of a formal Letter of Intent and a written Notice to Proceed with Engineering Drawings from the Buyer.

Seller shall only proceed with procurement and production of equipment and materials upon receipt of a formal Purchase Order and a written Notice to Proceed with Manufacturing/Equipment Procurement from the Buyer.

2.7 Proposed Project Schedule

The delivery schedule is presented based on current workload backlogs and production capacity. If a formal Purchase Order is not approved within the period of validity of this Proposal, the delivery schedule is subject to review and adjustment.

Seller would like to note that under the current exceptional circumstances of the COVID 19 Pandemic situation, Seller may not be in a position to guarantee and comply with the planned schedule for project delivery or performance and that should there be any new measures taken by any governmental authority which may impede or delay the said schedule or performance, Seller reserves the right to modify the schedule / contract accordingly. Seller will promptly inform Buyer of any changes which may impact the contract or the project.

Seller proposes to submit Shop Drawings in staggered submissions (see **Note 2** below). The procedure will allow for the Buyer to focus on review of submittals most important to keep the project moving forward in a timely manner. Review and approval on one submission provides the proper starting point for Seller to complete the next submission, etc., and reduces the amount of re-work required.

Seller's proposed drawing submission and equipment delivery schedule is below.

Please note that the full submittal package is not likely to be part of the scope covered by Wilson's sub-agreement. A more compact schedule can be discussed and agreed-upon between McCarthy and SUEZ that will provide sufficient information for McCarthy to arrive at a guaranteed maximum price.

- Seller: Submits Proposal – **September 24, 2021**
- Buyer: Issues Letter of Intent/Notice to Proceed (NTP) with Engineering Drawings – **October 1, 2021**
- Seller: Assembles project team and kicks off project internally – **within 2 weeks of Letter of Intent/NTP with Engineering Drawings**
- Seller: First Engineering Submittal ^{Notes 1 and 2} – **4 weeks** from accepted NTP with Engineering Drawings date
- Buyer: Issues Purchase Order – **120 days from Proposal Date**
- Seller: Completion of Shop Drawings – **24 weeks** from accepted NTP with Engineering Drawings date – assumes a minimum of six (6) Engineering Submittals with a maximum of two (2) weeks of review from the ENGINEER for each submittal ^{Note 2}

- Buyer & Seller: Submittal and Approval of Draft Operations and Maintenance Manuals ^{Note 3} – **60 days** from Completion of Shop Drawings
- Buyer: Issues NTP with Manufacturing/Equipment Procurement – **no later than April 1, 2022**
- Seller: Shipment of equipment – **26 weeks** from NTP with Manufacture of Equipment (partial shipments allowed)
- Buyer & Seller: Submittal and Approval of Final Operations and Maintenance Manuals – **estimated September 2022**
- Buyer & Seller: Operator Training Complete – **estimated April 2023**
- Buyer & Seller: Start of 90-Day Commissioning Period (includes 30-Day Operational Test) – **estimated April 2023**
- Buyer & Seller: Substantial Completion of the membrane system – **estimated July 2023**

Note 1: Please note that Seller's engineering team requires confirmation of information from the Buyer prior to commencing work on the First Engineering Submittal, including but not limited to:

- Confirmation of the hydraulic profile of the plant, especially regarding the feed to the membrane system and the pump discharge head requirements for all pumping applications connected outside of the Seller's system;
- Site considerations for plant layout and preliminary plant information including overall plant layout considerations from the Buyer and elevations;
- Relative humidity range;
- Confirmation of all site conditions such as elevation or any wind loading and seismic requirements.

Seller clarifies that the timeline defined above assumes that Seller's engineering team has all the required site information. If not, the timeline can only commence once the information has been received by Seller.

Note 2: The time indicated for drawing submittals is proposed as follows:

Mechanical Drawing Submittals

#1 – 4 weeks from acceptance of NTP with Engineering Drawings

Includes Preliminary Equipment List, P&IDs Legends and Symbols, and P&IDs

#2 – 4 weeks after ENGINEER approves Mechanical Drawing Submittal #1

Includes Instrument List, Automated Valve List, and re-issue of First Mechanical Drawing Submittal design information incorporating ENGINEER's comments

#3 – 4 weeks after ENGINEER approves Mechanical Drawing Submittal #2

Includes General Arrangement Drawings, Equipment Data Sheets/Cut Sheets, and re-issue of Second Mechanical Drawing Submittal design information incorporating ENGINEER's comments

#4 – 4 weeks after ENGINEER approves Mechanical Drawing Submittal #3

Includes Membrane Tank Field Assembly Drawings, Structural Analysis/Anchor Bolt Calculations, Manual Valve List, Instrument Data Sheets/Cut Sheets, Automatic Valve Data Sheets/Cut Sheets, and re-issue of Third Mechanical Drawing Submittal design information incorporating ENGINEER's comments

Electrical Drawing Submittals

#1 – 1 week after ENGINEER approves the P&IDs submitted with Mechanical Drawing Submittal #1

Includes Network Architecture Diagram, and Electrical Load List

#2 – 13 weeks after ENGINEER approves Electrical Drawing Submittal #1

Includes Control Philosophy, Control Logic and Sequence Charts, Panel Layouts, and Panel Schematic Wiring Diagrams, and re-issue of First Electrical Drawing Submittal design information incorporating ENGINEER's comments

Note 3: Spare Parts List will be submitted after Completion of Shop Drawings, with the Draft O&M Manual.

2.8 Membrane Module Replacement Price

The price of **replacement** ZeeWeed 500D membrane modules for this project is **\$1,450.00 USD per module**. Seller will guarantee this price for ten (10) years from the start date of the membrane warranty. Pricing for **replacement** modules is subject to adjustment for inflation from the date of this Proposal according to the North American Consumer Price Index (CPI) + 1.0%. If the same module is not available due to product improvements, an equivalent price per gallon of treatment capacity will be used.

The membrane **replacement** price quoted refers to replacement of installed membranes under the following two scenarios;

- Replacement of membrane modules during the warranty period,
- Replacement of membrane modules no longer under warranty but still within the guaranteed membrane replacement price period.

Under the first scenario, membrane modules replaced under warranty shall assume the remainder of the warranty for the membrane modules being replaced, with such warranty to be not less than a two (2) year full replacement warranty from the date of replacement with a new membrane module.

Under the second scenario, unless specified otherwise, membrane modules purchased to replace a membrane module whose warranty has expired shall be provided with a standard two (2) year full replacement warranty.

The membrane module **replacement** price is not applicable for membrane modules purchased for any non-replacement purposes, such as for flux reduction or hydraulic capacity increase.

The Specifications ask the Supplier to provide an additional purchase price, as a cost per module. The price of ZeeWeed 500D membrane modules purchased **for any non-replacement purposes**, such as for flux reduction or hydraulic capacity increase is **\$1,950.00 USD/module**. Seller will guarantee this price for ten (10) years from the date of substantial completion. Pricing for modules purchased **for any non-replacement purposes** is subject to adjustment for inflation from the date of this Proposal according to the North American Consumer Price Index (CPI) + 1.0%. If the same module is not available due to product improvements, an equivalent price per gallon of treatment capacity will be used. All modules purchased **for non-replacement purposes** shall be provided with a standard two (2) year full replacement warranty.

Membrane module price, either for replacement or for any non-replacement purposes, does not include bagging, boxing, crating, and will be shipped on the basis of INCOTERMS 2020 FCA SUEZ Manufacturing Facility. Membrane module prices are quoted without taxes.

2.9 Terms and Conditions

By accepting this Proposal, the Buyer agrees to include Seller's Proposal as a Contract document in any Purchase Order or Procurement Agreement.

Seller has prepared this Proposal based on the Technical Specifications for Reclaimed Water Interconnect Facility, Guaranteed Maximum Price (GMP) 1, dated August 11, 2021. In accordance with McCarthy Front Ends Article 2 – Check to Specs, a copy of the Technical Specifications has been included in **Appendix A** of SUEZ's Proposal, whereby SUEZ has used a check (✓) to denote that SUEZ complies with the Specification and an x (✗) to denote a deviation, along with an explanation of the deviation. The Check-marked Specifications in **Appendix A** help to clearly define SUEZ's scope of supply as part of SUEZ's Proposal Price.

For greater clarity, the Work Category Description in McCarthy's Front Ends, Article 5, has also been included (see below) with clarifications to align with the clarifications listed in the Check-marked Specifications in **Appendix A**.

Seller has prepared this Proposal based on the Terms and Conditions listed in McCarthy's Long Form Purchase Order (Rev. 02-22-2019) included with McCarthy's Front Ends (dated August 20, 2021) and the clarifications to those Terms and Conditions as provided within the SUEZ Supplemental Conditions found in **Appendix B** of this Proposal.

a. Work Category 11A – Membrane Equipment System

- (a) Provide all labor, material tools, equipment, and appurtenances as required to perform Work Category 11A – Membrane Equipment System, in accordance with and reasonably inferable from the Contract Documents, complete without exception unless otherwise noted below, including, but not limited to the following: ~~✗~~
- (b) Division 1 as it applies to this scope of work ~~✗~~
- (c) Specifications including but not limited to:
 - (i) ~~09900 Painting~~ ~~✗~~ SUEZ will provide vendor's standard specifications for review
 - (ii) 11295 Hydraulic Valves ✓
 - (iii) 11314 End Suction Centrifugal Pumps ✓
 - (iv) 11317 Positive Displacement Blowers ✓
 - (v) 11372 Air Compressors ✓
 - (vi) 11500.1 Membrane Equipment Systems ✓
 - (vii) ~~13127 Extruded Flat Panel Covers~~ ~~✗~~ Extruded Flat Panel Covers do not fall in the scope of supply by SUEZ. See Section 11500.1 item 2.3.E.12 which states that the Membrane basin covers will be provided by CMAR.
 - (viii) 13445 Pneumatic Controllers and Control Valves ✓
 - (ix) ~~13447 Electric Motor Actuators~~ ~~✗~~ Electric Motor Actuators are not required for membrane system operation, thus Section 13447 is not applicable to this project.
 - (x) ~~15062 Steel Pipe~~ ~~✗~~ Section 15062 is an AWWA carbon steel pipe specification which is not relevant to SUEZ's scope of supply
 - (xi) 16160 Enclosures ✓
 - (xii) 16161 Control Panels ✓
 - (xiii) 16225 Electric Motors 250 HP or less ✓
 - (xiv) 17137 Magnetic Flow Meters ✓
 - (xv) 17451 Programmable Logic Controller Hardware ✓
 - (xvi) 17452 Programmable Logic Controller System Software and Accessories ✓
 - (xvii) 17455 Operator Interface Terminal Software and Hardware ✓
- (d) Provide the following items including but not limited to:
 - (i) Four (4) UF Membrane Filtration Train System, four (4) cassettes installed per train, one ~~(1) cassette spaces per train~~ ~~✗~~ and one (1) spare cassette space per train

Only four (4) Permeate Pumps are included in the Proposal Price. SUEZ's Proposal Price does NOT include spare parts except as noted in SUEZ's Proposal

- (ii) Permeate Pumps: One (1) pump per train plus one ~~(1) uninstalled spare~~ ~~✗~~
- (iii) Membrane Agitation Air Blowers: minimum of two (2) blowers ✓
- (iv) Clean-In-Place (CIP System): One (1) duty and one (1) standby CIP Pump ✓
- (v) Air Compressor System: One (1) duty & one (1) standby, with air dryers, valves, fittings, instrumentation and controls ✓
- (vi) I&C for membrane maintenance/recovery cleaning feed and distribution system ✓
- (vii) Process control panels, PLC(s), HMI(s), and associated software programming and graphical displays ✓
- (viii) Membrane Permeate piping and Air Scour Supply piping within the limits of each membrane basin (above), with valves, instrumentation and controls ✓
- (ix) Supports for membrane cassettes/racks and plates ✓
- (x) All in basin piping for membrane effluent and air scour. ✓
- (xi) ~~Membrane Basin Covers~~ ~~✗~~ Membrane Basin Covers do not fall in the scope of supply by SUEZ.
- (e) Membrane modules, cassettes/racks, process instrumentation and associated equipment ✓
- (f) Membrane Backwash System ~~✗~~ For clarity, the Backwash Tank does NOT fall in SUEZ's scope of supply
- (g) Membrane Integrity Test System ✓
- (h) ~~Setting tools for Electric Motor Operators~~ ~~✗~~ Electric Motor Actuators are not required for membrane system operation.
- (i) Membrane Warranty: 5 year warranty from Final Acceptance (July 2023), with additional pro-rated 5 year warranty. System Component Warranty (pumps, valves, ancillary equipment): 1 year warranty from Final Acceptance (July 2023). ✓
- (j) ~~Provide all anchors and epoxy required for the installation of the equipment~~ ~~✗~~
- (k) Provide steel pipe design calculations by a registered professional engineer registered in the state of Arizona ✓
- (l) Provide name plates & tagging for all equipment ~~✗~~ Identification tags and pipe identification is by others
- (m) Provide adequate lifting lugs on equipment for proper installation ✓
- (n) Provide the minimum following manufacturer services: ~~✗~~ See SUEZ's modifications to Section 11500.1, item 3.3.B which clarifies the total number of days on-site and trips SUEZ has included in the Proposal Price. SUEZ has recommended an alternative number of days on-site and trips based on where SUEZ knows we will provide value to the OWNER.
 - (i) ~~Unloading and Installation training (2 days and 1 trip)~~
 - (ii) ~~Installation assistance and inspection (10 days and 2 trips)~~
 - (iii) ~~Operational Testing (30 days on site)~~
 - (iv) ~~Commissioning (10 days on site)~~
 - (v) Training (4 trips – 8 person days)

Anchor bolts and epoxy fall in the scope of supply of the CMAR. See Section 11500.1, item 1.3.A.1.c.

3 Scope of Supply

3.1 Feed and Treated Water Design Basis

The proposed membrane filtration system for the City of Chandler Reclaimed Water Interconnect Facility project is designed to treat water with feed water characteristics as defined in **Section 4**, the Warranty Section of this Proposal. Please also refer to the Warranty Section for details on treated water quality guarantees.

3.2 Process Overview

The proposed membrane filtration system for the City of Chandler Reclaimed Water Interconnect Facility project consists of four (4) membrane trains of SUEZ's ZeeWeed 500D membranes to meet the initial (current) treated water flow requirement of 10 MGD (net) at the design water temperature of 20°C. To meet the initial (current) flow requirement of 10 MGD (net) at 20°C each of the four (4) membrane trains include four (4) installed cassettes, with 68/68 installed modules per cassette, 440 ft² of membrane surface area per module.

The membrane tanks will be initially constructed to allow for one (1) spare cassette space per membrane train. To meet the future treated water flow requirement of 12.5 MGD (net) at the design water temperature of 20°C the spare cassette space in each membrane train will be installed with a cassette, with 68/68 installed modules per cassette, 440 ft² of membrane surface area per module.

The membrane system is designed to operate up to a maximum raw water turbidity of 800 NTU. The membrane system will operate at a recovery (at design capacity) of 95% up to a raw water turbidity of 135 NTU. When the raw water turbidity is from 135 to 800 NTU, the membrane system will adjust to operate at 90% recovery instead of 95% recovery (i.e. the membrane system will backwash more often). Cleaning protocols may also need to be modified during raw water turbidity peak events to maintain membrane performance, particularly if the peaks extend to more than 72 hours.

The proposed membrane system will treat water from a Salt River Project (SRP) Canal. The raw water from the SRP Canal Turnout Structure will be pumped from a Raw Water Pump Station (raw water pumps by others) to a bank of self-cleaning strainers (strainers by others), then flow to the membrane system feed channel which supplies the pre-screened water to the membrane trains.

Influent water to the membrane system will flow at a consistent rate. The membrane system is designed to increase flows through online trains to accommodate constant inlet feed flow to the membranes up to 10 MGD (net)/95% = 7,310 gpm (net), at the initial (current) conditions, during Maintenance Cleans, Membrane Integrity Tests, and backwashing, with all other trains otherwise in service. If a membrane train is off-line for Recovery Clean or for any other equipment repair or maintenance then the influent flow will be decreased. The feed flow that can be accommodated with one (1) train out of service, at the initial (current) conditions, for Recovery Clean or for any other equipment repair or maintenance is $7,310 \text{ gpm (net)} \times \frac{3}{4} = 5,482 \text{ gpm (net)}$.

Under normal operation, the membrane system will operate fully automatically as controlled by the membrane control system. Membrane trains will be taken out of standby into production as demand for water increases, and will then automatically cycle between production and backwash. Membrane Integrity Tests (MITs), Maintenance Cleans, Recovery Cleans, and neutralization will also be automatically controlled. Alarms will alert Operators to any conditions requiring attention, and the membrane trains and other subsystems as applicable will temporarily pause in a safe condition. When the alarm is cleared by the control system or Operator, the membrane train will automatically resume its operation.

ZeeWeed 500 Process Operations

Membrane trains are typically operated in one of the following modes:

- Production
- Backwash
- Backpulse
- Maintenance Clean (MC)
- Recovery Clean (RC)
- Neutralization
- Membrane Integrity Test (MIT)
- Standby

Production

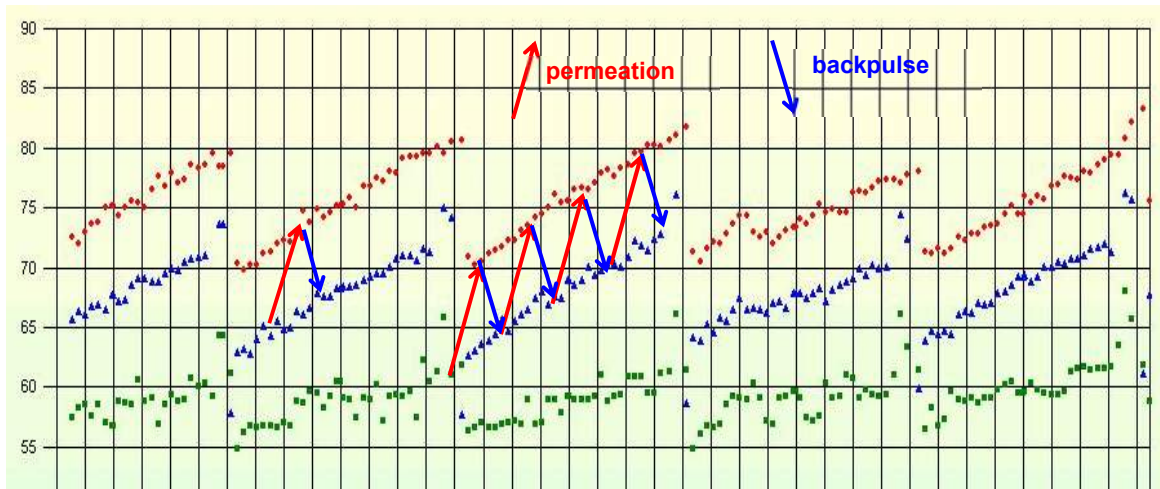
When operating in Production mode, the membrane tank inlet valve is open, the membrane tank is kept full of water, and the Process Pump is running, drawing water through the immersed membranes (“outside-in” flow path) and discharging to the common permeate header. SUEZ is supplying one (1) Process Pump per membrane train. Each Process Pump is equipped with a VFD (by others), and the membrane control system automatically monitors the flow rate, adjusting the pump speed as necessary to maintain the desired flow rate as the membrane fouls over time.

In basic filtration terms, each membrane train operates as a constant rate, declining head filter.

Backwash

In order to maintain the permeability that is lost as the membranes foul over time, the system periodically performs backwashes at a frequency determined by the system recovery setpoint.

The accumulation of feed solids that are rejected by the membrane slowly fouls the membranes over time, increasing the transmembrane pressure (TMP) and reducing permeability. Backwashing lowers the TMP, bringing it closer to that of the previous production cycle by removing the solids from the membrane surface through reversing the flow direction (backpulsing), aeration, and draining of the membrane tank. **No chemicals are added during the backwash procedure.** Many backwashes are performed each day, helping to maintain the TMP. The graph below shows the typical effect of backwashes in controlling TMP:



The backwash procedure begins with the membrane train operating in Production mode. The membrane tank inlet valve is closed and the level in the membrane tank is decreased to the backwash level. Permeate stored in the Backpulse Tank (by others) is backpulsed through the fibers (“inside-out” flow path) using the Process Pump. Air supplied from the Blower is simultaneously injected to scour solids from the membrane fibers and mix them into the water in the membrane tank. SUEZ is supplying one (1) duty and one (1) on-line stand-by Blower. Each Blower is controlled by VFD (by others). The entire contents of the membrane tank are then drained to flush away the solids. Once the membrane tank is empty, the backwash drain valve is closed and the inlet valve is reopened to refill the membrane tank and return to Production mode.

The backwash waste from draining the membrane tank is discharged by gravity to waste.

Backpulse

In instances where there is high raw water turbidity the membrane control system may implement intermittent backpulses. During Production mode, membrane trains will undergo periodic backpulsing to help keep the solids in the tank suspended and off the membrane fibers. During the periodic backpulse, the membrane tank inlet valve is closed and permeate is backpulsed through the fibers using the Process Pump while air is injected to scour the fibers. At the end of the backpulse the membrane tank inlet valve is opened and the membrane train is returned to Production. No waste is produced from these periodic backpulses.

Maintenance Clean (MC)

Maintenance Cleans are used to expose the membrane to a small concentration of chemical for a short period of time on a daily basis. These short duration cleans typically require approximately 42 minutes to complete, and consist of soaking the membranes in a chemical solution following a backwash. Sodium hypochlorite is used to remove organic fouling. And citric acid is used to remove inorganic fouling.

The proposed Maintenance Cleaning frequency is one (1) time per day per membrane train. Six (6) days per week, the cleaning chemical will be sodium hypochlorite. Sodium Hypochlorite Maintenance Cleans will be performed at a concentration of 250 mg/L.

One (1) day per week, the cleaning chemical will be citric acid. Citric Acid Maintenance Cleans will be performed at a concentration of 500 mg/L with a mineral acid dosed to drop the cleaning solution pH to 2.1. All cleaning chemical pumps, valves, instruments, etc. are supplied by others.

Maintenance Cleans (MCs) are scheduled by the Operator on the OIT, or can be initiated using a push button. When it is time to carry out a Maintenance Clean, the membrane train to be cleaned completes its current production cycle, and then performs a backwash (as described above) to remove solids. The cleaning procedure then begins with the transfer of permeate stored in the CIP Tank (by others) to the membrane tank using the CIP pump while injecting chemical in-line to prepare the cleaning solution in the membrane tank. SUEZ is supplying one (1) duty and one (1) on-line stand-by CIP Pump. Each CIP Pump is controlled by VFD (by others). Once the membrane tank is filled with the chemical solution, the membranes are allowed to soak for a period of 15 minutes. After the soak, the membranes are backpulsed by the Process Pump using permeate stored in the Backpulse Tank. The chemical solution is then transferred back to the CIP Tank using the CIP Pump. Additional flushing of the membrane tank and piping is also performed, with the flush water being pumped by the CIP Pump to the CIP Tank. The chemical cleaning waste in the CIP Tank can then be neutralized and disposed.

Once flushing steps are completed, the membrane inlet valve is reopened to refill the membrane tank and return the membrane train to Production.

Recovery Clean (RC)

Recovery Cleans are an intensive method for cleaning the membranes and are performed according to the design schedule, or when the membrane TMP is approaching its maximum. The Recovery Cleans typically require approximately 6 hours to complete, per chemical, and consist of soaking the membranes in a chemical solution following a backwash. These cleans are very similar to Maintenance Cleans, though they consist of longer soaking periods and are performed at higher concentrations. Two (2) separate chemicals are used in two (2) different soaks; sodium hypochlorite, to remove organic fouling, and citric acid, to remove inorganic fouling. A Recovery Clean typically occurs every 30 days per membrane train.

The proposed Recovery Cleaning frequency is twelve (12) per membrane train per year. The cleaning concentrations are 500 mg/L for Sodium Hypochlorite Recovery Cleans and 2,000 mg/L, with a mineral acid dosed to drop the cleaning solution pH to 2.1, for Citric Acid Recovery Cleans. All cleaning chemical pumps, valves, instruments, etc. are supplied by others.

Recovery Cleans (RCs) are scheduled by the Operator on the OIT, or can be initiated using a push button. The cleaning procedure is exactly the same as described above for maintenance cleaning, except the soak duration is increased to 5 hours.

Once flushing steps are completed, the membrane tank inlet valve is reopened to refill the membrane tank.

Neutralization

When a Maintenance Clean or Recovery Clean is complete and the membrane train has been refilled with feed water, the chemical cleaning waste in the CIP Tank can be neutralized without affecting the total downtime of the membrane system.

Neutralization is completed using sodium bisulfite and/or sodium hydroxide, as appropriate. Sodium bisulfite is used to quench the chlorine from a Sodium Hypochlorite Maintenance Clean or Recovery Clean. Sodium hydroxide is used to adjust the pH of the neutralized sodium hypochlorite waste or Citric Acid Maintenance Clean or Recovery Clean waste to within the appropriate discharge limits. The CIP Tank contents are circulated in the CIP Tank using the CIP Pump with the neutralization chemicals dosed in-line. All neutralization chemical pumps, valves, instruments, etc. are supplied by others. Chlorine and pH analyzers (by SUEZ) are used to indicate that neutralization is complete and that the waste can be discharged. The neutralized cleaning solution is then pumped to sewer.

Membrane Integrity Test (MIT)

The membrane system is designed for automatic Membrane Integrity Testing (MIT) once per day. The MITs are scheduled by the Operator on the OIT, or can be initiated using a push button. An MIT will also be automatically initiated by the membrane system PLC if a permeate turbidity trigger is reached.

The MIT operation is conducted offline. The membrane tank inlet valve is closed and the membrane tank level is drawn down to the MIT level by permeating (no waste generation). The membrane train isolation valve is then closed and the train piping, cassette piping, and hollow fiber lumens are pressurized with air. The pressurized air is provided by the air compressor system. SUEZ is supplying one (1) duty and one (1) on-line stand-by air compressor, mounted on one (1) horizontal air receiver tank, and one (1) duty and one (1) on-line stand-by air drier.

The air displaces the water from the fiber lumen through the membrane pores back into the tank until the internal pressure has stabilized. The air supply valve is then closed and the pressure decay is recorded over the duration of the test. The pressure decay is used by the membrane control system to calculate a log removal value (LRV) for *Cryptosporidium* for the system in accordance with the USEPA's Membrane Filtration Guidance Manual (MFGM) and SUEZ's Frequently Asked Questions: LRV in ZeeWeed Systems.

The membrane train is returned to service provided the LRV is above the alarm value.

The PLC is programmed to issue a train shut down alarm if the log removal value is less than the target value. At a set value above the target value, the PLC initiates an alert to advise the Operator that the system may require attention in the near future. The Operator need not take any action until the LRV reaches the target value but may decide to investigate the system and look for leaks in advance of reaching a shutdown condition.

Standby

To optimize power consumption and efficiency of the membrane system at times when the plant is operating at less than design flow, the control system may automatically remove a membrane train from operation and put it in standby. The membrane train is returned to operation without human intervention when the demand increases.

Overview

All automatic valves on the membrane system are pneumatically actuated. The SUEZ-supplied air compressors provide air for the pneumatically actuated valves.

SUEZ's membrane systems incorporate a high level of automation to enable easy and operator-friendly plant operations. The system also includes a high level of Operator overrides and manual operational capability. This combination provides a highly flexible operating system. The membrane control system looks after all operating sequences and routine operations (such as the system backwash, backpulse, Maintenance Cleans, and Membrane Integrity Tests) so Operators are free to monitor and provide value added services. Schedules are easy to understand and can be modified at the OIT by the Operator.

The system design summary is depicted in the following table:

Parameter	Quantity
Type of Membrane	ZeeWeed 500D
Module Surface Area	440 ft ²
Total Number of Membrane Trains	4
Number of Installed Cassettes per Train Current (Initial) Condition	4/5
Number of Installed Cassettes per Train Future Condition	5/5
Number of Installed Modules per Cassette	68/68
Maintenance Clean (MC) Protocol	1/day/train 6 times per week using 250 mg/L NaOCl 1 time per week using 500 mg/L citric acid with mineral acid for pH adjustment to 2.1
Membrane Integrity Test (MIT) Protocol	1/day/train
Recovery Clean (RC) Protocol	12/year/train 500 mg/L NaOCl followed by 2 g/L citric acid with mineral acid for pH adjustment to 2.1

Note: Cleaning protocols may need to be modified during raw water turbidity peak events to maintain membrane performance, particularly if the peaks extend to more than 72 hours.

3.3 Scope of Supply by SUEZ

The main equipment included in SUEZ's scope of supply for the City of Chandler Reclaimed Water Interconnect Facility project is listed in the tables below. These tables should be read in conjunction with the Piping and Instrumentation Diagrams (P&IDs) found in **Appendix C**. A general scope of supply table, including items not listed on the P&IDs, follows the detailed scope tables.

The P&IDs and scope of supply tables define SUEZ's scope of supply and that provided by the Contractor or Owner (by others). In case of conflict, SUEZ P&IDs take precedence for SUEZ supplied equipment and devices. On the P&IDs, items within SUEZ's scope of supply are shown as solid, and items not included in SUEZ's scope of supply are shown dotted.

Pipes shown as dotted are to be furnished by the Contractor (by others). The sizes of all pipes are depicted on the P&IDs. Valves are typically the same size as the pipe on which they are located.

Motor horsepower for equipment supplied by SUEZ is shown on the P&IDs.

The P&ID package in **Appendix C** includes:

415261-AA-01:	Title Page (sheet 1 of 1)
415261-AA-02:	Legend Sheet (sheet 1 of 2)
415261-AA-02:	Legend Sheet (sheet 2 of 2)
415261-AP-01:	Feed Channel (sheet 1 of 1)
415261-AP-02:	Membrane Blowers (sheet 1 of 1)
415261-AP-03:	Membrane Tanks (sheet 1 of 1)
415261-AP-05:	Process Pumps (sheet 1 of 1)
415261-AP-07:	Backpulse Tank (sheet 1 of 1)
415261-AP-10:	CIP System (sheet 1 of 1)
415261-AP-11:	Cleaning and Neutralization Chemical Systems (sheet 1 of 1)
415261-AP-12:	Compressed Air System (sheet 1 of 1)
415261-AP-13:	Common Permeate Header (sheet 1 of 1)
415261-AP-15:	Permeate Turbidimeter with Column (sheet 1 of 1)

SUEZ's scope of supply for a ZeeWeed 500D ultrafiltration water treatment system is as follows:

- Electrical rating on all motors is 460V / 3ph / 60 Hz. Single phase power requirement is 120V.
- Please note that the proposed equipment and instrumentation quoted is to be installed in an NFPA 820 non classified area.
- SUEZ will maintain SUEZ tag numbers. If custom tag numbering is required, it will be at additional cost.

All equipment will be **supplied loose-ship** unless otherwise noted.

Drawing: 415261-AP-01 sheet 1 of 1

Feed Channel			Supply By	
Equipment	Tag #	Qty	SUEZ	Others
Concrete feed channel ^{Note 1}	20-TK-101	1		x
Feed channel level transmitter	20-LIT-101	1	x	
Feed channel level transmitter isolation valve	20-HV-103	1	x	
Other valves, pipes, drains and items generally as denoted on dwg: 415261-AP-01 sheet 1 of 1	n/a	lot		x

Note 1: The concrete feed channel will be covered (covers and cover supports by others)

Drawing: 415261-AP-02 sheet 1 of 1

Membrane Blowers			Supply By	
Equipment	Tag #	Qty	SUEZ	Others
Membrane blower package ^{Note 1} Package includes: - Intake filter silencer - Dirty filter indicator - Blower with motor - Motor temperature switch - Reactive type discharge silencer - Spring loaded relief valve - Pressure gauge - Pressure gauge isolation valve - Discharge check valve - Discharge flexible connector with clamps for schedule 40 pipe - Acoustic enclosure	20-F-201-A/B n/a 20-B-201-A/B 20-TSH-201-A/B n/a 20-PSV-201-A/B 20-PI-203-A/B 20-HV-203-A/B 20-CV-201-A/B n/a n/a	2	x	
Blower VFD	20-VFD-201-A/B	2		x
Blower isolation valve	20-HV-201-A/B	2	x	
Aeration flow switch	20-FSL-201	1	x	
Other valves, pipes, drains and items generally as denoted on dwg: 415261-AP-02 sheet 1 of 1	n/a	lot		x

Note 1: The blower is shipped as an assembled package for installation by the Contractor (by others).

Drawing: 415261-AP-03 sheet 1 of 1

Membrane Tanks			Supply By	
Equipment	Tag # ^{Note 1}	Qty	SUEZ	Others
Membrane tank influent level control valve	20-LCV-111-X	4	x	
Concrete membrane tank ^{Notes 2 and 3}	20-TK-201-X	4		x
Membrane tank level transmitter	20-LIT-201-X	4	x	
Membrane tank level transmitter isolation valve	20-HV-204-X	4	x	
Aeration valve	20-FV-210-X	4	x	
ZeeWeed 500D modules	n/a	1,088	x	
ZeeWeed 500D 68-module cassettes	n/a	16	x	
Sets of ZeeWeed 500D cassette mounting brackets	n/a	16	x	
ZeeWeed 500D cassette air straub connections	n/a	16	x	
ZeeWeed 500D cassette permeate straub connections	n/a	16	x	
ZeeWeed 500D cassette air isolation hand valves	20-HV-204A/B/C/D-X	16	x	
ZeeWeed 500D cassette permeate isolation hand valves	20-HV-205A/B/C/D-X	16	x	
Air header (as delineated on the P&ID)	n/a	4	x	
Permeate header (as delineated on the P&ID)	n/a	4	x	
Pressure transmitter	20-PIT-301-X	4	x	
Membrane tank drain flow control valve	20-LCV-901-X	4	x	
Sample valve	20-HV-113-X	4	x	
CIP valve	20-FV-701-X	4	x	
MIT: Permeate header compressed air isolation valve	20-FV-212-X	4	x	
MIT: Isolation ball valve	20-HV-206-X	4	x	
Permeate header vent isolation valve	20-FV-230-X	4	x	
Permeate header vent silencer	20-SL-201-X	4	x	

Membrane Tanks		Supply By		
Equipment	Tag # ^{Note 1}	Qty	SUEZ	Others
Ejector assembly ^{Note 4} - Vacuum ejector inlet isolation valve - Vacuum ejector inlet valve - Vacuum ejector - Vacuum ejector pressure gauge - Piping, tubing and fittings as indicated on the drawing	20-HV-801-X 20-FV-801-X 20-E-801-X 20-PI-801-X n/a	4	x	
Air supply assembly ^{Note 4} - Air supply solenoid valve - Air supply filter - Air supply isolation valve - Piping, tubing and fittings as indicated on the drawing	20-SV-802-X 20-F-801-X 20-HV-802-X n/a	4	x	
Other valves, pipes, drains and items generally as denoted on dwg: 415261-AP-03 sheet 1 of 1	n/a	lot		x

Note 1: The “-X” in the SUEZ equipment tag refers to the train number, when X=1 for Train 1, X=2 for Train 2, and so on to Train 4.

Note 2: Concrete membrane tank must be lined appropriately for membrane cleaning chemical contact (by others).

Note 3: The concrete membrane tanks will be covered (covers and cover supports by others)

Note 4: The Ejector Assembly and Air Supply Assembly are shipped as separate, assembled units for installation by others.

Drawing: 415261-AP-05 sheet 1 of 1

Process Pumps			Supply By	
Equipment	Tag # ^{Note 1}	Qty	SUEZ	Others
Backpulse pressure switch	20-PSH-601-X	4	x	
Process Pump suction isolation valve	20-FV-301-X	4	x	
Process Pump suction pressure gauge	20-PI-301-X	4	x	
Process Pump suction pressure gauge isolation valve	20-HV-301-X	4	x	
Process Pump suction drain valve	20-HV-303-X	4	x	
Process Pump with motor	20-P-301-X	4	x	
Motor temperature switch	20-TSH-301-X	4	x	
Process Pump VFD	20-VFD-301-X	4		x
Process Pump discharge pressure gauge	20-PI-302-X	4	x	
Process Pump discharge pressure gauge isolation valve	20-HV-302-X	4	x	
Process Pump discharge check valve	20-CV-301-X	4	x	
Process Pump discharge drain valve	20-HV-304-X	4	x	
Process Pump flow meter	20-FIT-301-X	4	x	
Process Pump discharge isolation valve	20-FV-304-X	4	x	
Backpulse suction isolation valve	20-FV-620-X	4	x	
Backpulse discharge isolation valve	20-FV-621-X	4	x	
Permeate turbidimeter isolation valve	20-HV-305-X	4	x	
Permeate sample valve	20-HV-306-X	4	x	
Other valves, pipes, drains and items generally as denoted on dwg: 415261-AP-05 sheet 1 of 1	n/a	lot		x

Note 1: The “-X” in the SUEZ equipment tag refers to the train number, when X=1 for Train 1, X=2 for Train 2, and so on to Train 4.

Drawing: 415261-AP-07 sheet 1 of 1

Backpulse Tank			Supply By	
Equipment	Tag #	Qty	SUEZ	Others
Backpulse Tank fill valve	20-FV-603	1	x	
Backpulse Tank ^{Note 1}	20-TK-601	1		x
Backpulse Tank drain valve	20-HV-609	1	x	
Backpulse Tank level transmitter	20-LIT-601	1	x	
Backpulse Tank level transmitter isolation valve	20-HV-611	1	x	
Backpulse Tank isolation valve	20-HV-607	1	x	
Sodium hypochlorite isolation valve	23-HV-240	1	x	
Sodium hypochlorite check valve	23-CV-240	1	x	
Sodium hypochlorite dosing valve	23-FV-240	1	x	
Potable water fill valve	92-HV-001	1	x	
Other valves, pipes, drains and items generally as denoted on dwg: 415261-AP-07 sheet 1 of 1	n/a	lot		x

Note 1: Backpulse Tank (by others) must have a working volume of at least 4,490 US gallons.

Drawing: 415261-AP-10 sheet 1 of 1

CIP System			Supply By	
Equipment	Tag #	Qty	SUEZ	Others
CIP Tank fill valve	20-FV-712	1	x	
Concrete CIP Tank ^{Notes 1 to 3}	20-TK-701	1		x
CIP Tank drain valve	20-HV-709	1	x	
CIP Tank level transmitter	20-LIT-701	1	x	
CIP Tank level transmitter isolation valve	20-HV-711	1	x	
CIP Tank isolation valve	20-FV-713	1	x	
CIP Pump suction pressure gauge isolation valve	20-HV-704	1	x	
CIP Pump suction pressure gauge	20-PI-704	1	x	
CIP Pump suction isolation valve	20-HV-702-A/B	2	x	
CIP Pump suction drain valve	20-HV-706-A/B	2	x	
CIP Pump with motor	20-P-701-A/B	2	x	
Motor temperature switch	20-TSH-701-A/B	2	x	
CIP Pump VFD	20-VFD-701-A/B	2		x

CIP System			Supply By	
Equipment	Tag #	Qty	SUEZ	Others
CIP Pump discharge pressure gauge isolation valve	20-HV-703-A/B	2	x	
CIP Pump discharge pressure gauge	20-PI-703-A/B	2	x	
CIP Pump discharge check valve	20-CV-701-A/B	2	x	
CIP Pump discharge drain valve	20-HV-705-A/B	2	x	
CIP Pump discharge isolation valve	20-HV-701-A/B	2	x	
CIP Pump flow meter	20-FIT-701	1	x	
CIP temperature transmitter	20-TIT-701	1	x	
pH/Chlorine Analyzer Panel Panel includes: - Panel isolation valve - pH analyzer isolation valve - pH analyzer dosing valve - pH analyzer hand control valve - pH analyzer - Chlorine analyzer isolation valve - Chlorine analyzer dosing valve - Chlorine analyzer hand control valve - Chlorine analyzer - pH/Chlorine controller - panel board, piping (sch. 80 PVC), and PE tubing as indicated on the drawing	20-HV-721 20-HV-722 20-FV-722 20-HCV-722 20-AE-701 20-HV-723 20-FV-723 20-HCV-723 20-AE-702 20-AIT-701/702 n/a	1	x	
CIP to membrane tank valve	20-FV-711	1	x	
CIP from membrane tank valve	20-FV-710	1	x	
CIP neutralization loop valve	20-FV-731	1	x	
CIP to waste valve	20-FV-903	1	x	
CIP to waste check valve	20-CV-702	1	x	
Sodium hypochlorite dosing valve	23-FV-101	1		x
Sodium hypochlorite backpressure valve	23-BPV-101	1		x
Sodium hypochlorite isolation valve	23-HV-101	1		x
Sodium hypochlorite check valve	23-CV-101	1		x
Citric acid dosing valve	23-FV-301	1		x
Citric acid backpressure valve	23-BPV-301	1		x
Citric acid isolation valve	23-HV-301	1		x

CIP System			Supply By	
Equipment	Tag #	Qty	SUEZ	Others
Citric acid check valve	23-CV-301	1		x
Mineral acid dosing valve	23-FV-801	1		x
Mineral acid backpressure valve	23-BPV-801	1		x
Mineral acid isolation valve	23-HV-801	1		x
Mineral acid check valve	23-CV-801	1		x
Sodium hydroxide dosing valve	23-FV-601	1		x
Sodium hydroxide backpressure valve	23-BPV-601	1		x
Sodium hydroxide isolation valve	23-HV-601	1		x
Sodium hydroxide check valve	23-CV-601	1		x
Sodium bisulfite dosing valve	23-FV-701	1		x
Sodium bisulfite backpressure valve	23-BPV-701	1		x
Sodium bisulfite isolation valve	23-HV-701	1		x
Sodium bisulfite check valve	23-CV-701	1		x
Other valves, pipes, drains and items generally as denoted on dwg: 415261-AP-10 sheet 1 of 1	n/a	lot		x

Note 1: CIP Tank (by others) must have a working volume of at least 22,260 US gallons.

Note 2: Concrete CIP Tank must be lined appropriately for membrane cleaning chemical contact (by others).

Note 3: The concrete CIP Tanks will be covered (covers and cover supports by others).

Drawing: 415261-AP-11 sheet 1 of 1

Cleaning and Neutralization Chemical Systems			Supply By	
Equipment	Tag #	Qty	SUEZ	Others
Chemical pump system for dosing sodium hypochlorite	23-P-101-A/B	1		x
Chemical pump system for dosing citric acid	23-P-301-A/B	1		x
Chemical pump system for dosing mineral acid	23-P-801-A/B	1		x
Chemical pump system for dosing sodium bisulfite	23-P-701-A/B	1		x
Chemical pump system for dosing sodium hydroxide	23-P-601-A/B	1		x
Other valves, pipes, drains and items generally as denoted on dwg: 415261-AP-11 sheet 1 of 1	n/a	lot		x

Drawing: 415261-AP-12 sheet 1 of 1

Compressed Air System			Supply By	
Equipment	Tag #	Qty	SUEZ	Others
Duplex compressor system mounted on a horizontal air receiver tank ^{Note 1} Compressor system includes: - Compressor - Compressor inlet air filter - Pressure switch - Compressor control panel Horizontal air receiver tank Receiver tank includes: - Pressure relief valve - Pressure gauge - Tank drain valve ^{Note 2}	90-AC-001-A/B 90-F-001-A/B 90-PSL-001-A/B 90-CP-001 90-TK-001 90-PSV-001 90-PI-001 90-FV-001	1	x	
Air receiver tank isolation valve	90-HV-001	1	x	
Refrigerated air dryer with motor and auto drain valve	90-DR-001-A/B 90-M-002-A/B 90-FV-002-A/B	2	x	
Dryer isolation valves	90-HV-002-A/B	2	x	
	90-HV-003-A/B	2	x	
Compressed air panel ^{Note 3} Panel includes: - Primary coalescing filter isolation valve - Primary coalescing filter with auto drain and differential pressure indicator - Primary coalescing filter isolation valve - Primary coalescing filter bypass valve - Pressure switch - Air regulator - Pressure switch - Panel board and piping as indicated on the drawing	90-HV-004 90-F-020 90-PDI-001 90-HV-005 90-HV-006 90-PSL-003 90-PY-001 90-PSLL-002 n/a	1	x	

Compressed Air System			Supply By	
Equipment	Tag #	Qty	SUEZ	Others
MIT air panel ^{Note 3} Panel includes: - Filter isolation valve - Secondary coalescing filter with auto drain and differential pressure indicator - Activated carbon filter with auto drain - Air regulator - Pressure indicator - Pressure relief valve - Check valve - Automated valve - Isolation valve - Drain valve - Panel board and piping as indicated on the drawing	90-HV-007 90-F-003 90-PDI-002 90-F-004 90-PCY-002 90-PI-002 90-PSV-002 90-CV-002 90-FV-014 90-HV-012 90-FV-015 n/a	1	x	
Instrument air drain valve	90-HV-035	1	x	
Instrument air train isolation valve	n/a	4		x
MIT drain valve	90-HV-036	1	x	
Other valves, pipes, drains and items generally as denoted on dwg: 415261-AP-12 sheet 1 of 1	n/a	lot		x

Note 1: The duplex compressor system is shipped as an assembled package for installation by the Contractor (by others).

Note 2: Auto-drain valve on the air receiver tank plugs into local 120 VAC receptacle. This valve is not controlled by the membrane system PLC.

Note 3: The compressed air panel assembly and MIT air panel assembly are shipped as assembled panels for installation by others.

Drawing: 415261-AP-13 sheet 1 of 1

Common Permeate Header			Supply By	
Equipment	Tag #	Qty	SUEZ	Others
Common permeate header temperature transmitter	20-TIT-301	1	x	
Common permeate header flow meter	20-FIT-510	1		x
Common permeate header flow meter isolation valves	20-HV-507 20-HV-509	1 1		x x
Common permeate header flow meter by-pass valve	20-HV-508	1		x
Vacuum breaker	n/a	1		x
Other valves, pipes, drains and items generally as denoted on dwg: 415261-AP-13 sheet 1 of 1	n/a	lot		x

Drawing: 415261-AP-15 sheet 1 of 1

Permeate Turbidimeter		Supply By		
Equipment	Tag # ^{Note 1}	Qty	SUEZ	Others
Permeate turbidity panel ^{Note 2} Panel includes: - Turbidimeter inlet isolation valve - Turbidimeter inlet hand valve - Turbidimeter flow control - Turbidimeter - Turbidimeter outlet hand control valve - Turbidimeter outlet isolation valve - Panel board, piping (sch. 80 PVC), and PE tubing as indicated on the drawing	20-FV-324-X 20-HCV-324-X 20-FE-324-X 20-AE/AIT-323-X 20-HCV-323-X 20-FV-323-X n/a	4	x	
Degassing column ^{Note 3} with drain valve	20-TK-323-X 20-HV-324-X	4 4	x x	
Other valves, pipes, drains and items generally as denoted on dwg: 415261-AP-15 sheet 1 of 1	n/a	lot		x

Note 1: The “-X” in the SUEZ equipment tag refers to the train number, when X=1 for Train 1, X=2 for Train 2, and so on to Train 4.

Note 2: The permeate turbidity panels are shipped as assembled panels for installation by others.

Note 3: The degassing column is shipped loose for installation by others

Other items included in SUEZ’s scope of supply but not shown on the P&IDs include:

- Electrical and control equipment – see **Section 3.3.1** below
- Special Tools – see **Section 3.3.2** below
- Preparation of Shop Drawings and Design Services – see **Section 3.3.3** below
- Operation & Maintenance manuals
- All supplied equipment delivered to project site
- Construction Phase Services, including commissioning and Operator training – see **Section 3.3.4** below
- After-market Services – see **Section 3.3.5** below
- One (1) year Mechanical Warranty – see **Section 4**
- Ten (10) year Membrane Warranty – see **Section 4**

3.3.1 Electrical and Control Equipment

The membrane filtration system will be controlled by an Allen-Bradley ControlLogix Programmable Logic Controller (PLC) in combination with Allen-Bradley FlexIO modules. Allen-Bradley is the dominant PLC vendor in North America and the ControlLogix platform has proven to be a flexible and reliable platform.

SUEZ's PLC control system architecture will be built on a distributed I/O system that locates I/O as close as possible to the sensing devices to minimize wiring runs and separates I/O into process train groups to maximize redundancy.

ControlLogix-Based PLC System

The Allen-Bradley ControlLogix-based PLC system will consist of one (1) ControlLogix PLC CPU with distributed I/O to FlexIO modules. The ControlLogix PLC rack will be equipped with Ethernet modules for communications. An Ethernet switch will be provided for the SUEZ PanelView Plus 7 Graphic Terminal Operator Interface Terminal (OIT) and will be available for communication to other plant PLCs and to the plant SCADA system. Ethernet/IP will be employed as the communication network between the ControlLogix PLC and FlexIO modules.

The ControlLogix CPU, communication modules, and Ethernet switch will be housed in a free-standing Master Control Panel to be located indoors in the Electrical Building. Common equipment and motor I/O will be wired to this Master Control Panel and terminated to FlexIO modules.

I/O pertaining to a specific membrane train will be wired to a Remote I/O Panel dedicated to that membrane train. This Remote I/O Panel will be mounted outdoors, close to the membrane trains, and will contain a FlexIO Ethernet communication adapter and various FlexIO I/O modules. Expansion of this system can be easily accomplished by adding one (1) Remote I/O Panel for every membrane train.

Allen-Bradley ControlLogix modules will be of the following type:

CPU	A-B 1756-L73 series
Ethernet communication module	A-B 1756-EN2T
Ethernet DLR communication module	A-B 1756-EN2TR

Allen-Bradley FlexIO modules will be of the following type:

Ethernet DLR communication adapter	A-B 1794-AENTR
Digital Input: 16-point 24VDC sink	A-B 1794-IA16
Digital Output: 16-point 24VDC source	A-B 1794-OA16
Analog Input: 8-point 4-20mA	A-B 1794-IE8
Analog Output: 4-point 4-20mA	A-B 1794-OE4

Loop-powered analog inputs will be powered from a 24VDC power supply installed in the control panel.

Control System Components

The Master Control Panel housing the CPU will be rated NEMA 12 carbon steel. The Master Control Panel includes climate fans such that no maximum temperature ratings of the panel components are exceeded. Remote I/O panels will be rated NEMA 4X stainless steel. Since these panels are to be located outdoors they will come installed with sunshades and air conditioning units.

To protect against lightning and transient voltage surges, each control panel will be protected at the incoming power by a transient surge suppressor located in the control panel.

The PLC processor rack and OIT sub-system will be powered by an on-line UPS providing approximately 5 minutes of back-up time.

A single dry relay contact will be provided for remote/auto-dialer alarming.

Field wiring of all the I/O to and from the control panels will be by others in accordance with wiring schematics provided by SUEZ. Unless otherwise specified, control panels will be designed primarily to accommodate field wiring entering from the bottom of the enclosure. Field wiring will be terminated at terminal blocks.

Design, supply, and installation of any junction boxes will be by others.

SUEZ will provide the PLC programming software license; current version of Rockwell RSLogix 5000 Professional.

To provide warranty support, SUEZ will require remote access to the PLC and OIT. SUEZ has included a black box and VPN gateway located in the Master Control Panel. SUEZ's preferred method of remote access is via a secure high-speed internet connection over Ethernet. This can be accomplished with VPN technology through the Owner's existing internet connection or through a dedicated high-speed internet connection and ISP account. Please note that the internet connection and service shall be supplied by others.

Control Operation

All valves and control devices will be interlocked through the PLC to allow smooth and continuous automatic operation. Valves will open, close and/or modulate, depending on signals from the PLC. These signals will be predetermined through PLC programming and allow the system to operate at optimal conditions. Variable speed pumps will also be controlled by the PLC and vary their flow output based on level signals from the process tanks.

All operating parameters will be continuously monitored by the PLC. If an alarm or emergency condition occurs, the PLC program will instruct the various components to change operation conditions and/or shut down the system and alert the Operator. The system control logic will be designed with the ability to shut down the system in the event of an alarm condition that could be detrimental to the equipment.

OIT system

The OIT will be an Allen-Bradley PanelView Plus 7 Graphic Terminal. It will be installed on the door of the Master Control Panel. It will be programmed to provide the following features:

- Monitoring of the system and of individual devices
- Control of the system and of individual devices
- Adjustment of operating parameters
- Operator and supervisor level passwords
- Current alarm summary
- Recent alarm history
- Data logging
- Data trending
- PID loop trending

Please note that the extent of the logging and trending will be dependent on the amount of memory available for storage.

All monitoring, control, and alarm logic will reside in the PLC CPU. Data points defined in the CPU will be communicated over the Ethernet network to provide the Operator monitoring and control functionality at the OIT. These data points will be available to any device on the Ethernet network, such as the plant SCADA system (by others), to provide some or all of the operator functionality that is found on the OIT. SUEZ recommends that the plant SCADA system incorporate full operator functionality to act as a backup in the unlikely event of an OIT failure and to provide a more convenient location for Operator interaction.

Since the plant SCADA system will have access to the data in SUEZ's PLC, features such as alarm annunciation and logging, data logging and trending, and report generation can be easily implemented on the plant SCADA system. SUEZ's InSight system, when it resides on the plant SCADA system, will also require that the relevant performance data be logged at the plant SCADA system.

OIT Software Standards

OIT applications will be developed using SUEZ's standards as described below. OIT applications will be developed using Rockwell FactoryTalk View Machine Edition (ME) to run on an Allen-Bradley PanelView Plus 7.

SUEZ will provide the OIT programming software license; ESD – Studio 5000 Professional Edition.

Alarms triggered by the PLC will be displayed and recorded with a date and time stamp. The Active Alarm screen will list all alarms that are currently active. The Alarm History page will list all alarms that have occurred. All alarm messages will be configured with red text on a black background.

The OIT will be configured for various security levels to ensure that users are permitted the monitoring and control functionality that they have been granted. Unless otherwise specified, there will be four (4) security levels: GUEST, OPER, SUPER, and SUEZ, each level having an increasing level of privileges. The system will be configured to log out the current user automatically after a pre-determined amount of time or inactivity.

3.3.2 Special Tools

SUEZ's Proposal Price does not include spare parts. A spare parts list will be submitted after Completion of Shop Drawings at which time the Owner may decide what spare parts may be added to SUEZ's Proposal Price.

SUEZ's Proposal Price does include the following special tools:

Qty	Description
1	ZeeWeed Fiber Repair Kit
1	ZeeWeed 500D Lifting Bracket
4	ZeeWeed 500D Safety Hoist Ring
1	ZeeWeed 500D MARS Module Removal Tool
1	Set of Tools (used to disconnect a cassette) - One (1) permeate straub slider tool - One (1) permeate straub socket tool - One (1) cassette lockdown tool - One (1) air straub slider tool - One (1) air straub socket tool

3.3.3 Preparation of Shop Drawings and Design Services

SUEZ has an excellent track record working with a wide variety of Consulting Engineers, Owners, and Contractors. Our approach to project execution generates exceptional results. In the past SUEZ has worked on many projects with some of the industry's top Consulting Engineers.

SUEZ has been focused on the development of membrane systems for over 25 years. As a company, SUEZ has traveled up the "learning curve" of membrane treatment and has designed membrane systems of all sizes. All of our designs incorporate the lessons learned from previous experience.

SUEZ proposes to submit Shop Drawings in staggered submissions. (Please refer to **Note 2** in **Section 2.7** of SUEZ's Proposal for a description of what is included in each submittal.) The staggered submittal procedure will allow for the Engineer and Contractor to focus on review of submittals most important to keep the project moving forward in a timely manner. Review and approval of one submission provides the proper starting point for SUEZ's team to complete the next submission, etc., and reduces the amount of re-work required.

SUEZ's internal process of design review is intended to ensure submittals are of the highest quality prior to meeting with the Owner, Consulting Engineer, and Contractors. SUEZ's Project Engineer will participate in all key Design and Review Meetings with the Owner, Consulting Engineer, and Contractor. Changes agreed to in the meetings will then be integrated into the SUEZ system and reviewed internally to ensure the design incorporates the appropriate functionality.

Throughout the Design Phase and for the duration of the project, SUEZ's Project Engineer and Process Engineer, under the guidance of SUEZ's Project Manager, will work to coordinate the different operational groups within the team.

3.3.4 Construction Phase Services

With over 700 full scale membrane-based wastewater and water treatment plants commissioned and in operation, the Commissioning Group at SUEZ has developed a powerful infrastructure that provides timely support and management of all commissioning activities.

Throughout testing and commissioning, SUEZ will assign an internal Field Service Supervisor that will support the Field Service Representative (FSR) to ensure rapid response to any on-site issues that may arise.

During the Commissioning Phase of the project, regular updates will be provided to document site progress. Potential delay issues, site issues and planning for future activities will be highlighted within these reports. SUEZ's Project Manager will continue to coordinate all efforts.

The following is a summary of the on-site commissioning services provided by SUEZ and included in the Proposal Price. Services will be provided by trained SUEZ Field Service Representatives.

Task	No. of Person Days On-site ^{Note 1}	No. of Trips
Training to the Owner regarding unloading and installation of membrane equipment, and attendance at a pre-delivery site meeting with CMAR ^{Note 4}	0	0
Pre-commissioning inspection for the membrane equipment system ^{Note 5}	1	1
Component and System Testing ^{Note 6}	50	4
On-site assistance during the Operational Test ^{Note 7}	3	1
Additional assistance during the Commissioning Period ^{Note 8}	3	1
Training of Owner's Operators ^{Note 9}	5	2
One (1) day pre-startup meeting with CMAR and Owner ^{Note 10}	1	1
Two (2) day review of operations at the end of the first year of operation ^{Note 11}	2	1
Total	65	11

Note 1: No. of person days on-site is based on a not-to-exceed 10-hour workday.

Note 2: The cost of transportation to and from site, lodging, and meals has been included.

Note 3: Hours in excess of the table above will be billed at prevailing rates. See most recent Labor Rate Sheet attached.

Note 4: As per SUEZ's modifications to specification Section 11500.1, item 3.3.B.3. Training to the Owner regarding unloading and installation of membrane system equipment, and a pre-delivery site meeting with the CMAR can be accomplished virtually, without a Field Service Representative physically on-site.

- Note 5:** As per specification Section 11500.1, items 3.3.B.4. SUEZ has assumed that the 10 person days specified in item 3.3.B.4 are the same 2 weeks to oversee the proper placement and installation of all equipment supplied by the Supplier referenced in item 3.1.D. SUEZ does not provide value providing installation assistance, and suggests instead that the SUEZ Field Service Representative is on-site for one (1) day (one (1) trip) for the pre-commissioning inspection of the membrane equipment system as defined in item 3.1.K.
- Note 6:** Specification Section 11500.1, item 3.3 did not have a separate line item specifically for Component and System Tests. This is where SUEZ provides the most value to the Owner. See list of tasks associated with Component and System Tests described in Section 11500.1, item 3.2.C. SUEZ proposes 50 days on-site over four (4) trips for the completion on Component and System Tests.
- Note 7:** As per SUEZ's modifications to specification Section 11500.1, item 3.3.B.5. SUEZ will be on-site for the first three (3) days (one (1) trip) of the Operational Test.
- Note 8:** As per SUEZ's modifications to specification Section 11500.1, item 3.3.B.6. SUEZ will be on-site for an additional three (3) days (one (1) trip) for assistance during the Commissioning Period.
- Note 9:** As per specification Section 11500.1, item 3.3.B.7. The five (5) days of training include the four (4) days detailed in specification Section 01821, item 1.6.B, plus one (1) day of training called for in specification Section 11314, item 3.2.B. Is part of the total of 8 person-days (4 trips) (see Notes 10 and 11).
- Note 10:** As per specification Section 11500.1, item 3.3.B.7. Is part of total of 8 person-days (4 trips) (see Notes 9 and 11).
- Note 11:** As per specification Section 11500.1, item 3.3.B.7. Is part of total of 8 person-days (4 trips) (see Notes 9 and 10).

Additional Commissioning Services

Additional services required, beyond what has been included in the table above, are chargeable at the rates indicated in SUEZ's prevailing Field Service Labor Rates Sheet. These rates are effective as of January 1st this year, and are subject to adjustment at yearly intervals on December 31st.

North America On-Site Hourly Rates – \$USD/hr

Field Service Representative		Standard	Overtime	Holiday
field service representative	product support representative	\$175	\$262	\$350
Engineer Level				
project manager	electrical/controls engineer	\$195	\$292	\$390
process engineer	operator training			

Scheduling & Technical Support contact services at +1 (866) 271-5425 to schedule service. Support is available by phone M-F 8:30am to 5:00pm Eastern time (GMT-5).

Conditions

1. Rates are inclusive of travel and living expenses in Canada and the lower US. Remote sites, or those requiring special or urgent travel or accommodations, may incur additional charges.
2. In times of special circumstances (i.e. pandemic/national emergencies) additional costs may be incurred.
3. A minimum booking of 40 hours (one working week) is required for commissioning, startup or training services on capital projects or additional charges may be applied.
4. Travel time is charged at the applicable service rate. Travel hours begin at the SUEZ representative's residence or airport and end at arrival to the hotel or work site, and vice versa.
5. Hours exceeding a 10-hour day or a 40-hour work week may be considered overtime. Holiday rates apply based on US/Canada holidays and/or holidays observed in the country where the work is performed.
6. For extended duration assignments, staff rotations are scheduled on a monthly basis. Site-specific training required by customer will be billed as time worked.
7. Supplies, materials, consumables or services purchased for direct use during service will be charged separately.
8. State/provincial taxes, use taxes, withholding taxes and all other taxes are extra where applicable. Buyer is responsible to provide any applicable tax exemption certificates with its purchase order or work order.
9. All services provided are governed by SUEZ Water Technologies & Solutions general term and conditions. Additional or conflicting terms contained in purchase orders which authorize work are prohibited and shall not apply except where agreed to in writing.
10. For multiple scheduled or recurring site visits, please request a firm service proposal.
11. These rates are valid through December 31, 2021.

3.3.5 After-market Services

As per the Specifications, Section 11500.1, items 3.2.G and H the following services are included in the Proposal Price as part of the Seller's responsibilities following substantial completion:

- **24/7 Emergency Telephone Technical Support:**
 - Calls after hours – Emergency Telephone Support - for a period of three (3) years
- **InSight** - knowledge management solution:
 - InSight Pro – Process Consulting Service – for a period of two (2) years

The following after-market services are included at no additional cost:

- **Telephone Technical Support:**
 - Calls during business hours – included for the life of the membrane system
- **ModuleTrac:**
 - ModuleTrac – membrane tracking service – included for the first year
- **Partnership communication:** included for the life of the membrane system
 - Regional Lifecycle Manager (RLM);
 - ZeeWeed Users Group participation;
 - Warranty support.

Descriptions of each of these services follows below:

3.3.5.1 24/7 Telephone Technical Support

SUEZ's 24/7 telephone technical support provides a team of specialists available to help keep your system online and in production in the event of the membrane system operating outside of specified conditions.

Calls During Business Hours

For the life of the membrane system Plant Operators can call the daytime hours telephone number at any time during business hours and ask for technical support. Plant Operators will have telephone access to a skilled SUEZ technical support specialist who will assist plant Operators in troubleshooting of system problems such as electrical (PLC/OIT), mechanical and process control issues.

Calls After-Hours – 24/7 Emergency Telephone Technical Support

For a period of three (3) years after substantial completion Plant Operators have access to 24/7 Emergency Telephone Technical Support. Our technical support team is always on call and is equipped with system information to effectively talk a plant Operator through an emergency, potentially averting loss of plant production and expensive call outs. The telephone technical support group maintains access to all plant drawings for rapid reference during 24/7 support calls. The technical support specialist will manage the resources needed within SUEZ to assist you in resolving your plant issues. All customer issues are tracked through to resolution using SUEZ's state-of-the-art issue tracking software.

3.3.5.2 Monitoring Membrane Performance Through InSight

For a period of two (2) years following substantial completion SUEZ will provide InSight Process Consulting Service to the City of Chandler. InSight captures and transforms your plant data into meaningful and actionable information, ultimately providing the knowledge you need to maximize performance, avoid operational interruptions, optimize your processes, and reduce the total cost of operation.

InSight Pro – Process Consulting Service

InSight Pro puts a professional SUEZ process expert onto your team, collaborating to empower your operating team to apply the power of InSight.

The process expert is specifically assigned to your plant and will monitor key parameters on a regular rhythm using the InSight platform. The process expert will be in regular contact with the key members of your operations team to discuss and resolve performance, process and operational issues. While supporting your operations team with day-to-day issues. The process expert will also use InSight to bring attention to long term trends and provide operational recommendations.

As part of InSight Pro, the process expert provides bi-weekly process reports with analysis of key trends and recommendations to support plant operation, membrane cleaning and overall performance. In addition, an annual summary performance report is provided.

If the need for troubleshooting does arise, your SUEZ process expert is accessible, familiar with your system and empowered with accurate information to assist.

3.3.5.3 ModuleTrac

For a period of one (1) year following substantial completion plant Operators have access to ModuleTrac, SUEZ's new mobile application for iOS and Android devices. ModuleTrac offers a simplified, streamlined way to manage data collection and record-keeping for your ZeeWeed ultrafiltration membranes. ModuleTrac scans and organizes ZeeWeed membrane data, including location, repair and maintenance history, using a barcode located on each module.

The app is also linked with InSight, our powerful Asset Performance Management system, to help you:

- Organize and archive information into one, easy-to-use application;
- View historical data to understand the best and least-performing modules;
- Run reports and build graphs, charts and other visualizations;
- Uncover the root cause of issues and their location relationships.

3.3.5.4 Partnership Communication

SUEZ knows the importance and long term implications involved in selecting a membrane supplier. SUEZ is committed to building a partnership with the City of Chandler and believes communication is the essential ingredient to achieve this. SUEZ invests in the partnership through the following communication mechanisms:

- Access to a Regional Lifecycle Manager (RLM);
- Participation in the ZeeWeed Users Group;
- Dedicated Warranty Coordinator.

Regional Lifecycle Manager

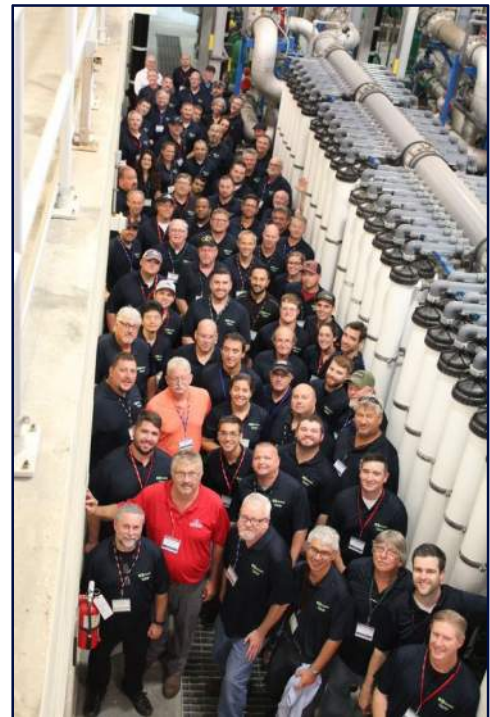
The Regional Lifecycle Manager (RLM) will act as the SUEZ “quarterback”, engaging in frequent communication with plant staff, ensuring timely access to all the technical resources provided by SUEZ. The RLM will also design a schedule and package of services suited to your needs and budget, including:

- Additional years of InSight and 24/7 telephone technical support coverage;
- Greater frequency of site visits and or special provisions for emergency site visits;
- Plant optimization & plant upgrades;
- Membrane replacement planning/budgeting;
- Membrane cleaning studies.

ZeeWeed Users Group

As an on-going support to ZeeWeed plants, an annual, two-day ZeeWeed Users Group meeting is chaired by an Owner and SUEZ helps organize the group meetings and a tour of the hosting ZeeWeed plant. New technologies are introduced, current issues are tabled, and roundtable discussions ensue. The Users Group has become an excellent forum for experienced Operators to keep current, to renew old acquaintances, to exchange the “tricks of the trade” with each other, and to impart their hard won knowledge to newer ZeeWeed Operators. Generous hospitality combines with informal experiences and exercises to enhance the esprit de corps between domestic and international plant Operators.

All ZeeWeed plants are invited to send Operators representing the plant. SUEZ covers conference, food, and hospitality expenses. The plant must cover the Operator’s travel and hotel expenses, and a small conference fee. SUEZ supports this forum to facilitate interaction between ZeeWeed plant Operators and to provide a forum for real-world feedback to SUEZ’s management, design and operations staff.



**2018 Drinking Water User’s
Group Meeting at Knox Chapman
Utility District, TN**

Warranty Support

To promptly manage warranty claims, SUEZ Lifecycle Services has a Warranty Coordinator dedicated to that function and that function only. Our Warranty Coordinator has access to all SUEZ resources to ensure timely resolution of problems that may occur.

3.4 Scope of Supply by Others

All delivery or services not specified in the Seller's scope of supply are included in the Buyer's scope of supply.

The Specifications list scope of supply by others, for example:

- Section 11500.1, item 1.3
- Section 11500.1, item 2.1

As best as possible Seller has attempted to delineate scope of supply using the Check-marked Specifications found in **Appendix A** of this Proposal.

In case not specifically called out in the Specifications, the following items are the responsibility of others:

3.4.1 Safety and Environmental

- First aid, emergency medical response, eyewash and safety showers in the water treatment area. Chemical spill response, security and fire protection systems per local codes.
- Environmental use and discharge permits for all chemicals at the Buyer's facility either listed in this document or proposed for use at a later date.
- Any special permits required for Seller's or Buyer's employees to perform work related to the water treatment system at the facility. All site testing, including soil, ground and surface water, and air emissions, etc.
- Disposal of all solid and liquid waste from Seller's system including waste materials generated during construction, startup and operation.
- Provide appropriate protection of the environment and local community, the health and safety of all workers and visitors at the site and the security of the facility. Provide safety related equipment and services such as site security, fire systems, lifting equipment and its operation, fall protection, adequate floor grating, ventilation, and safe access to equipment and electrical systems areas.
- Equipment and trained support personnel for any confined space entry required during equipment installation/startup/commissioning/servicing
- The Buyer will identify and inform Seller's personnel of any hazards present in the work place that could impact the delivery of Seller's scope of supply and agrees to work with Seller to remove, monitor, and control the hazards to a practical level.
- The Buyer will provide training to Seller's personnel on all relevant and standard company operating procedures and practices for performing work on site. Such training programs may include, but are not limited to, general environmental health & safety (EHS), HAZOP, fire protection, drug testing, incident notice, site conduct, standard first aid, chemical receiving, electrical safety, etc. Buyer will provide a certificate of training for Seller's personnel. This program will be fully documented, training materials will be provided, and attendance list will be kept.

3.4.2 Jobsite and Installation Review

- Review of Seller's Shop Drawings, Submittals and Check-marked Specifications.
- All easements, licenses and permits required by governmental or regulatory authorities in connection with the supply, erection and operation of the system.
- Overall plant design, detail drawings of all termination points where Seller's equipment or materials tie into equipment or materials supplied by others.
- The Buyer will provide all access structures (scaffolding) and mechanical lifting equipment (cranes, forklifts and scissor lifts).
- Providing a suitable site/shelter for the placement of the proposed equipment, either inside appropriate housing, or outdoors. Note: electrical equipment including the PLC may require air-conditioned rooms to prevent overheating of sensitive electronic equipment depending on climatic conditions.
- Storage of cassettes with UF membrane modules on site after shipment must meet SUEZ requirements (temperature controlled environment).
- Bulk chemical storage and tanks, including secondary containment in accordance with local codes.
- Supply and installation of all equipment anchor bolts and epoxy required for the installation of the equipment. (Seller will provide the anchorage calculations for all equipment supplied by the Seller.)
- Design, supply and installation of Instrument/Equipment identification tags and pipe identification.
- Design, supply and installation of passive ventilation system to relieve pressure or vacuum conditions in the membrane basins, such as may occur when the basins are being drained or filled.
- Seller has included sunshades for Remote I/O panels, which will be installed outdoors, but Buyer is to design, supply and install sunshades that may be required for all other outdoor equipment/instruments, as required.
- Any on-site painting or touch-up painting of equipment supplied (shop prime by Buyer).
- Turbidimeter to measure turbidity of the raw water upstream of the proposed membrane system.
- Plant SCADA. Seller will provide sufficient digital and programming information to the Buyer's SCADA Integrator to design and provide an operational interface between the Buyer's SCADA and the membrane control system.
- Configuration of instrument and PLC signals from the membrane system to the plant PLC or DCS.

3.4.3 Start-Up and Commissioning

- Installation and removal of temporary screens (0.5 mm mesh or punch hole) on all process lines feeding the membrane basins to prevent membrane damage if permeant screens are not in place during start-up and commissioning.

- Flushing and disinfection of all piping and tanks (including process equipment tanks) and verification of removal of all residual debris from construction.
- Alignments and required materials for rotating equipment.
- MEG testing of all field motor power wiring (as required).
- Continuity checks for all electrical field wiring per installation checklist.
- Hydro-testing of all field installed piping.
- On-site calibration of SUEZ-supplied instruments.
- Supply raw materials, oils/lubricants chemicals and utilities during start-up and operation.
- Supply of telephone/fax/modem access while Seller's staff members are on-site.
- Laboratory services, operating and maintenance personnel during equipment checkout, start-up and operation.
- Electrical and mechanical support labor for commissioning activities.

3.4.4 Facility Management

- The Buyer will provide such warehouse storage space and facilities, as are available at the site, and are reasonably appropriate to store parts, consumables, tools, etc. in accordance with manufacturers' recommendations. Such warehouse storage space will be a segregated area, secured and protected from adverse climate as may reasonably be required. Buyer will be responsible for risk of loss of Seller's parts while in storage at the site. Buyer will maintain Seller's parts stored at the site free and clear of any and all liens of Buyer and Buyer's lenders, bondholders, contractors, and other creditors of any nature.
- The Buyer will afford Seller's personnel free access and egress of the facility for all authorized work.
- The Buyer will provide workshop facilities with standard workshop tools and equipment, as is reasonably appropriate, that are necessary to meet the repair and maintenance requirements of the system. Such equipment includes, but is not limited to, benches, vices, drill press, electric saws, hand tools, power tools, pneumatic tools, etc.
- The Buyer will provide adequate illumination and emergency lighting for all areas in which the Seller will be executing the scope of supply.
- The Buyer will identify a Buyer project contact person to be available to Seller's personnel to address any issues related to Seller's execution of Seller's scope of work.
- The Buyer will be responsible for the equipment for movement of chemical drums, totes, and resins, as is reasonable.
- The Buyer will provide all site utilities such as raw water, instrument quality air, potable water and power required for operation of the proposed equipment included in this scope of supply.

4 Warranty

The Seller offers a comprehensive two-part warranty for the City of Chandler Reclaimed Water Interconnect Facility project as follows:

- **Mechanical Warranty:** The Seller will repair or replace any device or part thereof that was supplied by the Seller that proves to be defective. This warranty excludes the membrane modules.
- **Membrane Warranty:** This warranty provides protection and assurances to the Buyer/Owner with respect to the membrane modules.

Unless otherwise noted, all of the warranties start upon substantial completion, which is defined as successful completion of the Operational Test as described in **Section 4.4** below.

4.1 Warranty Provisions

In addition to the membrane warranty limitations as defined in the “**ZeeWeed Membrane Module Prorated Warranty**” document, found at the end of this Section of the Proposal, all of the warranties are subject to the following provisions:

General

- The equipment is operated and maintained at all times in accordance with the Seller’s Operations & Maintenance manual;
- The Seller has, until performance of its obligation herein is met, reasonable access to the equipment and the operational data relating thereto;
- The Buyer/Owner furnishes adequate and competent operating, supervisory and maintenance staff, and necessary laboratory facilities with test equipment and personnel;
- The Buyer/Owner utilizes the services of the Seller until its performance obligations are met;
- The Buyer/Owner supplies all necessary raw materials and services of a quantity and of a quality specified by the Seller; and
- An adequate and continuous power supply is available that will enable operation of all required equipment.

Screening

- Screening is required upstream of the membrane system. The opening size for the screens in any dimension must be 500 microns or less.
- Pre-screening must use mesh, punched hole or disc filter type screens. Wedge wire screens are not acceptable, nor is any unscreened bypass (even temporary).

- All tanks, clarifiers, settlers, channels, etc. following the screens are to be covered and protected from the outside elements such that no leaves, twigs or any foreign materials can enter the membrane train.

Process Parameters and Water Quality

- The use of any chemicals added to the treatment process (e.g. polymers, flocculants, coagulants, coagulant aids, oxidants, acids, bases...) that may come in contact with the ZeeWeed membranes must be approved by the Seller prior to use. This includes, but is not limited to, chemicals used in the feed water to the membranes, and chemicals used in processes outside of the Seller's system, streams which may be recycled or transferred directly or indirectly to the Seller's system (e.g. treated backwash waste water recycle). Pretreatment chemical dosages must be properly optimized by the Buyer/Owner based on feed water quality and membrane requirements. (Typical coagulants such as ferric, ACH, PACI or alum are generally acceptable as pretreatment.)
- The membrane system is guaranteed to perform its contractual obligations under the water quality parameters outlined in **Table 1**. Any value above or below the ranges stated may impact the system performance.
- Any compound not listed in **Table 1** and for which analytical data has not been supplied in the Specifications is assumed to be in such a concentration that it does not require removal by the treatment process, does not affect membrane performance, and will not need to be targeted by chemical cleanings to restore performance (e.g. algae, oil & grease).
- The membrane system's operation is warranted under the original membrane system design, and pre and post treatment designs as described in **Section 3** of the Proposal. Any changes such as, but not limited to, the design or operation of the membrane system, the configuration of the upstream or downstream unit operations, equipment sizing, chemical types and dosing rates must be reviewed and assessed by the Seller to determine their feasibility and potential impact on the system performance and warranty.

Treated Waste Water Recycle

- The membrane system is designed assuming that no streams such as backwash or chemical wastes from the membrane system or any other unit operations in other parts of the plant are directly or indirectly recycled ahead of the membrane system. If recycle streams are to be implemented at a later date, the performance of the membrane system may be impacted due to the buildup of foulants in the process loop, and consultation with the Seller would be required to define the new operating conditions and feasibility of the changes proposed.

Table 1 presents the water quality on which the design of the membrane system is based, as supplied in the Specifications, Section 11500.1, item 2.3.B.

The proposed membrane system will treat raw water from a Salt River Project (SRP) Canal. The raw water from the SRP Canal Turnout Structure will be pumped from a Raw Water Pump Station to a bank of self-cleaning strainers, then flow to the membrane system feed channel which supplies the pre-screened water to the membrane trains.

Table 1: Membrane System Feed Water Quality

Parameter	Specified or Assumed Note 1	Units	Annual Average Day	Maximum Month Average Day
Alkalinity	Specified	mg/L	171	190
pH	Specified	-	8.20	8.53
Temperature	Specified	°C	16 (minimum) 32 (maximum)	
Total Organic Carbon (TOC)	Assumed	mg/L	< 3.3	< 3.8
Dissolved Organic Carbon (DOC)	Assumed	mg/L	< 3.0	< 3.4
Apparent Color	Assumed	TCU	< 20	< 45
Turbidity Note 2	Specified	NTU	9.28	37.89
Total Suspended Solids	Specified	mg/L	33.7	185.0
Total Dissolved Solids (TDS)	Assumed	mg/L	< 150	< 180
Calcium	Assumed	mg/L	< 20	< 25
Magnesium	Assumed	mg/L	< 7	< 8
Barium	Assumed	mg/L	< 0.01	< 0.02
Strontium	Assumed	mg/L	< 0.01	< 0.02
Dissolved Iron	Assumed	mg/L	< 0.1	< 0.3
Sulfate	Assumed	mg/L	< 20	< 25
Dissolved Aluminum	Assumed	mg/L	< 0.01	< 0.02
Dissolved Manganese	Assumed	mg/L	< 0.01	< 0.02
Total Silica (SiO ₂)	Assumed	mg/L	< 0.5	< 2
Langelier Saturation Index (LSI)	Assumed	-	between -0.5 and 0.5	

Note 1: This column identifies whether the parameters listed in each row are assumed values because they were not supplied to the Seller in the Specifications, or if the values listed reference the Specifications.

Note 2: The membrane system is designed to operate up to a maximum raw water turbidity of 800 NTU. When the raw water turbidity is from 135 to 800 NTU, the membrane system will adjust operation to operate at 90% recovery instead of 95% recovery (i.e. the membrane system will backwash more often). Cleaning protocols may also need to be modified during raw water turbidity peak events to maintain membrane performance, particularly if the peaks extend to more than 72 hours.

4.2 Mechanical Warranty

The mechanical warranty period on all equipment supplied, unless otherwise noted, is twelve (12) months from the date of substantial completion or eighteen (18) months from equipment delivery, whichever occurs first. The mechanical warranty is only applicable to equipment supplied by the Seller. The Seller's obligation under this warranty is to repair or replace, at its factory, any device or part thereof, which shall prove to have been thus defective. Warranty repair, replacement or re-performance by Seller shall not extend or renew the applicable warranty period.

The Seller assumes no liability for any damage to the equipment caused by inadequate storage or handling per manufacturer's recommendations in supplied technical literature, or by defective or sub-standard workmanship of materials provided by the Buyer/Owner or any other third party responsible for handling, storing or installing the equipment.

The Buyer/Owner undertakes to give immediate notice to the Seller if goods or performance appear defective and to provide the Seller with reasonable opportunity to make inspections and tests. If the Seller is not at fault, the Buyer/Owner shall pay the Seller the costs and expenses associated with the inspections and tests.

Goods shall not be returned to the Seller without the Seller's permission. The Seller will provide the Buyer/Owner with a "Return Goods Authorization" (RGA) number to use for returned goods. All returns are F.C.A. – Oakville, Ontario, Canada. All costs associated with the removal and shipment of the defective part from the Buyer/Owner's facility to the Seller's factory and all costs related to return shipment to the Buyer/Owner's facility and installation of a repaired or replacement part shall be the Buyer/Owner's responsibility.

Implied warranties, including but not limited to warranties of fitness for particular purpose, use or application, and all other obligations or liabilities on the part of the Seller, unless such warranties, obligations or liabilities are expressly agreed to in writing by the Seller, are null and void.

4.3 Membrane Warranty

A ten (10) year membrane warranty is offered on the membrane modules with the first sixty (60) months offered as a full replacement warranty and the remaining sixty (60) months as a prorated warranty. The membrane warranty shall begin at the date of substantial completion or six (6) months from the date of delivery of the membranes to the Buyer, whichever occurs earliest. Refer to the **"ZeeWeed Membrane Module Prorated Warranty"** document found at the end of this Section of the Proposal, for a detailed description of the membrane warranty offered.

The parameters outlined in the sub-sections below are covered by the membrane warranty.

4.3.1 Capacity Guarantee

The Seller warrants, subject to the provisions set forth herein, that after stable operation of the membrane system has been attained and operators have acquired reasonable skills, the membrane modules supplied for this project will be capable of producing the results set forth in **Table 2**.

Table 2: Guaranteed Membrane Filtration System Performance - Capacity

Parameter	Current Criteria ^{Note 1}	Future Criteria ^{Note 1}
	Guaranteed Values	Guaranteed Values
Design daily net capacity with all trains operational at a temperature $\geq 20^{\circ}\text{C}$	10 MGD	12.5 MGD
Design daily net capacity under firm capacity conditions (one (1) train out of service) at a temperature $\geq 20^{\circ}\text{C}$	10 MGD	12.5 MGD

Note 1: Current Criteria represents four (4) out of five (5) installed cassettes per membrane train (68/68 installed modules per cassette). Future Criteria is achievable with five (5) out of five (5) installed cassettes per membrane train (68/68 installed modules per cassette). If the filterability is lower than expected, some of the spare space may be required to lower fluxes in order to meet the 10 MGD guarantee, which would lower production capacity with all cassettes filled at the future condition.

Note 2: The membranes and related equipment are designed for the maximum net daily production capacity year round, at the design temperature of 20°C .

Note 3: The membrane filtration system proposed as part of this offer is designed to provide its rated capacity on a net daily basis. Instantaneous permeate flows will vary as trains cycle through required automatically triggered sequences, such as backwashes, Maintenance Cleans and/or Membrane Integrity Tests. The feed flow rate to the membrane trains will be varied as trains cycle through backwashes, Maintenance Cleans, and Membrane Integrity Tests. It is anticipated that any feed equipment and controls provided by others will be responsive and maintain the level in the feed channel during the feed demand fluctuations of the membrane system at all capacities.

Note 4: Influent water to the membrane system will flow at a consistent rate. The membrane system will be designed to increase flows through online trains to accommodate constant inlet feed flow to the membranes up to 10 MGD (net)/95% = 7,310 gpm (net) during Maintenance Cleans, Membrane Integrity Test, and backwashing, with all other trains otherwise in service (at current conditions).

Note 5: If a train is off-line for Recovery Clean or for any other equipment repair or maintenance, then the influent flow will be decreased. The feed flow that can be accommodated with one (1) train out of service for Recovery Clean or for any other equipment repair or maintenance is $7,310 \text{ gpm (net)} \times \frac{3}{4} = 5,482 \text{ gpm (net)}$ (at current conditions).

Note 6: The membrane system is designed to operate up to a maximum raw water turbidity of 800 NTU. The membrane system will operate at a recovery (at design capacity) of 95% up to a raw water turbidity of 135 NTU. When the raw water turbidity is from 135 to 800 NTU, the membrane system will adjust operation to operate at 90% recovery instead of 95% recovery (i.e. the membrane system will backwash more often). Cleaning protocols may also need to be modified during raw water turbidity peak events to maintain membrane performance, particularly if the peaks extend to more than 72 hours.

4.3.2 Water Quality Guarantee

The Seller warrants, subject to the provisions set forth above, that after stable operation of the system has been attained and operators have acquired reasonable skills, the membrane modules supplied for this project will be capable of producing the results set forth in **Table 3**.

Table 3: Guaranteed Membrane Filtration System Performance – Water Quality

Parameter	Guaranteed Values
Turbidity (NTU) ^{Note 2}	≤ 0.5 NTU 100% of the time ≤ 0.1 NTU 95% of the time
Log Removal Value (LRV) for <i>Giardia</i> and <i>Crypto</i> ^{Notes 3 and 4}	≥ 3.0 Log

Note 1: All guarantees are contingent upon proper maintenance, calibration and service of instruments and other related equipment as per Seller's and original equipment manufacturers instruction.

Note 2: Guaranteed values are as measured by online instrumentation on the permeate for each train at 15-minute intervals over any continuous period of at least 24 hours in length. High readings not reflective of membrane integrity (instrument errors such as bubbles or particles that shake loose from the instrument piping) would not be considered.

Note 3: The Membrane Integrity Test (MIT) and LRV calculation will be performed in accordance with the latest versions of the USEPA's Long Term 2 Enhanced Surface Water Treatment Rule and the Membrane Filtration Guidance Manual, as outlined in SUEZ's LRV FAQ document.

Note 4: The LRV guarantee is based on being able to completely drain the membrane tanks during a backwash. The Seller will not be responsible for the impact on the VCF and LRV results if the hydraulics of the plant and piping design do not allow a 100% drain of membrane tanks after a backwash.

4.3.3 Membrane Integrity Warranty

Table 4 defines the limits of the membrane integrity warranty. Beyond the limits indicated, the membrane module warranty will be triggered.

Table 4: Guaranteed Membrane Filtration System Performance – Membrane Integrity

Parameter	Guaranteed Values
Ability to pass Membrane Integrity Test (MIT)	Yes

Note 1: The Membrane Integrity Test (MIT) will be performed in accordance with the latest versions of the USEPA's Long Term 2 Enhanced Surface Water Treatment Rule and the Membrane Filtration Guidance Manual, as outlined in SUEZ's LRV FAQ document.

Note 2: Seller has the opportunity to repair membrane modules if not able to pass the Membrane Integrity Test.

Note 3: Leaking fibers do not constitute a cause for repair, as long as the permeate quality is within the guaranteed values.

Note 4: Provided the membrane system integrity breach has been linked to fiber integrity, and other potential causes have been dismissed, fibers should be repaired by prioritizing the largest leaks and defects first to maximize the benefits of repairs in the facility, and should only be performed when:

- The turbidity is reaching the notification alarm setpoint in at least 20% of the readings
- The turbidity is reaching the shutdown alarm setpoint
- The LRV of a train is within 0.2 units of the guaranteed LRV
- The LRV of a train is reaching the shutdown alarm setpoint

4.3.4 Cleaning Frequency Guarantee

The Seller warrants, subject to the provisions set forth above, that after stable operation of the membrane system has been attained and operators have acquired reasonable skills, the membrane system supplied for this project will be capable of producing the results set forth in **Table 5**.

Table 5: Guaranteed Membrane Filtration System Performance – Cleaning Frequency

Parameter	Guaranteed Values
Maximum Maintenance Clean Frequency	one (1) per day
Maximum Recovery Clean Frequency	12 per year

Note 1: Cleaning shall be performed in accordance with the Operations & Maintenance Manual.

Note 2: The Recovery Cleaning Frequency must be shown to be above the guaranteed value following three (3) effective cleans, and the Seller shall have the opportunity to assist with optimizing the cleaning strategies for possible improvements before a warranty claim can be made.

4.4 Commissioning Period and Operational Test

As stated in Section 11500.1, item 3.2.E of the Specifications compliance with the requirements for production capacity (as per **Table 2** above), chemical cleaning interval (as per **Table 5** above), and membrane permeate quality (as per **Table 3** above) shall be determined during the 90-Day Commissioning Period.

The 30-Day Operational Test may be concurrent with the Commissioning Period and will be conducted to demonstrate the ability of the Seller's membrane system to meet the required performance.

The Operational Test shall begin within thirty (30) days following the Component and System Tests, following membrane system stabilization, or three (3) months from the date of delivery of the membranes to the Buyer, whichever occurs first.

During the Operational Test, when operating on influent water quality as outlined in **Table 1** above, the membrane system will demonstrate performance in accordance with:

- Permeate production capacity as per **Table 2** above;
- Membrane system will operate within the TMP limits for the ZeeWeed 500D membrane (i.e.: not exceed -12 psi in Production mode)

- Permeate water quality as per **Table 3** above;
- Cleaning frequency as per **Table 5** above;
- Membrane system will operate to verify that the membrane system PLC, OIT and network communications system operate as intended.

The proposed guaranteed performance criteria shall be met on a daily basis over a 24-hour period (midnight to midnight).

The Operational Test is subject to the following conditions:

- Test methodology will be defined in an Operational Test Plan issued by the Seller and agreed upon by all involved parties.
- Buyer/Owner shall operate the system during the test, with support from the Seller.
- Pre-treatment unit operations and/or chemicals (if applicable) will be optimized to maintain the design influent water quality and for the optimal performance of the equipment being performance tested.
- Testing shall include sampling to ensure feed water quality is within the parameters listed in **Table 1**. A minimum of three (3) grab samples shall be collected per parameter, evenly spaced over the course of the Operational Test. Samples shall be collected and analyzed in accordance with industry standards at an accredited third-party laboratory at the Buyer/Owner's expense.
- Performance with respect to effluent water quality will be demonstrated based on on-line instrumentation. Should results include values beyond the stated guarantees due to process upsets outside of Seller's control, additional testing shall be performed to establish that the equipment is not meeting performance requirements.
- Seller shall issue a report summarizing equipment performance during the Operational Test.

Upon successful completion of the Operational Test, the Seller shall give written notice to the Buyer/Owner to that effect. Within two (2) weeks immediately following receipt of such notice, the Buyer/Owner shall notify the Seller in writing that it accepts the system, or that it does not accept the system, in which latter case the Buyer/Owner shall state the specific reason for non-acceptance. In the absence of such reply from the Buyer/Owner within the two (2) week period, the system shall be deemed to have been accepted.

If, based on the results obtained at the completion of the Operational Test, it becomes apparent that the performance does not meet the guaranteed performance, then additional Operational Tests shall be conducted by the Buyer/Owner at a time mutually agreed between the Seller and the Buyer/Owner. In such event, the Seller shall be responsible to undertake all necessary reasonable corrective measures in an effort, consistent with commercial and technical reasonableness, to bring the equipment up to the guaranteed performance levels.

Successful completion of the 90-Day Commissioning Period, including the 30-Day Operational Test, concludes the Seller's obligation regarding performance guarantees, substantial completion is triggered, and the mechanical and membrane warranties begin.

ZeeWeed Membrane Module Prorated Warranty

This schedule sets out the warranty with respect to ZeeWeed membrane modules (“membrane modules”). No other warranties, expressed or implied are made in connection with the sale of these products, including, without limitation, warranties as to fitness for any purpose or use or merchantability of these products. The warranty provided herein will be the exclusive and sole remedy of Buyer. This warranty is not transferable.

1 Definitions

The following terms shall have the meaning set forth below when used in the warranty document:

- a. “Buyer” means McCarthy Building Companies, Inc.
- b. “Seller” means a business component of, or legal entity within the SUEZ Water Technologies & Solutions business which is selling the ZeeWeed membranes.
- c. “Full replacement” means that in the case of a valid warranty claim for a membrane module failure, Buyer receives a replacement membrane module and does not pay for the value of use of the membrane module prior to failure.
- d. “Prorated replacement” means Buyer pays for actual use of a membrane module from which Buyer has derived value over time. Prorated replacement allows the Seller to pay reasonable compensation under warranty for any product use not enjoyed by Buyer due to premature failure.

2 Warranty Product

This warranty applies to only the membrane modules supplied under the contract of sale. Membrane module means the hollow fiber ultrafiltration membranes and the potted plastic headers. This warranty does not cover air piping to the membrane module, permeate piping from the membrane module, piping connection fittings, connecting hardware and cassette frames with their associated components including but not limited to spacers, aerator tubes, aerator assemblies, screen, module dummies or module blanks.

3 Scope of Warranty

The Seller warrants that its membrane module(s) will be free of defects due to faulty materials or errors in manufacturing workmanship.

Regular membrane module inspection and normal fiber repair shall be the responsibility of Buyer.

All replacement membrane modules will be shipped on the basis of INCOTERMS 2020 FCA SUEZ manufacturing facility.

All ancillary costs including but not limited to bagging, boxing, crating, freight, freight insurance, applicable taxes, import duties, certifications, brokerage, receiving, forklift services, storage at site, reattachment hardware, hose/clamp/camlock replacement, crane services, installation, fiber repair materials, glycerin flushing, commissioning and waste disposal are the responsibility of Buyer.

4 Warranty Start Date

Membrane warranty will start on the earlier of:

- a. The date that installation of the original membrane module(s) has been substantially completed, or
- b. Six (6) months from the date of delivery of the original membrane module(s) to Buyer.

5 Warranty Duration

Total Warranty Duration: a total of **one hundred twenty (120)** months composed of a full replacement period and an extended prorated replacement period.

Full Replacement Warranty Duration: **Sixty (60)** months of full replacement warranty coverage.

Extended Prorated Replacement Warranty Duration: **Sixty (60)** months following the full replacement warranty period.

Membrane modules replaced under warranty shall assume the remainder of the warranty for the original membrane modules being replaced, with such warranty to be not less than a **24** month full replacement warranty from the date of replacement with a new membrane module.

Replacement membrane modules are covered by warranty only to the extent of the warranty of the original membrane module which has been replaced. At all events, this warranty shall expire and be of no force or effect **24** months following the warranty start date.

6 Membrane Module Replacement Price – Prorated Replacement

The base Membrane Module Replacement Price (MMRP) used to calculate the prorated amount to be paid by the Buyer to replace defective membrane modules under warranty shall be **\$1,450.00 USD per module** + adjustment for inflation. The inflation adjustment will be calculated according to changes in Consumer Price Index + one (1) percent for the period from date Seller accepts the purchase order. Membrane module prorated replacement price does not include bagging, boxing, crating, taxes and will be shipped on the basis of INCOTERMS 2020 FCA SUEZ Manufacturing facility.

For membrane modules supplied under valid warranty claims, the prorated share that the Buyer will pay is calculated as follows:

$$\text{Prorated Share of Price} = \frac{\text{Number of Whole Months Elapsed Between the Membrane Modules Claim Date and the Warranty Start Date}}{\text{Total Warranty Duration in Months}} \times \text{MMRP} \times \frac{\text{Changes in CPI} + 1\%}{100}$$

Consumer Price Index used: CPI-U, US City Average, All Urban Consumers, All Items Less Food and Energy, as published by the US Bureau of Labor Statistics

Note that this Membrane Module Replacement Price (MMRP) is not applicable for membrane modules requested for purchase by Buyer for any non-warranty or other purposes, including but not limited to flux reduction, or plant hydraulic capacity increases.

The price of ZeeWeed 500D membrane modules purchased for any non-replacement purposes, such as for flux reduction or hydraulic capacity increase is **\$1,950.00 USD/module**. Pricing for modules purchased for any non-replacement purposes is subject to adjustment for inflation from the date of this Proposal according to the Consumer Price Index (CPI) + one (1) percent. All modules purchased for non-replacement purposes shall be provided with a standard two (2) year full replacement warranty. Membrane module price for any non-replacement purposes does not include bagging, boxing, crating, taxes and will be shipped on the basis of INCOTERMS 2020 FCA SUEZ Manufacturing facility.

7 Notification of Claim

All claims filed under this warranty shall be made in writing by Buyer within 30 days of identifying a defect.

Buyer shall provide the following information:

- A description of the defect giving rise to the claim;
- Photographs showing the manufacturing defect;
- The serial number(s) of the membrane module(s) which is (are) the subject of the warranty claim; and
- Operating data and repair history for the life of membrane modules which are the subject of a warranty claim.

8 Verification of Claim

After receipt of written notification of a defect, the Seller will promptly undertake such investigations as, in the Seller's opinion, are necessary to verify whether a defect exists. The Seller reserves the right to require additional data as necessary to validate claims. Buyer may, in the course of these investigations, be requested to return membrane module(s) to the Seller for examination (see **Section 12**). The Seller may also conduct reasonable tests and inspections at Buyer's plant or premises. If the results of the investigation do not validate the defect claimed, Buyer will reimburse the Seller for all reasonable expenses associated with said investigation, including expenses for all tests, inspections, and associated travel.

9 Satisfaction of Claims

The Seller will have the right to satisfy claims under this warranty in a flexible manner. Such flexibility may include the repair of existing membrane modules or changes in operating protocols or membrane module replacement or by upgrading failed membrane modules with newer membrane module(s) that may embody design and efficiency improvements. Buyer consents to the supply of replacement membrane modules which may be of a different design than original membrane modules.

10 Operating Information

To maintain the membrane module warranty, membrane system operation records from initial start-up date until claim must be maintained by Buyer and made available to the Seller upon request. Records must be provided in sufficient detail as applicable to verify the subject of a warranty claim and can include but is not limited to, operation data including information on feed water quality, temperatures, flows, trans-membrane pressures, aeration rates, permeate quality, cleaning intervals, cleaning chemical concentrations, elapsed time since start-up, relevant analytical data and reporting of any screen bypass events.

Buyer shall maintain and share access to a single reference copy in electronic form of a membrane module map containing the history of activity by membrane module and the serial number for each module. Buyer shall log its procedures performed related to a membrane module including relocation of membrane modules, repairs, replacements and any other noteworthy events.

Buyer authorizes the Seller to conduct any reasonable review of operation and maintenance records or to inspect facilities where membrane modules are installed, upon reasonable notice to Buyer. Such reviews and/or inspections are intended to also assist the Seller and Buyer in detection of membrane system faults and to optimize the care and operation of the membrane modules.

11 Limitation of Warranties

Occurrence of any of the following as reasonably determined by the Seller will void this warranty:

- a. A material failure to operate the membrane system in accordance with Seller's operations and maintenance manual supplied to Buyer as part of the contract, including material failure to adhere to the Seller's specified membrane module cleaning procedures and the use of anything other than Seller-approved membrane module cleaning agents.
- b. Failure to adhere to the preventive maintenance program as presented in the Seller's operations and maintenance manual, in published product manuals and in specifications.
- c. Failure to adhere to all transportation and storage requirements. ZeeWeed membrane modules may be stored up to 12 months from date of receipt and must be transported and stored in original intact packaging out of direct sunlight in ambient temperatures between 5-35 Degrees Celsius. Storage beyond 12 months from date of receipt requires a written request to SUEZ to maintain membrane module warranties.
- d. Introduction of destructive foreign materials and chemical agents into the membrane module.
- e. Failure to maintain and provide system operating data and repair history for the life of membrane modules which are the subject of a warranty claim.

- f. Physical abuse or misuse, incorrect removal or installation of membrane modules by non-Seller personnel including fiber damage caused by operator error in handling of membrane modules or cassettes.
- g. Unauthorized alteration of any components or parts originally supplied by the Seller.
- h. Intentional damage.

12 Return Procedure

In the event that the return of a membrane module is required pursuant to this warranty, Buyer will first obtain a Return Goods Authorization (RGA) number from the Seller. Membrane module(s) shipped to the Seller for warranty examination must be shipped freight prepaid in environmentally controlled freight and storage with ambient air temperature between 5-35 Degree Celsius. If Buyer desires temporary replacement membrane module(s) to replace those alleged to be defective and returned to the Seller for warranty examination, Buyer shall be responsible for the cost associated with any such replacements until examination of the returned membrane modules pursuant to this warranty is complete. Any membrane module examined by Seller as part of a warranty claim where the membrane module is subsequently found to be performing as warranted or where a membrane module failure is not covered under the warranty will be returned to Buyer, freight collect or disposed of by Seller and the cost associated with any membrane analysis and diagnostic work will be levied against the Buyer based on SUEZ standard labor rates.

13 Disclaimer and Limitation on Liability

To the maximum extent permitted by law, in no event shall Seller be liable for any loss of profit or revenues, loss of production, loss of use of equipment or services or any associated equipment, interruption of business, cost of capital, cost of replacement water or power, downtime costs, increased operating costs, claims of Buyer's customers for such damages, or for any special, consequential, incidental, indirect, punitive or exemplary damages arising out of or relating to the performance or actual or alleged breach of the agreement, regardless of whether a claim is based in contract (including warranty or indemnity), extra-contractual liability, tort (including negligence or strict liability), statute, equity or any other legal theory.

Appendix A – Check-marked Specifications

SUEZ has prepared this Proposal based on the Technical Specifications for Reclaimed Water Interconnect Facility, Guaranteed Maximum Price (GMP) 1, dated August 11, 2021. In accordance with McCarthy Front Ends Article 2 – Check to Specs, a copy of the Technical Specifications has been included in SUEZ's Proposal, whereby SUEZ has used a check (✓) to denote that SUEZ complies with the Specification and an x (✗) to denote a deviation, along with an explanation of the deviation. The Check-marked Specifications help to clearly define SUEZ's scope of supply as part of SUEZ's Proposal Price.

Please find the Check-marked Specifications attached.

At the end of the Check-marked Specifications please find the comparison summary which shows the advantages of using the Bray butterfly valve vs an AWWA C504 valve.



CITY OF CHANDLER

PUBLIC WORKS & UTILITIES

Reclaimed Water Interconnect Facility

Project No. WW1901.203

GUARANTEED MAXIMUM PRICE (GMP) 1

August 11, 2021



**SPECIFICATIONS
FOR
RECLAIMED WATER INTERCONNECT FACILITY
GUARANTEED MAXIMUM PRICE (GMP) 1
CITY OF CHANDLER PUBLIC WORKS AND UTILITIES
DEPARTMENT
August 11, 2021**

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

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

I. CONTRACT AND SPECIFICATIONS

SECTION 01010 – Summary of Work

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

SECTION 01300 – Submittals

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

SECTION 01640 – Materials and Equipment

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

SECTION 01650 – Starting of Systems

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

SECTION 01660 – Field Tests of Equipment

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

SECTION 01730 – Operation and Maintenance Data

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

SECTION 01750 – Spare Parts and Maintenance Materials

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

SECTION 01821 – Instruction of Operations and Maintenance Personnel

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

SECTION 09900 – Painting

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

SECTION 11295 – Hydraulic Valves

Include Section 11295 – Hydraulic Valves attached as Attachment One of this Procurement Package.

SECTION 11314 – End Suction Centrifugal Pumps

Include Section 11314 – End Suction Centrifugal Pumps attached as Attachment One of this Procurement Package.

SECTION 11371 – Positive Displacement Blowers

Include Section 11371 – Positive Displacement Blowers attached as Attachment One of this Procurement Package.

SECTION 11372 – Air Compressors

Include Section 11372 – Air Compressors attached as Attachment One of this Procurement Package.

SECTION 11500.1 – Membrane Equipment System

Include Section 11500.1 – Membrane Equipment System attached as Attachment One of this Procurement Package.

SECTION 13127 – Extruded Flat Panel Covers

Include Section 13127 – Extruded Flat Panel Covers attached as Attachment One of this Procurement Package.

SECTION 13445 – Pneumatic Controllers and Control Valves

Include Section 13445 – Pneumatic Controllers and Control Valves attached as Attachment One of this Procurement Package.

SECTION 13447 – Electric Motor Actuators

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

SECTION 15062 – Steel Pipe

Include Section 15062 – Steel Pipe attached as Attachment One of this Procurement Package.

SECTION 16160 – Enclosures

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

SECTION 16161 – Control Panels

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

SECTION 16225 – Electric Motors 250 HP or Less

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

SECTION 16481 – Motor Control Centers

Include Section 16481 – Motor Control Centers attached as Attachment One of this Procurement Package.

SECTION 16485 – Variable Frequency Drives Low Voltage

Include Section 16485 – Variable Frequency Drives Low Voltage attached as Attachment One of this Procurement Package.

SECTION 17137 – Magnetic Flow Meters

Include Section 17137 – Magnetic Flow Meters attached as Attachment One of this Procurement Package.

SECTION 17451 – Programmable Logic Controller Hardware

Include Section 17451 – Programmable Logic Controller Hardware attached as Attachment One of this Procurement Package.

SECTION 17452 – Programmable Logic Controller System Software and Accessories

Include Section 17452 – Programmable Logic Controller System Software and Accessories attached as Attachment One of this Procurement Package.

SECTION 17455 – Operator Interface Terminal Software and Hardware

Include Section 17455 – Operator Interface and Terminal Software and Hardware attached as Attachment One of this Procurement Package.

II. FIGURES (PRELIMINARY – FOR REFERENCE ONLY)

I-0.00 – Instrumentation Standard Symbol and Legend

I-0.00 – Instrumentation Standard Symbols and Legend attached as Attachment Two of this Procurement Package.

I-1.04 – Membrane Filtration System Train No. 1 P&ID

I-1.04 – Membrane Filtration System Train No. 1 P&ID attached as Attachment Two of this Procurement Package.

I-1.08 – Membrane Filtration System Train Permeate Pump No. 1 P&ID

I-1.08 – Membrane Filtration System Permeate Pump No. 1 P&ID attached as Attachment Two of this Procurement Package.

I-1.12 – Membrane Filtration System Backpulse Tank P&ID

I-1.12 – Membrane Filtration System Backpulse Tank P&ID attached as Attachment Two of this Procurement Package.

I-1.13 – Membrane Filtration System CIP Tank P&ID

I-1.13 – Membrane Filtration System CIP Tank P&ID attached as Attachment Two of this Procurement Package.

I-1.14 – Membrane Filtration System CIP Pumps P&ID

I-1.14 – Membrane Filtration System CIP Pumps P&ID attached as Attachment Two of this Procurement Package.

I-1.15 – Membrane Filtration System CIP System P&ID

I-1.15 – Membrane Filtration System CIP System P&ID attached as Attachment Two of this Procurement Package.

I-1.17 – Membrane Filtration System Air Scour Blowers P&ID

I-1.17 – Membrane Filtration System Air Scour Blowers P&ID attached as Attachment Two of this Procurement Package.

ATTACHMENT ONE

GMP 1 - Specifications

SECTION 01010

SUMMARY OF WORK

PART 1 - GENERAL

1.1 SUMMARY

- A. The Work to be accomplished under the GMP 1 (Membrane Pre-Procurement) Contract Documents includes, but is not limited to procuring the following equipment required to install and provide a fully functional Membrane Filtration System:
1. Four Membrane Filtration System Treatment Trains and all accessories at the Reclaimed Water Interconnect Facility (RWIF) located at the Chandler Airport WRF. ✓
 2. Four Permeate Pumps, two CIP Pumps, Two Positive Displacement Blowers, and two Air Compressor Units essential to operate the Membrane Filtration System. ✓
 3. MCCs, VFDs, and Control Panels for operation of the above equipment. ✗
To clarify, MCCs and VFDs fall in the scope of supply by CMAR. See 11500.1, 1.3.A.3.a
- B. The following work/notes pertain to all equipment related to the membrane Filtration System at the RWIF:
- a. Provide minimum of one year warranty, starting upon substantial completion of work, on all warranted materials and labor. ✓
 - b. Provide one year warranty on start-up assistance. ✓
 - c. Provide on-site, hands-on operator training. ✓
 - d. All other miscellaneous work as specified in the Contract Documents. ✗
- SUEZ has marked the Contract Documents (this Specification) to clearly denote what work has been included in SUEZ's scope of supply.
- C. A subsequent package of Contract Documents will include the remainder of the Work for the Chandler RWIF Project including installation of equipment procured as part of this package. ✗ SUEZ's scope of supply does not include installation of equipment.

1.2 ACCESS TO AND FROM THE SITE

- A. The address for the Chandler Airport WRF is 905 East Queen Creek Road.
1. The CONTRACTOR'S personnel shall ingress and egress the site utilizing the existing west entrance to the site. ✓

1.3 DESCRIPTION OF SITE

- A. The Airport WRF site is located southwest of the Chandler Airport. The property is bounded by Queen Creek Road on the north, McQueen Road on the east, and Appleby Road (a dirt road) on the south. The Consolidated Canal passes through the southeast corner of the property. ✓

1.4 PROXIMITY TO CHANDLER MUNICIPAL AIRPORT

- A. The proximity of the Airport WRF site to the Chandler Municipal Airport, as a minimum, can create the following concerns:
1. Aircraft noise levels. ✓
 2. Obstructions to air navigation. ✓
 3. Radio Telemetry Interference. ✓
 4. Bird strike hazards to aircraft. ✓
- B. Obstructions to Air Navigation:
1. Part 77 of the Federal Aviation Regulations (FAR) relates to potential obstructions to air navigation. Due to this Project's proximity to an airport, the FAR requires that a Notice of Proposed Construction be filed with the Federal Aviation Administration (FAA) for this Project. The FAA may require obstruction marking or lighting on construction equipment or may limit the height of construction equipment that can be used on this site. ✓
 2. The CONTRACTOR shall be responsible for notifying the appropriate agencies, obtaining all required permits, and complying with applicable regulations. ✓ Note: SUEZ is not CONTRACTOR
- C. Radio Telemetry Interference:
1. The CONTRACTOR shall be responsible for coordination of construction site communications to prevent interference with aircraft communications and navigation. ✓ Note: SUEZ is not CONTRACTOR
- D. Bird Strike Hazards to Aircraft:
1. There is a potential for serious damage to an aircraft if the aircraft strikes a bird. The potential for bird strikes is increased by open bodies of water, refuse piles, or other activities which may attract birds. ✓
 2. The CONTRACTOR shall be responsible for mitigation of all such activities associated with the Project. ✓ Note: SUEZ is not CONTRACTOR
- E. The CONTRACTOR shall be responsible for public safety related to all Work at the WRF site. ✓ Note: SUEZ is not CONTRACTOR
- F. CONTRACTOR shall provide copies of all documentation/correspondence referenced in this section to the ENGINEER for reference. ✓ Note: SUEZ is not CONTRACTOR

1.5 PROXIMITY TO CHANDLER MUNICIPAL TRANSFER STATION

- A. The City of Chandler Municipal Transfer Station is located adjacent to the Airport WRF. Construction activities shall not interfere with operation of the transfer station. ✓
- B. City of Chandler Solid Waste Management Department utilizes the northwest portion of the site for storage and as a work yard. Construction activities shall not hinder normal operations. ✓

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01300

SUBMITTALS

General Note on Shop Drawing Submittals:
SUEZ proposes to submit Shop Drawings in staggered submissions. This procedure will allow for the CONTRACTOR and ENGINEER to focus on review of submittals most important to keep the project moving forward in a timely manner. Review and approval of one submission provides the proper starting point for SUEZ to complete the next submission, etc. Please refer to SUEZ's Proposal to review SUEZ's proposed staggered Shop Drawing submission schedule.

PART 1 - GENERAL

1.1 SUMMARY

- A. The CONTRACTOR shall include a completed transmittal form for all submittals. Transmittal forms will be furnished to CONTRACTOR by ENGINEER at the pre-construction conference. Submittals shall be sent to the ENGINEER. CONTRACTOR shall deliver and pick up submittals from ENGINEER'S office located at 1620 W. Fountainhead Pkwy, Suite 501, Tempe, AZ 85282, between the hours of 7:00 a.m. and 4:00 p.m. All submittals shall be addressed to Sreeram Rengaraj. ✓

1.2 SECTION INCLUDES

- A. Shop Drawings. ✓
- B. Material and equipment record. ✗ Material and equipment record is maintained by the CONTRACTOR. See item 1.6 below.
- C. Samples. ✗ Samples are not included in SUEZ's scope of supply
- D. Operation and Maintenance (O&M) Manuals. ✓
- E. Progress Schedule. ✓
- F. Progress reports. ✓
- G. Daily reports. ✗ Daily Reports fall in the scope of the CONTRACTOR. See item 1.10 below.
- H. Testing results. ✗ Testing Results fall in the scope of the CONTRACTOR. See item 1.11 below.
- I. ~~Pre-construction video.~~ ✗ Pre-construction video falls in the scope of supply by others.
- J. ~~Construction photographs.~~ ✗ Construction photographs fall in the scope of supply by others.
- K. Record Drawings. ✗ Record Drawings are maintained by the CONTRACTOR. See item 1.13 below.
- L. Spare parts lists. ✓
- M. List of spare parts furnished. ✓

General Clarification: SUEZ has proposed to submit Shop Drawings, Submittals, and O&M Manuals using SUEZ's standard format and numbering, except as noted below. If CONTRACTOR or ENGINEER requires changes or modifications to SUEZ's standard format, including changes or modifications to numbering, or if CONTRACTOR or ENGINEER require additional paperwork for the submission of Shop Drawings, Submittals, and O&M Manuals, this will be added to SUEZ's Proposal Price.

1.3 DATA REFERENCE SYMBOLS AND DESCRIPTIONS

A. The submittal data required for Shop Drawings and operations manuals shall contain, but not necessarily be limited to, that data and material as defined by the coded legend set forth below. The submittal data required shall be as indicated and specified under various headings of the Specifications. ✓

1. Letters of Certification of Compliance on materials, equipment, etc. ✓

2. ~~Samples.~~ ✗ Samples do not fall in SUEZ's scope of supply

3. Final Certified Drawings showing outline dimensions, foundation layout or mounting information, and other pertinent dimensions. ✓

4. ~~Field erection instructions, assembly drawings and/or diagrams, detailed reference drawing lists, lists of erection details, and list of spare parts supplied with equipment.~~ ✗

Clarification to 1.3.A.4 and 5: SUEZ will submit membrane tank General Arrangement Drawings and field assembly drawings only.

5. Shop Detail Drawings showing individual sub- assemblies and fabricated pieces with material specifications and other applicable data. ✗

6. Installation instructions, operating and/or service manuals, and all other data pertinent to operating or servicing the complete apparatus. Preventative maintenance instructions and recommended frequency. ✓

7. ~~Schematic and wiring diagrams of power, control, and piping systems.~~ A detailed description of operation shall be included for each diagram to describe all modes of operation of the system indicated. Where the integrated system requires interlocking and control of other components in normal operation, these components shall be included in the description of operation. ✗

SUEZ is supplying loose-ship equipment. Interconnecting wiring and piping falls in the scope of supply by others, thus SUEZ will not submit schematic wiring diagrams of power, control, and piping systems.

8. General bulletins and catalog cuts ~~describing complete apparatus, including operating principles and fundamentals.~~ ✗

9. ~~Service data sheets showing design performance, utility requirements, etc., as applicable to the specific duty for which the equipment is furnished.~~ ✗

10. Certified head and capacity curves for pumps. Impeller size furnished and maximum size available shall be noted on these data sheets. ✓

11. Curves and/or data ~~for overall range of operation from minimum to maximum capacity or load, showing capacity or load, utilities motive medium required, total or incremental differential head, and other pertinent information applicable to the equipment or its component assemblies.~~ ✗

12. Materials of construction of ~~all components.~~ ✗ Materials of construction of major components, not all.

SUEZ will submit Spare Parts List after completion of Shop Drawings, with the Draft O&M Manual.

13. ~~Renewal parts list with diagrammatic or cross-section drawings showing part identification. Material analysis or trades designation for each significant part is to be noted on parts lists or on a separate sheet.~~ ✗ Will provide a spare parts list only.

14. Stuffing box sizes; packing sizes; specifications and arrangement; and mechanical seal details, specifications, etc., if furnished in equipment. ✓

15. Bearing manufacturer's standard identification and/or interchangeable number for all anti-friction bearings in the equipment proper and its accessory items. ✓

16. ~~Material gradation, design mix, job mix formula, and/or material analysis.~~ ✗ Scope of supply by others.

17. ~~Concrete reinforcement drawings, details, and calculations.~~ Reinforcement drawings shall be redrawn by the CONTRACTOR to allow for clarity and scale necessary for easy review by the ENGINEER. ✗

Concrete reinforcement drawings do not fall in the scope of supply by SUEZ

18. Completed equipment data sheets. ✓

- B. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration. ✓

- C. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.** ✗

1.4 SHOP DRAWINGS

SUEZ will submit its Shop Drawing packages electronically only. The CONTRACTOR may print in hard copy to submit to the ENGINEER, if necessary.

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

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

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

- C. One copy of returned Shop Drawings shall be marked with red line comments. ✓
- D. Only one copy of "Revise and Resubmit", "Rejected", and "No Action Taken" Shop Drawings will be stamped. ✓
- E. If the CONTRACTOR requires additional copies of "No Exceptions Noted", "Exceptions Noted", or "No Action Taken" Shop Drawings, additional copies shall be included in original submittal. ✓
- F. The CONTRACTOR may request submittals be reviewed up to two times for each equipment or construction material item, regardless of manufacturer or supplier, by the ENGINEER. For additional reviews, CONTRACTOR will reimburse the ENGINEER for additional labor ~~as specified in Section 01013, Engineering Services.~~ ✗ Section 01013 is not included in these Specifications
- G. The CONTRACTOR will be held responsible for any delay in progress of the Work due to resubmittal of Shop Drawings. Time for completion of the Contract will not be extended due to the CONTRACTOR'S failure to promptly submit complete and acceptable Shop Drawings, product data, and samples. ✗
- H. Do not execute Work required by Shop Drawings until accepted Shop Drawings are received from the ENGINEER. ✓
- I. Before submitting Shop Drawings for review, the CONTRACTOR shall check Shop Drawings for accuracy, ascertain that all Work contiguous with and having bearing on other Work shown on Shop Drawings is accurately drawn, and that Work shown is in conformity with Contract requirements. The CONTRACTOR is responsible for all submittals from subcontractors and suppliers. ✓
- J. All such Drawings and details, when submitted, must bear the stamp of approval of the CONTRACTOR, bearing checked data, as evidence that such Drawings and details have been checked by him. Said "stamp" shall clearly state that the CONTRACTOR has checked the Drawings and, by his signature, he so certifies. Any Drawings submitted without such executed stamp of approval, or whenever it is evident (despite the stamp) that the Drawings have not been checked, they will be returned to the CONTRACTOR for resubmission and will not be considered. In such event, it will be deemed that the CONTRACTOR has not complied with this provision and the CONTRACTOR shall bear risk of all delays to the same extent as if no Drawings or details had been submitted. ✗
- K. The CONTRACTOR shall prepare composite Drawings and installation layouts, when required to solve tight field conditions. Such Drawings shall consist of dimensioned plans and elevations, and must give complete information particularly as to size and location of sleeves, inserts, attachments, openings, conduits, ducts, boxes, structural interferences, etc. These composite Drawings and installation layouts shall be coordinated in the field by the CONTRACTOR

SUEZ's preference is for returned Shop Drawings to be returned electronically.

Time for completion of the Contract will be extended if delay is due to changes from the ENGINEER, or out of SUEZ's control.

Clarification: This item falls in the scope of the CONTRACTOR, not SUEZ. For SUEZ's Drawings, SUEZ does not stamp or show checking over Supplier drawings

and his subcontractors for proper relationship to the work of other trades, based on field conditions, and shall be checked and approved by them before submission to the ENGINEER for his final review. The CONTRACTOR shall have competent technical personnel readily available for such coordinating and checking, as well as for supervision of field installation of work as per the Drawings and installation layouts, which have been previously determined by him to be correct and carry the ENGINEER'S review stamp. ✓

This item does not fall in SUEZ's scope of supply. SUEZ is not CONTRACTOR.

- L. Submission of Shop Drawings (in either original submission or when resubmitted with corrections) constitute evidence that the CONTRACTOR has checked all information thereon, and that he accepts and is willing to perform the Work as shown in a workmanlike manner and in accordance with best standard practice. ✓

This item does not fall in SUEZ's scope of supply. SUEZ is not CONTRACTOR

- M. Cost of any changes in construction due to improper checking and coordination by the CONTRACTOR shall be paid for by the CONTRACTOR, and the CONTRACTOR shall be responsible for all additional costs, including coordination. ✓

This item does not fall in SUEZ's scope of supply. SUEZ is not CONTRACTOR.

- N. Shop Drawings shall clearly delineate the following information:

1. ENGINEER'S name and Project number; Project name and address. ✓

2. Drawing title, number, date, and scale. ✓

3. ~~Names of CONTRACTOR, Subcontractor, and fabricator.~~ ✗

Not included on SUEZ drawings

4. ~~Working and erection dimensions.~~ ✗

Erection not in SUEZ scope of supply

5. Arrangements and sectional views. ✓

6. Necessary details, including complete information for making connections with other work. ✓

7. ~~Kinds of materials and finishes.~~ ✗

Finishes not shown on SUEZ drawings

8. ~~Show descriptive names of materials and equipment, classified item numbers, and locations at which materials or equipment are to be installed in the Work. Use same reference identification as shown on Contract Drawings.~~ ✗

SUEZ is not responsible for layout drawings of the entire system, therefore Shop Drawings will not show locations at which materials or equipment are to be installed in the Work.

- O. ~~If Shop Drawings show variations from Contract Documents because of standard shop practice or other reasons, make specific mention of such variations in a separate memo attached to information listed in Paragraph 1.3.B of this Section.~~ ✗

Not included in SUEZ's scope of supply.

- P. Shop drawing review will be general. It shall not relieve the CONTRACTOR of responsibility for accuracy of such Shop Drawings, nor proper fitting, construction of Work, furnishing of materials, or Work required by Contract Documents and not indicated on Shop Drawings. Shop drawing review shall not be construed as approving departures from Contract Documents. ✓

- Q. Review of Shop Drawings and schedules shall not relieve the CONTRACTOR from responsibility for any violation indicated on such Drawings or schedules of local, County, State, or Federal laws, rules, ordinances, or rules and regulations of commissions, boards, or other authorities or utilities having jurisdiction. ✓

- R. When product data, consisting of manufacturer's printed literature, is required to be submitted to the ENGINEER, it shall be submitted in original form. Any fading type of reproduction will not be accepted. Pertinent information shall be indicated and irrelevant information shall be crossed out. ~~✗~~
SUEZ will not cross out information on vendor documents.
- S. ~~Action taken by ENGINEER shall apply to entire submittal. ENGINEER shall not approve portions of a submittal while disapproving other portions. ✗~~
- T. Resubmitted submittal shall contain entirety of information to review. ✓
- U. The following is a list of anticipated submittals for this project, however it may not be a complete list. This list does not alleviate Contractor from obligations of requirements of each individual Technical Specification that may require additional information. See individual Technical Specification Sections for additional requirements. ~~✗~~

SUEZ strongly recommends approval of parts of submittals as this helps reduce the overall schedule. See SUEZ's proposed staggered submittal process in SUEZ's Proposal.

CHANDLER RWIF – PROCUREMENT SUBMITTAL LISTING		
ITEM NO.	SPEC SECT	DESCRIPTION OF SUBMITTAL
1	01650	STARTING OF SYSTEMS
2	01730	OPERATION AND MAINTENANCE DATA
3	01750	SPARE PARTS AND MAINTENANCE MATERIALS
4	01821	INSTRUCTION OF O & M PERSONNEL
5	09900	~~PAINTING~~
6	11314	END SUCION CENTRIFUGAL PUMPS
7	11371	POSITIVE DISPLACEMENT BLOWERS
8	11372	AIR COMPRESSORS
9	11500	MEMBRANE EQUIPMENT SYSTEM
10	16160	ENCLOSURES
11	16161	CONTROL PANELS
12	16225	ELECTRIC MOTORS 250 HORSEPOWER OR LESS
13	16481	~~MOTOR CONTROL CENTERS~~
14	16485	~~VARIABLE FREQUENCY DRIVES LOW VOLTAGE~~
15	17137	MAGNETIC FLOW METERS

SUEZ will provide vendor's standard paint specifications for review.

See specification Section 11500.1, item 1.3.A.3.a. Motor Control Centers and Variable Frequency Drives fall in the scope of supply of the CMAR, thus SUEZ is not responsible for Submittals listed in those sections of the specification.

1.5 PROCEDURE

- A. A letter of transmittal shall accompany each submittal. ~~If data for more than one Section of the Specifications is submitted, a separate transmittal letter shall accompany the data submitted for each Section. ✗~~

SUEZ will only submit one (1) letter of transmittal per submittal. The letter will clearly define all the sections that are included in the Submittal.

- B. All letters of transmittal shall be submitted in ~~duplicate. ✗~~
electronic format

C. At the beginning of each letter of transmittal, provide a reference heading indicating the following: ✓

1. OWNER'S Name City of Chandler
2. Project Name RWIF
3. Contract No. _____
4. Transmittal No. _____
5. Section No. _____

D. If any portion of a Shop Drawing deviates from the requirements of the Contract Documents, ~~CONTRACTOR shall specifically note each variation in his letter of transmittal.~~ ✗ Revisions to SUEZ's Drawings will be indicated on the Drawings, not in a letter of transmittal

E. All Shop Drawings submitted for approval shall have a title block with complete identifying information satisfactory to ENGINEER. ✓

F. ~~All Shop Drawings submitted shall bear the stamp of approval and signature of CONTRACTOR as evidence that they have been reviewed and verified to the completeness of the submittal by CONTRACTOR. Submittal without this stamp of approval will not be reviewed by ENGINEER and will be returned to CONTRACTOR. CONTRACTOR'S stamp shall contain the following minimum information:~~ ✗

This item does not fall in SUEZ's scope of supply. SUEZ is not CONTRACTOR.

~~Project Name:~~ RWIF

~~CONTRACTOR'S Name:~~ _____

~~Date:~~ _____

~~-----Reference-----~~

~~Item:~~ _____

~~Specifications:~~

~~Section:~~ _____

~~Page No.:~~ _____

~~Para. No.:~~ _____

~~Drawing No.:~~ _____ of _____

~~Location:~~ _____

~~Submittal No.:~~ _____

~~Approved By:~~ _____

G. ~~In order to identify and track all submittals as separate and unique items, CONTRACTOR shall utilize the submittal identification numbering system as follows:~~ ✗

1. ~~The Submittal Number shall be a separate and unique number correlating to each individual submittal that is required to be tracked as a separate and unique~~

SUEZ has a standard numbering system to identify and track all submittals.
SUEZ's standard number system will be used.

~~item. The Submittal Number shall be a two part, nine character, alpha/numeric number assigned by CONTRACTOR in the following manner:~~

- ~~a. The first part of the Submittal Number shall consist of five characters that pertain to the applicable Specification Section number.~~
- ~~b. The second part of the Submittal Number shall consist of three numbers. The first digit identifies the Submittal type as follows:
 - ~~1) 0 - Shop Drawing.~~
 - ~~2) 1 - Operations and Maintenance Manual.~~
 - ~~3) 2 - Training Manual.~~~~
- ~~c. The second and third digits (numbers 01 to 99) number each separate and unique Submittal submitted under each Specification Section.~~
- ~~d. A dash shall separate the two parts of the Submittal Number.~~
- ~~e. A typical Submittal Number for the third Working Shop Drawing submitted under Section 11400, Disc Filter System, would be 11400-0.03.~~
- ~~f. A typical Submittal Number for the first Working Operations and Maintenance Manual submitted under Section 11285, Hydraulic Gates, would be 11285-1.01.~~

1.6 MATERIAL AND EQUIPMENT RECORD

Clarification: Material and Equipment Record falls in the scope of the CONTRACTOR, not SUEZ
SUEZ is Supplier.

- A. The CONTRACTOR shall maintain an up-to-date record of all materials and equipment furnished by him and any subcontractors to be incorporated in the Work.
 1. The ENGINEER will furnish the CONTRACTOR a master of the materials and equipment form. The CONTRACTOR shall maintain the records on reproductions of this form in the field office. ✓
- B. The CONTRACTOR shall provide the following information on these forms:
 1. The Specification Paragraph and Section Number where material or equipment are called for. ✓
 2. Date ordered. ✓
 3. Date required. ✓
 4. The CONTRACTOR'S purchase order number. ✓
 5. Supplier's purchase order number. ✓
 6. Date promised. ✓
 7. Date received. ✓
 8. Supplier's name and address. ✓
 9. Remarks. ✓
 10. Shop Drawings and samples with approval date. ✓
 11. Physical dimensions and ratings. ✓
 12. Where submittal sheet describes items in addition to that item being submitted, the submitted item shall be clearly marked on the sheet and superfluous information shall be crossed out. ✓

- C. Three copies of the materials and equipment record shall be submitted to the ENGINEER with each Application for Payment. If the current record has not been submitted, the Application shall not be reviewed and shall be returned to the CONTRACTOR as incomplete. ✓
- D. The CONTRACTOR shall permit free access to these records, including information on items recently received and not yet posted to the record by the ENGINEER or authorized representative of the OWNER at any time. ✓

1.7 SAMPLES ✗ Samples are not included in SUEZ's scope of supply.

- ~~A. Deliver no material to the building site prior to receipt of the ENGINEER'S written approval. Furnish materials equal in every respect to approved samples and execute Work in conformity therewith. Samples shall be provided with respective Shop Drawings.~~
- ~~B. The approval or acceptance of samples will not preclude the rejection of any material upon the discovery of defects in same prior to the Final Acceptance of the completed Work.~~
- ~~C. After a material has been approved, no change in brand or make will be permitted unless satisfactory written evidence is presented to and approved by the ENGINEER that the manufacturer cannot make scheduled delivery of approved material, or that material delivered has been rejected and substitution of suitable material is an urgent necessity, or that other conditions are apparent which indicate approval of such substitute materials to be in best interest of the OWNER. CONTRACTOR shall provide complete Shop Drawings for replacement product.~~
- ~~D. All samples of materials requiring laboratory tests shall be submitted to laboratory for testing not less than 90 days before such materials are required to be used in the work. Submit all other samples for approval within 30 days after signing of the Contract.~~
- ~~E. Submit samples in duplicate, except where greater or lesser number is specifically required by these Specifications. Submittal shall be made only by the CONTRACTOR, unless he has authorized his subcontractor to submit them and has notified the ENGINEER to this effect.~~
- ~~F. Each sample shall be accompanied by a Shop Drawing form and an itemized transmittal form. The transmittal shall contain list of samples, Project, CONTRACTOR, manufacturer, brand, quarry, quality, etc.; also Project number, Specifications reference, ASTM number (if any), and material being furnished. Enclose copies of transmittal with samples. Any deviation from Contract requirements shall be so stated in the transmittal.~~

- ~~G. Label each sample by a securely attached label giving the Project, CONTRACTOR, subcontractor or supplier, manufacturer's name, product trade name and number, material type, Specification Section and Paragraph reference etc.; also Project name and number and ASTM number (if any).~~
- ~~H. Samples shall be of adequate size to permit proper evaluation. The samples submitted shall show the full range of colors, textures and dimensions, and other variable characteristics expected. Samples of different items that must match or whose finish relates shall be delivered at the same time to facilitate coordination.~~
- ~~Samples which are rejected by the ENGINEER must be resubmitted as soon as possible after notification of rejection, and shall be marked "Resubmitted Sample" in addition to other information required.~~
- ~~I. The right is reserved to require submission of samples of any material, any material lists, or any information whether or not specifically specified in the Specifications.~~

1.8 OPERATION AND MAINTENANCE MANUALS

- A. One hard copy and one electronic copy in PDF format of an Operations and Maintenance (O&M) Manual containing the following items, in addition to any instructions packed with the equipment, are required for each individual item of equipment:
1. Specifications. ✓
 2. Drawings. ✓
 3. Description of each individual item of equipment. ✓
 4. Manufacturer name, model number, and serial numbers. ✓
 5. Name address and phone number of both the manufacturer's customer service department and the local manufacturer's representative. ✓
 6. Installation instructions. ✓
 7. Operation and maintenance instructions, including lubrication schedule and lubricant specification. ✓
 8. Parts list and part numbers. ✓
 9. Additional data to be included in the manual shall be as required in these Specifications. ✓
 10. Temporary storage recommendations. ✓
 11. ~~Warranty information.~~ ✗ Warranty information for equipment supplied by SUEZ is not included in the O&M Manual.
- B. O&M Manuals are to be submitted to the ENGINEER upon delivery of the equipment to the site. Overall Project substantial completion will not be scheduled until all manuals are approved. Training shall not be scheduled until O&M Manuals are approved. Training shall not be scheduled until 30 days following delivery of approved O&M Manuals to the OWNER. Training shall be scheduled based on draft O&M Manuals upon approval of ENGINEER. ✓

- C. The respective manuals for the individual items of equipment shall be combined into bound volumes covering the complete operating installation with individual equipment items tabled separately. Information for equipment subassemblies not manufactured by the major supplier shall also be included with the respective equipment item. ✓
- D. Manuals for particular items of equipment which are in the same area (i.e., Permeate Pumps and Pneumatic Valves) should be bound in the same volume where practicable. ✓
- E. Upon completion of the installation of each item of equipment, the CONTRACTOR shall provide As-Built Drawings of the local control panel to be added to the O&M Manual, as well as set-up parameters such as those required for VFDs, instrumentation, calibration, etc. Manuals for particular items of equipment which are in the same area (i.e., belt press, belt press feed pumps, and conveyors) should be bound in the same volume where practicable. ✓ NOTE: SUEZ is not CONTRACTOR
- F. O&M Manuals shall be submitted in 3-ring binders meeting the following criteria:
1. Binders shall be Wilson Jones Custom View Organization, D-Ring, white, non-stick, back mounted, binder models 362-13W, 386-14W, 386-34W, 386-44W, 386-49W, or 386-54W; or approved equal. ✓ SUEZ will provide an "approved equal".
 2. Binder cover insert shall be created using a Microsoft word template supplied by ENGINEER. Modifications to the template shall be approved by the ENGINEER prior to submission of the O&M Manuals. The binder cover insert shall include the Specification number and title as presented within the Contract Documents, manufacturer name, year of purchase, year and month that equipment was placed into operation. ✓
 3. Binder spine insert shall be created using a Microsoft word template supplied by ENGINEER. Modifications to the template shall be approved by the ENGINEER prior to submission of the O&M Manuals. The spine insert shall include the Specification number and title as presented within the Contract Documents, manufacturer name, year of purchase, year and month that equipment was placed into operation. Spine insert shall read top to bottom. ✓

1.9 PROGRESS SCHEDULE

Section 01310 is not included in these Specifications

- ~~A. Progress Schedule as defined in Section 01310, Progress Schedule. ✗~~

1.10 DAILY REPORTS

Clarification: Daily Reports fall in the scope of the CONTRACTOR, not SUEZ.

- A. The CONTRACTOR will provide to the ENGINEER a daily report on a form provided by the ENGINEER indicating the Work in progress, Work completed, equipment used, numbers and category of personnel, and such other pertinent information as applicable. The daily reports shall be compiled and submitted monthly with the Application for Payment. The Application for Payment will not

be reviewed and shall be returned to the CONTRACTOR as incomplete if the reports do not accompany it. ✓

1.11 TESTING RESULTS

Clarification: Testing Results fall in the scope of the CONTRACTOR, not SUEZ.

- A. CONTRACTOR shall furnish to the ENGINEER copies of all testing results for all tests required in the Specifications. ✓

1.12 CONSTRUCTION PHOTOGRAPHS

Clarification: Construction Photographs fall in the scope of supply of the CONTRACTOR, not SUEZ

- ~~A. Construction photographs as defined in Section 01380, Construction Photographs. ✗~~
Section 01380 is not included in these Specifications

1.13 RECORD DRAWINGS

Clarification: Record Drawings fall in the scope of supply of the CONTRACTOR

Section 01700 is not included in these Specifications

- ~~A. Record Drawings as defined in Section 01700, Contract Closeout. The~~
CONTRACTOR shall update Record Drawings Monthly and make available for review to the ENGINEER monthly one week prior to the Application for Payment submittal. Failure of the CONTRACTOR to maintain updated Record Drawings can be justification for refusal of Application for Payment. ✗

1.14 UNIT RESPONSIBILITY

Clarification: Unit Responsibility falls in the scope of supply of the CONTRACTOR, not SUEZ.

- A. This Section contains the required Unit Responsibility Form for the CONTRACTOR to use in documenting Work required under this Contract. ✓
- B. The Unit Responsibility Form provided in Appendix A to this Section is referenced from other Sections in the Contract Documents. The CONTRACTOR shall submit it with the applicable equipment as required in those Sections. ✓

1.15 CONTRACTOR'S FORMS

Clarification: Contractor Forms fall in the scope of supply of the CONTRACTOR, not SUEZ.

- A. This Section contains the required forms for CONTRACTOR use in documenting testing Work and other Work required under this Contract. This Section supplements, but does not supersede, specific testing requirements found elsewhere in the Contract Documents. ✓
- B. The forms listed below are included in this Section are referenced from other Sections in the Contract Documents. CONTRACTOR may utilize standard forms when authorized by ENGINEER. Forms will include, but will not necessarily be limited to, the following. ✓

<u>Form Designation</u>	<u>Title</u>

A	Schedule of Values
B	Shop Drawings, Product Data and Sample Transmittal Schedule

C	Request for Change Order Proposal
D	Change Order Proposal
E	Request for Information
F	Request for Alteration
G	CONTRACTOR'S Daily Construction Report
H	Equipment Information Form
I	Manufacturer's Installation Certification Form
J	Equipment Test Report Form
K	Operation and Maintenance Transmittal Form
L	Manufacturer's Instruction Certification Form
M	Motor Data Form
N	Wire and Cable Resistance Test Data Form
O	Installed Motor Test Data Form
P	Dry Transformer Test Data Form
Q	Motor Control Center Test Form
R	Medium Voltage Motor Starter Test Form
S	Medium Voltage Switchgear Test Form
T	Protective Relay Test Form
U	Low Voltage Switchgear Test Form
V	Medium Voltage Load Interrupter Switch Test Form
W	Liquid-Filled Transformer Test Form
X	Automatic Transfer Switch Test Form
Y	Neutral Grounding Resistor Test
Z	Conduit and Wire Termination Sheet (not included)
AA	Loop Wiring and Insulation Resistance Test Data Form
BB	Control Circuit Piping Leak Test Form
CC	Controller Calibration Test Data Form
DD	Panel Indicator Calibration Test Data Form
EE	Recorder Calibration Test Data Form
FF	Signal Trip Calibration Test Data Form
GG	Field Switch Calibration Test Data Form
HH	Transmitter Calibration Test Data Form
II	Miscellaneous Instrument Calibration Test Data Form
JJ	Individual Loop Test Data Form
KK	Loop Commissioning Test Data Form
LL	Pipe Test Report

- C. CONTRACTOR shall complete the above referenced forms prior to start-up of each piece of equipment, as listed in the Equipment and Valve Schedule. Each form shall pertain to each equipment number. 
- D. The CONTRACTOR shall submit to ENGINEER for approval one month after completion of start-up, 3-ring binders with tabs for each process area and include all the forms completed prior to start-up. The forms shall be further tabbed within each process area of each form designation as listed above. For example, the

Chemical Facilities tab (22) shall include separate tabs for forms H, J, K, and etc.
The CONTRACTOR shall submit five copies of all 3-ring binders to the
ENGINEER for approval. ✓

E. All forms are provided in Appendix B of this Section. ✗

There is no Appendix B of this Section.

1.16 ADDITIONAL SUBMITTALS

A. All additional submittals as required by the Contract Documents. ✓

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

APPENDIX A - Unit Responsibility Form

(Job Title)

**CERTIFICATE OF UNIT RESPONSIBILITY
for Specification Section _____**

(Section title)

*In accordance with Paragraph 01600.1.2.B of the Contract Documents,
the undersigned manufacturer accepts unit responsibility for all
components of equipment furnished under specification
Section _____. We hereby certify that these components are
compatible and comprise a functional unit suitable for the specified
performance and design requirements.*

Notary Public

Name of Corporation

Commission expiration date

Address

Seal:

By: _____
Duly Authorized Official

Legal Title of Official

Date: _____

SECTION 01640

MATERIALS AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. The CONTRACTOR shall furnish all materials and equipment and perform all operations required to completely install and place in operation the various mechanical apparatus and systems indicated on the Drawings and as specified herein. It is not the intention to mention herein each and every item required. However, all installations shall be complete and operable in the methods intended. These general equipment requirements apply, in general, to all equipment. They shall supplement the detailed Equipment Specifications, but in case of conflict, the Equipment Specifications shall govern. ✓

1.2 RELATED SECTIONS

- A. Section 01300, Submittals. ✓

PART 2 - PRODUCTS

2.1 GENERAL

- A. Materials and equipment shall be of new, of first quality and best grade, essentially the standard catalog products of reputable manufacturers, and shall be of the type, size, and capacity, and for the type of service specified. It is the intent of these Specifications that the highest quality equipment shall be provided for the intended service. Units proposed shall be carefully matched to the particular hydraulic and mechanical requirements for each installation, and the CONTRACTOR shall submit complete hydraulic and mechanical data for approval of the ENGINEER. Where two or more units of the same class of equipment are required, these units shall be the products of a single manufacturer; however, the component parts of the system need not be the products of the same manufacturer unless otherwise specified. ✓
1. Materials and Workmanship. Materials used in the manufacture of the equipment shall be of the best quality used for the purpose in commercial practice. Materials shall be suitable for service conditions. Iron castings shall be tough, close-grained gray iron free from blowholes, flaws, or excessive shrinkage, and shall conform to ASTM A48. Except where otherwise specified, structural and miscellaneous fabricated steel used in items of equipment shall conform to the Standards of the American Institute of Steel Construction. All structural members shall be considered as subject to shock or vibratory loads. Unless otherwise specified, all steel which will

be submerged, all or in part, during normal operation of the equipment shall have a minimum nominal thickness of 1/4-inch. Equipment shall be installed in accordance with the recommendations of the manufacturer and the best standard practice for each type of equipment. ✓

The pump vendor commented that they will submit their standard GA drawing in PDF format.

It is unclear what the "coded legend set forth in Section 01300, Submittals" is referring to. It is assumed it is something that does not fall in SUEZ's scope of supply.

The pump vendor commented that they will provide a 300 series stainless steel nameplate.

2. Approval of Materials, Equipment, and Shop Drawings. Detailed Shop Drawings shall be prepared for the equipment to be furnished under this Project. ~~General Drawings for equipment will not be acceptable.~~ Approval of equipment under this provision shall not be construed as authorizing any deviations from the Specification unless the attention of the ENGINEER has been directed to the specific deviation. ✗
 - a. The decision of the ENGINEER on any questions concerning the acceptability of materials, equipment, or installation shall be final and binding. ~~The Shop Drawing material required for the various submittals shall be in accordance with the coded legend set forth in Section 01300, Submittals, and as indicated and specified under various headings of these specifications.~~ ✗
3. Nameplates: Equipment shall be furnished with nameplates of bronze, monel, or stainless steel. Aluminum will not be acceptable. Each nameplate shall include pertinent hydraulic and mechanical data. Information shown shall be permanently stamped or cast into each nameplate and shall include the manufacturer's name and model number. ✓
4. ASME Stamp: Where materials and equipment are specified to be constructed in accordance with the standard of the American Society of Mechanical Engineers Code for Unfired Pressure Vessels, the CONTRACTOR shall submit proof that the items furnished under this Section of the Specifications conform to such requirements. The ASME stamp, label, or listing will be acceptable as sufficient evidence that the items conform to these requirements and shall be provided on all pressure vessels falling within the ASME Code jurisdiction. ✓

B. Electric Motors:

1. General: Unless otherwise required by the detailed equipment specifications, motors furnished with equipment shall be rated for continuous duty at 50° C ambient temperature with a 1.15 service factor. Motors designated for use with variable speed drives and where indicated shall be derated to accommodate the application. Where frequent starting occurs, motors shall be designed for frequent starting duty equivalent to the duty service required by the driven equipment. The horsepower rating of each motor shall be as required to drive the equipment under full load, including all losses in speed reducers and power transmission, and to be non-overloading over the entire range of equipment head capacity curves without the use of motor service factors. It is the intent of this general specification to allow the manufacturer's standard motor on integrally constructed motor driven equipment such as appliances, hand tools, etc., that is specified by model number in which a redesign of the complete unit would be required for a motor with other features as may be specified herein. All motors furnished

under these Specifications shall be of recognized manufacture, of adequate capacity for the loads involved, and wound to the current characteristics noted. All motors shall conform to the standards of manufacture and performance of the National Electrical Manufacturers Association as shown in their latest publications. ✓

2. Enclosures: Unless otherwise required by the detailed equipment specifications, the enclosures for motors shall be as indicated below:
 - a. Motors installed outdoors shall be totally enclosed or totally enclosed fan-cooled except that vertically mounted motors may be weather protected Type I. ✓
 - b. Motors installed indoors may be open drip-proof unless otherwise indicated. ✓
3. Motor horsepower requirements in the equipment specifications are estimated. If the horsepower requirements for the equipment furnished vary from the estimated horsepower, the CONTRACTOR shall be responsible for making all necessary revisions to wiring, conduit, motor starters, circuit breaker, and other electrical equipment at no additional cost to OWNER. ✗
4. Anchor Bolts: Equipment suppliers shall furnish suitable anchor bolts of specified metallurgy for each item of equipment. Anchor bolts, together with templates or setting drawings, shall be delivered sufficiently early to permit setting the anchor bolts when the structural concrete is placed. Two nuts shall be furnished for each bolt. Unless otherwise shown or specified, anchor bolts for items of equipment mounted on baseplates shall be long enough to permit 1-1/2-inch of grout beneath the base plant and to provide adequate anchorage into structural concrete. ✗
5. Equipment Bases: A cast iron or welded steel baseplate shall be provided for each pump and other item of equipment which is to be installed on a concrete base. Each baseplate shall support the unit and its drive assembly, and shall be of a neat design with pads for anchoring the units. Baseplates shall be anchored to the concrete base with suitable anchor bolts and grouted in place. ✗
6. Equipment Guards: All belts or chain drives, fan blades, couplings, and other moving or rotating parts shall be covered on all sides by a safety guard. All safety guards in outdoor locations shall be designed to prevent the entrance of rain and dripping water. ✗
7. Special Tools and Accessories: Equipment requiring periodic repair and adjustment shall be furnished complete with all special tools, instruments, and accessories required for proper maintenance. Equipment requiring special devices for lifting or handling shall be furnished complete with those devices. ✗
8. Standard specifications prepared by recognized organizations mentioned elsewhere shall govern except as provided otherwise by these specifications and/or its accompanying drawings. Special care shall be exercised in requests for quotations and in orders, to refer to the standard specifications and to all modifications thereof. ✓
9. Standard Codes, Regulations, and Specifications: Unless indicated or specified otherwise, all materials and workmanship for the mechanical trades

Clarification: Where horsepower requirements for SUEZ equipment varies from what is listed in these specifications, SUEZ has provided comment and will NOT be responsible for making all necessary revisions, etc. SUEZ is not CONTRACTOR

Anchor bolts fall in the scope of supply of the CMAR. See Section 11500.1, item 1.3.A.1.c.

The pump vendor commented that they will be supplying their standard fabricated steel bedplates.

The pump vendor will supply their standard guards that have openings. The pump vendor can supply solid guards (shaft guards and coupling guards) for an additional cost, but cannot guarantee that they will prevent the entrance of rain and dripping water.

SUEZ's Proposal Price does NOT include Special Tools and Accessories except as noted in SUEZ's Proposal. Any additional Special Tools and Accessories will be at additional cost.

shall conform to the editions of the various standards, codes, manuals, and specifications in effect on the date of advertisement for bids, which are referred to in the various sections herein. ✓

PART 3 - EXECUTION

3.1 PROTECTION OF EQUIPMENT

- A. General. All equipment shall be boxed, crated, or otherwise completely enclosed and protected during shipment, handling, and storage. All equipment shall be protected from exposure to the elements and shall be kept thoroughly dry at all times. ✗ Clarification: This item falls in the scope of the CONTRACTOR.
- B. Painted surfaces shall be protected against impact, abrasion, discoloration, and other damage. All painted surfaces which are damaged prior to acceptance of equipment shall be repainted to the satisfaction of the ENGINEER. ✗
Clarification: This item falls in the scope of the CONTRACTOR.
- C. Electrical equipment, controls, and insulation shall be protected against dust, moisture, or water damage. ✗ Clarification: This item falls in the scope of the CONTRACTOR

3.2 INSTALLATION

- A. Installation of materials and equipment specified herein shall be performed in a workmanlike manner by mechanics skilled in their particular trade. Piping and equipment shall be installed square and plumb and accessible for proper operation and service. Installations shall be consistent in completeness and appearance whether enclosed or exposed. Any item which does not present a neat and workmanlike appearance shall be replaced without additional cost to OWNER. ✗
Clarification: This item falls in the scope of the CONTRACTOR

3.3 ELECTRIC WIRING

- A. The CONTRACTOR shall do all electric wiring of every type for both power supply and for instrumentation and control in accordance with the provisions specified herein, except for such items as are normally wired at their point of manufacture and so delivered, and unless specifically noted to the contrary herein. The CONTRACTOR shall erect all motors and shall mount all starters and controls, furnishing the supporting structures. ✓

3.4 GUARANTEE

- A. The CONTRACTOR shall guarantee all equipment against:
 - 1. Faulty or inadequate design. ✓
 - 2. Improper assembly or erection. ✓
 - 3. Defective workmanship or materials. ✓
 - 4. Leakage, breakage, or other failure. ✓
 - 5. The guarantee period shall be as defined in the General Conditions. ✓

END OF SECTION

SECTION 01650

STARTING OF SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Description:

1. This Section contains requirements for CONTRACTOR'S performance in documenting testing work required under this Contract. In addition, this Section contains requirements for CONTRACTOR'S starting of systems, performance testing during startup, performance testing of all mechanical, electrical, instrumentation, HVAC equipment and systems, and training. This Section supplements, but does not supersede specific testing requirements, found elsewhere in the Contract Documents. ✓

1.2 RELATED SECTIONS

- A. Section 01300, Submittals. ✓

1.3 SUBMITTALS

A. Descriptive submittals shall be made in accordance with Section 01300, Submittals. Submit for approval the following:

1. A complete description of CONTRACTOR'S plan for documenting the results from the test program in conformance with the requirements of Paragraph 2.1.A., below, including:
 - a. Proposed plan for documenting the calibration of all test instruments. ✓
 - b. Proposed plan for calibration of all instrument systems, including flow/level meters and all temperature, pressure, weight, and analysis systems. ✓
 - c. Sample forms for documenting the results of field pressure and performance tests. ✓
2. The credentials and certification of the testing laboratory proposed by CONTRACTOR for calibration of all test equipment. ✓
3. Pre-start-up check-out procedures reviewed and approved by the respective equipment manufacturers. ✓
4. Detailed testing plans, setting forth step-by-step descriptions of the procedures proposed by CONTRACTOR for the systematic startup and performance testing of all equipment and systems installed under this Contract. ✓
5. A schedule and subsequent updates, presenting CONTRACTOR'S plan for startup and performance testing the equipment and systems installed under this Contract. ✓
6. A schedule establishing the expected time period (calendar dates) when CONTRACTOR plans to commence performance testing of the completed

systems, along with a description of the temporary systems and installations planned to allow operational testing to take place. ✓

7. All records produced during the startup and testing program. ✓
8. Systems or unit process or any piece of equipment shall not be started up without the approved Operation and Maintenance Manuals being turned over to the OWNER. ✓
9. Written notice to ENGINEER a minimum of 72 hours prior to beginning of any test. ✓

B. Shop Drawings: Submit for approval the following:

1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration. ✓
2. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.** ✗

SUEZ preventative maintenance information package is part of the SUEZ O&M Manual. O&M Manuals are submitted after approval of Shop Drawings, not as part of the Submittal Package.

PART 2 - PRODUCTS

2.1 DOCUMENTATION

A. Documentation Plans

1. CONTRACTOR shall develop a records keeping system to document compliance with the requirements of this Section. Calibration documentation shall include identification (by make, manufacturer, model, and serial number) of all test equipment, date of original calibration, subsequent calibrations, calibration method, and test laboratory. ✓
2. Equipment and system documentation shall include date of test, equipment number or system name, nature of test, test objectives, test results, test

instruments employed for the test and signature spaces for the OWNER'S and ENGINEER'S witnesses. A separate file shall be established for each system and item of equipment. These files shall include the following information as a minimum:

- a. Metallurgical tests, if required in detailed Specification Section. ✓
 - b. Factory performance tests. ✓
 - c. Accelerometer recordings made during shipment, if required in detailed Specification Section. ✓
 - d. Field calibration tests¹. ✓
 - e. Field pressure tests¹. ✓
 - f. Field performance tests¹. ✓
 - g. Field operational tests¹. ✓
- (¹ Each of these tests are required even though not specifically noted in detailed Specification Section.)

B. Test Plans:

1. CONTRACTOR shall develop test plans detailing the coordinated, sequential testing of each item of equipment and system installed under this Contract. Each test plan shall be specific to the item of equipment or system to be tested. Test plans shall identify by specific equipment or tag number each device or control station to be manipulated or observed during the test procedure and the specific results to be observed or obtained. Test plans shall also be specific as to support systems required to complete the test work, temporary systems required during the test work, subcontractors and manufacturers' representatives to be present and expected test duration. As a minimum, the test plans shall include the following features:
 - a. Step-by-step proving procedure for all control and electrical circuits by imposing low voltage currents and using appropriate indicators to affirm that the circuit is properly identified and connected to the proper device. ✓
 - b. Calibration of all analysis instruments and control sensors. ✓
 - c. Performance testing of each individual item of mechanical, electrical, and instrumentation equipment. Performance tests shall be selected to duplicate the operating conditions described in the Contract Documents. ✓
 - d. System performance tests designed to duplicate, as closely as possible, operating conditions described in the Contract Documents. ✓
2. Test plans shall contain a complete description of the procedures to be employed to achieve the desired test environment. ✓
3. As a condition precedent to receiving progress payments in excess of 75% of the Contract amount, or in any event, progress payments due to CONTRACTOR eight weeks in advance of the proposed date the CONTRACTOR intends to begin any testing work (whichever occurs earliest in the Project Schedule), CONTRACTOR shall have submitted all test plans required for the systematic field performance and operational tests for all equipment and systems installed under this Contract. Once the ENGINEER has reviewed and approved CONTRACTOR'S test plans, CONTRACTOR shall reproduce the plans in sufficient number for CONTRACTOR'S purposes and an additional 10 copies for delivery to the ENGINEER. No test

work shall begin until the CONTRACTOR has delivered the specified number of final test plans to the ENGINEER. ✓

- C. Testing Schedule: CONTRACTOR shall provide a startup and testing schedule setting forth the sequence contemplated for performing the test work. The schedule shall be a CPM format, plotted against calendar time, shall detail the equipment and systems to be tested, and shall be coordinated with CONTRACTOR'S Progress Schedule ~~specified in Section 01310, Progress Schedule~~. The schedule shall show the contemplated start date, duration of the test and completion of each test. The test schedule shall be submitted no later than four weeks in advance of the date testing is to begin. The ENGINEER will not witness any testing work for the purpose of acceptance until CONTRACTOR has submitted a test schedule and the ENGINEER approves. The test schedule shall be updated weekly, showing actual dates of test work, indicating systems and equipment testing completed satisfactorily and meeting the requirements of the Contract Documents. ✗

Section 01310 is not included in these Specifications.

2.2 SYSTEM AND EQUIPMENT PERFORMANCE TESTS

- A. Each item of mechanical, electrical, instrumentation and HVAC equipment installed under this Contract shall be tested to demonstrate compliance with the performance requirements of the Contract Documents. Each electrical, instrumentation, mechanical, piping, and HVAC system installed or modified under this Contract shall be tested in accordance with the requirements of this Section. ✓
- B. Once all equipment and systems have been tested individually, CONTRACTOR shall proceed with performance testing in accordance with the requirements of Paragraph 3.3, below, simulating actual operating conditions to the greatest extent possible. CONTRACTOR shall install temporary connections, bulkheads and make other provisions to re-circulate process fluids or otherwise simulate anticipated operating conditions. During the operational testing period, CONTRACTOR'S Quality Assurance Manager and testing team shall monitor the characteristics of each machine and system and report any unusual conditions to the ENGINEER. ✓

PART 3 - EXECUTION

3.1 GENERAL

- A. CONTRACTOR shall organize teams made up of qualified representatives of equipment suppliers, subcontractors, CONTRACTOR'S independent testing laboratory, and others, as appropriate, to efficiently and expeditiously calibrate and test the equipment and systems installed and constructed under this Contract. The objective of the testing program shall be to demonstrate, to the OWNER'S and ENGINEER'S complete satisfaction, that the structures, systems, and equipment constructed and installed under this Contract meets all performance

requirements and the facility is Substantially Complete and ready for the commissioning process to commence. In addition, the testing program shall produce baseline-operating conditions for the OWNER to use in a Preventive Maintenance Program. The Preventive Maintenance Program shall be provided as part of the vendor supplied equipment Operations and Maintenance Manual as required by Specification Section 01300 Submittals. ✓

3.2 CALIBRATION OF FIXED INSTRUMENTS

- A. Calibration of analysis instruments, sensors, gauges, and meters installed under this Contract shall proceed on a system-by-system basis. No equipment or system performance test shall be performed until all instruments, gauges, and meters to be installed in that particular system have been calibrated and the calibration work has been witnessed by the OWNER and ENGINEER. ✓

Clarification: This item falls in the scope of the CONTRACTOR

3.3 PERFORMANCE TESTS

- A. General: Performance tests shall consists of the following:
1. Pressure or leakage tests. ✓
 2. Electrical testing as specified in Division 16, Electrical. ✓
 3. Wiring and piping, individual component, loop, loop commissioning and tuning testing, as specified in Division 17, Instrumentation. ✓
 4. Pre-startup check out for all mechanical and HVAC equipment specified in Division 15, Mechanical. Pre-startup check out procedures shall be reviewed and accepted by the respective equipment manufacturer. ✓
 5. Individual and system tests of all mechanical, electrical, HVAC, and instrumentation equipment and systems shall demonstrate compliance with the performance requirements of the Contract Documents. ✓
- B. Performance tests for any individual system shall be performed in the order listed above. The order may be altered only on the specific written authorization of the ENGINEER after receipt of a written request, complete with justification for the change in sequence. ✓
- C. Pressure and Leakage Tests: Pressure and leakage tests shall be conducted in accordance with applicable Sections. All acceptance tests shall be witnessed by the ENGINEER. Evidence of successful completion of the pressure and leakage tests shall be the ENGINEER'S signature on the test forms prepared by CONTRACTOR. ✓
- D. Equipment Checkout: Prior to energization (in the case of electrical systems and equipment), all circuits shall be rung out and tested for continuity and shielding in accordance with the requirements of Division 16, Electrical. ✓
- E. Component Calibration and Loop Testing: Prior to energization (in the case of instrumentation system and equipment), all loops and associated instruments shall be calibrated and tested, as specified in Division 17, Instrumentation. ✓

- F. Electrical Resistance: Electrical resistance testing shall be in accordance with the requirements of Division 16, Electrical. ✓
- G. Pre-Start-up Tests: Pre-start-up tests shall include the following
1. Alignment of equipment using reverse dial indicator method. ✓
 2. Pre-operation lubrication. ✓
 3. Tests in accordance with the manufacturers' recommendations for pre-start preparation and pre-operational check out procedures. ✓

3.4 DISINFECTION

- A. CONTRACTOR shall disinfect all new portions of the plant that are located downstream of, and including, reclaimed water pump station, backwash piping, non-potable water system, potable water system, and reclaimed water system. Disinfection shall be completed prior to bringing the specific process or component on-line. All disinfection shall be done in accordance with AWWA C-653. ✓
- B. The CONTRACTOR shall provide all chemicals, materials, equipment, and utilities to perform the disinfection. ✓

3.5 EQUIPMENT START-UP

- A. The CONTRACTOR in the presence of OWNER and ENGINEER shall place the newly installed equipment and facilities into operation and test, observe, and adjust all items until the units are properly adjusted and operating in accordance with the requirements of the manufacturer's data and the Contract Documents. After the new equipment has been put into operation, CONTRACTOR, ENGINEER, and Plant Operator shall go over in detail the standard operating procedures of the equipment. The work performed by CONTRACTOR shall include, but not be limited to, the following items:
1. Marking and numbering all valves, gates, and equipment which have been numbered in the Contract Documents. All valves and gates shall be labeled with the appropriate equipment identification tag as shown on the Drawings and specified in Section 10400, Equipment Identification Plates. ✓
 2. Labeling switches. ✓
 3. Testing of pumps and equipment for proper operation and verifying alignment and capacity. ✓
 4. Checking all electrical, electronic, and remotely controlled equipment for proper operation as specified under Section 01400, Quality Control. ✓
 5. Marking all new and existing exposed pipelines for identification as specified in Section 09900, Painting, and as labeled on the Drawings for pipe material, size, service, and direction of flow. ✓
 6. Testing of unit processes for proper operations. ✓
 7. Making all equipment adjustments required. ✓

SUEZ tag numbers on SUEZ drawings only. If Customer tag numbers are required on SUEZ drawings, there is an additional cost.

Section 10400 is not included in these Specifications. X

Section 01400 is not included in these Specifications. X

3.6 SUPERVISION OF INSTALLATION AND START-UP BY MANUFACTURER

NOTE: SUEZ is the equipment manufacturer

- A. An experienced, competent, and factory-employed representative of the equipment manufacturer shall visit the site of the work and inspect, check, adjust if necessary, and approve the equipment installation and shall be present when the equipment is placed in operation. The equipment manufacturer's representative shall revisit the job site as often as necessary until any trouble is corrected and the equipment installation and operation is satisfactory to the OWNER X the equipment manufacturer's representative shall furnish to OWNER a written report certifying that the equipment:
1. Has been properly installed and lubricated. ✓
 2. Is in accurate alignment. ✓
 3. Is free from any undue stress imposed by connecting piping or anchor bolts. ✓
 4. Has been operated under full load conditions and that it operated satisfactorily. ✓
- B. A resume of each factory personnel assigned to supervise installation and train OWNER'S personnel shall be submitted to the ENGINEER for approval prior to scheduling training and installing the equipment. ✓

3.7 SYSTEM PERFORMANCE TESTS

- A. General: Once all affected equipment has been subjected to the required pre-operational check out procedures and the ENGINEER has witnessed and has not found deficiencies in that portion of the Work, individual items of equipment and systems may be started and operated under simulated operating conditions to determine, as nearly as possible, whether the equipment and systems meet the requirements of these Specifications. ✓
- B. For each system performance test phase, the equipment shall be operated a sufficient period of time to determine machine operating characteristics, including noise, temperatures and vibration; to observe performance characteristics; and to permit initial adjustment of operating controls and shall last no less than seven continuous days. When testing requires the availability of auxiliary systems such as looped piping, electrical power, compressed air, control air, or instrumentation which have not yet been placed in service, CONTRACTOR shall provide acceptable substitute sources, capable of meeting the requirements of the machine, device, or system, at no additional cost to the OWNER. Disposal methods for test media shall be subject to review and approval by the OWNER and ENGINEER. During the performance test period, CONTRACTOR shall obtain baseline-operating data on all equipment with motors greater than one horsepower to include amperage, bearing temperatures, and vibration. The baseline data shall be collected for the OWNER to enter in a Preventive Maintenance Program. ✓

- C. Test results shall be within the tolerances set forth in the detailed Specification Sections of the Contract Documents. If no tolerances have been specified, test results shall conform to tolerances established by recognized industry practice. Where, in the case of an otherwise satisfactory performance test, any doubt, dispute, or difference should arise between the ENGINEER and CONTRACTOR regarding the test results or the methods or equipment used in the performance of such test, then the ENGINEER may order the test to be repeated. If the repeat test, using such modified methods or equipment as the ENGINEER may require, confirms the previous test, then all costs in connection with the repeat test will be paid by the OWNER. Otherwise, the costs shall be borne by CONTRACTOR. Where the results of any performance test fail to comply with the contract requirements for such test, then such repeat tests as may be necessary to achieve the contract requirements shall be made by CONTRACTOR at his expense. ✓
- D. CONTRACTOR shall provide, at no expense to the OWNER, all power, fuel, compressed air supplies, water, and chemicals, all labor, temporary piping, heating, ventilating, and air conditioning for any areas where permanent facilities are not complete and operable at the time of functional tests, and all other items and work required to complete the functional tests. Temporary facilities shall be maintained until permanent systems are in service. ✓
- E. Should the testing period be halted for any reason, the operational testing program shall be repeated, until the specified continuous period has been accomplished without interruption. All process units shall be brought to full operating conditions, including temperature, pressure, flow and level. ✓
- F. Record Documents shall conform to the requirements of Section 01300, Submittals, of facilities involved shall be accepted and ready for turnover to the OWNER 72 hours prior to operational testing. ✓
- G. Phase Retesting: If under test, any portion of the Work should fail to fulfill the Contract requirements and is adjusted, altered, renewed, or replaced, tests on that portion when so adjusted, altered, removed, or replaced, together with all other portions of the Work as are affected thereby, shall, unless otherwise directed by the ENGINEER, be repeated within reasonable time and in accordance with the specified conditions. CONTRACTOR shall pay to the OWNER all reasonable expenses incurred by the OWNER, including the costs of the ENGINEER, as a result of repeating such tests. ✓
- H. Post-Test Inspection: Once testing has been completed, all machines shall be rechecked for proper alignment and realigned, as required. All equipment shall be checked for loose connections, unusual movement, or other indications of improper operating characteristics. Any deficiencies shall be corrected to the satisfaction of the ENGINEER. All machines or devices which exhibit unusual or unacceptable operating characteristics shall be disassembled and inspected. Any defects found during the course of the inspection shall be repaired or the specific

part or entire equipment item shall be replaced to the complete satisfaction of the ENGINEER, at no additional cost to the OWNER. ✓

3.8 TRAINING

- A. Provide training per requirements of specification Section 01821, Instruction of Operations and Maintenance Personnel. ✓

END OF SECTION

SECTION 01660

FIELD TESTS OF EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION

- A. In addition to testing required by this Section, CONTRACTOR shall perform all other tests required by detailed Equipment Specifications. ✓
- B. No system or subsystem shall be started up for continuous operation unless all components, including instrumentation and monitoring systems, of that system or subsystem has been tested and proven to be operable as intended by the Contract Documents. ✓

1.2 PRELIMINARY TESTS

- A. CONTRACTOR shall make preliminary field tests of all equipment as soon as conditions permit. ✓
- B. Purpose of tests is to determine if equipment is:
 - 1. Properly installed. ✓
 - 2. In compliance with operating cycles. ✓
 - 3. Operational and free from overheating, overloading, vibration, or other operating problems. ✓
- C. CONTRACTOR shall furnish all labor, materials, instruments, fuel, incidentals, and expendables required, unless otherwise provided. ✓
- D. CONTRACTOR shall make all changes, adjustments, and replacements required to place equipment in service and test it. ✓
- E. ENGINEER and OWNER shall be given sufficient notice prior to witness tests. A minimum 48 hour notice shall be given. ✓

1.3 FINAL TESTS

- A. To the maximum extent possible, CONTRACTOR shall perform final field tests of equipment prior to initial start-up and operation of the Project. ✓
- B. Purpose of the tests is to demonstrate that equipment is:
 - 1. Properly installed. ✓
 - 2. Completely ready for operation by the OWNER. ✓
 - 3. In compliance with design conditions, material specifications, and all other requirements of the Contract Documents. ✓

- C. CONTRACTOR shall furnish all fuel and energy, labor, materials, instruments, chemicals, lubricants, and expendables required for the tests, where permanent facilities are not complete and operable at the time of testing, except where otherwise specified. ✓
- D. Until final field tests are completed and approved, CONTRACTOR shall make all necessary changes, adjustments, and replacements. ✓
- E. Systems or unit process, or any piece of equipment, shall not be started up without the approved Operation and Maintenance Manuals being turned over to the OWNER. ✓
- F. CONTRACTOR shall notify ENGINEER at least 48 hours prior to beginning of tests. CONTRACTOR shall keep notes and data on tests, and submit copy to the ENGINEER. ENGINEER and OWNER'S operating personnel shall witness all tests. ✓

1.4 MANUFACTURERS' AND SUPPLIERS' FIELD AND TEST DATA

NOTE: SUEZ is the manufacturer or supplier for SUEZ-provided equipment.

- A. An experienced, competent, and authorized representative of the manufacturer or supplier of each item of equipment, as required in these Specifications, shall visit the site of the Work and inspect, check, and approve the equipment installation. In each case, the equipment supplier's representative shall be present when the equipment is placed in operation. The equipment supplier's representative shall revisit the job site as often as necessary until all trouble is corrected and the equipment installation and operation is satisfactory to the ENGINEER. Sales representatives shall not be acceptable to perform start-up and training functions. ✗
- B. ~~One hard copy and~~ electronic copies of all test and field data collected by the manufacturers/suppliers of equipment during installation supervision and start-up services shall be submitted to the ENGINEER within 14 calendar days after the start-up services are complete. The test and field data shall be submitted, whether specified or not, in the detailed Equipment Specifications and shall include, but are not limited to, tolerance and alignment measurements where applicable to verify equipment has been satisfactorily installed, and all other information collected by the manufacturers/suppliers to satisfy themselves that equipment has been properly installed. The manufacturer shall submit to the ENGINEER a certification on the manufacturer's letterhead stating that the equipment has been properly installed and lubricated, is in accurate alignment, is free from any undue stress imposed by connecting piping or anchor bolts; and has been operated under full load conditions and it operated satisfactorily. In cases where the manufacturer/supplier's representative believes equipment is not properly installed he shall include with this submittal a punch list detailing the problems noted which require correction. The information required under this Section shall be furnished for all equipment and devices requiring installation and start-up services, as specified in these Specifications, including the detailed Mechanical, Electrical, and Instrumentation Specifications. ✗

In the event that the "trouble" is caused by incorrect installation or handling as described by SUEZ's contractual Drawings, Specifications, or Operations Manual, the cost of additional visits and time on the job site is the responsibility of the CONTRACTOR.

SUEZ will submit test and field data electronically only.

- C. The costs for this Work shall be included in the prices quoted by equipment suppliers. CONTRACTOR shall perform all Work required to install and place into operation the equipment in accordance with the manufacturer's recommendations. ✓

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01730

OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Provide Operation and Maintenance Data in the form of instructional manuals for use by the OWNER'S personnel for:
 - 1. All equipment and systems. ✓
 - 2. All valves, pumps, and related accessories. ✓
 - 3. All instruments and control devices. ✓
 - 4. All electrical gear. ✓
- B. Training or start-up on any system, process, or piece of equipment shall not be allowed until Operation and Maintenance Manuals and Lesson Training Plans are approved by the ENGINEER, and the approved Operation and Maintenance Manuals have been turned over to the OWNER. ✓
- C. Definitions:
 - 1. Operation and Maintenance Data:
 - a. The term "Operation and Maintenance Data" includes all product related information and documents which are required for preparation of the station Operation and Maintenance Manual. It also includes all data which shall accompany said manual as directed by current regulations of any participating government agency. ✓
 - b. Required Operation and Maintenance Data includes, but is not limited to, the following:
 - 1) Complete, detailed written operating instructions for each product or piece of equipment including equipment function; operating characteristics; limiting conditions; operating instructions for start up, normal, and emergency conditions; regulation and control; and shut down. ✓
 - 2) Complete, detailed written preventive maintenance instructions as defined below. ✓
 - 3) Recommended spare parts lists, by generic title and identification number, and local sources of supply for parts. ✓
 - 4) Written explanations of all safety considerations relating to operation and maintenance procedures. ✓
 - 5) Name, address, and phone number of manufacturer, manufacturer's local service representative, and subcontractor or installer. ✓

- 6) Copy of all approved Shop Drawings, ~~and a copy of the warranty bond and service contract as applicable~~, including circuit diagrams, schematics, and functional Drawings. ✖
 - 7) Control Diagrams: Internal and connection wiring, including logic diagrams, wiring diagrams for control panels, ladder logic for computer based systems, and connections between existing systems and new additions, and adjustments such as calibrations and set points for relays, and control or alarm contact settings. Provide all programming/wiring documentation needed for "in-house" troubleshooting and customizing. ✔
 - 8) Final test data, where applicable, shall be submitted as an appendix when completed. ✔
 - 9) Disassembly, reassembly, installation, alignment, adjustment, and checking instructions. ✔
2. Preventive Maintenance Instructions:
- a. The term "Preventive Maintenance Instructions" includes all information and instructions required to keep a product or piece of equipment properly lubricated, adjusted, and maintained so that the item functions economically throughout its full design life. ✔
 - b. Preventive Maintenance Instructions include, but are not limited to, the following:
 - 1) A written explanation with illustrations for each preventive maintenance task. ✔
 - 2) Recommended schedule for execution of preventive maintenance tasks. ✔
 - 3) Lubrication charts. ✔
 - 4) Table of alternative lubricants. ✔
 - 5) Trouble shooting instructions. ✔
 - 6) List of required maintenance tools and equipment. ✔

D. Submittals:

1. General: Submit operations and maintenance data to the ENGINEER within 60 days after approval of Shop Drawings, unless noted otherwise. ✔
2. Number of Copies: One hard copy of each item.
 - a. One preliminary copy of each O&M Manual shall be submitted to the ENGINEER for approval within 30 days of the approval of the Shop Drawing, which indicated further submittals are not required. The O&M Manual shall conform to the requirements as specified herein. ✔
 - b. 60 days prior to placing the equipment into service, submit one hard copies and one soft copy of the approved O&M Manual (except for field test data) to the ENGINEER. ✔
 - c. Soft copy shall be in CD format and shall include all information provided in hard copy. Text shall be in ".pdf" format. Drawings and figures shall be in AutoCAD ".dwg", or bitmap ".bmp", tiff ".tif", ipeg ".jpg", gif ".gif", or pc paint brush ".pcx". ✔

3. Letter of Transmittal: Provide a letter of transmittal with each submittal and include the following in the letter:
 - a. Date of submittal. ✓
 - b. Contract title and number. ✓
 - c. CONTRACTOR'S name and address. ✓ NOTE: SUEZ is not CONTRACTOR
 - d. A list of the attachments and the Specification Sections to which they relate. ✓
 - e. Reference to or explanation of related submittals already made or to be made at a future date. ✓
4. Format Requirements:
 - a. Use 8-1/2-inch by 11-inch paper of high rag content and quality. Larger Drawings or illustrations are acceptable if neatly folded to the specified size in a manner which will permit easy unfolding without removal from the binder. Provide reinforced punched binder tab, or provide flyleaf for each product. ✓
 - b. All text must be legible typewritten or machine printed originals or high quality copies of same. ✓
 - c. Each page shall have a binding margin of approximately 1-1/2-inches and be punched for placement in a 3-ring loose-leaf binder. Provide binders. Identify each binder with the following: ✓
 - 1) Title "OPERATING AND MAINTENANCE INSTRUCTIONS".
 - 2) Title of Project.
 - 3) Identity of building or structure as applicable.
 - 4) Identity of general subject matter covered.
 - d. Use dividers and indexed tabs between major categories of information such as operating instructions, preventive maintenance instructions, or other. When necessary, place each major category in a separate binder.
 - e. Provide a Table of Contents for each binder. ✓
 - f. Identify products by their functional names in the table of contents and at least once in each Chapter or Section. Thereafter, abbreviations and acronyms may be used if their meaning is explained in a table in the back of each binder. Use of model or catalog numbers or letters for identification is not acceptable. ✓
 - g. Upon completion of the installation of each item of equipment, the CONTRACTOR shall provide Drawings of the local control panel to be added to the O&M Manual. ✓ NOTE: SUEZ is not CONTRACTOR
 - h. Indicate all components of the equipment on catalog pages by highlighting or some other clearly definable medium for ease of identification. ✓
 - i. Final test data determined after installation of the equipment shall be submitted as an appendix to the Operations and Maintenance Manuals. ✓
- E. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to

indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration. ✓

SUEZ preventative maintenance information package is part of the SUEZ O&M Manual. O&M Manuals are submitted after approval of Shop Drawings, not as part of the Submittal Package.

- F. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.** ✗ NOTE: SUEZ is not CONTRACTOR

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01750

SPARE PARTS AND MAINTENANCE MATERIALS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. 60 days after approval of the Shop Drawing of the equipment specified in the individual Sections, CONTRACTOR shall furnish spare parts data and maintenance material for equipment. The data shall include a complete list of parts and supplies, with current unit prices and source or sources of supply. ✓
- B. Spare parts and materials ~~required to be supplied in the Contract Documents~~ shall be furnished in manufacturer's unopened cartons, boxes, crates or other protective covering suitable for preventing corrosion or deterioration for the maximum length of storage that may be normally anticipated. They shall be clearly marked and identified as to the name of manufacturer or supplier, applicable equipment, part number, description and location in the equipment. All parts shall be protected and packaged for a shelf life of at least 10 years. ✗
- C. During construction, store parts in buildings or trailers with floor, roof, and closed sides and in accordance with manufacturers' recommendations. Protect from weather, condensation, and humidity. ✗
- D. Parts and materials shall be delivered to the OWNER upon Substantial Completion of the Work or start-up. CONTRACTOR shall then place them in permanent storage rooms or areas approved by the OWNER. The turnover procedures shall be developed by the ENGINEER. ✓
- E. Provide a Letter of Transmittal and Spare Parts Receiver Form including the following:
1. Date of letter and transfer of parts and material. ✓
 2. Contract title and number. ✓
 3. CONTRACTOR'S name and address. ✓
 4. Transmittal should list applicable Specification Sections for each set of spare parts supplied. ✓
 5. Spare Parts Receiver Form. ✓
- F. CONTRACTOR shall be fully responsible for loss or damage to parts and materials until they are transmitted to the OWNER. ✓

SUEZ's Proposal Price does NOT include spare parts except as noted in SUEZ's Proposal. Any additional spare parts will be at additional cost.

Clarification: This item falls in the scope of the CONTRACTOR.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

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SPARE PARTS RECEIVER

SPECIFICATION SECTION 01750

CONTRACTOR PLEASE FILL OUT:

MANUFACTURER:_____

ITEM DESCRIPTION:_____

COST:_____

MANUFACTURER PART NUMBER:_____

SUPPLIER:_____

CROSS REFERENCE NUMBER:_____

VENDOR INFORMATION:_____

VENDOR ORDER PART NUMBER:_____

PART TO BE USED ON
WHAT EQUIPMENT:_____

EQUIPMENT NUMBER:_____

SPECIFICATION SECTION:_____

CITY PERSONNEL FILL IN:

BIN NUMBER:_____

AIMS NUMBER:_____

LOCATION IN STORES:_____

RECEIVED BY:_____

END OF SECTION

SECTION 01821

INSTRUCTION OF OPERATIONS AND MAINTENANCE PERSONNEL

PART 1 - GENERAL

1.1 DESCRIPTION

NOTE: Factory-trained maintenance specialist is SUEZ Field Service Representative for SUEZ-provided equipment.

- A. CONTRACTOR shall provide the services of factory-trained maintenance specialists to instruct OWNER'S operations and maintenance personnel in the recommended operation and the preventive maintenance procedures for equipment specified in the equipment Sections. ✓
- B. The qualifications of specialists shall be subject to approval by ENGINEER. ✓
- C. CONTRACTOR shall coordinate these services at times acceptable to OWNER and ENGINEER, with a minimum of 14 days prior notice. ✓
- D. Manufacturer shall provide a combination of classroom and field training. All training shall be conducted at the facility, unless otherwise stated in the Equipment Sections. Class size shall be limited to no more than 15 trainees. Manufacturer shall provide training for all plant shifts, or as approved by OWNER. ✓
- E. Manufacturer shall allow any and all training sessions to be videotaped by OWNER. ✓
- F. Section 01640, Materials and Equipment; Section 01650, Starting of Systems; Section 01660, Field Tests of Equipment; and, additional requirements for manufacturer's and supplier's field and test data. ✓
- G. Instruction of OWNER'S personnel shall commence only after the equipment has been started, approved Operation and Maintenance Manuals have been turned over to the OWNER, and acceptance tests have been completed according to the provisions in Section 01650, Starting of Systems. ✓
- H. CONTRACTOR shall submit a copy of this Section 01821, Instruction of Operations and Maintenance Personnel, to all manufacturers of equipment for this Contract. ✓

1.2 SUBMITTALS

- A. Manufacturer shall submit for approval the following:
 - 1. Proposed Lesson Plan for each scheduled instruction 28 days prior to commencement of training. Lesson plans shall be approved a minimum of 14 days prior to scheduled instruction. ✓

2. Credentials of their designated operations and maintenance instructor. Credentials shall include a brief resume and specific details of the instructor's experience pertaining to operation of, maintenance of, and training for the equipment specified. ✓
3. Training Request Form: CONTRACTOR shall submit the Training Request Form to the ENGINEER 28 days prior to the requested training date. ✓
4. There shall be separate "Operations" and "Maintenance" staff training. ✗

1.3 INSTRUCTION LESSON PLAN

Lesson plan includes both "Operations" and "Maintenance" staff training. It is not separate training.

- A. Manufacturer's proposed Lesson Plan shall include the elements presented in the outline of Instruction Lesson Plan in Paragraph 1.3.D., below, of this Section. Specific components and procedures shall be identified in the proposed Lesson Plan. ✓
- B. Manufacturer's proposed Lesson Plan shall detail specific instruction topics. Training aids to be utilized in the instruction shall be referenced and attached where applicable to the proposed Lesson Plan. "Hands-On" demonstrations planned for the instruction shall be described in the Lesson Plan. ✓
- C. The manufacturer shall indicate the estimated duration of each segment of the training Lesson Plan. ✓
- D. Instruction Lesson Plan shall include the following as a minimum:
 1. Equipment Operation:
 - a. Describe equipment's operating (process) function. ✓
 - b. Describe equipment's fundamental operating principals and dynamics. ✓
 - c. Identify equipment's mechanical, electrical and electronic components and features. ✓
 - d. Identify all support equipment associated with the operation of subject equipment (e.g., air intake filters, valve actuators, motors). ✓
 - e. Recommend standard operating procedures to cover start-up, routine monitoring and shutdown of the equipment. ✓
 2. Detailed Component Description:
 - a. Identify and describe in detail each component's function. ✓
 - b. Where applicable, group related components into subsystems. Describe subsystem functions and their interaction with other subsystems. ✓
 - c. Identify and describe in detail equipment safeties and control interlocks. ✓
 3. Equipment Preventive Maintenance (PM):
 - a. Describe PM inspection procedures required to:
 - 1) Perform an inspection of the equipment in operation. ✓
 - 2) Spot potential trouble symptoms and anticipate breakdowns. ✓
 - 3) Forecast maintenance requirements (predictive maintenance). ✓
 - b. Define the recommended PM intervals for each component. ✓
 - c. Provide lubricant and replacement part recommendations and limitations. ✓

- d. Describe appropriate cleaning practices and recommend intervals. ✓
 - e. Identify and describe the use of special tools required for maintenance of the equipment. ✓
 - f. Describe component removal/installation and disassembly/assembly procedures. ✓
 - g. Perform at least two "hands-on" demonstrations of preventive maintenance procedures. ✓
 - h. Describe recommended measuring instruments and procedures, and provide instruction on interpreting alignment measurements, as appropriate. ✓
 - i. Define recommended torquing, mounting, calibration and/or alignment procedures and settings, as appropriate. ✓
 - j. Describe recommended procedures to check/test equipment following a corrective repair. ✓
4. Equipment Troubleshooting:
- a. Define recommended systematic troubleshooting procedures. ✓
 - b. Provide component specific troubleshooting checklists. ✓
 - c. Describe applicable equipment testing and diagnostic procedures to facilitate troubleshooting. ✓

1.4 TRAINING AIDS

- A. The manufacturer's instructor shall incorporate training aids as appropriate to assist in the instruction. As a minimum, the training aids shall include text and figure handouts. Other appropriate training aids are:
- 1. Audio-Visual Aids (e.g., films, slides, videotapes, overhead transparencies, posters, blueprints, diagrams, catalogue sheets). ✓
 - 2. Equipment cutaways and samples (e.g., spare parts and damaged equipment). ✓
 - 3. Tools (e.g., repair tools, customized tools, measuring and calibrating instruments). ✓
- B. The manufacturer's instructor shall utilize descriptive class handouts during the instruction. Photocopied class handouts shall be good quality reproductions. Class handouts should accompany the instruction with frequent reference made to them. Customized handouts developed especially for the instruction are encouraged. Handouts planned for the instruction shall be attached with the manufacturer's proposed Lesson Plan. ✓

1.5 "HANDS-ON" DEMONSTRATIONS

- A. The manufacturer's instructor shall present "hands-on" demonstrations of operations and maintenance of the equipment for each scheduled group. The proposed "hands-on" demonstrations should be described in the manufacturer's proposed Lesson Plan. ✓

1.6 TRAINING SCHEDULE

- A. Each manufacturer shall provide as a minimum the following hours of training. Travel time and expenses are responsibility of manufacturer and are not included in training schedule time. ✓

- B. The CONTRACTOR shall provide experienced, competent manufacturers' representatives to train OWNER'S personnel in operation and maintenance procedures for equipment items specified below during the start-up period at no additional cost to OWNER. The Lesson Plans for these sessions shall be reviewed with the OWNER and the ENGINEER in one meeting prior to initiating training. Lesson Plans shall be submitted to the ENGINEER not less than one week prior to this meeting. CONTRACTOR will video tape the manufacturers' training sessions and provide OWNER with DVD format professional quality discs of the training sessions. The representatives shall present training programs and on-site demonstrations designed to fully acquaint plant personnel with all equipment features, routine scheduled maintenance procedures, alternative operational modes, emergency procedures, spare parts inventories, and demonstrate performance requirements of the Specifications. ~~Representatives shall remain on-site to observe operation of the equipment and further advise plant personnel for a minimum number of hours as specified below: ✗~~

SUEZ assumes that the four (4) days of training indicated in the table, plus one (1) day of training called for in Section 11314, item 3.2.B, for a total of five (5) days of training is part of the 8 person days for training Owner's operators called for in Section 11500.1, item 3.3.B.7 and in McCarthy's Front Ends, item 5.a.(n)(v). Any additional training days will be the responsibility of the CONTRACTOR.

Equipment	~~Additional~~ Training Days (Day = 8 hrs minimum)
Membrane Filtration System	2
Positive Displacement Blowers	1
Actuators	½
Turbidity Instrument	½

- C. A complete schedule of representatives and dates for operator training shall be submitted to OWNER prior to commencement of the start-up period. This schedule shall be prepared to accommodate the plant staff's work schedules, including training on all three shifts and staff flex time. ✓
- D. The plant operators work on a shift schedule. Develop the training schedule to account for training classes for each shift. ✓

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

TRAINING REQUEST FORM
CITY OF CHANDLER
WRF IMPROVEMENTS PROJECT

SPECIFICATION SECTION 01821
INSTRUCTION OF OPERATIONS AND MAINTENANCE PERSONNEL

Equipment Name: _____

Equipment Tag Number: _____

Equipment Description: _____

Specification Section: _____

Operations and Maintenance Data Submitted/Approved: _____

Start-up and Testing Complete/Date: _____

Lesson Plan Submitted/Approved: _____

Training Aids Submitted/Approved: _____

Hands-on Demonstration: _____

Training Schedule (Dates, Time, No. of Sessions): _____

END OF SECTION

SECTION 09900

PAINTING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes surface preparation and field painting of the following:
 - 1. Exposed exterior items and surfaces.
 - 2. Exposed interior items and surfaces.
 - 3. Surface preparation, priming, and finish coats specified in this Section are in addition to shop priming and surface treatment specified in other Sections.
- B. Paint exposed surfaces, except where the paint schedules indicate that a surface or material is not to be painted or is to remain natural. If the paint schedules do not specifically mention an item or a surface, paint the item or surface the same as similar adjacent materials or surfaces, whether or not schedules indicate colors. If the schedules do not indicate color or finish that is mentioned, the ENGINEER will select from standard colors and finishes available.
 - 1. Painting includes field painting of exposed bare and covered pipes and ducts (including color coding), hangers, exposed steel and iron work, and primed metal surfaces of mechanical and electrical equipment.
- C. Unless indicated otherwise, do not paint prefinished items, concealed surfaces, finished metal surfaces, operating parts, and labels.
 - 1. Prefinished items include, but are not limited to, the following factory-finished components:
 - a. Architectural woodwork and casework.
 - b. Motor nameplates.
 - c. Instrumentation and electrical mounting hardware such as nuts, bolts, screws, U-bolts, handles, latches, and hinges.
 - d. Analyzers, probes, nuts, bolts, and screws or any mounting hardware.
 - e. Metal toilet enclosures.
 - f. Acoustical ceiling panels.
 - g. Metal lockers.
 - h. Ceramic tile, windows, glass, resilient flooring; other architectural features, such as "finish" hardware, furnished in aluminum, bronze or plated ferrous metal, prefinished panels, or other items installed prefinished.
 - i. Finished mechanical and electrical equipment, except as indicated in the Specifications or on the Plans.
 - j. Light fixtures.
 - k. Interior distribution cabinets and switch gear, except as indicated.
 - 2. Concealed surfaces include walls or ceilings in the following generally inaccessible spaces:

- a. Foundation spaces, unless noted otherwise.
 - b. Surfaces behind furred areas.
 - c. Ceiling plenums.
 - d. Utility tunnels.
 - e. Pipe spaces.
 - f. Duct shafts.
3. Finished metal surfaces include the following:
- a. Stainless steel or chromium plated items.
 - b. Chromium plate.
 - c. Copper.
 - d. Bronze and brass.
 - e. Buried cast and ductile iron pipe encased with a protective polyethylene sleeve.
 - f. Anodized aluminum, aluminum gratings, and floor plates.
 - 1) Paint aluminum surfaces in contact with concrete, grout, masonry, wood, or dissimilar materials as described below:
 - a) Surface must be clean, dry, and free of oil, grease, and other contaminants. Surface preparation with SSPC-SP7 brush-off abrasive blast cleaning. Apply two coats of Tnemec Series 20 Pota-Pox or approved equal; each coat shall be 3-5 mils. Coating must be NSF 61 approved.
 - g. Prefinished louvers, except those in doors, unless otherwise noted and acoustical ceiling panels.
4. Operating parts include moving parts of operating equipment and the following:
- a. Valve and damper operators or handles.
 - b. Linkages.
 - c. Sensing devices.
 - d. Motor and fan shafts.
5. Labels: Do not paint over Underwriters Laboratories (UL), Factory Mutual (FM), fire rating labels, equipment serial number and capacity labels, or other code-required labels or equipment name, identification, performance rating, nomenclature plates, and equipment identification plates.

1.2 RELATED SECTIONS

- A. Division 1, General Requirements, Specification Sections, apply to this Section.

1.3 SECTION INCLUDES

- A. Surface preparation.
- B. Field application of paints and other coatings.
- C. Pipe identification markers.

- D. Surfaces to Be Finished are provided in the schedule at end of Section and in the Contract Documents.

1.4 REFERENCES

- A. ANSI A13.1, Scheme for the Identification of Piping Systems; 1981 (revised 1993).
- B. ASTM D16, Standard Terminology Relating to Paint, Varnish, Lacquer, and Related Products; 1995.
- C. OSHA 1910.144, Code of Federal Regulations (CFR) Title 29.
- D. SSPC (PM2), Steel Structures Painting Manual, Vol. 2, Systems and Specifications; Steel Structures Painting Council; 1995.

1.5 DEFINITIONS

- A. General: Standard coating terms defined in ASTM D16 apply to this Section.
 - 1. Flat refers to a lusterless or matte finish with a gloss range below 15 when measured at an 85 degree meter.
 - 2. Eggshell refers to low-sheen finish with a gloss range between 5 and 20 when measured at a 60-degree meter.
 - 3. Satin refers to low-sheen finish with a gloss range between 15 and 35 when measured at a 60 degree meter.
 - 4. Semi-gloss refers to medium-sheen finish with a gloss range between 30 and 65 when measured at a 60 degree meter.
 - 5. Full gloss refers to high-sheen finish with a gloss range more than 65 when measured at a 60 degree meter.
 - 6. Buried refers to covered with earth.
 - 7. Exposed or exposed surfaces refers to areas visible when permanent or built-in fixtures, grilles, and similar components are in place. Extend coatings in these areas, as required, to maintain the system integrity and provide desired protection.
 - 8. Submerged refers to materials which are permanently or intermittently below the maximum water or liquid surface elevation in open top structures, unless otherwise noted or otherwise shown; materials within liquid or residual solids carrying structures that are covered, including materials on the underside of the covers, whether in contact with liquids or not, unless otherwise noted or otherwise shown; materials within an enclosed process structure, whether in contact with liquids or not.

1.6 SUBMITTALS

- A. See Section 01300, Submittals, for submittal procedures.
- B. Product Data: For each paint system specified. Include block fillers and primers.

1. **Material List:** Provide an inclusive list of required coating materials. Indicate each material and cross-reference specific coating, finish system, and application. Identify each material by manufacturer's catalog number and general classification.
 2. **Manufacturer's Information:** Provide manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each coating material proposed for use.
 - a. Identify manufacturer's recommended, published spreading rate, and dry film thickness of each coating material proposed for use.
 - b. Indicate manufacturer's instructions on surface and special surface preparation procedures.
 - c. Include the following: Mixing instructions, shelf life, method of application, recommended number of coats, drying time of each coat including prime coat, required prime coat, compatible and non-compatible prime coats, and recommended thinners when required.
- C. **Pipe Identification Markers:** Submit product data and marker sample for each type of pipe identification required.
- D. **Maintenance Data:** Submit data on cleaning, touch-up, and repair of painted and coated surfaces.
- E. **Samples for Initial Selection:** Manufacturer's color charts showing the full range of colors available for each type of finish-coat material indicated. Submit two paper chip samples, 3-inch by 3-inch in size.
- F. Before supplying any material to the site, the painting subcontractor and the paint manufacturer's area representative shall prepare a complete schedule showing the materials proposed to be used for each treatment specified, and submit same to ARCHITECT and ENGINEER for review/approval.
- G. Paint colors will be specified by the ARCHITECT for the architectural paint system specified herein, who, before any Work is done, will furnish color chips and schedule showing where the various colors shall go.
- H. **Qualification Data:** For firms and persons specified in Paragraph 1.9 to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of Engineers or Architects and Owners, and other information specified.
- I. **Manufacturer's Certification:** Submit in accordance with Paragraph 3.8 at the completion of the Work.
- J. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓)

shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

1.7 REGULATORY REQUIREMENTS

- A. Conform to applicable code for flame and smoke rating and VOC requirements for products and finishes.
- B. Lead, heavy metals, cadmium, and chromate content of painting materials shall not exceed amount permitted by Federal, State, and local authorities.
- C. Coatings for surfaces in contact with potable water or water being treated for potable use shall not impart any taste or odor to the water or result in any organic or inorganic content in excess of the maximum contaminant level established by applicable laws or regulations.
- D. Comply with governing code requirements for air quality and material disposal regulations.

1.8 MOCK-UP

- A. Provide stepped-down job mock-ups for all painting and coating systems showing all components of the preparation and installation before any Work shall commence. Verify all dry film thicknesses, surface preparations, and methods of installation in addition to color and texture of the finished work.
- B. Provide mock-ups for each of the following substrates, illustrating painting and coating colors and finishes:
 - 1. Ferrous Metal: Provide panel equal to 4 square feet in size for each color and finish.
 - 2. Provide door and frame assembly for each paint coating color and finish.
- C. Locate where directed by ENGINEER.
- D. Mock-up(s) may remain as part of the Work.

- E. Work advanced without approved job mock-ups shall be completely removed and re-installed without additional compensation to the OWNER.

1.9 QUALITY ASSURANCE

- A. Applicator Qualifications: Engage an experienced applicator who has completed painting system applications similar in material and extent to that indicated for this Project with a record of successful in-service performance.
- B. Source Limitations: Obtain block fillers, primers, and undercoat materials for each coating system from the same manufacturer as the finish coats.
- C. Products shall be of best grade or first line.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to the Project site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label, and the following information:
 - 1. Product name or title of material.
 - 2. Product description (generic classification or binder type).
 - 3. Manufacturer's stock number, lot number, brand code, and date of manufacture.
 - 4. Contents by volume for pigment and vehicle constituents.
 - 5. Thinning instructions.
 - 6. Application instructions.
 - 7. Coverage and surface preparation.
 - 8. Drying time.
 - 9. Cleanup requirements.
 - 10. Instructions for mixing and reducing.
 - 11. Color name and number.
 - 12. Material Safety Data Sheets.
- B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45° F (7° C). Maintain containers used in storage in a clean condition, free of foreign materials and residue.
 - 1. Protect from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily. Take necessary measures to ensure that workers and work areas are protected from fire and health hazards resulting from handling, mixing, and application.
 - 2. Provide fire extinguishers and post caution signs warning against smoking and open flame when working with flammable materials.
- C. Protect work of other trades, whether being painted or not, against damage by painting. Correct damage by cleaning, repairing, or replacing and repainting, as approved by the ENGINEER. Provide "Wet Paint" signs to protect newly painted

finishes. Remove temporary protective wrappings provided by others to protect their work after completing painting operations.

1.11 PROJECT CONDITIONS

- A. Apply water-based paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 50° F and 120° F (10° C and 48.9° C).
- B. Apply solvent-thinned paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 45° F and 120° F (7.2° C and 48.9° C).
- C. Provide lighting level of 80 foot candles measured mid-height at substrate surface.
- D. Do not apply paint in snow, rain, fog, or mist; or when the relative humidity exceeds 85%; or at temperatures less than 5° F (3° C) above the dew point; or to damp or wet surfaces.
 - 1. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by manufacturer during application and drying periods.

1.12 UNUSED MATERIALS

- A. Furnish unused materials in unopened or opened and resealed containers for storage and identify with labels describing contents. Deliver materials to the OWNER.

1.13 EXTRA MATERIALS

- A. Supply one gallon of each color; store where directed.
- B. Label each container with color in addition to the manufacturer's label.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products listed in the paint schedules.
- B. Manufacturers Names: The following manufacturers are referred to in the paint schedules by use of shortened versions of their names, which are shown in parentheses:
 - 1. Benjamin Moore & Co. (Moore).
 - 2. PPG Industries, Inc. (PPG).
 - 3. Tnemec Co. (Tnemec).

4. Frazee Paint.
5. Ameron.
6. Valspar.

2.2 PAINT MATERIALS, GENERAL

- A. Paint exposed surfaces, except as indicated in Paragraph 1.4 and/or in Drawings/Specifications. If an item or surface is not specifically mentioned, paint the item or surface the same as similar adjacent materials of surfaces whether or not the schedule indicates color(s). If the schedule does not indicate color(s) or finish(es), the ENGINEER will select from standard colors and finishes available.
- B. Equipment supplied with a finished coat by the manufacturers shall be touched-up by the CONTRACTOR.
- C. Paints and Coatings: Ready mixed, except field-catalyzed coatings. Prepare pigments:
 1. To a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating.
 2. For good flow and brushing properties.
 3. Capable of drying or curing free of streaks or sags.
- D. Metals encased in concrete shall only receive a primer compatible with the covering material.
- E. All items under and around the metal canopies shall be considered exterior and painted with materials conforming to those specified in this Specification.
- F. Material Compatibility: Provide block fillers, primers, undercoats, and finish coat materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
- G. Material Quality: Provide manufacturer's best-quality paint material of the various coating types specified. Paint-material containers not displaying manufacturer's product identification will not be acceptable.
 1. Proprietary Names: Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Furnish manufacturer's material data and certificates of performance for proposed substitutions.
- H. Color Coding: Unless otherwise specified, all color coding of piping, ducts, and equipment shall comply with applicable standards of the following:
 1. ANSI A13.1.
 2. OSHA 1910.144.

- I. At completion of construction activities of other trades, touch-up and restore damaged or defaced painted surfaces.
- J. Architectural Color Schedule: Colors indicated are by Tnemec Company, Inc.: www.tnemec.com.
 - 1. Shading Devices: Match existing colors at existing Administration Building located on site.
 - 2. Exterior Hollow Metal Doors and Frames: Match existing colors at existing Administration Building located on site.
 - 3. Exposed CMU, Interior: 11WH White.
 - 4. Interior Hollow Metal Doors and Frames: 33GR Grey.
 - 5. Exposed Gypsum Board, Interior: 07WH Winter Mist.
- K. Colors: All colors as selected by ENGINEER from manufacturer's standards except as follows:
 - 1. Color of safety stripe at bollards match PPG 6-330 Safety Yellow.

2.3 PAINT SYSTEMS - INTERIOR AND EXTERIOR

- A. Field Primed Steel and Ferrous Metal:
 - 1. Exterior Exposure:
 - a. Surface Preparation: SSPC SP6 Commercial Abrasive Blast Cleaning.
 - b. Prime Coat: Series 69-1255 (beige) H.B. Epoxoline II; one coat; 4-6 mils DFT (dry film thickness).
 - c. Finish Coat: Series 73 Endura-Shield; one coat; 3-4 mils DFT.
 - 2. Interior Exposure:
 - a. Surface Preparation: SSPC SP6 Commercial Abrasive Blast Cleaning.
 - b. Prime Coat: Series 69-1255 (beige) H.B. Epoxoline II; one coat; 3-5 mils DFT.
 - c. Finish Coat: Series 69 H.B. Epoxoline; one coat; 4-6 mils DFT.
 - 3. Immersion or Partial Immersion Exposure:
 - a. Surface Preparation: SSPC SP10 Near-White Metal Abrasive Blast Cleaning.
 - b. Prime Coat: Series 66 H.B. Epoxoline; one coat; 4-6 mils DFT.
 - c. Finish Coat: Series 69 H.B. Epoxoline II; one coat; 4-6 mils DFT.
- B. Shop and Factory Primed Steel:
 - 1. Exterior Exposure:
 - a. Field Prime Coat (over factory prime coat): Series 135 (beige) Chembuild; one coat; 3-4 mils DFT.
 - b. Finish Coat: Series 73 Endura-Shield; one coat; 3-4 mils DFT.
 - 2. Interior Exposure:
 - a. Field Prime Coat (over factory prime coat): Series 135 (beige) Chembuild; one coat; 3-4 mils DFT.
 - b. Finish Coat: Series 69 H.B. Epoxoline; one coat; 4-6 mils DFT.
 - 3. Immersion or Partial Immersion Exposure:

- a. Surface Preparation: Brush off abrasive blast cleaning if required for recoat of the shop primer. Coating surface to be clean, dry, and free of contaminants prior to application of the field coats.
 - b. Prime Coat: Series 66 H.B. Epoxoline; one coat; 2.5-3 mils DFT.
 - c. Finish Coat: Series 69 H.B. Epoxoline II; one coat; 4-6 mils DFT.
- C. Galvanized Steel and Non-Ferrous Metals:
 - 1. Exterior Exposure:
 - a. Surface Preparation: Brush-off abrasive blast cleaning.
 - b. Prime Coat: Series 69-1255 (beige) H.B. Epoxoline II; one coat; 3-4 mils DFT.
 - c. Finish Coat: Series 73 Endure-Shield; one coat; 3-4 mils DFT.
 - 2. Interior Exposure:
 - a. Surface Preparation: Clean, dry and free of contaminants.
 - b. Prime Coat: Series 135 (beige) Chembuild; one coat; 3-4 mils.
 - c. Finish Coat: Series 69 H.B. Epoxoline II; one coat; 4-6 mils DFT.
 - 3. Immersion or Partial Immersion Exposure:
 - a. Surface Preparation: Brush-off abrasive blast cleaning.
 - b. Prime Coat: Series 66 H.B. Epoxoline; one coat; 4-6 mils DFT.
 - c. Finish Coat: Series 69 H.B. Epoxoline II; one coat; 4-6 mils DFT.
- D. Ductile and Cast Iron:
 - 1. Exterior Exposure:
 - a. Surface Preparation: Solvent scrub with stiff bristle brush, followed by brush-off abrasive blast cleaning to a minimum surface profile depth of 1.5 mils DFT.
 - b. Prime Coat: Series 69-1255 (beige) H.B. Epoxoline II; one coat; 3-5 mils DFT.
 - c. Finish Coat: Series 73 Endura-Shield; one coat; 3-4 mils DFT.
 - 2. Interior Exposure:
 - a. Surface Preparation: Clean, dry, and free of contaminants.
 - b. Prime Coat: Series 135 Chembuild; one coat; 4-6 mils DFT.
 - c. Finish Coat: Series 69 H.B. Epoxoline II; one coat; 4-6 mils DFT.
 - 3. Buried:
 - a. Surface Preparation: Solvent scrub with stiff bristle brush followed by brush-off abrasive blast cleaning to a minimum surface profile depth of 1.5 mils DFT.
 - b. Prime Coat: Series 69-1255 (beige) H.B. Epoxoline II; one coat; 3-5 mils DFT.
 - c. Finish Coat: Series 69 H.B. Epoxoline II; one coat; 4-6 mils DFT.
 - 4. Immersion:
 - a. Surface Preparation: Solvent scrub with stiff bristle brush, followed by brush-off abrasive blast cleaning to a minimum surface profile depth of 1.5 mils.
 - b. Prime Coat: Series 66 H.B. Epoxoline; one coat; 4-6 mils DFT.
 - c. Finish Coat: Series 69 H.B. Epoxoline II; one coat; 4-6 mils DFT.

- E. PVC:
 - 1. Exterior Exposure:
 - a. Surface Preparation: Clean, dry, and free of contaminants.
 - b. Prime Coat: Series 66 H.B. Epoxoline; one coat; 3-5 mils DFT.
 - c. Finish Coat: Series 73 Endure-Shield; one coat; 3-4 mils DFT.
 - 2. Interior Exposure:
 - a. Surface Preparation: Clean, dry, and free of contaminants.
 - b. Finish Coat: Series 66 H.B. Epoxoline; two coats; 3-5 mils DFT per coat.

2.4 PIPE IDENTIFICATION MARKERS

- A. Manufacturers: Provide products by one of the following:
 - 1. Seton Name Plate Company.
 - 2. W.H. Brady Company.
 - 3. Or equal.
- B. General: The size of lettering and marker shall conform to ANSI A13.1.
- C. Provide brass tags for pipes under 3/4-inch outside diameter. Provide plastic pipe markers for pipes over 3/4-inch.
- D. Plastic Pipe Markers: Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.
 - 1. Markers for piping up to 6-inch diameter shall be preformed to completely wrap around the pipe requiring no adhesive. Markers for pipes over 6-inch diameter shall be preformed to the contour of the pipe and attached with stainless steel spring fasteners.
- E. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2-inch diameter with smooth edges.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Inspect substrates, areas, and conditions, with the applicator present, under which painting will be performed for compliance with paint application requirements. Verify that surfaces are ready to receive work as instructed by the product manufacturer.
 - 1. Do not begin to apply paint until unsatisfactory conditions have been corrected and surfaces receiving paint are thoroughly dry.
 - 2. Start of painting will be construed as the applicator's acceptance of surfaces and conditions within a particular area.

- B. Coordination of Work: Review other Sections in which primers are provided to ensure compatibility of the total system for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.
 - 1. Notify the ENGINEER about anticipated problems using the materials specified over substrates primed by others.

3.2 PREPARATION

- A. Perform all preparation and cleaning procedures as specified herein and in strict accordance with the paint manufacturer's instructions for each particular substrate and atmospheric condition.
- B. Clean surfaces to be painted before applying paint or surface treatments. Remove oil and grease with clean cloths and cleaning solvents prior to mechanical cleaning. Program the cleaning and painting so that dust and other contaminants from the cleaning process will not fall in wet, newly painted surfaces.
- C. Furnish sufficient drop cloths, shields, and protective equipment to prevent spray or droppings from fouling surfaces not being painted and, in particular, surfaces within storage and preparation area.
- D. Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted. If removal is impractical or impossible because of the size or weight of the item, provide surface-applied protection before surface preparation and painting.
 - 1. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved.
- E. Surfaces: Correct defects and clean surfaces which affect Work of this Section. Remove or repair existing coatings that exhibit surface defects.
- F. Marks: Seal marks which may bleed through surface finishes with barrier coat compatible with paint.
- G. Impervious Surfaces: Remove mildew in accordance with paint manufacturer's recommendations.
- H. Cleaning: Before applying paint or other surface treatments, clean the substrates of substances that could impair the bond of the various coatings. Remove oil and grease before cleaning.
 - 1. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.
- I. Surface Preparation: Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition and as specified.

1. Provide barrier coats over incompatible primers or remove and reprime.
2. Cementitious Materials: Prepare concrete, concrete masonry block, cement plaster, and mineral fiber-reinforced cement panel surfaces to be painted. Remove stains, loose mortar, scale, salt, efflorescence, chalk, dust, dirt, grease, oils, release agents, and other foreign matter in accordance with paint manufacturers's recommendations. Do not use wire brushes for preparation or cleaning. Roughen as required to remove glaze. If hardeners or sealers have been used to improve curing, use mechanical methods of surface preparation.
 - a. Use abrasive blast cleaning methods if recommended by paint manufacturer.
 - b. Determine alkalinity and moisture content of surfaces by performing appropriate tests. If surfaces are sufficiently alkaline to cause the finish paint to blister and burn, correct this condition before application. Do not paint surfaces where moisture content exceeds that permitted in manufacturer's written instructions.
 - c. Clean concrete floors to be painted with a 5% solution of muriatic acid or other etching cleaner. Flush the floor with clean water to remove acid, neutralize with ammonia, rinse, allow to dry, and vacuum before painting.
3. Wood: Clean surfaces of dirt, oil, and other foreign substances with scrapers, mineral spirits, and sandpaper, as required. Sand surfaces exposed-to-view smooth and dust off.
 - a. Scrape and clean small, dry, seasoned knots, and apply a thin coat of white shellac or other recommended knot sealer before applying primer. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood filler. Sand smooth when dried.
 - b. Seal pitch streaks and sappy sections with sealer. Seal cracks, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks with caulking compound after prime coat has been applied; sand between coats. Back prime concealed surfaces before installation.
 - c. Prime, stain, or seal wood to be painted immediately on delivery. Prime edges, ends, faces, undersides, and backsides of wood, including cabinets, counters, cases, and paneling.
 - d. When transparent finish is required, back prime with spar varnish.
 - e. Seal tops, bottoms, and cutouts of unprimed wood doors with a heavy coat of varnish or sealer immediately on delivery.
4. Gypsum Board Surfaces to Be Painted: Fill minor defects with filler compound. Spot prime defects after repair.
5. Zinc Coated Surfaces: Remove surface contamination and oils and prepare for priming in accordance with metal manufacturer's recommendations.
6. Plaster Surfaces to Be Painted: Allow new plaster surfaces to cure 28 days. Remove grease, dirt, loose mortar, scale or alkali powder, high alkali surfaces, and other foreign matter in accordance with paint manufacturer's recommendation. Fill hairline cracks, small holes, and imperfections with

patching plaster that is compatible with paint. Make smooth and flush with adjacent surfaces. Do not use wire brushes for preparation or cleaning.

7. Aluminum: Remove surface contamination by steam or high pressure water. Remove oxidation with acid etch and solvent washing.
 8. Copper: Remove surface contamination by steam or high pressure water.
 9. Ferrous Metals: Clean and remove oil, grease, dirt, loose mill scale, and other foreign substances from ungalvanized ferrous metal surfaces that have not been shop coated as outlined in Paragraph 2.3. Use solvent or mechanical cleaning methods that comply with the Steel Structures Painting Council's (SSPC) recommendations.
 - a. Blast steel surfaces clean, as recommended by paint system manufacturer.
 - b. Touch-up bare areas and shop applied prime coats that have been damaged. Wire brush, clean with solvents recommended by paint manufacturer, and touch-up with the same primer as the shop coat.
 - c. For shop-primed ferrous metal surfaces, clean and prepare in accordance with manufacturer's recommendations. Feather edges to make touch-up patches inconspicuous. Prime bare steel surfaces. Provide barrier coat over entire shop primed items.
 10. Galvanized Surfaces: Clean galvanized surfaces with nonpetroleum-based solvents so surface is free of oil and surface contaminants. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods.
 11. Ductile Iron Pipe: All new ductile iron pipe (DIP) intended for immersion service shall be prepared per coating manufacturer's specifications and as specified herein.
 - a. Remove grease, rust scale, rust and touch-up any chipped or abraded areas on items that have been shop coated. Items intended for immersion service that have not been shop coated shall be sandblasted to "Near White Blast Cleaning" condition per SSPC SP-10 prior to receiving coating.
 - b. All new DIP intended for non-immersion service shall be sandblasted to "Commercial Blast Cleaning" condition per SSPC SP-6 prior to receiving coating.
- J. Materials Preparation: Mix and prepare paint materials according to manufacturer's written instructions.
1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.
 2. Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.
 3. Use only thinners approved by paint manufacturer and only within recommended limits.

- K. Tinting: Tint each undercoat a lighter shade to simplify identification of each coat when multiple coats of the same material are applied. Tint undercoats to match the color of the finish coat, but provide sufficient differences in shade of undercoats to distinguish each separate coat.

3.3 APPLICATION

- A. General: Apply paint according to manufacturer's written instructions. Use applicators and techniques best suited for substrate and type of material being applied.
1. Any spot measurement found below the required minimum dry film thickness shall be repainted by the CONTRACTOR in accordance with the manufacturer's instructions, at no additional cost to the OWNER.
 2. Do not apply finishes on surfaces that are not sufficiently dry. Allow each coat of finish to dry before following coat is applied, unless directed otherwise by the manufacturer.
 3. Where adjacent sealant is to be painted, do not apply finish coats until sealant is applied.
 4. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.
 5. Install piping identification markers after painting has been completed according to the color coding schedule indicated.
 6. Paint colors, surface treatments, and finishes are indicated in the schedules located at the end of this Section.
 7. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.
 8. Provide finish coats that are compatible with primers used.
 9. Finish edges, tops and bottoms of all doors the same as door faces. Both sides and all edges of doors to be finished simultaneously.
 10. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, convector covers, covers for finned-tube radiation, grilles, and similar components are in place. Extend coatings in these areas, as required, to maintain the system integrity and provide desired protection.
 11. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before the final installation of movable equipment, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 12. Paint interior surfaces of ducts with a flat, nonspecular black paint where visible through registers or grilles.
 13. Finish exterior doors on tops, bottoms, and side edges the same as exterior faces.
 14. Finish interior of wall and base cabinets and similar field-finished casework to match exterior.
 15. Sand lightly between each succeeding enamel or varnish coat.

- B. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pre-treated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.
1. The number of coats required are the same regardless of application method. Do not apply succeeding coats until the previous coat has cured, as recommended by the manufacturer. If sanding is required to produce a smooth, even surface according to manufacturer's written instructions, sand between applications.
 - a. Apply each coat in film thicknesses as recommended by the manufacturer.
 2. Unless recommended by the manufacturer, omit primer on factory finished metal surfaces indicated to be field painted or metal surfaces that have been shop primed and touch-up painted.
 3. If undercoats, stains, or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance. Give special attention to ensure edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.
 4. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until paint has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure, and where application of another coat of paint does not cause the undercoat to lift or lose adhesion.
- C. Application Procedures: Apply paints and coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions.
1. Brushes: Use brushes best suited for the type of material applied. Use brush of appropriate size for the surface or item being painted.
 2. Rollers: Use rollers of carpet, velvet back, or high-pile sheep's wool, as recommended by the manufacturer for the material and texture required.
 3. Spray Equipment: Use airless spray equipment with orifice size and pressure, as recommended by the manufacturer for the material and texture required.
- D. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate. Provide the total dry film thickness of each coat and of the entire system as recommended by the manufacturer.

3.4 FINISHING MECHANICAL AND ELECTRICAL EQUIPMENT

- A. Electrical and mechanical items to be painted include the following, whether factory prefinished or not, with color selected by the ENGINEER:
1. Exterior mechanical and electrical equipment and accessories including, but not limited to, the following:
 - a. Electrical and instrument panels, motor control centers, and switch gear.
 - b. Electrical conduit and accessories.
 - c. Transformers.

- d. Brackets.
 - e. Meter enclosures.
 - f. Conduit.
 - g. Components that are visible or exposed to the weather.
 - h. Exhaust fans and blowers.
 - 2. Exterior roof mounted mechanical and electrical equipment, any component of which is above adjacent parapets, including but not limited to, the following:
 - a. Roof mounted HVAC units.
 - b. Exhaust stacks, blowers, vents, etc.
 - c. Miscellaneous steel support components for mechanical equipment screens.
- B. Paint interior factory finished mechanical and electrical components selected by the ENGINEER from the manufacturer's standards, including, but not limited to, the following:
- 1. Piping (per color code and schedule), pipe hangers, and supports.
 - 2. Duct work.
 - 3. Duct throats behind grilles, registers, louvers, baffles, etc., shall be given one coat of flat acrylic latex (copolymer) black paint wherever visibility of the interior of the duct is allowed.
 - 4. Switchboards.
 - 5. Disconnect switches.
 - 6. Pumps, motors, and mechanical equipment.
 - 7. Gear reducers.
 - 8. Accessory items.
 - 9. Conduit and fittings (per color code and schedule).
 - 10. Switchgear.
 - 11. Panelboards.
- C. Block Fillers: Apply block fillers to concrete masonry block at a rate to ensure complete coverage with pores filled.
- D. Prime Coats: Before applying finish coats, apply a prime coat of material, as recommended by the manufacturer, to material that is required to be painted or finished and that has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn through or other defects due to insufficient sealing.
- E. Pigmented (Opaque) Finishes: Completely cover surfaces as necessary to provide a smooth, opaque surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.

- F. Transparent (Clear) Finishes: Use multiple coats to produce a glass smooth surface film of even luster. Provide a finish free of laps, runs, cloudiness, color irregularity, brush marks, orange peel, nail holes, or other surface imperfections.
- G. Provide satin finish for final coats.
- H. Stipple Enamel Finish: Roll and redistribute paint to an even and fine texture. Leave no evidence of rolling, such as laps, irregularity in texture, skid marks, or other surface imperfections.
- I. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
- J. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.
- K. Paint both sides and edges of plywood backboards for electrical equipment before installing backboards and mounting equipment on them.
- L. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with requirements.

3.5 FINISHING PROCESS EQUIPMENT AND FACILITIES

- A. The following process equipment and facilities shall be painted according to this Specification, including, but not limited to, the following:
 - 1. Headworks Building: Paint control panels, disconnects, transmitters, all new above ground, buried, and immersed piping and fittings, all new valves, pipe supports, exposed ductwork, interior CMU walls, gypsum board walls and ceilings, ladders, hollow metal doors and frames, etc.
 - 2. Headworks odor control scrubber: Paint all new above ground, buried, and immersed piping and fittings, all new valves, and pipe supports, etc.
 - 3. Chemical storage and containment area: Paint new above ground, buried and immersed piping and fittings, all new valves and pipe supports, chemical metering pumps and appurtenances, etc.

3.6 CLEANING

- A. Cleanup: At the end of each workday, remove empty cans, rags, rubbish, and other discarded paint materials from the site.
 - 1. After completing painting, clean glass and paint-spattered surfaces. Remove spattered paint by washing and scraping. Be careful not to scratch or damage adjacent finished surfaces.

3.7 PROTECTION

- A. Protect work of other trades, whether being painted or not, against damage by painting. Correct damage by cleaning, repairing, or replacing and repainting, as approved by ENGINEER.
- B. Provide "Wet Paint" signs to protect newly painted finishes. Remove temporary protective wrappings provided by others to protect their work after completing painting operations.
 - 1. At completion of construction activities of other trades, touch-up and restore damaged or defaced painted surfaces. Comply with procedures specified in PDCA P1.

3.8 FIELD QUALITY CONTROL

- A. CONTRACTOR shall provide a written report from the manufacturer certifying that paint has been applied in accordance with the manufacturer's requirements
- B. Provide ENGINEER with suitable testing materials in order for ENGINEER to carry out alkalinity and moisture tests prior to preparation and application.
- C. Provide ENGINEER with the following testing equipment, accurately calibrated, for use by the ENGINEER prior to surface preparation and application.
 - 1. Tinker and Razor Model M-1, K-D "Bird Dog", or equal, holiday detector, complete with necessary accessories.
 - 2. Microtest, Elcometer, or equal, magnetic dry film thickness gauge.
 - 3. Wet mil paint gauge for use during application.
- D. The ENGINEER reserves the right to test surfaces, film thicknesses, and paint products at any time and as often as the ENGINEER deems necessary during the period when paint is being applied.
 - 1. Any spot measurement found below the required minimum dry film thickness shall be repainted by the CONTRACTOR in accordance with the manufacturer's instructions, at no additional cost to the OWNER.
 - 2. Do not paint unsatisfactory surfaces until they have been corrected and are in accordance with paint manufacturer's recommendations.

3.9 PIPE COLOR CODING AND IDENTIFICATION SCHEDULE

- A. Install plastic pipe markers in accordance with manufacturer's instructions.
- B. Install tags with corrosion resistance chain.
- C. Locate identification markers and tags at the following locations:
 - 1. At each branch and riser takeoff.
 - a. At each pipe passage through a wall, floor, or ceiling.
 - b. On each horizontal and vertical pipe run at 25 foot intervals.

- D. Exposed, non-submerged, interior piping shall be color coded and provided with identification markers as follows, unless directed otherwise by the ENGINEER:

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

- E. Exposed piping, as defined earlier in this Specification, shall be color coded as listed above, except submerged pipes and pipes less than 3/8-inch diameter shall be painted the same as the wall or piece of equipment to which it is attached.
- F. Positive identification of the contents of a piping system shall be lettered legibly, giving the name of the contents in full or abbreviated form at no greater than 25 foot intervals between markings. Arrows shall be used to indicate direction of flow at no greater than 10 foot intervals. Contents shall be identified by additional details required by the ENGINEER, such as temperature, pressure, etc., as necessary to identify the hazard.
- G. Legend shall be brief and applied close to valves or flanges and adjacent to changes in direction, branches, and where pipes pass through walls or floors.
- H. Where two or more pipes run parallel, markings shall be applied in the same relative location on each as to be in vertical or horizontal line and present a neat appearance.

- I. In case a pipe is in such location that it can be seen only from one direction, such as pipes near a wall, two sets of the code designation shall be applied at each location, placed in two visible quadrants with respect to normal viewing positions.

Minimum Letter Sizes	
O.D. of Pipe (inches)	Height of Letters (inches)
3/4 - 1-1/4	1/2
1-1/2 - 2	3/4
2-1/2 - 6	1-1/4
8 - 10	2-1/2
Over 10	3-1/2

END OF SECTION

SECTION 11295

HYDRAULIC VALVES

PART 1 - GENERAL

1.1 SUMMARY

Membrane System Supplier to furnish all valves....

- A. ~~Furnish and install all valves~~ and valve accessories for water, non-potable water, wastewater, air, as indicated in the Drawings, as listed at the end of this Section, SUEZ's P&IDs and as specified herein, including all appurtenances required for a complete and operational installation. ✖

1.2 SECTION INCLUDES

- A. ~~Gate valves.~~ ✖ Not applicable to this project
- B. Butterfly valves. ✔
- C. Check valves. ✔
- D. Ball valves. ✔
- E. ~~Mud Valves~~ ✖ Not applicable to this project
- F. ~~Air/Vacuum Relief Valves~~ ✖ Not applicable to SUEZ's scope of supply as defined below
- G. Solenoid Valves ✔
- H. Pressure Reducing Valves ✔
- I. ~~Globe Valves~~ ✖ Not applicable to this project
- J. ~~Valve appurtenances.~~ ✖ None of the valve appurtenances listed in item 2.10 are applicable to SUEZ's scope of supply.

1.3 RELATED SECTIONS

- A. Section 01300, Submittals. ✔
- B. Section 01640, Materials and Equipment. ✔
- C. Section 01650, Starting of Systems. ✔
- D. ~~Section 09900, Painting.~~ ✖ The valve vendors take exception to Section 09900 - Painting Standard paint specifications can be provided to the CONTRACTOR and ENGINEER during the Submittal period for review. If changes to the vendor's standard paint specification are required, it will be at additional cost.
- E. ~~Section 13447, Electric Motor Actuators.~~ ✖ Electric Motor Actuators are not required for membrane system operation, thus Section 13447 is not applicable to this project.
- F. ~~Section 15050, Piping Systems.~~ ✖
Section 15050 is not included in these Specifications

1.4 REFERENCES

- A. ~~AWWA C500, Metal Seated Gate Valves For Water Supply Service.~~ ✗ Not applicable to SUEZ scope of supply
- B. ~~AWWA C504, Rubber Seated Butterfly Valves.~~ ✗ Not applicable to SUEZ scope of supply
- C. ~~AWWA C510, Double Check Valve Backflow Prevention Assembly.~~ ✗ Not applicable to SUEZ scope of supply
- D. ASME B16.1, Gray Iron Pipe Flanges and Flanged Fittings. ✓
- E. ~~ASME B46.1, Surface Texture (Surface Roughness, Waviness, and Lay).~~ ✗ Not applicable to SUEZ scope of supply
- F. ~~ASME A126, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.~~ ✗ Not applicable to SUEZ scope of supply
- G. ASTM A269, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service. ✓
- H. ASTM A48, Standard Specification for Gray Iron Castings. ✓
- I. ASTM A536, Standard Specification for Ductile Iron Castings. ✓
- J. ~~ASTM A582, Standard Specification for Free-Machining Stainless Steel Bars.~~ ✗ Not applicable to SUEZ scope of supply
- K. ~~ASTM B271, Standard Specification for Copper-Base Alloy Centrifugal Castings.~~ ✗ Not applicable to SUEZ scope of supply
- L. ASTM D429, Standard Test Methods for Rubber Property—Adhesion to Rigid Substrates. ✓
- M. ASTM D1784, Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds. ✓
- N. ASTM F439, Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80. ✓
- O. All other applicable ASTM and ANSI Standards. ✓

1.5 SUBMITTALS

- A. Descriptive submittals shall be made in accordance with the Data Reference Symbols defined in Section 01300, Submittals.
 - 1. All Valves: Shop Drawings and O&M Manuals:
 - a. ~~Final Certified~~ Drawings showing outline dimensions, foundation layout or mounting information, and other pertinent dimensions. ✗ Valve drawings will not be certified.
 - b. ~~Field erection instructions,~~ assembly drawings and/or diagrams, detailed reference drawing lists, ~~lists of erection details,~~ and list of spare parts supplied with equipment. ✗ There are no field erection instructions or list of erection details with the valves.
 - c. Shop Detail Drawings showing individual sub- assemblies and fabricated pieces with material specifications and other applicable data. ✓

Clarification: Items g, i and j are a part of the O&M Manuals, not a part of the Shop Drawing Submittal

- d. Installation instructions, operating and/or service manuals, and all other data pertinent to operating or servicing the complete apparatus. Preventative maintenance instructions and recommended frequency. ✓
- e. General bulletins and catalog cuts describing complete apparatus, ~~including operating principles and fundamentals.~~ ✗ Not included
- f. Service data sheets showing design performance, utility requirements, etc., as applicable to the specific duty for which the equipment is furnished. ✓
- g. Materials of construction of all components. ✓
- h. Renewal parts list ~~with diagrammatic or cross-section drawings showing part identification. Material analysis or trades designation for each significant part is to be noted on parts lists or on a separate sheet.~~ ✗ Not included
- i. Stuffing box sizes; packing sizes; specifications and arrangement; and mechanical seal details, specifications, etc., if furnished in equipment. ✓
- j. Bearing manufacturer's standard identification and/or interchangeable number for all anti-friction bearings in the equipment proper and its accessory items. ✓

SUEZ to submit Spare Parts List after completion of Shop Drawings, with the Draft O&M Manual

- B. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration. ✓

SUEZ preventative maintenance information package is part of the SUEZ O&M Manual. O&M Manuals are submitted after approval of Shop Drawings, not as part of the Submittal Package.

- C. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.** ✗

PART 2 - PRODUCTS

2.1 GENERAL

- ~~A. All buried valves shall be provided with a valve box and extension stem.~~ ✗

Not applicable to SUEZ scope of supply

2.2 GATE VALVES ~~X~~ Not applicable to this project

~~A. Cast Iron Gate Valves:~~

- ~~1. Gate valves shall conform to AWWA C509, 200 psi working pressure, resilient seated, iron body, bronze mounted, non-rising stem. All valves shall have an opening direction of counter-clockwise. All gate valves shall be as manufactured by Mueller Company, American Flow Control; or approved equal.~~
- ~~2. All above ground gate valves shall have handwheel/lever/t-handle geared operators or electric actuators as specified in the Equipment Schedule or as shown on the Drawings. All buried valves shall be equipped with valve box and extension stem per City of Chandler standard details and either a handwheel and pedestal, actuator and pedestal, or with operating nut as specified in the Equipment Schedule or as shown on the Drawings. Valves specified with an operating nut shall be installed with a ground level valve position indicator. Valves with actuators shall have sealed geared actuators with extension stems and torque tubes.~~
- ~~3. Valves will be provided with torque tube pedestal assemblies where pedestals are indicated on the Plans. Assemblies shall consist of a torque tube and a pedestal. Torque tubes shall be designed for a maximum deflection of no more than 0.75 degrees when measured at the disc edge. The pedestal shall be made of high strength cast iron and shall support the full weight of the torque tube by use of corrosion resistant thrust bearings located in the pedestal. Design of a torque tube shall allow ± 2 inches of free movement along the tube longitudinal axis. Pedestal shall have a height of 3 feet above the operating floor. Torque tube floorstand assemblies shall be factory assembled and shipped as integral units. For buried valves with actuators, the actuators shall be located on pedestals with overriding handwheel. See Section 13447, Electric Motor Actuators, for Actuator Specifications.~~

2.3 BUTTERFLY VALVES

General Exception to Butterfly Valve Specification:

SUEZ will provide butterfly valves that do NOT meet AWWA C504.
SUEZ will supply butterfly valves superior to AWWA C504 valves which are better suited for a membrane application.
SUEZ will supply Bray Series 30/31 Resilient Seated Butterfly Valves with ductile iron body, nylon-coated ductile iron/316SS disc, 416SS stem, and EPDM seat. SUEZ has included a comparison summary which shows the advantages of using the Bray butterfly valve vs an AWWA C504 valve.

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~~A. Butterfly valves – AWWA C504~~ ~~X~~

- ~~1. Butterfly valves shall be tight-closing, rubber-seat type with rubber seats that are securely fastened to the valve body or valve disc. No metal-to-metal seating surfaces shall be permitted. Valves shall be bubble-tight at rated pressures with flow in either direction and shall be satisfactory for applications involving valve operation after long periods of inactivity. Valve disc shall rotate 90 degrees from the full open position to the tight shut position. The handwheel operators shall be traveling nut, self-locking type and shall be designed to hold the valve in any intermediate position between fully open and fully closed without creeping or fluttering. Valve operators shall be equipped with mechanical stop-limiting devices to prevent over-travel of the disc in the open and closed positions. Valves shall close with a clockwise rotation. Operators shall conform to the requirements of AWWA C504.~~ ~~X~~

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2. ~~Valve bodies shall be constructed of cast iron ASTM A48, Class 40, or ASTM A126, Class B. Two trunnions for shaft bearings shall be integral with each valve body. Minimum body shell thicknesses shall be in strict accordance with AWWA Standard C504. ✖~~
3. ~~Valve disc shall be constructed of ductile iron ASTM A536, Grade 65-45-12, or cast iron ASTM A48, Class C. ✖~~
4. ~~Shafts of all valves shall be turned, ground, and polished. Valve shafts shall be constructed of 18-8 Type 316 stainless steel. Shaft diameters must meet minimum requirements established by AWWA Standard C504 for Class 150B. ✖~~
5. ~~Valve seats shall be Buna-N for water and EPDM for air service at conditions up to 250° F. Valves shall have seats that are bonded or mechanically retained to the valve body or valve disc. ✖~~
6. ~~Valves shall be fitted with sleeve type bearings. Bearings shall be corrosion resistant and self-lubricating. Bearing load shall not exceed 20% of the compressive strength of the bearing or shaft material. Bearings shall be high temperature for air valves. ✖~~
7. ~~Packing shall be Chevron V-type adjustable for above ground service and non-adjustable wear compensating for submerged or buried service. ✖~~
8. ~~Valves will be provided with torque tube pedestal assemblies where indicated on the Plans. Assemblies shall consist of a torque tube extension or a pedestal. Torque tubes shall be designed for a maximum deflection of no more than 0.75 degrees when measured at the disc edge. The pedestal shall be made of high strength cast iron and shall support the full weight of the extension rod by use of corrosion resistant thrust bearings located in the pedestal. Torque tube shall be made of carbon steel. Design of a torque tube shall allow ±2-inches of free movement along the tube longitudinal axis. Pedestal or torque tube extension shall have a height of 3 feet above the operating floor. Torque tube or pedestal assemblies shall be factory assembled as integral units where applicable. ✖~~
9. ~~All above ground butterfly valves shall have handwheel/lever/t-handle geared operators or electric actuators as specified in the Equipment Schedule or as shown on the Drawings. ✖ All buried valves shall be equipped with valve box and extension stem per City of Chandler standard details and either a handwheel and pedestal, actuator and pedestal, or with operating nut, as specified in the Equipment Schedule or as shown on the Drawings. Valves specified with an operating nut shall be installed with a ground level valve position indicator. ✖~~
10. ~~All buried butterfly valves shall be side mounted with a buried service gear operator and extended nut as specified in this Section. ✖~~
11. ~~Certified Drawing and Material Specifications shall be furnished by the manufacturer through the CONTRACTOR covering all items included in Sections 1 and 2 of AWWA C504. ✖~~ Butterfly valves shall be as manufactured by Bray, DeZurik, Henry Pratt Company, Mueller, Val-Matic, or equal.

Electric actuators are not relevant for this project. Any automatically actuated valves will have pneumatic actuation.

Buried valves are not relevant to SUEZ's scope of supply.

Buried butterfly valves are not relevant to SUEZ's scope of supply.

The Bray butterfly valves supplied by SUEZ do not meet AWWA C504.

2.4 CHECK VALVES

A. ~~CPVC and PVC Ball Check Valves (CKB): ✖~~

- ~~1. Ball check valves shall be self-contained, straight-through designed, automatic valves which prevent reversal of flow direction. Ball check valves shall ensure a positive seal to prevent reversal of flow, with extremely low back pressure.~~
 - ~~2. Ball shall be supported by a system of guide ribs to full flow with minimum turbulence and chatter.~~
 - ~~3. Valves shall be able to operate in horizontal and vertical position and shall be thermoplastic construction in PVC. Valves shall contain Viton O-ring seals. Valves shall be 150 psi at 75° F.~~
 - ~~4. Ball check valves shall be as manufactured by Watts Regulator or approved equal.~~
- SUEZ's scope of supply does not include CPVC Spring Loaded Ball Check Valves
- B. CPVC Spring Loaded Ball Check Valves (SCKB):** ~~×~~
- ~~1. Spring loaded ball check valves shall be self-contained, straight-through designed, automatic valves which prevent reversal of flow direction. Spring loaded ball check valves shall ensure a positive seal to prevent reversal of flow, with extremely low back pressure.~~
 - ~~2. Ball shall be supported by a system of guide ribs to full flow with minimum turbulence and chatter.~~
 - ~~3. Valves shall be able to operate in horizontal and vertical position and shall be thermoplastic construction in PVC. Valves shall contain Viton O-ring seals. Valves shall be 150 psi at 75° F.~~
 - ~~4. Product and Manufacturer (Manufacturers listed in alphabetical order):~~
 - ~~a. Heflin-Harrington,~~
 - ~~b. Ryan Herco.,~~
 - ~~c. Or approved equal.~~
- C. Swing Check Valves (CKS):**
- ~~1. Swing check valves shall be of the spring-loaded, non-slamming type. Swing check valves for wastewater or sludge pumping shall be designed to operate in the horizontal position. Valves shall have manual spring-loaded operators outside the valve body for backflushing.~~ ~~×~~
 - ~~2. All materials of construction shall be certified in writing to conform to ASTM Specifications as follows:~~ ~~×~~
 - ~~a. Body, Cover: Cast iron, ASTM A126, Grade B.~~
 - ~~b. Disc, Disc Arm: Ductile iron, ASTM A536.~~
 - ~~c. Seat: Stainless steel, ASTM B148.~~
 - ~~d. Disc Seat: Buna-N.~~
 - ~~e. Pivot Shaft: Stainless steel, Type 17-4 PH.~~
 - ~~3. Product and Manufacturer (Manufacturers listed in alphabetical order):~~
 - ~~a. Series 6000 CLS, as manufactured by APCO,~~
 - ~~b. Or approved equal.~~ ~~×~~
- Swing Check Valves on Permeate/Backpulse Lines have cast iron body, stainless steel disc and trim. EPDM N O-ring seat integral to body, 316SS spacers.
Swing Check Valves on CIP Lines have stainless steel body, stainless steel disc and trim. EPDM O-ring seat integral to body, 316SS spacers.
- SUEZ has proposed to supply Bray Ritepro Corporation swing check valves

2.5 BALL VALVES

A. CPVC Ball Valves:

1. Ball valves shall be constructed of chlorinated polyvinyl chloride conforming to ASTM F439 and ASTM D1784. Valves shall be true union with ~~Viton~~ seals and locked in Teflon seat carrier. Operation shall be 1/4 turn from full open to full closed with the hand lever parallel to flow in the full open position. Valves shall be rated at 200 psi at 70° F. ~~✗~~
Allow for Viton or EPDM seals. Viton may not be necessary in all applications.
2. Product and Manufacturer (Manufacturers listed in alphabetical order):
 - a. Heflin-Harrington, ~~✗~~
 - b. Ryan Herco., ~~✗~~ SUEZ standard CPVC Ball Valve manufacturer is George Fischer.
 - c. Spears ~~✗~~
 - d. Or approved equal. ~~✗~~

~~2.6 AIR/VACUUM RELIEF VALVES ✗~~

The Air/Vacuum Relief Valve defined below is not part of SUEZ's scope of supply.

- ~~A. The air/vacuum valve allows large volumes of air to escape out the large orifice when filling a pipeline and closes when liquid enters the air and vacuum valve. During the large orifice closure, the small air release orifice will open to allow small pockets of air to escape automatically and independently of the large orifice through an attached air release valve.~~
- ~~B. The large orifice shall also allow large volumes of air to enter during pipeline drainage to break the vacuum. The body inlet must be dampened to protect the lower float from direct forces of rushing air and water and to prevent premature valve shut-off causing water hammer in the air and vacuum valve. The floats shall be heavy stainless steel, hermetically sealed, designed to withstand 1,000 psi. The top plug or float shall be center guided through hex bushings for positive shut-off.~~
- ~~C. The main valve parts shall be a body, cover, baffle, float, and seat. The baffle shall shield the float from direct impact of air and water to prevent premature float closure. The seat shall slip fit into the baffle or cover and lock in place without any distortion.~~
- ~~D. The entire float and baffle assembly must be shrouded with a water diffuser to prevent water from slamming the float shut. Outlets shall be threaded.~~
- ~~E. Materials of Construction shall be as follows:
 1. Air and Vacuum Valve Body, Cover: 316 SST.
 2. Float: Polypropylene.
 3. Seat: Buna-N.~~
- ~~F. Product and Manufacturer (Manufacturers listed in alphabetical order):
 1. ARI Model D-26 (with low pressure seal option) for RAS pumps,
 2. ARI Model D-025 L NS for WAS pumps,
 3. Or approved equal.~~

2.7 SOLENOID VALVES

A. 2-way solenoid valves:

1. Manufacturers: One of the following or equal (manufacturers listed in alphabetical order)

- a. Automatic Switch Company, Series 8210. ✓
- b. Skinner Electric Valve Division, Series C. ✓

SUEZ standard Solenoid Valve manufacturer is ASCO

B. Design:

1. Valves: Suitable for service under the following conditions:

- a. Fluid: Reclaimed water. ✓
- b. Temperature of fluid: 80 degrees Fahrenheit. ✓
- c. Piping test pressure: 100 pounds per square inch gauge. ✓

2. Unless otherwise indicated on the Drawings, provide valves that:

- a. Minimum NEMA Type 4 enclosure. ✓
- b. 120 VAC operation. ✓
- c. Suitable for use as indicated on the Drawings. ✗ SUEZ's Drawings
- d. Minimum Class F coil insulation. ✓
- e. Normally closed ✓

3. 2-way valves: Furnish with openings of size equal to or larger than the nominal size designation of the valve. ✓

- ~~4. Furnish with manual/bypass operators. ✗ Not included~~

C. Materials:

1. Body: Type 316 Stainless Steel. ✓
2. Seats: Resilient material. ✓

2.8 PRESSURE REDUCING VALVES

- ### A. Manufacturers: One of the following or equal (manufacturers listed in alphabetical order)

1. Watts Regulator, Series 223. ✓
2. Wilkins, 500 Series. ✓

SUEZ standard Pressure Reducing Valve Manufacturer is Pneumatics

- ### B. Direct operated, single seat type pressure reducing valve. ✓

C. Materials:

1. Body and spring cover: Bronze. ✓
2. Valve seat: Series 300 stainless steel. ✓
3. Diaphragm: Buna Nitrile. ✓
4. Disk: Buna Nitrile. ✓

~~2.9 GLOBE VALVES~~



Not applicable to SUEZ scope of supply

- ### ~~A. Manufacturers: One of the following or equal (manufacturers listed in alphabetical order)~~

- ~~1. Crane, No. 1 Globe.~~
- ~~2. Lunkheimer Company, Figure 2140 Globe.~~

~~B. Design:~~

- ~~1. Size and configuration: Indicated in the Drawings.~~
- ~~2. Valves: Class 125 threaded ends, rated for 250 degrees Fahrenheit at pressure of 170 psi~~

2.10 VALVE APPURTENANCES

~~A. Extension Stems, Stem Guides, Wrenches, and Keys:~~

~~Not applicable to SUEZ scope of supply~~

- ~~1. Provide intermediate stem guide for extensions more than 7 feet long.~~
- ~~2. Stem brackets and guides shall be made of cast iron and have fully adjustable bronzed bushed guide block. Fasten brackets to walls with approved expansion bolts.~~
- ~~3. Operating nuts about 2-inches square shall be included with each extension stem and located in floor box or grating recess, as required.~~
- ~~4. Provide operating key or wrench of suitable length and size for each valve that is not readily accessible to direct operation.~~

~~B. Floor Boxes: Provide cast iron floor boxes for all valves which are to be operated from floor above valve. Boxes shall be equal in depth to floor slab. Boxes shall have cast iron covers and shall be fitted with bronze bushing.~~

~~Not applicable to SUEZ scope of supply~~

~~C. Valve Boxes: Provide each buried valve with a valve box as follows:~~

~~✗~~

- ~~1. Made of heavy pattern cast iron construction with two-piece adjustable telescoping type.~~
- ~~2. Lower section shall enclose operating nut and stuffing box and rest on bonnet.~~
- ~~3. Inside diameter shall be at least 4-1/2-inches.~~
- ~~4. Provide extension stem and operating nut.~~
- ~~5. Cover shall be heavy-duty cast iron with direction to open arrow cast in.~~
- ~~6. Provide ground level valve position indicator for all buried valves.~~

~~Not applicable to SUEZ scope of supply~~

2.11 SHOP PAINTING

~~✗~~

~~A. The manufacturer shall paint all PVC valves to be installed in exterior exposure as follows:~~

- ~~1. Surface Preparation: Clean, dry, and free of contaminants.~~
- ~~2. Prime Coat: Series 66 H.B Epoxoline; one coat, 3-5 mils DFT.~~
- ~~3. CONTRACTOR shall determine the quantity of each type of valve to the manufacturer.~~
- ~~4. CONTRACTOR shall provide finished coat per Section 09900, Painting. Final color selection shall be approved by ENGINEER prior to application.~~

~~The valve vendors take exception to Section 09900 - Painting
Standard paint specifications can be provided to the CONTRACTOR AND ENGINEER during the Submittal period for review. If changes to the vendor's standard paint specification are required, it will be at additional cost.~~

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Workmanship shall be of the highest grade throughout and in accordance with the best standard practice for this type of equipment. ✖
- B. Valves of the various types and pattern shall be installed at the respective locations as shown on the Drawings, listed in the Equipment Schedule, and specified herein. All appurtenances required for operation and control of the valves shall be included. Joints and connections shall be made in accordance with applicable requirements for pipe line or pipe joints. Valve stems shall be plumb and vertical unless otherwise specifically shown. Each valve shall be adjusted for smooth and easy operation and shall be watertight when placed in operation under maximum working pressure. ✖

Clarification: This item falls in the scope of the CONTRACTOR.

Clarification: This item falls in the scope of the CONTRACTOR.

3.2 MANUFACTURER'S FIELD SERVICE

- A. Equipment Start-up: A factory trained representative of the ~~manufacturer~~ shall visit the site and provide installation and start-up services as specified in Section 01650, Starting of Systems. Sales representatives shall not be acceptable to perform start-up and training functions. ✖
- B. Training: A factory employed representative of the ~~manufacturer~~ shall visit the site and provide operator training services, in addition to equipment start-up services, as specified in Section 01650, Starting of Systems. ✖

Membrane System Supplier

Visits will be performed by Membrane System Supplier's Field Service Representative.

Membrane System Supplier

END OF SECTION

SECTION 11314

END SUCTION CENTRIFUGAL PUMPS

PART 1 - GENERAL

1.1 SUMMARY

Membrane System Supplier

- A. The ~~CONTRACTOR~~ shall provide ~~all labor~~, materials, equipment, and incidentals required to furnish ~~and install~~ end suction centrifugal pumps complete and operational with motors, ~~control equipment~~, and accessories ~~as shown on the Drawings and~~ as specified. The pumps furnished ~~and installed~~ in accordance with this Section, shall include ~~five~~ end suction centrifugal pumps for the membrane system Permeate Pumps and two end suction centrifugal pumps for the membrane system Clean-In-Place (CIP) Pumps. The Process and CIP Pumps shall have NSF certification. ✖

Only four (4) end suction centrifugal Permeate Pumps are included in the Proposal Price. SUEZ's Proposal Price does NOT include spare parts except as noted in SUEZ's Proposal. Any additional spare parts, such as a spare Permeate Pump, will be at additional cost.

1.2 REFERENCES

- A. Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
1. Antifriction Bearing Manufacturers Association (AFBMA). ✔
 2. National Electric Code (NEC). ✔
 3. American National Standards Institute (ANSI). ✔
 4. American Society for Testing and Materials (ASTM). ✔
 5. Underwriters Laboratories, Inc. (UL). ✔
 6. American National Standards Institute/Hydraulic Institute (ANSI/HI). ✔

1.3 SYSTEM DESCRIPTION

Only four (4) end suction centrifugal Permeate Pumps are included in the Proposal Price. SUEZ's Proposal Price does NOT include spare parts except as noted in SUEZ's Proposal. Any additional spare parts, such as a spare Permeate Pump, will be at additional cost.

- A. ~~Five~~ ^{Four} Permeate pumps and two CIP pumps shall be installed ~~as shown in the Drawings~~. Each pump shall be mounted on a structural steel horizontal base atop a concrete equipment pad and secured with anchor bolts in accordance with the manufacturer's recommendations ~~and as shown on the Drawings~~. ✖
- E. Pumps shall be heavy-duty, end suction centrifugal pump units designed, constructed, and installed for the service intended. ✔
- C. Provide reducers as necessary to ensure pump locations, pipe locations, and pipe sizes are as shown on the Drawings. If reducers affect pump locations, pipe locations, or pipe sizes, the CONTRACTOR shall notify the ENGINEER before construction of the pump station proceeds. ✖

Clarification: This item falls in the scope of the CONTRACTOR.

Clarify that installation of the pumps and supply and installation of anchor bolts falls in the scope of supply of the CONTRACTOR.

1.4 PUMP DESIGN CRITERIA

A. All end suction centrifugal pumps shall meet the below criteria: ✖

Service	Permeate Pump	CIP Pump
Quantity	~~5~~ 4	2
Maximum Rated Design Flow (gpm)	~~3,407~~ 3,740	~~3,079~~ 2,450
Maximum Rated Design Head (feet)	~~50~~ 48	11
Minimum Overall Efficiency (%)	81	80
Maximum Motor Horsepower	~~60~~ 75	15
Maximum Speed	900	900
Voltage	460	460
Power Phases	3	3
Power Frequency (Hz)	60	60
Discharge Flow Diameters	~~12~~ 10	14
Suction Flow Diameter	~~14~~ 12	14

1.5 SUBMITTALS

A. Shop Drawings: Submit for approval the following:

- Letters of Certification of Compliance on materials, equipment, etc. ✔
- Final Certified Drawings showing outline dimensions, foundation layout, or mounting information, and other pertinent dimensions. ✔
- Assembly drawings and/or diagrams, detailed reference drawing lists, and lists of erection details. ✖ Pump vendor clarified that field erection details will be per their Installation and Operations Manual (IOM).
- ~~Shop Detail Drawings showing individual sub-assemblies and fabricated pieces with material specifications and other applicable data. ✖~~ Pump vendor commented that pump cross section drawing will be provided only.
- Installation instructions, operating and/or service manuals, and all other data pertinent to operating or servicing the complete apparatus. Preventative maintenance instructions and recommended frequency. ✔
- Schematic and wiring diagrams of power, control, and piping systems. A detailed description of operation shall be included for each diagram to describe all modes of operation of the system indicated. Where the integrated system requires interlocking and control of other components in

normal operation, these components shall be included in the description of operation. ✓

7. General bulletins and product literature describing complete apparatus including operating principles and fundamentals. ✓
8. Service data sheets showing design performance, utility requirements, etc., as applicable to the specific duty for which the equipment is furnished. ✓
9. Head capacity curves for pumps. Impeller size furnished and maximum size available shall be noted on these data sheets. ✓
10. Curves and/or data for overall range of operation from minimum to maximum capacity or load, showing capacity or load, utilities motive medium required, total or incremental differential head, and other pertinent information applicable to the equipment or its component assemblies. ✓
11. Materials of construction of all components. ✓
12. Renewal parts list with diagrammatic or cross-section drawings showing part identification. ~~Material analysis or trades designation for each significant part is to be noted on parts lists or on a separate sheet.~~ ✗
13. Mechanical seal details, specifications, etc., bearing manufacturer's standard identification and/or interchangeable number for all anti-friction bearings in the equipment proper and its accessory items. ✓

SUEZ to submit Spare Parts List after completion of Shop Drawings, with the Draft O&M Manual

Pump vendor stated that Material Analysis will not be noted on parts list. Certified Material Test Reports (CMTR) are available for pump components at additional cost, if required.

B. Shop Tests: Submit for approval:

1. Pump casings shall be hydrostatically tested to twice the discharge head or 1-1/2 times the shutoff head, whichever is greater. ✓
2. ~~Running Test: Pump assembly shall be operated from zero to maximum capacity as shown on the approved curve. Results of the test shall be shown in a plot of test curves showing head, flow, horsepower, efficiency, and current. Readings shall be taken at rated speed capacity points including shut-off, design point, and minimum head for which pump is designed to operate.~~ ✗
3. Each test shall be witnessed by the Factory Registered Engineer, who is an employee of the pump manufacturer. ~~Engineer shall sign and seal all copies of curves and shall certify that hydrostatic tests were performed. Tests shall be conducted in conformance with applicable Hydraulic Institute Standards.~~ ✗
4. Pumps shall not be shipped until the ENGINEER has approved the test reports. ✓

Pump vendor commented that non-witnessed performance test will be provided at the rated speed only. Capacity points at the rated speed only.

Pump vendor commented that the Factory Registered Engineer will witness the test only.

C. Field Test Results:

1. Submit a written report giving the results of the required field tests. ✗

Clarification: Field tests fall in the scope of the CONTRACTOR

D. Manufacturer's Reports:

1. Submit written report of the results of each visit by a manufacturer's serviceman, including purpose and time of visit, tasks performed, and results obtained. ✗

Clarification: Visits will be performed by Membrane System Supplier's Field Service Representative. Visits by the pump vendor's representative can be provided, but at additional cost.

E. Operation and Maintenance Manuals: Submit complete Operation and Maintenance Manuals, including field erection instructions, in conformance with the Operation and Maintenance Manuals Section of Section 01300, Submittals. ✓

- F. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration. ✓

SUEZ preventative maintenance information package is part of the SUEZ O&M Manual. O&M Manuals are submitted after approval of Shop Drawings, not as part of the Submittal Package.

- G. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.** ✗

1.6 QUALITY ASSURANCE

- A. Manufacturers regularly engaged in the manufacture of the centrifugal pump equipment, as specified herein, and who can demonstrate equipment of this specified design, in actual service for not less than five years will be considered as acceptable manufacturers. All like items shall be furnished by one manufacturer to ensure uniformity and interchangeability of parts. Manufacturer shall guarantee all equipment furnished as per the warranty stated below; however, this shall not be construed as relieving the CONTRACTOR from his responsibility for the proper installation and functioning of the Work. ✓
- B. Require pump manufacturer to furnish and coordinate pump, driver, ~~drive~~, and pump components as specified and scheduled below and to provide written installation and check out requirements. ✗ Drives, or VFDs, fall in the scope of the CONTRACTOR
- C. Manufacturer shall have five installations of same size equipment in same application within the last five years in the United States. Manufacturer to submit installation information, including size, location, and a total of three operator contact names and operator phone numbers with the Submittals. ✓
- D. ~~Complete assemblies, including motor, all accessories shall be listed and approved by OSHA, UL, and NSF where applicable.~~ ✗
Pump vendor clarifies that pumps will be to OSHA, UL, NSF, where applicable

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to the site to ensure uninterrupted progress of the Work. ✓
Deliver anchor bolts and anchorage devices, which are to be embedded in cast-in-place concrete, in ample time so as not to delay that Work. ✗

Clarification: Anchor bolts and anchorage devices fall in the scope of the CONTRACTOR. See Section 11500.1, item 1.3.A.1.c

- B. Store materials to permit easy access for inspection and identification. Keep steel members off the ground using pallets, platforms, and other supports. Protect steel members and packaged materials from corrosion and deterioration. ✗

Clarification: This item falls in the scope of the CONTRACTOR

- C. Store mechanical equipment in covered storage off the ground and prevent condensation. ✗

Clarification: This item falls in the scope of the CONTRACTOR.

Pump vendor comments that pumps will include vendor's standard preservation and preparation suitable for overland transport and short term storage.

1.8 WARRANTY

- A. The pump manufacturer shall warrant the units being supplied to the OWNER against defects in workmanship and material for a period of 12 months from substantial completion. The warranty shall cover parts and labor and shall be in printed form. The warranty shall apply to all similar units. ✗

Must include a sunset clause. Add "or 18 months from date of delivery" after "substantial completion."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Pumps (listed in alphabetical order):
1. Flowserve ✓
 2. ITT Goulds ✓
 3. Or approved equal. ✓
- B. The naming of a manufacturer in this Specification is not an indication that the manufacturer's standard equipment is acceptable in lieu of the specified component features. Naming is only an indication that the manufacturer may have the capability of engineering and supplying a system as specified. ✓

2.2 PUMP COMPONENTS

- A. Pump Construction:
1. Each pump shall be designed for clockwise rotation when viewed from motor end and include the following design features.

- a. Pump End Components:

- 1) Casing: The pump casing shall be concentric volute, diffuser, type, back pull-out design with flanged suction and discharge connections. The Permeate Pump casing shall be constructed of cast iron. The CIP Pump casing shall be Duplex stainless steel type CD4MCuN. The pump discharge shall be center line oriented to allow simplified system design and installation. Pump casing

The pump vendor comments that the grade of cast iron for the Process Pumps may vary to the grade listed in this section.

vent/fill and drain shall be provided with stainless steel plugs.
Wetted pump materials shall be NSF certified. ✖

Pump vendor has stated that Duplex stainless steel (CD4MCuN) impellers have been quoted for both the Process and CIP pumps. Impellers for both pumps are the open type. Both services will be NSF certified.

- 2) Floating Suction O-ring: The pump shall be provided with easily replaceable suction O-ring and be lubricated and self-aligning to maintain maximum pump efficiency without adjustments of impeller clearances. ✔
- 3) Impeller: The impeller shall be of the balanced non-clogging type made of Duplex stainless steel (CD4MCuN). It shall be of one-piece construction, single suction, enclosed or open taper cut, radial flow design with well-rounded leading vanes. ✖
- 4) Seal Housing: The seal housing shall be a self-flushing design, and shall hold the stationary seat of the mechanical shaft seal. The Permeate Pump stuffing box shall be cast iron and the CIP Pump stuffing box shall be Duplex stainless steel. The seal housing shall be clamped in place over a machined fit on the motor adapter to maintain component alignment and O-ring sealed to insure against leakage. ✔
- 5) ~~Mechanical Seal: The pump shaft seal shall be a John Crane Type 21 as standard, constructed of the following materials: ✖~~
 - a) ~~Seal Type: Standard.~~
 - b) ~~Stationary Face: Sil-Carb.~~
 - c) ~~Rotary: Carbon.~~
 - d) ~~Elastomers: Viton.~~
 - e) ~~Metal Components: 316 stainless steel.~~

The pump vendor states that seals will be Single Cartridge, Chesterton Type 155, NSF certified.

B. Motor:

The motor vendor commented that Class H insulation with 80K rise on DOL / 105K rise on VFD is included. If Class H insulation with 70K rise on DOL / 95K rise on VFD is required, it can be provided, but at additional cost.

1. The motor shall be TEFC premium efficiency, designed for continuous duty at 50° C, capable of sustaining a minimum of 15 starts per hour with a minimum service factor of 1.15. The close coupled motor shall be a wash down type. Overload protection must be provided. See Section 16225, Electric Motors 250 Horsepower or Less, for motor specifications. ✖

C. Control:

1. Provide the necessary control devices and equipment for the control of each pump ~~in accordance with Section 17454, Operations and Control Descriptions.~~ The CONTRACTOR shall be responsible for control panels as shown on the Drawings. ✖ Section 17454 is not included in these Specifications.

2.3 SPARE PARTS

A. Each type and size of pump shall be furnished with the following spare parts, carefully boxed or packaged and plainly marked for reordering:

1. One set of gaskets. ✖
2. One set of special tools required for maintenance or operation. ✖
3. One set of mechanical seals. ✖

SUEZ's Proposal Price does NOT include spare parts except as noted in SUEZ's Proposal. Any additional spare parts will be at additional cost.

- B. CONTRACTOR shall store and safeguard spare parts until completion of the Work, at which time they shall be inventoried, delivered, and placed in an area designated by the OWNER. ✓

2.4 PUMP SHOP PAINTING

Pump vendor takes exception to Section 09900 - Painting. Pump vendor has included it's standard paint (single coat). Pump vendor can provide a two part Epoxy Paint plan with sand blast, for an additional cost. Pump vendor can provide their standard paint specification to the CONTRACTOR and ENGINEER during the Submittal period for review. If changes to the vendor's standard paint specification are required, it will be at additional cost.

- A. The manufacturer shall paint the pumps as follows:
1. Pumps, motors, drives, frames, baseplates, appurtenances, etc., shall receive shop primer and shop finish coating ~~conforming to the requirements of Section 09900, Painting.~~ If any damage to the paint system occurs, the equipment shall be repainted as directed by the ENGINEER. ✗
 2. All gears, bearing surfaces, machined surfaces, and other surfaces which are to remain unpainted shall receive a heavy application of grease or other rust-resistant coating. This coating shall be maintained during storage and until the equipment is placed into operation. ✗ Clarification: Maintaining the coating falls in the scope of the CONTRACTOR.
 3. CONTRACTOR shall provide finished coat per Section 09900, Painting. Final color selection shall be approved by ENGINEER prior to application. ✓
 4. CONTRACTOR shall certify, in writing, that the shop primer and shop finish coating system conforms to the requirements of Section 09900, Painting. ✓

PART 3 - EXECUTION

3.1 INSTALLATION

- A. The pumps and accessories shall be installed in accordance with the manufacturer's recommendations and approved Shop Drawings. ✗ Clarification: This item falls in the scope of the CONTRACTOR.
- B. All pumps shall be installed on concrete equipment pads and secured with anchor bolts in accordance with the manufacturer's recommendations ~~and as shown on the Drawings.~~ Supplier shall design anchor bolts and shall provide location for anchor bolts. Anchor bolts for equipment will be provided and installed by CMAR. Pump bases shall be grout-filled for vibration and noise control. ✗ Clarification: Pump installation falls in the scope of the CONTRACTOR.
- C. Piping shall be supported independent of the pumps. ✗ Clarification: This item falls in the scope of the CONTRACTOR.
- D. Using laser alignment, check and align all pump, motor, and flexible shafting. ✗ Clarification: This item falls in the scope of the CONTRACTOR.

3.2 MANUFACTURERS' FIELD SERVICE

- A. Equipment Start-up: A factory employed representative of the ~~manufacturer~~ Membrane System Supplier shall visit the site and provide installation and start-up services as specified in Section 01650, Starting of Systems. ✗ Visits will be performed by Membrane System Supplier's Field Service Representative. Visits by the pump vendor's representative can be provided, but at additional cost.
- B. Training: A factory employed representative of the ~~manufacturer~~ Membrane System Supplier shall visit the site and provide eight hours of operator training services, in addition to equipment start-up services, as specified in Section 01650, Starting of Systems. ✗ Visits will be performed by Membrane System Supplier's Field Service Representative. Visits by the pump vendor's representative can be provided, but at additional cost.

END OF SECTION

SECTION 11371

POSITIVE DISPLACEMENT BLOWERS

PART 1 - GENERAL

1.1 SUMMARY

The Membrane System Supplier shall furnish...

- A. ~~Furnish and install~~ two (2) skid-mounted positive displacement blowers for the Membrane Air Scour System. The skid mounted units shall have integral piping for all equipment, discharge isolation butterfly valves, check valves, relief valves, silencers, expansion joints, air filters, and all appurtenances required to construct complete and operable positive displacement blower systems, ~~as shown on the Plans and specified herein.~~  as defined by the Membrane System Supplier
- B. ~~Furnish and install~~ two acoustical noise enclosures.  Installation falls in the scope of the CONTRACTOR

1.2 SECTION INCLUDES

- A. Membrane Air Scour System Blowers: Two units. 

1.3 RELATED SECTIONS

SUEZ's Drawings

- A. ~~Drawings~~ and General Provisions of the Contract, including General and Supplementary Conditions, apply to this Section. 
- B. Section 01300, Submittals. 
- C. Section 01640, Materials and Equipment. 
- D. Section 01650, Starting of Systems. 
- E. ~~Section 09900 - Painting.~~  Blower vendor takes exception to Section 09900 - Painting
Blower vendor will provide their standard paint specification to the CONTRACTOR and ENGINEER during the Submittal period for review. If changes to the vendor's standard paint specification are required, it will be at additional cost. Blower vendor (Aerzen) did comment that there are several Aerzen blowers installed at the City of Chandler without a paint upgrade.
- F. ~~Section 11295 - Hydraulic Valves.~~  The valves included with the Blower package do not conform with Section 11295, Hydraulic Valves
- G. ~~Section 15260 - Piping Insulation.~~  Section 15260 is not included in these Specifications
- H. ~~Section 16195 - Electrical Identification.~~  Section 16195 is not included in these Specifications
- I. ~~Section 16161 - Control Panels.~~  Blower vendor takes exception to Section 16161 - Control Panels.
Separate control panels are not included. Control of the blower will be through the membrane system control system.
- J. Section 16225 - Electric Motors 250 Horsepower or Less. 
- K. ~~Section 16485 - Variable Frequency Drives - Low Voltage.~~  See specification Section 11500.1, item 1.3.A.3.a which states that VFDs fall in the scope of supply of the CMAR.

1.4 REFERENCES

- A. American Iron and Steel Institute (AISI). ✓
- B. American National Standards Institute (ANSI). ✓
- C. American Society for Testing Materials (ASTM).
 - 1. A48, Standard Specification for Gray Iron Casting. ✓

1.5 SUBMITTALS

- A. Submit for approval the following:
 - 1. Letters of Certification of Compliance on materials, equipment, etc. ✓
 - 2. Field erection instructions, diagrams, lists of erection details, and list of items to be repaired. The formal test protocol for use during performance testing, if required. ✓
 - 3. Schematic and wiring diagrams of power, control, and piping systems with all devices, terminals, and wires uniquely numbered. Clearly indicate between factory and field wiring. All field wiring shall be terminated on labeled terminal blocks. A detailed description of operation shall be included for each diagram to describe all modes of operation of the system indicated. Where the integrated system requires interlocking and control of other components in normal operation, these components shall be included in the description of operation. ✓
 - 4. General bulletins and catalog cuts describing complete apparatus, ~~including operating principles and fundamentals.~~ ✗
 - 5. ~~Renewal parts list with diagrammatic or cross-section drawings showing part identification. Material analysis or trades designation for each significant part is to be noted on parts lists or on a separate sheet.~~ ✗
 - 6. Recommended list of spare parts and safety equipment along with price and ordering information. ~~Spare parts and safety equipment at a minimum shall include the equipment listed in Paragraph 2.3 of this Specification.~~ ✗
 - 7. ~~Positive displacement blowers manufacturer on-site~~ factory-trained representative's complete signed report of results of the inspection, operation, adjustments, and tests. Include the manufacturer's certificate that equipment is ready for permanent operation, and that nothing in installation will render manufacturer's warranty null and void. ✗
 - 8. Operation and Maintenance data shall be submitted per Section 01300, Submittals. ✓
 - 9. All equipment manufacturers shall submit evidence of conformance with the Specifications as required by the individual Specification Sections. ✓
- B. Shop Drawings: Submit for approval the following:
 - 1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked

Blower vendor clarified that field erection details and use during performance testing will be per their Installation and Operations Manual (IOM).

SUEZ to submit Spare Parts List after completion of Shop Drawings, with the Draft O&M Manual

Spare parts are not listed in Paragraph 2.3 of this Specification.

Membrane System Supplier's factory-trained representative's....

to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration. ✓

SUEZ preventative maintenance information package is part of the SUEZ O&M Manual. O&M Manuals are submitted after approval of Shop Drawings, not as part of the Submittal Package.

2. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.** ✗

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to the site to insure uninterrupted progress of the Work. ✓
- B. Handle all blowers and associated equipment properly, in accordance with Manufacturer's recommendations. Equipment that is in anyway damaged will not be acceptable. ✗ Clarification: This item falls in the scope of the CONTRACTOR.
- C. Store materials to permit easy access for inspection and identification. ✗
Clarification: This item falls in the scope of the CONTRACTOR.
- D. Each blower must be stored and maintained in accordance with Manufacturer recommendation. CONTRACTOR is required to show proof of the proper storage and maintenance, which must be approved and verified by ENGINEER. Improper storage will result in replacement and service of the equipment at CONTRACTOR'S expense. ✓

1.7 WARRANTY

- A. The manufacturer shall warrant, in writing that all equipment supplied by them shall be free from defects in material and workmanship, for a period of 12 months from the date of substantial completion, unless noted otherwise within the Specifications. ✗

Must include a sunset clause. Add "or 18 months from date of delivery" after "substantial completion."

1.8 QUALITY ASSURANCE

- A. Manufacturer shall have a minimum of 5 years of experience manufacturing blower systems and shall show evidence of at least 5 installations in satisfactory operation for 5 years in similar environments and operating conditions. ✓
- B. Supplies all accessories including motor. ✓

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. AERZEN. ✓
- B. Naming of a manufacturer in the Specifications is not an indication that the manufacturer's proposed or standard equipment is acceptable in lieu of the specified components and features. Naming is only an indication that the manufacturer may have the capability of engineering and supplying a system as specified ✓

2.2 DESIGN CRITERIA

- A. Positive Displacement Blower:
 - 1. Number of Blowers: 2 (1 duty, 1 standby). ✓
 - 2. Rated Speed: ~~1,800 rpm, maximum.~~ ✗
 - 3. ~~Rated Air Flow at Rated Speed: 3,000 scfm.~~ ✗
 - 4. ~~Required Air Flow Range: 801 to 3,000 scfm.~~ ✗
 - 5. Inlet Piping Pressure: 0.20 pound per square inch. ✓
 - 6. Rated Discharge Pressure: 2.8 to 5.7 psig. ✓
 - 7. Rated Inlet Pressure: 14.1 psia ✓
 - 8. Inlet Temperature: 25° to 110° Fahrenheit ✓
 - 9. Inlet Humidity: 0% to 36%. ✓
 - 10. Approximate Site Elevation: 1,190 feet above sea level. ✓
 - B. Motor: As specified in Section 16225, Electric Motors 250 Horsepower or Less, except as otherwise specified or supplemented below:
 - 1. Motor Power Supply: 480 volts, 3 phase, 60 hertz. ✓
 - 2. Motor Horsepower: ~~150.~~ ✗ 125 hp
 - 3. Motor Speed, Maximum: 1,800 rpm. ✓
 - 4. Motor Enclosure: TEFC. ✓
 - 5. Motor Service Factor: 1.15 at altitude. ✓
 - C. Drive: Belt type automatic tension designed with a minimum 1.4 service factor based on motor horsepower. ✓
- The Blower vendor comments that their recommendation is to address % of max blower speed as opposed to actual RPM. A blower designed between 75 to 95% is ideal
- Initial Design Capacity: 1,990 scfm
Future Design Capacity: 2,490 scfm

- D. Noise control: Sound pressure levels radiated from equipment furnished shall not exceed 80 dBA (mean, A-weighted) at 3 feet (RE 2 x 10⁻⁵ N/m²) for free field condition when unit is in operation at the rated flow with the sound enclosure is in place. ✓
- E. ~~Provide control panel, instrumentation, and alarms as indicated on the P&ID Drawings and as specified in Section 17454.~~ ✗ Section 17454 is not included in these specifications. A separate control panel is not included with the Blowers. Control of the Blowers is through the membrane system control system. Instrumentation and alarms will be as indicated on the SUEZ P&ID drawings and documents.
- F. ~~System operation: System operation shall be manual through a vendor supplied control panel.~~ ✗ Control of the Blowers is through the membrane system control system.
- G. All components listed in this Section shall be mounted and piped (including instrument tubing and acoustical enclosure), by the blower equipment supplier. ✓

2.3 MATERIALS

- A. General: A separate control panel is not included with the Blowers. Control of the Blowers is through the membrane system control system.
1. Blower package: Complete with blower, motor, inlet and discharge silencers, valves, inlet filters, acoustic enclosure, instrumentation, ~~controller, and appurtenances.~~ Manufacturer to furnish all required lubrication ~~and anchor bolts, including anchorage for acoustical enclosure.~~ ✗ Anchor bolts fall in the scope of supply of the CMAR. See Section 11500.1, item 1.3.A.1.c.
 2. Blower rating: As specified above. ✗ See modifications above
 3. Rotation direction of blower shall match requirements of piping. ✓
- B. Blower and Drive:
1. General:
 - a. Blower shall deliver oil-free air. ✓
 - b. Blower and Motor Mounting: On common base. ✓
 - c. Lifting Provisions: Lifting eyes on blowers, motors, and base so each major component or entire unit can be lifted. ✓
 - d. ~~Piping Connections: 125 pound class flanges meeting ANSI B16.1.~~ ✗ Blower comes with flexible connector with clamps for schedule 40 pipe. Flanged connections on the intake and discharge are possible, but at additional cost.
 2. Type: Positive displacement rotary blowers using 3 lobes to pressurize a trapped volume of air at a controlled rate prior to exposing it to a discharge pressure. ✓
 3. Casing and head plates:
 - a. Blower casing: One piece with separate head plates and end covers. ✓
 - b. Casing and head plates: Made of close-grained, machined cast iron. ✓
 - c. End covers and head plates: Reinforced with bosses at penetrations with cast, machined support feet as required. ✓
 4. Impellers:
 - a. Material: Ductile iron or cast iron. ✓
 - b. Design: Straight, 3-lobe, involute type. ✓
 - c. Balance: Statically and dynamically, by removing metal from impeller body. ✓
 - d. Operation: Free of rubbing without need for liquid seals or lubrication. ✓

- e. Timing: Positively by a pair of accurately machined, heat treated, alloy steel timing gears. ✓
- f. Shafts: Alloy steel forgings, pressed into each end of each impeller and pinned or one piece design. ✓
- g. Impeller assembly support: Anti-friction type bearings, sized for a minimum ABMA L-10 life of 100,000 hours. ✓
- h. Each impeller shall be of the stiff design with first lateral critical speed at least 120 percent of the maximum allowable operating speed. ✓
- 5. Lubrication:
 - a. Positive Oil Seal: Provided at each bearing. ✓
 - b. Seal Design: Capable of preventing lubricant from leaking into air stream. ✓
 - c. Vent Provisions: Capable of venting impeller side of oil seal to atmosphere while eliminating possible carryover of lubricant into air stream. ✓
 - d. Drive-end bearings: Oil lubricated. ✓
 - e. Timing gears and gear-end bearings: Splash oil lubricated. ✓
 - f. Blowers shipment: With openings sealed after injection of rust inhibitor. ✓

2.4 APPURTENANCES

~~A. Inlet filter: 2-stage pleated media type, using replaceable pleated lofted fiber elements with final media efficiency of not less than 45 percent per ASHRAE Standard 52-76, or integral cleanable filter/silencer. Inlet filter to include resettable tell-tale Replace Filter indicator.~~ ✗

See air intake filter
description in item
2.4.C.6 below

- B. Inlet and discharge silencers:
 - 1. Manufacturers: One of the following or equal:
 - a. Aerzen, equivalent product. ✓
 - 2. Construction: Welded steel. ✓
 - 3. Discharge silencer: Sized for flow and furnished with absorption material or other noise cancellation techniques as required. ✓
 - 4. Silencers sizing: For design conditions and specifically designed for use with positive displacement blowers, size as indicated on the Drawings unless the manufacturer recommends a larger size. ✓
 - 5. Mounting of silencers: Within acoustic enclosure and per manufacturer. ✓
- C. Acoustic enclosure:
 - 1. General: Each blower shall be supplied with a sound enclosure covering the entire blower package including the drive motor. The sound enclosure must be designed for easy inspection and maintenance of all blower package components. The sound enclosure shall not interfere with this requirement and shall not require disassembly of the piping or use of tools to meet the aforementioned requirements. Operator shall not be required to reach over any component of the blower package to perform oil filling and draining. Panels shall be internally and externally powder coated. Sound enclosure acoustic material, as a minimum, shall comply with UL 94-HF1 for fire retardant, self-extinguishing, non-dripping materials. Materials with a lesser

rating are not acceptable. If used, non-flammable packing materials such as compressed mineral fibers are only acceptable if lined with appropriate retaining mat and supported by galvanized perforated sheet. The enclosure shall provide suitable protection for outdoor installation under the specified site conditions (seismic, wind load, and snow load). The enclosure and the blower package must both be mounted on a skid / oil-drip pan designed for meeting environment protection standards and for easy transportation and installation. A grounding strap shall be installed between the blower base and the package skid to bypass any vibration isolating mounts. Electrical components, instrumentation and instrument connections shall not be mounted or interface with moving panels of the sound enclosure. ✓

2. Galvanized sheet-metal sandwich construction. ✓
3. With noise attenuating walls and with ventilation openings ported, ducted, shielded, and lined with acoustic absorptive material as required to achieve specified noise levels. ✓
4. Seismic structural calculations:
Submit seismic structural calculations in conformance with the following requirements:
 - a. Design spectral acceleration at short periods. $S_{DS} = 0.19$. ✓
 - b. Design spectral acceleration at period of 1-second, $S_{D1} = 0.09$. ✓
 - c. Risk Category: III ✓
 - d. Component amplification factor, a_p = in accordance with ASCE 7, Tables 13.5-1 and 13.6-1. ✓
 - e. Component response modification factor, R_p = in accordance with ASCE 7, Tables 13.5-1 and 13.6-1. ✓
 - f. Component importance factor, I_p = in accordance with ASCE 7 Chapter 13. ✓
 - g. Seismic Design Category: Category B. ✓
 - h. The calculations shall be prepared and stamped by a structural engineer registered in the State of Arizona. ✓
5. With ventilation system designed for not more than 10 degrees Fahrenheit air temperature rise with blower operating at maximum load. ✓
6. With an enclosure ventilation air intake filter:
 - a. Of disposable, dry type, pleated lofted cotton and polyester fiber media construction, securely bonded to a welded galvanized wire backing, with a frame of heavy duty paperboard. ✓
 - b. Sized for not more than 400 feet per minute face velocity. ✓
 - c. With ASHRAE 52.2 cleaning efficiency of not less than 25 percent. ✓
 - d. With thickness not less than 2 inches. ✓
 - e. With an easily visible and resettable "replace filter" indicator with retained indication independent of blower on/off status. ✓
7. With removable access panels located for maintenance and inspection access to the housed equipment, each weighing not more than 40 pounds, or hinge if weight exceeds 40 pounds. ✓

D. Pressure relief valve:

1. Provide each blower with a pressure-relief valve sized to receive full blower capacity with 10 percent accumulation. ✓
2. Suitable for use in the specified service and under specified conditions. ✓
3. Field adjustable spring loaded and sized for full blower capacity. ✓

E. Check valves:

Blower vendor's standard check valve

1. Provide each blower with ~~line-sized (minimum), heavy-duty, low-pressure drop, tight shutoff valve designed to prevent damage due to reverse rotation in the case of system pressure surge.~~ ✗
2. Suitable for use in the service specified and capable of providing a gastight seal upon closure with minimum pressure loss when opened. ✓
3. Valve plates of aluminum, bronze, or other anti corrosion material and an EPDM flat full-contact seal. The valve shall be removable without disturbing the piping. Check valve performance losses shall be included by the blower vendor in the blower performance calculation and shall be factory assembled. ✓
4. Sealing element: Suitable for use with air temperatures as great as 275 degrees Fahrenheit. ✓

F. Switches:

Not included. A high inlet differential air pressure switch can be included, but at additional cost. Not a required accessory for this application

1. ~~High inlet differential air pressure switch:~~ ✗
 - a. ~~Adjustable and as recommended by blower manufacturer. Initial setting as recommended by blower manufacturer.~~
 - b. ~~Activation shuts down unit and activates an alarm condition.~~
2. ~~Low oil level switch:~~ ✗
 - a. ~~As recommended by blower manufacturer.~~
 - b. ~~Activation shuts down unit and activates an alarm condition.~~
3. ~~High motor temperature switch:~~ ✗
 - a. ~~As recommended by motor manufacturer.~~
 - b. ~~Activation shuts down unit and activates an alarm condition.~~
4. ~~High discharge air temperature switch:~~ ✗
 - a. ~~Adjustable and as recommended by blower manufacturer. Initial setting as recommended by blower manufacturer.~~
 - b. ~~Activation shuts down unit and activates an alarm condition.~~
5. ~~High discharge pressure switch:~~ ✗
 - a. ~~Adjustable and as recommended by blower manufacturer.~~
 - b. ~~Initial setting as recommended by blower manufacturer.~~
 - c. ~~Activation shuts down unit and activates an alarm condition.~~

Not included. Not a required accessory for this application.

Not included. A high motor temperature switch can be included, but at additional cost. Not a required accessory for this application

Not included. A high discharge air temperature switch can be included, but at additional cost. Not a required accessory for this application

Not included. A high discharge pressure switch can be included, but at additional cost. Not a required accessory for this application

G. Sensors:

1. ~~Discharge air temperature elements:~~ ✗
 - a. ~~With thermowell, suitable for mounting in discharge piping of enclosure.~~
 - b. ~~Range of 0 to 300 degrees Fahrenheit or as recommended by blower manufacturer.~~
 - c. ~~With local and remote indication of temperature.~~

Not included. Discharge air temperature elements can be included, but at additional cost. Not a required accessory for this application

H. Other safety devices and controls: As recommended by blower manufacturer. ✓

- I. Piping pressure gauges:
 - 1. Type on Discharge Side of Blower Piping: Pressure gauge calibrated in psig with a range of 0 to 30 psig. ✓
 - 2. A suitable tee handled corporation stop or ball valve and snubber shall be installed between each gauge and connection to air piping. ✓
 - 3. Pressure gauges outside acoustic enclosure shall be supplied by Contractor. ✓
- J. Rubber expansion joints:
 - 1. Provided at discharge flange of blower enclosure. ✓
 - 2. Includes split backing plates for mounting. ✓
 - 3. Suitable for pressures up to 30 inches mercury vacuum, 15 psig pressure and temperature up to 300 degrees Fahrenheit. ✓
 - 4. Manufacturers: One of the following or equal:
 - a. General Rubber, or equal. ✓
 - 5. Expansion joints outside acoustic enclosure shall be supplied by Contractor. ✓
- K. Discharge piping insulation: ~~As specified in Section 15082, and~~ as indicated on the Drawings. Insulation outside acoustic enclosure shall be supplied by Contractor. ✗ ~~Section 15082 is not included in these Specifications.~~
- L. Supports and bracing: As required to support blower, associated equipment, and piping, and to prevent excessive or harmful vibration or movement of equipment or piping shall be supplied by Contractor. ✓

2.5 SHOP PRIMING AND FINISHING

- ~~A. Prepare and shop paint surfaces as specified in Sections 09900, Painting.~~ ✗
- ~~B. Acoustic enclosure shall be powder coated.~~ ✗

Blower vendor takes exception to Section 09900 - Painting. Blower vendor will provide their standard paint specification to the CONTRACTOR and ENGINEER during the Submittal period for review. If changes to the vendor's standard paint specification are required, it will be at additional cost. Blower vendor (Aerzen) did comment that there are several Aerzen blowers installed at the City of Chandler without a paint upgrade.

PART 3 - EXECUTION

3.1 INSPECTION

Membrane System Supplier

- A. ~~The manufacturer shall furnish experienced startup service personnel to inspect the final installation and supervise the field startup tests of the equipment and software. The services of the representative shall be provided for a minimum of two 8 hour days for each blower and two 8 hour days for the blower control system adjustment and optimization. If there are difficulties in operation of the equipment due to the manufacturer's fabrication and programming or Contractor's installation, additional service shall be provided at no extra cost to Owner.~~ ✗
 - 1. Provide, as a minimum, the following field services: Provide written documentation for check out including who performed the work, when performed, what was final setting or tolerance, and who witnessed the final settings.
 - a. Verify proper connection of piping and installation of accessories. ✓

as specified in Section 11500.1, item 3.3. Any additional days on site required beyond item 3.3 will be charged at the prevailing labor rates.

- b. Check leveling of blower enclosure. ✓
- c. Confirm proper wiring of all instruments and field wired items. ✓
- 2. A minimum 8 hour, for each blower, field acceptance test shall demonstrate that, under all conditions of operation, each unit:
 - a. Has not been damaged by transportation or installation. ✓
 - b. Has been properly installed. ✓
 - c. Has no mechanical defects. ✓
 - d. Has fully functional instrumentation that are properly calibrated and set. ✓
 - e. Will start, run, and stop in the prescribed manner. ✓
 - f. Will run through the entire range of specified pressure and flow. ✓
 - g. Has the proper shutdown sequence of standard stop, soft stop, and emergency stop. ✓
 - h. Is free of overheating of any parts. ✓
 - i. Is free of objectionable vibration and noise. ✓
 - j. Is free of overloading of any parts. ✓
- 3. Conduct a minimum of 8 hour field acceptance test of each blower's instrumentation, controls, and valves. The test shall demonstrate the following:
 - a. The air flow control loop will automatically control online blower without hunting. ✓
 - b. The entire blower system and instrumentation operates in a stable fashion, without hunting, maintains air flow setpoint. ✓
- 4. Field acceptance testing shall be conducted after the installation of all equipment has been completed, all instrumentation has been calibrated and is working as intended, and the equipment has operated for a sufficient period to make all desirable corrections and adjustments. Contractor shall schedule testing with the full knowledge and consent of Owner and shall ensure no adverse effect on the operation of plant facilities. ✓

~~B. The manufacturer shall furnish the services of the programmer responsible for programming and integrating the blower control system described in this Section. The services of the programmer shall be provided for a minimum of two 8 hour days to assist Owner's programmer with integrating the blower system software programs with the plant DCS system as well as coordinate with monitoring for the plant DCS system. The programmer must have complete knowledge of proper blower operation and of the blower system software programs supplied in this Section. The programmer must be involved with the submittal preparation process and certifies that the product will meet the control system design intent.~~ ✗

The blower controls and programming is part of the membrane system control system and programming. No separate integration with the plant DCS system is required.

3.2 INSTALLATION

- A. Each blower skid unit shall be mounted on a flat and level concrete surface in accordance with the recommendations of the manufacturer. ✗

Clarification: Installation falls in the scope of the CONTRACTOR, not SUEZ

3.3 TESTING

- Membrane System Supplier's
- A. After installation of equipment, approval of installation by ~~manufacturer's~~ representative, and operation equipment for sufficient period to make corrections and adjustments, test blower system in the presence of Engineer. ~~✗~~
 - B. The process startup shall be executed in conjunction with Owner's personnel to coordinate loop-tuning activities so that the entire system works in harmony.
 - C. During test period, take and record readings of essential data at 30 minute intervals, including but not limited to noise, vibration, and air temperature, and operating pressures.

3.4 ~~MANUFACTURER'S FIELD SERVICE~~

- Membrane System Supplier's
- Membrane System Supplier's
- A. Employ and pay for services of ~~equipment manufacturer's~~ field service representative(s) to: ~~✗~~
 - 1. Inspect equipment covered by these Specifications.
 - 2. Supervise pre-start adjustments and installation checks.
 - 3. Conduct initial start-up of equipment and perform operational checks.
 - 4. Provide a written statement that manufacturer's equipment has been installed properly, started up, and is ready for operation.
 - 5. Installation/start-up shall conform to Specification Section 01650, Starting of Systems.
 - ~~B. The services of the representative shall be provided for a minimum of two 8 hour days for each blower and two 8 hour days for the blower control system adjustment and optimization. ✗~~
 - C. A minimum of a eight hour time period is required for training services.
 - D. Sales representatives shall not be acceptable to perform start-up and training functions.

Visits will be performed by Membrane System Supplier's Field Service Representative. Visits by the blower vendor's representative can be provided, but at additional cost.

SUEZ's Field Service Representative will be on-site as specified in Section 11500.1, item 3.3. Any additional days on site required beyond item 3.3 will be charged at the prevailing labor rates.

END OF SECTION

SECTION 11372
AIR COMPRESSORS

PART 1 - GENERAL

1.1 SUMMARY

Membrane System Supplier

- A. The ~~CONTRACTOR~~ shall provide ~~all labor~~, materials, equipment, and incidentals required to furnish ~~and install~~ two (2) Air Compressors for the Membrane System valves, instrumentation, and Membrane Integrity Test. The Air Compressor units shall have integral piping for all equipment, discharge isolation valves, ~~check valves~~, relief valves, silencers, expansion joints, air filters, and all appurtenances required to construct complete and operable air compressor systems, as ~~shown on the Plans and~~ specified herein. This Section describes the requirements for providing the following: ~~✗~~
1. Air Compressors.
 2. Receiver.
 3. Accessories.

1.2 RELATED SECTIONS

- B. Drawings and General Provisions of the Contract, including General and Supplementary Conditions, apply to this Section. ~~✓~~
- C. Section 01300, Submittals. ~~✓~~
- D. Section 01640, Materials and Equipment. ~~✓~~
- E. Section 01650, Starting of Systems. ~~✓~~
- F. ~~Section 09900 - Painting.~~ ~~✗~~ Air Compressor vendor takes exception to Section 09900 - Painting
Air Compressor vendor will provide their standard paint specification to the CONTRACTOR and ENGINEER during the Submittal period for review. If changes to the vendor's standard paint specification are required, it will be at additional cost.
- G. Section 11295 – Hydraulic Valves. ~~✓~~
- H. ~~Section 15260 - Piping Insulation.~~ ~~✗~~ Section 15260 is not included in these Specifications
- I. ~~Section 16195 - Electrical Identification.~~ ~~✗~~ Section 16195 is not included in these Specifications
- J. ~~Section 16161 - Control Panels.~~ ~~✗~~ Air Compressor vendor takes exception to Section 16161 - Control Panels
Units operate start/stop via pressure switches with standard starters and sequence panel included. Section 16161 was NOT reviewed to see if panel met the specification. See comments to control equipment in item 2.4 below.
- K. ~~Section 16225 - Electric Motors 250 Horsepower or Less.~~ ~~✗~~ Air Compressor vendor takes exception to Section 16225. Air Compressor vendor meets the motor specifications listed in item 2.1.E below.
- L. ~~Section 16485 - Variable Frequency Drives - Low Voltage.~~ ~~✗~~
VFDs are not required for the Air Compressors.
Additionally, see specification Section 11500.1, item 1.3.A.3.a which states that VFDs fall in the scope of supply of the CMAR.

1.3 REFERENCES

- A. Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
1. American Society of Mechanical Engineers (ASME):
 - a. B16.11 - Forge Fittings, Socket-Welding and Threaded. ✓
 - b. B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings. ✓
 - c. B31.1 - Power Piping. ✓
 2. ASTM International (ASTM):
 - a. A 53 - Standard Specification For Pipe, Steel, Black And Hot-Dipped, Zinc-Coated, Welded And Seamless. ✓
 - b. A 269 - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service. ✓
 - c. B 88 - Standard Specification for Seamless Copper Water Tube. ✓
 3. National Electrical Manufacturers Association (NEMA):
 - a. NEMA MG-1 - Motors and Generators. ✓

1.4 SUBMITTALS

- A. Submit for approval the following:
1. Letters of Certification of Compliance on materials, equipment, etc. ✓
 4. Field erection instructions, diagrams, lists of erection details, and list of items to be repaired. The formal test protocol for use during performance testing, if required. ✓
 2. Schematic and wiring diagrams of power, control, and piping systems with all devices, terminals, and wires uniquely numbered. Clearly indicate between factory and field wiring. All field wiring shall be terminated on labeled terminal blocks. A detailed description of operation shall be included for each diagram to describe all modes of operation of the system indicated. Where the integrated system requires interlocking and control of other components in normal operation, these components shall be included in the description of operation. ✓
 3. General bulletins and catalog cuts describing complete apparatus, including operating principles and fundamentals. ✓
 4. Renewal parts list with diagrammatic or cross-section drawings showing part identification. Material analysis or trades designation for each significant part is to be noted on parts lists or on a separate sheet. ✓
 5. Recommended list of spare parts and safety equipment along with price and ordering information. Spare parts and safety equipment at a minimum shall include the equipment listed in Paragraph 2.3 of this Specification. ✗
 6. ~~Air Compressor manufacturer~~ on-site representative's complete signed report of results of the inspection, operation, adjustments, and tests. Include the manufacturer's certificate that equipment is ready for permanent operation, and that nothing in installation will render manufacturer's warranty null and void. ✗
 7. Operation and Maintenance data shall be submitted per Section 01300, Submittals. ✓
 8. All equipment manufacturers shall submit evidence of conformance with the Specifications as required by the individual Specification Sections. ✓

B. Shop Drawings: Submit for approval the following:

1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration. ✓
2. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.** ✗

SUEZ preventative maintenance information package is part of the SUEZ O&M Manual. O&M Manuals are submitted after approval of Shop Drawings, not as part of the Submittal Package.

1.5 QUALITY ASSURANCE

- A. Manufacturers regularly engaged in the manufacture of the air compressor equipment, as specified herein, and who can demonstrate equipment of this specified design, in actual service for not less than five years will be considered as acceptable manufacturers. All like items shall be furnished by one manufacturer to ensure uniformity and interchangeability of parts. Manufacturer shall guarantee all equipment furnished as per the warranty stated below; however, this shall not be construed as relieving the CONTRACTOR from his responsibility for the proper installation and functioning of the Work. ✓
- B. Require air compressor manufacturer to furnish and coordinate all compressor components as specified and scheduled below and to provide written installation and check out requirements. ✓
- C. Manufacturer shall have five installations of same size equipment in same application within the last five years in the United States. Manufacturer to submit installation information, including size, location, and a total of three operator contact names and operator phone numbers with the Submittals. ✓
- D. Complete assemblies, including motor, all accessories shall be listed and approved by OSHA and NSF where applicable. ✓

Clarification: Compressed air equipment approved by OSHA. NSF is not applicable.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to the site to insure uninterrupted progress of the Work. ✓
- B. Handle all air compressors and associated equipment properly, in accordance with Manufacturer's recommendations. Equipment that is in anyway damaged will not be acceptable. ✗ Clarification: This item falls in the scope of the CONTRACTOR.
- C. Store materials to permit easy access for inspection and identification. Keep steel members off the ground using pallets, platforms, and other supports. Protect steel members and packaged materials from corrosion and deterioration. ✗
Clarification: This item falls in the scope of the CONTRACTOR
- D. Store mechanical equipment in covered storage off the ground and prevent condensation. ✗
Clarification: This item falls in the scope of the CONTRACTOR.
- E. Each air compressor must be stored and maintained in accordance with Manufacturer recommendation. CONTRACTOR is required to show proof of the proper storage and maintenance, which must be approved and verified by ENGINEER. Improper storage will result in replacement and service of the equipment at CONTRACTOR'S expense. ✓

1.7 WARRANTY

- A. The manufacturer shall warrant, in writing that all equipment supplied by them shall be free from defects in material and workmanship, for a period of 12 months from the date of substantial completion, unless noted otherwise within the Specifications. ✗
Must include a sunset clause. Add, "or 18 months from date of delivery" after "substantial completion,".

1.8 QUALITY ASSURANCE

- A. Manufacturer shall have a minimum of 5 years of experience manufacturing air compressor systems and shall show evidence of at least 5 installations in satisfactory operation for 5 years in similar environments and operating conditions. ✓
- B. Supplies all accessories including motor. ✓

1.9 ENVIRONMENTAL CONDITIONS

- A. ~~As specified in Section 15050.~~ ✗ Section 15050 is not included in these Specifications.
- B. The equipment to be provided under this Section shall be suitable for installation and operation under the following conditions:
 - 1. Project site elevation at Airport Water Reclamation Facility: 1220 feet above sea level. ✓
- C. Air compressors will be designed for indoor operation at wastewater treatment facilities within Maricopa County, Arizona. Air handling units will be used to maintain an ambient temperature in the space where the air compressors are located that will not to exceed 95 degrees Fahrenheit. ✓

1.10 MAINTENANCE

A. Spare parts:

1. Supply to the Owner spare parts, any specialized tools required in the manufacturer's maintenance procedures, and 3 air filters. Submit spare parts in accordance with Section 01750. ~~✗~~ SUEZ's Proposal Price does NOT include spare parts except as noted in SUEZ's Proposal. Any additional spare parts will be at additional cost.

PART 2 - PRODUCTS

2.1 AIR COMPRESSOR

A. Manufacturers: One of the following or equal:

1. Quincy, PLT. ✓
2. Ingersoll Rand. ✓
3. Or approved equal. ✓

B. Type: The air compressors shall be reciprocating, 2-stage, V-belt driven compressor mounted on a horizontal air receiver, meeting the requirements of the membrane system Supplier. ✓

C. Two compressor units shall be mounted on one receiver. Each compressor shall be capable of independently meeting the design requirements to provide full redundancy. Refer to the Drawings for layout. ~~✗~~ Refer to SUEZ Submittal Drawings

1. Compressor unit, including crankshaft, cylinders, flywheel, and motor shall be 2 stage, and shall be air cooled, splash lube, completely sealed against dirt, and providing a large oil sump. ✓
2. A finned, multi-tube intercooler shall be provided between stages and shall include a safety valve to prevent over pressurization. A dry-type 10 micron filter silencer shall be provided on the air inlet. ✓
3. ~~A low oil level switch shall be provided to automatically stop the compressor if the oil level gets too low. ✗~~ Not included. Not required if air compressor is maintained regularly. Can be added, but at additional cost.
4. An air-cooled aftercooler shall lower the discharge air temperature to within 25 degrees Fahrenheit of the ambient air temperature. ✓
5. Compressor bearings shall be oil lubricated. ✓
6. Each compressor shall be driven by an electric motor integral with the compressor. ✓
7. ~~Compressor shall include all anchor bolts required for anchorage. ✗~~
Anchor bolts fall in the scope of supply of the CMAR. See Section 11500.1, item 1.3.A.1.c.

D. Receiver:

1. Air receiver shall be ASME, National Board coded, and tested to 1.5 times the design working pressure of 200 pounds per square inch. ✓
2. Receiver shall be provided with pressure gauge, safety valve, and automatic condensate drain trap. ✓
3. All taps shall be NPT threaded, and receivers shall be provided with sturdy, steel mounting feet. ✓

- E. Motor: As specified in Section 16225, Electric Motors 250 Horsepower or Less, except as otherwise specified or supplemented below:
1. Compressor motor: 460 VAC, 3 phase, 60 hertz, TEFC, 1.15 service factor, severe duty, energy efficient, with self-lubricated ball bearings. ✓
 2. Designed, manufactured, and tested in accordance with NEMA MG-1. ✓
- F. Equipment identification plates:
1. A 16 gauge stainless steel identification plate shall be securely mounted on the compressors and receivers in a readily visible location. ~~The plate shall bear the 1/4 inch die-stamped equipment number indicated in this Section.~~ ✗ No equipment number is indicated in this Section

2.2 COALESCING FILTER

- A. Manufacturers:
1. Finite Filter Division, Parker Hannifin Corp. H-Series. ✗
 2. Or approved equal. ✓ Approved equal: Deltech 300 Series
- B. Materials:
1. Housing: Metallic. ✗ Die cast aluminum and chromated housing
 2. Element, Coalescing Type: Glass fiber. ✗
- C. ~~Components:~~
1. ~~Filter to be sized for same capacity as compressor.~~ ✗
 2. ~~Housing: Two piece, with threaded bowl to head.~~ ✗
 3. ~~Elements: Replaceable with resilient end seals.~~ ✗
- C. Connections
1. Inlet and outlet: threaded 1/4" - 1" NPT (size varies based on system capacity)
 2. Automatic brass drain: threaded 1/8" FPT
- D. Accessories:
1. ~~Drain Trap: Internally mounted automatic mechanical type.~~ ✗
 2. ~~Air Dryer or Desiccator~~ ✗
1. Differential gauge
 2. Audible safety alarm
 3. Internal automatic drain

2.3 PIPING

- Clarification: All interconnecting piping and tubing between the air compressors and the air receiver tank shall be shop installed. All piping and tubing outside of the duplex air compressor/air receiver tank package falls in the scope of supply by CONTRACTOR.
- A. General:
1. ~~All interconnecting piping and tubing between components of the equipment package shall be shop installed.~~ ✗
 2. Piping from the compressor discharges to the receiver shall be sized not less than the compressor discharge connection size and shall be ASTM A 53, seamless, Grade B, Schedule 40 black steel pipe with ASME B16.11, Class 3000, forged steel socket-welding fittings or Schedule 80 black steel pipe with Class 3000 forged steel threaded fittings. "Close" nipples will not be acceptable. ✓
- B. Pneumatic control and instrument tubing:
1. In accordance with ASTM A 269, Type 316, stainless steel tubing with Parker-Hannifin "Ferulok," Crawford "Swagelock," or equal, Type 316 stainless steel flareless double ferrule compression fittings. ✗
 2. Tubing shall not be less than 1/4 inch OD with a wall thickness of 0.028 inch. ✗

Clarification: Pneumatic control and instrument tubing falls in the scope of supply by CONTRACTOR. City of Chandler
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- C. Piping between the package receiver and the air dryer shall be ASTM B 88, Type K, hard drawn copper tubing with ASME B16.18 solder-joint fittings. ✖

Clarification: Piping between the package receiver and the air dryer falls in the scope of supply by CONTRACTOR.

- D. All piping and tubing shall be run in vertical and horizontal planes. Piping shall be arranged to ensure that undue stresses, from thermal expansion, are not transmitted to equipment components. ✖ Clarification: All piping and tubing outside the compressed air package falls in the scope of supply by CONTRACTOR.
- E. All control and instrument tubing shall be continuously supported. ✖

Clarification: support of all control and instrument tubing is by CONTRACTOR.

2.4 CONTROL EQUIPMENT

- A. All control equipment for each compressor shall be furnished as required for a complete installation, requiring only field connection of the electrical power supply and discrete inputs to plant SCADA system. ✖ The compressed air system does not connect to plant SCADA system.
- B. Equipment shall include the following: Duplex control panels come standard with alternator, power switching relay and Auto/Comp1/Comp2 switch, two hour meters and two TOA switches.
1. ~~All control switches, pressure switches, timing relays, auxiliary relays, elapsed time meters, circuit breaker combination magnetic motor starters, and other accessories required for control of each compressor.~~ ✖
 2. ~~Each starter shall include a thermal magnetic circuit breaker with external operating handle.~~ ✖ Not included. This requires a special panel with Circuit Breakers.
 3. Starter overloads shall be matched to motor current and shall be provided with a reset pushbutton. ✔
- C. All control equipment for each compressor package shall be housed in a control panel mounted on the receiver. ✔
- D. All system wiring shall be shop installed to terminal blocks in the control panel. Wiring from the panel to system components shall be completely enclosed in liquidtight flexible conduit. ✔
- E. ~~All pneumatic tubing shall be shop installed to bulkhead fittings at the control panel. All field connections shall be made to the fittings at the panel.~~ ✖ Not applicable
- F. Control panel enclosure: NEMA 1
1. ~~The control panel shall be NEMA 12 construction, fabricated from 14 USS gauge or heavier steel and shall be equipped with a full size gasketed door with chromium-plated or stainless steel three point latch and hinges.~~ ✖
 2. ~~A screened vent shall be provided in the bottom of the control panel.~~ ✖ Not included.
 3. All control devices shall be rigidly mounted within the enclosure except for breaker handles, selector switches, pushbuttons, and indicating lights, which shall be mounted on the panel door. ✖ Clarification: Pressure switches are mounted on tank, not in control panel
- G. ~~Internal panel tubing shall be run in horizontal and vertical planes and shall be rigidly supported to withstand handling and shipping without damage. Compression type bulkhead fittings shall be provided through the panel for all connections.~~ ✖ Not applicable

H. Panel wiring:

1. Internal panel wiring shall be neatly bundled and tied and identified with suitable wire markers. ✓
2. Terminal blocks for external connections shall be furnished complete with marking strips, covers, and pressure connectors. ✓
3. A terminal shall be provided for each conductor of external circuits. ✓
4. All wiring shall be grouped or cabled and securely attached to the panel. ✓
5. Clearance for field wiring shall be provided between the terminal strips and base. ✓

I. Compressor control:

1. General: The compressed air package shall be furnished with a control system which shall start and stop the compressors as required. ~~The control system shall unload the compressors on shutdown and while coming up to speed during startup. Unloading shall be accomplished by inlet valve control.~~ ✗ The units start/stop with pressure switches, unload for load-less start.
2. The compressor control package shall include a dual control system that is operator selected to be either Start/Stop operation with a pressure switch or constant speed control with unloading. ✓

J. Protection controls:

1. ~~A protection control system shall be provided for each compressor. The control system shall stop the compressor on either motor overload or low oil level.~~ ✗

Not included. Not required if air compressor is maintained regularly. Can be added, but at additional cost.

K. A mechanical latching relay circuit with a common "Reset" pushbutton shall be provided. ✓

~~L. Provide running and fail contacts. Contacts shall be dry, rated 120 VAC, 10 amp.~~ ✗

Not included. Can be added, but at additional cost.

2.5 ACCESSORIES

A. The compressed air equipment package shall be provided with the following accessory equipment:

1. Safety valves:

- a. Safety valves with manual lifting levers shall be installed in the compressor discharge piping and on the receiver. ✓
- b. Valves in the compressor discharge piping shall be capable of protecting the compressors from damage when operating against a closed discharge valve and shall be suitable for the maximum compressor discharge air temperature. ✓
- c. The safety valve on the receiver shall be capable of protecting the receiver from excessive pressure. ✓

2. Safety guards: All compressor cooling fans shall be provided with safety guards. ✓

3. Intake filter muffler:

- a. Provide each compressor with a dry type intake filter muffler supported by the suction pipe and close coupled to the compressor intake connection. ✓
- b. Intake filter muffler shall have an outer cover and replaceable filter element. ✓

4. ~~Discharge check valves:~~

- a. ~~A line-mounted check valve shall be provided in the discharge piping leading from each compressor.~~ ✗ Not included

- ~~b. Check valves shall be sized in accordance with the manufacturer's recommendations and shall be suitable for service with reciprocating compressors at the maximum compressor discharge air temperature.~~ ❌ Not included
- 5. Shutoff valves:
 - a. Type: All shutoff valves shall be ball valves. ✔️
 - b. Valves in steel piping shall have carbon steel bodies, chrome-plated or stainless steel balls, and reinforced Teflon seals and seats. ✔️
 - c. Valves in the compressor discharge piping shall be suitable for the maximum compressor discharge air temperature. ✔️
- 6. Receiver vent valve:
 - ~~a. Provide a globe type vent valve with bronze body and brass stem on each receiver.~~ ❌ Not included
- 7. Pressure gauges:
 - ~~a. As specified in Section 17121.~~ ❌ Section 17121 is not included in these Specifications.
- 8. Pressure switches:
 - a. Each pressure switch shall have SPDT contacts rated 10 amperes at 120 volts alternating currents and shall be complete with shutoff valve. ❌ There are no separate valves on pressure switches
 - ~~b. Pressure switches mounted inside the control panel shall have NEMA 1 housings.~~ ❌ Pressure switches are mounted on tank, not in control panel
- B. Finishes:
 - ~~1. Shop and field painting of piping and equipment shall be as specified in Section 09900.~~ ❌ Air Compressor Vendor takes exception to Section 09900 - Painting. Air Compressor Vendor will provide their standard paint specification to the CONTRACTOR and ENGINEER during the Submittal period for review. If changes to the Vendor's standard paint specification are required, it will be at additional cost.

PART 3 - EXECUTION

3.1 INSTALLATION

Clarify that CONTRACTOR to:

A. Install equipment in accordance....

B. Install piping in such a manner....

- A. Install equipment in accordance with these Specifications and the manufacturer's installation instructions. ❌

- B. Install piping in such manner as not to place a strain on any part of the equipment. ❌

- ~~C. Complete installation, testing, start-up, and certification in accordance with Sections 01756, 15050, 15958.~~ ❌ Sections 01756, 15050, and 15958 are not included in these Specifications.

- ~~D. All lubricants shall be per Section 01600 and provided by the compressor manufacturer.~~ ❌ Section 01600 is not included in these Specifications.

3.2 FIELD TESTS AND INSPECTION

Supply of lubricants does not fall in the scope of supply by SUEZ and should be provided by others.

- A. Provide equipment and apparatus required for performing inspections and tests. ❌ Equipment and apparatus required for performing inspections and tests falls in the scope of supply by others.
- B. Correct defects and repeat the respective inspections and tests. Pressure test gauges shall be currently certified as being accurate to within 1 percent of their full scale. Use gauges with maximum scale between 1-1/2 and 2 times the test pressure. ❌ Equipment and apparatus required for performing inspections and tests falls in the scope of supply by others.

END OF SECTION

SECTION 11500.1 MEMBRANE FILTRATION SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section outlines the furnishing of a complete and operable Membrane Filtration System and provides the Scope of Work that shall be performed by the Membrane System Supplier (MSS) for the City of Chandler's Airport Water Reclamation Facility located in Maricopa County, Arizona. ✓
- B. The Membrane Filtration System to be installed as shown on the Preliminary Drawings and/or specified within include , but not be limited to the following major components:
1. Low pressure membrane air scour blower system with associated valves and instrumentation. ✓
 2. Membrane modules, cassettes, frames and all hardware required to support membranes within concrete membrane tanks. ✓
 3. Piping and valves internal to the membrane tanks with termination points at or near the edge of the tanks. ✓
 4. Membrane Tank covers, and all beams and support structure required to support covers within concrete tanks. ✗
 5. Permeate pumping and backpulse system, including loose-shipped valves, instruments, controls, backpulse tankage, and air extraction system. ✗
 6. All instruments, controls and pumps required for CIP cleaning (CIP tank to be concrete by construction contractor). ✓
 7. Filters and instruments required to regulate compressed air for the membrane system operation. ✓
 8. Membrane integrity test system. ✓
 9. UF/MF system process instrumentation and control (I&C) system including PLC system panel. ✓

For clarity, Membrane Tank covers, and all beams and support structure required to support covers within concrete tanks do not fall in SUEZ's scope of supply. See item 2.3.E.12 in this Section which states that Membrane basin covers will be provided by CMAR.

For clarity, backpulse tankage does not fall in SUEZ's scope of supply. See item 2.3.E.4 in this Section which states that CMAR to provide backwash volume (tank).

1.2 RELATED SECTIONS

- A. Section 01010, Summary of Work. ✓
- B. Section 01300, Submittals. ✓
- C. Section 01640, Materials and Equipment. ✓
- D. Section 01650, Starting of Systems. ✓
- E. Section 01660, Field Tests of Equipment. ✓
- F. Section 11295 – Hydraulic Valves. ✓
- G. ~~Section 13447, Electric Motor Actuators.~~ ✗ Section is 13447 is not applicable to this project. There are no electric motor actuators included in SUEZ's scope of supply.
- H. Division 16, Electrical. ✓

I. Division 17, Instrumentation. ✓

J. ~~Section 17454, Operation and Control Description.~~ ✗ Section 17454 is not included in these Specifications.

1.3 WORK BY OTHERS

A. The following items are supplied by CMAR and will include:

1. Structural:

- a. Building of concrete tanks, structure and pads for housing the supplied membrane equipment including permeate pumps, blowers, etc. (please note that the membrane basins will not be located within a building). ✓
- b. Protective coatings for concrete, if required. ✓
- c. Anchor bolts; anchor bolt design by Supplier in accordance with IBC 2006 and available software programs, such as Hilti Profis. Use stainless steel epoxy anchor bolts for submerged anchors. ✓

Clarification: Will use latest version of IBC code

2. Mechanical:

- a. Pipe supports and hangers, as needed and as shown. ✓
- b. Hoist equipment above the membrane basins for installation and removal of the membrane cassettes. ✓
- c. Single connection points will be provided by CMAR, unless otherwise noted, for each membrane basin for the following:
 - 1) Membrane Effluent (Permeate) ✓
 - 2) Air scour supply ✓
 - 3) Chemical valves and feed lines for Maintenance Clean/Recovery Clean: ✓
 - a) Sodium hypochlorite.
 - b) Citric acid.
 - c) Caustic Soda
 - d) Sodium bisulfite
 - e) Hydrochloric acid
 - d. Backpulse storage tank for backpulse cleaning cycles. ✓
 - e. Installation materials for instrumentation and automatic valves including but not limited to air/sample line tubing, fittings, and mountings. ✓

3. Electrical and Instrumentation:

- a. Motor control centers and variable frequency drives. ✓
- b. Electrical wiring interconnections (including wiring, conduit, and other appurtenances required to provide power connections as needed) from the electrical power source to the membrane system MCC and PLC. ✗
- c. Ethernet communications connection to the Owner's Plant Control System. ✓

Clarification: CMAR to also provide all interconnecting wiring, conduit and cable tray between SUEZ control and power equipment shipped loose to site, as per SUEZ's Drawings.

4. Other:

- a. Receiving, unloading, and safe storage of equipment at site or a storage facility until ready for installation. ✓
- b. Equipment and membrane cassette installation. ✓
- c. Raw materials, chemicals, and utilities during equipment testing. ✓
- d. Any onsite painting or touch-up painting of equipment supplied (~~shop prime by the Supplier.~~ ✗ SUEZ had not included shop prime in its scope of supply.
- e. Removal and disposal of glycerin or other compounds used to preserve membranes during shipment. ✓

B. The following items are supplied by Owner and will include:

- 1. Laboratory services, operating and maintenance personnel during equipment checkout,

startup, and operations. ✓

1.4 SUBMITTALS

SUEZ will submit submittals in electronic format only

A. Shop Drawings: Submit for approval the following (~~one hardcopy and one softcopy~~): ✗

1. Letters of Certification of Compliance on materials, equipment, etc. ✓
2. Detailed specifications and drawings as specified in Section 01300 containing ~~complete piping and flow diagrams of the proposed installation, including dimensions, weights, and complete parts lists. Drawings shall show proposed anchorage of equipment and appurtenances and equipment relationship to other parts of the work including clearances for installation.~~ ✗
3. ~~Field assembly instructions, assembly drawings and/or diagrams, detailed reference drawing lists, and lists of assembly details.~~ ✗
4. List of materials, list of equipment (with model number, size, weight), including a complete list of parts and supplies ~~with current unit prices and sources of supply.~~ List of parts recommended by the Manufacturer to be replaced after 1 and 3 year(s) service. List of special tools for each type of equipment furnished including special tools necessary for adjustment, operation, maintenance, and disassembly. ✗ List will not include prices.
5. Installation instructions, operating and/or service manuals, and all other data pertinent to operating or servicing the complete apparatus. Preventative maintenance instructions and recommended frequency. ✗
6. ~~Wiring and control schematics and control logic diagrams for all electrical and control components furnished.~~ ✗ SUEZ's standard control design will be supplied
7. A complete process description detailing all process parameters ✓
8. Documentation that the manufacturer has produced, supplied, and placed into satisfactory service, equipment similar to that specified herein. ✓
9. Recommended list of spare parts and safety equipment, along with price and ordering information. ✓
10. ~~Complete data sheet (ISA data sheet)~~ for each instrument supplied. ✗
11. Process and instrumentation diagrams (P&IDs) of the Membrane Filtration System. ✓
12. CONTRACTOR shall submit specification section with check marks next to each section denoting submittal complies with section, or an "X" next to the section denoting a deviation from the specification. Justification for any deviations must also be included. ✓

Site plot plan showing placement of equipment, pipe routing, and anchoring does not fall in SUEZ's scope of supply.

Field assembly instructions are not included. SUEZ will provide General Arrangement and Field Assembly drawings only.

SUEZ standard instrument data sheets will be provided. They are based on ISA data sheets.

Clarification: SUEZ preventative maintenance information package is part of the SUEZ O&M Manual. O&M Manuals are submitted after approval of Shop Drawings, not as part of the Submittal Package.

B. Seismic structural calculations:

1. Submit seismic structural calculations in conformance with the following requirements:
 - a. Design spectral acceleration at short periods. $S_{DS} = 0.19$. ✓
 - b. Design spectral acceleration at period of 1-second, $S_{D1} = 0.09$. ✓
 - c. Risk Category: III ✓
 - d. Component amplification factor, a_p = in accordance with ASCE 7, Tables 13.5-1 and 13.6-1. ✓
 - e. Component response modification factor, R_p = in accordance with ASCE 7, Tables 13.5-1 and 13.6-1. ✓
 - f. Component importance factor, I_p = in accordance with ASCE 7 Chapter 13. ✓
 - g. Seismic Design Category: Category B. ✓
 - h. The calculations shall be prepared and stamped by a structural engineer registered in the State of Arizona. ✓

C. Manufacturer's installation instructions:

Installation and checkout instructions are not included. SUEZ will provide General Arrangement and Field Assembly drawings only.

1. ~~Installation and checkout instructions including lubrication and initial start-up procedures.~~ ✖
 2. ~~Do not install equipment until all installation instructions have been supplied.~~ ✖
- D. No equipment shall be shipped until the ENGINEER approves the Shop Drawings. ✔
- E. Shop Test Results: Submit results of routine factory motor tests. ✔
- F. Field Test Results: Submit ~~a written~~ ^{an electronic} report giving the results of the required field tests. ✖
- G. Manufacturer's Reports: Submit ~~written~~ ^{an electronic} report of the results of each visit by a manufacturer's serviceman, including purpose and time of visit, personnel present, tasks performed, and results obtained. ✖ Clarification: Manufacturer is SUEZ. Manufacturer's servicement is SUEZ's Field Service Representative
- H. Operation and Maintenance Manuals: Submit complete Operation and Maintenance Manuals in conformance with the Operation and Maintenance Manuals Section of Section 01300, Submittals. ✔ And conformance with Section 01730 Operation and Maintenance Data
- I. The MANUFACTURER shall provide a written guarantee detailing permeate quality. This guarantee shall be based upon laboratory test, and past operating experience. The guarantee is based on past operating experience; documentation of that experience shall be submitted with the proposal. ✔
- J. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration. ✔
- K. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.** ✖
- 1.5 QUALITY ASSURANCE
- A. Manufacturer: Company specializing in the manufacture of products specified in this Section with minimum five years documented experience and at least 15 similar-sized filtration installations in service. ✔

SUEZ preventative maintenance information package is part of the SUEZ O&M Manual. O&M Manuals are submitted after approval of Shop Drawings, not as part of the Submittal Package.

- B. Inspection and Testing Requirement: The ENGINEER reserves the right to reject delivery of any or all pieces of equipment found, upon inspection, to have any or all of the following: tear, cracks, chips, rust, foreign matter, non-standard welding. ✓
- C. Shop Tests:
1. Motor Tests: Perform a routine test on each drive motor at the manufacturer's factory. ~~The test shall consist of: Running Light Current; Locked Rotor Current; Winding Resistance; High Potential; and Bearing Inspection.~~ ✗ Motor manufacturers will perform their standard tests.
- D. Responsibility: To ensure that all the equipment required for the installation of the Membrane Filtration System is properly coordinated and will function as a unit in accordance with the intent of these Specifications, the CONTRACTOR shall obtain all the equipment specified under this Section, from a single supplier in whom the responsibility for the proper function of all the equipment, regardless of manufacturer, as an integrated and coordinated system shall be vested. The intent of this paragraph is to establish unit responsibility for all the equipment with the Membrane Filtration System equipment supplier. The use of the word "responsibility" relating to the equipment supplier is in no way intended to relieve the CONTRACTOR'S ultimate responsibility for equipment coordination, installation, operation, and guarantee. ✓
- E. The CONTRACTOR shall guarantee the Membrane Filtration System as required under the General Conditions, and as specified herein. If, during the guarantee period, the Membrane Filtration System fails or does not meet any of the specified requirements or test criteria herein, the CONTRACTOR shall correct such deficiencies as may be necessary to meet these requirements and criteria, and at no additional cost to the OWNER. The ENGINEER must first review any proposed remedial measures before any work is done. ✓

1.6 WARRANTY

- A. Supplier shall provide a guaranteed membrane replacement or additional purchase price, as a cost per module ~~and as a cost for the total system.~~ ✗ Will provide as a cost per module only
- B. Supplier shall warrant membranes for a minimum of 5 years. The warranty shall not be pro-rated. All warranty and support shall be provided directly by the Supplier and not the local representative. ✓
- C. Membrane modules shall be warranted on a pro-rated basis for an additional period of 5 years following the 5-year non-pro-rated warranty period. Membranes replaced under warranty shall assume the balance of the remaining original warranty. ✓
- D. Supplier shall warrant membrane modules under the following terms:
1. Supplier shall repair, replace, or add at no cost to the Owner, any membrane modules that fail before the end of the full replacement (i.e., non-prorated warranty) warranty period which shall commence after successful completion of the Operational Test. ✓ Failure is defined as any of the following:
 - a. Inability of membrane to pass direct integrity test as specified within this Section. ✓
 - b. Inability to meet production capacity requirements as specified. ✓
 - c. Inability to meet membrane cleaning frequency requirements as specified. ✓
 - d. Inability to meet membrane permeate quality requirements as specified. ✓
 2. The Supplier shall further warrant all system components, including pumps, valves, and ancillary equipment for a minimum period of 12 months following the date of successful completion of the Operational Test. ✗
 Must include a sunset clause.
 Add "or 18 months from the date of delivery" after "Operational Test".

The Supplier will work with the ENGINEER and CONTRACTOR until a satisfactory result has been achieved

3. If Supplier is unable to modify the system through addition of membranes or other elements, and cannot satisfy requirements of Operational Test, or system fails to meet specified performance criteria during the warranty period following the date of successful completion of the Operational Test, then Supplier shall be responsible for complete removal of nonconforming system and subsequent installation of membrane products that are capable of meeting specified performance conditions. ✖
- E. The warranty period, membrane equipment system components found to be defective shall be replaced as follows:
 1. Any membrane equipment system component found to be defective within the first 12 months of the warranty period (5 years for membrane modules) shall be repaired or replaced with new components at no cost to the Owner. ✔
 2. If membrane modules are found to be defective past the fifth year and up to, and including the final month during the pro-rated 5-year warranty period, the cost for replacement shall be determined as follows: ✔

applicable CPI adjustment + 1.0%

$$\text{Pro Rated Module Price} = (\text{Module Price} \times \text{applicable CPI adjustment} \times \text{Months of Beneficial Use}) / \text{Membrane Module Warranty Period in Months}$$
 ✖
 3. Owner shall be responsible for shipping and handling of components for membrane components defective past the second year. ✔
- F. The Supplier shall guarantee that for components manufactured by the Supplier, replacement parts shall continue to be available to the Owner for a minimum of 20 years from date of successful completion of Operational Test. Supplier shall guarantee that, if Supplier or Supplier's product line is sold, Supplier shall make provisions such that all guarantees, warranties, and bonds will remain in effect and that replacement parts and operational support continue to be available to the Owner for the time period specified above. ✔
- G. Warranty submittals:
 1. Submit for approval prior to the shipment of the membrane modules, quality assurance/quality control (QA/QC) reports in letter format for membrane modules. As a minimum, the reports shall include:
 - a. The membrane module model and part number, manufacturing lot number and serial number. Indicate the nominal or absolute pore size, inside and outside fiber diameter, effective fiber length, and effective feed side surface area of the membrane module. ✔
 - b. The membrane module normalized specific flux (permeability, gpm/psi at 20°C). ✔
 - c. A certification by the membrane module supplier that each membrane module has passed the membrane module suppliers' QA/QC (integrity) tests. ✔
 - d. Certification of wet testing for each membrane module conducted at the membrane module supplier's facilities. The membrane module supplier shall certify that each membrane module has passed the quality assurance/quality control tests for membrane element integrity. ✔
 - e. Identify modules that have undergone pinning or repair for more than 0.1 percent of original fibers at the factory. ✔
 2. Identification of operating parameters and limits required to satisfy and maintain membrane module warranty. ✔
 3. Changes in the Supplier's established operational and maintenance guidelines cannot be applied retroactively to invalidate the membrane module warranty. ✔

1.7 DELIVERY AND SCHEDULE

- A. Provide notification in writing to the Owner and CMAR of approximate delivery date(s) 12 weeks before delivery. Notify same of actual delivery date at least 7 days before delivery. Provide description and approximate weight of shipping container and required equipment for unloading. Supplier shall coordinate delivery, unloading, and storage with CMAR. ✓
- B. Supplier shall coordinate with CMAR in delivery of equipment. ~~Supplier shall revise schedule for delivering equipment packages if requested by CMAR without additional cost to CMAR.~~ ✗

PART 2 - PRODUCTS

See SUEZ's Supplemental Terms and Conditions to McCarthy's Long Form Purchase Order, New Article 4.6 which states that the place of delivery shall be firm and fixed, provided that Buyer may notify Seller no later than forty-five (45) days prior to the scheduled shipment date of the Equipment of an alternate point of delivery, and Buyer shall compensate Seller for any additional cost in implementing the change.

2.1 GENERAL

- A. Membrane equipment shall be provided complete, with all necessary components, accessories, and appurtenances required to make a complete and operable system. Interconnecting piping between membrane basins and ancillary systems, including air blowers, air compressors, chemical metering systems, and backwash volume will be provided by the CMAR. ✓
- B. Membrane modules and equipment shall be prefabricated, preassembled, and tested before shipment to the site. ✓
- C. Supplier shall provide the equipment as described in these Specifications:
 - 1. Items shall be new and unused, and shall be Supplier's most current product line at the time of product submittal. ✓
 - 2. Designed to use latest generation membrane modules having greater membrane area or improved performance characteristics. ✓
 - 3. Furnished as a complete and operable system including ~~all piping and valves.~~ ✗
- D. Supplier shall design anchor bolts based on 4,000-psi concrete in accordance with paragraph ~~1.06~~ and shall provide location for anchor bolts. Anchor bolts for equipment will be provided and installed by CMAR. ✗
- E. Any carbon steel components provided are to be for uses that do not come into contact with water or chemicals. ✓

See item 2.1.A above.
"Interconnecting piping between membrane basins and ancillary systems, ... will be provided by the CMAR."

Correct reference is to paragraph 1.3.A.1.c.

2.2 MANUFACTURER

- A. Suez. ✓
- B. Alternate vendors shall comply with the alternate package documents. ✓
- C. The naming of a manufacturer in this Specification is not an indication that the manufacturer's standard equipment is acceptable in lieu of the specified component features. Naming is only an indication that the manufacturer may have the capability of engineering and supplying a system as specified. ✓

2.3 DESIGN CRITERIA & REQUIREMENTS

- A. Flow
 - 1. Membranes and related equipment are to be designed for the maximum net daily production year round, at the design water temperature specified. (The design temperature is listed in item 2.3.B.a as 20 degrees C.)
 - 2. The production flow rate is to be based on the following feed water parameters to the MSS: ✗

Influent water to the membrane system will flow at a consistent rate.

Table 1 represents the maximum net permeate flow for the current project (Current Criteria) and in the future (Future Criteria).

Table 1: Production Flow Design Criteria				
	Current Criteria		Future Criteria	
Total Permeate Flow (MGD)	10	10	12.5	12.5
Trains in Operation	4	3*	4	3*
Cassettes Installed / Train	4	4	5	5
Cassettes Spaces / Train	5	5	5	5
Recovery Rate	> 95%	> 95%	> 95%	> 95%

~~*During Backpulse (5 – 25 min./train, every 2 hours); During Maintenance Clean (15–30 minutes/train, once per day); During Recovery Clean (6 – 24 hours/train, once per month).~~ ❌

* The membrane system will be designed to increase flows through online trains to accommodate constant inlet feed flow to the membranes up to 10 MGD (net)/95% = 7,310 gpm (net) during Maintenance Cleans, Membrane Integrity Test, and Backwashing, with all other trains otherwise in service.

b. If a train is off-line for Recovery Clean or for any other equipment repair or maintenance, then the influent flow will be decreased. The feed flow that can be accommodated with one train out of service for Recovery Clean or for any other equipment repair or maintenance is 7,310 gpm (net) x 3/4 = 5,482 gpm (net).

Note:

- Design Net Production is based on daily average. Instantaneous production flow rates may vary during the day to meet average permeate flow of 10 MGD. ✔️
- ~~During Recovery Clean of one Train, where three Trains are in operation, production shall meet 10 MGD. This applies even during Backpulse and Maintenance Clean cycles of one of the three operating trains.~~ ❌
- Recovery when feed water > 135 NTU, < 800 NTU 90% ✔️
- Maximum CIP/Maintenance Clean Frequency 1/day ❌
- Maximum Recovery Clean Frequency 12 / year ✔️
- ~~Cleaning protocols may be modified during raw water turbidity peak events to maintain membrane performance, particularly if the turbidity peak events extend to more than 72 hours.~~

B. Feed Water Quality ✔️

Table 2: Influent Water Quality		
Parameter	Annual Average Day	Maximum Month Average Day
TSS (mg/L)	33.7	185.0
Turbidity (NTU)	9.28	37.89
pH (SU)	8.20	8.53
Alkalinity (mg/L)	171	190
Temperature (°C)	16 (minimum) 32 (maximum)	

Note:

- Minimum design water temperature for design of MFS shall be 20 degrees C. Below this, treatment capacity may change according to the EPA MFGM temperature/flux adjustment calculation shown below, or cleaning frequency will be impacted. ❌

Equation 2.11 (EPA MFGM, 2005): $TCF = \frac{\mu_T}{\mu_{20}}$

Where:

TCF = temperature correction factor (dimensionless)

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Note that the MFGM provides Equation 2.8 for estimating water viscosity as a function of water temperature. SUEZ prefers to use a 4th order polynomial based on water viscosity data in the temperature range of 0 to 40 deg C. Supporting data can be provided upon request.

μ_T = viscosity of water at temperature T (cp)
 μ_{20} = viscosity of water at 20° C (cp)

Equation 2.12 (EPA MFGM, 2005): $J_{20} = J_T \times TCF$

C. Permeate Water Quality

1. Permeate from the MFS shall meet the following requirements:

- a. Turbidity (NTU) ≤ 0.5 100% of the time¹ ✓
- b. Turbidity (NTU) ≤ 0.1 95% of the time¹ ✓
- c. LRV: ≥ 3.0 log ✓

Note 1: Based on readings taken on 15-minute intervals over any continuous period of at least 24 hours in length. Low range, laser type turbidity monitors shall be provided on the permeate of each membrane train to measure permeate turbidity. ✓

D. Membrane modules shall house hollow fiber type membranes. All the modules in each membrane tank shall be connected to a common permeate header, which shall be connected to the permeate pump. The permeate shall move through the membranes by applying a suction force with the permeate pump to the inside of the membrane fibers. The permeate flow during normal operation shall be from the outside of the membrane fibers to the inside. Operating Environment

1. The membranes shall be installed in new basins built by the Contractor. ✓
2. The membrane basins will be located in a facility supplied by the Contractor. ✓

E. The Supplier under this Contract shall provide the following in accordance with the appropriate Specification:

1. Permeate pumps (one pump furnished per membrane train ~~and one uninstalled spare~~), vacuum system, air extraction system, and all valves, instrumentation and controls. ✗
2. Membrane agitation air blowers including instrumentation and controls. ✓
3. Membrane modules, cassettes/racks, process instrumentation and associated equipment. ✓
4. Membrane backwash system, including valves, fittings, instrumentation, and controls. CMAR to provide backwash volume (tank) as a component of the reclaimed water pump station. ✓
5. Instrumentation and controls for membrane maintenance/recovery cleaning feed and distribution system. ✓
6. Air compressor system, including compressor (one duty, one standby), air dryers, valves, fittings, instrumentation, and controls. ✓
7. Process control panels, PLC(s), Human Machine Interface(s), and associated software programming and graphical displays. ✓
8. Membrane permeate piping and air scour supply piping within the limits of each membrane basin (above basin). ✓
9. All in-basin piping for membrane effluent and air scour. ✓
10. Membrane basin drain valves will be provided ~~by the CMAR~~ and controlled by the Supplier. ✗
11. All supports for membrane cassettes/racks and plates. ✓
12. Membrane basin covers will be provided by CMAR. ✓

Only four (4) Permeate Pumps are included in the Proposal Price. SUEZ's Proposal Price does NOT include spare parts except as noted in SUEZ's Proposal. Any additional spare parts, such as a spare Permeate Pump, will be at additional cost.

SUEZ has included the membrane train drain valves in SUEZ's scope of supply.

2.4 MEMBRANE FILTRATION SYSTEM

A. The membrane basins shall be constructed of reinforced concrete by the CMAR. Four basins shall

be provided for the membrane equipment system, complete with elevated walkways (grating and supports), handrail, stairs, and supports. ✓

B. See the Drawings for space available for the membrane equipment system including the membrane basins. ✓

C. Piping supports shall be provided by the CMAR to support the header pipes and associated valves and appurtenances on each basin, as indicated on the Drawings. Supports to be connected to each membrane basin in a configuration to match the requirements of the layout shown on the Drawings. Exact elevations and pipe header lengths to be determined by the Supplier. Pipe headers shall be factory assembled, and shipped and delivered as a single component. Provide appropriate connections to piping to be connected in the field. ✓

D. Basins shall be designed and equipped with covers on top of each basin. ~~Support and configuration of covers to be determined and designed by Supplier.~~ Decking and support configuration shall allow for the removal of membrane cassettes without removal of the entire deck. ~~Submit proposed decking design and support details for review by Engineer.~~ ✗

E. Stairways, elevated platform, and aluminum railing shall be provided by CMAR as indicated on the Drawings. Railing design shall meet all applicable OSHA and safety requirements. The railing layout shall allow operators to walk from the stairway and platform onto each tank. Submit proposed stairway, platform, and railing design and basin connection details for review by Engineer. ✓

F. The Supplier is responsible for configuring ~~piping~~ ^{permeate and air piping} within the limits of the membrane basins to meet the basin size, connections, and configuration indicated on ~~the Drawings.~~ ^{SUEZ's Drawings} ✗

H. The membrane basins shall be equipped with a passive ventilation system to relieve pressure or vacuum conditions in the basins, such as may occur when the basins are being drained or filled. ~~Supplier shall design the passive ventilation system and submit for Engineer's review.~~ CMAR shall provide the passive and/or active ventilation system and install it. ✗ ^{Design of the passive ventilation system does not fall in SUEZ's scope of supply.}

2.5 MEMBRANE EQUIPMENT

A. Membranes

1. Use hollow fibers having a nominal pore size of 0.04 µm or less. ✓
2. Flow shall be from the outside through the membrane fibers and filtered water (permeate) shall be collected from the inside of the fibers. ✓ ^{1,000 mg/L as Cl₂}
3. Membranes shall be constructed of chemically resistant material and shall be capable of being washed in high chlorine solutions (up to ~~1,500 mg/L~~) and low pH solutions for time periods required for maintenance and recovery cleans provided in this Specification. ✗
4. Membranes shall be physically strong enough to withstand the operating conditions associated with water quality conditions specified in ~~Table 1~~ and the peak design flow rate. ✗
5. Membranes shall be able to withstand backwash flow from inside to outside, as proposed without any indication of damage. ✓ ^{Feed water quality conditions are specified in Table 2.}

B. Membrane Modules

1. The membranes shall be assembled into a housing called a membrane module. ✓
2. Hollow fiber modules are to be constructed such that the fibers are arranged vertically, and permanently bonded in position at both ends. Hollow fibers shall be "reinforced". The

- polymeric membrane surface shall be permanently bonded to a reinforcing material made of nylon or a similarly suitable material. ✓
3. The materials used to hold the membrane fibers in place shall be chemical resistant to high concentrations of chlorine (maximum 1,000 mg/L) for 10 hours, and low pH (range 2 to 3) and high pH wash solutions (range 10 to 10.5) for 10 hours respectively. ✓
 4. Membrane modules are to be constructed of chemically resistant materials matching the immersed chemical resistance of the fibers. ✓
 5. The filtration area of each module is to be based on the wetted external surface area of the fibers. ✓
 6. The top and bottom sections of the module shall be connected with corrosion resistant materials and allow permeate to be withdrawn from the top of each module. ✓
 7. The base of each cassette shall contain diffusers or jets to allow compressed air to escape and travel upwards past and between the membrane fibers creating an agitation effect. ✗ Air is from blower, not air compressor.
 8. All non-steel components of the membrane modules shall be UV resistant and have a chemical resistance at least equal to that of the membranes. ✓

C. Membrane Racks/Cassettes

1. Membrane modules shall be assembled into units called cassettes. ✓
2. Each cassette shall be supported within a frame manufactured of Type 316L stainless steel. ✓
3. Provide isolation valves for the permeate and agitation air to provide means of isolating and removing individual cassettes from the remainder of the system, without draining the basin, and enabling the system to produce permeate with one or more cassettes out of service. ✓
4. Each frame shall be fitted with lifting eyes (~~one at each end~~) to allow the entire membrane cassette to be lifted into and out of the membrane basin and transported away from the basin. ✗
5. All fasteners, including nuts, bolts, screws, cables, washers, and other appurtenances associated with the membrane cassette and housing shall be manufactured from Type 316 stainless steel. ✓

2.6 PERMEATE SYSTEM

A. Permeate Suction Piping

1. Provide each membrane train with a permeate header for filtrate collection. ✓
2. All cassettes in a membrane basin or train shall connect to the permeate header. ✓
3. Each membrane train shall be in a separate, isolatable concrete basin. ✓
4. The pipe connections between the membrane cassettes and the permeate header shall be capable of operating at the positive and negative pressures expected for this system. ✓

B. Permeate / Backpulse Pumps

1. Provide a pumped permeate collection system including pumps, controls, isolation valves, check valves, flow meters, and pressure gauges. ✓
2. Provide an individual permeate pumping system for each train. The Permeate Pumps shall meet the requirements of Specification 11314, End Suction Centrifugal Pumps. ✓
3. Motors shall comply with the requirements of Specification Section 16225, Electric Motors 250 Horsepower or Less. ✓
4. Each pump shall have sufficient capacity to operate one membrane train and meet the design flow rates per train resulting from the design flow and redundancy requirements specified herein. This requirement shall be met at the maximum transmembrane pressure and allow for all other system losses. ✓
5. Each pump shall be able to maintain a constant permeate flow regardless of transmembrane pressure up to the maximum transmembrane pressure. ✓

6. The permeate pump shall deliver sufficient total dynamic head to drive downstream processes. ✓
7. Provide the following at a minimum as part of the Permeate Pump System.
 - a. Process Pump for each train ✓
 - b. Feed flow control valve for each train ✓
 - c. Backwash drain flow control valve for each train ✓
 - d. Level transmitter and isolation valve for each train ✓
 - e. Pressure transmitter for each train ✓
 - f. Automated and manual valve for MIT air isolation for each train ✓
 - g. A vacuum ejector and associated valves for each train to allow for periodic air removal ✓
 - h. Permeate turbidity meter and associated valves for each train ✓
 - i. Backpulse suction isolation valve for each train ✓
 - j. Backpulse discharge isolation valve for each train ✓
 - k. Air scour isolation valve for each train ✓
8. All valves shall comply with the requirements of Specification Section 11295 – Hydraulic Valves. ✓
9. Instrument air compressors and associated appurtenances to operate pneumatic valves and instrumentation shall comply with the requirements of Specification Section 11372 – Air Compressors. ✓

2.7 CLEANING SYSTEMS

The blower package includes a check valve, pressure gauge and discharge safety valve. Isolation valve and low flow switch will be supplied loose. Blowers will NOT be supplied with a separate control panel. All control of the blowers will be through the membrane control system. Blowers will NOT be supplied with flow transmitters, high-pressure switches, nor flowmeters. These instruments are not required for a functioning system.

A. Agitation Air System

1. Provide membrane agitation air blower system including blowers, ~~control panels~~, isolation valves, check valves, pressure gauges, discharge pressure safety valves, ~~flow transmitters~~, low flow switches, ~~high-pressure switches~~, ~~flowmeters~~, and other associated appurtenances, as required to meet system performance requirements. ✗
2. Provide air scour supply piping within the limits of each membrane basin and instrumentation and control functions to control the operation of the membrane agitation air blowers. ✓
3. Membrane agitation air blowers shall provide airflow to scour the membranes for control of fouling, and to assist in keeping the solids in a membrane basin in suspension. ✓
4. Provide a minimum of two membrane agitation air blowers per the requirements of Specification Section 11371. ✓
5. Motors shall comply with the requirements of Specification Section 16225. ✓
6. ~~Control Panels shall comply with the requirements of Specification Section 16161.~~ ✗

Blowers will NOT be supplied with separate control panels.

B. Backwash or Backpulse System

All control of the blowers will be through the membrane control system.

1. Provide permeate pumps, valves, meters and control elements, and other components to provide an automated backwash system. ✓
2. The backpulse system shall deliver the required backwash flow at worst-case hydraulic conditions (maximum system headloss and maximum transmembrane pressure). Backpulse system shall be capable of backpulse pressure up to 12 psi. ✓
3. Backpulse volume will be provided by others. ✓
4. Provide the backpulse system appurtenances, control elements (valves, pressure sensors, flowmeters, etc.), and instrumentation and control functions required to operate the backpulse system. ✓
5. Initiation of all functions shall be automatically controlled by the vendor supplied PLC. Backwash shall be automatically initiated based on time, process water volume, or TMP. System shall also allow operator to initiate a backwash and control each piece of equipment

and valves manually. ✓

C. Clean-In-Place (CIP) System

1. Provide two CIP Pumps (one duty+ one standby) to direct CIP water from a concrete CIP Tank (by others). Pumps shall comply with the requirements of Specification Section 11314. ✓
2. Provide ~~duty/stand-by configuration~~ with all required instrumentation and controls required for fully automated operation including check valves, manual isolation valves, pressure gauges, and flow measurement. ✗ Not all required instrumentation is provided in duty/stand-by configuration, for example, flow measurement.
3. Provide CIP tank isolation valves and an instrumentation for a functional CIP system. ✓
4. Motors shall comply with Specification Section 16225 – Electric Motors 250 Horsepower or Less. ✓

D. Chemical Feed System

1. Chemical Cleaning and Neutralization feed systems by others. ✓

E. Compressed Air Filters and Instruments

1. Provide compressed air for membrane system pneumatic valve actuation and membrane integrity testing. ✓
2. Provide air quality and flow requirements. ✓
3. Provide air filter assemblies mounted on a panel which includes, air regulators, isolation valves, discharge pressure gauge, discharge pressure switch, and other related appurtenances to produce, deliver and monitor the compressed air for the pneumatically actuated valves on the MFS and for the membrane integrity tests. ✓

F. Membrane Integrity Test System

1. The Membrane Filtration System shall include an air-hold integrity test to provide a positive means of monitoring the integrity of the membranes and membrane system. The test shall be conducted using pressure or vacuum and be designed in accordance with Chapter 4 and Appendices B through D of the U.S. EPA Membrane Filtration Guidance Manual (November 2005). ✓
2. The membrane integrity test system shall detect membrane defects having a minimum size of 3 microns. ✓
3. The membrane integrity test system shall operate automatically, controlled by the vendor supplied PLC. Operators shall have the ability to manually initiate a MIT from the HMI screen. ✓
4. Integrity tests registering below the indicated LRV value will automatically alarm a failure and automatically shut down the specific membrane train. ✓

G. Membrane Permeate Header/Air Scour Piping

1. Piping shall conform to requirements specified in Division 15. ✓ Header sizes and material shall be as shown on SUEZ's Drawings.
2. Provide one (1) permeate header and one (1) air header per membrane train. Header sizes and material shall be as shown on the Drawings and as scheduled in Specification Sections 15050 and 15052. The permeate headers shall include tie points for: ✗ Sections 15050 and 15052 are not included in these Specifications.
 - a. A single finished permeate and backpulse tie point per train ✓
 - b. A single air removal / ejector tie point per train ✓
 - c. A single compressed air for membrane integrity test tie point per train. ✓
3. The air headers shall include tie points for:
 - a. A single backwash air scour tie point per train. ✓

~~H. Membrane Tank Feed Header~~ ✗

The Membrane Tank Feed Header does not fall in SUEZ's scope of supply. City of Chandler
The Membrane Tank Feed Headers will be designed, supplied and installed by RWIF
others. 11500.1-13 GMP 1

1. ~~Piping shall conform to requirements specified in Division 15.~~ ❌
2. ~~Provide one (1) feed water header per membrane train. Header size shall be as shown on the Drawings and as scheduled in Specification Sections 15050 and 15052. Header will include a minimum of six (6) laterals to distribute feed water evenly throughout the membrane tank.~~ ❌

I. Valves and Actuators

1. Provide all check valves, control valves, solenoid valves, isolation valves and actuators required for a completely functional system. ✔️
2. Check Valves: Provide per Specification Section 11295. ✔️
3. Ball Valves, (PVC) 2-Inch and Smaller: ~~Provide per Specification Section 15065.~~ ❌
4. Ball Valves, (SS): Provide per Specification Section 11295. ❌
5. General Purpose ~~AWWA~~ Butterfly Valves: ❌
 - a. Service conditions: General service and manual and automated isolation. ✔️
 - b. Supplier-supplied butterfly valves shall be supplied in accordance with Section 11295. Valve discs shall be ~~Type 316 stainless steel.~~ ❌
 - c. CMAR-supplied butterfly valves shall be in accordance with Section 11295. Valve discs shall be Type 316 stainless steel. ✔️
 - d. Provide Pneumatic Actuators used for OPEN/CLOSE application where fast action is required in accordance with Section 13445 – Pneumatic Controllers and Control Valves. ✔️
6. ~~Industrial Class Butterfly Valves:~~ ❌
 - a. ~~Service conditions: Modulating aeration for membrane equipment system.~~
 - b. ~~Supplier-supplied butterfly valves shall be supplied in accordance with Section 11295. Valve discs shall be Type 316 stainless steel.~~
 - c. ~~CMAR-supplied butterfly valves shall be in accordance with Section 11295. Valve discs shall be Type 316 stainless steel.~~
 - d. ~~Provide Pneumatic Actuators used for OPEN/CLOSE application where fast action is required in accordance with Section 13445 – Pneumatic Controllers and Control Valves.~~
7. Solenoid Valves: Provide per Specification Section 11295. ✔️
8. Electric Motor Actuators: Provide per Specification Section 13447.

Section 15065 is not included in these Specifications.

There is no reference to SS Ball Valves in Section 11295, only CPVC Ball Vavles.

The Butterfly Valves supplied by SUEZ are not AWWA C504 valves.

Valve discs will be Nylon 11 Coated Ductile Iron, except on CIP lines where valve discs are Type 316 stainless steel.

Industrial Class Butterfly Valves are not applicable to this project.

There is no modulating aeration requirement for the membrane system.

J. Electrical

1. Electrical components shall be provided in accordance with the requirements of Division 16, Electrical. ✔️
2. Three-phase, 60-Hz, 480 V ac power will be available for the membrane equipment. ✔️
3. Notwithstanding anything to the contrary in this specification, all variable frequency drives and motor control center equipment will be provided by the installation CMAR. ✔️
4. Each membrane train shall have its own remote input/output panel ~~and control equipment independent from each other.~~ ❌
5. Electrical material and equipment shall have UL listing wherever standards have been established by that agency. ✔️
6. Complete electrical assembly shall meet all requirements of the National Electrical Code, the National Electrical Manufacturers Association (NEMA), the National Fire Protection Association (NFPA), all applicable state and local codes. ✔️

Section 13447 is not applicable to this project.

There are no electric motor actuators included in SUEZ's scope of supply.

There is a common PLC with remote I/O panels for each membrane train.

K. Instrumentation

1. Provide the following field instrumentation components in accordance with the requirements of Division 17.
 - e. Transmembrane pressure transmitters (1 per tank) ✔️

Clarification: Wilson's P&IDs show level switches in the membrane tank. SUEZ will not provide level switches, but will supply level transmitters instead as detailed below.

Clarification: Wilson's P&IDs show a turbidimeter on the common permeate header. SUEZ has not provided a turbidimeter on the common permeate header and will only supply one (1) turbidimeter per membrane tank as detailed below.

- f. Membrane tank level transmitters (1 per tank) ✓
- g. Permeate turbidimeter panels (1 per tank) ✓
- h. High pressure switches (1 per permeate pump) ✓ Clarification: PSH is for backwash duty
- i. Suction pressure gauges (1 per permeate pump, 1 on CIP suction manifold) ✓
- j. Discharge pressure gauges (1 per permeate pump) ✓ (and 1 per CIP Pump)
- k. Magnetic flowmeter (1 per permeate pump, 1 on CIP manifold) ✗
- l. Backpulse tank level transmitter (1 per backpulse tank) ✓
- m. CIP tank level transmitter (1) ✓
- n. ~~CIP pump suction pressure gauge (1)~~ ✗ Already noted above
- o. ~~CIP pump discharge pressure gauge (1)~~ ✗ Already noted above
- p. ~~CIP pump magnetic flowmeter (1)~~ ✗ Already noted above
- q. CIP temperature transmitter (1) ✓
- r. CIP chlorine and pH analyzer panel (1) ✓
- s. Compressed air cleaning system panel that includes the following instruments:
 - (i) Pressure switch for MIT operation ✓
 - (ii) Pressure gauge for MIT operation ✓

L. Control System

- 1) The control system shall allow for complete automation of the Membrane Filtration System. ✓
- 2) Provide control panels, PLC and Human Machine Interface hardware and software, Membrane Control System software package, data links with the Owner's Plant Control System, graphic display and configuration, instruments, and instrumentation and control components in accordance with Division 16 and 17. ✓
- 3) ~~Control system shall be provided for the functionality described in Specification Section 17454.~~ ✗ Section 17454 is not included in these Specifications.

2.8 SPECIAL TOOLS

- A. The MSS shall furnish all special tools required for routine operation of the MFS. Special tools include the following:
 - 1. Hand tools used for cassette and module removal (if required). ✓
 - 2. Repair vessel and means to repair the membrane fibers/flat plate. ✓
 - 3. Instrumentation and means to identify any required membrane repairs. ✓

2.9 SPARE PARTS

- A. Procedures: See Section 01750 – Spare Parts and Maintenance Materials. ✓
- B. Provide a "standard" spare parts list, including prices for all replaceable parts associated with the membrane equipment system, including the following at a minimum:
 - 1. One spare set of expendable material such as gaskets, seals, and packing. ✗
 - 2. ~~One set of new and unused special tools required for installation, operation, and maintenance.~~ ✗ Included in Proposal Price. See Special Tools in item 2.8.A.1 above.
 - 3. ~~One repair kit for sealing off damaged membrane fibers within the membrane module.~~ ✗
 - 4. ~~All jigs, fixtures, clamps, lifting beams, hooks, and other instruments required facilitating the removal, disassembly, re-assembly, and installation of each item of equipment within the system.~~ ✗ This item falls in the scope of supply of the CONTRACTOR.
 - 5. Reagents/chemicals, calibration sets, and spare parts as specified for individual equipment

Included in Proposal Price. See Special Tools in item 2.8.A.2 above.

Clarification:
Refer to Item 1.4.A.9 of this Section which states as part of the Shop Drawings to submit, "Recommended list of spare parts and safety equipment, along with price and ordering information."

SUEZ's Proposal Price does NOT include spare parts except as noted in SUEZ's proposal. Any additional spare parts will be at additional cost.

Clarification:
Refer to Item 1.4.A.9 of this Section which states as part of the Shop Drawings to submit, "Recommended list of spare parts and safety equipment, along with price and ordering information."

- items or instruments. ✖
6. Spare parts for instruments, PLC hardware and control devices as specified in Divisions 16 and 17. ✖
- C. Provide recommendations for spare parts and materials for the first 12 months of facility specific system operation. Cross-reference with the spare parts list and provide a total cost for all recommended spare parts. ✔
- D. Guarantee availability of "appropriate" spare parts as listed above or equivalent alternatives for a period no less than 20 years. ✔

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Supplier shall furnish installation instructions and recommendations to CMAR. ✔
- B. The Supplier shall provide training to the CMAR for installation of membrane equipment. ~~The training shall be conducted on-site by an authorized, experienced, employee of the Supplier.~~ ✖ Training shall be conducted virtually by an authorized, experienced employee of the Supplier.
- C. CMAR will install the membrane equipment system membrane cassettes, pumps, valves, and piping in accordance with Supplier's instructions and recommendations. ✔
- D. ~~An employee of the Supplier shall be present at the site to oversee the proper placement and installation of all equipment supplied by the Supplier for at least 2 weeks.~~ ✖
- E. ~~The representative of the Supplier shall also be present to oversee the assembly installation of the associated anchor bolts for Supplier furnished equipment.~~ ✖
- F. The Supplier shall be responsible for identification of the volume and concentration of the membrane module storage solution and rinsing requirements for membrane modules. ✔
- G. The CMAR shall be responsible for making any adjustments and/or modifications to the installation process that may become necessary to ensure that all equipment is properly installed and stored. ✖ Any adjustments and/or modifications to the installation process will need to be reviewed by the Supplier (SUEZ).
- H. The CMAR shall be responsible for rinsing and disposing of the membrane storage solution. CMAR shall be responsible for keeping the membranes wetted after removing the membranes from the storage solution. ✔
- I. Supplier shall record location of each membrane module in each membrane tank with their respective serial numbers. ✔
- J. CMAR shall clean all tanks and piping of construction debris prior to installing the membranes. ✔
- K. After the installation is complete, the Supplier, CMAR, and Engineer shall jointly perform a

SUEZ has assumed the 2 weeks referenced in item 3.1.D are the same 10 person-days referenced in item 3.3.B.4. SUEZ does not provide value being on-site to oversee proper placement and installation of equipment. Instead, SUEZ will be on-site for a one (1) day pre-commissioning inspection for the membrane equipment system (see item 3.1.K below).

pre-commissioning inspection of the membrane equipment system. The inspection shall identify the following:

1. Mechanical:
 - a. Membrane units shall be completely installed and unit and interconnecting piping pressure tested. ✓
 - b. The cleaning system shall be completely installed and pressure tested. ✓
 - c. The compressed air system shall be completely installed and the piping pressure tested. ✓
 - d. The air scour system piping shall be completely installed and the piping pressure tested. ✓
2. Electrical:
 - a. All local control panels shall be installed and terminations completed. ✓
 - b. All 480, 120, and 24 VDC power supplies shall be connected and verified. ✓
 - c. The documentation associated with the inspection of electrical terminations shall be provided by the CMAR to the Supplier. ✓
3. Instrumentation:
 - a. Instruments shall be properly installed and calibrated. ✓

Any adjustments and/or modifications to the installation process will need to be reviewed by the Supplier (SUEZ).

- L. The CMAR shall be responsible for making any adjustments and/or modifications to the installation process that may become necessary to ensure that all equipment is properly installed. ✗
 1. The inspection shall identify any equipment that has not been properly installed, detailing the outstanding installation issues on a "punch list" and noting the party who shall be responsible for each correction and identify the items that require correction before commissioning can begin. ✓
 2. Once the corrections identified have been made, a "Notice of Completed. Installation" shall be issued by the Engineer and testing and commissioning shall commence. ✓

3.2 TESTING AND COMMISSIONING

- A. Procedures: See Section 01650 – Starting of Systems and Section 01660 – Field Tests of Equipment. ✓
- B. Following the Engineer's issuance of a "Notice of Completed Installation", the Supplier shall perform Component, System, and Operational Tests, on the membrane equipment system. It will be the responsibility of the Supplier and CMAR to communicate to arrange the times for testing and startup activities; however, the CMAR must confirm that these times are acceptable to the Owner. ✓
- C. Component and System Tests:
 1. Once written "Notice of Completed Installation" has been issued, Supplier shall coordinate with CMAR to perform Component and System testing of the membrane equipment system. ✓
 2. To perform the Component and System Tests, the Supplier shall operate all valves, controls, and other devices to ensure they are functional and ready for performance testing. ✓
 3. Purpose of the Component and System Test shall be to demonstrate the effectiveness of the following system components and features:
 - a. Automatic START/STOP and flow control of membrane trains using Plant Control System. ✓
 - b. Manual flow control using membrane HMI and PLC. ✓
 - c. Automatic backwashing at various time intervals. ✓

- d. Automatic shutoff and alarm for various failure modes for each membrane train and for entire membrane equipment system. ✓
- e. START and STOP of air system. ✓
- f. Determination of clean water permeability of each membrane train and temperature correction of the clean water permeability for each train. ✓
- g. Monitoring and recovery of operating data. ✓
- h. Monitoring and control from remote workstation. (Remote workstations and connectivity to be provided by CMAR.) ✓
- i. Automatic switchover from normal power to emergency power, and emergency power to normal power (if emergency power is provided, otherwise automatic restart from power fail). ✓
- j. All control functions, both at local system and remote workstation. ✓
- k. Operation of systems for Maintenance Cleans and Recovery Cleans. ✓
- l. Operation of all monitoring instruments. ✓
- m. Bubble point testing of the membrane modules. ✓

D. Operational Test:

1. Following the Component and System Tests, the Supplier, CMAR, and Owner shall complete a 30 day Operational Test. ~~The Supplier shall be on-site for the first and last week of the 30-day Operational Test plus additional 7 days of site time.~~ The 30-day Operational Test shall be initiated following membrane system stabilization and completed during the 90 day Commissioning Period. During the Operational Test, ~~the Supplier shall take the lead and be responsible to test the membrane equipment system,~~ the CMAR shall be responsible for testing all other equipment associated with the secondary process as part of the overall plant testing, and the Owner shall provide assistance with controlling ancillary facilities. ✗
2. Supplier shall submit the Operational Test Report within 21 days of completion of the test period. ✓
3. To perform the test, the Supplier shall assist the Owner in continuously ^{remotely} ~~operating~~ ^{monitoring} the membrane equipment system over a 30-day test period, and collect and summarize data to demonstrate that the system meets the performance test requirements for the parameters listed below. In all cases, compliance with the requirements of this Specification shall be determined for each calendar day, and to successfully pass the test, membrane equipment system must comply with requirements for each of the 30 days of the Operational Test:
 - a. Production Capacity: System meets production capacity requirements under conditions specified in Performance Requirements specified in Paragraph ~~2.3.C~~ of these specifications. ✗ ^{Correct reference is to Paragraph 2.3.A.}
 - b. Pressure Limitations: System operates within the TMP limit that is specified by the Supplier. ✓
 - c. Membrane Permeate Quality: Membrane permeate quality meets requirements under conditions specified in Performance Requirements specified in Paragraph ~~2.3.D~~ of these specifications. ✗ ^{Correct reference is to Paragraph 2.3.C.}
 - d. Maintenance Clean: Perform Maintenance Clean at the frequency equal to or less than specified in Performance Requirements in this Section. ✓
 - e. Recovery Clean: Perform the recovery clean operation at the end of the 30-day test period on one membrane train. Using the TMP and temperature corrected permeability data from the 30 day operation, the recovery clean interval when averaged over one year, shall not exceed the minimum frequency specified in Performance Requirements in this Section. ✓
 - f. Control System: Verify that the PLC, Process Control, SCADA and network communications systems operate as intended. Verify that automatic transfer to redundant or backup systems is permitted, with operator intervention to restart or to re-

Note that item 3.3.B.5 below states that the Supplier shall be on-site for the full duration of the 30-day Operational Test. SUEZ does not provide value being on-site during the Operational Test. The Owner will operate the membrane system during the Operational Test. Test parameters may be monitored remotely by SUEZ. SUEZ instead suggests that SUEZ's Field Service Representative will be on-site for the first three (3) days of the Operational Test.

establish normal operation during weekday periods between 8:00 a.m. and 4:00 p.m. Any other manual intervention to restart or to re-establish normal operation of the control system is considered a system failure. ✓✓

4. Successful completion of the Operational Test will be defined as 30 continuous days of operation and demonstration that system meets all performance requirements established herein. ✓✓
5. A major failure in the system is one that decreases system capacity below 75 percent of design capacity for more than 24 hours, or, for control systems, a major failure is any event that requires operator intervention to restart or to re-establish normal system operation beyond that described above. ✓✓
6. If membrane equipment system fails to successfully complete Operational Test, Supplier shall have the option of repeating the test over a second 30-day period:
 - a. If the system fails to successfully complete the Operational Test during second test period, Supplier shall prepare a written plan for modifying the system to meet all test requirements. ✓✓
 - b. Supplier shall submit the written plan within 7 days after the second unsuccessful test period ends. ✓✓
 - c. If in the opinion of the Owner, Supplier cannot modify or supplement its system to meet performance requirements specified herein, the Supplier shall remove their system and install an alternate membrane system as required to meet performance requirements at sole cost of Supplier. This requirement shall be secured by the Performance Bond. ✓✓
7. During the Operational Test, CMAR and Owner shall have the option of collecting samples for independent analyses to confirm measurements and analyses conducted by Supplier. ✓✓
8. Owner shall have the option of witnessing all testing performed by the Supplier. ✓✓

E. Commissioning Period:

1. Compliance with the requirements for production capacity, chemical cleaning interval, and membrane permeate quality shall be determined during the Commissioning Period. ✓✓
2. The Commissioning Period shall begin and end at Owner's discretion, within the limits defined herein:
 - a. The 30-day Operational Test may be concurrent with the Commissioning period. ✓✓
 - b. Duration: 90 days. ✓✓
3. Owner shall operate the plant during the Commissioning Period; however, Supplier and CMAR shall provide onsite assistance and remote support. ✓✓
4. Supplier is responsible for monitoring operating conditions and performance during the Commissioning Period for the purpose of demonstrating compliance with the specified membrane equipment system performance requirements. ✓✓
5. Supplier shall summarize data at the end of the Commissioning Period and prepare report results in writing to the Owner. ✓✓
6. The Commissioning Period Report shall include a narrative description, tables, and graphs of production capacity, TMP versus time, maintenance clean and recovery clean frequency, permeate turbidity, ~~permeate TSS concentration~~, and other parameters necessary to document the performance of the system and demonstrate compliance with the specified membrane equipment system performance requirements. ✗
7. Supplier shall submit the Commissioning Period report within 30 days following the end of the Commissioning Period. ✓✓
8. Owner and Engineer may conduct their own monitoring and record keeping during the Commissioning Period. ✓✓
9. The following parameters shall be evaluated to determine compliance with specified membrane

Remove permeate TSS.
Permeate turbidity is part
of the Permeate Water
Quality Requirements,
not permeate TSS.
(see item 2.3.C)

Chemical Cleaning Interval: If the interval for Maintenance Cleans and Recovery Cleans during the Commissioning test is shorter than the Supplier's proposed interval (not more frequently than required in this specification), Supplier shall provide to Owner a written plan of modifications to the membrane system to achieve compliance with the requirements. Upon implementation of plan modifications, the Commissioning tests shall re-commence in its entirety.

equipment system performance requirements:

- a. Membrane Permeate Quality: If the system fails to comply with requirements for membrane permeate quality, Supplier shall provide to Owner a written plan of modifications to the membrane system (such as repairing damaged fibers, replacing seals, complete replacement of membrane system) to achieve compliance with the requirements. Upon implementation of plan of modifications, the Commissioning tests shall re-commence in its entirety. ✓
 - b. Chemical Cleaning Interval: If the interval for Maintenance Cleans and Recovery Cleans during the Commissioning tests is shorter than the Supplier's proposed interval (not more frequently than required in this specification), ~~and/or chemical usage is greater than the Supplier's initial estimates, Supplier shall pay Owner for total costs of additional chemicals that will be needed per year in a one-time payment based on the 20-year present worth using a 6 percent interest rate and a 3 percent inflation rate, and the cost per gallon of each chemical.~~ ✗
 - c. Production Capacity: Production capacity shall be reported in units of million gallons per day (mgd). ✓
10. Successful completion of Commissioning concludes the Supplier's obligation regarding performance guarantees. ✓
- F. Training: Provide training to Owner personnel as required for complete understanding of process, mechanical, electrical, and control system relationships. Refer to Paragraph 3.3.B of these Specifications. Training to be provided prior to the Operational Test. ✓
- G. Telephone:
1. Provide telephone support by means of a toll-free phone number for a minimum period of 3 years following installation and startup. ✓
 2. Provide a list of three or more names of individuals qualified to support operation, and provide mobile phone contact numbers for these individuals, if available. ✓
 3. At least one of the listed individuals shall be available at all times including nights, weekends, and holidays in the event of an emergency. ✓
- H. Internet Monitoring:
1. Provide internet monitoring service and support for a minimum period of 2 years following installation and startup. ✓

3.3 MANUFACTURER'S FIELD SERVICES

- A. Provide onsite services in accordance with Section See Section 01650 – Starting of Systems and Section 01660 – Field Tests of Equipment, and as described herein. ✓
- B. In addition to the time necessary to complete the requirements established elsewhere within these documents, Supplier shall provide the following during construction and testing:
1. Provide onsite services for the WRF site at times designated by the Owner and CMAR, for the minimum person-days listed below, travel time excluded. If the minimum person-days and trips listed below are insufficient in the opinion of the Supplier, the Supplier shall recommend an alternative number of person-days and trips. ✓
 2. Provide qualified individual who has previously provided onsite services for the installation, testing, and startup of Supplier's identical system of similar size. ✓
 3. ~~2 person-days (one trip) to~~ provide training to the Owner regarding unloading and installation of membrane equipment system, including attendance at a one day pre-delivery site meeting with the CMAR. ✗

~~Training to the Owner regarding unloading and installation of membrane system equipment, and a pre-delivery site meeting with the CMAR can be accomplished virtually without the Supplier's Field Service Representative on-site.~~

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4. One (1) person-day (one (1) trip) for pre-commissioning inspection of the membrane system as defined in item 3.1.K.
Fifty (50) person-days (four (4) trips) for Component and System Testing as defined in item 3.2.C.
5. Three (3) person-days (one (1) trip) at the start of the Operational Test.
6. Three (3) person-days (one (1) trip) for additional assistance during the Commissioning Period.
 4. ~~10 person-days (two trips) for providing installation assistance, pre-commissioning inspection for the membrane equipment system, and Component and System Testing.~~ ❌
 5. ~~30 days on-site assistance during the Operational Test.~~ ❌
 6. ~~10 person-days (three trips) for additional assistance during the Commissioning Period.~~ ❌
 7. 8 person-days (4 trips) for training of the Owner's operators including attendance at a 1 day pre-startup site meeting with the CMAR and the Owner and a 2-day review of operations at the end of the first year of operation. ✔️
 8. Service time spent remedying equipment deficiencies/problems shall not count toward the listed service days and trips. ✔️
 9. MFS Manufacturer shall provide itemized costs for their Manufacturer's Field Services identified above. ✔️ See SUEZ Labor Rate Sheet in SUEZ's proposal.

** END OF SECTION **

NOTE REGARDING ITEM 3.3.B.:

Before SUEZ's modifications, item 3.3.B described SUEZ's Field Service Representative on-site for a total of 60 days over 10 trips. With SUEZ's modifications SUEZ is proposing that the Field Service Representative is on-site for a total of 65 days over 11 trips. As per item 3.3.B.1 above, SUEZ has recommended an alternative number of days on-site and trips based on where SUEZ knows we will provide value to the OWNER.

Hours in excess of the person-days and trips described in the modifications above will be billed at prevailing rates.

GENERAL NOTE FOR ALL OF SECTION 13127:

Extruded Flat Panel Covers do not fall in the scope of supply by SUEZ.

See Section 11500.1, item 2.3.E.12 which states that Membrane basin covers will be provided by CMAR.

As such, SUEZ takes complete exception to this section of the Specification and has not provided a review nor comments.

SECTION 13127

EXTRUDED FLAT PANEL COVERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Furnish all labor, materials, and equipment required to design, fabricate, deliver, and install a new extruded flat aluminum cover structure with all appurtenances required for a complete and operational installation.
 - 1. Membrane Trains 1 thru 4.
 - 2. Membrane Facility Common Influent Channel.
 - 3. CIP Tank.
- B. The enclosure shall be a flat cover structure conforming to the dimensions indicated on the Drawings, a rectangle aluminum structure with stainless steel structure members.
- C. All metal components of the aluminum structure shall be aluminum with cold-formed stainless steel. No galvanized, painted, or plated steel shall be used.
- D. The structure shall be designed as a substantially airtight system under all design load and temperature conditions. All raw edges of the aluminum panels shall be covered and sealed.
- E. The cover manufacturer shall provide 4 access hatches each for each Membrane Train. Coordinate pipe support attachments and penetrations as shown in the Drawings.

1.2 RELATED SECTIONS

- A. Drawings and General Provisions of the Contract, including General Supplementary Conditions apply to this Section.
- B. Section 01300, Submittals.
- C. Section 01640, Materials and Equipment.
- D. Section 01650, Starting of Systems.
- E. Section 09900, Painting.
- F. Division 13, Special Construction.

G. Division 15, Mechanical.

H. Division 16, Electrical.

1.3 REFERENCES

- A. Aluminum Association Specifications for Aluminum Structures.
- B. Aluminum Association Aluminum Design Manual, Specification, and Guidelines for Aluminum Structures.
- C. ASCE 8-90, Specification for the Design of Cold-Formed Stainless Steel Structural Members.
- D. ASTM C864-90, Standard Specifications for Performed Gasket and Sealing Material.
- E. ASTM F593, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.

1.4 SUBMITTALS

- A. Drawings describing the completed structure and all its components shall be submitted, complete with materials of construction and typical details. Drawings shall be sealed and signed by a qualified Professional Engineer registered in the State of Arizona.
- B. Records certifying the satisfactory inspection of all structural welds of aluminum components shall be submitted prior to delivery of all fabricated materials.
- C. Design calculations verifying conformance to deflection limits shall be submitted. Deflection calculations are required for structural members as well as walking surfaces.
- D. Descriptive and Operation and Maintenance Data submittals shall be made in accordance with the Data Reference Symbols defined in Section 01300, Submittals.
 - 1. Covers: Shop Drawings and O&M Manuals:
 - a. Letters of Certification of Compliance on materials, equipment, etc.
 - b. Final Certified Drawings showing outline dimensions, foundation layout or mounting information, and other pertinent dimensions.
 - c. Field erection instructions, assembly drawings and/or diagrams, detailed reference drawing lists, lists of erection details, and list of spare parts supplied with equipment.

- d. Shop Detail Drawings showing individual sub- assemblies and fabricated pieces with material specifications and other applicable data.
 - e. General bulletins and catalog cuts describing complete apparatus, including operating principles and fundamentals.
 - f. Materials of construction of all components.
- E. All equipment manufactures shall submit evidence of conformance with the Specifications as required by the individual Specifications Sections. Naming of a manufacturer in the Specifications is not an indication that the manufacturer's proposed or standard equipment is acceptable in lieu of the specified components and features. Naming is only an indication that the manufacturer may have the capability of engineering and supplying a system as specified.
- F. Before executing any of the Work in this Section prints or Drawings shall be submitted to the ENGINEER showing dimensions, sizes, thickness, gauges, materials, finishes, joint attachments, erection procedure, and thermal expansion allowances.
- G. A complete set of design calculations for the covers shall be submitted. These calculations shall be signed by a Registered Professional Engineer. All Work shall be fabricated and erected in accordance with the approved Drawings.
- H. Certification that the specified material alloys, sizes, and quantities have been furnished shall be submitted upon completion of the Project.
- I. Unit responsibility form not required for extruded flat panel covers.
- J. Each Shop Drawing Submittal shall include a hard copy of the relevant Specification Section and shall be clearly marked to indicate whether the requirements for equipment and/or services in the Specification Section are met by writing "accept" or "deviate" next to each Paragraph. If clarifications are needed to any of the Paragraphs in the Specification Sections due to deviations, they shall be addressed next to the Paragraph as such and explained further with any additional information necessary. If any exceptions and/or deviations are proposed to any of the Specifications, they shall be clearly noted as such in the Submittal, and an explanation of any deviation and/or exception shall be provided. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

PART 2 - PRODUCTS

2.1 DESCRIPTION

- A. The flat cover shall be clear-span and self-supporting from the peripheral structure. The aluminum cover shall be composed of panels and beams. All panels shall interlock with the adjoining beam and panels without the use of threaded fasteners. Uplift of each panel will be resisted with the use of an integral latch system. The use of structural members in contact with the contents of the basin is expressly prohibited. The flat cover shall consist of removable panels each weighing no more than 150 lbs. The required lifting force per panel shall not exceed the dead weight of the panel. Each panel must be able to be removed without needing to remove more than the two adjacent panels. The need for removing flashing or "hold-down" extrusions longer than the width of the panel is prohibited. The flat cover shall have an integral aggressively non-skid surface. Raised surfaces without the use of texturing to achieve slip resistant is not acceptable. The use of checkered plate, paint, tape, sandblasting, or other applied systems to achieve the slip resistant surface is expressly prohibited.
- B. The design shall prevent water pooling which may result in over-stressing the flat cover.
- C. Cover manufacturer shall provide access hatches, gravity vents, and pipe penetrations as shown on the Drawings.
- D. The removable closure panels shall be attached continuously along their edges to the structural members using an interlocking joint. Elastomeric weather seal gasket shall form a substantially airtight seal along the panel edges. The gaskets shall be fully enclosed to prevent ultraviolet exposure.
- E. Access to any location under the cover shall be gained through integral gear hinged access hatches. The Access Hatch Panels shall have the identical properties as the rest of the aluminum cover including loads, deflection and slip resistance specifications. The hinged access panels shall be the full panel width. The length of the access panel shall be clearly indicated on drawings. Hinged panel components including hinges, decking and lifting handles shall be extruded 6061-T6. While in the closed position the hatches will be completely flush therefore posing no tripping hazard. In the open position the panel shall lie flat on the cover and will not need a hold open device.
- F. The cover system shall be mounted on aluminum angle attached to the inside face of the concrete to match existing aluminum cover systems in appearance and functionality. No portion of the cover system shall be mounted to the top surface of the concrete wall. The aluminum angle shall be mounted at an elevation that provides a zero transition between the cover system and the top of concrete.

2.2 MATERIALS

- A. The following is a summary of approved materials and/or material specifications. All aluminum alloys shall be defined by the Aluminum Association and published in the Aluminum Standards and Data:
1. Bolts and Fasteners: All bolts and fasteners shall be 2024-T4 or 7075-T73 aluminum or Series 300 stainless steel.
 2. Structural Shapes: Aluminum structural shapes shall be alloy 6061-T6, 6005A-T6, or 6063-T6. Load supporting surfaces shall be of sufficient thickness to meet or exceed all loading requirements specified in this Section.
 3. Miscellaneous Shapes: Miscellaneous aluminum shapes shall be alloy 6061-T6, 6005A-T6, or 6063-T6.
 4. Gaskets: All gaskets shall be Neoprene conforming to ASTM C864-90, resistant to ozone and shielded from exposure to ultraviolet light.
 5. Sealant: All sealants shall be resistant to ozone and ultraviolet light and conform with Federal Specification TT-S-00230C.
 6. Anchors shall be epoxy-type. Expansion-type anchors are not permitted.

2.3 EXPERIENCE

- A. No equipment shall be supplied by any manufacturer not regularly engaged in the manufacturing and production of flat covers in the size and character herein specified. The manufacturer must have designed, manufactured and installed at least one roof of the same type and of similar size as units specified herein. This roof must be in satisfactory use for a period not less than five years.

2.4 DESIGN LOADS

- A. The entire flat cover shall be designed to sustain the loads specified herein, within the stress limitations of the Aluminum Association Specifications for Aluminum Structures.
- B. The load cases to be considered shall be those described below, unless more severe loads are specified by the purchaser.
1. Dead Load: The dead load shall be defined as the weight of the structure and all material permanently attached to and supported by the structure.
 2. Live Load: The uniform live load shall be the greater of 30 psf or the live load specified by the purchaser.
 3. Wind Load: The wind load shall be obtained by ASCE 7-98.
 4. Vacuum/Pressure Load: The vacuum load shall not exceed 3 psf.
 5. Panel Design Load: In addition to the above mentioned loads, the aluminum panels shall be designed for a 400 lb load distributed over 1 square foot at any location. These loads are to be taken as acting separately from one another and not simultaneously with the other design loads.

6. Load Combinations: The loads described above shall be applied to the flat cover in the following combinations:
 - a. Dead Load.
 - b. Dead Load, Uniform Live Load, and Vacuum Load.
 - c. Dead Load, Unbalanced Live Load, and Vacuum Load.
 - d. Dead Load, Wind Load, and Pressure Load.
 - e. Dead Load, Uniform Live Load, and Wind Load.
 - f. Dead Load, Unbalanced Live Load, and Wind Load.
7. Deflections: For the above loads and load combinations, the deflection of all components (structural and cladding) shall not exceed $L/240$ with L equal to the short span of the component. This deflection limit applies not only to the flat cover as a whole, but also to the skin of the cover spanning between the supporting edges of each panel or module. Calculations stamped by a Registered Professional Engineer shall be provided at the time of submittal to ensure that this requirement has been met.
8. Temperature: The load combinations listed above shall be considered for a temperature change of 100°F below the installation temperature and 100°F above the installation temperature and for a material temperature range of 40°F below zero to 160°F above zero.

2.5 CONNECTIONS

- A. In no case shall a joint be designed to sustain a greater total resultant shear force than that which would be allowed by summing the allowable shear force of the individual fasteners, based on their net cross-section areas through the shear plane and the allowable shear stress of the material. The use of manufacturers' test data to rationalize an increase in assumed fastener strengths is prohibited. In no case shall values greater than those published by the Aluminum Association and ASTM F593 for aluminum and stainless steel fasteners, respectively, be used. The allowable stresses are as follows:

<u>Fastener Material</u>	<u>Allowable Shear Stress</u>
Series 300 Stainless Steel	20% of Minimum Tensile Strength as published in ASTM F593
6061-T6 Aluminum	11 ksi
7075-T73 Aluminum	18 ksi

2.6 MANUFACTURERS

- A. Ultraflote Corp., Houston, TX.
- B. Conservatek Industries, Inc., Conroe, TX.
- C. Hallsten Corporation.

- D. Or approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. All Work shall be executed by skilled mechanics with a supervisor experience in the erection of flat covers. The flat cover shall be erected plumb and level and in proper alignment.
- B. Field refabrication of structural components or panels will not be accepted. Forcing of the structure to achieve fit-up during construction is expressly forbidden and not acceptable.
- C. All sealant joints shall be tooled slightly concave after sealant is installed. Care shall be taken to keep sealant confined to joint area, and any outside of the joint shall be moved so that the panels will be free from misplaced sealant. All gasket materials shall be continuous; splices will not be allowed between right angles.

3.2 WARRANTY

- A. The flat cover manufacturer shall warrant that the work described herein shall be free from defects (workmanship and material). The flat cover manufacturer shall replace or repair only faulty workmanship or defective material furnished by it that is reported to it within one year from the date of completion of this scope of Work.

END OF SECTION

SECTION 13445

PNEUMATIC CONTROLLERS AND CONTROL VALVES

PART 1 - GENERAL

1.1 SUMMARY

Membrane System Supplier shall...

- A. Furnish ~~and install~~ all valves and valve accessories for water, non-potable water, wastewater, air, as indicated in the Drawings, as listed at the end of this Section, SUEZ's Drawings and as specified herein, including all appurtenances required for a complete and operational installation. ✖

1.2 SECTION INCLUDES

- A. ~~3-way control valves.~~ ✖ Not relevant to SUEZ's scope of supply

1.3 RELATED SECTIONS

- A. Section 01300, Submittals. ✔
- B. Section 01640, Materials and Equipment. ✔
- C. Section 01650, Starting of Systems. ✔
- D. ~~Section 09900, Painting.~~ ✖
- E. ~~Section 15050, Piping Systems.~~ ✖
- Valve vendors take exception to Section 09900 - Painting
Valve vendors will provide their standard paint specification to the CONTRACTOR and ENGINEER during the Submittal period for review. If changes to the vendor's standard paint specification are required, it will be at additional cost.
- Section 15050 is not included in these Specifications.

1.4 REFERENCES

- A. National Electrical Manufacturers Association (NEMA):
1. 250-Enclosures for Electrical Equipment (1000 V Maximum). ✔
- B. All other applicable ASTM and ANSI Standards. ✔

1.5 SUBMITTALS

- A. Descriptive submittals shall be made in accordance with the Data Reference Symbols defined in Section 01300, Submittals.
1. All Valves: Shop Drawings and O&M Manuals:
 - a. ~~Final Certified~~ Drawings showing outline dimensions, foundation layout or mounting information, and other pertinent dimensions ✖
 - b. ~~Field erection instructions,~~ assembly drawings and/or diagrams, detailed reference drawing lists, ~~lists of erection details,~~ and list of spare parts supplied with equipment. ✖
 - c. Shop Detail Drawings showing individual sub- assemblies and fabricated pieces with material specifications and other applicable data. ✔
- Valve drawings will not be certified.
- There are no field erection instructions or list of erection details with the valves.

- d. Installation instructions, operating and/or service manuals, and all other data pertinent to operating or servicing the complete apparatus. Preventative maintenance instructions and recommended frequency. ✓
- e. General bulletins and catalog cuts describing complete apparatus, ~~including operating principles and fundamentals.~~ ✗ Not included.
- f. Service data sheets showing design performance, utility requirements, etc., as applicable to the specific duty for which the equipment is furnished. ✓
- g. Materials of construction of all components. ✓
- h. Renewal parts list ~~with diagrammatic or cross-section drawings showing part identification. Material analysis or trades designation for each significant part is to be noted on parts lists or on a separate sheet.~~ ✗ Not included
- i. Stuffing box sizes; packing sizes; specifications and arrangement; and mechanical seal details, specifications, etc., if furnished in equipment. ✓
- j. Bearing manufacturer's standard identification and/or interchangeable number for all anti-friction bearings in the equipment proper and its accessory items. ✓

B. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration. ✓

C. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.** ✗

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Clarification: Items g, i and j are a part of the O&M Manuals, not a part of the Shop Drawing Submittal

SUEZ to submit Spare Parts List after Completion of Shop Drawings, with the Draft O&M Manual

SUEZ preventative maintenance information package is part of the SUEZ O&M Manual. O&M Manuals are submitted after approval of Shop Drawings, not as part of the Submittal Package.

PART 2 - PRODUCTS

2.1 MATERIALS

There are no pneumatic temperature controllers in SUEZ's scope of supply

- A. ~~Pneumatic temperature controllers:~~ ~~✗~~
- ~~1. Manufacturers: One of the following or equal:~~
 - ~~a. Fisher & Porter Company, Model 51-1401-TC11.~~
 - ~~b. Bray Controls, Series 92/93.~~
 - ~~2. Design:~~
 - ~~a. Temperature controllers: Pneumatic proportional type.~~
 - ~~b. Controller: Include Class 1A, liquid filled, temperature measuring system and the following capabilities:~~
 - ~~1) A span of 100 to 200 degrees Fahrenheit.~~
 - ~~2) Measurement to within plus or minus 1.0 percent of the measuring span.~~
 - ~~3) Repeatability within 0.2 percent per span.~~
 - ~~4) Air output signal of 3 to 15 pounds per square inch gauge.~~
 - ~~5) Proportional band adjustable from 4.0 to 400 percent.~~
 - ~~c. Provide controllers with reset adjustable from 0.2 to 25 minutes per repeat.~~
 - ~~1) Provide with external reset feedback connection to the reset bellows to prevent reset "wind-up".~~
 - ~~d. Provide and external set-point knob.~~
 - ~~e. Provide selector relay valve where two temperature controllers are used to control the output of 1, 3-way control valve.~~
 - ~~3. Materials:~~
 - ~~a. Enclosure: NEMA Type 4X with shatterproof glass in the case door.~~
 - ~~b. Connecting tubing: Type 316 stainless steel with Type 302 or Type 304 stainless steel armor.~~
 - ~~c. Measuring bulbs: Provide a flexible extension and a fixed union with Type 316 stainless steel well.~~
- B. ~~3-way control valves:~~ ~~✗~~ Not relevant to SUEZ's scope of supply
- ~~1. Manufacturers: One of the following or equal:~~
 - ~~a. Fisher Controls Company, "YO" type design with a Type 657 actuators.~~
 - ~~b. Hammed-Dahl Control and Instrument Division of ITT Corporation, Model V830 with Hammel-Dahl A40A actuators.~~
 - ~~c. Bray Controls, Series 63 with Series 50 Status Monitors.~~
 - ~~2. Design:~~
 - ~~a. 3-way control valves: Suitable for diverging service and for operation in response to a signal transmitted by pneumatic temperature controllers.~~
 - ~~b. Valve: Suitable for service under pressures equal to and less than 125 pounds per square inch gauge, and under a maximum temperature of 350 degrees Fahrenheit.~~

- c. ~~Valve and actuator: Capable of seating against an unbalanced pressure of 30 pounds per square inch gauge, with a 3 to 15 pounds per square inch gauge, air signal supplied from the temperature controllers.~~
 - 1) ~~Diaphragm on the actuator: Sized to operate with a 3 to 15 pounds per square inch gauge, pressure without a booster.~~
- d. ~~Valve: Furnish with a valve coefficient not less than 243 at full travel and a value coefficient of not less than 122 at mid travel.~~
- e. ~~Plug: For throttling service with a V-port.~~
- 3. ~~Materials:~~
 - a. ~~Body, bonnet, and bottom flange: Cast iron.~~
 - b. ~~Trim: Type 316 stainless steel.~~
 - c. ~~Packing, Teflon V-ring.~~

2.2 SHOP PAINTING

SUEZ will not paint PVC valves

If required, PVC valves can be painted by the CONTRACTOR at site

CONTRACTOR

- A. The ~~manufacturer~~ shall paint all PVC valves to be installed in exterior exposure as follows: ✗
 - 1. Surface Preparation: Clean, dry, and free of contaminants. ✗
 - 2. Prime Coat: Series 66 H.B Epoxoline; one coat, 3-5 mils DFT. ✗
 - 3. ~~CONTRACTOR shall determine the quantity of each type of valve to the manufacturer.~~ ✗ Manufacturer will determine the quantity of each type of valve
 - 4. CONTRACTOR shall provide finished coat per Section 09900, Painting. Final color selection shall be approved by ENGINEER prior to application. ✓

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Workmanship shall be of the highest grade throughout and in accordance with the best standard practice for this type of equipment. ✗
- B. Valves of the various types and pattern shall be installed at the respective locations as shown on the Drawings, listed in the Equipment Schedule, and specified herein. All appurtenances required for operation and control of the valves shall be included. Joints and connections shall be made in accordance with applicable requirements for pipe line or pipe joints. Valve stems shall be plumb and vertical unless otherwise specifically shown. Each valve shall be adjusted for smooth and easy operation and shall be watertight when placed in operation under maximum working pressure. ✗

Clarification: This item falls in the scope of the CONTRACTOR.

Clarification: This item falls in the scope of the CONTRACTOR.

3.2 MANUFACTURER'S FIELD SERVICE

Membrane System Supplier

- A. Equipment Start-up: A factory trained representative of the ~~manufacturer~~ shall visit the site and provide installation and start-up services as specified in Section 01650, Starting of Systems. Sales representatives shall not be acceptable to perform start-up and training functions. ✗ Visits will be performed by Membrane System Supplier's Field Service Representative.

Membrane System Supplier

- B. Training: A factory employed representative of the ~~manufacturer~~ shall visit the site and provide operator training services, in addition to equipment start-up services, as specified in Section 01650, Starting of Systems. ❌

END OF SECTION

GENERAL NOTE FOR ALL OF SECTION 13447

Electric Motor Actuators are not required for membrane system operation, thus Section 13447 is not applicable to this project. As such, SUEZ takes complete exception to this section of the Specification and has not provided review nor comments.

SECTION 13447

ELECTRIC MOTOR ACTUATORS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes: Electric motor-driven actuators for valves and gates as identified in the valves and gate schedule as MOV or EDR (Electric Discrete Run Open / Run Close Valve Actuator), except for specialty actuators specified with individual valves.
- B. Related sections:
 - 1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
 - 2. It is the Contractor's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of Contractor's Work.
 - 3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the Contractor to see that the completed Work complies accurately with the Contract Documents.
 - a. Section 11285 - Hydraulic Gates and Stop Logs.
 - b. Section 11295 - Hydraulic Valves.
 - c. Section 16225 - Electric Motors 250 Horsepower or Less.
 - d. Section 09900 - Painting.

1.2 REFERENCES

- A. American Water Works Association (AWWA):
 - 1. AWWA C504 - Rubber-Seated Butterfly Valves.
 - 2. AWWA C542 - Electric Motor Actuators for Valves and Slide Gates.
- B. FM Global (FM).
- C. National Electrical Manufacturers Association (NEMA):
 - 1. MG-1 Standard for Electrical motors.
- D. Underwriters Laboratories (UL) - UL 674, UL 1004.

1.3 DEFINITIONS

- A. NEMA:
 - 1. Type 4X enclosure in accordance with NEMA 250.
 - 2. Type 7 enclosure in accordance with NEMA 250.

1.4 SUBMITTALS

- A. Product data:
 - 1. Electrical ratings:
 - a. Voltage and number of phases.
 - b. Starting and running current.
 - c. Voltage levels and source for control and status.
 - 2. Description of integral control interface.
 - 3. Integral and remote control station components.
 - 4. Environmental ratings, including NEMA enclosure rating and submergence capabilities.
 - 5. Gear ratios for both manual and motorized actuation.
 - 6. Opening and closing directions.
 - 7. Allowable starts per hour.
 - 8. List of all included options and accessories.
 - 9. Full travel times.
 - 10. Gearbox data including gear ratio, and gearbox efficiency.
 - 11. Affidavit in accordance with AWWA C542.
- B. Shop drawings:
 - 1. Wiring diagrams:
 - a. Include all options and expansion cards furnished with each actuator.
 - 2. Dimensioned drawings of each valve and actuator combination.
 - 3. Dimensioned drawings of each valve gearbox.
 - 4. Electric motor data.
- C. Calculations: Submit the following for each valve/gate size and class:
 - 1. Operating torque calculations.
 - 2. Maximum torque calculations for seating and unseating.
 - 3. Maximum operating torque at starting and normal operation.
 - 4. Indicate factor of safety for all torque calculations.
- D. Test reports:
 - 1. Factory test report and certificate.
- E. Manufacturer's instructions:
 - 1. Include manufacturer's instructions, description of system operation, start-up data and troubleshooting check lists.
- F. Operations and maintenance data:
 - 1. Include manufacturer's literature; cleaning procedures, replacement part lists, wiring diagrams, and repair data.
 - 2. Include a list of all configurable parameters, and the final values for each.
 - 3. List of recommended spare parts.
 - 4. List of special tools necessary for proper operation and/or maintenance.
 - 5. Exploded view drawings that illustrate all assemblies, sub-assemblies, and components.

6. Routine test procedures for all electronic and electrical circuits.
 7. Troubleshooting chart covering the complete valve and controls/electrical power systems, showing description of trouble, probable cause, and suggested remedy.
 8. Certified factory and field-test results.
- G. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
- H. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**

1.5 QUALITY ASSURANCE

- A. Obtain required information from the valve/gate supplier, including but not limited to:
1. Interface to gate or valve.
 2. Operating range:
 - a. Quarter turn or multi-turn.
 - b. Required turns for full travel on multi-turn applications.
 3. Direction of rotation for opening and closing.
 4. Maximum and normal torque requirements.
- B. All motorized, intelligent actuators shall be the product of a single manufacturer for all valve and gate applications on this project, regardless of gate or valve type, manufacturer, or supplier.

1.6 WARRANTY

- A. Refer to Contract Document 01010 – Summary of Work.

1.7 SPARE PARTS

- A. Provide the following spare parts (minimum 10 percent of total number of actuators of each model type furnished, but not less than 1 for each model of actuator furnished):
 - 1. Stem nut.
 - 2. Worm shaft subassembly.
 - 3. Drive sleeve subassembly.
 - 4. Complete actuator seal kit.
 - 5. Actuator gearbox oil (sufficient quantity to fill 4 gearboxes).
 - 6. Encoder.
 - 7. Control module.
- B. Provide 1 spare motor for each size motor furnished.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable manufacturers for lines 3 inches and smaller:
 - 1. RCI:
 - a. RCEL-005L, with Receptacle (quarter-turn)
 - 2. Hayward:
 - a. Series EJM (quarter-turn).
 - 3. Rotork:
 - a. ROM Series (quarter turn).
 - 4. Rotork:
 - CVA Series (multi- turn).
- B. Acceptable Manufacturers for lines 4 inches and larger, and actuated gates:
 - 1. Rotork Controls, Inc.:
 - a. IQ (multi-turn).
 - b. IQT (quarter-turn).
 - 2. Limitorque Corporation:
 - a. Accutronix MX (multi-turn).
 - b. Accutronix QkX (quarter-turn).
 - 3. Or equal from EIM Corporation.

2.2 MANUFACTURED UNITS

- A. Actuators for valves 3 inches and smaller:
 - 1. Provide actuators complete and operable with all components and accessories required for operation.

2. Power supply:
 - a. 120 VAC.
 - b. Valve motion independent of power supply phase rotation.
3. Size actuator to move valves from full open to closed position within the time indicated in the Motorized Actuator Schedule:
 - a. If an operating time is not indicated on the Schedule, size the actuator to move valves at minimum 12 inches per minute under maximum load. Measure rate of closure for valves at maximum diameter of disc, plug, or ball.
4. Control inputs:
 - a. Capable of using discrete 120 VAC and 24VDC inputs, as shown on DRAWINGS.
 - b. Isolated inputs capable of operating from external control voltage source
 - c. Provide for the following control inputs:
 - 1) OPEN.
 - 2) CLOSE.
5. Status outputs:
 - a. Dry contact outputs configured for the functions indicated on the Drawings. Provide the following outputs for all actuators:
 - 1) FULLY CLOSED.
 - 2) FULLY OPEN.
 - b. All output contacts rated for minimum 3 amps, 120 VAC.
6. Analog input:
 - a. Provide a 4-20 milliamp analog input for analog modulating valves when indicated on the Drawings.
 - b. Modulate valve to maintain position based on analog input value.
 - c. Maximum input impedance 250 ohms.
7. Analog output:
 - a. Provide an isolated 4-20 milliamp analog output when indicated on the Drawings.
8. Materials:
 - a. Construct motorized actuators of materials suitable for the environment in which the valve or gate is to be installed.
9. Components:
 - a. Motors:
 - 1) Specifically designed for valve actuator service with high starting torque, totally enclosed non-ventilated construction.
 - 2) Torque ratings equal to or greater than that required for valve seating and dynamic torques with a 25 percent factor of safety.
 - 3) Rated for operating under the following conditions without exceeding temperature limits with ambient temperature of 40 degrees Celsius.
 - a) Continuous operation for 15 minutes or twice the open-to-close operating time (whichever is greater) at normal operating torque or 33 percent of maximum torque (whichever is greater).

- b) 60 starts per hour for open/close service or 1,200 starts per hour for modulating service.
 - b. Enclosures:
 - 1) Actuator housing ratings as indicated in the Motorized Actuator Schedule.
 - 2) Stainless steel external fasteners.
 - 3) Provide the following minimum enclosure ratings:
 - a) NEMA Type 4X for outdoor, wet or corrosive area applications.
 - b) NEMA Type 7 certified by FM for Class I, Division 1, Groups C, D, E, F and G, for actuators installed in Class I, Division 1 and 2 areas.
 - c. Manual Override:
 - 1) Allen key operation.
 - d. Gearing: Hardened alloy steel spur or helical gears and self-locking, alloy bronze worm gear set:
 - 1) Accurately cut to assure minimum backlash.
 - e. Bearings:
 - 1) Anti-friction bearing with caged balls or rollers throughout.
 - 2) Sealed-for-life type thrust bearings housed in a separate thrust base.
 - f. Drive bushing:
 - 1) Easily detachable for machining to suit the valve stem or gearbox input shaft.
 - 2) Positioned in a detachable base of the actuator.
- B. Actuators for valves 4 inch and larger, and actuated gates:
 - 1. Provide actuators complete and operable with all components and accessories required for operation.
 - 2. Power supply:
 - a. Voltage and phases as indicated on the DRAWINGS and/or Valve and Gate Actuator Schedule.
 - b. Valve or gate motion independent of power supply phase rotation.
 - 3. Size actuator to move gates or valves from full open to closed position within the time indicated in the Valve and Gate Actuator Schedule:
 - a. If an operating time is not indicated on the Schedule, size the actuator to move gates or valves at minimum 12 inches per minute under maximum load.
 - b. Measure rate of closure for valves at maximum diameter of disc, plug, or ball.

4. Control interface:
 - a. Configuration:
 - 1) Provide a non-intrusive, non-contacting interface for configuring all input and output settings, control values, ranges, torque switch settings, valve positions switch settings, and options.
 - a) Configurable from a hand-held configuring tool or input devices on the actuator.
 - b. Local interface, integral to actuator:
 - 1) Selector switches:
 - a) Local-Off-Remote:
 - i. Motor actuator operation is prevented with the switch in OFF.
 - b) Open-Close:
 - i. Controls the valve when Local-OFF-Remote is in LOCAL.
 - ii. Spring return to center.
 - iii. Configurable between maintained (actuator runs until end of travel, high torque, or a local-stop-remote is switched to STOP) and momentary (actuator stops when lever is released).
 - c. Control inputs:
 - 1) Capable of using 120 VAC or 24 VDC inputs, as shown on DRAWINGS.
 - 2) Controls the valve when Local-OFF-Remote is in REMOTE.
 - 3) Isolated inputs capable of operating from external control voltage source or internal power supply:
 - a) Furnish control power supplies within the actuator.
 - 4) Provide the following inputs:
 - a) OPEN.
 - b) CLOSE.
 - c) OFF.
 - d) OPEN and CLOSE inputs configurable between maintained (actuator runs until end of travel, high torque, or a OFF input) and momentary (actuator stops when command is removed).
 - d. Status outputs:
 - 1) Monitor relay output: Dry contact, normally closed, opens when actuator is not in REMOTE or in the event of any internal fault or alarm condition.
 - 2) Dry contact outputs configured for the functions indicated on the Drawings. Provide the following outputs for all actuators:
 - a) FULLY CLOSED.
 - b) FULLY OPEN.
 - c) Local-Off-Remote in REMOTE position.
 - 3) All output contacts rated for 5 amps, 120 VAC and 24 VDC.

- e. Analog input:
 - 1) Provide a 4-20 milliampere analog input for analog modulating valves when indicated on the Drawings.
 - 2) Modulate valve to maintain position based on analog input value.
 - 3) Maximum input impedance 250 ohms.
- f. Analog output(s):
 - 1) Provide an isolated 4-20 milliampere analog outputs when indicated on the Drawings:
 - a) Loop power sourced from the actuator power supply.
 - b) Capable of driving into a load up to 500 ohms.
 - c) Output proportional to process value(s) indicated on the Drawings.
 - d) Valve or gate position.
 - e) Operating torque.

2.3 FEATURES

- A. Time delay on reversal: Incorporate time delay between stopping actuator and starting in opposite direction to limit excessive current, torque, and heating from instantaneous reversal.

2.4 MATERIALS

- A. Construct motorized actuators of materials suitable for the environment in which the valve or gate is to be installed.

2.5 COMPONENTS

- A. Motors:
 - 1. Specifically designed for valve actuator service with high starting torque, totally enclosed non-ventilated construction.
 - 2. Torque ratings equal to or greater than that required for valve seating and dynamic torques with a minimum of 25 percent factor of safety:
 - a. Design requirements for rubber-seated AWWA butterfly valves:
 - 1) Design valves and actuators for maximum operating torque, in accordance with and using safety factors required in AWWA C504 and AWWA C542:
 - a) Valve actuator torque requirement for open-close service: Not less than the required valve-seating and dynamic torques under design operating conditions in accordance with AWWA C504.
 - b) Valve actuator torque requirement for modulating service: Not less than twice the required valve dynamic torque under design operating conditions in accordance with AWWA C504.
 - b. Design requirements for slide gates, gate valves, knife gate valves, globe valves, and diaphragm valves:
 - 1) Design valves and actuators for maximum operating torque, in accordance with and using safety factors required in AWWA C542.

- 2) Design for the maximum torque and thrust running load over the full cycle.
 - 3) Maximum torque or thrust rating: The actuator stall torque or maximum thrust output shall not exceed the torque or thrust capability of the valve or gate, as determined by the valve or gate manufacturer.
 3. Capable of being removed and replaced without draining the actuator gear case.
 4. Motor bearings shall be amply proportioned of the anti-friction type and permanently lubricated.
 5. Rated for operating under the following conditions without exceeding temperature limits with ambient temperature of 40 degrees Celsius:
 - a. Continuous operation for 15 minutes or twice the open-to-close operating time (whichever is greater) at normal operating torque or 33 percent of maximum torque (whichever is greater).
 - b. 60 starts per hour for open/close service or 1,200 starts per hour for modulating service.
 6. Provide the following motor protection features:
 - a. Jammed valve (no valve motion detected through a time delay).
 - b. High motor temperature (sensed by embedded thermostats).
 - c. High torque.
 - d. Single phasing protection for 3-phase motors.
- B. Enclosures:
1. Actuator housing ratings as indicated in the Valve and Gate Actuator Schedule.
 2. Stainless steel external fasteners.
 3. Provide seals for each of the following areas:
 - a. Between the terminal compartment and the internal electrical elements.
 - b. Between the mechanical and electrical portions to protect from the ingress of oil, and to protect the mechanical components of oil from dust and moisture when the electrical terminal is open.
 4. Provide the following minimum enclosure ratings:
 - a. NEMA Type 4X for general applications.
- C. Position sensing:
1. Integral with valve actuator.
 2. Gearing: Intermittent type; bronze or stainless steel; grease lubricated; totally enclosed.
 3. Contacts: Heavy duty and silver-plated with wiping action or encoder wheel.
 - a. Remote indication contacts: As indicated on the Drawings.
 4. Switches: Adjustable; allowing for trip points from fully open to closed positions of valve travel; not subject to breakage or slippage due to over travel; permits visible verification of switch position without disassembly.
 5. Capable of retaining position and monitoring valve or gate motion when valve is manually actuated and when main power is not present.

6. Valve range and position switch outputs field adjustable.
- D. Torque sensing:
1. Capable of interrupting control circuit in both opening and closing when valve torque overload occurs.
 2. Silver-plated contacts.
 3. Graduated dials for both open and close directions of travel, each independently adjustable or 0-100 LTD display.
 4. Positive means to limit adjustability to avoid exceeding actuator output torque capability with solid-state sensor embedded within the torque transducer.
 5. Permits visible verification of switch position without disassembly.
 6. Torque shutdown setting: 40 percent to 100 percent rated torque:
 - a. Adjustable in 1 percent increments.
 7. Capable of interrupting control circuit during both opening and closing and when valve torque overload occurs.
 8. Independent of variations in frequency, voltage, or temperature.
 9. Provide a temporary inhibit of the torque sensing system during unseating or during starting in mid-travel against high inertia loads.
- E. Manual actuators:
1. Hand wheel for manual operation:
 - a. Maximum 80-pound pull on rim when operating gate or valve under maximum load.
 - b. Provide pull chain when motorized actuator is located more than 6 feet above floor surface.
 - 1) Chain shall be of sufficient length to reach approximately 4 feet above the operating level.
 - 2) Where the chain obstructs an aisle or walkway, provide holdback or other means to ensure chain does not create a nuisance or hazard to operating personnel.
 2. Declutch lever: With padlock, capable of mechanically disengaging motor and related gearing and freeing hand wheel for manual operation.
- F. Gearing: Hardened alloy steel spur or helical gears and self-locking, alloy bronze worm gear set:
1. Accurately cut to assure minimum backlash.
- G. Bearings:
1. Anti-friction bearing with caged balls or rollers throughout.
 2. Sealed-for-life type thrust bearings housed in a separate thrust base.
- H. Drive bushing:
1. Easily detachable for machining to suit the valve stem or gearbox input shaft.
 2. Positioned in a detachable base of the actuator.

- I. Lubrication:
 - 1. Provide totally enclosed actuator gearing with oil filled gear case suitable for operation at any angle.
 - a. Suitable for standard SAE80EP gear oil.
 - 2. Actuators requiring special or exotic lubricants are not acceptable.
 - 3. Provide seals for all shafts.

2.6 ACCESSORIES

- A. Setting tool:
 - 1. If required for setting or configuring the actuator, provide a hand-held setting tool.
 - a. Furnish 1 setting tool for every 10 actuators.
 - b. Capable of communicating with PC-based configuration software, and transferring the following in either direction between the computer and programmer and setting tool, and between the setting tool and actuator.
 - c. Actuator configurations:
 - 1) Capable of storing up to ten different configurations.
 - d. Diagnostic data.
 - 1) Capable of storing 4 complete sets of diagnostic data.

2.7 SOURCE QUALITY CONTROL

- A. Factory test:
 - 1. Test each actuator in the factory, and submit an individual test certificate for each actuator.
 - 2. Perform a high potential test and record the following information:
 - a. Test voltage.
 - 3. Simulate a maximum and typical valve loads and record the following information:
 - a. Current and power factor at maximum and set torque values.
 - b. Torque as measured by the actuator.
 - c. Actuator output speed or operating time.
 - 4. Performance testing: Conduct performance test for each actuator simulating valve operating torque from full-open to full-close and from full-close to full-open. The following information shall be recorded during each performance test:
 - a. Torque at maximum torque setting.
 - b. Current at maximum torque setting.
 - c. Test voltage and frequency.
 - d. Actuator output speed and operating time for full-open to full-close.
 - e. Amperage draw on motors at breakaway and under normal operation.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install actuators in accordance with manufacturer's instructions.

3.2 MOTORIZED ACTUATOR SCHEDULE

- A. Provide all actuators required by the Drawings. Major process actuators are listed in the Valve and Gate Actuator Schedule. The schedule does not include all number and types of actuators required for the Project.
- B. Abbreviations relating to type:
 - 1. BFV = Butterfly Valve.
 - 2. BV = Ball Valve.
 - 3. PV = Plug Valve.
 - 4. SG = Slide Gate.
 - 5. KGV = Knife Gate Valve.
 - 6. TSV = Telescoping Valve.
- C. Abbreviations relating to actuator type:
 - 1. O/C = Open and Close Service.
- D. Abbreviations relating to controls:
 - 1. MB = Modbus RTU (RS-485).
 - 2. NET = Manufacturer's proprietary network.
 - 3. A = Analog (4-20 mA) control, modulating duty.
 - 4. D = Discrete control, modulating duty.
 - 5. D-O/C = Discrete Open/Close.

(The remainder of this page left intentionally blank).

GENERAL NOTE FOR ALL OF SECTION 15062

Upon review of Section 15062 it was determined that this Section is an AWWA carbon steel pipe specification which is not relevant to SUEZ's scope of supply. SUEZ will supply stainless steel permeate and air header pipes which conform to SUEZ's pipe specification for stainless steel pipe. SUEZ's pipe specification can be provided upon request. As such, SUEZ takes complete exception to this section of the Specification and has not provided review nor comment.

SECTION 15062

STEEL PIPE

PART 1 - GENERAL

1.1 SUMMARY

- A. Scope:
 - 1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified, and required to furnish and install steel pipe and fittings.
 - 2. The extent of steel pipe to be provided is shown on the Drawings and in the Schedules included in Sections 15051, Buried Piping Installation, and 15052, Exposed Piping Installation.

1.2 RELATED SECTIONS

- A. Section 09900, Painting.
- B. Section 15050, Piping Systems.
- C. Section 15051, Buried Piping Installation.
- D. Section 15052, Exposed Piping Installation.
- E. Section 15066, Stainless Steel Pipe.
- F. Section 15120, Piping Specialties and Accessories.
- G. Section 15140, Supports and Anchors.

1.3 REFERENCES

- A. Manufacturer Qualifications:
 - 1. Manufacturer shall have a minimum of five years of experience in the production of steel pipe and fittings and shall show evidence of satisfactory service in at least five installations.
 - 2. Steel pipe and fittings shall be the product of one manufacturer.
- B. Reference Standards: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
 - 1. ASTM E96, Test Method for Water Vapor Transmission of Materials.
 - 2. ASME B16.5, Pipe Flanges and Flanged Fittings.
 - 3. ANSI B36.10, Welded and Seamless Wrought Steel Pipe.
 - 4. ASTM A53, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
 - 5. ASTM B209, Aluminum and Aluminum Alloy Sheet and Plate.

6. ASTM A194, Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature service.
 7. ASTM C921, Determining properties of Jacketing materials for Thermal Insulation.
 8. ASTM A234, Piping Fittings of Wrought Carbon steel and Alloy steel for moderate and high temperatures.
 9. ASTM C547, Mineral Fiber Pipe installation.
 10. ASTM A36, Carbon Structural Steel.
 11. ASTM C150, Portland cement.
 12. ASTM A193, Alloy-Steel and Stainless steel bolting for High Temperature or High Pressure service and other Special purpose applications.
 13. ASTM A307, Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
 14. AWWA C200, Steel Water Pipe 6-inches and Larger.
 15. AWWA C203, Coal-Tar Protective Coatings and Linings for Steel Water Pipelines-Enamel and Tape-Hot Applied.
 16. AWWA C205, Cement-Mortar Protective Lining and Coating for Steel Water Pipe - 4-inches and Larger - Shop Applied.
 17. AWWA C206, Field Welding of Steel Water Pipe.
 18. AWWA C207, Steel Pipe Flanges for Waterworks Service - Sizes 4-inches through 144-inches.
 19. AWWA C208, Dimensions for Fabricated Steel Water Pipe Fittings.
 20. AWWA C209, Cold-Applied Tape Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines.
 21. ASME B1.1, Unified Tech Screw Threads.
 22. ASME B16.21, Nonmetallic Flat Gaskets for Pipe Flanges.
- C. Verification of Field Conditions: Verify and, if required, correct indicated dimensions and sizes of pipe connections by field measurement prior to preparation of design drawings and fabrications of shop fabricated pipe.

1.4 SUBMITTALS

- A. Shop Drawings: Submit for approval the following:
1. Detailed Drawings and data on pipe, fittings, gaskets, and appurtenances. Submit these with Shop Drawings required under Section 15052, Exposed Piping Installation.
 2. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or

services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

3. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**

- B. Certificates: Submit Certificates of Compliance with referenced standard.
- C. Design calculations, including determination of wall thickness satisfactory for external loading, special loading, and internal pressure. The design calculations shall be signed and sealed by a Registered Professional ENGINEER licensed in the State of Arizona.
- D. Mill certificates for cement used in fabrication of piping.
- E. Test reports for rubber gaskets for the characteristics specified hereinafter.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Refer to Section 15052, Exposed Piping Installation.

PART 2 - PRODUCTS

2.1 DESIGN CONDITIONS FOR LIQUID SERVICE PIPE 24-INCHES AND LARGER

- A. Pipe and fittings shall be designed by CONTRACTOR.
- B. Design shall be in accordance with the recommended procedures in AWWA Manual M11, as complemented and modified herein. A design pressure of 150 psi for pipes larger than 16-inches and 200 psi for pipes 16-inches and smaller shall be used in equation 4-1 of AWWA Manual M11.
- C. Joints shall be welded by the CONTRACTOR per AWWA Manual M11.
- D. Thickness of pipe, fittings, and specials shall be the thicker of:
 1. The thickness designed in accordance with the design methods specified in the preceding Paragraph 2.1.B.
 2. The thickness specified in the following:
 - a. For pipes 26-inches and less in nominal diameter, not less than 3/8-inch.

- b. For pipes more than 26-inches and less than 38-inches in nominal diameter, not less than 0.5-inch.
 - c. For pipes 38-inches to and less than 56-inches in nominal diameter, not less than 5/8-inch.
 - d. For pipe 56-inches to and including 72-inches in nominal diameter, not less than 13/16-inch.
- 3. A D/t ratio (diameter over thickness) of 240.
- E. The working stress for steel used for fabrication of pipe shall not exceed 50% of the yield stress, or 18,000 psi, minimum.
- F. The laying lengths shall not be longer than 40 feet and not shorter than 20 feet, except as follows:
 - 1. Laying length of pipe shall be not longer than 40 feet.
 - 2. Short pieces shall be provided as necessary for curves, closures, and to locate fittings and specials.
- G. Longitudinal and girth seams for straight seam pipe shall be no greater in number than would be required for the fabrication of pipe with 96-inch by 120-inch steel plates.
 - 1. Longitudinal seams shall be offset at the girth seams.
- H. Where piping is designated to be flanged or welded in order to restrain thrust, the design of the cylinder and flange or welded joint shall take into account the effect of stresses caused by thrust loads.
- I. Steel cylinder shall be subjected to no more than 50% of the yield stress.
- J. Design steel pipe and welds between pipes for the axial thrust exerted by full working pressure. All joints shall be restrained.
- K. Nominal pipe diameter refers to the outside diameter for steel pipe smaller than 45-inches and the inside diameter for steel pipe 45-inches and larger. Nominal pipe diameters are prior to any coating or linings to be applied.

2.2 DETAILED REQUIREMENTS - LIQUID SERVICE

- A. Steel pipe shall be ASTM A36. Thickness class shall be as follows, except as shown on the piping schedule:
 - 1. Exposed Pipe:
 - 2. 12-inches and Smaller: Minimum 3/8-inch wall thickness.
 - 3. 24-inches and Larger: Refer to Paragraph 2.1.
- B. Material, manufacturing operations, testing and inspection of pipe shall be in conformance with applicable portions of AWWA C200.

- C. All special sections and fittings shall be made with component parts having the dimensions, ends, and other details as shown and as herein specified. All fittings shall have the same minimum wall thickness as the pipe.
- D. Galvanized steel pipe shall conform to ASTM A53, latest revision, Schedule 40 and shall be hot-dip galvanized. Fittings shall be hot-dip galvanized malleable iron.
- E. Mechanical Coupled Joints: Outside ends shall be free from surface defects and shall have welds ground to surface smooth for a sufficient distance from the end. Pipe shall be grooved for a segmental, clamp type, mechanical coupling, whose housing shall enclose a U-shaped rubber gasket. The housing shall lock pipe ends together to prevent end movement.
- F. Flanged Joints: Pipe ends shall be fitted with steel pipe flanges in accordance with AWWA C207. Flange shall be AWWA Standard steel ring type Class D. Flanges shall be attached to pipe by means of two fillet welds. Gasket shall have full face, one-piece construction of rubber, 1/16-inch thick for pipe 12-inches in diameter and smaller and 3/32-inch thick for pipe larger than 12-inches. Buried or submerged bolts and nuts shall be Type 316 stainless steel.
- G. Welded Joints: Joints shall be lap joints, unless otherwise specified. The field welding of the joints shall meet the applicable requirements of AWWAC206. Lugs shall be welded to the pipe where required for harnessing of flexible couplings. The lugs shall be as required by the manufacturer of the couplings.
- H. Threaded Joint: Steel pipe less than 4-inches in diameter shall be furnished, unless otherwise shown or specified, with threaded end and line couplings. Threads shall conform to ANSI B2.1, tapered threads 3/4-inch per foot. Use Teflon tape on threaded joints.
- I. Fittings: Fittings shall be fabricated of the same material as the pipeline of which they are a part. Unless otherwise shown or approved, all fittings shall conform to AWWA C208.
- J. Couplings:
 - 1. Sleeve Type, Flexible Couplings:
 - a. Pressure and service shall be the same as connected piping.
 - b. Materials: Steel.
 - c. Gaskets: Suitable for specified service.
 - d. Bolts and Nuts: Alloy steel, corrosion-resistant, prime coated. Buried couplings shall have Type 316 stainless steel bolts and nuts.
 - e. Harnessing:
 - 1) Harness all couplings to restrain all pressure piping.

- 2) Dimensions, sizes, spacing, and materials for lugs, tie bolts, washers, and nuts shall conform to the standards of the manufacturer for the pipe size, wall thickness, and working pressure required.
- 3) No less than two bolts shall be furnished for each coupling.
- 4) Flexible couplings for flanged steel pipe shall be harnessed with tie bolts and lugs conforming to AWWA Manual M11 "Steel Pipe Design and Installation".
- 5) Lugs shall be fabricated from steel equal to or better than that specified for the pipe to be harnessed. The lugs shall be shop welded to the pipe.
- 6) Lugs and tie bolts shall be designed for 150% of the piping system test pressure specified in Section 15051, Buried Piping Installation, and Section 15052, Exposed Piping Installation.
- 7) Tie bolts, nuts, and washers shall be ASTM A193, Grade B7, steel or better.
- f. Product and Manufacturer: Provide couplings as manufactured by one of the following:
 - 1) Dresser Industries, Style 38.
 - 2) Rockwell International Corporation.
 - 3) Or approved equal.
2. Flanged Adapters:
 - a. Pressure and service shall be the same as connected piping.
 - b. Materials: Steel.
 - c. Bolts and Nuts: Alloy steel, corrosion-resistant. Buried adapters shall have Type 316 stainless steel bolts and nuts.
 - d. Harnessing:
 - 1) Flanged coupling adapters for steel pipe shall be harnessed by using tie bolts and lugs as specified for flexible couplings.
 - e. Product and Manufacturer: Provide flanged adapters as manufactured by one of the following:
 - 1) Dresser Industries Style 128.
 - 2) Rockwell International Corporation.
 - 3) Or approved equal.
- K. Coatings and Linings:
 1. The exterior of exposed steel pipe shall receive a commercial blast cleaning according to Steel Structures Painting Council, SSPC-SP-6. Immediately after cleaning, the pipe surface shall be prime coated in the shop. Paint system shall be in accordance with the requirements of Section 09900, Painting.
 2. Where specified in Section 15052, Exposed Piping Installation, interior of pipe shall be cement mortar lined. The lining shall be shop applied and meet the applicable requirements of AWWA C205. Lining shall be twice the standard thickness.

2. Cement shall conform to ASTM C150, Type II Low Alkali.

2.3 STEEL PIPE AND FITTINGS FOR AIR SERVICE

- A. This Section of the Specification covers the steel pipe for air service. See Section 15052, Exposed Piping Installation, and Drawings locations.
- B. Steel pipe for air service (blower buildings) shall be welded Schedule 10S with standard thickness conforming to API 5LB, ANSI B36.10, and ASTM A53.
 1. Compound shall be suitable for the service and shall be provided maximum protection against corrosion and leakage. Steel pipe for air services shall not have any internal lining or coating. Steel pipe has been proposed for Centrifugal blower suction and discharge piping.
- C. Steel fittings shall conform to ASTM A234, shall be welded type, and shall be Schedule 10.
- D. Where flanged joints are required for steel pipe, faced slip-on or weld neck type flanges shall be furnished and shop welded to the pipe, special, or fittings. Flanges shall be 150 lb forged and rolled steel conforming to ASME B16.5. Flanges shall be back faced or spot faced on the back for bolt heads and nuts. Flanged bolts for use with steel flanges shall be of carbon steel conforming to ASTM A307, Grade B. Nuts shall be of the cold-pressed type conforming to ASTM A194, Grade 1. Bolts and nuts shall be threaded in accordance with ASME B1.1 for coarse thread series, Class 2 fit. Gaskets shall be 1/16-inch compressed ring conforming to ASME B16.21.
- E. The CONTRACTOR shall ensure coordination of dimensions and drilling patterns of all piping, fittings, specials, valves, and ancillary items. Nuts and bolts shall have hexagonal patterns. Diameters of flange bolts for each size of flange shall conform to ANSI Standard Specifications and the lengths shall be such that the installed projections are not less than 1/8-inch, nor greater than 3/8-inch beyond the outer nut face.
- F. Pipe and fittings shall be capable of withstanding a continuous working pressure of 150 psi at 200° F.
- G. Pipe Insulation:
 1. Glass fiber insulation shall conform to ASTM C547; rigid molded, non-combustible.
 - a. 'K' ('ksi') Value: ASTM C335, 0.23 at 75° F (0.035 at 24° C).
 - b. Minimum Service Temperature: -20° F (-28.9° C).
 - c. Maximum Service Temperature: 300° F (150° C).
 - d. Maximum Moisture Absorption: ASTM C553; 0.2% by volume maximum.
 - e. Micro-Lok manufactured by Manville, or approved equal.

2. All Service Vapor Barrier Jacket:
 - a. ASTM C921, white 35 lb Kraft paper reinforced with glass fiber yarn and bonded to aluminized film with flame resistant adhesive.
 - b. Moisture Vapor Transmission: ASTM E96; 0.02 perm.
 - c. Secure with self-sealing longitudinal laps and butt strips.
3. Fabrication Adhesive: Non-flammable, quick setting; Spark-Fas 85-20 manufactured by Foster Products Corp.; Drion 85-75 manufactured by Foster Products Corp., or approved equal.
4. Vapor Barrier Mastic Finish:
 - a. Piping Service At or Below Ambient Temperature: Single component, elastomeric coating containing Hypalon, white color, maximum 0.02 perm; Monolar 60-95 manufactured by Foster Products Corp.; or approved equal.
 - b. Piping Service Above Ambient Temperature: Water based mastic, white color, minimum 3.0 perm; Seal Fas G-P-M 3 5-00 manufactured by Foster Products Corp.; WC-5 manufactured by Vimasco Corp.; or approved equal.
5. All steel pipes to be insulated shall be wrapped with an aluminum jacket conforming to ASTM B209. Jacket shall be corrugated with a thickness of 0.016-inch sheet and fitting shall be 0.020-inch thick die shaped fitting covers with factory attached protective liner. Joining shall be longitudinal slip joints and 2-inch laps. Metal jacket bands shall be 3/8-inch wide, 0.020-inch thick aluminum. Aluminum jacket shall be manufactured by Childers or approved equal.

2.4 MARKING FOR IDENTIFICATION

- A. All pipeline materials shall be stamped, marked, or identified with the following:
 1. Name or trade mark of the manufacturer.
 2. Pipe class and specification designation.
 3. Size and length dimensions.
 4. Date and place of manufacture.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. For exposed piping installation, refer to Section 15052, Exposed Piping Installation.
- B. Buried steel piping will not be accepted.

END OF SECTION

SECTION 16160

ENCLOSURES

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. This Specification includes enclosures to house electrical controls, instruments, terminal blocks, and serve a junction boxes ~~where shown on the Drawings.~~ ✖

1.2 SUBMITTALS

- A. ~~Products shall be submitted in accordance with Section 16000, General Electrical Requirements, and elsewhere in the Contract Documents, prior to installation.~~ ✖
Section 16000 is not included in these Specifications.

- B. Shop Drawings: Submit for approval the following:

1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration. ✓
2. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.** ✖

SUEZ preventative maintenance information package is part of the SUEZ O&M Manual. O&M Manuals are submitted after approval of Shop Drawings, not as part of the Submittal Package.

1.3 MANUFACTURERS

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

PART 2 - PRODUCTS

2.1 STEEL

- A. Enclosures shall be fabricated from stainless steel with seams that are continuously welded. Doors shall have full length piano hinges with the door removable by pulling the hinge pin. ✓
- B. A rolled lip shall be provided around three sides of the door and around all sides of the enclosure opening. The gasket shall be attached with oil-resistant adhesive and held in place with steel retaining strips. Exterior hardware, such as clamps, screws, and hinge pins, shall be of stainless steel for outdoor installations. A hasp and staple shall be provided for padlocking. Each enclosure shall have a print pocket. All wires entering or leaving the enclosure shall terminate on terminal strips. All wires and terminals shall be clearly identified as specified elsewhere in these Specifications. ✓
- C. Finish shall be white enamel interior, light gray enamel, ANSI 61 exterior, over phosphatized surfaces. Special finishes and colors shall be furnished for wet locations. Drawings should be checked for special conditions. ✓

2.2 NEMA RATING

Clarification: SUEZ's Master Control Panel will be located indoors, and shall be NEMA 12. The membrane train Remote I/O Panels will be located outdoors and shall be NEMA 4X, 316 stainless steel.

- A. ~~Unless otherwise indicated on the Drawings,~~ enclosures shall be NEMA 12 for indoors and NEMA 4X for corrosive areas and outdoor installations. NEMA 4X enclosures shall be 316 stainless steel, unless noted otherwise. NEMA 4X enclosures shall also be used in wet or wash down areas. ✗
- B. ~~Hazardous locations as indicated on plans shall be Nema 7.~~ ✗

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Enclosures shall be installed ~~as indicated on the Drawings and~~ according to manufacturer's instructions. ✗ This item falls in the scope of the CONTRACTOR
- B. Enclosures shall be properly grounded and shall include ground straps connected to hinged doors and accessories. ✗ This item falls in the scope of the CONTRACTOR

END OF SECTION

SECTION 16161

CONTROL PANELS

PART 1 - GENERAL

1.1 SCOPE

- A. Contract Documents illustrate and specify functional and general construction requirements of the panel components and do not necessarily show or specify all components, wiring, and accessories required for a completely integrated system. ✓
- B. Provide all labor, materials, equipment, documentation including drawings and incidentals as shown on the Drawings, specified and required to design, furnish, install, calibrate, test, start-up, program, configure, commission and place into satisfactory operation all panels, intermediate termination panels and/or enclosures including panel components and instruments. ✗ This item falls in the scope of the CONTRACTOR
- C. Conform the design and construction of panels to the specifications herein ✗ This item falls in the scope of the CONTRACTOR
- D. For vendor packages, markup this specification for proposed control panel components against the relevant sub-section. ✓

1.2 COORDINATION

- A. Coordinate the installation of all items specified herein and required to ensure the complete and proper interfacing of all the components and systems. ✗ This item falls in the scope of the CONTRACTOR
- B. All control loops to function as ~~described in Section 17, Control Descriptions and~~ depicted on the CONTRACT DRAWINGS. ✗ Section 17, Control Descriptions, is not included in these Specifications.

1.3 DEFINITIONS

- A. Intermediate Termination Panel (ITP): An Intermediate Termination Panel is any junction box that has terminals to terminate wires and no electrical or electronic powered devices. These panels act as interim termination points for field wiring to be connected to the control systems equipment. Please note that junction boxes and pull boxes are different. ITP's are sometimes referred to as junction boxes. However, pull boxes are not allowed to have any wire splicing devices, including terminal blocks. ✓
- B. Local Control Panel (LCP): A Local Control Panel is an industrial piece of equipment that contains electrical or electronic devices, in addition to wire terminals. Typically, it is a local panel connected to a specific piece of equipment to provide control and/or monitoring of that equipment. A local control panel contains voltages of 120VAC or below. ✓

- C. Motor Control Panel (MCP): A Motor Control Panel is an industrial piece of equipment that houses components for the power distribution and starting of motors. The components may include motor starters and variable frequency drives. ✓

1.4 QUALITY ASSURANCE

- A. Reference Standards: Construction of panels and the installation and interconnection of all equipment and devices mounted within also comply with applicable provisions of the following, except where otherwise shown or specified.
1. National Fire Protection Association 79 ✓
 2. National Electrical Code (NEC) current adoption. ✓
 3. National Electrical Manufacturer's Association Standards (NEMA). ✓
 4. American Society for Testing and Materials (ASTM). ✓
 5. Operational Safety and Health Administration (OSHA) Regulations. ✓
 6. State and local code requirements. ✓
 7. Where any conflict arises between codes or standards, the more stringent requirement applies. ✓
 8. All panel devices shall bear the label of the Underwriters' Laboratory (UL), Inc. or be UL Recognized. Some products certified by UL are components that are intended to be used in the manufacture of a complete listed product. These components cannot bear the UL symbol, but may use a special Recognized Component Mark.
 - a. The UL/UR listed number shall be documented on the Bill of Materials on the drawings. ✓
 9. The assembled LCP's and MCP's are to be conformed to meet UL 508A requirements and labeling. ✓
- B. Panel to be designed, schematics drawn and assembled by the manufacturer. ✓
- ~~Utilize one of the following Panel Manufacturers: ✗~~
1. ~~Zak Controls, 4970 East Beverly Rd., Phoenix AZ 85044 (602) 267-0100.~~
 2. ~~RDC Electrical, 3411 South 44th St., Phoenix, AZ 85308 (602) 437-0760.~~
 3. ~~Keller Electrical Industries, Inc., 1881 East University Dr., Phoenix AZ 85034 (602) 437-3015.~~
 4. ~~Vertech Industrial Systems, 4409 East Baseline Rd., Phoenix, AZ 85042, Tel: (480) 756-2300.~~
 5. ~~Prime Controls LP, 1515 W University Dr #104, Tempe, AZ 85281, Tel: (480)-781-0220~~

SUEZ's panel(s) will be designed and assembled by SUEZ's panel manufacturer (local to SUEZ's Membrane Headquarters in Toronto, Ontario, Canada).

1.5 SUBMITTALS

- A. General: Reference Section 01300, Submittals
1. ~~Reference Section 01330, Submittals Procedures. ✗~~
 2. Panels shall be furnished in accordance with the requirements as shown on SUEZ's Drawings, and as specified in Division 16, Section 16050 and Division 17000, Sections 17456, 17453, 17460 and 1761. ✗
Division 16, Section 16050, and Division 17000, Sections 17456, 17453, 17460, and 1761 are not included in these Specifications.

3. Generate drawing package utilizing AutoCAD versions 2004 through 2015. If utilizing a newer AutoCAD version, submit files saved at version 2015. ✓
 4. Drawing package shall contain complete wiring and schematic diagrams, control diagrams loop drawings, a complete Bill of Material, and any other details required to demonstrate that the system has been coordinated and will properly function as a unit. Drawings shall show proposed layout, anchorage, support and appurtenances of equipment and equipment relationship to other parts of the work including clearances for maintenance and operations. ✓
 5. Submit legible hard copies of the panel drawing package printed on 11" x 17" sheets. ✓
 6. Submit manufacturer's technical data sheets and product literature for the panel and all components utilized. Clearly identify exact equipment and material that is being supplied on the manufacturer's data sheets. ✓
 7. Submit a sample nameplate with the submittal. ✓
 8. Identify general location of all conduit entry points on the Front Elevation drawing of the documentation package. ✓
 9. Submit calculations and recommended cooling and heating load requirements. ✓
 10. Utilize the Hoffman Temperature Calculation tool at: http://www.hoffmanonline.com/product_catalog/tools/index.aspx?cat_1=34&cat_2=375&SelectCatID=375&CatId=375. ✓
 11. Submit location and tube routing details for air conditioner drain line. Coordinate drain location with ENGINEER. ✓
- B. Shop Drawings: Submit for approval the following:
1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration. ✓
 2. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE**

**WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF
PREVENTIVE MAINTENANCE INFORMATION. ✓**

1.6 O&M MANUALS

- A. Comply with the requirements of Section 01730, Operation and Maintenance Data. ✓
- B. Provide an electronic copy of the panel drawing package on a separate CD. Panel Drawings are to be provided electronically in AutoCAD version 2004 through 2015. If utilizing a newer AutoCAD version, submit files saved at version 2015. ✓

1.7 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Comply with manufacturers requirements for Transportation and Handling of Materials and Equipment. ✓
- B. Comply with manufacturers requirements for Storage of Materials and Equipment. ✓
- C. Provide a hard copy of the panel drawings, size 11" x 17", inside the panel upon delivery. ✓

PART 2 - PRODUCTS

2.1 PANEL ENCLOSURES

- A. General:
 - 1. Conform panels and enclosures to the NEMA requirements as stated in Specification 16160, Enclosures. ✓
 - 2. All outdoor panels shall be provided with sunshade structures. ✓ Sunshade structures shall be constructed as shown on ~~CONTRACT DRAWINGS.~~ ✗ SUEZ's Drawings
 - 3. Sizes shown on contract drawings are estimates. Furnish panels and enclosures sized to house all equipment, instruments, front panel mounted devices, power supplies, power distribution panels, wiring and other components installed within. ✓
 - 4. Size the panel to provide ~~20%~~ spare free space capacity. ✗ 10% is SUEZ standard
 - 5. Use stainless steel fasteners throughout. ✓
 - 6. Provide interior mounting panels and shelves constructed of minimum 12 gage steel. ✓
 - 7. Provide 12"x12" print pocket in panels with a 24" or larger door. Mount on inside door where no door mounted devices are located. If there is not enough room for a 12"x12" print pocket, provide a sized pocket to fit available room. ✓
 - 8. Provide enclosure mounting supports as required for floor, frame, or wall mounting. Indoor wall mount panels utilizing stainless steel unistrut. Outdoor wall mount panels utilizing PVC-coated Unistrut. ✓

B. Construction Features:

1. General Construction Features - Provide the following convenience accessories inside of each panel.
 - a. One or more 120 VAC light fixtures with a minimum 40 watt lamp or LEDs with a snap switch for on/off control. ✓
 - b. Provide grounding studs or lugs for metal panels and doors. ✓
 - c. Provide all electrical components and devices, support hardware, fasteners, and interconnecting wiring required to make the panels and/or enclosures complete and operational. ✓
 - d. Provide oil resistant gasket completely around each door or opening. ✓
 - e. For panels located in the field or outdoors that have door mounted devices which do not meet the NEMA rating for the area, provide a window kit that includes a hinged door with a clear plastic window and an oil resistant gasket to encompass all non-NEMA rated panel instruments for this area. ✓
 - f. Provide full height doors. ✓
 - g. Provide panels with no extra holes or knockouts unless shown on ~~Contract DRAWINGS.~~ ✗ SUEZ's Drawings

C. Environment:

1. General:
 - a. Provide the following panel(s) with an air conditioner, heat exchanger or ventilation fan based on the submitted calculations for cooling and/or heating load requirements.
 - 1) As Required by cooling and/or heating calculations. ✓
 - b. Provide a heater for all panels located outdoors to maintain a minimum temperature of 68°F. ✓
 - c. Provide a separate supplementary protector for the cooling or heating equipment. ✓
 - d. Provide thermostats to automatically control heating and cooling requirements. ✓
 - e. Provide a high temperature switch, for alarm purposes, in all panels that require air conditioners, heat exchangers or ventilation fans. The contact shall be wired to alarm to the Process Control Information System. ✓
 - 1) Products and Manufacturers:
 - a) Hoffman ATEMNC. ✓
 - b) Or Equal. ✓
2. Air Conditioner:
 - a. Coordinate utilization of air conditioners with the ENGINEER. ✓
 - b. Provide an automatically controlled closed loop air conditioner with filtered and adjustable air louvers to maintain temperature inside each enclosure below the maximum operating temperature rating of the lowest rated component. ✓
 - c. Provide a condensation drain line for each air conditioner. ✓
 - d. Coordinate space requirements for maintenance. ✓
 - e. Provide NEMA 4X for outdoor locations. ✓

- f. Coat heating and cooling elements including external housing that are in contact with Plant's ambient environment with Heresite, or equal, for protection from hydrogen sulfide corrosion with hydrogen sulfide levels up to seven ppm.
 - 1) Coordinate application of coating with the ENGINEER. ✓
 - g. Product and Manufacturer:
 - 1) Hoffman (McClean). ✓
 - 3. Heat Exchanger:
 - a. Coordinate utilization of heat exchangers with the ENGINEER. ✓
 - b. Provide an automatically controlled heat exchanger to maintain temperature inside each enclosure below the maximum operating temperature rating of the lowest rated component. ✓
 - c. Coordinate space requirements for maintenance. ✓
 - d. Products and Manufacturers: 1) Hoffman. ✓
 - 4. Ventilation Fan:
 - a. Coordinate utilization of ventilation fans with the ENGINEER. ✓
 - b. Provide automatically controlled ventilation fans with filter to maintain temperature of indoor enclosures below the maximum operating temperature of the lowest rated component. ✓
 - c. Products and Manufacturers: 1) Hoffman. 2) Or Equal. ✓
 - 5. Heater:
 - a. Provide adequately sized automatically controlled 120 VAC heaters to maintain temperature inside each enclosure above 40°F to a maximum of 80°F when the outside temperature is 0°F through 40°F. ✓
 - b. Maintain a minimum four inch clearance or minimum clearance recommendations from the manufacturers from any device. ✓
 - c. Product and Manufacturer: 1) Hoffman. 2) Or Equal. ✓
- D. Identification:
 - 1. Provide laminated plastic nameplates with a white background and black lettering for identification of panels and components. ✓
 - 2. Construct nameplates with 1/16" plastic and with beveled edges. ✓
 - 3. Nameplate Mounting:
 - a. Indoor panels: Mount nameplates to the panel utilizing glue. ✓
 - b. Outdoor panels: Mount nameplates to the panel utilizing glue and with two self-sealing 1/4" stainless steel screws by APM Hexseal. ✓
 - c. Glue Product and Manufacturer:
 - 1) Gorilla Glue. ✓
 - 2) Or Equal. ✓

3) ~~Provide nameplates according to Table 2.1.C.5 and Section 3.1.B:~~ ✖

Nameplate Specifications			
Type	Size	Font	Font Size
Manufacturer Nameplate	*1½" x 6"	Arial	1/8"
Panel Nameplate	*2" x 7"	Arial	1/2"
Device Nameplate	*1½" x 2½"	Arial	3/16"

SUEZ standard nameplate design will be supplied

~~Table 2.1.C.5 Nameplate Specifications~~

~~* This is a minimum height size requirement.~~ Size nameplates large enough to display the information required to clearly identify the panel.

2.2 PANEL DEVICES

A. General:

1. Provide DIN rail mounted devices where practical. ✔
2. All devices mounted on the exterior of the panel shall match the NEMA rating of the panel. ✔

B. Internal Component Labeling:

1. Provide a device label for devices mounted inside the panel that conforms to the criteria below:
 - a. ~~Instruments: Provide label with the instrument loop number as shown on the CONTRACT DRAWINGS. Place label below the instrument on the backplane.~~ ✖ SUEZ standard labels will be provided
 - b. Supplementary Protector: Label each supplementary protector with CB and the number assigned in the supplementary protector schedule. Place label on the backplane. ✔
 - c. Fuses: Label each fuse with FU and the number assigned in the fuse schedule. Place a label on the backplane that includes the fuse number and the fuse size. ✔

- d. Control Relays: Label each relay with CR and the number assigned in the panel drawings. Place label below the relay on the backplane. ✓
- e. Terminal Strips: Label each terminal strip with the terminal strip type. (ex. TB1, TB2, ATB). Place label above the terminal block or at first terminal on the backplane. ✓
- f. Door Mounted Devices: Provide a label on the interior of the front panel door for every panel device. The label should contain the same information as shown on the front panel nameplate. Place the label below the device. ✓
- g. ~~Wireway Covers: Label wireways with the voltage that is being routed through it. For example; "24 VDC" for DC voltage or "120VAC" for AC voltage. Place label on wireway cover. Coordinate label size to fit on wireway cover. ✗ SUEZ standard wireway labels will be provided~~
- h. Identify internal components with permanent adhesive plastic labels.
 - 1) Product and Manufacturer:
 - a) Brady USA Inc. ✓
 - b) Or Equal ✓
 - 2) ~~Provide device label size and fonts per Table 2.2.B.1: ✗~~

Device	Label Size	Font Size	# Points	Brady Part #
(Wireways) 24VDC	1"x 4"	Arial	48 Points	PTL-42-422
(Wireways) 120VAC	1"x 4"	Arial	48 Points	PTL-42-422
Misc. Device Labels	1"x 1"	Arial	16 Points	PTL-19-423
Panel Door Devices	1" x 1.5"	Arial	8 Points	PTL-31-423

SUEZ standard device labels will be supplied

~~Table 2.2.B.1 Panel Interior Device Label~~

C. DIN Rail:

1. General: DIN rail is the metal rail used to mount various electrical components in a panel. ✓
2. Mount all internal components on DIN Rail. ✓
3. ~~DIN Rail for terminal blocks shall be raised DIN rail to match the height of the wireways. ✗ Not recommended. This does not match SUEZ design practices.~~
4. Product and Manufacturer, Provide one of the following:
 - a. Phoenix Contact. ✓
 - b. Or Equal. ✓

D. Control Circuit – Supplementary Protectors:

1. Provide single pole supplementary circuit protectors with the following features, 120 Volt AC, DIN rail mounted and UL 1099 listed with auxiliary contacts. ✓
2. Provide end caps, marking strips, insulated side jumpers and other accessories. ✓

3. Product and Manufacturer, Provide one of the following models where “xx” is the appropriate rating.
 - a. Phoenix Contact, TMC 1-M1-xxA. ✓
 - b. Allen-Bradley, 1492-SP1Bxxx. ✓
 - c. Idec, NRC-11-0-L-xxA-AA. ✓

- E. Air Conditioner or Heater Supplementary Protectors:
 1. Provide supplementary protectors with the following features, 120 Volt AC, DIN rail mounted and UL 489 listed with auxiliary contacts. ✓
 2. Product and Manufacturer, Provide one of the following:
 - a. Allen-Bradley, Bulletin 1489. ✓
 - b. Or Equal. ✓

- F. Control Relays:
 1. Type: General purpose, plug-in socket base type rated for continuous duty. ✓
 2. Construction Features:
 - a. Coil Voltages: 120 VAC. ✓
 - b. Contacts:
 - 1) Silver cadmium oxide rated not less than ten amperes resistive at 120 VAC or 28 VDC continuous. ✓
 - 2) For switching low energy circuits (less than 200 ma) fine silver, gold flashed contacts rated not less than three amperes resistive at 120 VAC or 28 VDC continuous shall be provided. ✓
 - 3) Number of contacts:
 - a) Minimum: Two double pole/double throw contact sets ✓
 - b) Maximum: Four double pole/double throw contact sets. ✓
 - c) Socket type to be blade. ✓
 - d) Relay Enclosure: Dust-proof plastic enclosure. ✓
 - e) Relays shall have an LED indicating lamp to show energized state. ✓
 3. Product and Manufacturer: Provide one of the following:
 - a. Type R and/or Type K, as manufactured by Square D Company. ✓
 - b. Type RH and/or Type RY, as manufactured by IDEC. ✓
 - c. Potter & Brumfield. ✓

- G. ~~Time Delay Relay:~~ ✗ Not applicable to SUEZ's scope of supply
 1. ~~Type: Dial adjustable, plug-in type time delay relay providing delay-on-make, delay-on-break one shots or interval operation.~~
 2. ~~Construction Features:~~
 - a. ~~MOS digital circuit with transformer coupled power.~~
 - b. ~~Switch selectable ranges.~~
 - c. ~~Minimum Setting: Three percent of range; except 50 ms for one second range.~~
 - d. ~~Contacts:~~
 - 1) ~~Type: DPDT.~~
 - 2) ~~Rating: Seven amps resistive at 120 VAC, seven amps at 24 VDC.~~
 - e. ~~Housing:~~

- 1) ~~Plug-in design with dust and moisture resistant molded plastic case.~~
- f. ~~Power Input: 120 VAC.~~
- 3. ~~Product and Manufacturer: Provide one of the following:~~
 - a. ~~Manufactured by Automatic Timing and Controls Company.~~
 - b. ~~Manufactured by IDEC.~~

H. Selector Switches, Pushbuttons and Indicating Lights:

- 1. General:
 - a. Selector switches, pushbuttons and indicating lights shall be supplied by one manufacturer and be of the same series or model type. ✓
 - b. Type: 30mm, Heavy duty industrial, oil tight, corrosion resistant, with interchangeable pilot lights, plug-in construction, double break silver contacts, chrome plated lock rings, and modular contacts. ✓
 - c. Mounting: Flush mounted on panel front, unless otherwise noted. ✓
 - d. NEMA rated to match panel in which mounted. ✓
 - e. Provide individual legend plates for indication of switch, pushbutton, and light function (e.g., Open, Closed, Hand-Off-Auto). A list shall be submitted for review and approval. ✓

I. Selector Switches:

- a. Type: Provide selector switches with number of positions as required to perform intended functions as shown on ~~the Drawings~~ and as specified. ✗ SUEZ's Drawings
- b. Contacts:
 - 1) Provide number and arrangement of contacts as required to perform intended functions specified, but not less than one double pole, double throw contact per switch. ✓
 - 2) Type: Double break, silver contacts with movable contact blade providing scrubbing action. ✓
 - 3) Rating: Compatible with AC or DC current with devices simultaneously operated by the switch contacts, but not less than ten amperes resistive at 120 volts AC or DC continuous. ✓
- c. Switch Operator: Standard black knob. ✓
- 2. Pushbuttons (Standard or Illuminated):
 - a. Momentary Type: Provide momentary, boot type pushbuttons as required to perform intended functions specified and shown on the Drawings. Boot color to be red for stop buttons and black for other functions. ✓
 - 1) Provide extended head pushbuttons for all stop functions. ✓
 - 2) Provide flush head pushbuttons for all other functions. ✓
 - b. Maintained Type: Provide maintained, push/pull, "Mushroom" type, red in color, to perform intended functions as specified, and as shown on ~~the drawings~~. ✗ SUEZ's Drawings
 - 1) Emergency Stop button shall be red and the base of the button shall be yellow. ✓
 - c. Contacts: Comply with the requirements specified for selector switches. ✓
 - d. Lock-out: Provide locking mechanism for all lock-out functions. ✓
- 3. Indicating Lights:

- a. Type: Compact, integral non-transformer type. ✓
- b. Lamps: 120 VAC, high-intensity LED type (20,000 hours minimum).
Indicating lights shall have clear lenses and LED lamps colored as shown on the Drawings ✓
- c. Common, push-to-test circuitry shall be provided for each panel to simultaneously test all indicating lights on the panel using a single pushbutton when there are 10 or more lights on the panel. Control panels with less than 10 lights shall utilize individual push-to-test lights and control circuitry. ✓
- d. Button and Lamp Colors:
 - 1) Red for indication of open, on, or running. ✓
 - 2) Green for indication of closed, off (ready), or stopped. ✓
 - 3) YELLOW for indication of equipment malfunction, process trouble or alarms. ✓
 - 4) White for indication of electrical control power on. ✓
- 4. Rotary Cam Switches:
 - a. Provide rotary cam switches with number of positions and poles as required performing the signal switching function specified and shown on the Drawings. ✗ SUEZ's Drawings
 - b. Contacts:
 - 1) Gold-flashed contacts housed in mechanical contact blocks with number and arrangement of contacts as required performing intended function. ✓
 - 2) Contact Rating: Compatible with AC or DC through-put current of signals and devices simultaneously operated by the switch contacts, but not less than 20 amperes at 600 VAC or 250 VDC continuous. ✓
 - c. Switch Operator: Standard black knob. ✓
- 5. Product and Manufacturer: Provide one of the following:
 - a. Square D. ✓
 - b. Allen-Bradley Co. ✓
 - c. Eaton. ✓

J. Potentiometer: ✗ Not applicable to SUEZ's scope of supply.

- ~~1. Type: Industrial potentiometer operator, direct acting, 3/4 to full turn; and standard 3-wire potentiometer.~~
- ~~2. Required Features:~~
 - ~~a. NEMA rated to match panel in which mounted.~~
 - ~~b. Resistance Range: 0 to 10,000 Ohms.~~
 - ~~c. Resistance Element: Wire wound or conductive plastic.~~
 - ~~d. Power Rating: Two watts.~~
 - ~~e. Mounting: Flush mounted on panel front, unless otherwise noted.~~
 - ~~f. Provide legend plate for indication of position (0 to 100 percent).~~
- ~~3. Product and Manufacturer: Provide one of the following:~~
 - ~~a. Square D.~~
 - ~~b. Allen-Bradley Co.~~
 - ~~c. Eaton.~~

K. Power Supply:

1. General:

- a. Panel power supply source, type, voltage, number of circuits and circuit ratings shall be as shown on ~~the Contract Drawings.~~ ~~✗~~ SUEZ's Drawings
- b. Panels shall be provided with an internal 120 VAC with number of circuits and separate supplementary protectors sized as required to distribute power to the panel components. ✓

L. 24VDC Power Supplies:

1. General:

- a. Single unit and multiple unit power supplies, located in panels, as required. ✓
- b. Single Unit Required Features:
 - 1) Solid state circuitry. ✓
 - 2) Surface mounting. ✓
 - 3) Input Power: 120 VAC, ± 10 percent, 60 Hz. ✓
 - 4) Output Power: 24 VDC or as required. ✓
 - 5) Line/Load Regulation: 0.05 percent. ✓
 - 6) Ripple: 0.25 mv RMS. ✓
 - 7) Overload Protection: Internal preset or fused. ✓

2. Product and Manufacturer: Provide one of the following:

- a. Acopian Corporation. ✓
- b. Power One. ✓
- c. Lambda. ✓
- d. Sola. ✓

~~3. If redundant power supplies are required: Provide one of the following: ✗~~

- ~~a. Lambda DPL-PU/E.~~
- ~~b. Phoenix Contact Quint-Diode/40.~~ Not applicable to SUEZ scope of supply.
- ~~c. Puls.~~
- ~~d. Or Equal.~~

M. Wire:

1. General:

- a. Provide internal wiring of Type MTW stranded copper wire with thermoplastic insulation with no nylon jacket rated for 600 V at 90°C for single conductors. ✓
- b. No utilization of Type THHN for panel wiring. ✓
- c. For DC panel signal wiring, use #16 AWG shielded minimum. ✓
- d. For AC power wiring, use #14 AWG minimum. For AC signal and control wiring, use #16 AWG minimum. For wiring carrying more than 15 amps, use sizes required by NEC and NFPA 79 Standards. ✓
- e. Identify wires at each end using heat shrink labels with permanent number codes using a Brady LS2000 Labeling System, or equal. ✓
- f. Panels conform to the wire color code as shown in Table 2.2.K.1.f Wire Color Code and NFPA 79 Standards. ✓

2. Product and Manufacturer: Provide one of the following:

- a. Carol. ✓

- b. Belden. ✓
- c. Anixter. ✓

WIRE COLOR CODE TABLE (Inside Panels)			
TYPE	FUNCTION	INSULATION COLOR	WIRE SIZE
AC POWER - HOT	120VAC	**BLACK	#14
AC POWER - NEUTRAL	120VAC	WHITE	#14
AC GROUND	120VAC	GREEN	#14
AC CONTROL	120VAC	**RED	#16
ISOLATED DC GROUND	GROUND	GREEN W/YELLOW	#16
DC POWER	SOURCE	BLUE	#16
DC POWER	COMMON	WHITE /BLUE	#16
CONTROL	FOREIGN VOLTAGES	YELLOW	#16
LOW VOLTAGE AC	24 VAC SOURCE	BROWN	#16
LOW VOLTAGE AC	24 VAC COMMON	BROWN W/WHITE	#16
*AC POWER	480 VAC PHASE A	BROWN	Size to FLA
*AC POWER	480 VAC PHASE B	ORANGE	Size to FLA
*AC POWER	480 VAC PHASE C	YELLOW	Size to FLA
TEMPORARY	TEMPORARY	PURPLE	Size to FLA

Table 2.2.K.1.f Wire Color Code *✓ For Motor Control Panels (MCP's) that are permitted to contain 480 VAC

** - Black 120 VAC wires are hot unless powered down via supplementary circuit protector. Red 120 VAC wires are hot based on the control logic state. ✓

N. Single Shielded Pair Cable:

1. Tinned copper, nineteen strand, PVC insulated conductors, No. 16 AWG minimum, twisted with aluminum-polyester shield, stranded tinned 16 AWG copper drain wire and PVC black or gray outer jacket. Wire conductor colors shall be black (-neg) and red (+pos). 600 Volt Tray Cable (TC) rated. ✓
2. Product and Manufacturer: Provide one of the following:
 - a. Belden Company (No. 9342). ✓
 - b. Okonite Company. ✓
 - c. Dekoron Wire and Cable Company. ✓

O. Wire Terminations: ✗ SUEZ's standard for wire terminations will be provided

1. ~~Terminate all field and internal component wiring using insulated ferruled connectors attached with manufacturer's recommended tool.~~
2. ~~Excessive stripping of the wire so as to allow bare wire outside the insulated ferrule is not permitted.~~
3. ~~Utilize insulated double ferruled connectors wherever two wires terminate on the same terminal block connection.~~
4. ~~Product and Manufacturer: Provide one of the following:~~
 - a. ~~Phoenix Contact – Cipline.~~
 - b. ~~Thomas & Betts.~~
 - c. ~~Weidmuller.~~

P. Terminal Blocks: ✗ SUEZ's standard for terminal blocks will be provided.

1. ~~General:~~
 - a. ~~Numerically code terminals utilizing terminal block manufacturer's marking system. Information must be printed directly on the terminal label. Sticky back labels are not permitted.~~
 - b. ~~Terminal blocks must be DIN rail mountable with screw clamp connections. Spring cage connections are not permitted.~~
 - c. ~~Double level terminal blocks are permitted for use with signals on Analog Terminal Block (ATB) only.~~
 - d. ~~Terminals used for analog signals on ATB shall be colored blue.~~
 - e. ~~Terminal block jumpers must be connected via screw clamp. Screw clamped comb jumpers are permitted. Plug in jumpers are not permitted.~~
 2. ~~Product and Manufacturer: For each terminal strip type provide one of the following:~~
 - a. ~~Power Terminal Block (PTB).~~
 - 1) ~~Phoenix Contact, Type UK 5 N, Color Gray, Model # 30 04 36 2.~~
 - 2) ~~Allen Bradley, Type 1492-J4, Color Gray, Model # 1492-J4.~~
 - 3) ~~Weidmuller, Type WSU 4, Color Dark Beige, Model # 1020100000.~~
 - b. ~~Field Wiring Discrete Signal Terminal Blocks (TB1 and TB2).~~
 - 1) ~~Phoenix Contact, Type UDK 3, Double Connection, Color Gray, Model # 27 75 37 5.~~
 - c. ~~Weidmuller, Type WDK 2.5V, Double Connection, Double Level, Internal Connection, Color Dark Beige, Model # 1905060000.~~
 - d. ~~Field Wiring Analog or Internal Wiring DC Power (ATB) - Single Level~~
- ~~Terminal Blocks:~~

- ~~1) Phoenix Contact, Type UK 3N BU, Color Blue, Model # 30 01 51 4.~~
- ~~2) Allen Bradley, Type 1492-J3-B, Color Blue, Model # 1492-J3-B.~~
- ~~3) Weidmuller, Type WDU 2.5 BL, Color Blue, Model # 1020080000.~~
- e. ~~Field Wiring Analog or Internal Wiring DC Power (ATB) - Double Level Terminal Blocks. Alternating double and single level ATB terminal blocks are permitted.~~
 - ~~1) Phoenix Contact, Type MBKKB 2,5 BU, Double Level, Color Blue, Model # 27 71 09 4.~~
 - ~~2) Allen Bradley, Type 1492-JD3-B, Double Level, Color Blue, 3) Model # 1492-JD3-B.~~
 - ~~3) Weidmuller, Type WDK 2.5 BL, Double Level, Color Blue, 5) Model # 1021580000.~~

Q. Surge Protection:

1. Provide DC surge protection with integrated varistor for all analog signal loops that are terminated to Programmable Logic Controllers. ✓
2. Provide maintenance free, self-restoring surge protection to protect the electronic instrumentation system from surges propagating along the signal and power supply lines. Device shall be removable without interrupting the circuit. ✓
3. Provide a separate surge protector for the positive and a separate surge protector for the negative polarity of each loop. ✓
4. Mount the surge protectors on the ATB. ✓
5. Ground the surge protectors to the panel DC ground bus. ✓
6. Label the surge protectors in sequential order starting with the ATB signals. ✓
7. Required Features:
 - a. Amp Rating: Compatible with working voltage and current of device being protected. ✓
 - b. Voltage Rating: Compatible with the working voltage of protected device. ✓
 - c. Reaction Time: nanosecond range. ✓
8. Product and Manufacturer: Provide one of the following:
 - a. Phoenix Contact. ✓
 - b. Advanced protection Technologies. ✓
 - c. EDCO. ✓
 - d. Or Equal. ✓

R. Wireways:

1. General:
 - a. ~~Mount wireways using stainless steel bolts. Drill and tap the sub-panel to accommodate the bolts. ✗~~ SUEZ standard materials and manufacturing will be provided.
 - b. Color to be Gray or White throughout the entire panel. Provide only one color. ✓
 - c. All wireways to include cover. ✓
 - d. ~~Wireway covers to be labeled as per section 2.2.B. ✗~~ SUEZ standard labels will be provided.
2. Product and Manufacturer: Provide one of the following:

- a. Panduit. ✓
- b. Thomas & Betts. ✓
- c. Or Equal. ✓

- S. ~~Alarms:~~ ✗ Not applicable to SUEZ's scope fo supply.
Alarms will be displayed on SUEZ's Operator Interface Terminal.
1. ~~Audible alarms shall be UL listed, 120VAC, with solid state circuitry, vibrating horn, non-metallic corrosion resistant housing, with required mounting hardware, suitable for outdoor use capable of producing 100 dB at 10 feet. The audible alarm shall be manufactured by Federal Signal model 350, Edwards Model 870-EX, or equal.~~
 2. ~~Rotating beacons for interior and/or exterior locations shall be UL listed, 120VAC, with motor and cooling fan, rotating lights at 60 times per minute minimum, capable of producing 36,000 candlepower with required mounting hardware. Lens color shall be verified at the time of construction. The rotating beacons shall be manufactured by Federal Signal Model 371L or equal.~~
 3. ~~Rotating beacons for corrosive and/or hazardous locations shall be UL listed, 120VAC, with solid state circuitry, rotating lights at 60 times per minute minimum, suitable for outdoor use capable of producing 36,000 candlepower with required mounting hardware. Lens color shall be verified at the time of construction. The rotating beacons shall be manufactured by Edwards Model 52EX, or equal.~~
 4. ~~Strobe beacons shall be UL listed, NEMA 4X, 120VAC, flashing at 80 times per minute minimum, producing peak candlepower of 520,000, effective candlepower of 165, with required mounting hardware. Lens color shall be verified at the time of construction. The rotating beacons shall be manufactured by Federal Signal model 151XST, Edwards Model 92EX, or equal.~~

- T. ~~Intrinsically Safe Barriers:~~ ✗ Not applicable to SUEZ's scope of supply.
No area classification
1. ~~Intrinsic safety barriers shall permit connection of devices located in a hazardous area to other devices located in a safe area. Intrinsic safety barriers shall be EMC compliant, 10 to 35VDC, 35mA output current, hazardous area terminals identified by blue labels, terminals accommodating conductors up to 12AWG, ambient temperature rating of -20° C to +60° C. The intrinsic safety barriers shall be manufactured by MTL Inc., Ronan Engineering Co., R. Stahl Inc., A.T.C., or equal.~~

- U. ~~Elapsed Time Meters and Time Clocks:~~ ✗ Not applicable to SUEZ's scope of supply
1. ~~Elapsed time meters shall be self powered, non-reset, solid state counter which provides silent, accurate and noise immune operation. Elapsed time meters shall require no external power, five year minimum battery life, 120VAC power, accessories for panel mounting, nameplate below LCD display reading "HOURS", liquid crystal display with 6 digits approximately 2-inches high with 50,000 hour minimum display life and indication of sufficient battery power. The elapsed time meters shall be manufactured by Durant, Automatic Timing and Controls, a Division of Sycon Corp., or equal.~~

- ~~2. Time clocks shall be microprocessor based, have 24 hour time control, up to 24 operations per day, programmable from panel face keys, skip-a-day feature allowing schedule to be skipped for one to seven days, SPDT switch contact rated at 15 amps at 120VAC, with battery carryover to maintain time and program during power outage for 275 hours. The time clocks shall be manufactured by Tork, Paragon Electric Company, or equal.~~

V. Motor Starters and Overload Relays:

- ~~1. Refer to Specification Section 16480, Motor Controllers. ✖~~
Section 16480 is not included in these Specifications.

PART 3 - EXECUTION:

3.1 EXTERIOR PANEL:

~~A. Component Layout: ✖~~

SUEZ will provide it's standard Exterior Panel Component Layout. CONTRACTOR and ENGINEER may review the Exterior Panel Component Layout during the Submittal Review process. If any changes from SUEZ's standard are required, they will be at additional cost.

- ~~1. Arrange associated control and indication devices for a particular part of the process in close proximity to each other.~~
- ~~2. Mount indicating lights above control switches and push buttons.~~
- ~~3. Standard component spacing is 3 1/2" center to center and 3 1/2" above and below. It is acceptable to use more space if required, but spatial consistency must be maintained.~~
- ~~4. Maximum height for panel exterior-mounted devices is 6'-0" from the floor. Minimum height for panel exterior-mounted devices is 3'-0" from the floor.~~
- ~~5. Locate alarm horn at the top of the panel. The alarm horn may be located above 6'-0" device height limitation.~~
- ~~6. Unless otherwise noted; route field wiring through the bottom of the enclosure. Provide watertight conduit openings.~~

~~B. Exterior Panel Nameplates: ✖~~

SUEZ will provide it's standard Exterior Panel Nameplates. CONTRACTOR and ENGINEER may review the Exterior Panel Nameplates during the Submittal Review process. If any changes from SUEZ's standard are required, they will be at additional cost.

- ~~1. General:~~
 - ~~a. Refer to Section 2.1.D for material and size requirements.~~
 - ~~b. Provide specific panel identification on nameplates derived from the contract specifications and drawings.~~
 - ~~c. Obtain ENGINEER approval for panel identification for panels that are not identified in the contract specifications and drawings.~~
- ~~2. Panel Manufacturer Identifier and Power Requirements Nameplate (NP-1):~~
 - ~~a. Mount nameplate in the upper left corner of the panel front.~~
 - ~~b. Provide the following information for each circuit feeding the panel:~~
 - ~~1) The first line indicates the name of the manufacturer, location and phone number of who assembled the panel.~~
 - ~~2) The following lines:~~
 - ~~a) Include panel voltage, current, phase, frequency, short circuit current rating for each panel feed.~~
 - ~~b) Provide switchboard name and circuit number for each circuit feeding the panel.~~

c) Refer to figure 3.1.B.2.

~~WILSON & Sons, CHANDLER, AZ 85226 - (480) 555-1234~~
~~120 VAC, 0.5 AMPS, 1Ø, 60HZ, SCCR 5KA, FED FROM LP 34, CIRCUIT 6~~
~~120 VAC, 7.5 AMPS, 1Ø, 60HZ, SCCR 8KA, FED FROM LP 34, CIRCUIT 8~~

Figure 3.1.B.2

~~Panel Manufacturer Identifier and Power Requirements Nameplate (NP-1)~~

3. ~~Panel Identification Nameplate (NP-2)~~
 - a. ~~Mount panel identification nameplate in the top, center of the panel.~~
 - b. ~~Provide the following information:~~
 - 1) ~~The first line of text is an abbreviation of the panel as shown on the CONTRACT drawings.~~
 - 2) ~~The second line of text on the nameplate is used to spell out the process abbreviation.~~
 - 3) Refer to figure 3.1.B.3.

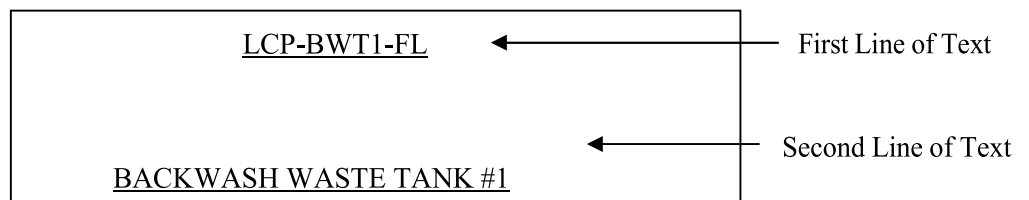


Figure 3.1.B.3

~~Panel Identification Nameplate (NP-2)~~

4. ~~Panel Component Nameplates~~
 - a. ~~Mount nameplates above all control and indicating devices.~~
 - b. ~~Provide the following information:~~
 - 1) ~~The first line indicates the instrument device loop identifier and number as shown on the DRAWINGS.~~
 - 2) ~~The second line identifies the system equipment that the component is associated with.~~
 - 3) ~~The third line identifies the control position, condition of the equipment or the alarm state being monitored.~~

4) ~~Refer to figure 3.1.B.4.~~

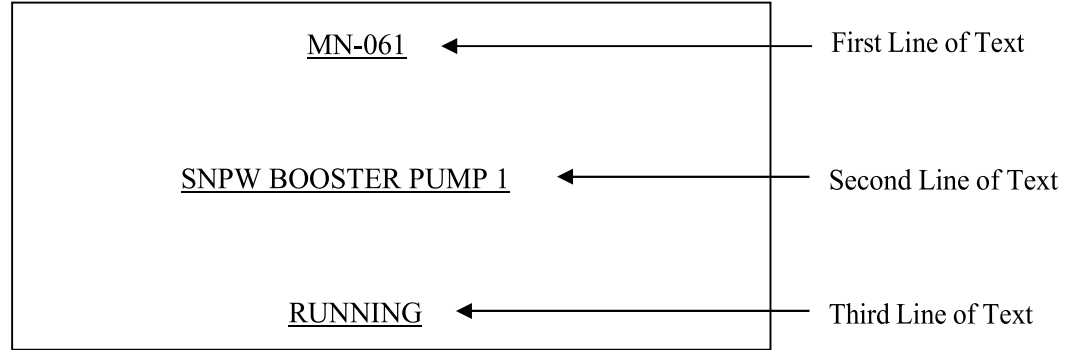


Figure 3.1.B.4
Panel Component Nameplates

3.2 INTERIOR PANEL

A. General:

1. All Wall Mounted Panels - Where conduit enters the panel, maintain a minimum of 4" clearance from any device or wireway to allow room for routing of field wiring. ✓
2. Concrete Pad or Floor Mounted LCP's and MCP's – Where conduits enter the panel through the concrete pad, maintain a minimum of 6" clearance from any device or wireway to allow room for routing of field wiring. Where conduit enters the panel sides or top, maintain a minimum of 4" clearance from any device or wireway to allow room for routing of field wiring. ✓
3. Elevated Floor Mounted LCP's and MCP's - Where conduit enters the panel, maintain a minimum of 4" clearance from any device or wireway to allow room for routing of field wiring. ✓
4. Concrete Pad, Floor Mounted or Elevated Floor Mounted ITP's - Where conduits enter the panel through the top or bottom, maintain a minimum of 6" clearance from any device or wireway to allow room for routing of field wiring. ✓
5. Locate and install all devices and components so that connections can be easily made and that there is ample room for servicing each item. ✓
6. Maintain a minimum 2'0" clearance between components mounted on side panels and components mounted on the opposing side panel. ✓
7. Components mounted on the back panel are to be unobstructed by any components mounted on side panels. ✓
8. Adequately support and restrain all devices and components mounted on or within the panel to prevent any movement. ✓

B. Panel Incoming Power:

1. Panel power fed from lighting panels, or other sources with fused or circuit breaker protection, shall be wired to the Power Terminal Blocks (PTBs). Power sources entering the panel are to be provided with a separate neutral and

ground. The PTBs shall have a separate terminal for the hot and neutral for each circuit. The ground to be terminated to the AC ground bar. ✓

2. Mount the PTBs near the top left corner of the panel. ✓
3. Multiple power sources may be required for each panel. Power requirements are identified on ~~the CONTRACT DRAWINGS.~~ ✗ The following additional power sources may be required for the panel. SUEZ's Drawings
 - a. Control Logic Power and Light Fixture. ✓
 - b. Air Conditioning. ✓
4. ~~Arrange the terminal strip in an orderly manner with circuit conductors grouped together. For instance, terminate the hot and neutral conductors on consecutive terminals. Label terminals and internal wiring as H1 and N1 (Control Logic), H2 and N2 (Air Conditioning). Identify each additional source in sequential order beginning with H3 and N3.~~ ✗
5. ~~Terminate all incoming power on one side of the terminal strip.~~ ✗

SUEZ standard control design will be provided.

C. ~~AC Power Distribution:~~ ✗

1. ~~Identify the wire extending from the PTB to the supplementary protector as H1 and H2, etc. Using H1 as an example; the wire terminated to the line side of the supplementary protector is labeled H1, the wire terminated to the load side of the supplementary protector is labeled as L1-1.~~
2. ~~If L1-1 passes through an additional supplementary protector to feed panel components, this supplementary protector can be shown on the drawings in a horizontal or vertical position on a schematic rung and the wire terminated to the line side of the supplementary protector is labeled L1-1. The wire terminated to the load side of the supplementary protector is labeled L1 (the Supplementary Protector #) and the wire color is black.~~
3. ~~If the panel controls multiple pieces of equipment, such as two pumps with separate control circuits, provide a supplementary protector for each control circuit.~~
4. ~~Powering 120 VAC field 4-wire instruments from the panel is not permitted.~~

SUEZ standard control design and labeling will be provided.

D. ~~DC Power Distribution:~~ ✗

1. ~~Mount DC power supplies near the top right of the panel. Mount fuses associated with the power supply in close proximity to the power supplies.~~
2. ~~Identify terminals used for DC power distribution as PTB-DC.~~
3. ~~Provide a fuse for each analog loop that loop power is provided by a power supply located in the panel.~~

SUEZ standard control design and labeling will be provided.

E. Grounding:

1. AC Ground:
 - a. Provide the AC ground bus bar with cage type or screw terminals installed near the bottom of the back panel with extended mounting bolts. ✓
 - b. Provide adequate metal to metal contact between the AC ground bus bar and the back plane. ✓
 - c. Connect all AC power sources and devices to ground at this ground bus. ✓
 - d. Connect all panel enclosure doors to the AC ground bus. ✓
 - e. Connect all side panels to the AC ground bus. ✓

- f. Provide a connection point on the ground bus for connection to the ground grid system. ✓
2. DC Ground:
 - a. Install the isolated DC grounding bus bar with cage type or screw terminals installed near the bottom of the back panel at a minimum distance of 6" from the AC ground bus. ✓
 - b. The isolated grounding bus bar consists of two non-conductive mounting blocks with a single copper grounding bar attached between them. ✓
 - c. Connect all shields (SH) requiring loop grounding in the panel from the analog signal terminals to the DC grounding bus bar. ✓
 - d. To avoid ground loops, connect analog cable signal shields to ground at one location only, preferably in the LCP, MCP or ITP; not in the field. Maintain consistency for the termination point of signal shield for all analog signals. ✓
 - e. Provide a connection point on the ground bus for connection to the ground grid system. ✓
 - f. Figure 3.2 illustrates a typical ground system within a panel. The illustration depicts the physical terminations of the ground wires in the panel. ✓ ~~Ground Conductor AWC size to ground grid system shall be as stated in Specification 16170, Grounding and Bonding.~~ ✗

Section 16170 is not included in these Specifications

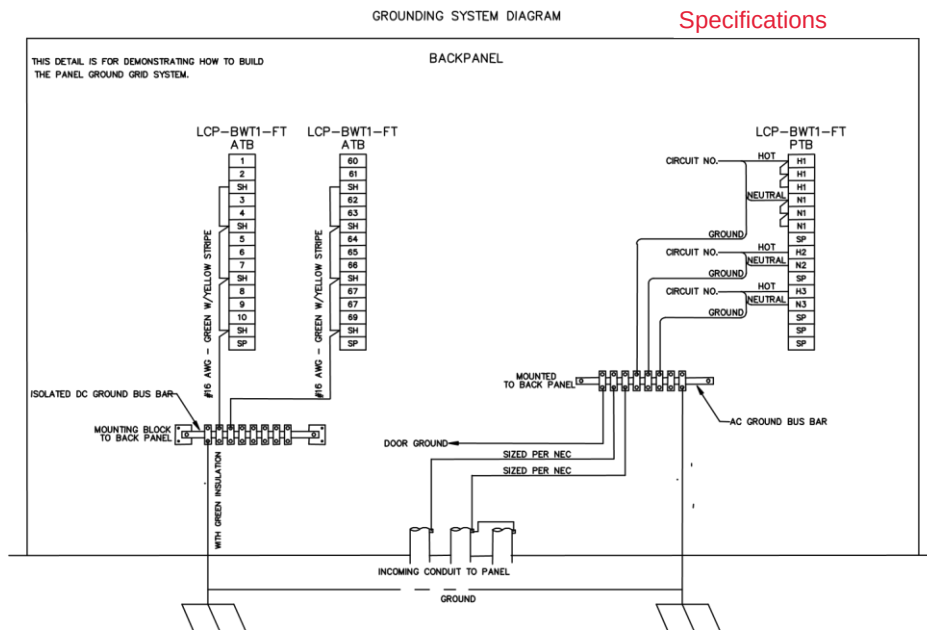


Figure 3.2 Typical Grounding Systems

F. Circuit Protection: ✗

1. ~~Provide an isolating supplementary protector for each group of control logic. For example: the start, stop and reset control circuit for Pump #1 has a dedicated supplementary protector supplying power to the control logic. Pump #2 requires a separate isolating supplementary protector for the control logic.~~

SUEZ standard control design will be provided.

- ~~2. Provide an isolating supplementary protector for each component requiring 120 VAC power.~~
- ~~3. A supplementary protector is not required for control circuits powered from a fused control power transformer in an MCP.~~
- ~~4. Size supplementary protector to handle the connected load.~~
- ~~5. Mount supplementary protector next to the PTBs near the top left corner of the panel.~~
- ~~6. Provide an auxiliary contact for each supplementary protector. Wire each auxiliary contact from the supplementary protector in series to one "Power fail" relay. Send one Power Fail status to the Process Control Information System.~~

G. Internal Panel Wiring:

1. Route all internal wiring using wireways. Terminate all internal wires on one side of the terminal blocks. The opposite side of the terminal block shall remain available for field wires. ✓
2. Where wires pass through panel walls, provide suitable bushings to prevent cutting or abrading of insulation. ✓
3. Adequately support and restrain all wiring runs to prevent sagging or other movement. Wires extended from the control logic to the panel door devices are to be wrapped in plastic protective wire wrap designed for this purpose. ✓
4. Wire splicing is not allowed at any time. ✓
5. Utilize two wires (hot and return leg) with field wiring for each field input. It is not acceptable to utilize one common Hot for multiple field inputs. ✓
- ~~6. Terminate wires with a non-insulated ferrule type crimp connector. Excessive stripping of the insulation to allow bare wire strands between the insulation and the ferrule is not permitted.~~ ✗ Not applicable
7. Orientate wire labels on the individual conductor or cable so that wire labels are legible without having to twist or move the connectors. Securely heat shrink the labels around the conductor. Label wires or cables with the number assigned in the panel documentation. Refer to Section 2.2.K.1.e for wire label materials. ✓
8. DC wiring for analog and discrete field or Process Control Information System signals that enter or leave the panel are to be terminated on the Analog Terminal Block (ATB). ✓
9. AC wiring for discrete field signals that enter or leave the panel are to be terminated on the Terminal Block 1 (TB1). ✓
10. AC wiring for discrete Process Control Information System signals that enter or leave the panel are to be terminated on Terminal Block 2 (TB2). ✓
- ~~11. The terminal blocks (TB1, TB2 or ATB) can be mounted on the left or right side panels.~~ ✗ SUEZ standard design will be applied
12. Provide a minimum of 10% spare terminal DIN rail space per terminal strip. ✓
13. Signals from the field that enter the panel and only pass through the panel from the field to the Process Control Information System require internal wiring from TB1 to TB2. ✓
- ~~14. Arrange all control wiring associated with a particular piece of process equipment together on adjacent terminal blocks.~~ ✗ Not applicable

15. Identify wire number by the schematic rung numbers. Label TB1 and TB2 terminals with the rung number associated with the internal wire number connected to the terminal. Label ATB terminals in sequential order starting with the number 1. Identify analog shield terminations with an "SH" on the terminal block. ✓
16. Multi-conductor cables of two pair or more shall have the outer cable insulation removed before entering the wireway. ✓
17. Route all DC power and analog signals at a minimum of six inches from AC power and controls. When the six inch minimum distance is not available, provide a metallic barrier that extends 3" beyond the tallest wireway between the analog and discrete wireways. ✓

H. Wireways:

1. Mount wireways from the internal panel components and terminal blocks with a minimum 2" spacing. ✓
2. ~~Arrange wireways to maintain a six inch minimum distance between analog and discrete circuit wiring.~~ ✗ Not applicable
3. Provide wireways for all field wiring. Arrange wireways to allow field wiring to enter from the top or bottom of the panel. ✓
4. Align wireways between back and side panels. ✓
5. Install a wireway on both sides of each terminal strip. ✓
6. Size wireways to prevent conductor fill from exceeding 50% of the interior cross-sectional area of the wireway. ✓
7. In addition to the above requirements, for ITP's, wireways are not to be common for two terminal strips. Each terminal strip shall have a dedicated wireway on each side of the strip. ✓

I. Control Logic:

1. The Start commands are to be designed utilizing normally open contacts from pushbuttons and/or the Process Control Information System and shall be of a momentary signal that will require a seal circuit to maintain operation. Constant signals from positions switches are not allowed unless noted on ~~the CONTRACT DRAWINGS.~~ ✗ SUEZ's Drawings
2. All system failure, safety logic control devices or normal operations that are intended to cause the equipment to stop are to be wired in series with the start seal circuit. The unsealing of the start command on any fault or normal operation that causes the equipment to stop will require another start command to reseal. ✓
3. Provide interlocks for the control functions of Local and Computer Modes in series with the Start and Stop logic. Provide a closed switch or relay contact to the Process Control Information System to identify when the equipment is in Computer Mode. ✓
4. Provide control logic of voltage ~~120 VAC.~~ ✗ 24 VDC
5. Use power relays when control relay contacts are insufficient for the designated load. ✓
6. Terminate the "Hot" conductor on the common of the switch or relay contact. ✓

7. Control alarm logic shall be wired in a fail safe mode from the field device to the panel circuitry to alarm when a field wire has failed. ✓

3.3 PANEL DRAWING DOCUMENTATION ✗

SUEZ takes exception to item 3.3.

In general SUEZ's standard panel drawing documentation meets 80 to 90% of the requirements listed in item 3.3, but there will be slight variations.

CONTRACTOR AND ENGINEER may comment on any variations from the Specifications during the Shop Drawing Submittal process.

As such, SUEZ did not review item 3.3 in detail.

A. General:

1. Files of the title block, panel symbols for front and internal sub-panel elevations, terminal strips, control schematics, analog loops, etc. are available in hard copy and AutoCAD .dwg format from the OWNER upon request through the ENGINEER via Example Panel Drawing Packages and Drawing Templates.
2. Provide drawing copies in the following format:
 - a. Hard Copy - B Size - 11" X 17".
 - b. ~~Hard Copy - D Size - 22" X 34".~~
 - c. Soft Copy in .DWG.
3. The panel drawing documentation package consists of the following drawings types arranged in the following order.
 - a. Cover Sheet.
 - a. Symbols and Legends 1 – Exterior and Interior Panel Symbols.
 - b. Symbols and Legends 2 – Schematic Symbols.
 - c. Front Panel Elevation.
 - d. Interior/Sub Panel Layout.
 - e. Terminal Strip Drawings.
 - f. Control Schematics.
 - g. Analog Loop Diagrams.
 - h. Point to Point Discrete Wiring Diagrams.
4. Drawing Scale:
 - a. Provide Front Elevation and Interior/Sub Panel Layout Drawings proportionately correct and to scale. Create all drawings on a D Size layout.
5. Border and Title Block:
 - a. Provide each drawing with a border and title block information.
 - b. Utilize the border and title block as provided in the Drawing Templates referenced in Section 3.03.A.1.

B. Panel Drawing Types:

1. General:
 - a. Provide a complete documentation package for each panel consisting of the drawings in the order listed in Section 3.03.A.3.
2. Cover:
 - a. Cover sheet for the panel documentation shall include the following information.
 - 1) Located on the left half of the sheet to include the manufacturers name, address, phone number, web address, project reference number and ul508a certification number.
 - 2) On the right half of the sheet include the following, "customer name" "department" and the project title, project number, the panel

full title, the panel abbreviation, the facility area in which the panel exists, submittal date, volume number and sheet count.

3. Symbols & Legends:
 - a. Utilize the Symbols and Legend sheets as provided by the OWNER upon request from the ENGINEER.
 - b. Additional symbols may be added if an existing symbol on the Symbol and Legend sheets does not exist.
4. Front Elevation Drawing:
 - a. The Front Elevation drawing illustrates the arrangement of the panel and position of the devices on the front face of the panel.
 - b. Provide panel dimensions in inches. Provide dimensions for height, width, and depth. If the panel is small in size, the Front Elevation Drawing and Internal layout Drawing can be combined on one drawing.
 - c. Provide the nameplate schedule on the Front Elevation drawing.
 - d. Device Callouts:
 - 1) Device callout hexagons are utilized to reference a device to the bill of materials. Place the bill of material item number inside the hexagon.
 - 2) Provide a leader from the hexagon that will point to the device.
 - 3) For a typical of multiple devices of the same type, only one device callout is necessary.
 - e. Provide air conditioning heating and cooling information as provided by the Hoffman Temperature Calculation tool at:
http://www.hoffmanonline.com/product_catalog/tools/index.aspx?cat_1=34&cat_2=375&SelectCatID=375&CatId=375.
5. Interior Sub Panel Layout:
 - a. General:
 - 1) The Interior Sub Panel Layout drawing identifies the individual interior components and their physical location.
 - 2) Draw all components within the panel to scale.
 - 3) Include all interior sub panels if the panel has sub panels on the side walls.
 - b. Provide the following information on the Interior Sub Panel Layout Drawing. Utilize the formats provided on the Drawing Templates. The information can be shown on a second sheet if needed to drawing clutter.
 - 1) Bill of Materials:
 - a) Include the devices on the Front Panel Elevation and the Interior Sub Panel(s) Elevation.
 - b) Include items that are not specifically shown on the Front Panel Elevation or the Interior Sub Panel Layout drawing, such as wire size, color and type, on the bill of materials.
 - c) The utilization or insertion of Microsoft Excel files for the Bill of Materials is not allowed.
 - 2) Fuse Schedule.
 - 3) Supplementary Protector Schedule.

- c. Label and identify all devices, including terminal strips, relays, fuses, timers, power supplies and other special components on the drawing.
 - d. For unique devices not shown on the Symbols and Legend Sheets, use rectangles and squares with the appropriate dimensions of the device.
 - e. Device Callouts:
 - 1) Device callout hexagons are utilized to reference a device to the bill of materials. Place the bill of material item number inside the hexagon.
 - 2) Provide a leader from the hexagon that will point to the device.
 - 3) For a typical of multiple devices of the same type, only one device callout is necessary.
6. Terminal Strip Drawing:
- a. General:
 - 1) Terminal Strip Drawings provides locations for wiring terminations from field devices and other equipment external to the panel.
 - 2) Display the wiring connections exactly as they are physically installed. For example, if field wiring is terminated to the left side of the terminal strip, the terminal strip drawing displays the wiring connections to the left side of the terminal block.
 - 3) There are 5 different types of terminal strips and each has a specific function. The following is a brief description of each:
 - a) For LCP's and MCP's:
 - a) Power Terminal Block (PTB) – Power supply/supplies to the panel (120 VAC or higher). Identify terminal block number with the wire number assigned in the control logic drawings. Identify power sources with the originating panel, voltage and circuit number.
 - b) Field Wiring Discrete Signal Terminal Blocks (TB1) – Discrete field inputs and outputs to/from the panel. Identify terminal block number with the rung number assigned in the control logic drawings.
 - c) Field Wiring Discrete Signal Terminal Blocks (TB2) – Discrete inputs and outputs to/from the Process Control Information System. Identify terminal block number with the rung number assigned in the control logic drawings.
 - d) Field Wiring Analog (ATB) or Internal Wiring DC Power
 - e) Terminal Blocks - Field or Process Control Information System Analog inputs and outputs to/from the panel, including 4-20 mA, 1-5 VDC, thermocouple or Resistance Temperature Detectors (RTD's). Identify terminal block number with consecutive numbers starting with number 1.
 - f) The shield wire terminal block is to be label "SH".
 - g) For ITP's:
 - i. TB-A thru Z – Discrete field inputs and outputs to/from the panel.

- ii. ATB-A thru Z – Analog inputs and outputs to/from the panel.
 - 4) It is acceptable, if space available, to combine TB1, TB2, ATB and PTB on a single terminal strip drawing.
 - 5) Identify spare terminals with an “SP” inside the rectangle.
 - 6) Display terminals in the order they appear in the panel.
 - 7) Place field wire labels on each line extending toward the terminal. Obtain this information from the cable and conduit schedules. If wire labels are unavailable, place seven “X’s” where wire tag normally resides. Provide this information prior to final deliverable of the Operations & Maintenance Manuals.
 - 8) Signal description consists of 3 lines of text. Center the text next to the terminals.
 - a) The 1st line of text lists the Equipment Name.
 - b) The 2nd line of text is for the Signal Function.
 - c) The 3rd line of text is the Signal Loop Number, if applicable.
7. Control Schematic:
- a. General:
 - 1) Control Schematics show the controls associated with pieces of process equipment and provide a visual depiction of the majority of control wiring.
 - b. Control Schematic Components:
 - 1) Power Rail:
 - a) Represent the power rail with two parallel vertical lines that extend vertically down the schematic.
 - b) Each drawing includes two sets of power rails separated by 2.5”.
 - c) Identify each power rail with the wire number such as L1 at the top and bottom of each power rail.
 - d) The left power rail represents the “Hot” side of the power source. The right power rail represents the “Neutral” side of the power source.
 - 2) Power Source:
 - a) Identify power source(s) with the originating panel, voltage and circuit number between the “Hot” terminal and “Neutral” terminal on the first rung of the portion of the schematic for each source.
 - b) Indicate the terminals from the PTB providing the source and neutral powering the rail.
 - c) A supplementary protector or fuse is displayed in the power rail directly below the power source (Hot) terminal. Label the supplementary protector or fuse with the supplementary protector or fuse number and current rating.
 - d) Power layout for LCP’s:
 - i. In the first portion of the schematic, display power to the general purpose receptacle and panel light.

- ii. In the second portion of the schematic, display power to the air conditioner and/or heater.
 - iii. In the third portion of the schematic, display the power to the control logic.
 - iv. See Sections 3.2.B Panel Incoming Power and 3.2.C AC Power Distribution.
- e) Power layout for MCP's:
 - i. The first portion is for the typical 480 VAC motor control circuit with starter and disconnect, the next sections are the same as for the LCP's.
- f) Rung Number:
- 3) Rung Number:
 - a) Rung numbers are used to identify the location and cross referencing of devices within the schematic and provide a practical means of labeling conductors and terminals within the panel.
 - b) Rung numbers are a sequential series of numbers starting with number 1. Locate the numbers vertically along the left side of the "Hot" power rail.
 - c) Rungs are to be spaced on 0.5" centers based on a D Sized drawing.
- 4) Wire Numbering:
 - a) On the downstream side of the first device on a rung, the wire number takes the rung number appearing to the left of the power rail. If a second device is located in the circuit, the wire number to the right of the second device takes the rung number, but is appended with an "A". The wire number to the right of the third device is appended with a "B", and so on.
 - b) When the electrical connection originated on the previous rung, the wire numbers continue to use the previous rung number as the base.
 - c) Connections to the power neutral rail take on the power neutral rail's wire number N#.
- 5) Electrical Connections:
 - a) Represent electrical connections as a solid small circle where two or more wires interconnect.
 - b) Represent electrical connections as a hollow small circle where wires terminate to a device.
- 6) Electrical Wiring:
 - a) Electrical wires or circuits are represented by horizontal rungs that connect terminal blocks, relays, contacts and all other components used in the electrical schematic.
 - b) Space the schematic electrical wiring every other rung at a minimum.
 - c) Identify each wire with the rung number as the wire number.

- d) Label each wire with the conductor insulation color below each electrical wire. Refer to Table 2.2.K.1.f.
 - e) Indicate electrical wiring that is external to the panel with dashed lines.
- 7) Device Labeling:
- a) Symbols in the schematic for field devices, pilot lights, switches, push buttons etc. requires two lines of text above the device and one line of text below the device to describe the usage of the device.
 - i. The first line of text above the device is the name of the equipment with which the device is associated.
 - ii. The second line of text above the device is the control function of the device.
 - iii. The line of text under the device is the loop number.
 - b) Relay and timer symbol labels are to be identified with consecutive number starting with the number 1 or the rung number. For relay coils and contacts, identify the relay base terminal connection. Normally open or normally closed contacts refer to the de-energized or “off the shelf” state.
 - c) Symbols in the schematic for contacts of relays, timers, etc. require two lines of text above the contact and two lines of text below the contact to describe the usage and coil reference of the contact.
 - i. The first line of text above the contact is the name of the equipment the device is associated with.
 - ii. The second line of text above the device is the control function of the device.
 - iii. The first line of text under the device is the relay or timer number to reference the relay or timer in the schematic.
 - iv. The second line of text under the device is the rung number of the relay or timer to reference where the relay or timer is located in the schematic. If using the rung number for the relay or timer coil, the rung number under the contact is not required.
 - v. For relays and timer contact references, at the right of the neutral power rail, the schematic rung number location of all associated contacts is shown. If the contact is normally closed, underline the reference number. If a contact is unused, “SP” is shown.
- 8) Field Contacts:
- a) Show Field Contacts connected to their respective TB1 or TB2 Terminals.
 - b) The connection lines from the contact to the terminal are dashed to designate they originate from outside the panel.
- 9) Selector Switches:

- a) Always show the switch in the far-left position, the switch contacts are shown as either opened or closed in this state. If they're in the closed state, the contact is shown closed, indicated by a line shown below and touching the two side small circles. If the contact is open in this position, a line is drawn above the two side small circles, but not touching them.
 - b) Show each position of the switch directly above its respective location on the switch. This indicates whether it is a two, three, four, or more position (pole) switch, and shows what the nameplate on each position will read.
 - c) To indicate which positions the contact is closed, show a contact legend in parenthesis below and to the right of the contact. If the contact is closed in a position, an "X" is shown in the order of the contact position in which it is closed. If the contact is open in a position, an "O" is shown.
 - d) When a selector switch is continued onto another sheet or further down on the same sheet, the continuation note is shown below the selector switch. Where the switch is continued, the same note appears, but on the top of the contact.
- 10) Push Buttons:
- a) Represent the push button contact in its "off the shelf" state.
- 11) Terminals:
- a) Terminal numbers are dependent upon the specific rung number that they appear in the schematic logic. As a horizontal electrical connection is followed from left to right, the first terminal number takes on the number of the rung. The second terminal number also takes the rung number but is appended by the letter A, the third by the letter B, and so on.
- 12) Programmable Logic Controller:
- a) Panels that contain a Programmable Logic Controller (PLC) require connection information for the PLC I/O modules.
 - i. Utilize the PLC drawings as provided in the Drawing Templates referenced in Section 3.03.A.1.
 - b) Module Layout:
 - i. Represent the module with a 1 1/2" wide vertical rectangle with a length suitable to encompass a maximum of 16 channels or 8 analog per section based on type of module.
 - ii. Two cards can be shown per sheet.
 - iii. Display field wiring (inputs) including TB1 and field device connections with a description on the left side of the module symbol.
 - iv. Label the module with model number, input voltage, rack number and slot number above the module symbol.
 - iv. Number each screw terminal per manufacturer's data.

- v. Display the associated PLC register address with each signal.
 - vi. Identify the positive and negative legs of the analog cable.
 - vii. Include all required jumpers for signal type and all 120VAC and 24VDC power requirements.
- 13) 480 Volt Equipment:
 - a) a) Provide the motor horsepower, full load amps and motor identification.
- 14) Contact Development:
 - a) The last sheet of the control schematic displays contacts for internal panel relay contacts that connect with external field equipment or the Process Control Information System (PCIS).
 - b) Organizes into two sections. The first section lists all contacts extending to the PCIS. Title this section "Contacts to PCIS". The second section lists all contacts extending into the field equipment external to the panel. Title this section "Contacts to Field". Group multiple contacts related to a single piece of equipment together.
 - c) Each contact includes a signal description and its associated relay number and relay rung number location. Device signals require the appropriate symbol from the Schematic Legend Sheet.
- 8. Analog Loop Diagrams:
 - a. General:
 - 1) The analog loop diagram only displays the portion of the instrument loop that passes through a particular panel.
 - 2) The analog loop diagram displays the connections between field instruments, panels and the PCIS.
 - 3) Analog loop diagrams are reserved for analog signals and control loops, but may be used to show complex connections for a particular instrument or device.
 - 4) Divide each loop into three different segments.
 - a) The left segment is "FIELD" connections. This segment provides information on terminations external to the panel (i.e., connected panels, instrument transmitters). If the first segment is another panel, the panel name replaces the "FIELD" label.
 - b) The center segment is the internal panel wiring and controls.
 - c) The right segment information represents output or input signals to downstream panels or the PCIS.
 - 5) Identify shield grounding location.
 - 6) Identify surge protection devices for each signal. Include surge protection for positive and negative leads. Utilize the surge protection block symbol from the legends and symbols sheet.
 - 7) Identify the cable number, wire color and polarity for each cable in the loop.

3.4 INSTALLATION

- A. Install equipment in conformance with NEC. Mounting panels on handrails is not allowed. ~~✗~~ This item falls in the scope of the CONTRACTOR
- B. Unless otherwise noted, install indoor free standing panels on 4-inch concrete pad. Extend pad 4-inches beyond outside dimensions of base, all sides. Lay grout after panel sills have been securely fastened down. ~~✗~~ This item falls in the scope of the CONTRACTOR
- C. Unless otherwise noted, install outdoor free standing panels on a reinforced concrete pedestal: ~~✗~~ This item falls in the scope of the CONTRACTOR
1. Minimum Thickness: 8-inches with No. 4 steel reinforcing bars at 12-inches on centers, each way. ~~✗~~
 2. Minimum Size: 4-inches larger than outer dimensions of base, all sides. ~~✗~~
 3. ~~Provide excavation and backfill work in conformance with Section 02260, Excavation Support and Protection. ~~✗~~ Section 02260 is not included in these Specifications.~~
 4. ~~Provide concrete work in conformance with Section 03300, Cast-In-Place Concrete. ~~✗~~ Section 03300 is not included in these Specifications.~~
 5. Seal the contact surface between the panel base along the outside perimeter of the panel using RTV sealant. ~~✗~~ This item falls in the scope of the CONTRACTOR
 6. ~~Install anchor bolts and anchor in accordance with Section 05190, Mechanically Anchoring and Fastening to Concrete and Masonry. ~~✗~~ Section 05190 is not included in these Specifications.~~
- D. Elevated Panels with floor stands:
1. 1. When installing conduits through bottom, utilize bushings to retain the NEMA rating of the panel. ~~✗~~ This item falls in the scope of the CONTRACTOR
- E. Install each item in accordance with manufacturer's recommendations and in accordance with the Contract Documents. ✓

3.5 RECORD DRAWINGS:

- A. Maintain a set of red-line panel drawings to reflect changes or deviations that occur during installation, start-up and commissioning and incorporates these deviations into the final Operation & Maintenance Manual. ✓

3.6 SPARE PARTS AND TEST EQUIPMENT

- A. Furnish and deliver the spare parts and test equipment as outlined below, identical and interchangeable with similar parts furnished under this Specification. ~~✗~~
- B. Pack spare parts in containers suitable for long term storage, bearing labels clearly designating the contents and the pieces of equipment for which they are intended. ✓
- C. The following constitutes the minimum spare parts:
1. Five of each type of control relay for each 40 or less furnished for this Contract. ~~✗~~

SUEZ's Proposal Price does NOT include spare parts except as noted in SUEZ's proposal. Any additional spare parts will be at additional cost.

2. One replacement power supply for each type and size furnished for this Contract. ✖
3. One per ten (two, if fewer than twenty) of each type of panel mounted instrument including lights and pushbuttons. ✖
4. One dozen of each type and size of fuse used in panels and instruments. ✖

- D. The following constitutes the minimum test and calibration equipment:
1. All tooling required to insert, extract and connect any internal or external connector, including edge connectors. ✖
 2. All special calibration equipment required for system calibration. ✖

SUEZ's Proposal Price does NOT include test and calibration equipment.

3.7 TESTING AND ADJUSTMENTS:

- A. Perform system testing and make any adjustments necessary in accordance with this Section and Section 17000, Instrumentation. ✖ Section 17000 is not included in these Specifications.
- B. Perform power supply, voltage adjustments to tolerances required by the appurtenant equipment. ✔

- C. A Factory Acceptance Test shall be conducted before the panel is shipped to the site.

1. ~~The Factory Acceptance test shall be witnessed by the ENGINEER and OWNER.~~ ✖
2. The Factory Acceptance Test Report shall be utilized to document the test. ✔
3. ~~All Control Panels require the Factory Acceptance Test to be witnessed by ENGINEER and OWNER.~~ ✖
4. Provide all labor, materials, equipment and incidentals as shown on the Drawings, specified and required to perform factory testing, before shipment, at the manufacturer's facility to verify that system components are functioning properly and that they meet the functional and performance requirements of the Contract Documents. ✖
5. Submit information on factory testing procedures to verify that testing shall fulfill the requirements as specified herein. ~~Submittal shall be made at least two months in advance of any scheduled testing and shall include dates of scheduled tests.~~ ✖
6. ~~Notify ENGINEER, in writing, at least four weeks before expected initiation of tests. OWNER and ENGINEER may elect to be present at CONTRACTOR'S facilities during operational test of system equipment, either for individual units or as an integrated system. Presence of OWNER and ENGINEER during testing does not relieve CONTRACTOR from conforming to the requirements of the Contract Documents and shall in no way imply acceptance of the equipment.~~ ✖

CLARIFICATION:
SUEZ's Proposal Price does not include costs associated with Factory Acceptance Tests witnessed by ENGINEER and OWNER.

If ENGINEER and/or OWNER require to be present to witness Factory Acceptance Tests of the Control Panel, all costs associated travel and living (i.e. transportation, meals, accommodations) fall in the scope of supply by others. Any costs incurred by SUEZ to accommodate Factory Acceptance Tests witnessed by ENGINEER and/or OWNER will be added to the Proposal Price.

- D. System Hardware Operational Testing:
1. All input/output devices and components shall be tested to verify operability and basic calibration. ✔

2. All system hardware components equipment shall be tested to verify proper operation of the equipment as stand alone units. Test shall include, but not be limited to, the following:
 - a. AC/DC power checks. ✓
 - b. Power fail/restart tests. ✓
 - c. Diagnostics checks. ✓
 - d. Test demonstrating that all specified equipment functional capabilities are working properly. ✓
 - e. All system components shall be tested to verify that communication between units is working properly. ✓

3.8 MANUFACTURER'S SERVICE

The factory-trained service representative will be SUEZ's Field Service Representative

- A. Provide the services of qualified factory-trained service representative to check and approve the installation of the panel(s). ✓
- B. The factory trained service representative shall be provided for installation supervision, start-up and testing services. The representative shall make a minimum of 2 visits to the site to approve the completed installation and to perform start-up testing of the equipment. The representative shall coordinate each visit with the ENGINEER prior to arrival on the site. The representative shall test operate the system in the presence of the ENGINEER and verify that the equipment conforms to requirements. ~~The representative shall revisit the job site as often as necessary until the installation and testing is entirely satisfactory.~~ ✗
- C. The factory trained service representative shall be provided for operation and maintenance personnel training services. The representative shall make a minimum of 1 visits to the site to perform the services as described under Section ~~01782~~, Operations and Maintenance Data. The representative shall coordinate each visit with the ENGINEER prior to arrival on the site. ✗
- D. For the factory trained service representative, all costs, including travel, lodging, meals and incidentals, shall be considered as included in the bid price. ✗
- E. Warranty: Standard Manufacturers ~~and General Contractor Warranties.~~ ✗

SUEZ's Proposal Price includes the number of person-days and trips as specified in Section 11500.1, item 3.3.B. Any days or trips in excess of what is stated in that specification item will be billed at prevailing rates.

The correct reference is to Section 01730, Operation and Maintenance Data

END OF SECTION

SUEZ's Proposal Price includes costs for travel, lodging, meals and incidentals for the number of person-days and trips as specified in Section 11500.1, item 3.3.B. Any days or trip in excess of what is stated in that specification item will be billed at prevailing rates.

GENERAL NOTE:

Specification Section 16225 was given to the pump manufacturer and blower manufacturer for review by their motor vendors.

This section was NOT reviewed by the air compressor manufacturer (not relevant to the compressed air system).

The pump motor manufacturer provided comments as they deemed applicable (see comments below).

The blower motor manufacturer simply stated they have provided:

Nema premium, VFD rated, 125 hp, 1800 rpm, TEFC, 460V/60HZ,

IEEE-841 Thermostat, bearing RTDs, SGR, class H insulation, class F temperature rise

ELECTRIC MOTORS 250 HORSEPOWER OR LESS

Section 16225 has not been check-marked as other sections. Only the pump motor vendor comments are included below.

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. This Section includes alternating current induction motors, 250 horsepower or less, to be provided with the driven equipment. Unless specified otherwise, electric motors shall be provided by the manufacturer of the driven equipment under an assumption of unit responsibility. This Section refers to motors by enclosure type as defined in NEMA MG 1, except as noted.

B. Horsepower Rating:

1. Motor horsepower ratings noted in individual equipment Specifications are estimates only and it is the responsibility of CONTRACTOR to furnish motors, electric circuits, and other equipment of ample horsepower capacity to operate the equipment furnished without exceeding the manufacturer's nameplate full-load current at rated manufacturer's nameplate voltage. Full-load current information shall be furnished with the individual submittals.

1.2 QUALITY ASSURANCE

- A. General:** Motors shall be built in accordance with UL 674, UL 1004, NEMA Standard MG 1, and to the requirements specified.

- B. Reference Standards:** Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified. In case of conflict between the requirements of this Section and those of the listed documents, the requirements of this Section shall prevail.

1. AFBMA 9: Load Rating and Fatigue Life for Ball Bearings.
2. AFBMA 11: Load Ratings and Fatigue Life for Roller Bearings.
3. IEEE 112: Standard Test Procedures for Polyphase Induction Motors and Generators.
4. IEEE 841, Standard for Petroleum and Chemical Industry - Totally Enclosed Fan Cooled (TEFC) Squirrel Cage Induction Motors - Up to and Including 500 HP.
5. NEMA ICS 2: Industrial Control Devices, Controllers and Assemblies.
6. NEMA ICS 6: Enclosures for Industrial Controls and Systems.
7. NEMA 250, Enclosures for Electrical Equipment (1000 volts maximum).
8. NEMA MG 1: Motors and Generators.
9. NEMA MG1-31: Application Considerations for Constant Speed Motors Used on a Sinusoidal Bus with Harmonic Content and General Purpose Motors Used with Adjustable-Voltage or Adjustable- Frequency Controls or Both.
10. UL.674: Electric Motors and Generators for Use in Class I Division I Hazardous Locations
11. UL 1004: Electric Motors.

The pump motor vendor commented that motors are built as per NEMA MG-1, IEEE841 with CSA Certification and UL listed.

C. Factory Tests:

1. The manufacturer's factory motor Prototype Tests per IEEE Standard 112 Appendix-A on motors through 250 horsepower shall be submitted as Product Data for the motor, and actual factory tests for motors are not required:
 - a. Winding resistance in ohms and converted to 25 degree C.
 - b. Resistive Unbalance and Quarter Voltage Impedance, as applicable.
 - c. Locked-Rotor current (Single phase).
 - d. High Potential.
 - e. No-Load Excitation (volts, amperes, RPM).
 - f. Bearing vibration check.
 - g. Efficiency, Power Factor, Current at 115%, 100%, 75%, 50%, and no load.

The pump motor vendor commented that Prototype test results are subject to their availability.

D. Warranty:

1. ~~Motors 1/2 horsepower and greater shall be warranted against defects in materials and workmanship for a period of 5 years under the specified uses and with normal operation and service. This warranty shall be delivered, in writing, to the Owner and shall include, as a minimum, 100 percent full payment coverage for parts and labor during the first 60 months of operation.~~

To match with all other sections of the specification, this item should read: "The motor manufacturer shall warrant the units being supplied to the OWNER against defects in workmanship and material for a period of 12 months from substantial completion, or 18 months from shipment. The warranty shall cover parts and labor and shall be in printed form. The warranty shall apply to all similar units."

1.3 SUBMITTALS

A. Submittals shall include the following:

1. Shop Drawings: Submit for approval the following:
 - a. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
 - b. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.** ✖
2. Manufacture completed IEEE Standard 841 Date Sheet for AC Squirrel Cage Induction Motors with required factory data of motors supplied.
3. Speed-Torque curve per 1.2 C Factory Tests.

SUEZ preventative maintenance information package is part of the SUEZ O&M Manual. O&M Manuals are submitted after approval of Shop Drawings, not as part of the Submittal Package.

4. Factory Test Data: Including Guaranteed Minimum Efficiency for 115% load, 100% load, 75% load, 50% load, and no load.
5. Guaranteed vibration level when measured per MG 1, Figure 7-6:
 - a. Displacement: 0.0025 inch peak-to-peak
 - b. Velocity: 0.10 inches per second peak
 - c. Acceleration: 1g (gravity) peak.
6. Motor heating curve for motors per 1.2 C Factory Tests.
7. Motor outline, dimensions, and weight.
8. Manufacturer's descriptive information relative to motor features.
9. Response curve where a winding over-temperature device is required.
10. For all inverter duty motors: Manufacturer's certification that the motor is compatible with the adjustable frequency drive to be used.
11. Disassembly and repair documentation.

1.4 POWER SUPPLY VARIATIONS

- A. Motors shall operate successfully under running conditions at rated load with +/- 10-percent of rated voltage with rated frequency or +/- 5-percent of rated frequency with rated voltage.

1.5 AMBIENT CONDITIONS

- A. Unless specified otherwise, motors shall be suitable for continuous operation at an elevation of approximately 1,200 feet above mean sea level. Motors to be installed outdoors, exposed to the weather, shall be suitable for continuous operation in a 50° C ambient temperature; motors to be installed indoors shall be suitable for continuous operation in 50° C ambient temperature, unless otherwise noted.

1.6 NEMA WINDING TEMPERATURES

- A. NEMA MG 1 Table 12-7 motors insulation system maximum winding temperatures in degrees-Centigrade (C), with the degrees-Fahrenheit (F) insulation system class specified herein.
 1. Forty degree-C ambient (104 degree-F) is the basis for temperature rise.
 2. For 50 degree C ambient (122F) and above, refer to the driven equipment specifications for additional requirements.

Insulation System Class	Degrees C / F	Temperature Rise by Resistance
A	140 / 284	NA
B	165 / 329	B-rise: 40 + 80 = 120 Degrees C / 248 F
F	190 / 374	F-rise: 40 + 105 = 145 Degrees C / 293 F
H	215 / 419	H-rise: 40 + 125 = 165 Degrees C / 329 F

1.7 NEMA MOTOR TEMPERATURE PROTECTION TYPES

- A. The NEMA design shall limit the temperatures of the windings without using a thermal device:
 - 1. Type-1: Winding Running and Locked Rotor Over-temperature Protection.
 - 2. Type-2: Winding Running Over-temperature Protection.

PART 2 - PRODUCTS

2.1 MANUFACTURER'S NAMEPLATES

- A. Factory installed manufacturer's nameplates shall be stainless steel with embossed or pre-printed lettering and fastened to the motor frame with Type 316 stainless steel pins. Manufacturer's nameplates shall have stamped on them the motor manufacturer's name, design voltage; number of hertz and phase; horsepower rating; amperage and temperature rise at rated load, full load speed, NEMA code letter, service factor, minimum guaranteed efficiency, model number, AFBMA bearing number, serial number and maintenance manual number in accordance with NEMA MG1-10.40.1.
- B. A separate factory installed manufacturer's nameplate shall provide lubrication instructions and a separate manufacturer's nameplate connection diagram for dual voltage motors.
- C. Additionally, factory to provide the following information on manufacturer's nameplates or additional manufacturer's nameplates for:
 - 1. Motors 1/2 horsepower and larger: Indicate the ABMA L-10 rated life for the motor bearings.
 - 2. Motors 2 to 50 horsepower: Indicate the NEMA nominal efficiency.
 - 3. Motors 50 horsepower and larger: Indicate NEMA guaranteed minimum efficiency.
 - 4. Explosion-Proof motors: Indicate UL frame temperature limit code.
 - 5. Space heater information.
 - 6. NEMA MG 1 Over Temperature Protection Type Number.

2.2 CONSTRUCTION

- A. Unless specified otherwise, all motors provided under this Section shall have the following features of construction and operation:
 - 1. Motor voltage, speed and enclosures are specified in the detailed equipment Specifications. Motors furnished with equipment shall comply with this Section.
 - 2. All motors shall be of the motor manufacturer's premium energy-efficient design, different from manufacturer's standard product through the use of premium materials, design and improved manufacturing process that reduces motor losses approximately 40 percent from standard efficient designs.
 - 3. Motor efficiency shall be determined in accordance with NEMA Standard MG1-12.54.1 and guaranteed minimum full load efficiency labeled on manufacturer's motor nameplate in accordance with NEMA Standard MG1-12.54.2 or MG1-10.40.1 below.
 - 4. Minimum efficiencies shall not be less than those listed in Paragraph 2.4.E., below.

5. All motors shall successfully operate under power supply variations in accordance with NEMA MG1-14.30.
6. All motors shall be NEMA Design B with torque and starting currents in accordance with NEMA MG1-12.35 and 12.37, except in special applications requiring higher starting torques where NEMA Design C is permitted.
7. All motors shall have a 1.15 service factor. Polyphase integral horsepower motors shall be sized so that, under maximum load conditions imposed by the driven equipment, for the conditions specified, the manufacturer's motor nameplate rated horsepower and Class B temperature rise will not be exceeded. Motors with a service factor of 1.15 shall be selected for operation within their full load rating without applying the service factor.
8. Each motor shall be of the speed and horsepower specified or required to properly operate the driven equipment, torque characteristics as required by the drive load and suitable for direct coupling or V-belt drive, as shown on the Drawings and specified herein. Motors shall be designed for full voltage starting, unless otherwise specified.
9. Frames shall be of corrosion-resistant cast iron with integrally cast feet or bases. End bells, conduit box and cover and bases shall be cast iron, with precision machined bearing fits, ASTM Type A-48, Class 25 or better. UL approved automatic stainless steel breather drains shall be provided in the lowest part of front and back brackets to allow drainage of condensation on TEFC and explosion proof motors.
10. Each stator core assembly shall consist of stacked lamination made from specially selected electrical sheet silicon steel.
11. Insulation materials shall be non-hygroscopic and meet or exceed Class H definition, utilizing materials and insulation systems evaluated in accordance with IEEE 117 classification tests. Motor temperature rating shall not exceed Class F temperature limits as measured by resistance method when the motor is operated at full load at 1.0 service factor continuously in a maximum ambient temperature of 50° C. Windings shall be copper.
12. Rotor cages for motors 50 HP or less shall be die cast aluminum or fabricated copper. Shafts shall be made from carbon steel. Rotor cages for motors larger than 50 HP shall be copper only.
13. Rotors on frames 213T and above shall be keyed shrunk or welded to shaft and rotating assembly dynamically balanced to NEMA limits in accordance with MG1-12.06. Balance weights, if required, shall be secured to the rotor resistance ring or fan blades by rivets. Machine screws and nuts are prohibited. The entire rotating assembly between bearing inner caps shall be coated with a corrosion-resistant epoxy.
14. Bearings shall be ball, open, single row, deep groove, Conrad type, and shall have a Class 3 internal fit conforming to AFBMA Std. 20. For belted duty applications, drive end bearing may be cylindrical roller type. Bearings shall be selected to provide L-10 rating life of 100,000 hours minimum. Calculations shall be based on external loads using NEMA applications limits in accordance with MG1-14.41 and typical sheave weights and internal loads defined by the manufacturer, including magnetic pull and rotating assembly weight.
15. Bearing temperature rise at rated load shall not exceed 60° C. Temperature rise shall be measured by RTD or thermocouple at bearing outer race. Bearing AFBMA identification number shall be stamped on manufacturer's motor nameplate.

The pump motor vendor commented that they provide die cast aluminum rotors for both lines

The pump motor vendor commented that their rotors will be assembled as per their standard procedures and design

The pump motor vendor commented that bearing life is subject to load, mounting and coupling data.

Pump motor vendor states that they have provided their standard paint, which is not USDA approved. Paint specification can be provided to the CONTRACTOR and ENGINEER for review.

16. Motor lubrication system shall consist of a sealed bearing or a grease inlet on motor bracket with capped grease fitting on inlet, grease relief plug 180 degrees from inlet, grease reservoir in bracket and grease reservoir in cast inner cap. Motor shall be greased by manufacturer with a premium moisture resistant polyuria thickened grease containing rust inhibitors and suitable for operation over temperatures from -25° C to 120° C.
17. All bolt and cap screws shall be of high strength, SAE Grade 5 zinc-plated and chromatic steel. Screwdriver slot fasteners are unacceptable.
18. All motor parts including frame, brackets, fan cover and terminal box shall receive a minimum of two coats of high grade USDA accepted epoxy paint. Motor assembly shall successfully withstand salt spray tests for corrosion in accordance with ASTM B-117 for 96 hours.
19. All motors shall be painted the same color as the driven equipment.
20. Two-speed motors shall be two-winding motors. Two-speed, one-winding consequential-pole motors that require special motor starters are prohibited.

2.3 MOTORS LESS THAN 1/2 HORSEPOWER Not Applicable to this project.

A. General:

- ~~1. Unless otherwise specified, motors less than 1/2 horsepower shall be squirrel cage, single phase, capacitor start, induction run type. Construction features listed in Paragraph 2.2, above, shall be as normally supplied by the equipment manufacturer. Single phase motors shall have Class B insulation, minimum. Small fan motors may be split-phase or shaded pole type. Windings shall be copper.~~

B. Rating:

- ~~1. Unless otherwise specified, motors shall be rated for operation at 115 volts, single phase, 60 Hz, and shall be continuous time rated in conformance with NEMA Standard MG 1, Paragraph 10.35. Dual voltage (115/230) rated motors are acceptable if all leads are brought out to the conduit box. Motors shall be non-overloading at all points of the equipment operation.~~

C. Enclosures:

- ~~1. Unless otherwise specified, motors shall have totally enclosed fan cooled or totally enclosed non-ventilated enclosures.~~

2.4 MOTORS 1/2 HORSEPOWER THROUGH 250 HORSEPOWER

A. General:

1. Unless otherwise specified, motors 1/2 horsepower through 250 horsepower shall be three phase, squirrel cage, full voltage start induction type. Unless otherwise specified, motors shall have a NEMA MG 1-1.16 design letter B or C torque characteristic as required by the driven equipment's starting torque requirements.

B. Rating:

1. Unless otherwise specified, motors shall be rated for operation at 460 volts, 3 phase, 60 Hz, and shall be continuous time rated in accordance with NEMA Standard MG 1, Paragraph 10.35.

2. Motors for variable frequency systems shall not be required to deliver more than 80 percent of the motor's service factor rating by any load imposed by the driven machine at any specified operating condition or any condition imposed by the driven machine's performance curve at maximum operating speed.

C. Enclosure and Insulation:

1. General: Motors shall be classified as Type 1 (Process) and Type 2 (Explosion proof). Enclosures and insulation systems shall be as specified in the following paragraphs. Temperature rise for all motor types shall not exceed that permitted by Note II, Paragraph 12.42, NEMA MG 1. The insulation shall be non-hygroscopic.
 - a. Type 1 Motors (Process): Type 1 motors shall be premium energy efficient motors, totally enclosed, fan cooled. All motors shall have Class H insulation with Class B temperature rise. Motors shall conform to IEEE 841. All internal surfaces shall be coated with an epoxy paint. Motors shall be rated for corrosive atmosphere duty.
 - b. Type 2 Motors (Explosion proof): Explosion proof motors shall be UL listed in accordance with UL 674 for Class I, Group D hazardous atmospheres. The motor shall have Class H insulation and shall conform to IEEE 841. Steel frame motors will not be permitted. A UL-approved Type 316 stainless steel breather/drain device shall be provided in the motor drain hole. The motor shall be provided with a frame temperature thermostat which meets the UL frame temperature limit code T2A (280°C). The thermostat shall contain an automatically reset, normally closed contact rated two amperes at 115 volts AC.

D. Motors for Variable Frequency Drives:

1. Motors intended for use with variable frequency drives shall be compatible with the characteristics of the intended variable frequency inverters. Motors shall be Type 1 or Type 2 as specified in the detailed Specification. Insulation for all motors operating with variable frequency drives shall be Class H with Class F temperature rise. Variable frequency drive motors shall be premium energy-efficient motors. Motors shall be capable of withstanding a pulse voltage of at least 1750 volts with a rate of rise up to 750V/micro second. The motors shall be certified by the manufacturer as suitable for inverter duty.
2. All motors connected to variable frequency drives shall be equipped with shaft grounding rings. Shaft grounding devices must be factory installed or installed by a reputable motor shop with the expertise in the proper installation of the devices. If the shaft grounding devices are not factory installed, a third party shall be engaged to test the installation to ensure no damaging shaft currents are present.

- E. Minimum Manufacturer's Nameplate Efficiency: Motor minimum manufacturer's nameplate efficiency, determined in accordance with IEEE 112B testing procedures, when operating on a sinusoidal power source shall conform to the following:

HORSEPOWER RANGE	SPEED, RPM		
	1200	1800	3600
1-2	82.5	84.5	82.5

3-5	89.5	88.5	86.5
7-25	90.2	90.2	89.5
30-60	92.4	92.4	89.8
75-250	94.1	93.7	91.7

~~F. Vertical Motors:~~

- ~~1. Unless otherwise specified, vertical motors shall be full voltage with a Type P base specifically designed for vertical installation. Universal position motors are not acceptable. Vertical motors shall have solid shafts, unless otherwise specified. Vertical motors shall conform to either Type 1 or Type 2 motor requirements as specified under Paragraph 2.4.C., above. Thrust bearing rating shall be compatible with the loads imposed by the driven equipment.~~ Not applicable to this project.

G. Conduit Boxes:

1. CAUTION: External conduit boxes on motors shall be sized to accommodate oversized feeder conductors and as shown on the Drawings shall, in any case, not be less than one size larger than NEMA standards. The conduit boxes shall be diagonally split and rotatable in 90 degree steps. A gasket shall be furnished between the conduit box and frame. Motor leads shall be stranded copper wire, Class H or better insulated, non-wicking, with permanent identifications spaced 1-1/2-inches maximum. Clamp type grounding terminals shall be provided in the conduit boxes.

H. Lifting Eyes:

1. Motors weighing more than 50 pounds shall be fitted with at least one lifting eye.

I. Current Imbalance:

1. Current imbalance shall not exceed the values tabulated below when the motor is operating at any load within its service factor rating and is supplied by a balanced voltage system.
 - a. Under five horsepower: Ten percent
 - b. Five horsepower and above: Ten percent
2. Imbalance criteria shall be based upon the lowest value measured.

2.5 MOTOR TYPES

A. The following Standard motor types shall conform to the following requirements:

1. Horizontal Dripproof: Provide horizontal motors with an enclosure that meets NEMA Standard MG 1 for open, dripproof construction. Provide screen over all air openings.
2. Horizontal Totally Enclosed Fan-Cooled: Provide totally enclosed fan-cooled (TEFC) motors with frame sizes 182 and larger with cast iron frames and end shields. Smaller frame sizes may be constructed of rolled steel with cast metal end shields. Provide motors with condensate drain holes. For frame size 286 and larger, provide automatic breather/drain device in drain hole.

3. Vertical Weather Protected Type I: Provide vertical motors with an enclosure that meets NEMA Standard MG 1 for weather protected Type I (WP-I) enclosure. Provide screens over all air openings.
4. Vertical Totally Enclosed Fan-Cooled: Provide vertical motor with an enclosure identical to the requirements for the horizontal TEFC motors.
5. Explosion proof: Provide all horizontal and vertical motors with TEFC explosion proof enclosures, UL listed for Class 1, Division 1, Group D hazardous atmosphere.
6. Submersible: Submersible motors UL listed for explosion proof atmospheres in accordance with subsequent sections of this specification. In addition, provide submersible motors with two mechanical seals; the lower one outside the motor and protecting the upper one, which is in an oil filled chamber. Provide moisture detector probes in the oil filled seal chamber to indicate the presence of moisture in the seal chamber. Provide a temperature detector and switch rated 3 amperes, 120 volts minimum, set to operate when the internal motor temperature exceeds a preset limit. Provide any relays or solid state controls for separate mounting.
7. Horizontal, Totally Enclosed, Fan-Cooled, Severe Duty: Provide horizontal (TEFC), severe duty motors suitable for contaminated environments, including gasketed conduit box, stainless steel drains, double-shielded bearings, and corrosion resistant paint. Provide motors manufactured by Reliance Electric SXT-XT-XE, Century Type SCE E-Plus, or equal.
8. Vertical, Totally Enclosed, Fan-Cooled, Severe Duty: Provide vertical (TEFC), severe duty motors with the requirements identical to horizontal (TEFC), severe duty motors, above.

2.6 PRODUCT DATA

- A. The following information shall be provided for each motor in accordance with the individual equipment specification.
 1. Motor outline, dimensions and weight.
 2. Manufacturer's general descriptive information relative to motor features.
 3. Where a winding over-temperature device is required, provide a response curve for the temperature device.
 4. Applicable operation and maintenance information specified in Section 01730, Operation and Maintenance Data. Provided overhaul instructions for each motor five HP and over.

2.7 ACCEPTABLE PRODUCTS

- A. The following manufacturer's motors generally meet the class and performance requirements of this specification when furnished with appropriate modifications and additional features as specified:
 1. General Electric Inc.
 2. Emerson US Motors.
 3. Siemens.

The Process and CIP pump motors proposed for this project are from WEG.

PART 3 - EXECUTIONGROUNDING AND BONDING

- A. Verify the circuit ground cable (green) is identified and connected to the grounding lug terminal in the conduit box.
- B. Provide supplementary grounding by installing a bond from the motor frame to the grounding electrode system as indicated on the drawings.

4.2 FIELD TESTING

- A. Verify breather/drain fittings have been installed as specified herein.
- B. Provide winding insulation resistance testing for motors to be witnessed by owner or engineer before connection is complete. Winding insulation resistance shall be not less than 10-megohm measured with a 1000-VAC megohmmeter at 1-minute at or corrected to 40-degree C.
- C. Provide motor phases current imbalance testing to be witnessed by owner or engineer.
- D. Test motors in accordance with ~~Specification 16920, Electrical Acceptance Testing.~~
Section 16920 is not included in these Specifications

END OF SECTION

SECTION 16481

MOTOR CONTROL CENTERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 1, General Requirements, Specification Sections apply to this Section.

1.2 SUMMARY

- A. This Section includes new motor control centers for use on AC circuits rated 600 VAC.
- B. This section also includes modifications to existing motor control centers rated 600VAC.

1.3 SUBMITTALS

- A. Product Data: For each type of controller and each type of motor control center. Include dimensions and manufacturer's technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each motor control center.
 - 1. Dimensioned Plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings. Include the following:
 - a. Each installed unit's type and details.
 - b. Nameplate legends.
 - c. Short circuit current ratings of buses and installed units.
 - d. Vertical and horizontal bus capacities.
 - e. UL listing for series rating of overcurrent protective devices in combination controllers.
 - f. Features, characteristics, ratings, and factory settings of each motor control center unit.
 - 2. Wiring Diagrams: Power, signal, and control wiring for class and type of motor control center. Differentiate between manufacturer-installed and field-installed wiring. Provide schematic wiring diagram for each type of controller.
 - 3. Submit for approval the following:
 - a. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification

compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

- b. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**
- C. Manufacturer Seismic Qualification Certification: Submit certification that motor control centers, accessories, and components will withstand seismic forces defined for the site.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event".
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- D. Qualification Data: For firms and persons specified in Paragraph 1.4 of this Specification.
- E. Field Test Reports: Written reports specified in Part 3 of this Specification.
- F. Manufacturer's field service report.
- G. Maintenance Data: For motor control centers, all installed devices, and components to include in maintenance manuals specified in Division 1, General

Requirements. In addition to requirements specified in Section 01700, Contract Closeout, include the following:

1. Routine maintenance requirements for motor control centers and all installed components.
 2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
- H. Load-Current and Overload-Relay List: Compile after motors have been installed and arrange to demonstrate that selection of heaters suits actual motor nameplate full-load currents.
- I. Arc Flash Hazard Survey and appropriate labeling shall be done on all circuits 300 volts and above.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Maintain, within 100 miles of Project site, a service center capable of providing training, parts, and emergency maintenance and repairs.
- B. Source Limitations: Obtain controllers of a single type through one source from a single manufacturer.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. Comply with NFPA 70.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver motor control centers in shipping splits of lengths that can be moved past obstructions in delivery path as indicated.
- B. Handle motor control centers according to NEMA ICS 2.3, "Instructions for the Handling, Installation, Operation, and Maintenance of Motor Control Centers", use factory-installed lifting provisions.
- C. Store motor control centers indoors in clean, dry space with uniform temperature to prevent condensation. Protect motor control centers from exposure to dirt, fumes, water, corrosive substances, and physical damage.
- D. If stored in areas subjected to weather, cover motor control centers to protect from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside controllers; install electric heating of sufficient wattage to prevent condensation.

1.6 PROJECT CONDITIONS

- A. Existing Utilities: Do not interrupt utilities serving facilities occupied by OWNER or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
 - 1. Notify construction manager at least two days in advance of proposed utility interruptions. Identify extent and duration of utility interruptions.
 - 2. Indicate method of providing temporary utilities.
 - 3. Do not proceed with utility interruptions without Construction Manager's written permission.

1.7 COORDINATION

- A. Coordinate layout and installation of motor control centers with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Section 03300, Cast-In-Place Concrete.
- C. Coordinate features of motor control centers, installed units, and accessory devices with pilot devices and control circuits to which they connect.
- D. Coordinate features, accessories, and functions of each motor control center, each controller, and each installed unit with ratings and characteristics of supply circuit, motor, required control sequence, and duty cycle of motor and load.

1.8 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Spare Fuses: Furnish one spare for every two installed, but not less than one set of three of each type and rating.
 - 2. Indicating Lights: Two of each type installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products from the following:
 - 1. Eaton.

2. Square D Company.
3. Allen-Bradley.

2.2 MOTOR CONTROL CENTERS

- A. Wiring: NEMA ICS 3, Class I, Type B.
- B. Enclosures: Flush- or surface-mounted cabinets as indicated.
 1. Outdoor Locations: NEMA 250, Type 3R, provide intrusion switches on all sectional doors.
 2. Indoor Locations: NEMA Type 1A enclosure.
 3. Compartments: Modular; individual doors with concealed hinges and quick-captive screw fasteners. Interlocks on combination controller units requiring disconnecting means in OFF position before door can be opened or closed, except by operating a permissive release device.
 4. Interchangeability: Compartments constructed to allow for removal of units without opening adjacent doors, disconnecting adjacent compartments, or disturbing operation of other units in motor control center. Interchangeability of units requiring the same size compartment and constructed to permit ready rearrangement of units, such as replacing three single units with a unit requiring three spaces, without cutting or welding.
 5. Wiring Spaces: Wiring channel in each vertical section for vertical and horizontal wiring to each unit compartment; supports to hold wiring in place.
- C. Short Circuit Current Rating for Each Section: Greater than indicated available fault current in symmetrical amperes at motor control center location or that required by power utility, whichever is greater.

2.3 BUSES

- A. Material: Tin-plated copper, 98% conductivity.
- B. Ampacity Ratings: As indicated on the Drawings for horizontal busses, 300 amperes minimum for vertical buses.
- C. Neutral Buses: Full size.
- D. Equipment Ground Bus: Non-insulated, horizontal copper bus, 2-inches by 1/4-inch, minimum.
- E. Horizontal Bus Arrangement: Main phase, neutral and ground buses extended with same capacity the entire length of motor control center, with provision for future extension at both ends by bolt holes and captive bus splice sections or equivalent.

2.4 FUNCTIONAL FEATURES

- A. Description: Modular arrangement of controllers, control devices, overcurrent protective devices, transformers, panelboards, instruments, indicating panels, blank panels, and other items mounted in compartments of motor control center.
- B. Controller Units:
 - 1. Provide Motor Controller units supplied by the same manufacturer as the motor control center.
 - 2. Provide units with short circuit current ratings equal to or greater than short circuit current rating of motor control center section.
 - 3. Equip units in Type B and Type C motor control centers with pull-apart terminal strips or drawout terminal boards for external control connections.
- C. Overcurrent Protective Devices: Individual feeder-tap units through 225 A rating shall have drawout mountings with connectors that automatically line up and connect with vertical-section buses while being racked into their normal, energized positions.
- D. Surge Protection Devices: Connect to motor control center bus. Provide surge protective devices in accordance with Section 16282, Surge Protective Devices.
- E. Transformer housing section for a transformer and a distribution panel with connections, as shown on the Drawings.
- F. Spaces and Blank Units: Compartments fully bused and equipped with guide rails or equivalent, ready for insertion of drawout units.
- G. Spare Units: Type, sizes, and ratings indicated; installed in compartments indicated "spare".
- H. Provide power quality metering.

2.5 MOTOR CONTROLLERS

- A. Description: NEMA ICS 2, Class A, full voltage, non-reversing, across-the-line, unless otherwise indicated.
- B. Control Circuit: 120 volt; obtained from integral control power transformer with a control power transformer of sufficient capacity to operate connected pilot, indicating and control devices, +100% spare capacity.
- C. Combination Controller: Factory-assembled combination controller and disconnect switch.
 - 1. Circuit Breaker Disconnecting Means: NEMA AB 1, motor-circuit protector with field-adjustable, short circuit trip coordinated with motor locked-rotor amperes.

- D. Adjustable Overload Relay: Dip switch selectable for motor running overload protection with NEMA ICS 2, Class 10 tripping characteristic, and selected to protect motor against voltage and current unbalance and single phasing. Provide relay with Class II ground-fault protection, with start and run delays to prevent nuisance trip on starting.
- E. Bypass Controller: NEMA ICS 2, full-voltage, non-reversing controller with across-the-line starting capability in manual bypass mode. Provide motor overload protection under both modes of operation with control logic that allows common start-stop capability in either mode.
- F. Solid-State, Reduced-Voltage Controller: Provide Solid State Motor Controllers internal to MCC bucket in accordance with Section 16482, Solid State Motor Controllers.
- G. Variable Frequency Drive: Provide Variable Frequency Drive motor controllers internal to MCC bucket in accordance with Section 16485, Variable Frequency Drives.

2.6 FEEDER OVERCURRENT PROTECTION

- A. Thermal-Magnetic Circuit Breakers: Provide as shown on DRAWINGS. Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger. All breakers 600 amp and larger shall be 100% rated.
 - 1. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
 - 2. Electronic Trip Unit Circuit Breakers: RMS sensing; field-replaceable rating plug; with the following field-adjustable settings:
 - a. Instantaneous trip.
 - b. Long- and short-time pickup levels.
 - c. Long- and short-time time adjustments.
 - d. Ground-fault pickup level, time delay, and I²t response.
 - 3. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
 - 4. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker; trip activation on fuse opening or on opening of fuse compartment door.
 - 5. GFCI Circuit Breakers: Single- and 2-pole configurations with 5 mA trip sensitivity.
 - 6. Molded-Case Switch: Molded-case circuit breaker without trip units.
- B. Molded-Case, Circuit-Breaker Features and Accessories: Provide as shown on DRAWINGS. Standard frame sizes, trip ratings, and number of poles.

1. Lugs: Mechanical style, suitable for number, size, trip ratings, and material of conductors.
2. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
3. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
4. Communication Capability: Circuit breaker-mounted communication module with functions and features compatible with power monitoring and control system.
5. Shunt Trip: 120 volt trip coil energized from separate circuit, set to trip at 75% of rated voltage.
6. Undervoltage Trip: Set to operate at 35% to 75% of rated voltage with field-adjustable 0.1 to 0.6 second time delay.

2.7 MOTOR CONTROL CENTER ACCESSORIES

- A. Devices shall be factory installed in controller enclosure and shall be of the same manufacturer as the motor control center, unless otherwise indicated.
- B. Pushbutton Stations, Pilot Lights, and Selector Switches: Provide pushbuttons, pilot lights, and selector switches in accordance with Section 16161, Control Panels.
- C. Stop and Lockout Pushbutton Station: Momentary-break, pushbutton station with a factory-applied hasp arranged so padlock can be used to lock pushbutton in depressed position with control circuit open.
- D. Control Relays: Provide auxiliary and adjustable time-delay relays in accordance with Section 16161, Control Panels.
- E. Elapsed Time Meters: Provide elapsed time meters in accordance with Section 16161, Control Panels.
- F. Meters: Panel-type, 2-1/2-inch minimum size with 90 degree or 120 degree scale, and $\pm 2\%$ accuracy. Where indicated, provide transfer device with an OFF position. Meters shall indicate the following:
 1. Ammeter: Output current, with current sensors rated to suit application.
 2. Voltmeter: Output voltage.
 3. Frequency Meter: Output frequency.
- G. Multifunction Digital-Metering Monitor: UL listed or recognized, microprocessor-based unit suitable for three- or four-wire systems and with the following features:

- H. Provide metering in accordance with Section 16430, Customer Power Metering System.
- I. Phase Failure and Undervoltage Relays: Solid-state sensing circuit with isolated output contacts for hardwired connection. Provide adjustable undervoltage setting.
- J. Current Sensing, Phase Failure Relays: Solid-state sensing circuit with isolated output contacts for hardwired connection; arranged to operate on phase failure, phase reversal, current unbalance of from 30% to 40%, or loss of supply voltage; with adjustable response delay.
- K. Spare Fuse Cabinet: Identified cabinet with hinged, lockable door.

2.8 FACTORY FINISHES

- A. Manufacturer's standard prime-coat finish ready for field painting.
- B. Finish: Manufacturer's standard paint applied to factory-assembled and -tested controllers before shipping.

2.9 ENVIROMENTAL CONTROL

- A. Environmental Controls:
 - 1. Furnish circulation fans near hot spots where required to prevent temperature from exceeding instrument and equipment ratings.
 - 2. Over-temperature switches shall be utilized to provide special cooling if required to maintain operating temperatures within the manufacturer's specified temperature range.
 - 3. Air conditioning cooling applications shall also include means of preventing moisture condensation inside the enclosure.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and surfaces to receive motor control centers for compliance with requirements, installation tolerances, and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

- A. Select features of each controller to coordinate with ratings and characteristics of supply circuit and motor; required control sequence; duty cycle of motor, drive, and load; and configuration of pilot device and control circuit affecting controller functions.

- B. Select horsepower rating of controllers to suit motor controlled.

3.3 INSTALLATION

- A. See Section 16050, Basic Materials and Methods, for general installation instructions.
- B. Anchor each motor control center assembly to steel-channel sills arranged and sized according to manufacturer's written instructions. Attach by bolting. Level and grout sills flush with motor control center mounting surface.
- C. Install motor control centers on concrete bases complying with Section 03300, Cast-In-Place Concrete.

3.4 IDENTIFICATION

- A. Identify motor control center, motor control center components, and control wiring according to Section 16195, Electrical Identification.
- B. Operating Instructions: Frame printed operating instructions for motor control centers, including control sequences and emergency procedures. Fabricate frame of finished metal and cover instructions with clear acrylic plastic. Mount on front of motor control centers.

3.5 CONTROL WIRING INSTALLATION

- A. Install wiring between motor control devices.
- B. Bundle, train, and support wiring in enclosures.
- C. Connect hand-off-automatic switch and other automatic control devices where available.
 - 1. Connect selector switches to bypass only manual and automatic control devices that have no safety functions when switch is in "hand" position.
 - 2. Connect selector switches with motor control circuit in both "hand" and "automatic" positions for safety-type control devices such as low and high pressure cutouts, high temperature cutouts, and motor overload protectors.

3.6 CONNECTIONS

- A. Conduit installation requirements are specified in other Division 16, Electrical, Sections. Drawings indicate general arrangement of conduit, fittings, and specialties.
- B. Ground equipment.

- C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.7 FIELD QUALITY CONTROL

- A. Prepare for Acceptance Tests as follows:
 - 1. Test insulation resistance for each motor control center element, bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- B. Testing: Perform the following field quality control testing:
 - 1. Perform each electrical test and visual and mechanical inspection indicated in NETA ATS, Sections 7.5, 7.6, and 7.16.
 - 2. Certify compliance with test parameters.
 - 3. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- C. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including pre-testing and adjusting solid-state controllers.
- D. Test Reports: Prepare a written report to record the following:
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

3.8 ADJUSTING

- A. Set field-adjustable switches and circuit breaker trip ranges.

3.9 CLEANING

- A. Clean controllers internally, on completion of installation, according to manufacturer's written instructions. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

3.10 START-UP SERVICE

- A. Engage a factory-authorized service representative to perform start-up service.
- B. Verify that motor control centers and components are installed and connected according to the Contract Documents.
- C. Verify that electrical wiring installation complies with manufacturer's submittal and installation requirements in Division 16, Electrical, Sections.

- D. Complete installation and start-up checks according to manufacturer's written instructions.

3.11 DEMONSTRATION

- A. Engage a factory-authorized service representative to train OWNER'S maintenance personnel to adjust, operate, and maintain motor control centers.
 - 1. Train OWNER'S maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining equipment and schedules.
 - 2. Review data in maintenance manuals. Refer to Section 01700, Contract Closeout.
 - 3. Schedule training with OWNER, through Construction Manager, with at least seven days advance notice.

END OF SECTION

SECTION 16485

VARIABLE FREQUENCY DRIVES - LOW VOLTAGE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Variable Frequency Drive (VFD) systems rated 480 VAC or lower.

1.2 VFD FEATURES

A. The VFDs shall be provided with the following features:

1. Fused control circuit transformer.
2. Provision for 4 to 20 mA input speed reference signal.
3. Electrically isolated auxiliary contacts for ready, running, and trouble status.
4. Adjustable minimum/maximum frequency limits.
5. Independent timed linear acceleration and deceleration.
6. Adjustable motor slip compensation based on motor current.
7. Terminal blocks for control and signal wires entering and leaving the controller.
8. Output transistors shall be insulated gate bipolar transistors (IGBT) type, or Darlington pair.
9. Current limit.
10. Programmable automatic restart.
11. 4 to 20 mA output signal proportional to VFD output frequency.
12. Digital keypad for configuration, programming, local control, and monitoring.
13. Microprocessor-based control for system logic sequencing functions.
14. VFD shall have a minimum 18-pulse input circuit (for VFD's rated 40 HP and above) designed to reduce harmonic distortion.
15. VFD's below 40 HP rating shall have a 6 pulse input circuit designed to reduce harmonic distortion.
16. Ethernet port for TCP/IP communications.

1.3 FUNCTIONAL REQUIREMENTS

- A. Supply Power: The VFD shall operate continuously with supply power of 480 volts $\pm 10\%$, 60 Hz $\pm 3\%$. The VFD shall remain on line and operate without damage to either the VFD or its connected load during a supply power variation of plus 50% lasting for a period of up to 0.01 seconds and minus 100% lasting for a period of up to 0.5 seconds.
- B. Ambient Conditions: The VFDs shall operate continuously as specified in an ambient temperature of 0° C to +40° C and an ambient humidity of 0% to 90%,

- non-condensing. Provide air conditioning as required to maintain the VFD manufacturers' maximum ambient temperature rating.
- C. Load: The VFD system shall be capable of 110% continuous current overload. Variable torque inverters shall be capable of delivering 120% of the specified load for up to 60 seconds, and constant torque inverters shall deliver 150% overload current for 120 seconds.
 - D. Power Factor: Displacement power factor shall be not less than 0.95 at rated full speed and load. Overall power factor, including harmonic distortion, shall be 0.85, or greater. CONTRACTOR shall provide power factor correction components as necessary to meet this requirement.
 - E. Efficiency: Efficiency of VFD systems shall be at least 96% at 60 Hz output driving the specified maximum load.
 - F. Frequency and Voltage Regulation: VFD output frequency shall be regulated to within 0.6 Hz of the frequency set point. VFD output voltage shall be regulated to within $\pm 1.0\%$ of that value which will produce minimum motor heating at any operating frequency within the specified range.
 - G. Frequency Range: VFD shall be capable of continuous operation with the specified load at any frequency between 0.1 Hz and 60 Hz.
 - H. Space: VFD system size shall not exceed the size allotments specified on the Drawings, nor shall any portion of the VFD system exceed a height of 90-inches. VFD system shall be front accessible and shall not require rear access. The VFD equipment shall be suitable for mounting directly against the wall without any clearance for ventilation or other purposes. VFD units shall be arranged as required for entry of incoming line cables and as required for entry of load cables.
 - I. Ambient Noise: Free field noise generated by the VFD shall not exceed 85 dBA at 3 feet out from any point on the VFD cabinet under any normal operating condition.

1.4 PROTECTION AND ANNUNCIATION

- A. Overcurrent Protection: The VFD system shall provide electronic current limit at 150% of motor nameplate current. Current limit shall be accurate to within 1.0% and shall smoothly limit motor speed at whatever value is necessary to limit motor current to that value.
- B. The VFD shall also provide motor running overcurrent protection in compliance with NFPA 70.
- C. Short Circuit Protection: The VFD shall be fully protected against load faults. Bolted faults, phase-to-phase, or phase-to-ground shall not damage the unit. Any impedance or other current limiting necessary to meet this requirement shall be

provided as part of the VFD system, and any losses caused by current limiting devices shall be included in efficiency calculation for the VFD system.

- D. Line Voltage: The VFD shall be protected against high and low line voltage on one or more phases.
- E. Internal Faults: The VFD shall incorporate an internal fault monitoring system to detect malfunctions. This system shall be designed to protect the VFD from transient and sustained faults, and to limit damage that may be caused by these faults.
- F. Overtemperature: Overtemperature circuitry shall shut down the VFD upon overheating and display an overtemperature alarm, or message.
- G. Diagnostics: The VFD shall be provided with a fault diagnostics system that indicates the cause of any shutdown. The system shall store faults in memory and discard the oldest faults as new ones fill the memory. Faults shall be accessible via a digital keypad, also used for local control and programming.

1.5 EXTERNAL CONTROL AND MONITORING

- A. Speed Reference: The VFD shall accept a 4 to 20 milliampere direct current speed reference signal. Speed reference input shall be galvanically isolated and input resistance shall not exceed 250 ohms.
- B. Ready Signal: The VFD shall provide a contact closure that indicates that the controller line power supply is within acceptable tolerances, the control circuits are normal, and there are no internal or external fault conditions that have not been reset. Presence of this signal indicates that the controller should start normally.
- C. Running Signal: The VFD shall provide a contact closure which indicates that the controller is running.
- D. System Trouble: Isolated normally open contacts for remote fault annunciation shall be provided and wired to terminal blocks, which shall be labeled and identified. Contact shall close under fault conditions. Fault conditions that drive the outputs shall be selectable from the digital keypad.
- E. The VFD control circuitry shall shutdown the VFD if the motor overheats. Motor winding temperature switches, or RTDs shall be connected if provided by the motor manufacturer.

1.6 QUALITY ASSURANCE

- A. This Section contains references to the following documents. They are a part of this Section as specified and modified. In case of conflict between the

requirements of this Section and those of the listed documents, the requirements of this Section shall prevail.

1. IEEE 519-1992, Guide for Harmonic Control in Electric Power Systems.
 2. NEMA 250-85, Enclosures for Industrial Control and Systems.
 3. NEMA ICS 2-83, Industrial Control Devices, Controllers and Assemblies.
 4. NEMA ICS 3-83, Industrial Systems.
 5. NFPA 70-87, National Electrical Code (NEC).
 6. Underwriters Laboratories, UL 508.
- B. The VFD shall comply with the applicable requirements of NEMA ICS 3 and additional standards referenced by ICS 3.
- C. The VFDs specified in this Section shall be the product of a single vendor. The CONTRACTOR shall assign unit responsibility for the adjustable frequency drives in this section. The CONTRACTOR shall submit letters of certification with the Shop Drawings from the VFD manufacturer, the motor manufacturer, and the driven equipment manufacturer stating that they have reviewed each application and that the combination will satisfy the application duties required, for the actual motor sizes required, regardless of deviations from the scheduled "nominal horsepower".
- D. VFD manufacturing facility shall be ISO 9001 certified.

1.7 SUBMITTALS

- A. The following information shall be provided in accordance with the Contract Documents:
1. Catalog and technical data.
 2. Outline dimensions, shipping section dimensions, weight, and foundation requirements for all assemblies.
 3. External connection wiring diagram showing function and identification of all terminals requiring field connections.
 4. Line harmonic distortion calculations and filter design if applicable.
 5. Component fabrication drawings consisting of detailed circuit schematics, printed circuit board drawings, and chassis layouts for all electrical and electronic components.
 6. Manufacturer's certification that VFD can withstand fault conditions specified in Paragraph 1.4.
 7. Manufacturer's certification that VFD can withstand environmental conditions specified in Paragraph 1.4.
- B. Shop Drawings: Submit for approval the following:
1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If

deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

2. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.**

1.8 COOLING REQUIREMENTS

- A. VFDs shall be supplied with air conditioning, where shown on the Drawings. The air conditioner shall be mounted and ducted to provide efficient cooling of the VFD. Where air conditioners are mounted on a NEMA 12, 3R, or 4 enclosure, the installation shall maintain the NEMA rating of the enclosure. Enclosure cooling shall be closed-loop, with no outside air entering the enclosure. The unit shall be mounted either on the door, or the side, of the enclosure. Size units to maintain a maximum 40° C operating temperature for the VFDs, based on a 50° C outdoor temperature.
- B. Air conditioners installed outdoors shall be supplied with outdoor packages and low operating temperature kits. Air conditioners shall be equipped with integral, or wall mounted thermostats.
- C. Air circulation shall be furnished by dual centrifugal blowers; one for the enclosure closed-loop circuit and one for the ambient air circuit.
- D. A hot-gas bypass valve shall regulate the air conditioner cooling and prevent freezing of the coils when operating in low ambient temperatures and low heat loads.
- E. Air filters shall be standard disposable-type furnace filters with a large surface area. Only half the filter surface area shall be used at one time, so that the filter can be inverted, exposing the unused half to the air flow.
- F. Air conditioner cabinets shall be constructed of cold rolled steel, with a phosphatized and baked enamel finish.

- G. The air conditioners shall be available in single phase voltages of 120 and 240 volts. Manufacturers shall be McLean Midwest, BARD, or equal.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. The VFDs shall be manufactured by one of the following:
1. Eaton.
 2. Allen Bradley.
 3. Square D.
 4. Toshiba.
- B. AC reactors shall be manufactured by one of the following:
1. TCI.
 2. MIRUS.
 3. Powersmiths.
 4. Or equal.

2.2 ENCLOSURES

- A. Enclosures shall be as shown on the Drawings, with force ventilated gasketed enclosures. UL approved Class 1 filters shall be provided on ventilation openings. Cabinets shall be fabricated from 14 gauge minimum thickness stainless steel. Cabinet shall be provided with an interior frame or otherwise formed so as to provide a rigid structure. Doors shall be hung on removable-pin hinges and equipped with vault-type latch capable of accepting a 3/8-inch shackle padlock. Three-point latch hardware shall be provided. Door width shall not exceed 30-inches.

2.3 INVERTER

- A. A door-interlocked, flange-mounted, through-the-door power disconnecting means shall be provided to protect the inverter against internal faults and as a backup for external load faults. Provide a thermal-magnetic circuit breaker as the main disconnecting means for each VFD enclosure as specified in Section 16481.2.06, Motor Control Centers—Feeder Overcurrent Protection. Load faults shall normally be cleared by the inverter assembly.
- B. Line reactors for harmonic filtering shall be provided on each VFD below 40 HP to reduce total harmonic distortion (THD) of the voltage and current power source. Total voltage and current harmonic distortion, including contribution of notching, and with all VFDs in operation shall not exceed the limits set forth for a general system in IEEE 519-1992, Tables 10.2 and 10.3. The voltage THD shall not exceed 5% and the current THD shall not exceed 10% as measured at the point of common coupling. The point of common coupling (PCC) is defined

herein as the circuit breakers feeding each VFD, or where each VFD connects to the bus.

- C. AC reactor coils in output circuitry of the VFD shall be provided to limit inductive switching surges such that the measured RMS voltage at the motor terminations does not exceed 480 VAC line to line, as shown on DRAWINGS.
- D. Provide EMI/RFI filtering to eliminate radio interference between 10 KHZ and 30 MHZ.
- E. Provide VFD manufacture's recommended inverter output dv/dt filters within VFD enclosure where conductor length from VFD to motor equals or exceeds 100 feet. Provide in submittal, the manufacture's recommended data for filters.

2.4 CONTROL DEVICES

- A. See Control Devices Schematic for requirements.
- B. Control devices and indicating lamps shall be provided in accordance with Section 16161, Control Panels.

PART 3 - EXECUTION

3.1 FIELD INSTALLATION

- A. Each VFD shall be installed and tested by the CONTRACTOR with the assistance of factory-trained engineers in accordance with the manufacturer's specifications and the Contract Documents. The installation shall be certified on forms provided in the Contract Documents.

3.2 TESTING

- A. Test in accordance with Specification 16920, Electrical Acceptance Testing.

3.3 TRAINING

- A. Provide four hours of VFD training for the OWNER'S operations and maintenance staff. Training shall be certified on forms provided in the Contract Documents. Training shall cover VFD theory of operation, features and functions available, normal operation, troubleshooting, and routine maintenance. The CONTRACTOR shall submit a syllabus for the training session for approval a minimum of three weeks prior to conducting the class. Provide each attendee with a class syllabus detailing each topic to be discussed.
- B. Provide VFD training in accordance with Section 01410, Testing.

3.4 SPARE PARTS

- A. The following spare parts shall be supplied with each type or frame size of VFD:
 - 1. Three sets of all replaceable fuses.
 - 2. One of each type of replaceable printed circuit board.
 - 3. Two of each type of output power transistor.
- B. Provide three spare air conditioner filters for each type and size of air conditioner installed.

END OF SECTION

SECTION 17137

MAGNETIC FLOW METERS

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. This Section covers the magnetic flow meters to be provided where indicated on ~~the Drawings. The flow meters shall consist of two parts with manufacturer supplied interconnecting wiring, the field installed flow element and the flow indicating transmitter.~~  SUEZ's Drawings SUEZ will supply compact (one piece) magnetic flow meters.
- B. ~~Related Work specified elsewhere includes, but is not limited to Section 16000, General Electrical Requirements. Also, refer to requirements of Contract Documents for testing, adjusting, and balancing of systems.~~ 

Section 16000 is not included in these Specifications.

1.2 QUALITY ASSURANCE

- A. Equipment to be furnished under this Section shall be the product of firms regularly engaged in the design and manufacture of this type of equipment. Manufacturer shall assume responsibility for, and guarantee performance of equipment furnished. However, this shall not be construed as relieving the CONTRACTOR from responsibility for the proper installation and functioning of the Work. 

1.3 SUBMITTALS

- A. The following material shall be submitted to the ENGINEER prior to installation, ~~in accordance with Section 16000, General Electrical Requirements, and as required elsewhere in the Contract Documents:~~  Section 16000 is not included in these Specifications.
1. Where applicable, provide complete manufacturer's part number, identifying scaling, operating range, housing and wetted parts materials, NEMA rating, product options, consumable materials, and other pertinent information. 
 2. Prior to Final Acceptance of the Work, the CONTRACTOR shall provide Operations and Maintenance Manuals, in accordance with the Contract Documents. 
- B. Shop Drawings: Submit for approval the following:
1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a

detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration. ✓

SUEZ preventative maintenance information package is part of the SUEZ O&M Manual. O&M Manuals are submitted after approval of Shop Drawings, not as part of the Submittal Package.

2. The CONTRACTOR shall submit the preventive maintenance information package as part of the shop drawing submittal package to the ENGINEER for review and approval. **SHOP DRAWING SUBMITTAL PACKAGE WILL NOT BE APPROVED WITHOUT ACCEPTANCE OF PREVENTIVE MAINTENANCE INFORMATION.** ✗

PART 2 - PRODUCTS

2.1 MAGNETIC FLOW METERS

A. Acceptable Manufacturers (Manufacturers listed in alphabetical order):

1. Endress+Hauser model Pro-Mag W400 ✗ SUEZ will supply E&H Promag 10W series
2. Krohne ✓
3. Toshiba LF654 ✓

B. Materials:

1. All mounting hardware shall be 316 stainless steel, the instrument enclosure shall be rated NEMA 4X, the flow sensor liner shall be polyurethane lined, and the electrode material shall be 316 stainless steel. ✗

Clarification: Flow sensor liner for permeate/backpulse service will be polyurethane lined. Flow sensor liner for CIP service requires Teflon lining.

C. Design and Fabrication:

1. Utilize characterized field principle of electromagnetic induction to produce signal directly proportional to flow rate. ✓
2. Provide flanged end connections, per ANSI B16, rated for piping system operating and test conditions. ✓
3. Operating Pressure: 100 psi. ✓
4. Operating Temperature: 122° F. ✓
5. Grounding Requirements:
 - a. ~~Non-metallic or Lined Pipe:~~
 - 1) ~~Inlet and outlet grounding rings of same material as electrode.~~ ✗
 - b. Conductive Piping:
 - 1) Conductive path between the meter and the piping flanges. ✓
6. ~~Provide cable between magnetic flow meter and transmitter.~~ ✗
7. Pulsed DC magnetic field excitation. ✓
8. Automatic zero. ✓
9. Adjustable low flow cutoff. ✓

Not applicable to SUEZ scope of supply

Cable is only required if using remote mag meters. Cable by others.

10. 16-character alphanumeric display shall indicate user-defined flow units and total flow. All menu advice and commands shall be viewed on this display. ✓
11. ~~Minimum signal lock (empty tube zero) to prevent false measurement when tube is empty.~~ ✗
Mag meter will have empty pipe detection signal, but will not have minimum signal lock
12. Accuracy:
 - a. $\pm 0.5\%$ of rate above 1 fps. ✓
 - b. ± 0.01 fps below 1.0 fps. ✓
 - c. 4mA to 20 mA DC isolated output into maximum 800 ohms. ✓
 - d. Scaled frequency output, 24 VDC. ✓
 - e. Power supply: 117 V $\pm 10\%$, 60 HZ. ✓
 - f. Meter operable as specified in liquids with 5.0 micro-ohm/cm or more conductivity. ✓
13. Electrodes shall be self-cleaning. ✓

~~2.2 MAGNETIC FLOW METERS FOR CHEMICAL SERVICE~~ ✗

Not applicable to SUEZ's scope of supply.
Chemical dosing of cleaning and neutralization chemicals falls in the scope of supply by others.

~~A. Acceptable Manufacturers:~~

1. ~~Endress+Hauser model Pro-Mag 53H.~~

~~B. Design and Fabrication:~~

1. ~~The metering tube sensors shall be of the proper sizes to measure the design flow rate of the piping and shall be noted in the instrument schedule.~~
2. ~~Materials:~~
 - a. ~~Seals, Orings and Flange gaskets: Viton.~~
 - b. ~~Tube: Stainless steel with PFA liner.~~
 - c. ~~Electrodes: The two measuring electrodes and empty pipe electrode shall be constructed of a material compatible with the measured fluid.~~
 - d. ~~40% Aluminum Chlorohydrate: PTFE or PFA~~
 - e. ~~50% Citric Acid: Tantalum.~~
 - f. ~~12.5% Sodium Hypochlorite: Platinum.~~
 - g. ~~33% Hydrochloric Acid: PTFE, ETFE, or PFA~~
 - h. ~~50% Sodium Hydroxide: Type C22 Ni-Alloy~~
 - i. ~~38% Sodium Bisulfite: PTFE, ETFE, or PFA~~
 - j. ~~Grounding rings: Inlet and outlet, same as electrodes.~~
 - k. ~~Housing: Aluminum housing shall enclose the coil assemblies and internal wiring.~~
 - l. ~~Process connections: PVDF flanges, rated NEMA 4X.~~
 - m. ~~Transmitter housing: Powder coated cast aluminum with NEMA 4X rating.~~

~~C. Electrodes:~~

1. ~~Meters 5/16 inches diameter and larger shall have a third electrode of the same material to serve as an empty pipe detector.~~
2. ~~The electrode circuit shall have a minimum impedance of 1012 ohms to overcome moderate coating buildup.~~

~~D. Transmitter:~~

- ~~1. The transmitter shall be a microprocessor controller mounted remotely.~~
- ~~2. The flowmeter shall have a backlit LCD display used for programming as well as for simultaneous display of flow rate and total flow in user selectable engineering units, and readout of diagnostic error messages.~~
- ~~3. All programming parameters shall be access-code protected~~
- ~~4. The electronics shall include infinitely adjustable low flow cutoff.~~
- ~~5. The power supply to the transmitter shall be 117 V $\pm$ 10%, 60 Hz.~~
- ~~6. Upon any power failure, the unit shall retain all setup parameters and accumulated measurements internally in non-volatile memory. All units shall be protected against voltage spikes from the power source with internal transient protection.~~
- ~~7. The transmitter shall output a scaled 4 to 20 mA DC directly proportional to flow rate plus a scaled 24 VDC pulse or open collector frequency output. The analog output shall include an adjustable low flow cutoff.~~
- ~~8. The transmitter shall have an algorithm which recognizes pulsating flows from chemical metering pumps and allows for precise measurement of these irregular flow rates.~~

~~E. Accessories:~~

- ~~1. Grounding:

 - ~~a. Tantalum electrodes: Provide inlet and outlet grounding rings.~~
 - ~~b. Platinum electrodes: Provide grounding pins.~~~~
- ~~2. Provide a stainless steel tag labeled with the instrument tag number.~~
- ~~3. Provide a standard hand-held HART communicator with the current device drivers for every ten flow meters provided, with a minimum of two.~~

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Equipment and materials specified in this Section shall be installed and connected as specified, and as shown on the Drawings. The CONTRACTOR shall coordinate the installation with the other trades, to insure proper installation of the flow element, transmitter, and associated conduit and cables. ~~✗~~

Clarification: This item falls in the scope of the CONTRACTOR.
- B. The CONTRACTOR shall calibrate the instruments to the proper ranges, as required by the OWNER and the ENGINEER. Where analog signals are connected to local, or remote monitoring equipment, the CONTRACTOR shall verify that the calibrated ranges and scaling of the local and remote indicators are correct. ~~✗~~

Clarification: This item falls in the scope of the CONTRACTOR. SUEZ is not CONTRACTOR.

3.2 ACCEPTANCE

- A. Prior to Final Acceptance of the Work, the CONTRACTOR shall certify the equipment and installation included under this Section to be free of defects, and suitable for trouble-free operation under the conditions set forth in these Specifications. This requirement is in addition to the manufacturer's guarantee. ~~✗~~ ✓

3.3 SPARE PARTS

- A. Provide the OWNER with a list of the manufacturers' recommended spare parts. ✓

SUEZ's Proposal Price does NOT include spare parts except as noted in SUEZ's proposal. Any additional spare parts will be at additional cost.

END OF SECTION

To clarify, refer to Section 11500.1, item 1.4.A.9 which states that as part of the Shop Drawings to submit, "Recommended list of spare parts and safety equipment, along with price and ordering information."

SECTION 17451

PROGRAMMABLE LOGIC CONTROLLER HARDWARE

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. This Section covers the programmable logic controller (PLC) used for control and monitoring, ~~as indicated on Drawings.~~ ✖ ~~as indicated on SUEZ's Drawings~~
- B. Provide software support and debugging time for a period of 30 days after start-up of the equipment under PLC control. ✔

1.2 SUBMITTALS

- A. Submittals shall include the following:
 - 1. Manufacturer's data on electrical characteristics, capabilities, and physical properties. ✔
 - 2. Wiring diagrams showing connections to all devices; input and output (I/O), analog, and discrete. The wiring diagrams shall indicate the I/O address point to be used in the PLC programs. ✔
 - 3. A tag database for each ladder logic element, timer, counter, and register. ✔
- B. PLC ladder logic program complete with I/O memory map and addressing, I/O module physical slot locations, and cross-referenced list of program elements such as contacts, coils, timers, and other devices. The PLC program shall be documented with symbol names for each program element or device, and comments shall clearly describe the logic for each rung of the ladder logic. This Submittal shall be provided for review prior to field start-up of the equipment under PLC control. The CONTRACTOR shall make corrections to the program logic as requested by the OWNER or the ENGINEER, and resubmit the document for review and approval. ✔

1.3 MANUFACTURERS

The PLC shall be a Control Logix L7X series with latest firmware manufactured by Allen-Bradley/Rockwell Automation. ✔

PART 2 - PRODUCTS

2.1 PROGRAMMABLE LOGIC CONTROLLER

- A. PLCs shall be furnished with hardware and software necessary to monitor and control equipment as listed in the Specifications and shown on the Drawings. Each field input and output shown as an I/O point shall be connected as per manufacturer's recommendations. Additionally, the CONTRACTOR shall provide the hardware, software, and installation necessary for connecting additional future equipment as indicated on the Drawings. The type of field input and output shall be defined as follows: 

1. ~~Analog inputs Isolated (4 to 20 mA DC) 1756-IF8I.~~
2. ~~Analog outputs Isolated (4 to 20 mA DC) 1756-OF8I.~~
3. ~~Discrete inputs (120 VAC). 1756-IA16 or 1756-IA32~~
4. ~~Discrete outputs (24VDC) 1756-OB16D or 1756-OB32 in addition to interposing relays.~~
5. ~~Non-Volatile Flash Memory Card: 1784-SD1.~~
6. ~~Power Supply: 1769-PA75.~~

SUEZ will provide its standard control system, which is ControlLogix with Flex I/O.

- B. The logic control programs shall reside in the PLCs. The program shall consist of software relay and attendant logic control. Control loop and logic flow diagrams shown on the Drawings, or control descriptions listed herein, shall be fully implemented. 

2.2 INPUT/OUTPUT MODULES

- A. Analog inputs shall have a minimum of 24 bits resolution. Analog outputs shall have a minimum of 16 bits resolution. Analog input modules shall be configurable for 4 to 20 mA or 1 to 5 VDC signals. Analog output modules shall be selectable for 4 to 20 mA or 1 to 5 VDC signals. Provide external or user power as needed. 
- B. Indicator lights shall also be provided on each I/O point to indicate status of each signal. Each individual input or output point shall be optically isolated to protect the controller I/O circuitry from high voltage transients. External wiring shall terminate on removable terminal blocks to allow quick installation or extraction of 16 or 32 point I/O modules without disconnecting field wiring. Labels shall be provided on modules that indicate the I/O address of each termination. 
- C. The power supply shall provide power for the processor and I/O modules. The power supply shall have a hold-up time (the time the system is operational during a brief power loss), typically between 20 milliseconds and 3 seconds. Power requirement shall be 120 VAC or 24 VDC. 
- D. Provide a minimum of ~~25%~~ spare I/O of each type connected to terminals for future expansion.  SUEZ standard is to provide a minimum of 10% spare I/O.

2.3 STORAGE AND DOWNLOADING OF PLC PROGRAMS

- A. The PLC shall be programmable through an RS-232/USB port or Ethernet/IP connected to a personal computer through a standard cable. The PLC programming software shall be provided with the user's manuals, original diskettes, and licensing agreement for registration by the OWNER. Cables, adapters, connectors, or other hardware required to connect to the PLC shall be provided to the OWNER. ✓
- B. The PLC programming software shall enable the user to write the PLC program on-line or off-line. The software shall include utilities to manage PLC program files, document and print the programs, configure the programming environment, monitor and force the PLC addresses while on-line, and configure the PLC memory and addressing structure. ✓

PART 3 - EXECUTION

3.1 INSTALLATION

- A. PLC shall be installed as indicated on ~~the Drawings~~ ^{SUEZ's Drawings} designed for the PLC enclosure and according to the manufacturer's instructions. ✗

3.2 START-UP AND TESTING

- A. Upon completion of the installation, start-up shall be performed by a ~~factory trained Controls Engineer~~ ^{SUEZ's Field Service Representative}. Operating and maintenance instruction books shall be supplied upon delivery of the unit and procedures explained to operating personnel. ✗
- B. The PLC program and I/O shall be thoroughly tested. Each input and output signal shall be tested for correct indication and control function. The CONTRACTOR shall demonstrate operation of the PLC control logic with simulated inputs, before the entire system is started, and run in automatic mode. ✓
- C. Program changes made as a result of start-up testing and debugging shall be fully documented. Submit the latest program changes to the logic for review, and update the Operation and Maintenance Manuals with the latest program printout and diskette. ✓
- D. Proportional-Integral-Derivative (PID) loops shall be tested and tuned to provide a stable control over the process variable, with uniform internal analog range scaling. ✓

Five (5) days (each day = 8 hours minimum) of training has been included in SUEZ's Proposal Price as specified in Section 11500.1, item 3.3 B. Those five (5) days of training include the four (4) days of training on membrane filtration system, positive displacement blowers, actuators, and turbidity instrument specified in Section 01821, item 1.6.B, and the one (1) day of training on pumps specified in Section 11314, item 3.2.B. It is assumed the eight hours of training on the control system listed here is included in the five (5) days of training detailed above. If not, and an additional day of training is required, it will be at additional cost.

3.3 TRAINING

- A. Provide eight hours of training on the control system. Instruction shall include a description of the control system operation. Teach the operators how to make control system parameter changes (set points, timer values, etc.) and show them how to enter passwords to make these changes. ✖

3.4 SPARES

- A. Furnish a minimum of two spare I/O module of each type, and two power supply modules. ✖
- B. Furnish 10 fuses of each type and size used in the power supply and I/O modules. ✖

END OF SECTION

SECTION 17452

PROGRAMMABLE LOGIC CONTROLLER SYSTEM SOFTWARE AND ACCESSORIES

PART 1 - GENERAL

1.1 SCOPE

- A. This Section includes furnishing all programmable logic controllers (PLCs) as indicated on ~~the Drawings~~ and specified herein. ~~✗~~
SUEZ's Drawings
- B. ~~Related Work specified elsewhere includes, but not limited to, Section 16000, General Electrical Requirements. Also refer to requirements of Contract Documents for testing, adjusting, and balancing of systems. ✗~~

Section 16000 is not included in these Specifications.

1.2 QUALITY ASSURANCE

- A. Use programmable logic controller system manufacturer approved hardware, such as cable, mounting hardware, connectors, enclosures, racks, communication cable, splitters, terminators, and taps. ✓
- B. Programmable Logic Controller Installer Qualifications:
 - 1. Qualified by completion of the programmable logic controller manufacturer's training course. ✓
 - 2. Experience of installing at least five installations equal to scope of Project. ✓
- C. Provide a single source responsibility for programmable logic controller system mounting, installation, and wiring. ✓
- D. Design and test the programmable logic controller system to operate in an industrial environment per NEMA Standard UCS 2-230 (Arc Test) and IEEE C37.90a CSWC. ✓
- E. The CONTRACTOR shall ensure sufficient time for programming on-site, interfacing with other process equipment, and testing. ✓

1.3 SUBMITTALS

- A. Shop Drawings and Product Data: Include description of components, methods of connecting components, and the following:

1. ~~Hard copy of the programmable logic controller application program with full I/O documentation and explanation of conventions.~~ ❌ Hard copy of program will not be provided
2. Three copies of the programmable logic controller application program on CD-ROMS. ✔️
3. System interconnection diagram drawing for PLCs, radios, antennas, Modbus Plus data highway, Ethernet data highway, and field instrumentation. ✔️
4. Panel and enclosure plans, sections, and details. ✔️
5. Access opening locations and required clearances for each panel and enclosure. ✔️
6. Mounting plates and details for input and output chassis. ✔️
7. Enclosure internal wiring and terminal blocks. ✔️
8. Tabular Input and Output (I/O) Listing, Including the Following Data:
 - a. Each I/O point, chassis number, module number, module I/O point number, name of I/O device. ✔️
 - b. Instrumentation tag number of the I/O device ~~in the Contract Documents.~~ ❌ as shown in SUEZ's Shop Drawings
 - c. Electrical characteristics of the I/O signal. ✔️
 - d. PLC internal address of each I/O. ✔️
9. ~~Hard copies and machine-readable copies of PLC programs and personal computer graphics, reports, and database configuration.~~ ❌ Hard copy of the program will not be provided

B. Operating and Maintenance Manuals: Include the following:

1. Programming procedures. ✔️
2. Operations manuals. ✔️
3. Maintenance and troubleshooting manuals. ✔️
4. Spare parts manuals. ✔️
5. Configuration manuals. ✔️
6. List of service personnel contacts, including 24 hour service hot lines. ✔️

1.4 PLC DIAGNOSTICS

- A. Configure the PLC programs to monitor the diagnostic registers in the PLC. Publish the status of these registers to SCADA for alarm of a PLC diagnostic failure. The following diagnostic status words shall be monitored:
1. Module status and module failures. ✔️
 2. Internal battery condition. ✔️
 3. Power supply status. ✔️

1.5 PLC APPLICATION PROGRAMMING SOFTWARE

SUEZ's Shop Drawing Submittals and P&IDs

- A. Refer to ~~the Contract Documents and P&IDs~~ for the process control descriptions and functional requirements to be implemented using the following application software packages. ❌

SUEZ will provide its standard PLC Programming documentation, including how rung comments are conveyed.

1. Furnish and install complete packages of RSLOGIX 5000, version 20 or newer and RXLINX Version 3.8 or newer, using primarily Function Block Diagram (FBD). ✓
2. PLC Programming:
 - a. Submit two copies of the PLC programs for review, prior to installation. The programs shall be fully documented with unique symbol names for each program element (coils, contacts, inputs, outputs, etc.), ~~and comments for every three rungs of logic. The rung comments shall clearly describe the function of the logic so that another programmer can understand the logic and be able to debug and modify the programs at a later date.~~ ✓
 - b. Once the programs have been reviewed, comments and changes shall be incorporated into the programs and submitted for a final review. Upon final review of the programs, install the programs in the PLCs to test the control logic using simulated I/O. ✓
 - c. Provide instruction, maintenance manuals, and diagrams for supplied programs, device drivers, and custom designed subprograms and device drivers developed for this Project. Provide all materials in one or more three-ring binders. Separate sections by laminated numbered or descriptive tabs, with a table of contents to aid the user in finding specific information. Three-ring binders shall have labels on the spine identifying the contents of each volume. ✓
 - d. ~~Submit a training schedule in accordance with these Specifications.~~ ✓ See 1.6. ON-SITE TRAINING below
 - e. Submittals shall be complete, neat, and orderly. ✓
 - f. Submit two CD-ROM copies of the PLC software programming in their final configuration. Also submit all original software registered in the OWNER'S name, and all original documentation that accompanies the original software diskettes. ✓
 - g. All programming shall be coordinated with the OWNER, who will provide programming standards to be used. ✓
 - h. OWNER and programmer will hold programming kick-off meeting to coordinate scope and requirements. ✓

1.6 ON-SITE TRAINING

- A. Arrange for instruction of the OWNER'S designated personnel. The instruction shall commence within 30 days of OWNER request. Training shall include a minimum of eight hours of OWNER training. ✓
- B. The OWNER reserves the right to split training periods to accommodate personnel schedules. ✓

Clarification: Five (5) days (each day = 8 hours minimum) of training has been included in SUEZ's Proposal Price as specified in Section 11500.1, item 3.3 B. Those five (5) days of training include the four (4) days of training on membrane filtration system, positive displacement blowers, actuators, and turbidity instrument specified in Section 01821, item 1.6.B, and the one (1) day of training on pumps specified in Section 11314, item 3.2.B.

- C. The training sessions shall be structured to provide the OWNER'S personnel with a maximum of hands-on experience. ✓
- D. Control System Overview Training Shall Consist of the Following Topics:
 - 1. Definition of control modes, such as HAND, AUTO, LOCAL, and REMOTE. ✓
 - 2. Entering and changing setpoints. ✓
- E. Provide the OWNER with the ability to program the PLCs, add new network components and PLCs as needed for future expansion of the system. ✓

SUEZ will provide the OWNER with the ability to program the PLCs, but it is not recommended for the OWNER to change the program without approval by SUEZ.

1.7 START-UP SUPPORT

- A. The CONTRACTOR shall have field service and programming personnel on-site to provide start-up and commissioning services for a period of at least five days. The start-up service shall be coordinated with the ENGINEER. The start-up service shall be required prior to starting the final acceptance test. ✓

1.8 PROGRAMMING SUPPORT

- A. The CONTRACTOR shall be available to provide programming services for a period of at least 15 days. The start of this service shall commence after successful completion of the final acceptance test. This service shall consist of:
 - 1. Furnishing additional programming that may be required. ✓
 - 2. Assisting OWNER'S personnel with additional technical support and training. ✓

CLARIFICATION:
SUEZ's Proposal
Price does not
include costs
associated with
Factory Witness
Testing.
If ENGINEER and/or
OWNER require to
be present to witness
factory tests, all costs
associated travel and
living (i.e.
transportation, meals,
accommodations) fall
in the scope of supply
by others.

1.9 FACTORY WITNESS TESTING

- A. Hardware and software components of the PLC system shall be thoroughly tested and "burned in" at the factory by the CONTRACTOR. Inform the ENGINEER 10 working days prior to the testing of the equipment. The ENGINEER and OWNER shall witness these tests before shipment to the site. Provide copies of all test reports to the ENGINEER. ✓
- B. The CONTRACTOR shall be responsible for all transportation, meals, and accommodation expenses for the OWNER'S and ENGINEER'S representative witnessing the factory test. ✓

1.10 ON-SITE TESTING

- A. On-site testing of the PLC system shall be performed prior to the final acceptance test. Submit a testing schedule detailing the timing and extent of the proposed testing and the test procedures to be followed. ✓
- B. Prior to the final acceptance test, the ENGINEER will review the status of the PLC system and determine if the final acceptance test can be performed. All primary elements shall be calibrated and all I/O signals shall be fully functional prior to the start of the final acceptance test. ✓
- C. Perform the PLC system final acceptance test and confirm the operation of all control loops, primary elements, control functions and sequences, and monitoring functions required of the complete PLC system. The PLC shall be operated continuously throughout the test without software or hardware failure. In the event of a failure, the acceptance test shall be terminated, the hardware or software failure shall be corrected, and the acceptance test shall be restarted. The ENGINEER and the OWNER shall determine if it is necessary to restart the test at the first day of the test. The final acceptance test shall run uninterrupted for seven calendar days. ✓

1.11 GENERAL PROGRAMMING REQUIREMENTS

- A. The software development and programming of the control functions described herein shall be completed by the date defined in the Contract Documents. PLC programs shall meet the performance requirements described herein, and the control needs of the OWNER. ✓
- B. The control descriptions provided herein do not provide every programming detail such as timers, function blocks, coils, contacts, or other relay ladder logic elements that are required to write and implement complete PLC programs. The control descriptions are intended to describe the overall functional capability of the particular process being described. Communication with the OWNER and the ENGINEER shall be necessary to convey the additional information needed to produce the working PLC programs. ✓
- C. Any discrepancies in these documents shall be brought to the attention of the ENGINEER, in writing. The ENGINEER will then issue further explanation. The decision of the ENGINEER will be final. ✓
- D. Control logic shall be programmed, furnished, and installed as specified. The CONTRACTOR shall be required to test and demonstrate to the satisfaction of the ENGINEER that the control logic functions as specified. ✓

- E. The PLC programs shall meet industry norms, and function in such a way as to maintain safe and reliable operation of the equipment they are designed to control. If the ENGINEER determines that the control logic and PLC programming fails to perform the functions described herein in a safe and reliable manner, the CONTRACTOR shall modify and correct the programs. ✓
- F. The PLC shall not be able to control any equipment item that is not in the Auto or Remote mode. ✓
- G. The PLCs shall be programmed to monitor each of their respective analog signal inputs for instrument failures. If the input signal falls below 4 milliamps due to a short circuit, or an open current loop, the PLC shall produce an alarm signal to SCADA. ✓
- H. All motorized equipment (i.e., wells and pumps) will have Accumulation Runtime Counters associated with them. ✓

PART 2 - PRODUCTS

2.1 APPLICATION SOFTWARE, PROGRAMMING HARDWARE, AND TRAINING

- ~~A. Provide fully annotated software with Logic Flow Diagram, rung-by-rung description, register, and variable cross-referencing. Reference program to control descriptions by Logic Flow Diagram.~~ ✗ SUEZ's standard control literature will be provided

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install the programmable logic controller system in accordance with the programmable logic controller manufacturer's instructions and recommendations, including grounding specifications. ✓

3.2 DEMONSTRATION

- A. Establish a mutually agreed upon time for demonstrations with the ENGINEER. ✓
- B. Deliver written notification of demonstrations to ENGINEER at least seven days before demonstrations. Include an agenda for the demonstration and testing procedures with notification. ✓

- C. Demonstrate functional operation of programmable logic controller system hardware and logic program at system assembly location prior to shipment. ✓
- D. Demonstrate full functional operation of programmable logic controller system hardware and logic program at the Project job site when fully integrated to the field I/Os. ✓

END OF SECTION

SECTION 17455

OPERATOR INTERFACE TERMINAL SOFTWARE AND HARDWARE

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Supply and programming of Operator Interface Terminals (OIT) used to monitor and control electrical and process equipment. ✓
- B. Startup and commissioning of control systems using OIT. ✓
- C. Programming software supplied to owner. ✓

1.2 SUBMITTALS

- D. Manufacturers literature showing:
 - 1. Physical characteristics, dimensions, and weights. ✓
 - 2. Mounting and installation requirements. ✓
 - 3. Wiring information including power requirements and communication capabilities and cabling information. ✓
 - 4. Available memory and screen storage information. ✓
 - 5. Recommended spare parts. ✓
 - 6. OIT screen development software information including:
 - a. Minimum computer memory requirements for installation and use. ✓
 - b. Communication ports and cables to download OIT programs. ✓
- E. Proposed OIT screens showing the following:
 - 1. Number of proposed screens. ✓
 - 2. Proposed color and graphics standards for OIT screen development. ✓
 - 3. Menu tree showing how the operator will access all screens ✓
 - 4. Description of each screen listing control and display points and indicating what actions the operator may perform on the screen. ✓

Clarification: Description of each screen listing control and display points and indicating what actions the operator may perform on the screen is not part of the Shop Drawing Submittal, rather will be part of the Operations and Maintenance Manual.

1.3 GENERAL

- F. OIT's are to be new, the most current version, and compatible with PLCs provided for this project. ✓
- G. Provide the latest version of the OIT programming software and use it to develop the OIT screens. License the software in the name of the owner. Deliver it to the Owner's programmer within 30 days of accepted plant startup or the stated date of project substantial completion. ✓

PART 2 – PRODUCTS

2.1 OPERATOR INTERFACE TERMINAL

- H. Manufacturer shall be Allen Bradley PanelView Plus. ✓
- I. Shall communicate directly with the PLC over Ethernet/IP or DF1, DH-485. ✓
- J. Shall be minimum 10” diagonal screens, color, with touchscreen keys. ✓
- K. Shall be capable of alarm detection and processing, discrete and analog display and control. ✓

PART 3 - EXECUTION

3.1 OPERATOR INTERFACE TERMINAL

- L. Mount the OIT in the control panel at an elevation and location convenient for operator access. ✓
- M. Program the OIT to perform all control and monitoring functions required by these specifications and the drawings. ✓
- N. Test the programming to verify all required functions. ✓
- O. Provide startup and commissioning assistance to make the plant operational. ✓
- P. Deliver “As Built” OIT programs, documentation, and original programming disks, manuals, and literature to owner ✓
- Q. Warranty OIT programming for a period of one year from date of substantial completion. ✗
Correct errors and software “bugs” at no cost to owner for that period of time. ✓

Must include a sunset clause. Add "or 18 months from date of delivery" after "substantial completion."

END OF SECTION

ATTACHMENT TWO

GMP 1 – Figures (Preliminary – Not for Construction)

The following pages include piping and instrumentation diagrams (P&IDs) prepared by Wilson. Wilson's P&IDs and the P&IDs prepared by SUEZ differ in format and delineation of scope of supply. As such, SUEZ takes complete exception to Attachment Two and has not provided a review nor comments. The differences between the two sets of P&IDs are to be resolved before the 60% Submittal.

SUEZ's Proposal Price is based on the scope shown in SUEZ's P&IDs, which can be found in Appendix C of SUEZ's Proposal.

LINE SYMBOLS	P&ID ABBREVIATIONS		ISA INSTRUMENT IDENTIFICATION TABLE		TAG NUMBERS AND DESIGNATIONS																																																																																																														
MAJOR PROCESS PIPING OR FLOW CHANNEL EXISTING PROCESS PIPING SECONDARY PROCESS PIPING EXISTING SECONDARY PROCESS PIPING MISCELLANEOUS PIPING EXISTING PIPING AND EQUIPMENT FUTURE PIPING AND EQUIPMENT ELECTRICAL SIGNAL HYDRAULIC SIGNAL PNEUMATIC SIGNAL ELECTRICAL DIRECTION ARROW FLOW ARROW FOR PROCESS PIPING PROCESS OR SIGNAL LINE GOING TO ANOTHER SHEET (MATCH LETTERS) PROCESS OR SIGNAL LINE FROM ANOTHER SHEET (MATCH LETTERS) PROCESS LINES CROSSING DATA COMMUNICATIONS LINK VENDOR PACKAGE BOUNDARY	A AMPERE AFD ADJUSTABLE FREQUENCY DRIVE AI ANALOG INPUT AIC AMPS INTERRUPTING CAPACITY AR AIR RELIEF VALVE AO ANALOG OUTPUT ABE ANOXIC BASIN EFFLUENT AS AIR SUPPLY ATS AUTOMATIC TRANSFER SWITCH AUTO AUTOMATIC CB CIRCUIT BREAKER CL2 CHLORINE CON CONTACTOR COP COPPER CV CONTROL VALVE DCS DISTRIBUTED CONTROL SYSTEM DI DISCRETE INPUT DO DISSOLVED OXYGEN, DISCRETE OUTPUT DP DIFFERENTIAL PRESSURE DWG DRAWING ECO EMERGENCY GAS OFF ETM ELAPSED TIME METER ETMF ELAPSED TIME METER (FAST SPEED) ETMS ELAPSED TIME METER (SLOW SPEED) EOL ELECTRONIC OVERLOAD EXIST EXISTING FOU FOUL AIR FC FAIL CLOSED FE FINAL EFFLUENT FR FORWARD-REVERSE FVNR FULL VOLTAGE NON-REVERSING FW FINISHED WATER GND GROUND GAL GALLONS GPD GALLONS PER DAY GPH GALLONS PER HOUR GPM GALLONS PER MINUTE H HIGH H2S HYDROGEN SULFIDE HMI HUMAN MACHINE INTERFACE HS HAND SWITCH HMS HAND SWITCH MAINTAINED HOA HAND-OFF-AUTO IO INPUT/OUTPUT IOE INTERNAL-OFF-EXTERNAL J JUNCTION BOX LAN LOCAL AREA NETWORK LCP LOOP CONTROLLER LCF LOCAL CONTROL PANEL LOS LOCK-OFF-STOP LR LOCAL/REMOTE LS LEVEL (i.e., FLOAT) SWITCH M MOTOR MA MANUAL/AUTO MA MILLIAMPERE MC MANUFACTURE CABLE MCC MOTOR CONTROL CENTER MCP MOTOR CIRCUIT PROTECTOR MFR(S) MANUFACTURER(S) MGL MILLION GALLONS PER DAY MH MANHOLE MLR MIXED LIQUOR RETURN MO MOISTURE MOD MODULATED MTU MASTER TELEMETRY UNIT NPW NON-POTABLE WATER NS NITROGEN SUPPLY NTU TURBIDITY O/C OPEN / CLOSE OCL OPEN-CLOSE-AUTO OOR OPEN-CLOSE-REMOTE OP OPERATOR INTERFACE TERMINAL OL OVERLOAD OO ON/OFF (MAINTAINED) OOA ON-OFF-AUTO OOA ON-OFF-REMOTE OSC OPEN-STOP-CLOSE PAH PRESSURE ALARM HIGH PER PERMISSIVE PLC PROGRAMMABLE LOGIC CONTROLLER PNE PANEL PO PULSE OUTPUT POS POSITION POT POTENTIOMETER POT POSITION PPH POUNDS PER GALLON PPH POUNDS PER HOUR PPM PARTS PER MILLION PR PAIR PRE PRESSURE PS PRESSURE SWITCH PSI POUNDS PER SQUARE INCH PV PROCESS VALVE RA RETURN ACTIVATED SLUDGE RAW RAW WATER REM REMOTE RF RADIO FREQUENCY M REMOTE INPUT OUTPUT RS RAW SEWAGE RSP RAW SEWAGE PUMP RST RESET RTD RESISTANCE TEMPERATURE DETECTOR RTU REMOTE TELEMETRY UNIT RUN RUN (FAST SPEED) RUN RUN (SLOW SPEED) SB SLUDGE BLANKET SEQ SERVICE ENTRANCE EQUIPMENT SEL SERVICE ENTRANCE SECTION SLS SINGLE LOOP CONTROLLER SLOS START-LOCK-OFF-STOP SO2 SULFUR DIOXIDE SOV SOLENOID OPERATED VALVE SP SET POINT SPD SPEED SPP SPARE SS START/STOP (MAINTAINED) SSS SOLID STATE STARTER (SOFT START) STR MOTOR STARTER TAH TEMPERATURE ALARM HIGH T/M TEMPERATURE AND/OR MOISTURE TEMP TEMPERATURE TS TEMPERATURE SWITCH TSS TOTAL SUSPENDED 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INSTRUMENTATION STANDARD
SYMBOLS AND LEGEND
CITY PROJECT NO. WW-901.203
WILSON PROJECT NO. 2-1007

Design: EES Drawn: EES Checked: PWP
Date: 9/2021 Wilson Project No.: 21007
Revision Description By
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INSTRUMENTATION STANDARD SYMBOLS AND LEGEND

CITY PROJECT NO. WW1901.203
WILSON PROJECT NO. 21007

Design: ER
Date: 9/2021
Revision

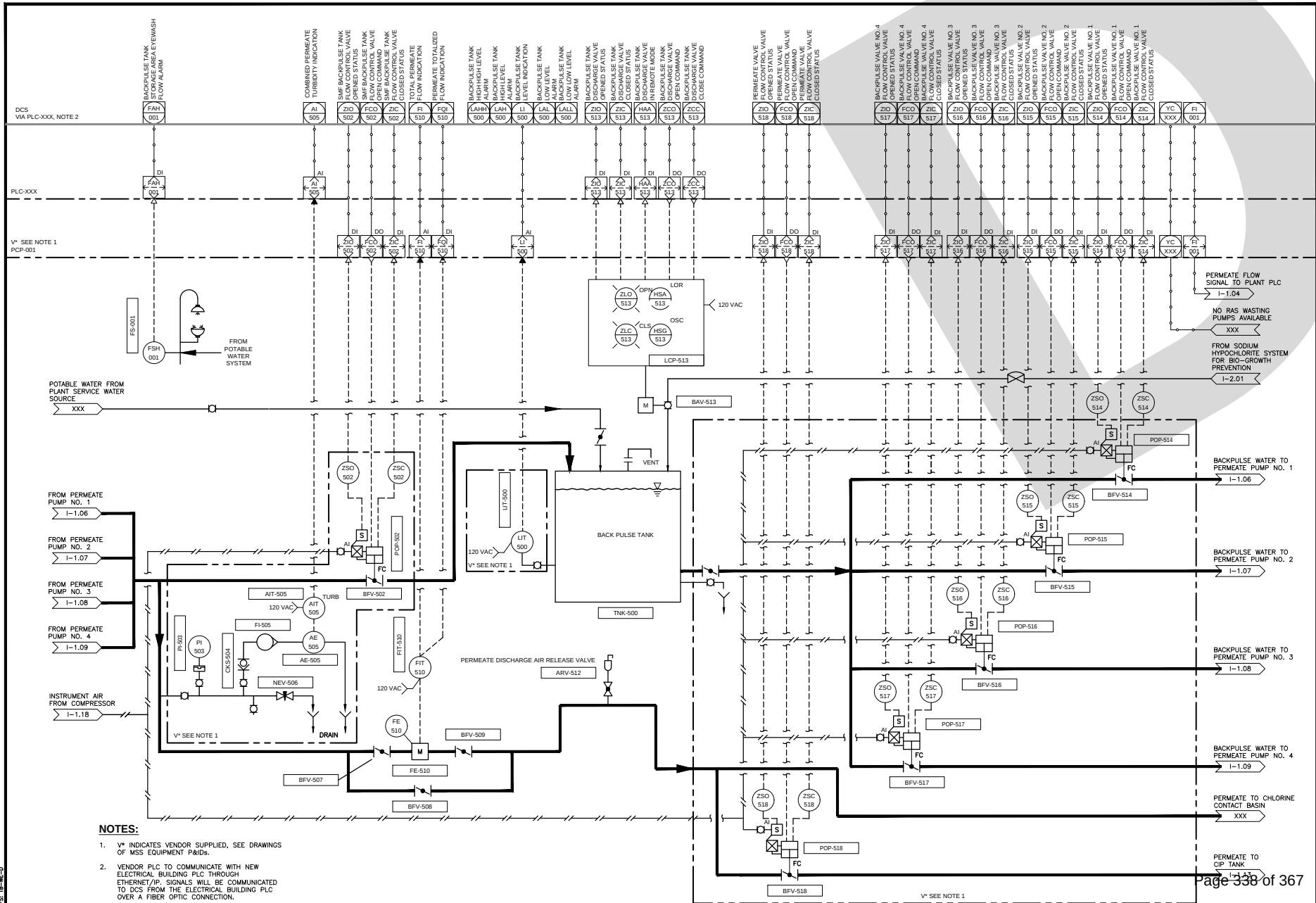
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MEMBRANE FILTRATION SYSTEM
BACKPULSE TANK P&ID

CITY PROJECT NO. W1901.203
WILSON PROJECT NO. 21007

Design: ER	Drawn: ER	Checked: RPK
Date: 9/2021	Wilson Project No.: 21007	
Revision	Date	Description

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Page 338 of 367
Sheet No. I-1.12

DCS
VIA PLC-XXX, NOTE 2

V*
PCP-001

INSTRUMENT AIR
FROM COMPRESSOR

PERMEATE FROM
COMMON PERMEATE
HEADER

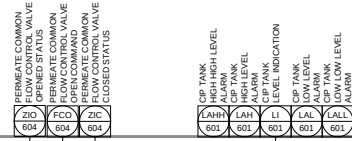
OVERFLOW/DRAIN
TO SEWER/WASTE

TO/FROM MEMBRANE
TRAIN NO. 1

TO/FROM MEMBRANE
TRAIN NO. 2

TO/FROM MEMBRANE
TRAIN NO. 3

TO/FROM MEMBRANE
TRAIN NO. 4



CIP TANK
HIGH TEMPERATURE
ALARM



ZSO 604

ZSC 604

PCP-604

BFV-604

V* SEE NOTE 1

LIT 601

120 VAC

V* SEE NOTE 1

CIP TANK

VENT

TNK-600

TSH-602

V* SEE NOTE 1

PCP-608

BFV-608

V* SEE NOTE 1

TO CIP PUMP No. 1

I-1.14

TO CIP PUMP No. 2

I-1.14

FROM CIP PUMP
DISCHARGE

I-1.15

NEUTRALIZATION LOOP

I-1.15

NOTES:

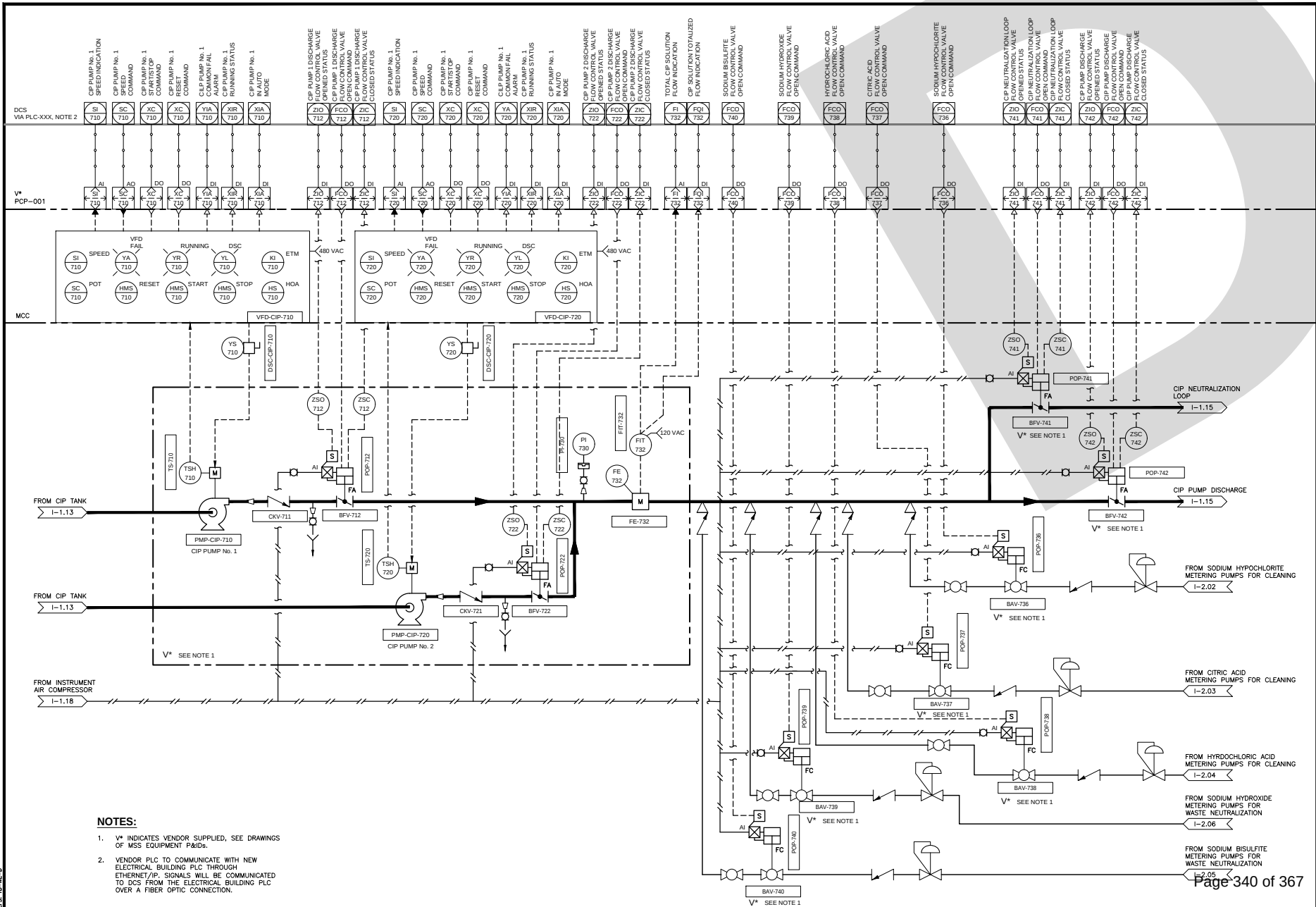
1. V* INDICATES VENDOR SUPPLIED, SEE DRAWINGS OF MSS EQUIPMENT P&IDs.
2. VENDOR PLC TO COMMUNICATE WITH NEW ELECTRICAL BUILDING PLC THROUGH ETHERNET/IP. SIGNALS WILL BE COMMUNICATED TO DCS FROM THE ELECTRICAL BUILDING PLC OVER A FIBER OPTIC CONNECTION.

CITY OF CHANDLER
RECLAIMED WATER INTERCONNECT FACILITY
MEMBRANE FILTRATION SYSTEM
CIP TANK P&ID
CITY PROJECT NO. WM1901.203
WILSON PROJECT NO. 21007

Design: ER	Drawn: ER	Checked: RPK
Date: 9/2021	Wilson	Project No.: 21007
Revision	Date	Description

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MEMBRANE FILTRATION SYSTEM
CIP PUMPS PAD

CITY PROJECT NO. WW1901.203
WILSON PROJECT NO. 21007

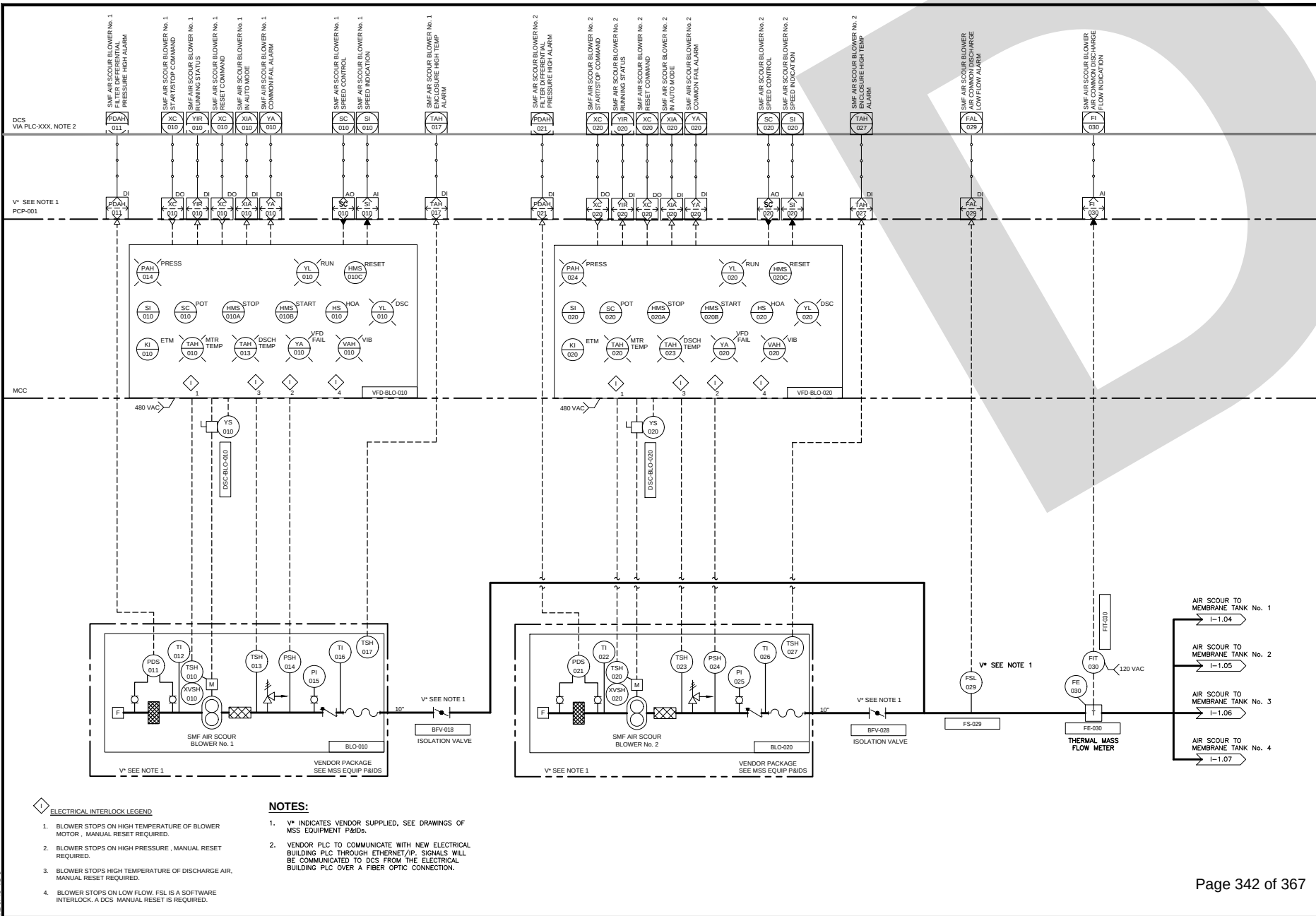
Design:	Date:	Revision:	Description:	By:
9/20/21	9/20/21			

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Sheet No. I-1.14



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**MEMBRANE FILTRATION SYSTEM
AIR SCOUR BLOWERS**

CITY PROJECT NO. WW1901.203
WILSON PROJECT NO. 21007

Design: FR	Drawn: FR	Checked: RPK	Project No.: 21007	Date: 9/2021	Revision	Description	By

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Sheet No. I-1.17

	AWWA Valves Vs Bray Resilient Seated Valves							
						= Advantage		
No.	CATEGORY		AWWA CL-150B BFV's		Comments	Bray Valves		Comments
	Size Range		3 inch		-168 inch		1.5 inches	- 72 inch
	1 Sizes 3-20 inch		Class 150 B only		150 PSIG	3 inch - 12 inch 175 PSIG		
					14 inch 20 inch 150 PSIG			
2	Sizes 24-168 inch		Class 25/75/150B only		25/75/150 PSIG			
		Class 150 B		Class 75 B		175 PSIG	75/50 PSIG	
3	Shaft Diameters in inches	4 inch valve	0.625	0.625		0.625	0.63	
		6 inch valve	1	0.75		0.75	0.75	
		8 inch valve	1.125	0.875		0.875	0.88	
		10 inch valve	1.375	1.125		1.1875	1.19	
		12 inch valve	1.5	1.25		1.1875	1.19	
		14 inch valve	1.75	1.5		1.375	1.38	
		16 inch valve	2	1.625		1.375	1.38	
		18 inch valve	2.25	1.875		1.9867	1.99	
		20 inch valve	2.5	2.125		1.9867	1.99	
AWWA for transient conditions and Pump Discharge								
4	Pressure Ratings		150 PSIG	25/75/150 PSIG		50/75/150/175	PSIG	
5	Maximum Delta P		150PSIG	75 PSIG		175 PSIG	50 PSIG	
6	Maximum Hydrostatic		300 PSIG	150 Psig		350 PSIG		
7	Seat Adjustability		24 inch / larger	24 inch / larger		Not required	ANY SIZE	
8	Maximum Velocity Class 150A		8 FPS	8 FPS		35FPS		
9	Maximum Velocity Class 150B		15 FPS	15 FPS		35 FPS		
10	Body Wall Thickness		AWWA	AWWA		ASTM		
11	Seat replacement Capability	3-20 inch	No	No		Yes		
12	Seat replacement Capability	24-168 inch	Yes	Yes		Yes		
13	Seat Adjustability 3-20 inch		No	No		Not required		
14	Seat Adjustability 24-168 inch		Yes	Yes		Not Required		
15	Seating Unseating torques	4 inch	410	NA		465	267	Bray has huge cost reduction
		6 inch	1007	NA		1045	537	advantage on Actuation

AWWA Valves Vs Bray Resilient Seated Valves								
								= Advantage
No.	CATEGORY		AWWA CL-150B BFV's		Comments	Bray Valves		Comments
		8 inch	2107	NA		1915	983	
		10 inch	3862	NA		2940	1493	
		12 inch	5777	NA		4545	2280	
		14 inch	5054	NA		6450	3300	
		16 inch	7100	NA		9000	4267	
		18 inch	11118	NA		11900	5267	
		20 inch	14528	NA		15500	6867	
16	Trim Options	AWWA Limited	ss	ss		NDI /SS / BRZ/Teflon		
17	Various ratings	150B / 75B	not below 24 inch.			yes all sizes		
18	Body Styles Cast Iron	Flanged A 126 CI - B	yes			24 inch and larger		
		Wafer A 126 CL-B	yes 3-20 inch Pratt only			All sizes		
		Lug A 126 CL - B	No	No		2 inch - 20 inch		
19	Shaft Material	AWWA 18-8 STD	304 /316		304 / 316	416 / 304 /316/17-4PH		
20	Disc Material	AWWA- CI STD.	CI/DI-SS edge or 316 SS			NDI / SS/BRZ		
21	Seat Material	AWWA- One	Buna-N	Buna - N		EPDM / BUNA/VITON		
	Seat Temperature Rating		250 F	250 F		250 F	250 F	
	Seat Curing Process		Sulphur	Sulphur		Peroxide	Peroxide	
	ASTM - 429 Pull test		3"-20 inch.	24" plus - no		No	No	
22	FDA approval		No	No		Yes	Yes	
23	NSF Approval		Yes	Yes		Yes	Yes	
24	ID of Valve exposed to Media		Yes	Yes		No	No	
25	Internal Coating required		Yes	Yes		No	No	
26	Standard adjustable packing		No	No		No	No	
27	Subject to Internal Tubuculation		Yes	Yes		No	No	
28	Body-Journal shaft Isolation		Yes	Yes		Optional	Optional	
29	Ministry Of Environment non - object letter		No	No		Yes	Yes	

	AWWA Valves Vs Bray Resilient Seated Valves																																																																																																																																			
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30	CV's -Valve Capacities/Pumping Cost @\$/kwh																																																																																																																																			
	Annual Pumping Cost Comparison for Industrial Butterfly Valves Formula used 0.188448 Conditions Pumping Costs due to head loss in valve (in \$ for 20 years usage) =(QHR * 1.51) / E All flow rates calculated at an average liquid velocity of 12 ft/sec using Schd. 40 piping H = 2.33 (Q/Cv)² All Cv values are taken from published values at full open conditions Q = G.P.M. H = Head loss in feet of water R = Unit cost electricity in \$/kwh = \$0.04 Toronto rate <table><thead><tr><th>Size</th><th>Flow rate</th><th colspan="2">AWWA</th><th rowspan="2"></th><th colspan="2">BRAY</th></tr><tr><th></th><th>USGPM</th><th>Cv</th><th>Cost</th><th>Cv</th><th>Cost</th></tr></thead><tbody><tr><td>3 inch -</td><td>265</td><td>290</td><td>955.05</td><td></td><td>461</td><td>377.94</td></tr><tr><td>4 inch</td><td>470</td><td>530</td><td>1595.24</td><td></td><td>841</td><td>633.56</td></tr><tr><td>6 inch</td><td>1059</td><td>1270</td><td>3178.08</td><td></td><td>1850</td><td>1497.71</td></tr><tr><td>8 inch</td><td>1880</td><td>2550</td><td>4410.40</td><td></td><td>3316</td><td>2608.13</td></tr><tr><td>10 inch</td><td>2940</td><td>4020</td><td>6786.94</td><td></td><td>5430</td><td>3719.86</td></tr><tr><td>12 inch</td><td>4236</td><td>6090</td><td>8845.40</td><td></td><td>8077</td><td>5028.66</td></tr><tr><td>14 inch</td><td>5762</td><td>7070</td><td>16518.30</td><td></td><td>10538</td><td>7435.11</td></tr><tr><td>16 inch</td><td>7525</td><td>9550</td><td>20164.95</td><td></td><td>13966</td><td>9428.87</td></tr><tr><td>18 inch</td><td>9525</td><td>12100</td><td>25474.67</td><td></td><td>17214</td><td>12586.81</td></tr><tr><td>20 inch</td><td>11778</td><td>15100</td><td>30927.52</td><td></td><td>22339</td><td>14130.95</td></tr><tr><td>24 inch</td><td>26523</td><td>23100</td><td>150913.57</td><td></td><td>33154</td><td>73262.27</td></tr><tr><td>30 inch</td><td>26741</td><td>37200</td><td>59639.14</td><td></td><td>52443</td><td>30008.35</td></tr><tr><td>36 inch</td><td>38157</td><td>53300</td><td>84401.96</td><td></td><td>77089</td><td>40348.01</td></tr><tr><td>48 inch</td><td>67760</td><td>N/A</td><td>N/A</td><td></td><td>132888</td><td>76038.40</td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td>413811.21</td><td></td><td></td><td>277104.64</td></tr></tbody></table> 31 Direct Bury Actuation Yes Yes No No 32 Face To Face AWWA AWWA MSS-SP-67							Size	Flow rate	AWWA			BRAY			USGPM	Cv	Cost	Cv	Cost	3 inch -	265	290	955.05		461	377.94	4 inch	470	530	1595.24		841	633.56	6 inch	1059	1270	3178.08		1850	1497.71	8 inch	1880	2550	4410.40		3316	2608.13	10 inch	2940	4020	6786.94		5430	3719.86	12 inch	4236	6090	8845.40		8077	5028.66	14 inch	5762	7070	16518.30		10538	7435.11	16 inch	7525	9550	20164.95		13966	9428.87	18 inch	9525	12100	25474.67		17214	12586.81	20 inch	11778	15100	30927.52		22339	14130.95	24 inch	26523	23100	150913.57		33154	73262.27	30 inch	26741	37200	59639.14		52443	30008.35	36 inch	38157	53300	84401.96		77089	40348.01	48 inch	67760	N/A	N/A		132888	76038.40											413811.21			277104.64
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Appendix B – SUEZ Supplemental Conditions

SUEZ has prepared this Proposal based on the Terms and Conditions listed in McCarthy's Long Form Purchase Order (Rev. 02-22-2019) included with McCarthy's Front Ends (dated August 20, 2021) and the clarifications to those Terms and Conditions as provided within the SUEZ Supplemental Conditions.

Please find SUEZ's Supplemental Conditions attached.

McCarthy Building
Companies, Inc.
6225 North 24th Street,
Suite 200
Phoenix, Arizona
85016

THE FOLLOWING SUPPLEMENTAL TERMS AND CONDITIONS AS SET FORTH HEREIN ARE PART OF THIS PURCHASE ORDER.

ARTICLE 3. PAYMENT

Replace Article 3.1 with the following:

From payments received from Owner, Purchaser agrees to pay Seller for the Services furnished as specified, subject to additions and deductions for changes agreed to in writing by the Parties.

Notwithstanding anything to the contrary herein or elsewhere in the Contract Documents, Buyer shall make payments to Seller within sixty (60) days of receipt of Seller's approved invoice or within fourteen (14) days of Buyer's receipt of such payment from Owner, whichever occurs earliest, except for those payments withheld by Owner due to actions or inactions attributable to Seller.

Payments by Purchaser under this Purchase Order is conditioned upon receipt, inspection and acceptance by Purchaser of goods conforming to this Purchase Order.

ARTICLE 4. SHIPPING

Replace Article 4.1 with the following:

The times set forth for delivery are of the essence, and unless a delivery date is otherwise specified on the face hereof, all deliveries shall conform to the date or dates specified from time to time by Purchaser's representative and agreed to by Seller. Seller shall only be entitled to and granted an extension of time if Purchaser is so entitled and granted under its contract with the Project Owner. The Prime Contract may contain a liquidated damages clause under which Contractor may be liable for liquidated damages in completing the Project. Should Seller default in the performance of this Purchase Order, which delay causes delay to the critical path of the Project, Seller shall be liable for liquidated damages to Buyer as a result of such default. Seller shall not be liable under this Section if such default is caused by the provisions of Article 28, provided that notice of same shall be furnished in writing by Seller to Buyer within forty-eight (48) hours of occurrence. Seller's liability for liquidated damages is limited to only if liquidated damages are paid by Buyer and for which Buyer can establish Seller's proportionate share of responsibility. The payment of specified liquidated damages by Seller shall be capped at the maximum liability of the 10% of the contract price. The Parties acknowledge and agree that the terms, conditions and amounts fixed as schedule liquidated damages are reasonable, considering the damages that Buyer can

reasonably be expected to sustain, and that these amounts are agreed upon and fixed as liquidated damages because of the difficulty of ascertaining the exact amount of damages that may be sustained as a result of delay or performance deficiencies and are Buyer's sole and exclusive remedy for delay by Seller in achieving completion of the Work within the time specified in the Purchase Order.

Add a New Article 4.6 as follows:

4.6 The place of delivery specified herein shall be firm and fixed, provided that Buyer may notify Seller no later than forty-five (45) days prior to the scheduled shipment date of the Equipment of an alternate point of delivery, Buyer shall compensate Seller for any additional cost in implementing the change. If any part of the Equipment cannot be delivered when ready due to any cause not attributable to Seller, Buyer shall designate a suitable storage location, and Seller shall ship such Equipment to storage. Title and risk of loss shall thereupon pass to Buyer and amounts payable to Seller upon delivery or shipment shall be paid by Buyer along with expenses incurred by Seller. Buyer shall pay any increase, and Buyer shall pay directly all costs for storage and subsequent transportation.

ARTICLE 8 PERFORMANCE GUARANTEES

Replace the Article with the following:

Seller hereby guarantees that the materials, equipment and/or systems furnished under this Purchase Order shall operate and perform as defined in the Contract Documents. Should the materials, equipment and/or systems fail to meet the required performance, Seller shall repair or replace, at Seller's expense, any/or all components, parts, materials, labor, supplies, tools, and consumables necessary to achieve the required level of performance.

ARTICLE 10 TERMINATION

Replace Article 10 with the following:

This Agreement and any performance pursuant to it may be terminated by either Party, and the consequences of such termination shall be as set out in the next paragraph, if the other Party

(a) becomes insolvent, makes an assignment for the benefit of its creditors, has a receiver or trustee appointed for the benefit of its creditors, or files for protection from creditors under any bankruptcy or insolvency laws; or

(b) fails to make any payment when due or to establish any payment security required by this Agreement or commits a material breach or defaults in its material obligations under this Agreement, and such default is not cured within thirty (30) days of written notice from the other Party.

Upon the termination of this Agreement by Buyer for cause (i) Seller shall reimburse Buyer the difference between that portion of the Agreement price allocable to the terminated scope and the actual amounts reasonably incurred by Buyer to complete that scope, and (ii) Buyer shall pay to Seller (a) the portion of the Agreement price allocable to Equipment completed, and (b) amounts for Services performed before the effective date of termination. Upon the termination

of this Agreement by Seller for cause Buyer shall pay to Seller within thirty (30) days of receipt of invoice the price of all Equipment or Services delivered at the date of termination, plus an amount equal to all costs and expenses incurred in the engineering, sourcing, financing, procurement, manufacture, storage and transportation of the Equipment including materials, work in progress and any cancellation charges assessed against Seller by Seller's suppliers including reasonable overhead and profit on all such costs and expenses.

ARTICLE 15 APPLICABLE LAW

Add a new Article 15.1

15.1 All permits, authorizations, and licenses which are required to construct, install and/or operate Buyer's facility or equipment, to use the Equipment, or to manage and dispose of any wastes, discharges, and residues resulting from Buyer's use of the Equipment, shall be obtained and maintained by Buyer at Buyer's sole expense. Buyer is responsible for compliance with all laws and regulations applicable to the storage, use, handling, installation, maintenance, removal, registration, and labelling of all Equipment after delivery of the Equipment, as well as for the proper management and disposal of all wastes, discharges, and residues.

ARTICLE 16 WARRANTY

Replace Article 16 with the following:

The Seller warrants that all articles, material and work supplied by the Seller under this Purchase Order will be free from defects in design, material and workmanship and will conform to the Specifications, Drawings, samples or other descriptions furnished or adopted by the Purchaser. Seller also warrants to Purchaser that services will be performed in a first-class workmanlike manner consistent with industry standards. In addition, if material furnished contains one or more manufacturer's warranties, Seller hereby assigns such warranties to Purchaser. All warranties shall survive inspection, acceptance and payment. Seller agrees to repair or replace free of charge any part or parts which prove defective or which operate unsatisfactorily. Seller also guarantees that the items as specified in the Purchase Order are of sufficient size or capacity to perform as specified. Seller's sole responsibility and Buyer's exclusive remedy arising out of or relating to the Equipment or Services or any breach of these warranties is limited to Seller making all necessary alterations, repairs, and replacement free of charge. If the defects or failure to function cannot be corrected, Seller agrees to promptly replace said items free of charge or to remove the items and refund the full purchase price. Seller agrees to promptly make good, without cost to Purchaser, any and all defects due to faulty materials which may appear within the guarantee or warranty period so established in the prime agreement, and if no such period is stipulated in the prime agreement, then such guarantees shall be for a period of one year from the date of completion and acceptance of the Project by the Project Owner or eighteen months from delivery, whichever occurs first.

The warranties and remedies are conditioned upon (a) proper unloading, handling, storage, installation, use, operation, and maintenance of the Equipment and Buyer's facility and all related system in accordance with Seller's instructions and, in the absence, generally accepted industry practice, (b) Buyer keeping accurate and complete records of operation and

maintenance during the warranty period and providing Seller access to those records, and (c) modification or repair of Equipment or Services only as authorized by Seller in writing.

The warranties and remedies set forth in this article are in lieu of and exclude all other warranties and remedies, statutory, express or implied, including any warranty of merchantability or of fitness for a particular purpose.

ARTICLE 19 INDEMNITY

Replace Article 19 with the following:

THE SELLER SHALL INDEMNIFY, DEFEND AND HOLD PURCHASER AND THE PROJECT OWNER HARMLESS FOR, FROM AND AGAINST ALL SUITS, CLAIMS, LOSSES OR DAMAGES THAT MAY BE BASED UPON ANY ALLEGED INJURY TO OR THE DEATH OF ANY PERSON PHYSICAL DAMAGE TO THIRD -PARTY PROPERTY TO THE EXTENT CAUSED BY THE NEGLIGENCE OF SELLER WHILE ENGAGED IN ACTIVITIES UNDER THIS AGREEMENT, REGARDLESS OF WHETHER IT IS CAUSED IN PART BY THE ACTS, OMISSIONS OR NEGLIGENCE OF A PARTY INDEMNIFIED HEREUNDER. SELLER SHALL, AT ITS OWN COST AND EXPENSE, PAY ALL COSTS AND EXPENSES OF SUIT INCLUDING ATTORNEYS' FEES IN CONNECTION THEREWITH AND IF ANY JUDGMENT SHALL BE RENDERED AGAINST THE PURCHASER IN ANY SUCH ACTION OR ACTIONS THE SELLER SHALL SATISFY AND DISCHARGE THE SAME WITHOUT COST OR EXPENSE TO PURCHASER. PURCHASER SHALL BE ENTITLED TO SELECT COUNSEL OF ITS CHOOSING, SUBJECT TO SELLER'S REASONABLE APPROVAL, IN CONNECTION WITH ANY INDEMNITY OBLIGATION OWED TO PURCHASER BY SELLER PURSUANT TO THIS PARAGRAPH. BUYER SHALL LIKEWISE INDEMNIFY AND HOLD HARMLESS SELLER FROM CLAIMS FOR PHYSICAL DAMAGE TO THIRD PARTY PROPERTY OR INJURY TO PERSONS, INCLUDING DEATH, TO THE EXTENT CAUSED BY THE NEGLIGENCE OF THE BUYER. IN THE EVENT SUCH DAMAGE OR INJURY IS CAUSED BY THE JOINT OR CONCURRENT NEGLIGENCE OF SELLER AND BUYER, THE LOSS SHALL BE BORNE BY EACH PARTY IN PROPORTION TO ITS NEGLIGENCE.

ARTICLE 20 INSURANCE

Replace Article 20 with the following:

Seller shall provide evidence of insurance by means of an ACCORD Certificate to Purchaser covering its obligations under this Purchase Order. Such insurance coverage shall include Commercial General Liability including Products/Completed Operation coverage with limits of \$2,000,000 per occurrence and \$4,000,000 general aggregate/products completed operations aggregate; and Automobile liability coverage with limits of \$1,000,000. Such insurance coverage shall be evidenced by a Certificate of Insurance and shall name the Purchaser, the Project Owner as well as any additional entities required by the Owner Contract as Additional Insureds on all such insurance policies but only in respect of work performed by or on behalf of the named insured, Seller, and only to the extent that the additional insured is held liable for the negligence or other culpability of Seller. Coverage under Seller's policy does not extend to liability arising out of the additional insured's own negligence. Such additional insured coverage shall be primary and non- contributory to any other policies maintained by Purchaser or the Project Owner. The Commercial General Liability Policy additional insured

coverage shall be provided on ISO endorsement form CG 20 26 07 04 or equivalent endorsement as determined and approved by Purchaser, unless otherwise limited by applicable law. If Seller's scope of work includes on-site services in connection with installation, additional insured endorsements CG 20 10 and CG 20 37, or equivalent endorsements providing coverage to the fullest extent allowed by law must be provided, unless otherwise limited by applicable law. These insurance policies shall include a Waiver of Subrogation in favor of the Purchaser and the Project Owner but only to the extent that the Buyer is provided protection as an additional insured. Purchaser reserves the right to request additional coverage or endorsements as Purchaser may require based on the nature and scope of the goods and services being provided herein.

If Seller's operations include the transportation of any hazardous material, the Automobile Liability policy shall contain coverage for transportation of hazardous materials by endorsement CA 99 48 or its equivalent. The Automobile policy will attach a MCS-90 endorsement.

In addition, Seller shall maintain Workers' Compensation insurance with limits established by statute in the state where the services will be provided under this agreement. All Seller employees shall be covered under such policies, including employees who are sole proprietors, members or partners, whether or not required by applicable law.

All insurance requirements shall flow down to on-site suppliers and delivery entities of any tier and any flow down of these requirements does not relieve Seller of its obligation to provide the insurance required herein

Replace Article 20.3 with the following:

In addition to the coverage specifications listed above, such policy shall provide and the Certificate of Insurance will list, that the retroactive date coincides with or precedes Seller's commencement of work under this Purchase Order. If insurance is terminated for any reason, Seller shall purchase an extended reporting provision for the duration of the applicable statute of repose and any applicable statute of limitations to report claims in connection with this Purchase Order.

ARTICLE 28 EXCUSABLE DELAYS (NEW)

Add the following new Article 28

Seller shall not be liable nor in breach or default of its obligations under this Agreement to the extent performance of such obligations is delayed or prevented, directly or indirectly, due to causes beyond the reasonable control of Seller, including, but not limited to: acts of God, natural disasters, unusually severe weather, fire, terrorism, war (declared or undeclared) epidemics, material shortages, insurrection, act (or omissions) of Buyer or Buyer's contractors/suppliers or agents, any act (or omission) by any governmental authority, strikes, labor disputes, transportation shortages, or vendor non-performance. The delivery or performance date shall be extended for a period equal to the time lost by reason of delay or non-performance, plus such additional time as may be necessary to overcome the effect of the delay or non-performance. If delivery or performance is delayed for a period exceeding 180 (one hundred and

eighty) days, either Party may terminate this Agreement without further liability provided that Seller shall be paid an amount equal to that which would be payable to Seller under the article entitled "Termination". If Seller is delayed by any acts (or omissions) of Buyer, or by the prerequisite work of Buyer's other contractors or suppliers, Seller shall be entitled to an equitable adjustment in schedule, price and/or performance, as applicable.

ARTICLE 29 CONFIDENTIALITY INTELLECTUAL PROPERTY

Add the following new Article 29

Both Parties agree to keep confidential the other Party's proprietary non-public information, if any, which may be acquired in connection with this Agreement. Buyer will not, without Seller's advance written consent, subject Equipment to testing, analysis, or any type of reverse engineering. Seller retains all intellectual property rights including copyright which it has in all drawings and data or other deliverables (including the Equipment) supplied or developed under this Agreement. Buyer agrees that it will not file patent applications on the Equipment or any development or enhancement of the Equipment, or of processes and methods of using the Equipment, without Seller's express prior written permission. Buyer further agrees that in any event any such patents will not be asserted against Seller or its other buyers based upon purchase and use of such Equipment. Seller grants to Buyer a non-exclusive, non-terminable, royalty free license to use the intellectual property embedded in Equipment delivered to and paid for by the Buyer, as well as any drawings, design or data delivered to and paid for by the Buyer, for the purposes of owning, financing, using, operating and maintaining the relevant Equipment at Buyer's site. Such license may only be assigned to a subsequent owner of the Equipment or to an operations and maintenance subcontractor. Such license does not extend to the re-creation of the Equipment or the manufacture of spares or consumables by Buyer or third parties. Any software Seller owns and provides pursuant to this Agreement shall remain Seller's property. Seller provides to Buyer a limited, non-exclusive and terminable royalty free project-specific license to such software for the use, operation or maintenance at Buyer's site of any Equipment purchased hereunder to which the software is a necessary component. Buyer agrees not to copy, sub-license, translate, transfer, reverse engineer, or decode the software.

ARTICLE 30 LIMITATION OF LIABILITY (NEW)

Add the following new Article 30

Notwithstanding anything else contained in this Agreement, to the maximum extent permitted by law, and regardless of whether a claim is based in contract (including warranty or indemnity), extra-contractual liability, tort (including negligence or strict liability), statute, equity or any other legal theory:

(a) EXCLUDING SELLER'S THIRD-PARTY INDEMNITY OBLIGATIONS, GROSS NEGLIGENCE OR WILLFUL MISCONDUCT AND LIABILITY FOR BREACH OF CONFIDENTIALITY THE TOTAL LIABILITY OF THE SELLER FOR ALL CLAIMS ARISING OUT OF OR RELATING TO THE PERFORMANCE OR BREACH OF THIS AGREEMENT OR USE OF ANY EQUIPMENT OR SERVICES SHALL NOT EXCEED THE TOTAL PRICE PAID BY BUYER UNDER THIS AGREEMENT;

(b) IN NO EVENT SHALL EITHER PARTY BE LIABLE FOR ANY LOSS OF PROFIT OR REVENUES, LOSS OF PRODUCTION, LOSS OF USE OF EQUIPMENT OR SERVICES OR ANY ASSOCIATED EQUIPMENT, INTERRUPTION OF BUSINESS, COST OF CAPITAL, COST OF REPLACEMENT WATER OR POWER, DOWNTIME COSTS, INCREASED OPERATING COSTS, CLAIMS OF BUYER'S CUSTOMERS FOR SUCH DAMAGES, OR FOR ANY SPECIAL, CONSEQUENTIAL, INCIDENTAL, INDIRECT, PUNITIVE OR EXEMPLARY DAMAGES;

(c) SELLER'S LIABILITY SHALL END UPON EXPIRATION OF THE APPLICABLE WARRANTY PERIOD, PROVIDED THAT BUYER MAY CONTINUE TO ENFORCE A CLAIM FOR WHICH IT HAS GIVEN NOTICE PRIOR TO THAT DATE BY COMMENCING AN ACTION OR ARBITRATION, AS APPLICABLE UNDER THIS AGREEMENT, BEFORE EXPIRATION OF ANY STATUTE OF LIMITATIONS OR OTHER LEGAL TIME LIMITATION BUT IN NO EVENT – TO THE EXTENT PERMITTED BY APPLICABLE LAW – LATER THAN FIVE (5) MONTHS AFTER EXPIRATION OF SUCH WARRANTY PERIOD.

Appendix C – Piping and Instrumentation Diagrams

The main equipment included in SUEZ's scope of supply for the City of Chandler Reclaimed Water Interconnect Facility project is listed in tables found in **Section 3** of this Proposal. These tables should be read in conjunction with the Piping and Instrumentation Diagrams (P&IDs) found attached. A general scope of supply table, including items not listed on the P&IDs, follows the detailed scope tables.

The P&IDs and scope of supply tables define SUEZ's scope of supply and that provided by the Contractor or Owner (by others). In case of conflict, SUEZ's P&IDs take precedence for SUEZ supplied equipment and devices. On the P&IDs, items within SUEZ's scope of supply are shown as solid, and items not included in SUEZ's scope of supply are shown dotted.

Pipes shown as dotted are to be furnished by the Contractor (by others). The sizes of all pipes are depicted on the P&IDs. Valves are typically the same size as the pipe on which they are located.

Motor horsepower for equipment supplied by SUEZ is shown on the P&IDs.

The P&ID package includes:

415261-AA-01:	Title Page (sheet 1 of 1)
415261-AA-02:	Legend Sheet (sheet 1 of 2)
415261-AA-02:	Legend Sheet (sheet 2 of 2)
415261-AP-01:	Feed Channel (sheet 1 of 1)
415261-AP-02:	Membrane Blowers (sheet 1 of 1)
415261-AP-03:	Membrane Tanks (sheet 1 of 1)
415261-AP-05:	Process Pumps (sheet 1 of 1)
415261-AP-07:	Backpulse Tank (sheet 1 of 1)
415261-AP-10:	CIP System (sheet 1 of 1)
415261-AP-11:	Cleaning and Neutralization Chemical Systems (sheet 1 of 1)
415261-AP-12:	Compressed Air System (sheet 1 of 1)
415261-AP-13:	Common Permeate Header (sheet 1 of 1)
415261-AP-15:	Permeate Turbidimeter with Column (sheet 1 of 1)



Water Technologies & Solutions

CITY OF CHANDLER, AZ RECLAIMED WATER INTERCONNECT FACILITY ZEEWEED 500D MEMBRANE FILTRATION SYSTEM

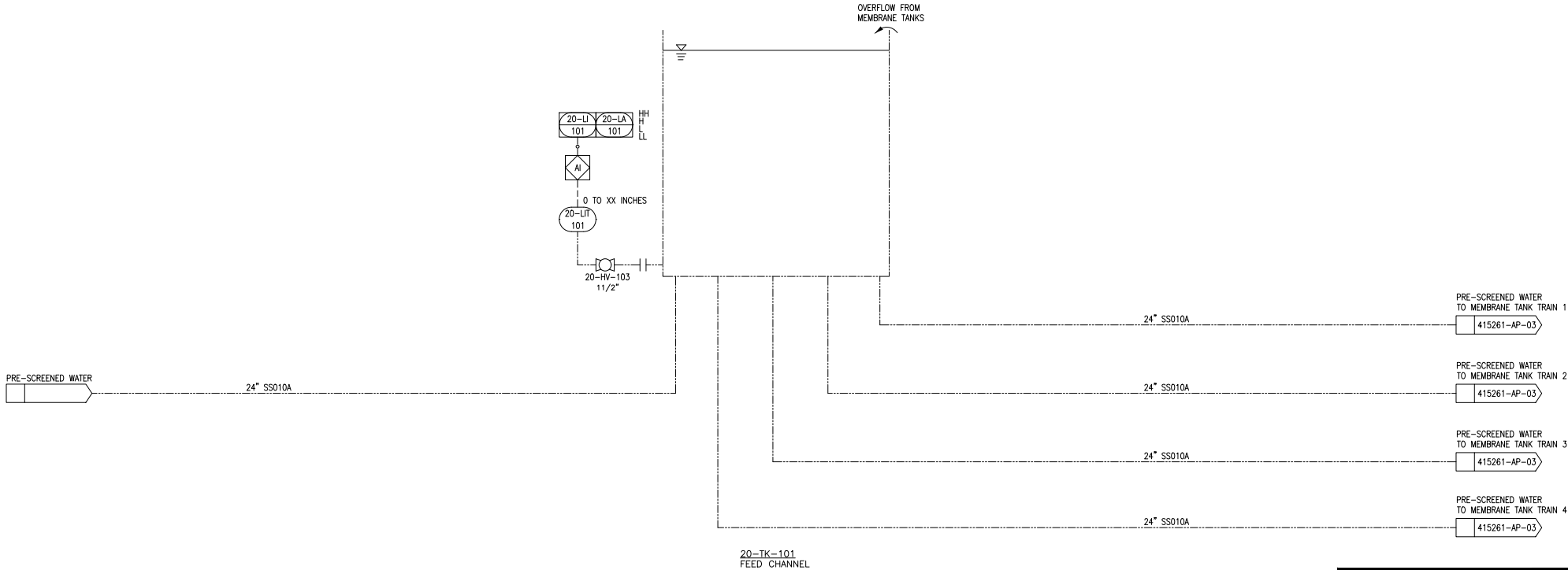
PIPING AND INSTRUMENTATION DIAGRAMS

										TOLERANCES UNLESS NOTED DECIMALS ANGLES .X XX XXX FRAC.			CUSTOMER INFORMATION		CITY OF CHANDLER, AZ RWIF	TITLE PAGE	DRAWING NUMBER 415261-AA-01 Page 355 of 367				REVISION A		
A INITIAL RELEASE						PSK KK		16 SEP 21					REF. -				DOC. OWNER:						
REV DESCRIPTION		ECO		DWN		APPR		APPR		DATE													
PROPERTY AND CONFIDENTIAL: THIS DRAWING AND ALL INFORMATION AND KNOWLEDGE CONTAINED OR REFERRED HEREIN ARE THE CONFIDENTIAL AND PROPRIETARY PROPERTY OF SUEZ AND AS SUCH ARE INSTRUMENTS OF SERVICE FOR USE SOLELY WITH RESPECT TO THIS PROJECT. THESE INSTRUMENTS OF SERVICE SHALL NOT BE REPRODUCED, TRANSMITTED, DISCLOSED OR USED OTHERWISE IN WHOLE OR IN PART, WITHOUT PRIOR WRITTEN AGREEMENT BY SUEZ AND MUST BE IMMEDIATELY RETURNED OR DESTROYED UPON REQUEST.																							
														PROJECT NO. 415261		PART/MATERIAL NO. -		SCALE N.T.S		SIZE D		SHEET 1 of 1	

8	7	6	5	4	3	2	1		
CONTROL VALVE ACTUATORS	VALVE SYMBOLS	RELIEF	PUMPS, BLOWERS, & COMPRESSORS	FLOW ELEMENT	CONNECTIONS	FILTERS	VESSELS/TRIM	MISCELLANEOUS	SCOPE BREAK
ACTUATED VALVE OPERATION IS NORMALLY CLOSED UNLESS MARKED OTHERWISE PISTON DOUBLE ACTING PISTON SPRING TO OPEN PISTON SPRING TO CLOSE DIAPHRAGM DOUBLE ACTING DIAPHRAGM SPRING TO OPEN DIAPHRAGM SPRING TO CLOSE DIAPHRAGM DOUBLE BALANCING BACK PRESSURE CONTROL (EXTERNAL REGULATING) BACK PRESSURE CONTROL (INTERNAL REGULATING) PRESSURE REDUCING (EXTERNAL REGULATING) PRESSURE REDUCING (INTERNAL REGULATING) ROTARY MOTOR ANALOG ROTARY MOTOR DIGITAL I/P CONVERTER POSITIONER TRAVEL STOP GEAR MANUAL GEAR WHEEL CHAIN MANUAL CHAIN WHEEL SOLENOID SOLENOID 3 WAY SOLENOID 4 WAY	OPEN DURING NORMAL PROCESS OPERATION CLOSED DURING NORMAL PROCESS OPERATION GATE (OR GENERIC) BALL BUTTERFLY NEEDLE GLOBE DIAPHRAGM ANGLE PLUG PINCH V-BALL KNIFE GATE UPWARD OPENING SLIDING GATE DOWNWARD OPENING SLIDING GATE MANUAL BLAST GATE BACKFLOW PREVENTER CHECK INJECTION QUILL FOOT FLOAT MUD 3 WAY 4 WAY 5 WAY 6 WAY 2 VALVE MANIFOLD 3 VALVE MANIFOLD 5 VALVE MANIFOLD SAMPLE	PRESSURE SAFETY VACUUM SAFETY MULTIFUNCTION PRESSURE RUPTURE DISK VACUUM RUPTURE DISK AIR RELEASE VACUUM BREAKER VENT VENT GROUND DRAIN	CENTRIFUGAL PUMP PROPELLER PUMP METERING PUMP AIR OPERATED DOUBLE DIAPHRAGM PUMP POSITIVE DISPLACEMENT PUMP VERTICAL TURBINE PUMP CAN PUMP WELL PUMP DRUM PUMP SUBMERSIBLE SUMP PUMP HYDRAULIC PRESSURE BOOSTER CENTRIFUGAL/REGENERATIVE BLOWER ROTARY LOBE COMPRESSOR BLOWER VACUUM PUMP (DRY) VACUUM PUMP LIQUID RING AIR COMPRESSOR PISTON AIR COMPRESSOR ROTARY SCREW REFRIGERATED AIR DRYER FAN ERI PRESSURE EXCHANGER MOTOR	PADDLE WHEEL ANNUBAR FLOW NOZZLE FLUME MAGNETIC PITOT SONIC/ULTRASONIC TURBINE VENTURI TUBE VORTEX MASS FLOW/CORIOLIS ROTAMETER IN-LINE FLOW GLASS FLOW STRAIGHTENER FIXED ORIFICE ADJUSTABLE ORIFICE RESTRICTED ORIFICE RESTRICTED ORIFICE ANGLE ORIFICE PLATE QUICK-CHANGE	FLANGE FLANGE BLIND MECHANICAL COUPLING OR VICTAULIC MECHANICAL COUPLING OR VICTAULIC PLUG SANITARY SANITARY PLUG THREADED THREADED PLUG SOCKET UNION CAMLOCK CAMLOCK PLUG HOSE BARB WELDED PIPE CAP PLAIN END PIPE COUPLING REDUCER COMPRESSION FITTING COMPRESSION FITTING PLUG SPECTACLE BLIND OPEN SPECTACLE BLIND CLOSED HEATING TANK HEATER HEAT EXCHANGER IN-LINE HEATER PLATE & FRAME HEAT EXCHANGER DESUPERHEATER	FIXED SCREEN TOP HAT STRAINER BAR SCREEN HEPA FILTER Y STRAINER CONICAL STRAINER FILTER PUMP SCREEN STEAM TRAP RESIN TRAP RO/UF FOUR PORT HOUSING TWO PORT HOUSING END PORT HOUSING MEMBRANE MODULE	CONICAL BOTTOM TANK TANK (CLOSED TOP) TANK (OPEN TOP) DOMED TANK PRESSURE VESSEL HORIZONTAL/VERTICAL OR RECEIVER PROPELLER AGITATOR VORTEX BREAKER VESSEL INSULATION LEVEL GLASS ELLIPTICAL MANWAY MANHOLE MANHOLE W/ DAVIT ARM VESSEL SIGHT GLASS WATER LEVEL LADDER/PLATFORM	MUFFLER EDUCTOR STATIC MIXER EXPANSION JOINT SILENCER VIBRATION ISOLATOR HIGH PRESSURE FLEXIBLE CONNECTOR INJECTION SPARGER DIAPHRAGM SEAL/ GAUGE GUARD PULSATION DAMPENER SPRAYER NOZZLE DESICCANT AIR DRYER HYDROMETER POT COARSE BUBBLE DIFFUSER ELEVATION VIEW FINE BUBBLE DIFFUSER ELEVATION VIEW THERMOWELL TOP MOUNT LEVEL SWITCH ULTRASONIC LEVEL CALIBRATION COLUMN PIG TAIL ION EXCHANGE BOTTLE	CLIENT/OTHER SUEZ MATERIAL BREAK MATERIAL A MATERIAL B PIPE INSULATION/ DOUBLE CONTAINMENT PP 2' ("PP" INDICATES PERSONNEL PROTECTION - OPTIONAL) LINE TYPES PRIMARY PROCESS SECONDARY PROCESS SAMPLE/DRAINS/ VENTS/ETC PRIMARY PROCESS (BY OTHERS) SECONDARY PROCESS (BY OTHERS) FUTURE EQUIPMENT LIMIT OR BOUNDARY LINE EQUIPMENT EQUIPMENT (BY OTHERS) FLEX HOSE/TUBING SOFTWARE-LINK ELECTRICAL ELECTROMAGNETIC OR SONIC SIGNAL (WIRELESS) PNEUMATIC HYDRAULIC SIGNAL CAPILLARY TUBING HEAT-TRACING STEAM-TRACE ELECTRICAL-TRACE MISCELLANEOUS LINE OBJECTS SLOPE CONTINUATION SYMBOL CROSSOVER LINE REVISION CLOUD REVISION TRIANGLE
TOLERANCES UNLESS NOTED DECIMALS ANGLES FRAC. INITIAL RELEASE REV DESCRIPTION ECO DWN APPR DATE 16 SEP 21				CUSTOMER INFORMATION CITY OF CHANDLER, AZ RWIF				LEGEND SHEET Page 152 of 187 PROJECT NO. 415261 PART/MATERIAL NO. SCALE N.T.S. SIZE D SHEET 1 OF 2	
8	7	6	5	4	3	2	1		

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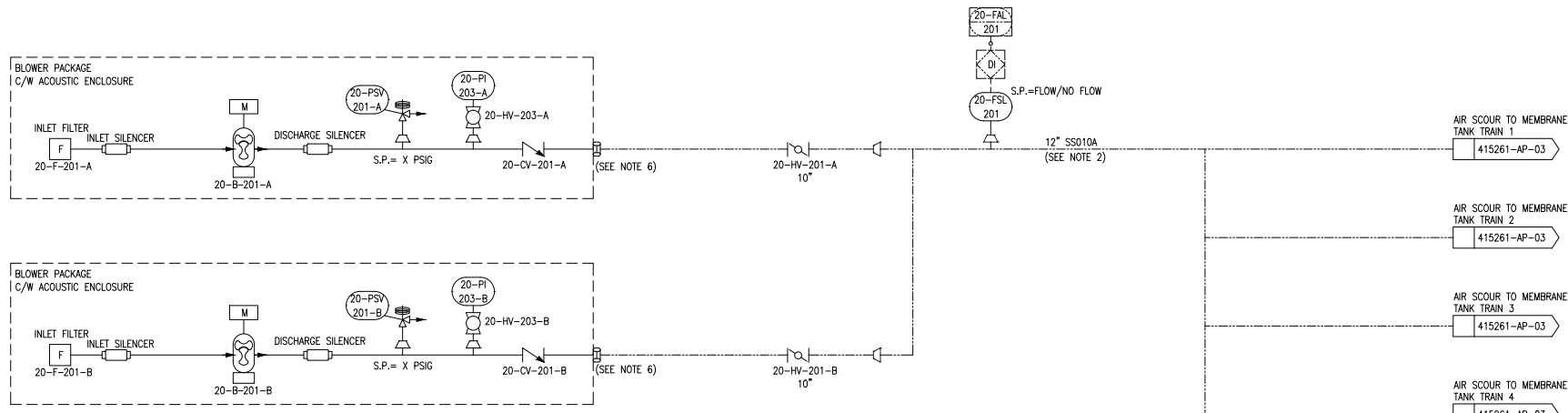
- NOTES:
1. ALL DOTTED LINES/EQUIPMENT BY OTHERS.
 2. ALL DRAIN POINTS TO BE PLUMBED TO DRAIN BY OTHERS.
 3. FINAL SIZING AND DESIGN TO BE VERIFIED DURING DETAILED PROJECT ENGINEERING.



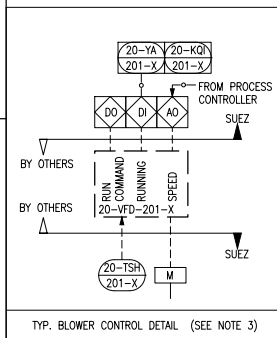

**REFERENCE ONLY
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TOLERANCES UNLESS NOTED						CUSTOMER INFORMATION		P&ID, FEED CHANNEL		DRAWING NUMBER		REVISION
DECIMALS						CITY OF CHANDLER, AZ RWIF		415261-AP-01		415261-AP-01		A
ANGLES								Page 958 of 967		DOC. OWNER:		
FRAC.								PROJECT NO.		PART/MATERIAL NO.		SHEET
								415261				1 OF 1
								SCALE		NONE		SIZE
								D				
								LAST SAVED: Friday, September 24, 2021 9:37:33 AM				

- NOTES:
1. ALL DOTTED-LINE EQUIPMENT TO BE SUPPLIED BY OTHERS.....
 2. ALL DRAIN POINTS TO BE PLUMBED TO DRAIN BY OTHERS.
 3. SYSTEM INTEGRATOR IS RESPONSIBLE FOR HOT AIR PIPE INSULATION FOR PERSONAL PROTECTION, AS APPLICABLE.
 4. VFD MUST BE CONSTANT TORQUE.
 5. DUTY/STANDBY OPERATION ONLY.
 6. THE ACTUAL BLOWER DISCHARGE PRESSURE IS DETERMINED BASED ON MAXIMUM POSSIBLE LIQUID LEVEL IN TANKS BEING AERATED.
 7. BLOWER DISCHARGE FLEXIBLE SLEEVE.
 8. FINAL SIZING AND DESIGN TO BE VERIFIED DURING DETAILED PROJECT ENGINEERING.



20-B-201-A/B
MEMBRANE AIR SCOUR BLOWERS
INITIAL DESIGN CAPACITY: 1,990 SCFM @ 5.5 PSIG
FUTURE DESIGN CAPACITY: 2,490 SCFM @ 5.7 PSIG
125 HP, 1800 RPM, 460V/3ph/60Hz



TYP. BLOWER CONTROL DETAIL (SEE NOTE 3)

REV		DESCRIPTION	ECO	DNW	APPR	DATE
A		INITIAL RELEASE				16 SEP 21
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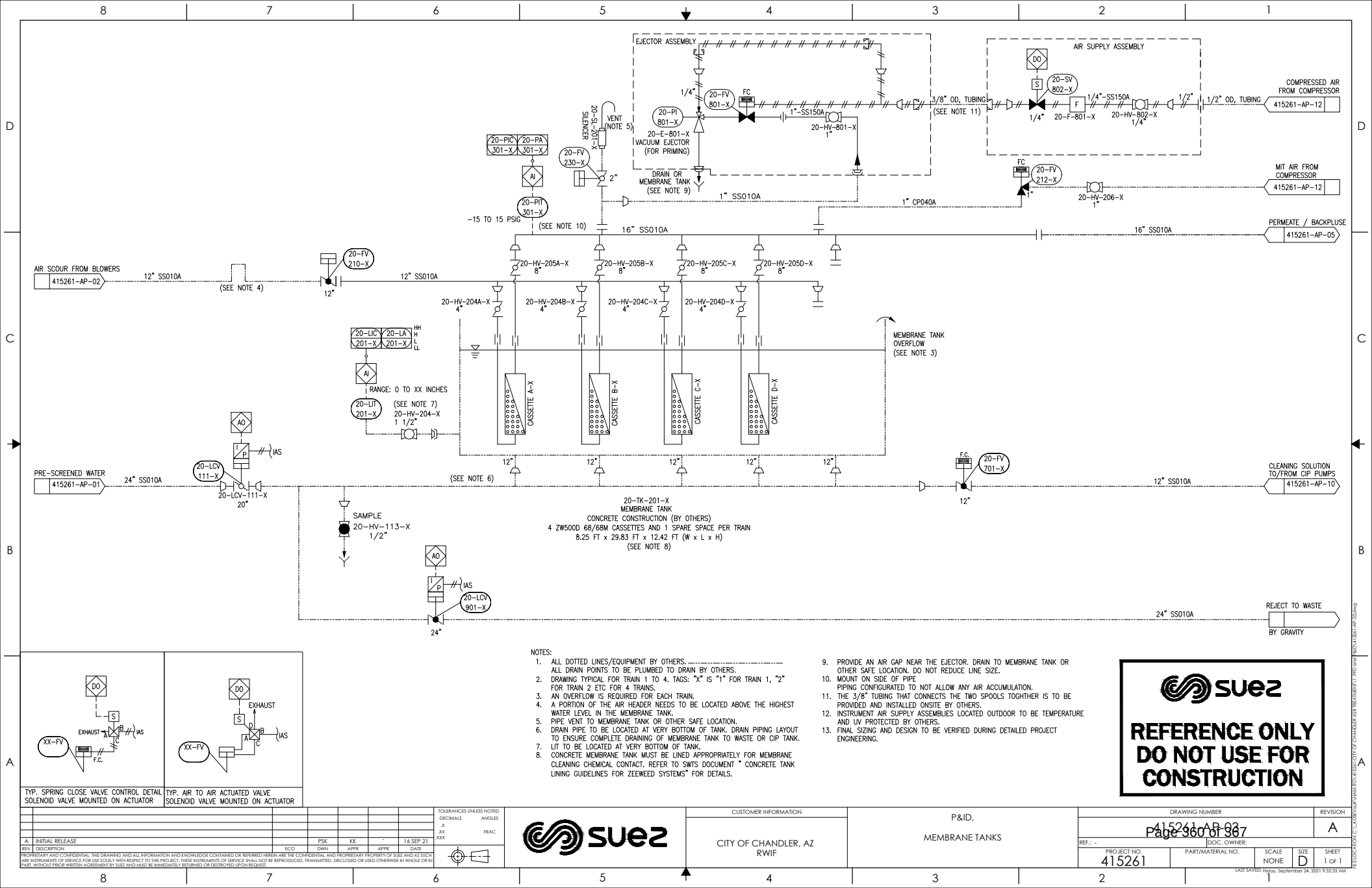


CUSTOMER INFORMATION
CITY OF CHANDLER, AZ
RWIF

P&ID,
MEMBRANE BLOWERS

DRAWING NUMBER		REVISION	
415261-AP-03		A	
REF: -	DOC. OWNER:	PART/MATERIAL NO.	SHEET
PROJECT NO. 415261		SCALE NONE	1 OF 1

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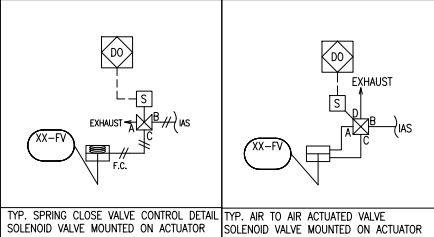


NOTES:

- ALL DOTTED LINES/EQUIPMENT BY OTHERS.
- ALL DRAIN POINTS TO BE PLUMBED TO DRAIN BY OTHERS.
- DRAWING TYPICAL FOR TRAIN 1 TO 4. TAGS: "X" IS "1" FOR TRAIN 1, "2" FOR TRAIN 2 ETC FOR 4 TRAINS.
- AN OVERFLOW IS REQUIRED FOR EACH TRAIN.
- A PORTION OF THE AIR HEADER NEEDS TO BE LOCATED ABOVE THE HIGHEST WATER LEVEL IN THE MEMBRANE TANK.
- PIPE VENT TO MEMBRANE TANK OR OTHER SAFE LOCATION.
- DRAIN PIPE TO BE LOCATED AT VERY BOTTOM OF TANK. DRAIN PIPING LAYOUT TO ENSURE COMPLETE DRAINING OF MEMBRANE TANK TO WASTE OR CIP TANK.
- LIT TO BE LOCATED AT VERY BOTTOM OF TANK.
- CONCRETE MEMBRANE TANK MUST BE LINED APPROPRIATELY FOR MEMBRANE CLEANING CHEMICAL CONTACT. REFER TO SWIS DOCUMENT "CONCRETE TANK LINING GUIDELINES FOR ZEEWEED SYSTEMS" FOR DETAILS.
- PROVIDE AN AIR GAP NEAR THE EJECTOR. DRAIN TO MEMBRANE TANK OR OTHER SAFE LOCATION. DO NOT REDUCE LINE SIZE.
- MOUNT ON SIDE OF PIPE.
- PIPING CONFIGURED TO NOT ALLOW ANY AIR ACCUMULATION.
- THE 3/8" TUBING THAT CONNECTS THE TWO SPOOLS TOGETHER IS TO BE PROVIDED AND INSTALLED ONSITE BY OTHERS.
- INSTRUMENT AIR SUPPLY ASSEMBLIES LOCATED OUTDOOR TO BE TEMPERATURE AND UV PROTECTED BY OTHERS.
- FINAL SIZING AND DESIGN TO BE VERIFIED DURING DETAILED PROJECT ENGINEERING.



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REV	DESCRIPTION	ECO	DNW	APPR	DATE
A	INITIAL RELEASE				16 SEP 21

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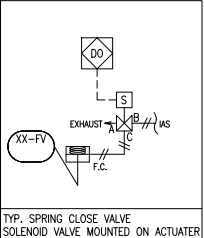
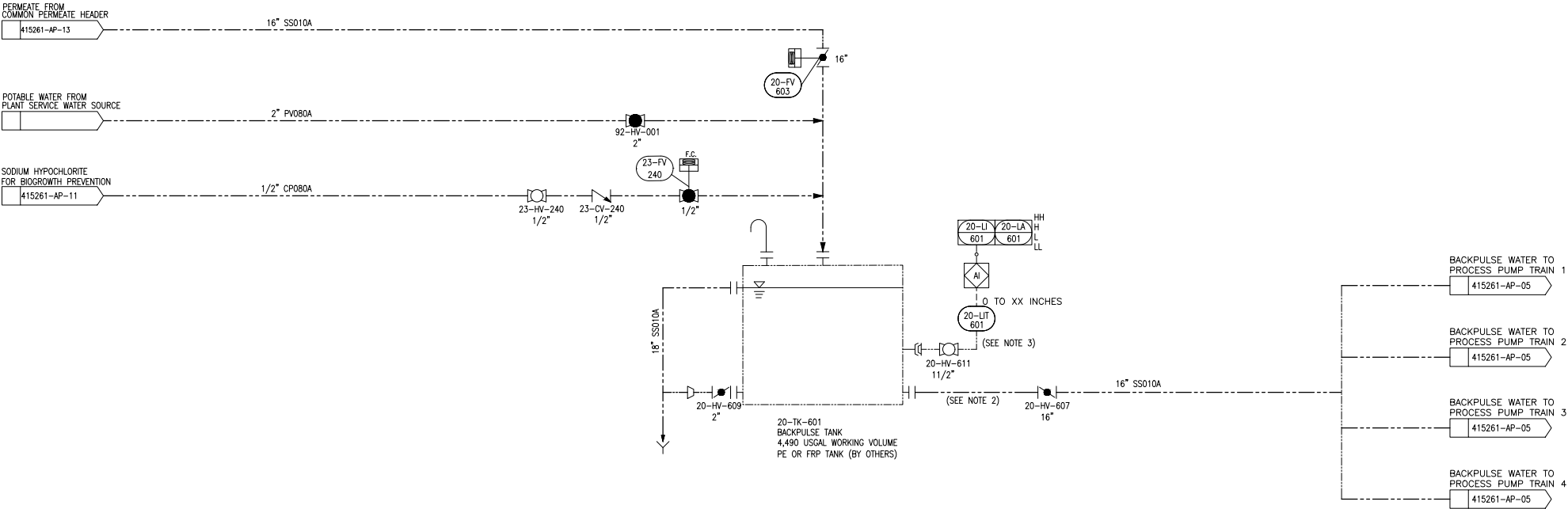
CUSTOMER INFORMATION
CITY OF CHANDLER, AZ
RWIF

P&ID,
MEMBRANE TANKS

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PROJECT NO.	PART/MATERIAL NO.	SCALE	SHEET
415261		NONE	1 OF 1

LAST SAVED: Friday, September 24, 2021 9:32:33 AM

- NOTES:
1. ALL DOTTED LINES/EQUIPMENT BY OTHERS. -----
 2. ALL DRAIN POINTS TO BE PLUMBED TO DRAIN BY OTHERS.
 3. PIPE SPOOL FOR ISOLATION VALVE ACTUATION.
 4. LIT TO BE LOCATED AT VERY BOTTOM OF TANK.
 5. FINAL SIZING AND DESIGN TO BE VERIFIED DURING DETAILED PROJECT ENGINEERING.



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A	INITIAL RELEASE		PRM	KK	06 SEP 21

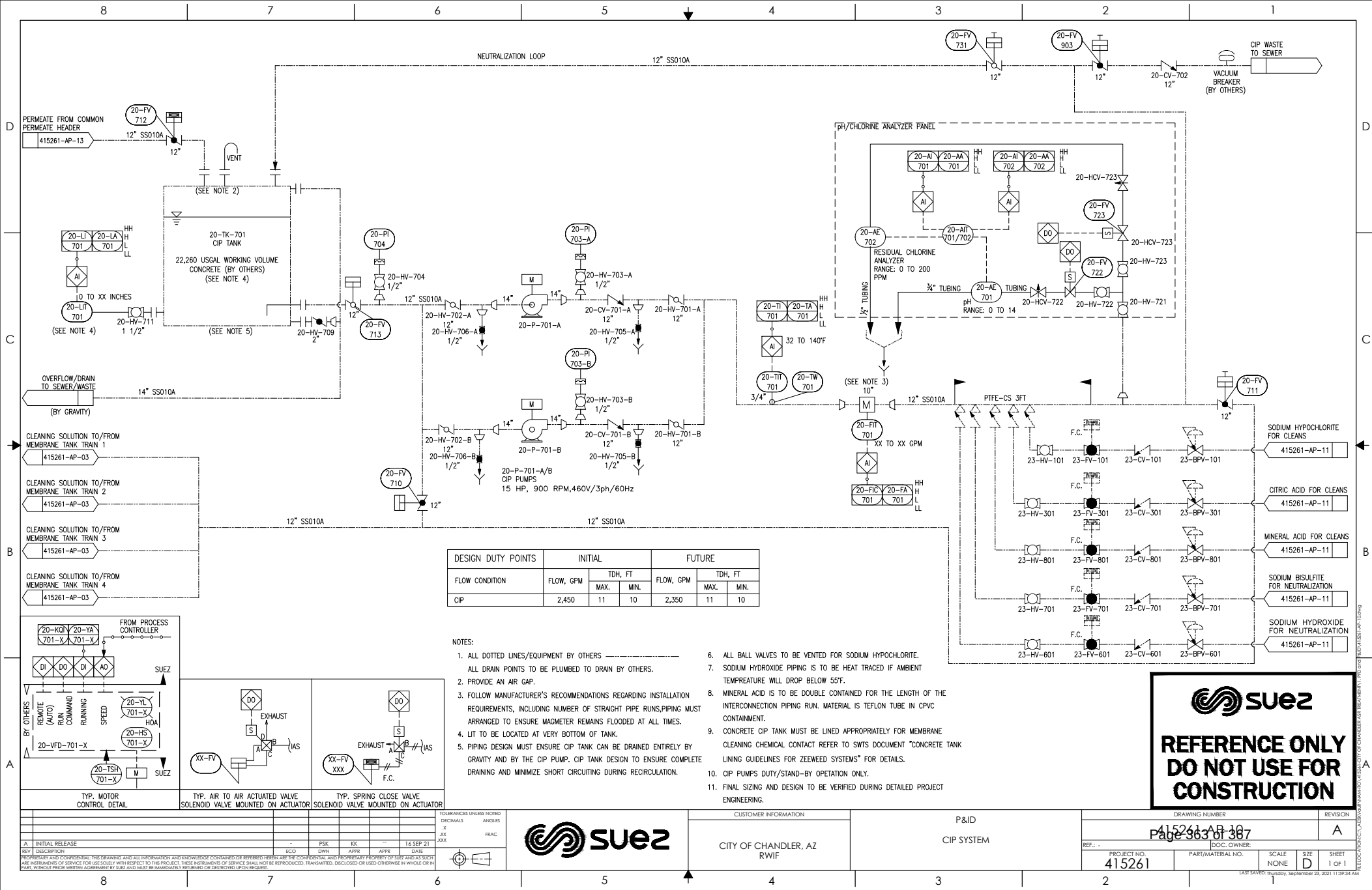
TOLERANCES UNLESS NOTED	DECIMALS	ANGLES
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XXX		

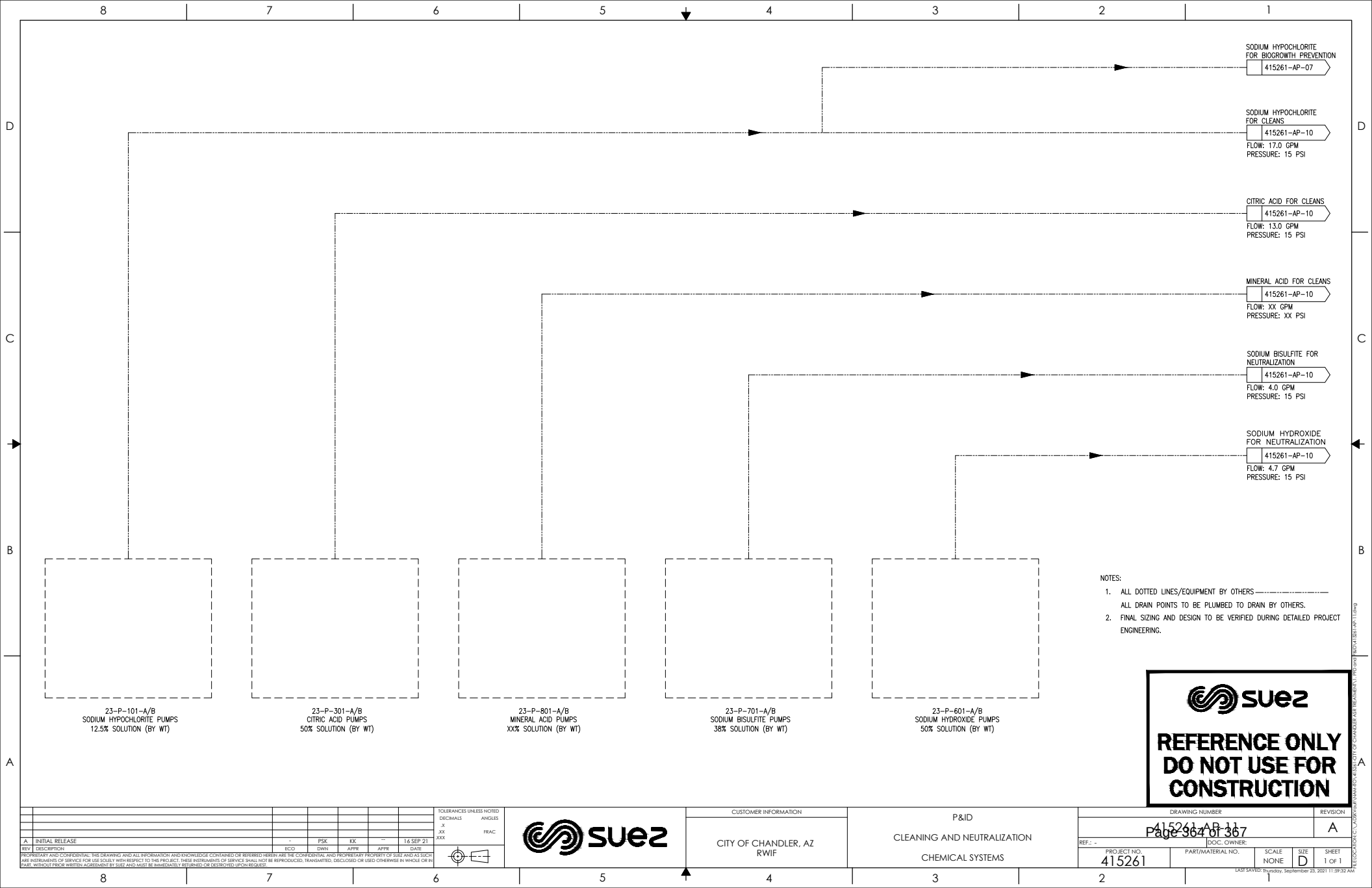


CITY OF CHANDLER, AZ
RWIF

P&ID
BACKPULSE TANK

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SODIUM HYPOCHLORITE
FOR BIOGROWTH PREVENTION
415261-AP-07

SODIUM HYPOCHLORITE
FOR CLEANS
415261-AP-10
FLOW: 17.0 GPM
PRESSURE: 15 PSI

CITRIC ACID FOR CLEANS
415261-AP-10
FLOW: 13.0 GPM
PRESSURE: 15 PSI

MINERAL ACID FOR CLEANS
415261-AP-10
FLOW: XX GPM
PRESSURE: XX PSI

SODIUM BISULFITE FOR
NEUTRALIZATION
415261-AP-10
FLOW: 4.0 GPM
PRESSURE: 15 PSI

SODIUM HYDROXIDE
FOR NEUTRALIZATION
415261-AP-10
FLOW: 4.7 GPM
PRESSURE: 15 PSI

23-P-101-A/B
SODIUM HYPOCHLORITE PUMPS
12.5% SOLUTION (BY WT)

23-P-301-A/B
CITRIC ACID PUMPS
50% SOLUTION (BY WT)

23-P-801-A/B
MINERAL ACID PUMPS
XX% SOLUTION (BY WT)

23-P-701-A/B
SODIUM BISULFITE PUMPS
38% SOLUTION (BY WT)

23-P-601-A/B
SODIUM HYDROXIDE PUMPS
50% SOLUTION (BY WT)

- NOTES:
1. ALL DOTTED LINES/EQUIPMENT BY OTHERS -----
 2. ALL DRAIN POINTS TO BE PLUMBED TO DRAIN BY OTHERS.
 3. FINAL SIZING AND DESIGN TO BE VERIFIED DURING DETAILED PROJECT ENGINEERING.



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A	INITIAL RELEASE	PSK	KK	16 SEP 21

TOLERANCES UNLESS NOTED
DECIMALS
ANGLES
FRAC.

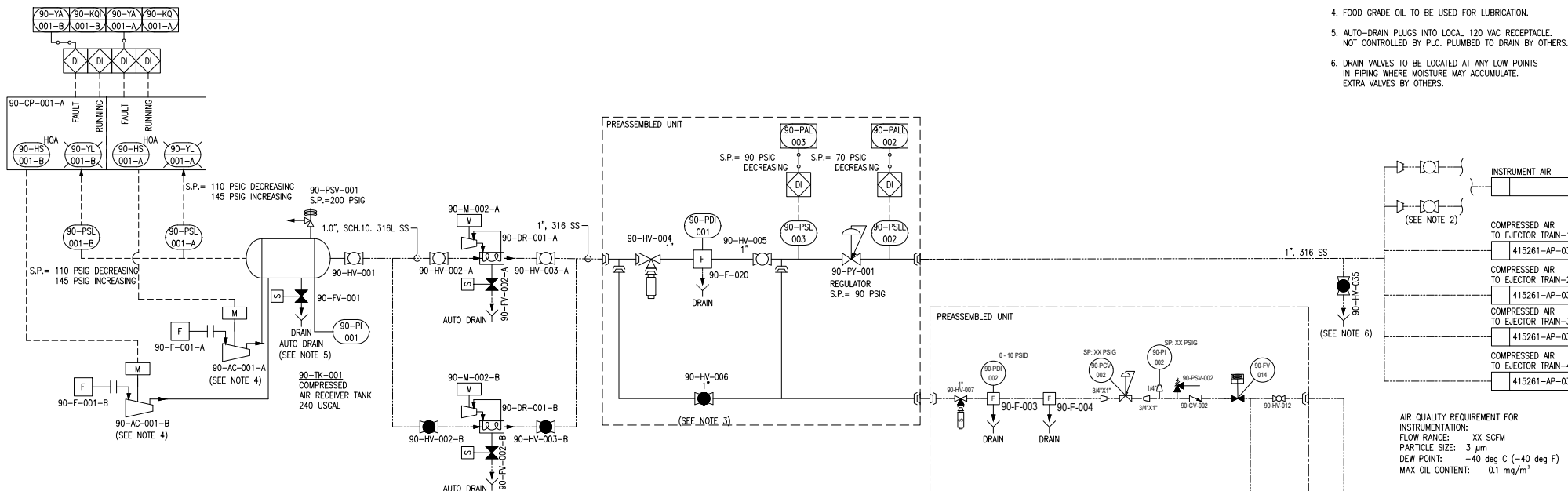


CITY OF CHANDLER, AZ
RWIF

P&ID
CLEANING AND NEUTRALIZATION
CHEMICAL SYSTEMS

DRAWING NUMBER	REVISION
415261-AP-11	A
REF. -	DOC. OWNER
PROJECT NO. 415261	PART/MATERIAL NO.
SCALE NONE	SIZE D
SHEET 1 OF 1	

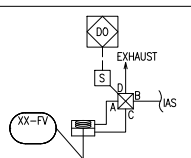
- NOTES:
1. ALL DOTTED LINES/EQUIPMENT BY CONTRACTOR.
 2. MULTIPLE LINES WITH AT LEAST 1 ISOLATION VALVE PER TRAIN.
 3. HANDLE FOR BYPASS VALVE TO BE LOCKED IN CLOSED POSITION.
 4. FOOD GRADE OIL TO BE USED FOR LUBRICATION.
 5. AUTO-DRAIN PLUGS INTO LOCAL 120 VAC RECEPTACLE. NOT CONTROLLED BY PLC. PLUMBED TO DRAIN BY OTHERS.
 6. DRAIN VALVES TO BE LOCATED AT ANY LOW POINTS IN PIPING WHERE MOISTURE MAY ACCUMULATE. EXTRA VALVES BY OTHERS.



AIR QUALITY REQUIREMENT FOR INSTRUMENTATION:
 FLOW RANGE: XX SCFM
 PARTICLE SIZE: 3 µm
 DEW POINT: -40 deg C (-40 deg F)
 MAX OIL CONTENT: 0.1 mg/m³

AIR QUALITY REQUIREMENT FOR MIT:
 FLOW RANGE: XX SCFM
 PARTICLE SIZE: 0.01 µm
 DEW POINT: -40 deg C (-40 deg F)
 MAX OIL CONTENT: 0.004 mg/m³

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TWO(2) 100% AIR COMPRESSOR
 90-AC-001-A/B
 101 CFM @175 PSI
 30 HP, 460VAC/3 PH/60Hz

TWO(2) 100% AIR DRYER
 90-DR-001-A/B
 132 CFM @100 PSI
 115VAC/1 PH/60Hz

ONE(1) 100% PRIMARY COALESCING
 90-F-020
 FILTER W/INTEGRAL
 AUTO-DRAIN
 3 µm

ONE(1) 100% SECONDARY COALESCING
 90-F-021
 FILTER W/INTEGRAL
 AUTO-DRAIN
 0.01 µm

ONE(1) 100% ACTIVATED CARBON
 90-F-022
 FILTER W/INTEGRAL
 MANUAL-DRAIN
 0.01 µm

TYP. SPRING CLOSE VALVE
 SOLENOID VALVE MOUNTED ON ACTUATOR

REV	DESCRIPTION	ECO	PSK	DWN	KK	APPR	DATE
1	INITIAL RELEASE						16 SEP 21
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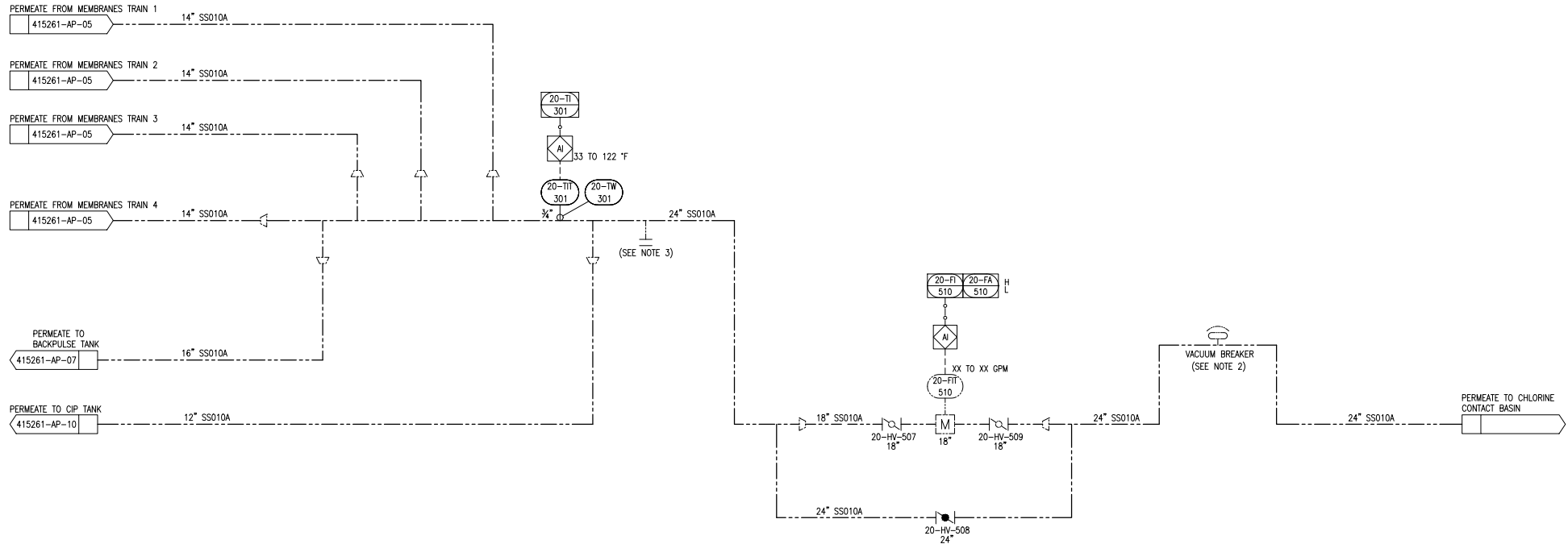
CITY OF CHANDLER, AZ
RWIF

P&ID
COMPRESSED AIR SYSTEM

DRAWING NUMBER		REVISION
415261-AP-12		A
PROJECT NO.	PART/MATERIAL NO.	SHEET
415261		1 OF 1
LAST SAVED: Thursday, September 23, 2021 11:57:30 AM		

NOTE:

1. ALL DOTTED LINES/EQUIPMENT BY OTHERS. -----
2. ALL DRAIN POINTS TO BE PLUMBED TO DRAIN BY OTHERS.
3. PROVIDE BACKPRESSURE IF REQUIRED TO FILL BACKPULSE AND CIP TANKS.
4. TEMPORARY CONNECTION TO ALLOW RECIRCULATION OF PERMEATE TO THE HEAD OF THE PLANT FOR COMMISSIONING.
5. FINAL SIZING AND DESIGN TO BE VERIFIED DURING DETAILED PROJECT ENGINEERING.



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A	INITIAL RELEASE		PSK	KK	16 SEP 21

TOLERANCES UNLESS NOTED	DECIMALS	ANGLES
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	XXX	FRAC.



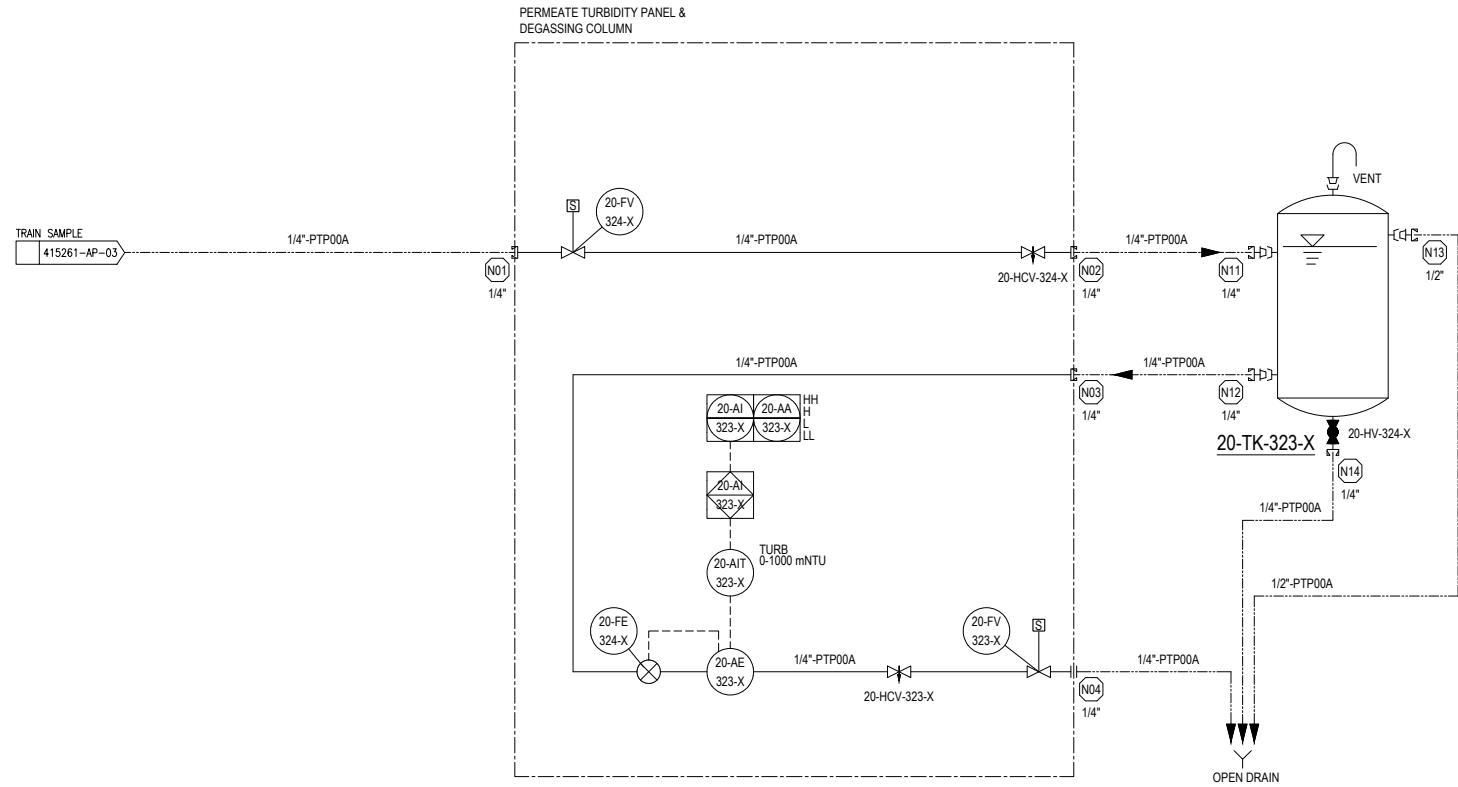
CITY OF CHANDLER, AZ
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P&ID
COMMON PERMEATE HEADER

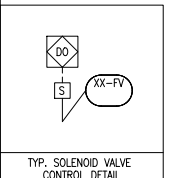
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PROJECT NO. 415261	PART/MATERIAL NO. -
SCALE 1	SIZE D
SHEET 1 OF 1	

LAST SAVED: Friday, September 24, 2021 9:40:16 AM

- NOTES:
1. ALL DOTTED LINES\EQUIPMENTS BY OTHERS. -----
 2. ALL DRAIN POINTS TO BE PLUMBED TO ATMOSPHERIC DRAIN (BY OTHERS).
 3. DRAWING TYPICAL FOR TRAINS 1 TO 4
"X" IS REPLACED WITH "-1" FOR TRAIN 1, "-2" FOR TRAIN 2 ETC FOR 4 TRAINS.
 4. TURBIDIMETER TRANSMITTER MUST BE CONFIGURED TO FAIL HIGH.
 5. FLOW SET TO 3.3 GPH.



20-TK-323-X
DEGASSING COLUMN
VOLUME: 0.66 USGAL
MOC: PVC(CLEAR), SCH. 80



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A	INITIAL RELEASE				16 SEP 21

TOLERANCES UNLESS NOTED	DECIMALS	ANGLES
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	XXX	FRAC.



CUSTOMER INFORMATION
CITY OF CHANDLER, AZ RWIF

P&ID,
PERMEATE TURBIDIMETER, W/COLUMN

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					SHEET 1 of 1

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EXHIBIT E



RECLAIMED WATER INTERCONNECT FACILITY – GMP 1
Project No. WW1901.402

SUBCONTRACTOR'S LIST FORM

If CM@Risk intends to subcontract any portion of this contract, 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

N/A