



South Oslo Road Water Treatment Plant (WTP) Improvements

Prepared For:
Indian River County Utilities Department

Prepared By:
Kimley-Horn and Associates, Inc.
1920 Wekiva Way, Suite 200
West Palm Beach FL 33411
Ca 00000696

MARCH 2021
PROJECT NO. 044572100



SECTION 01000

TABLE OF CONTENTS

<u>Division</u>	<u>Section</u>	<u>Title</u>
1		GENERAL REQUIREMENTS
	01010	Summary of Work
	01030	Hurricane Preparedness
	01050	Field Engineering and Surveying
	01150	Measurement and Payment
	01200	Coordination and Project Meetings
	01300	Submittals
	01410	Testing Laboratory Services
	01590	Field Offices and Sheds
	01600	Material and Equipment
	01700	Project Closeout
	01720	Project Record Drawings
	01730	Operation and Maintenance Manuals
2		SITE WORK
	02016	Existing Utilities and Underground Structures
	02065	Demolition
	02150	Dewatering
	02200	Earthwork, Excavation and Backfill
	02270	Erosion and Sedimentation Control
	02485	Grassing
	02510	Paving and Surfacing
	02580	Pavement Markings
	02670	Flushing, Testing and Disinfection
3		CONCRETE
	03100	Concrete Formwork
	03200	Concrete Reinforcement
	03300	Cast-in-Place Concrete
4		MASONRY – NOT USED
5		METALS
	05120	Structural Steel
	05500	Miscellaneous Metals
	05700	Anchors, Fasteners and Injection Adhesives
6		WOOD AND PLASTICS
	06300	Laboratory
	06610	Fiberglass Fabrications

7		THERMAL AND MOISTURE PROTECTION
	07190	Vapor Barrier
	07920	Joint Sealants
8		DOORS AND WINDOWS – NOT USED
9		FINISHES
	09900	Painting
10		SPECIALTIES
	10400	Identifying Devices
11		EQUIPMENT
	11209	Membrane Softening System
	11212	Liquid Carbon Dioxide Storage Tank
	11280	Control Valves
	11504	Sulfuric Acid Equipment
	11506	Membrane Cleaning System
	11507	Caustic Equipment
	11508	Scale Inhibitor Equipment
	11930	Pumps – General
	11931	Horizontal End Suction Pumps (Motors Only)
	11932	FRP Horizontal End Suction Pump
	11936	Vertical Turbine Pumps & Motors
12		FURNISHINGS – NOT USED
13		SPECIAL CONSTRUCTION
	13080	Vibration and Alignment
	13441	Instrumentation Components
14		CONVEYING SYSTEMS – NOT USED
15		MECHANICAL
	15000	Basic Mechanical Requirements
	15100	Piping and Valves
	15260	Piping Insulation
	15410	Plumbing Piping
	15430	Plumbing Specialties
	15440	Plumbing Fixtures
16		ELECTRICAL (NOT INCLUDED IN PERMIT SUBMITTAL)
	16000	Electrical General Requirements
	16001	Electrical Demolition
	16050	Basic Materials and Methods
	16110	Lightning Protection
	16681	Variable Frequency Drives

16690	Electric Motors
16901	Instrumentation and Control Systems
16910	Programmable Logic Controller
16913	PLC and SCADA Programming

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 01010
SUMMARY OF WORK

PART 1 - GENERAL

1.1 WORK COVERED BY THESE CONTRACT DOCUMENTS

- A. Furnish all labor and materials necessary to construct the improvements to the existing South Oslo Road Water Treatment Plant in Indian River County, Florida, including the following but not including the additive alternates listed herein: site preparation, demolition, drainage improvements, paving, grading, miscellaneous yard and process piping improvements, feedwater pump motor replacement, transfer pump motor replacement, four (4) 1.875 mgd nanofiltration trains, two (2) new high service pumps, chemical piping replacement, electrical equipment, instrumentation, valves, piping, WTP and wellfield PLC & SCADA system equipment, process piping trenches, painting and coatings; and all accessory items to provide a complete operating system as depicted in these documents.
- B. Contractor's Duties:
 - 1. Except as specifically noted, provide and pay for:
 - a. Mobilization and demobilization.
 - b. Labor, materials, and equipment.
 - c. Tools, construction equipment, and fuel.
 - d. Electric, water and utilities required for construction.
 - e. Freight and sales tax.
 - f. Testing and laboratory services.
 - g. Surveying and field engineering.
 - h. Record Information in a format acceptable to the Engineer. Information will be used by the Engineer for Record Drawing development.
 - i. Compliance with all of the conditions of the permits issued for this project.
 - j. Construction dewatering.

1.2 WORK COVERED BY WATER TREATMENT PLANT CONTRACT DOCUMENTS (ADDITIVE ALTERNATES)

- A. The following work shall be included under additive alternate bid items which the Owner may elect to construct under this contract in the priorities listed. The work under these additive alternates is depicted on the drawings and specified herein:
 - 1. **Additive Alternate 1:** Items under this bid item shall include the following:
 - a. Demolition of existing membrane CIP system and construction of new as shown on the contract drawings. Work includes a new fiberglass ANSI end suction pump, insulated fiberglass tanks, cartridge filter vessel, heater, mixer, control panel, piping, valves, structural support improvements, process piping trench improvements for CIP system, and all other appurtenances necessary to make a complete and functional CIP system as shown on the contract drawings and described herein.
 - 2. **Additive Alternate 2:** Items under this bid item shall include the following:

- a. Renovations to the existing WTP laboratory including flooring replacement, replacement of base and wall cabinetry, new countertops, sinks, plumbing, electrical chases, painting, and miscellaneous improvements as shown on the contract drawings and described herein.
3. **Additive Alternate 3:** Items under this bid item shall include the following:
 - a. Construction of a second bulk sodium hydroxide (caustic) storage tank, piping, valves, heat trace, insulation, and all other components as shown on the contract drawings and described herein.
4. **Additive Alternate 4:** Items under this bid item shall include the following:
 - a. Construction of a 30-ton bulk liquid CO₂ storage tank, complete with vaporizer, vapor heater, enclosure, piping, reinforced concrete support slab, grading and drainage improvements as shown on the contract drawings and described herein.
5. **Additive Alternate 5:** Items under this bid item shall include the following:
 - a. Construction of the redundant 18-inch transfer piping to the ground storage tanks. Work under this bid item includes all labor and materials necessary to provide the complete redundant transfer main, modifications to the existing transfer piping, relocation of light pole and existing carrier water pump & associated equipment, removal and re-installation of existing degasifier access ladder and cage, and all other improvements as depicted on the construction plans.
6. **Additive Alternate 6:** Items under this bid item shall include the following:
 - a. Construction and replacement of the existing finished water panel with new, including FRP status panel, supports, piping, rotameters, analyzers, stack, valves, etc. This additive alternate does not include the pressure switches, flow switches, and flow meters as these components are included in the base bid.
7. **Additive Alternate 7:** Items under this bid item shall include the following:
 - a. Construction and replacement of Well S6 instrumentation including pressure switch, pressure transmitter, flow meter, level transmitter and motor starter and enclosure, conduit, wiring, etc. as depicted on the construction plans.

1.3 CONTRACTS

- A. Construct the Work under a Lump Sum Price contract in accordance with the contract documents and with the Owner.
- B. Subcontractors (when used) shall work directly for the contractor.

1.4 WORK BY OTHERS AND FUTURE WORK

- A. The Owner reserves the right to add to the work in accordance with the Contract Documents.
- B. The Owner reserves the right to direct purchase significant pieces of equipment and/or materials included in this contract by means of a deductive Change Order to this Contract and issuance of a Purchase Order to the supplier or vendor of the equipment or materials for the purpose of the sales tax end use savings.
- C. The programming for the Programmable Logic Controller (PLC) and computer systems (HMI) will be provided by Mark Biehl with Control Systems Design.
 1. The bidder and their instrumentation and controls (I & C) supplier will coordinate as necessary with the programmer, and shall supply, install and test the complete instrumentation including 5-point calibration on all instruments with completed calibration

sheets. This includes furnishing and installing the PLC, testing, including processors, discrete I/O devices, analog I/O devices, network routers, peripherals and software requirements.

2. Contact information for Control Systems Design, Inc. is as follows; P: (941) 907-8815; e-mail: mb.csdinc@gmail.com.

1.5 WORK SEQUENCE

- A. To minimize plant shutdowns, specific sequence of work will be discussed and decided at the Pre-Work Conference, whereas certain areas may be assigned priority to accommodate Owner's needs.
- B. Sequence of construction is provided for the contractor's benefit. Contractor shall read the sequence of construction in its entirety to fully understand the proposed work and how each improvement impacts operations. Equipment and materials required in subsequent tasks must be procured in advance to minimize impacts to operations.
- C. Electrical, PLC and SCADA system improvements associated with each of the improvements proposed shall be completed in advance or concurrent to the associated task.
- D. The suggested sequence of construction is provided to minimize impacts to operations and shutdown durations during construction.
- E. The following sequence of construction is suggested for the **high service pumps and piping**:
 1. Phase 1:
 - a. Construct 14, 20 and 24-inch high service pump suction yard piping improvements. Contractor shall coordinate draining of the west ground storage tank with the owner to facilitate new tank penetration and rehabilitation of existing tank penetration. Perform disinfection and leak testing per specifications. Upon engineer's acceptance, owner will fill tank. **Only one (1) tank may be out of service at any given time.**
 - b. Construct high service pumps 4 and 5. Construct 24-inch finished water main to existing 30-inch transmission main and 30"x24" wet tap. Conduct functional testing and compliance water quality sampling. High service pumps 4 & 5 fully functional and online.
 2. Phase 2:
 - a. Construct 14, 20 and 24-inch high service pump suction yard piping improvements. Contractor shall coordinate draining of the east ground storage tank with the owner to facilitate new tank penetration and rehabilitation of existing tank penetration. Perform disinfection and leak testing per specifications. Upon engineer's acceptance, owner will fill tank. **Only one (1) tank may be out of service at any given time.**
 - b. Furnish/install bell joint restraints and concrete thrust collar for existing 24/30-inch finished water main. Construct 24-inch sleeve for line stop on existing 24-inch finished water main.
 - c. Sink line stop. Remove flow meter in existing vault and replace with 24-inch spool pipe and valve. Remove line stop and close valve.
 - d. Construct dual high service pump discharge meter header. Complete connections to existing 24-inch finished water main.
 3. Phase 3:
 - a. Construct trench piping improvements to high service pumps 1, 2 & 3 as shown in the plans.
 - b. High service pumps 1, 2 and 3 become re-activated. All five (5) high service pumps are to be fully functional and operational.

- F. The following sequence of construction is provided for the membrane system replacement:
1. General, pre-phase 1:
 - a. Construct new trenches & trench extensions as shown in these drawings.
 - b. Demolish existing membrane clean-in-place system, complete.
 - c. Construct permeate - raw water blend improvements. Construct 14-inch permeate yard piping from blend location to process building.
 - d. Construct concentrate piping connection to concentrate treatment facility. Construct 10-inch concentrate yard piping from CTF to process building.
 2. Phase 1 (NF2):
 - a. Replace feedwater pump 2 motor with new, inverter duty rated, TEFC per specifications. Replace soft starter with variable frequency drive. Refer to electrical drawings.
 - b. Remove feed piping to train 2 as shown in plans. Install temporary blind flange on existing feedwater header.
 - c. Demolish train 2. Install temporary blind flanges on permeate and concentrate headers.
 - d. Construct new dedicated feedwater piping to train 2 as shown in the plans. Install temporary blind flange where spare feedwater valve will be installed. Construct train 2, complete.
 - e. Conduct train functional testing per specifications. Conduct bacteriological sampling and submit two (2) consecutive passing results along with feed and permeate water quality test results to the engineer for review.
 - f. Engineer will submit request for partial clearance to FDEP for acceptance.
 3. Phase 2 (NF3):
 - a. Upon acceptance of train 2, contractor is permitted to begin work on train 3. **No other trains shall be taken out of service until train 2 has been accepted by the engineer and owner.**
 - b. Remove feed piping to train 3 as shown in plans. Install temporary blind flange on existing feedwater header.
 - c. Demolish train 3. Install temporary blind flanges on permeate and concentrate headers.
 - d. Construct new dedicated feedwater piping to train 3 as shown in the plans. Install temporary blind flange where spare feedwater valve will be installed. Construct train 3, complete.
 - e. Conduct functional testing per specifications. Conduct bacteriological sampling and submit two (2) consecutive passing results along with feed and permeate water quality test results to the engineer for review.
 - f. Engineer will submit request for partial clearance to FDEP for acceptance.
 4. Phase 3 (NF4):
 - a. Upon acceptance of train 3, contractor is permitted to begin work on train 4. **No other trains shall be taken out of service until train 3 has been accepted by the engineer and owner.**
 - b. Replace feedwater pump 4 motor with new, inverter duty rated, TEFC per specifications. Refer to electrical drawings.
 - c. Demolish feed piping to train 4 & demolish existing 8-inch feedwater header (eastern half). Install temporary blind flange on existing flange to maintain service of feedwater header to trains 1 and 2 (western half).

- d. Demolish train 4. Install temporary blind flanges on permeate and concentrate headers.
 - e. Construct new dedicated feedwater piping to train 4 as shown in the plans. Install temporary blind flange where spare feedwater valve will be installed. Construct train 4, complete.
 - f. Remove existing 14-inch and 10-inch PVC permeate piping within trench. Install 14-inch lug butterfly valve and temporary blind flange in trench to maintain operation of trains 1 & 2.
 - g. Remove existing 8-inch PVC concentrate piping and install 8-inch lug butterfly valve and temporary blind flange to maintain operation of trains 1 & 2.
 - h. Construct new 8-inch concentrate piping. Complete connection to new 10-inch concentrate piping constructed in step d.
 - i. Construct new 14-inch permeate piping. Complete connection to permeate piping constructed in step c.
 - j. Conduct functional testing per specifications. Conduct bacteriological sampling and submit two (2) consecutive passing results along with feed and permeate water quality test results to the engineer for review.
 - k. Bac-t results for this event may account for the new train and permeate piping. If contractor wishes to conduct separate bac-t samples for the train and the process piping, contractor may do so at his or her expense.
 - l. Engineer will submit request for partial clearance to FDEP for acceptance.
5. Phase 4 (NF1):
- a. Upon acceptance of train 4, contractor is permitted to begin work on train 1. **No other trains shall be taken out of service until train 4 has been accepted by the engineer and owner.**
 - b. Replace existing feedwater pump 1 and 5 motors with new, inverter duty rated, TEFC per specifications. Replace soft starters with variable frequency drives. Refer to electrical drawings.
 - c. Remove feed piping to train 1 and remaining feed header piping as shown in plans.
 - d. Demolish train 1. Isolate permeate and concentrate flows through trains 3 & 4, close valves in trench. Demolish 16/18-inch PVC permeate piping and 8-inch concentrate piping.
 - e. Construct new 16-inch permeate piping and 8-inch concentrate piping.
 - f. Relocate dump valve as shown in plans and install (2) blind flanges in place of existing location.
 - g. Construct new dedicated feedwater piping to train 1 as shown in the plans. Construct spare feedwater piping from feedwater pump 5 to all four trains as shown in the plans.
 - h. Conduct train functional testing per specifications. Conduct bacteriological sampling and submit two (2) consecutive passing results along with feed and permeate water quality test results to the engineer for review.
 - i. Engineer will submit request for partial clearance to FDEP for acceptance.
6. All other improvements shown in the plans may be completed at any time during the construction such that they do not impact the sequencing described herein.

1.6 CONTRACTOR-FURNISHED PRODUCTS AND RESPONSIBILITIES

- A. Products furnished to the site and paid for by Contractor: All products necessary to complete the work described herein these contract documents and specifications to provide a complete and functional
- B. Contractor's Responsibilities:
 - 1. Review and incorporate Owner-reviewed shop drawings, product data, and samples into the construction of the project.
 - 2. Receive and unload products at site; inspect for completeness or damage jointly with Owner.
 - 3. Repair or replace items damaged after receipt.
 - 4. Arrange and pay for product delivery to site.
 - 5. Handle, store, protect and install all delivered products.
 - 6. Submit claims for transportation damage and replace damaged, defective, or deficient items.
 - 7. Arrange for manufacturers' warranties, inspections, and service.

1.7 PERMITS REQUIRED

- A. The Owner will obtain the appropriate FDEP permit for the project.
- B. Contractor shall obtain any required dewatering permits required for the execution of the work.
- C. Contractor shall prepare and submit permit application and plans to Indian River County Building Department and pay the associated permit application fees. The Contractor will be responsible to submit the permit application, obtain the permit and associated subcontractor permits.

1.8 CONTRACTOR'S USE OF THE PREMISES

- A. All work shall be within the limits of construction shown on the plans.
- B. Access to the site shall be from Oslo Road. Contractor shall not obstruct or park along the right of way or any roadways or parking areas.
- C. Time restrictions for performing work: All work shall be performed during daylight working hours, Monday through Friday, 7:00 AM to 6:00 PM. The Contractor may extend working hours only if approved in writing by the Owner.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

Not used.

- END OF SECTION -

SECTION 01030
HURRICANE PREPAREDNESS

PART 1 - GENERAL

1.1 HURRICANE PREPAREDNESS PLAN

- A. The Contractor's attention is drawn to the possibility of hurricane or severe storm conditions occurring at the site of work during the course of Contract Work.
- B. Within fourteen (14) days of the date of the Notice to Proceed, the Contractor shall submit to the Engineer and Owner a Hurricane Preparedness Plan specific to this project. The plan should outline the necessary measures which the Contractor proposes to perform at no additional cost to the Owner in case of a hurricane or severe weather warning.
- C. In the event of inclement weather, or whenever the Owner shall direct, the Contractor shall, and will, cause Subcontractors to protect carefully the Work and materials against damage or injury. Work and materials damaged due to inclement weather shall be removed and replaced at the expense of the Contractor.
 - 1. Hurricane Watch: Upon designation of a hurricane watch, the Contractor shall be responsible for storing all loose supplies and strapping down or removing large materials and equipment on the job site that may pose a danger. In addition, the Contractor shall remove all bulkheads and plugs in pipelines that would impede drainage in the case of flooding. Structures that may be in danger of floatation shall be flooded. The Contractor shall also cooperate with the Owner in protecting any other structures at the site.
 - 2. Hurricane Warning: No mobile "temporary facility" under the control of or on the property of the Owner shall be staffed during a hurricane warning. Contractor facilities meeting these criteria shall be evacuated. Reasonable steps shall be taken to protect all such facilities and their contents from damage and to avoid the facility causing damage to the surroundings.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

Not used.

- END OF SECTION -

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 01050
FIELD ENGINEERING AND SURVEYING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Provide and pay for field engineering and surveying services required for the project.
- B. Owner's representative will identify existing control points, as required.
- C. Related requirements in other parts of the project manual:
 - 1. Conditions of the Contract.
- D. Related requirements specified in other sections and divisions:
 - 1. Section 01010 - Summary of Work.
 - 2. Section 01720 – Project Record Drawings.

1.2 QUALIFICATIONS OF SURVEYOR

- A. Qualified Land Surveyor registered in the state of Florida.

1.3 SURVEY REFERENCE POINTS

- A. Existing basic horizontal and vertical control points for the project are those designated on the drawings.
- B. Contractor shall locate and protect survey control and reference points.

1.4 PROJECT SURVEY REQUIREMENTS

- A. Establish lines, grades, and elevations by instrumentation or similar appropriate means utilizing recognized engineering survey practices.
- B. Horizontal alignment for the proposed construction will be controlled by right-of-way lines, property line, and existing structures. The Contractor shall be responsible to establish reference lines and necessary offsets to establish piping alignment, and equipment and structure location.
- C. Vertical alignment for the proposed construction will be based on the existing grades and benchmark identified on the drawings. The Contractor shall be responsible to establish proposed grades. The grade stakes shall be provided by the Contractor.

1.5 RECORDS

- A. Maintain a complete, accurate log of all control and survey work as it progresses.
- B. Submit a copy of the site drawing and certificate signed by land surveyor that the elevations and locations of the Work are in conformance with the Contract Documents.

1.6 SUBMITTALS

- A. Deliver Submit name and address of Surveyor/Engineer or Owner.
- B. On request, submit copies of field notes.

1.7 EXAMINATION

- A. Contractor is responsible for verifying survey control points prior to initiation of work.
- B. Contractor shall promptly notify Engineer of any discrepancies discovered.

1.8 QUALITY CONTROL

- A. Quality control of the Work shall be the Contractor's responsibility and Contractor shall make every effort to produce the best quality of work, as specified on the drawings and specifications.
- B. Twenty-four (24) hour notification to the Engineer by the Contractor shall be required for all specified field investigations unless otherwise noted.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

Not used.

- END OF SECTION -

SECTION 01150
MEASUREMENT AND PAYMENT

PART 1 - GENERAL

1.1 SCOPE OF THIS SECTION

- A. The following explanation of the Measurement and Payment for the Schedule of Payment items is provided; however, the omission or reference to any item shall not alter the intent of the Bid Form or relieve the Contractor of the necessity of constructing a complete project under this Contract.
- B. The quotations prepared by the Contractor for the various items of work are intended to establish a total price for completion of the work in its entirety. Should the Contractor feel that the cost for any particular work item has not been established by the Bid Items or this Section, the Contractor shall notify the Owner prior to submitting a Bid. If no notice is provided by Contractor to the Owner at least three days prior to the date Bids are due, Owner will expect that the submitted Bid includes all costs to complete the Work in its entirety.
- C. The Owner reserves the right to increase or decrease the quantity of any item or portion of the work during the progress of construction in accordance with the terms of the Contract.
- D. Unit prices, if used, are used as a means for computing the bid, for Contract purposes, for periodic payments, for determining value of additions or deletions.
- E. Payment shall be made for the items listed on the Bid Form on the basis of the work actually performed and completed, such work including but not limited to, the furnishing of all necessary labor, materials, equipment, tools, transportation, delivery, disposal of waste and surplus material, and backfilling as shown in the plans, and all other appurtenances to complete the construction and installation of the work as shown on the drawings and described in the specifications. estimated quantities
- F. Where quantities are shown they are approximate and are given only as a basis of calculation upon which the award of the contract is to be made. The Owner or ENGINEER do not assume any responsibility for the final quantities, nor shall CONTRACTOR claim misunderstanding because of such estimate of quantities. Final payment will be made only for the satisfactorily completed quantity of each item.

1.2 SUBMITTALS

- A. Project Unit Costs and Payment Information:
 - 1. Schedule of Values to provide a breakdown of the work within each unit price item.
 - 2. Application for Payment
 - 3. Final Application for Payment
 - 4. Submittals shall be in accordance with Section 01300.

1.3 SCHEDULE OF VALUES

- A. Contractor shall prepare a detailed schedule of values for Owner's review with the signed Agreement to the Owner. The schedule shall contain sufficient detail quantifying the component parts of Work for the purpose of making monthly progress payments during the construction

period. Monthly progress payments will be based on the percentage of work demolished, procured, prepared, installed, completed, and accepted by the Owner.

- B. The schedule shall contain sufficient detail for proper identification of work accomplished. The sum of all scheduled items shall equal the total value of the contract. The sum of the breakdown of each Bid Item shall equal the total value of the Bid Item.
- C. Unit Price Work: Reflect unit price quantity and price breakdown from the conformed bid form.
- D. Lump Sum Work:
 - 1. Reflect Schedule of Values
 - 2. List Bonds and Insurance, Mobilization, Demobilization, Facility Startup and Contract Closeout separately.
 - 3. Breakdown Divisions 2 through 17 with appropriate subdivision of each Specification.
- E. An unbalanced, front end loaded schedule will not be accepted by Owner.

1.4 APPLICATION FOR PAYMENT

- A. Include accepted schedule of values for each portion of work and the unit price breakdown for the work to be paid on a unit price basis, and a listing of Owner selected equipment, if applicable, and allowances, as appropriate.
- B. Preparation:
 - 1. List each Change Order and Written Amendment executed prior to date of submission as a separate line item.
 - 2. Submit application for payment, a listing of materials on hand as applicable, and such supporting data as may be requested by the Owner/Engineer.
 - 3. Include Owner's Application for Payment Cover Sheet and partial or full releases of liens, as appropriate, for all subcontractors, suppliers, and Contractor.

1.5 COSTS INCLUDED IN PAYMENT ITEMS

- A. No separate payment will be made for the following items and the cost of such work shall be included in the applicable pay items of work.
 - 1. Clearing and grubbing.
 - 2. Trench excavation, including necessary pavement removal, except as otherwise specified.
 - 3. Structural fill, backfill, density testing and grading.
 - 4. Replacement of unpaved roadways, grass and shrubbery plots.
 - 5. Cleanup.
 - 6. Foundation and borrow materials, except as hereinafter specified.
 - 7. Testing and placing existing AND new systems in operation, as described in the contract documents.
 - 8. Any material and equipment required to be installed and utilized for tests.
 - 9. Maintaining the existing quality of service during construction.
 - 10. Maintaining or detouring of the traffic, with all equipment and manpower to comply with Roadway and Traffic Standards, FDOT Indices 600, 601, 602, 603, 605, 607, 611, 612, 613, 616, 617, 618, 619, 625, 628, 630, and 635.
 - 11. Appurtenant work as required for a complete and operable system.
 - 12. Cost for security (if special circumstances apply, approval must be received by the Engineer, in writing).
 - 13. Record drawings.

14. Distribution of door hangers.
15. Material storage areas.
16. Disposal of excess fill and debris.
17. Scheduling and calling for utility locates.
- B. Cleanup Contractor's attention is called to the fact that cleanup is considered a part of the work of construction. No payment will be made until cleanup is essentially complete.
- C. Work Outside Authorized Limits No payment will be made for work constructed outside the authorized limits of work.

1.6 CHANGE ORDER PROCEDURE

- A. As defined in the General Conditions, a Change Order is a written order to the CONTRACTOR signed by the Owner authorizing an addition, deletion or revision in the Work, or an adjustment in the Contract Price or the Contract Time which is issued after the execution of the Agreement.
- B. The following procedure shall be used in processing Change Orders:
- C. For Additions to the Work:
 1. The Owner shall issue a written order to the CONTRACTOR directing them to accomplish the additional work. The CONTRACTOR shall review the order and if they feel that the additional work entitles them to additional payment or additional time, they may submit a claim as prescribed in the General Conditions of the Contract.
- D. For Deletions from the Work:
 1. The Owner shall issue a written order to the CONTRACTOR directing them to make the change. If the Owner feels that the contract price should be reduced as a result of the change, the Owner shall make a claim for the reduction as provided in the General Conditions of the Contract.
- E. Cost of the changes in the work shall be determined in accordance with the requirements spelled out in the General Conditions of the Contract. Modifications to incorporate the changes in cost will be made as the amount of any change is determined.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

3.1 BID ITEMS

- A. Bid item #1 – Mobilization/De-mobilization
 1. The quantity to be paid for under this Section shall be on a lump sum basis. The Contractor's lump sum price shall include full compensation for all work related to mobilization and demobilization, and any other related work, except for any work designated to be paid for separately or to be specifically included in the costs of other work under the Contract.
 2. Basis of Payment: Payment shall be made at the Contract Lump Sum Price and shall include, but not be limited to, the preparatory work and operations in mobilizing for beginning work on the project, including those operations necessary for the movement of personnel, equipment, supplies and incidentals to the project site and establishment of temporary provisions, controls, and utilities. This item shall include those permits that are required to be

obtained by the contractor. This item shall also include field surveying/layout and complete record drawings in accordance with the project specifications and the applicable standards.

3. The items specified in this Section consist of the costs of any pre and post construction expenses necessary for the start and completion of the project, excluding the cost of construction materials. The sum of mobilization and demobilization shall not exceed 10% of the contract price. Partial Payments for mobilization shall be as follows:

<u>Construction Percent</u> <u>Complete Lump</u>	<u>Allowable Percent of</u> <u>Sum for Mobilization</u>
5%	25%
10%	50%
25%	75%
100%	100%

B. Bid Item #2 – Bonds and Insurance

1. Method of Measurement: The quantity to be paid for under this Section shall be on a lump sum basis. The work specified in this Section consists of securing the appropriate bonds and insurance policies in the amounts specified by the contract documents.
2. Basis of Payment: Payment shall be made at the Contract Lump Sum Price and shall include all compensation for bonds, insurance and indemnification in accordance with the Contract documents.

C. Bid item #3 – Nanofiltration Train Replacement

1. The quantity to be paid for under this Section shall be on a lump sum basis, based on the percentage of the Item completed, and accepted by Owner.
2. Basis of Payment: Payment shall be at the Contract Lump Sum Price and shall include, but not limited to, furnishing all materials, labor, and equipment required to demolish, in phases agreed to by the Owner, the four (4) existing nanofiltration trains, complete, and construct four (4) new nanofiltration trains, complete with train frame, pressure vessels, membrane elements, process piping, valves (manual and electrically actuated), instrumentation, electrical, remote input/output panel, and any other items shown on the contract drawings and required for a complete and functional system.

D. Bid Item #4 – Building Process Piping Improvements (*Excludes Additive Alternate Work)

1. The quantity to be paid for under this Section shall be on a lump sum basis, based on the percentage of the Item completed, and accepted by Owner.
2. Basis of Payment: Payment shall be at the Contract Lump Sum Price and shall include, but not limited to, furnishing all materials, labor, and equipment required to construct, in phases, the proposed feedwater, concentrate and permeate piping improvements within the process building, including all valves, grooved pipe connections, flanges, check valves, couplings, relocation of existing dump valve and actuator, piping supports and any other items shown on the contract drawings and required for a complete and functional system.

E. Bid Item #5 – Trench Improvements and Rehabilitation (*Excludes Additive Alternate Work)

1. The quantity to be paid for under this Section shall be on a lump sum basis, based on the percentage of the Item completed, and accepted by Owner.
2. Basis of Payment: Payment shall be at the Contract Lump Sum Price and shall include, but not limited to, furnishing all materials, labor, and equipment required to construct the process piping trench modifications, trench extensions, new bar grating, grating supports, hardware,

grating m-clips, floating slab, trench repair, trench coating, and any other items shown on the contract drawings and required for a complete and functional system. This bid item does not include process piping improvements described in Bid Item #4.

- F. Bid Item #6 – Small Diameter Process Piping Replacement (*Excludes Additive Alternate Work)
1. The quantity to be paid for under this Section shall be on a lump sum basis, based on the percentage of the Item completed, and accepted by Owner.
 2. Basis of Payment: Payment shall be at the Contract Lump Sum Price and shall include, but not limited to, furnishing all materials, labor, and equipment required to construct the new sulfuric acid metering pump skid, sulfuric acid feed piping, scale inhibitor feed piping, injectors, electrically actuated isolation valves, relocate the fluoride pump skid and appurtenances, relocate existing air compressor equipment, new air piping to the CTF, and any other items shown on the contract drawings and required for complete and functional systems.
- G. Bid Item #7 – HSP Suction Piping Improvements
1. The quantity to be paid for under this Section shall be on a lump sum basis, based on the percentage of the Item completed, and accepted by Owner.
 2. Basis of Payment: Payment shall be at the Contract Lump Sum Price and shall include, but not limited to, furnishing all materials, labor, and equipment required to construct the new high service pump suction piping, valves, fittings, ground storage tank penetrations, supports and any other items shown on the contract drawings and required for a complete and functional system.
- H. Bid Item #8 – HSP Discharge Piping Improvements
1. The quantity to be paid for under this Section shall be on a lump sum basis, based on the percentage of the Item completed, and accepted by Owner.
 2. Basis of Payment: Payment shall be at the Contract Lump Sum Price and shall include, but not limited to, furnishing all materials, labor, and equipment required to construct the new high service discharge piping headers, flow meters, piping, supports, valves, pressure switches, flow switches, pressure transmitters, flow meters, other misc. instrumentation, line stops, restraints, abandon existing flow meter pit, and any other items shown on the contract drawings and required for a complete and functional system.
- I. Bid Item #9 – Electrical Improvements (*Excludes Additive Alternate Work)
1. The quantity to be paid for under this Section shall be on a lump sum basis, based on the percentage of the Item completed, and accepted by Owner.
 2. Basis of Payment: Payment shall be at the Contract Lump Sum Price and shall include, but not limited to, furnishing all materials, labor, and equipment required to construct, in phases outlined or accepted by the Owner, the proposed electrical panels, variable frequency drives, disconnects, wire, conduit, electrical accessories and any other items shown on the contract drawings and required for complete and functional systems.
- J. Bid Item #10 – Miscellaneous Site Work (*Excludes Additive Alternate Work)
1. The quantity to be paid for under this Section shall be on a lump sum basis, based on the percentage of the Item completed, and accepted by Owner.
- Basis of Payment: Payment shall be made at the Contract Lump Sum Price and shall include, but not be limited to, furnishing all materials, labor, and equipment required to install the site related components as shown on the drawings including sidewalk construction, concrete

equipment pads, parking stalls, shell rock parking areas, and any other items shown in the contract drawings and required for a complete and fully functional system. Work under this bid item also includes site restoration required to restore the project area to an equal or better condition than what was existing prior to the start of the project, including any irrigation, grassing, landscaping, mulch, planters, concrete curbing, concrete flume, concrete slab, asphalt pavement, fencing, debris removal, painting, pavement striping, or any other restoration and/or clean up required for a complete project, and all other related work, except for any work designated to be paid for separately or to be specifically included in the costs of other work under the Contract.

K. Bid Item #11 – Permeate Yard Piping Improvements

1. The quantity to be paid for under this Section shall be on a lump sum basis, based on the percentage of the Item completed, and accepted by Owner.
2. Basis of Payment: Payment shall be at the Contract Lump Sum Price and shall include, but not limited to, furnishing all materials, labor, and equipment required to construct the new permeate piping from the process building to the raw water bypass connection, the raw water bypass header improvements, the combined permeate-blend water header, valves, piping, supports, any other items shown on the contract drawings and required for a complete and functional system.

L. Bid Item #12 – High Service Pumps 4 & 5

1. The quantity to be paid for under this Section shall be on a lump sum basis, based on the percentage of the Item completed, and accepted by Owner.
- Basis of Payment: Payment shall be at the Contract Lump Sum Price and shall include, but not limited to, furnishing all materials, labor, and equipment required to new vertical turbine high service pumps, piping, valves, fittings, instrumentation, piping supports, reinforced concrete support pad, and any other items shown in the contract drawings and required for a complete and functional system.

M. Bid Item #13 – Concentrate Yard Piping Improvements

1. The quantity to be paid for under this Section shall be on a lump sum basis, based on the percentage of the Item completed, and accepted by Owner.
2. Basis of Payment: Payment shall be at the Contract Lump Sum Price and shall include, but not limited to, furnishing all materials, labor, and equipment required to construct the new concentrate main from the process building to the CTF including all piping, valves, modifications to existing CTF, piping supports and any other items shown on the contract drawings and required for a complete and functional system.

N. Bid Item #14 – Well PLC/SCADA Improvements

1. The quantity to be paid for under this Section shall be on a lump sum basis, based on the percentage of the Item completed, and accepted by Owner.
2. Basis of Payment: Payment shall be at the Contract Lump Sum Price and shall include, but not limited to, furnishing all materials, labor, and equipment required to construct the new raw water well control panels, wire, conduit, fiber optic cable, PLC hardware, relays, controls, electrical accessories and any other items shown on the contract drawings and required for a complete and functional system.

O. Bid Item #15 – WTP PLC/SCADA Improvements

1. The quantity to be paid for under this Section shall be on a lump sum basis, based on the percentage of the Item completed, and accepted by Owner.
 2. Basis of Payment: Payment shall be at the Contract Lump Sum Price and shall include, but not limited to, furnishing all materials, labor, and equipment required to construct hardware upgrades within existing remote I/O panels, wiring, installation of ethernet communications, miscellaneous electrical and controls items and any other items shown on the contract drawings and required for a complete and functional system.
- P. Bid Item #16 – Undefined Conditions Allowance
1. Included in this allowance is work associated with undefined conditions or reasonably anticipated conditions associated with the Work. This is an allowance, to be used solely at the discretion of the Owner and any to be completed under this item must be specifically approved in writing by the Owner, prior to the Work being initiated. Owner must approve in writing the mutually agreed upon total cost and additional time (if any) associated with said Work. Any work completed by the Contractor, under this Bid/Pay Item without the Owner's prior written approval will not be approved for payment by the Owner. The Owner reserves the right to award any, all, or none of the money associated with this allowance.
- Q. Additive Alternate 1 – Membrane Clean-in-Place System Replacement
1. The quantity to be paid for under this Section shall be on a lump sum basis, based on the percentage of the Item completed, and accepted by Owner.
 2. Basis of Payment: Payment shall be at the Contract Lump Sum Price and shall include, but not limited to, furnishing all materials, labor, and equipment required to demolish the existing cleaning system, construct the cleaning tanks, heater, mixer, pump, cartridge filter vessel, piping, valves, electrical, controls, structural supports, process pipe trench improvements, any other items shown on the contract drawings and required for a complete and functional system.
- R. Additive Alternate 2 – Laboratory Renovation
1. The quantity to be paid for under this Section shall be on a lump sum basis, based on the percentage of the Item completed, and accepted by Owner.
 2. Basis of Payment: Payment shall be at the Contract Lump Sum Price and shall include, but not limited to, furnishing all materials, labor, and equipment required to renovate the existing WTP laboratory replacing base and wall cabinetry, new sinks, countertops, electrical chases, wiring, conduit, receptacles, plumbing, shelving, furniture, and any other items shown on the contract drawings and required for a complete and functional system.
- S. Additive Alternate 3 – Caustic System Improvements
1. The quantity to be paid for under this Section shall be on a lump sum basis, based on the percentage of the Item completed, and accepted by Owner.
 2. Basis of Payment: Payment shall be at the Contract Lump Sum Price and shall include, but not limited to, furnishing all materials, labor, and equipment required to construct the new 4,000 gallon bulk sodium hydroxide (NaOH) storage tank, piping, valves, instrumentation, heat tracing, insulation, electrical, containment area restoration, tank supports, and any other items shown on the contract drawings and required for a complete and functional system.
- T. Additive Alternate 4 – CO₂ System Improvements
1. The quantity to be paid for under this Section shall be on a lump sum basis, based on the percentage of the Item completed, and accepted by Owner.

2. Basis of Payment: Payment shall be at the Contract Lump Sum Price and shall include, but not limited to, furnishing all materials, labor, and equipment required to construct the new 30-ton bulk liquid carbon dioxide storage tank, vaporizer, vapor enclosure, vapor heater, piping, valves, electrical, instrumentation, structural support slab, access slab, drainage improvements, wire, conduit, electrical accessories and any other items shown on the contract drawings and required for a complete and functional system.
- U. Additive Alternate 5 – Transfer Piping Improvements
1. The quantity to be paid for under this Section shall be on a lump sum basis, based on the percentage of the Item completed, and accepted by Owner.
 2. Basis of Payment: Payment shall be at the Contract Lump Sum Price and shall include, but not limited to, furnishing all materials, labor, and equipment required to construct the redundant transfer piping including all fittings, valves, piping, equipment removal/reinstallation, sidewalk replacement, connections and any other items shown on the contract drawings and required for a complete and functional system.
- V. Additive Alternate 6 – Finished Water Panel Replacement
1. The quantity to be paid for under this Section shall be on a lump sum basis, based on the percentage of the Item completed, and accepted by Owner.
 2. Basis of Payment: Payment shall be at the Contract Lump Sum Price and shall include, but not limited to, furnishing all materials, labor, and equipment required to construct the proposed finished water panel including all fittings, valves, piping, analyzers, drain piping, stack and any other items shown on the contract drawings and required for a complete and functional system. This additive alternate does NOT include installation of proposed pressure switches, flow switches, pressure transmitters and flow meters to support the high service discharge piping improvements as described under Base Bid Item #8.
- W. Additive Alternate 7 – Well S6 Motor Starter and Instrumentation Upgrades
1. The quantity to be paid for under this Section shall be on a lump sum basis, based on the percentage of the Item completed, and accepted by Owner.
 2. Basis of Payment: Payment shall be at the Contract Lump Sum Price and shall include, but not limited to, furnishing all materials, labor, and equipment required to replace the motor starter, enclosure, flow meter, pressure transmitter, level transmitter, pressure switch, wiring, conduit, etc as depicted on the contract drawings. This additive alternate does NOT include installation of new control panel and associated fiber optic conduit to support the upgraded communications as described under Base Bid item #14.

3.2 NON-PAYMENT FOR REJECTED OR UNUSED PRODUCTS

- A. Payment will not be made for following:
1. Loading, hauling, and disposing of rejected material.
 2. Quantities of excavated material wasted or disposed of in manner not called for under Contract Documents.
 3. Rejected loads of material, including material rejected after it has been placed by reason of failure of Contractor to conform to provisions of Contract Documents.
 4. Material not unloaded from transporting vehicle.
 5. Defective Work not accepted by Owner.
 6. Material remaining on hand after completion of Work.

3.3 PARTIAL PAYMENT FOR STORED MATERIALS AND EQUIPMENT

- A. Partial Payment: No partial payments will be made for materials and equipment delivered or stored for this project.
- B. Final Payment: Will be made only for products incorporated in Work; remaining products, for which partial payments have been made, shall revert to Contractor unless otherwise agreed, and partial payments made for those items will be deducted from final payment.
- C. Final Payment will not be made until all Record Drawings are acceptable to Owner/Engineer, Operation and Maintenance Manuals are final and acceptable to Owner/Engineer, final release of liens have been received for Contractor, Sub-contractor, suppliers, and vendors, all spare parts have been received (by Owner), and all punch list items are complete and acceptable to Owner/Engineer.

- END OF SECTION -

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 01200
COORDINATION AND PROJECT MEETINGS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Engineer shall schedule and administer a preconstruction meeting, periodic progress meetings, and specially called meetings throughout the progress of the work. Engineer shall:
 - 1. Distribute written notice of each meeting.
 - 2. Make physical arrangements for meetings.
 - 3. Preside at meetings.
 - 4. Record the minutes, include all significant proceedings and decisions.
 - 5. Reproduce and distribute copies of minutes:
 - a. To all participants in the meeting.
 - b. To all parties affected by decisions made at the meeting.
- B. Representatives of contractors, subcontractors and suppliers attending the meetings shall be qualified and authorized to act on behalf of the entity each represents.

1.2 RELATED REQUIREMENTS SPECIFIED ELSEWHERE

- A. Section 01010 - Summary of Work

1.3 PRE-CONSTRUCTION MEETING

- A. To be held prior to the Notice to Proceed.
- B. Location: The project site, or as designated by the Engineer.
- C. Attendance:
 - 1. Owner's Representative
 - 2. Engineer's Representative
 - 3. Contractor
 - 4. Contractor's Superintendent
 - 5. Major Subcontractors
 - 6. Others as appropriate

1.4 PROGRESS MEETINGS

- A. Hold periodic meetings as required by progress of the work. Preferably, monthly at the beginning of the project, twice per month toward the latter part of the project, then weekly during start-up, commissioning, and operational testing.
- B. Location of the meetings: Project site, or as designated by the Engineer.
- C. Attendance:
 - 1. Owner's Representative
 - 2. Engineer's Representative
 - 3. Subcontractors as appropriate
 - 4. Suppliers as appropriate

1.5 EMERGENCY MEETINGS

- A. May be called by Owner, Engineer or Contractor with a minimum of three hours' notice to resolve conditions of an emergency nature.

1.6 QUALITY ASSURANCE

- A. Perform Work in accordance with Indian River County Utilities Minimum Design and Construction Standards, where applicable.
- B. Fabricated piping shall meet all ASME code requirements as specified herein.
- C. Valves: Manufacturer's name and pressure rating marked on valve body.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store valves in shipping containers with labeling in place.

PART 2 - PRODUCTS

Not used.

PART 3 - PRODUCTS

Not used.

- END OF SECTION -

SECTION 01300
SUBMITTALS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Contractor shall submit to the Engineer, shop drawings, project data and samples required by specification sections.

1.2 SCHEDULES

- A. Prepare and submit a Construction Schedule.
- B. Prepare and submit a separate schedule listing dates for submission of shop drawings and projected return dates.
- C. Schedules shall be updated and re-submitted on a monthly basis throughout the duration of the project.
- D. Prepare and submit two-week look ahead schedules bi-weekly throughout duration of the project.
- E. Coordinate all work with OWNER operations staff. Construction activities that impact operations require 48 hours advance notice and approval from the OWNER.

PART 2 - PRODUCTS

2.1 SHOP DRAWINGS

- A. Original drawings, prepared by Contractor, Subcontractor, Supplier or Distributor, which illustrate portions of the Work; showing fabrication, layout, setting or erection details including, but not limited to the following:
 - 1. Pumps, motors, all rotating equipment
 - a. Certified pump performance test curves for all new and rehabilitated/refurbished pumps
 - 2. Valves and operators (w/ specific locations)
 - 3. Piping, valves, fittings, etc. (w/ specific locations)
 - 4. Ground storage tank rehabilitation materials and procedure
 - 5. Concrete mix designs (with specific locations), grouts, etc.
 - 6. Concrete reinforcement
 - 7. Panel fabrication drawings
 - 8. Asphalt and base material
 - 9. NF System Components
 - 10. Electrical equipment, VFDs, panelboards, conductors, conduit, etc.
 - 11. Instrumentation
 - 12. Miscellaneous metals
- B. Prepare submittals by a qualified detailer.
- C. Identify details by reference to sheet numbers and detail shown on Contract Drawings.

2.2 PROJECT DATA

- A. Manufacturer's standard schematic drawings:

1. Modify drawings to delete information which is not applicable to project.
2. Supplement standard information to provide additional information applicable to project.
- B. Manufacturer's catalog sheets, brochures, diagrams, schedules, performance charts, illustrations and other standard descriptive data.
 1. Clearly mark each copy to identify pertinent materials, products or models.
 2. Show dimensions and clearances required.
 3. Show performance characteristics and capacities.
 4. Show wiring diagrams and controls.

2.3 SAMPLES

- A. Physical examples to illustrate materials, equipment or workmanship, and to establish standards by which completed work is judged.
- B. Office samples of sufficient size and quantity to clearly illustrate:
 1. Functional characteristics of product or material, with integrally related parts and attachment devices.
 2. Full range of color samples.

2.4 PAY REQUESTS

- A. Pay Requests shall be made in accordance with the requirements of the Agreement between Owner and Contractor. Payment requests shall include updated schedules as required in required 01300-1.2.

PART 3 - EXECUTION

3.1 SUBMISSION REQUIREMENTS

- A. Schedule submissions at least 14 days before dates reviewed submittals will be needed.
- B. Submit number of copies of Shop Drawings, Project Datum and Samples which Contractor requires for distribution plus 4 copies for the Owner and Engineer.
- C. Accompany submittals with transmittal letter, in duplicate, containing:
 1. Date.
 2. Project title and number.
 3. Contractor's name and address.
 4. Notification of deviations from Contract Documents.
 5. Other pertinent data.
- D. Submittals must include:
 1. Date of submittal and revision dates.
 2. Project title and number.
 3. The names of:
 - a. Engineer.
 - b. Contractor.
 - c. Subcontractor.
 - d. Supplier.
 - e. Manufacturer.
 - f. Separate detailer when pertinent.
 4. Identification of product or material.

5. Relation to adjacent structure or materials.
6. Field dimensions, clearly identified as such.
7. Identification of deviations from Contract Documents.
8. Contractor's stamp, initialed or signed, certifying to review of submittal, verification of field measurements and compliance with Contract Documents.

3.2 RESUBMISSION REQUIREMENTS

- A. Shop Drawings:
 1. Revise initial drawings as required and resubmit as specified for initial submittal.
 2. Clearly indicate on shop drawings all changes or revisions which have been made other than those requested by Engineer.
 3. Re-submittals without all comments from original review addressed will be returned to the contractor.
- B. Project Data and Samples:
 1. Submit new datum and samples as required for initial submittal.

3.3 DISTRIBUTION OF SUBMITTALS AFTER REVIEW

- A. Distribute copies of Shop Drawings and Project Datum which carry Engineer's stamp, to:
 1. Contractor's file.
 2. Job site file.
 3. Record Documents file.
 4. Other prime contractors.
 5. Subcontractors.
 6. Supplier.
 7. Fabricator.
- B. Distribute samples as directed.

- END OF SECTION -

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 01410
TESTING LABORATORY SERVICES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Contractor shall employ and pay for services of an Independent Testing Laboratory to perform specified services.
- B. Inspection, Sampling and Testing is required for:
 - 1. Densities and proctors (for soil compaction)
 - 2. Cast-in-place Concrete (slump and compressive strength)
 - 3. Bacteriological clearance
 - 4. Painting
 - 5. Water Quality Tests
 - 6. Other operations specified in these specifications or as required by the Engineer.
- C. Contractor's employment of Testing Laboratory shall in no way relieve Contractor of their obligation to perform Work in accordance with Contract.

1.2 QUALIFICATION OF LABORATORY

- A. Meet "Recommended Requirements for Independent Laboratory Qualification", latest edition, published by American Council of Independent Laboratories.
- B. Meet basic requirements of ASTM E 329-90 "Standard Practice for Use in the Evaluation of Testing Agencies for Concrete and Steel as Used in Construction".
- C. Certified in the State of Florida in accordance with FDEP requirements.

1.3 LABORATORY DUTIES; LIMITATIONS OF AUTHORITY

- A. Cooperate with Engineer and Contractor; provide qualified personnel promptly on notice.
- B. Perform specified inspections, sampling and testing of materials and methods of construction:
 - 1. Comply with specified standards; ASTM, other recognized authorities, and as specified.
 - 2. Ascertain compliance with requirements of Contract Documents.
- C. Promptly notify Engineer, and Contractor, of irregularities or deficiencies of Work which are observed during performance of services.
- D. Promptly submit 2 copies of reports of inspections and tests to Engineer, including:
 - 1. Date issued.
 - 2. Project title and number.
 - 3. Testing Laboratory name and address.
 - 4. Name of Inspector
 - 5. Date of inspection or sampling.
 - 6. Record of temperature and weather.
 - 7. Date of test.
 - 8. Identification of product and specification section.
 - 9. Location in project.
 - 10. Type of inspection or test.
 - 11. Observations regarding compliance with Contract Documents.

- E. Laboratory is not authorized to:
 - 1. Release, revoke, alter, or enlarge on, requirements of Contract Documents.
 - 2. Approve or accept any portion of Work.
 - 3. Perform any duties of the Contractor.

1.4 CONTRACTOR'S RESPONSIBILITIES

- A. Select laboratory, and coordinate testing with Lab and Engineer's representative.
- B. Cooperate with Laboratory personnel, provide access to Work.
- C. Provide to Laboratory, preliminary representative samples of materials to be tested, in required quantities.
- D. Furnish copies of mill test reports.
- E. Furnish casual labor and facilities:
 - 1. To provide access to Work to be tested.
 - 2. To obtain and handle samples at the site.
 - 3. To facilitate inspections and tests.
 - 4. For Laboratory's exclusive use for storage and curing of test samples.
- F. Notify Laboratory sufficiently in advance of operations to allow for his assignment of personnel and scheduling of tests.
- G. Pay for services of the Testing Laboratory to perform additional inspections, sampling and testing required:
 - 1. For Contractor's convenience.
 - 2. When initial tests indicate Work does not comply with Contract Documents.
 - 3. Such payment shall be made directly by the Contractor.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

Not used.

- END OF SECTION -

**SECTION 01590
FIELD OFFICES AND SHEDS**

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Temporary Field Offices and Sheds.
- B. Maintenance and Cleaning.
- C. Relocation and Removal.

1.2 DESCRIPTION OF FACILITIES

- A. Contractor shall furnish office trailer, including all temporary utilities to a common area for all temporary facilities as indicated on the drawings. Contractor shall assume lease of trailer for the duration of the project, and include operating costs as described herein.

PART 2 - PRODUCTS

2.1 MATERIALS, EQUIPMENT, FURNISHINGS

- A. Serviceable, new or used, adequate for required purpose.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Fill and grade sites for temporary structures to provide drainage away from buildings.

3.2 INSTALLATION

- A. Install office spaces ready for occupancy 15 days after date fixed in Notice to Proceed.
- B. Parking: Two gravel-surfaced parking spaces for use by the Owner and Engineer, connected to office by walk.
- C. Provide all trailer hold-down restraints per Indian River County Code requirements.
- D. Provide all permits as required.

3.3 UTILITIES

- A. Furnish utility services required for general use at the project site, including the following as a minimum:
 - 1. Potable water use
 - 2. Sanitary sewer
 - 3. Portable sanitary facilities
 - 4. Electric power service
 - 5. Telephone service

3.4 ENGINEER OFFICE

- A. Furnish additional items for the office as listed herein:
 - 1. One desk, 54 x 30 inches, with three drawers.

2. One metal, double-door storage cabinet under table.
3. Plan rack to hold working Drawings, shop drawings, and Record Documents.
4. One standard four-drawer legal size metal filing cabinet with locks and two keys per lock.
5. 8 linear ft. of metal bookshelves.
6. Two swivel arm chairs.
7. Two straight chairs.
8. One tackboard, 36 x 30 inches.
9. One wastebasket per desk and table.
10. Fax Machine:
 - a. Provide fax machine or convenient access to fax machine at Contractor's office. Contractor to pay all fax costs.
11. Copying Machine:
 - a. Provide acceptable copying machine or convenient access to copying machine at Contractor's office. Contractor to supply copier paper and pay all costs.

3.5 MAINTENANCE AND CLEANING

- A. Weekly janitorial services, cleaning and maintenance for office and storage areas.
- B. Maintain approach walks.
- C. Servicing HVAC system.

3.6 REMOVAL

- A. At completion of Work remove buildings, foundations, utility services, and debris. Restore areas.
- B. Obtain approval of Engineer prior to removing Engineer office.

- END OF SECTION -

SECTION 01600
MATERIAL AND EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The contractor is responsible for transportation, handling, storage, and protection of all proposed equipment to be delivered to the site as part of this project.
- B. The contractor is responsible for coordinating all deliveries to the project site with the OWNER.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

3.1 TRANSPORTATION AND HANDLING

- A. Deliver manufactured materials and products to the project site as needed for installation, undamaged, in original packages, containers, or bundles, as packaged by the manufacturer with manufacturer's name, brand, seals, and labels intact. Materials other than those designated within the specifications shall not be delivered to the project site.

3.2 STORAGE AND PROTECTION

- A. Protect and preserve all materials until final acceptance of the project. Store all materials in a manner to facilitate inspection and to prevent damage, contamination, intermixing, or theft.
- B. Miscellaneous metal, reinforcement bars, welded wire fabric, and masonry reinforcement materials shall be stored to prevent contact with the ground and from being damaged by its own weight or by other loads. Reinforcement which has become muddy shall be cleaned before use.
- C. Store cementitious materials in weathertight sheds on elevated floors away from damp surfaces.
- D. Do not use and dispose of materials that have been stored for longer than their maximum recommended shelf life or beyond their recommend shelf date.
- E. Store and protect all material and equipment in accordance with manufacturer's recommendations.

3.3 PROTECTION OF EQUIPMENT

- A. Keep products clean by elevating above ground or floor and by using suitable coverings. Take such precautions as are necessary to protect apparatus and materials from damage. Failure to protect materials is sufficient cause for rejection of the apparatus or material in question.
- B. Protect factory finish from damage during construction operations and until acceptance of the project. Satisfactorily restore any finishes that become stained or damaged.

- END OF SECTION -

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 01700
PROJECT CLOSEOUT

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Comply with requirements stated in the Agreement between Owner and Contractor and in Specifications for administrative procedures in closing out the Work.

1.2 RELATED REQUIREMENTS SPECIFIED ELSEWHERE

- A. Section 01720 - Project Record Drawings
- B. Section 01730 – Operating and Maintenance Manuals

1.3 SUBSTANTIAL COMPLETION

- A. Substantial completion shall be defined as beneficial use of all proposed equipment. Beneficial use will not occur until the four (4) new nanofiltration (NF) trains, process piping, two (2) high service pumps, membrane clean-in-place system, trench improvements, electrical work, and all other components shown herein have been constructed, tested, and accepted by the Owner and Engineer of record. Completion of the ground storage tank connections, disinfection, flushing, and leak testing for the two (2) ground storage tanks, must also occur prior to beneficial use.
- B. The Contractor shall deliver to the Engineer the Record Drawings and a draft copy of the Operations and Maintenance manuals for review and deliver to the Owner a complete set of all spare parts.
- C. When Contractor considers the Work is substantially complete, Contractor shall submit to Engineer:
 - 1. A written notice that the Work or designated portion thereof, is substantially complete.
- D. Within a reasonable time after receipt of such notice, Engineer will perform a field investigation to determine the status of completion.
- E. Should Engineer determine that the Work is not substantially complete:
 - 1. Engineer will promptly notify the Contractor in writing, giving the reasons therefore.
 - 2. Contractor shall remedy the deficiencies in the Work, and send a second written notice of substantial completion to the Engineer.
 - 3. Engineer will reinvestigate the Work.
- F. When the Engineer finds that the Work is substantially complete, he will:
 - 1. Prepare and deliver to Owner a tentative Certificate of Substantial Completion, with a tentative list of items to be completed or corrected before final payment.
 - 2. After consideration of any objections made by the Owner and when Engineer considers the Work substantially complete, he will execute and deliver to the Owner and the Contractor a definite Certificate of Substantial Completion with a revised tentative list of items to be completed or corrected.

1.4 FINAL SITE REVIEWS

- A. When Contractor considers Work is complete, he shall submit written certification that:
 - 1. Contract Documents have been reviewed.

2. Work has been investigated for compliance with Contract Documents.
3. Work has been completed in accordance with Contract Documents.
4. Equipment and systems have been tested in the presence of the Owner's representative and are operational.
5. Work is completed and ready for Final Investigation.
- B. Engineer will perform a field investigation to verify the status of completion with reasonable promptness after receipt of such certification.
- C. Should Engineer consider that the Work is incomplete or defective:
 1. Engineer will promptly notify the Contractor in writing, listing the incomplete or defective work.
 2. Contractor shall take immediate steps to remedy the stated deficiencies and send a second written certification to Engineer that the Work is complete.
 3. Engineer will reinvestigate the Work.
- D. When the Engineer finds that the Work is acceptable under the Contract Documents, he shall request the Contractor to make closeout submittals.

1.5 CONTRACTOR'S CLOSEOUT SUBMITTALS TO ENGINEER

- A. Project Record Drawings to the requirements specified.
- B. Operating and Maintenance Manuals to the requirements specified.
- C. Contractor's affidavit of payment of debts and claims.
 1. Contractor's release or waiver of liens.
- D. Separate releases or waivers of liens for subcontractors, suppliers and others with lien rights against property of Owner, together with list of those parties.

1.6 FINAL ADJUSTMENTS OF ACCOUNTS

- A. Submit a final statement of accounting to Engineer.
- B. Statement shall reflect all adjustments to the Contract Sum:
 1. The original Contract Sum.
 2. Additions and deductions resulting from:
 - a. Previous Change Orders.
 - b. Allowances.
 - c. Unit Prices.
 - d. Deductions for uncorrected Work.
 - e. Deductions for liquidated damages.
 - f. Deductions for re-inspection payments.
 - g. Other adjustments.
 3. Total Contract Sum, as adjusted.
 4. Previous payments.
 5. Sum remaining due.
- C. Engineer will prepare a final Change Order reflecting approved adjustments to the Contract Sum which was not previously made by Change Orders.

1.7 FINAL APPLICATION FOR PAYMENT

- A. Contractor shall submit the final Application for Payment in accordance with procedures and requirements stated in the Condition of the Contract.

1.8 FINAL CERTIFICATE FOR PAYMENT

- A. Engineer will issue final certificate in accordance with provisions of the Contract Documents.

1.9 POST-CONSTRUCTION INSPECTION

- A. Prior to expiration of one year from Date of Substantial Completion, Engineer will make visual field investigation of Project in company with Owner and Contractor to determine whether correction of Work is required, in accordance with provisions of the Contract Documents.
- B. For Guarantees beyond one year, Engineer will make field investigations at request of Owner, after notification to Contractor.
- C. Engineer will promptly notify Contractor, in writing, of any observed deficiencies.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

Not used.

- END OF SECTION -

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 01720
PROJECT RECORD DRAWINGS

PART 1 - GENERAL

1.1 PROJECT RECORD DOCUMENTS

- A. Maintain at the site for the Owner one record copy of:
 - 1. Drawings.
 - 2. Specifications.
 - 3. Addenda.
 - 4. Change Orders and other Modifications to the Contract.
 - 5. Engineer Field Orders or written instructions.
 - 6. Reviewed Shop Drawings.
 - 7. Field test records.

1.2 RELATED REQUIREMENTS SPECIFIED ELSEWHERE

- A. Conditions of the Contracts
- B. Section 01700 – Project closeout

1.3 MAINTENANCE OF DOCUMENTS

- A. Store documents in approved location apart from documents used for construction.
- B. Maintain documents in a clean, dry, legible condition and in good order. Do not use record documents for construction purposes.
- C. Make documents available at all times for inspection by Engineer and Owner. Record drawing information shall be maintained concurrently with Pay Requests and updated project schedules.

1.4 MARKING DEVICES

- A. Provide ink marking pens for recording information in a color code.

1.5 RECORDING

- A. Label each document "PROJECT RECORD" in neat large printed letters.
- B. Record information currently with construction progress.
 - 1. Do not conceal any work until required information is recorded.
- C. Drawings shall be drawn to record actual construction:
 - 1. Field changes of dimension and detail.
 - 2. Changes made by Field Order or by Change Order.
 - 3. Details not on original Contract Drawings.
- D. Specifications and Addenda; Legibly mark each Section to record:
 - 1. Manufacturer, trade name, catalog number, and supplier of each item actually installed.
 - 2. Changes made by Field Order or by Change Order.

1.6 SUBMITTAL

- A. At Contract Close-out, Record Documents shall be submitted to Engineer in the following formats for Owner:
 - 1. One set on 24" x 36".

- B. Accompany submittal with transmittal letter in duplicate, containing:
1. Date.
 2. Project title and number.
 3. Contractor's name and address.
 4. Title and number of each record document.
 5. Signature of Contractor or his authorized representative.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

Not used.

- END OF SECTION -

SECTION 01730
OPERATION AND MAINTENANCE MANUALS

PART 1 - GENERAL

1.1 RELATED INFORMATION

- A. Compile product data and related information appropriate for Owner's maintenance and operation of products furnished under the Contract.
 - 1. Prepare operating and maintenance data as specified in this Section and as referenced in other pertinent sections of Specifications.
- B. Instruct Owner's personnel in the maintenance of products and in the operation of equipment and systems.
- C. Related Requirements Specified in Other Sections.
 - 1. Section 01300 - Submittals
 - 2. Section 01720 - Project Record Drawings

1.2 FORM OF SUBMITTALS

- A. Prepare data in the form of an instructional manual and electronic format for use by Owner's personnel.
- B. Hard-Copy Format:
 - 1. Size: 8-1/2 in. x 11 in.
 - 2. Text: Manufacturer's printed data, or neatly typewritten.
 - 3. Drawings:
 - a. Provide reinforced punch binder tab, bind in with text.
 - b. Fold larger drawings to the size of the text pages.
 - 4. Provide fly-leaf for each separate product, or each piece of operating equipment.
 - a. Provide typed description of product, and major component parts of equipment.
 - 5. Cover: Identify each volume with typed or printed title "OPERATING AND MAINTENANCE INSTRUCTIONS". List:
 - a. Title of Project.
 - b. Identity of separate structure as applicable.
 - c. Identity of general subject matter covered in the manual.
- C. Binders:
 - 1. Commercial quality expandable catalog binders with durable and cleanable plastic covers.
 - 2. When multiple binders are used, correlate the data into related consistent groupings.
- D. Electronic format shall be in .pdf file format. Copies of specific manuals shall either be scanned or converted to .pdf format and submitted on CD disc to Owner. Submit after approval of hard copies from Engineer.

1.3 CONTENT OF MANUAL

- A. Neatly typewritten table of contents for each volume, arranged in a systematic order.
 - 1. Contractor, name of responsible principal, address and telephone number.
 - 2. A list of each product required to be included, indexed to the content of the volume.
 - 3. List, with each product, the name, address and telephone number of:

- a. Subcontractor or installer.
 - b. Maintenance contractor, as appropriate.
 - c. Identify the area of responsibility of each.
 - d. Local source of supply for parts and replacement.
4. Identify each product by product name and other identifying symbols as set forth in Contract Documents.
- B. Product Data:
 1. Include only those sheets which are pertinent to the specific product.
 2. Annotate each sheet to:
 - a. Clearly identify the specific product or part installed.
 - b. Clearly identify the data applicable to the installation.
 - c. Delete references to inapplicable information.
- C. Drawings:
 1. Supplement product data with drawings as necessary to clearly illustrate relations of component parts of equipment and systems.
 2. Coordinate drawings with information in Project Record Documents to assure correct illustration of completed installation.
 3. Do not use Project Record Documents as maintenance drawings.
- D. Written text, as required to supplement product data for the particular installation:
 1. Organize in a consistent format under separate headings for different procedures.
 2. Provide a logical sequence of instructions for each procedure.
- E. Copy of each warranty issued.
 1. Provide information sheet for Owner's personnel, give:
 - a. Proper procedures in the event of failure.
 - b. Instances which might affect the validity of warranties.

1.4 MANUAL FOR EQUIPMENT AND SYSTEMS

- A. Submit six (6) complete copies of manual in final form and two compact discs (CD) in PDF format. CD shall include bookmarks and chapters to closely duplicate that of the paper copy.
- B. Content, for each unit of equipment and system, as appropriate:
 1. Description of unit and component parts.
 - a. Function, normal operating characteristics, and limiting conditions.
 - b. Performance curves, engineering data and tests.
 - c. Complete nomenclature and commercial number of all replaceable parts.
 2. Operating procedures:
 - a. Start-up, break-in, routine and normal operating instructions.
 - b. Regulation, control, stopping, shut-down and emergency instructions.
 - c. Summer and winter operating instructions.
 - d. Alignment, adjusting and checking.
 3. Servicing and lubrication schedule:
 - a. List of lubricants required for each piece of equipment.
 - b. Schedule for manufacturer recommended maintenance.
 4. Manufacturer's printed operating and maintenance instructions.
 5. Original manufacturer's parts list, illustrations, assembly drawings and diagrams required for maintenance.

6. Other data as required under pertinent sections of specifications.

1.5 SUBMITTAL SCHEDULE

- A. Submit one copy of completed data in final form fifteen days prior to final inspection or acceptance. Electronic submittal for initial review is acceptable.
 1. Copy will be returned after final inspection or acceptance, with comments.
- B. Submit specified number of copies of approved data in final form 10 days after final inspection or acceptance.

1.6 INSTRUCTION OF OWNER'S PERSONNEL

- A. Prior to final inspection or acceptance, fully instruct Owner's designated operating and maintenance personnel in the operation, adjustment and maintenance of all products, equipment and systems.
- B. Operating and maintenance manual shall constitute the basis of instruction.
 1. Review contents of manual with personnel in full detail to explain all aspects of operations and maintenance.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

Not used.

- END OF SECTION -

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 02016
EXISTING UTILITIES AND UNDERGROUND STRUCTURES

PART 1 - GENERAL

1.1 GENERAL

- A. The plans depict the approximate location of the existing utilities. The locations of those facilities (horizontal and vertical) were obtained from record drawings. Guarantee is not made that all existing underground utilities are shown or that the location of those shown are entirely accurate. Finding the actual location of any existing utilities is the contractor's responsibility and shall be done before he commences any work in the vicinity. Furthermore, the contractor shall be fully responsible for any and all damages due to the contractor's failure to exactly locate and preserve any and all underground utilities.

1.2 CONTRACTOR'S RESPONSIBILITIES

- A. Contractor shall notify the Sunshine State One Call of Florida (SSOCF) service at 811, 48 hours prior to digging.
- B. Locate the cables, ducts, conduit, pipeline, etc. in advance of the proposed construction.
- C. Notify Engineer of any substantial changes and/or conflicts that would require a deviation in the plans. Late discovery of existing underground utilities does not constitute "required" deviations should early discovery prevent them.
- D. Repair any damage done to existing utilities at no additional expense to the Owner.
- E. Remove or modify those utilities scheduled to be removed or modified on the plans.

1.3 PRECONSTRUCTION VIDEO

- A. At least one (1) week prior to the start of construction, the contractor shall have video recordings taken of the entire project area. This area includes but is not limited to, the entire site work area, the construction staging area, site access driveways, the areas around all of the existing structures, including ground storage tanks, buildings, treatment process components, fencing, and all portions of the electrical building. Such recordings shall be provided to the Owner and Engineer before the commencement of construction. These recordings shall serve as record of the conditions as they existed prior to the start of the work. They will be used in the event of a dispute that arises from restoration or damage claims. The contractor shall pay particular attention to any existing damage within the work area and ensure that these items are documented on the video prior to construction.
- B. Video tapes are to be delivered to the Owner and Engineer on a DVD in a standard video format that is able to be viewed on a Windows operating system. All videotapes shall become the property of the Owner.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

Not used.

- END OF SECTION -

SECTION 02065
DEMOLITION

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. The Contractor shall furnish all supervised labor, materials, equipment, and incidentals required for the removal of all items necessary to be removed in order construct the project as indicated on the plans and in accordance with the specifications.
- B. The Contractor is responsible for removal of all debris from the site and proper disposal of debris.

1.2 CONDITION OF STRUCTURES

- A. By submitting a bid, the Contractor affirms that the Contractor has carefully examined the site and all conditions affecting the Work. Conditions existing at the time of inspection for bidding purposes will be maintained by the Owner insofar as practicable.

1.3 RULES AND REGULATIONS

- A. The Building Code of the State of Florida, latest edition, shall control the demolition, modification or alteration of the existing site.
- B. No blasting shall be done on site.

1.4 SUBMITTALS

- A. Contractor shall follow sequence of demolition and construction of proposed equipment as described herein.
- B. Provide a detailed sequence of demolition and removal work as part of the Contractor's schedule.

1.5 ACCESS

- A. Conduct demolition and modification operations, and the removal of equipment and debris to ensure minimum interference with roads and walks both on-site and off-site and to ensure minimum interference with occupied or used facilities.
- B. Special attention is directed towards maintaining safe and convenient access to the existing facilities by Owner's operations personnel and associated vehicles.
- C. Do not close or obstruct streets, walks or other occupied or used facilities without permission from the Owner. Provide alternate routes around closed or obstructed traffic in access ways.

1.6 PROTECTION

- A. The Contractor shall conduct construction activities to minimize damage to adjacent buildings, structures, utilities, storm drainage, and other facilities, including persons.

1.7 DAMAGE

- A. The Contractor shall immediately report damage caused to adjacent facilities by demolition operations. The Contractor shall promptly make all required repairs as directed by the Engineer and at no cost to the Owner.

1.8 UTILITIES

- A. It shall be the Contractor's responsibility to maintain existing utilities in service and protect against damage during demolition operations.
- B. Existing facility must remain in full operation without any impact to operations, other than what is described in the summary of work, specification section 01010.

1.9 POLLUTION CONTROL

- A. For pollution control, use sprinkling, temporary enclosures, and other suitable methods as necessary to limit the amount of dust and dirt rising and scattering in the air to the lowest level of air pollution practical for the conditions of work. Comply with the governing regulations.
- B. Clean adjacent structures and improvements of all dust, dirt, and debris caused by demolition operations. Return areas to conditions existing prior to the start of work.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

3.1 REMOVAL OF EXISTING EQUIPMENT, PIPING AND APPURTENANCES

- A. Subject to the constraints of maintaining the existing utilities in operation; existing appurtenances not necessary for the operation of the newly modified facilities shall remain the property of the Owner unless otherwise directed by the Owner. The Contractor shall remove, clean, and prepare for storage all equipment to remain as directed by the Owner. If the Owner elects not to retain ownership of a certain item, the item shall become the property of the Contractor and shall be removed from the site at the Contractor's expense.
- B. All equipment and materials to be stored for reinstallation or salvage shall be properly protected from damage.
- C. Any items of equipment damaged or lost due to the Contractor's carelessness, mishandling, or faulty procedures and/or workmanship shall be repaired or replaced in kind to the satisfaction of the Engineer.

- END OF SECTION -

SECTION 02150
DEWATERING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. The work covered by this Section consists of furnishing all permits, labor, equipment, appliance and materials, and performing all operations required for dewatering all excavations, if required, complete.

1.2 RELATED SECTIONS SPECIFIED ELSEWHERE

- A. Drawings and general provisions of the Contract, including the General and Supplementary Conditions and Division 1 Specification sections, apply to this section.
- B. Section 02200 – Earthwork, Excavation, and Backfill.

1.3 SUBMITTALS

- A. Submit the dewatering method or plan in accordance with Submittal specifications prior to commencing dewatering if it is determined by the Contractor that dewatering beyond that allowed by a no-notice dewatering permit is required to construct the project.
- B. The Contractor shall prepare and submit the necessary permit applications and supporting documents for the purposes of obtaining a dewatering permit from the South Florida Water Management District and any other required agencies.

PART 2 - PRODUCTS

2.1 TEMPORARY FACILITIES

- A. All materials and equipment shall be suitable and adequate to function continuously as a dewatering system.
- B. All material and equipment used in the dewatering system remain the property of the Contractor and shall be removed off-site when dewatering is completed.

PART 3 - EXECUTION

3.1 METHODS

- A. The method of dewatering is to be selected by the Contractor and may include:
 - 1. Wellpoints
 - 2. Sump pumps
 - 3. Bedding rock
 - 4. Dewatering wells
 - 5. Other approved items.

3.2 DISCHARGE

- A. The Contractor shall provide all labor, materials, tools and equipment necessary to properly control the quality of the discharge from his dewatering operations as described herein. The

Contractor shall comply with all applicable laws, rules and regulations governing the discharge of water from his dewatering operations.

- B. Contractor shall not discharge water in any manner that will:
 - 1. Adversely affect water quality of nearby water bodies.
 - 2. Violate Federal, State or local laws or regulations.
 - 3. Allow discharge to flow onto private property.
 - 4. Hamper movement of traffic.
 - 5. Damage portions of the work previously constructed.
 - 6. Damage portions of existing facilities or structures.
 - 7. Violate the conditions of the SFWMD Dewatering Permit.
 - 8. Violate the conditions of the Stormwater Pollution Prevention Plan.
- C. Contractor shall obtain and pay for any permits required to discharge the dewatering waters.
- D. Contractor shall coordinate and pay for any water quality monitoring program that may be required by the applicable dewatering permit(s).

- END OF SECTION -

SECTION 02200
EARTHWORK, EXCAVATION, AND BACKFILL

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. The work covered by this section consists of furnishing all labor, equipment, and materials, and performing all earthwork operations to include:
 - 1. Excavation and backfill of structures, foundations, and pavements.
 - 2. Surface preparation for structures, foundations, and pavements.
 - 3. Excavation and backfill of pipe trenches
 - 4. Site grading
 - 5. Soil compaction and stabilization requirements
 - 6. Soil testing

1.2 REFERENCES

- A. Florida Department of Transportation Standard Specifications for Road and Bridge Construction, Latest Edition.
- B. American Society for Testing and Materials (ASTM)
 - D698 Moisture-Density Relationship of Soils.
 - D1556 Standard Method of Test for Density of Soil in Place by Sand Cone Method.
 - D1557 Method for Test for Moisture-Density Relations of Soils Using a 10-Pound Rammer and 18-Inch Drop.
 - D2487 Classification of Soils for Engineering Purposes
 - D2922 Density of Soil and Soil-Aggregate in Place by Nuclear Methods

1.3 RELATED SECTIONS SPECIFIED ELSEWHERE

- A. Drawings and general provisions of the Contract, including the General and Supplementary Conditions and Division 1 Specification sections, apply to this section.
- B. Section 01410 - Testing Laboratory Services
- C. Section 02016 - Existing Utilities and Underground Structures
- D. Section 02150 – Dewatering
- E. Section 15100 – Piping and Valves

1.4 FIELD MEASUREMENTS AND COORDINATION

- A. Verify that survey benchmark, control point, and intended elevations for the work are as shown on the Drawings.
- B. Verify that work associated with lower elevation utilities is complete before placing higher elevation utilities.
- C. Maintain carefully all benchmarks, monuments and other reference points; if disturbed or destroyed, replace at no expense to Owner.

1.5 SUBSURFACE SOILS DATA

- A. Owner and Engineer make no representations or statements as to site or soil conditions and therefore do not assume any responsibility for actual site or soil conditions. It shall be Contractor's responsibility to determine for himself existing site and/or soil conditions.

PART 2 - PRODUCTS

2.1 EXCAVATION

- A. All excavation is unclassified. Complete all excavation regardless of the type, nature, or condition of the materials encountered.

2.2 SOURCE QUALITY CONTROL

- A. If tests for a material type fail three times, the Engineer may reject the source supplier and require the contractor to submit a new source for approval, at no additional cost to the Owner. The on-site soils are considered acceptable material and may be used, provided that it meets the specified requirements.
- B. Quality control of the work shall be the Contractor's responsibility and Contractor shall make every effort to produce the best quality work as specified on the Drawings and in these Specifications.

2.3 STRUCTURAL FILL AND BACKFILL

- A. Fill and backfill under and around all structures shall be suitable approved imported or on-site material. Material shall be free of organic material, shall have not more than 10 percent by dry weight passing the U.S. Standard No. 200 sieve, and shall have no rocks larger than 1 inches in size.
- B. On site organic soils or other on-site soils with more than 10% by dry weight passing the U.S. Standard No. 200 sieve are not suitable for use as fill under structures, pavers, pavements, and concrete.

2.4 EARTHFILL

- A. On-site excavated material free from roots, trash, and rocks larger than 1 inch.

2.5 WATER FOR COMPACTION

- A. Contractor shall furnish potable water, as required. Contractor may coordinate with the Owner to arrange for a hydrant meter for water during construction. Costs associated with the hydrant meter shall be paid for by the Contractor.

2.6 EQUIPMENT

- A. All equipment shall be suitable and adequate to perform the work specified. Compaction equipment shall be vibratory type.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Identify required lines, levels, contours, and datum locations. Protect bench marks, survey control points, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

- B. Locate, identify, and protect utilities that remain from damage.

3.2 STRIPPING TOPSOIL

- A. Stripping of topsoil shall be performed prior to any cutting, excavation, removal and/or replacement or fill materials.
- B. Strip topsoil from area within boundaries of proposed construction lines to a depth of approximately 4-inches. The top materials stripped shall be removed and disposed of off-site, unless authorized for use on the site by the Owner/Engineer.
- C. Stripping of topsoil shall ensure that entire site is stripped and scraped clean of all brush, weeds, grass, roots, vegetation, etc.

3.3 CUTTING

- A. Except as otherwise specified, after stripping of topsoil all site areas which are above elevation required shall be cut to subgrades required by drawings.

3.4 PROOF ROLLING

- A. Not Used.

3.5 FILLING

- A. Except as otherwise specified, after stripping of topsoil all site areas which are below elevation required shall be compacted as specified and then over such areas clean granular fill placed and compacted in layers not exceeding 12" in uncompacted thickness. Each layer of fill shall be compacted to at least 95% of the modified proctor maximum dry density (ASTM D1557). Filling and compaction shall continue until subgrades required for various areas are reached. All holes and depressions caused from removal of trees, stumps, etc. shall be filled and compacted. Fill shall be good clean material as previously specified.

3.6 EXCAVATION UNDER STRUCTURES AND PAVEMENT AREAS

- A. Excavation shall be performed to elevations and dimensions required by drawings with suitable allowance made for construction operations and inspections. Excavation carried to depths below required elevations shall be replaced in layers a maximum of 4" in depth and compacted in a manner to achieve a minimum density of 98% of the maximum dry density as determined by a modified proctor in accordance with ASTM D-1557. Contractor may place additional concrete in lieu of replacing and compacting excess excavation as specified above to fill excess cut. Correction of excess cut shall be responsibility of Contractor at no additional cost to Owner.
- B. Compact disturbed load bearing soil in direct contact with foundations to achieve a minimum density of 98% of the maximum dry density as determined by a modified proctor in accordance with ASTM D-1557.
- C. Slope banks with machine to angle of repose or provide necessary shoring.
- D. Do not interfere with 45 degree bearing splay of existing foundations without providing adequate means of shoring protection.
- E. Grade top perimeter of excavation to prevent surface water from draining into excavation.
- F. Notify Engineer of unexpected subsurface conditions and discontinue affected Work in area until notified to resume work.
- G. Correct areas over excavated in accordance with this section.
- H. Remove excavated material unsuitable for backfill from site.

- I. When muck or other deleterious materials is encountered in the excavation, it shall be completely removed within the area of the structure or pavement and to a depth where acceptable material is encountered. After removal of all muck or other deleterious material, the area shall be backfilled with approved fill material to the specified grade.

3.7 TRENCH EXCAVATION AND PREPARATION

- A. Excavation: Excavate as required for the installation of all piping, utilities, conduits, and appurtenances.
- B. Trench Width: Cut trenches sufficiently wide to enable installation, compaction and inspection. The maximum width will not be limited except where excessive trench width would cause damage to adjacent structures or piping.
- C. Grade: Excavate the bottom of the trench to the line and grade shown, or as established by the Engineer with proper allowance for pipe bedding.
- D. All trench work shall comply with the Trench Safety Act of 1990, with latest revisions.
- E. Piping shall be installed in a dry trench.
- F. When acceptable material is encountered in the trench, the bottom shall be excavated and graded to the depth required so as to provide a uniform and continuous bearing and support for the pipe on solid and undisturbed ground at every point between bell holes.
- G. Bell holes shall be provided at each joint to permit the joint to be made properly. At no time shall the bells support the pipe when in the trench.
- H. When muck or other deleterious materials is encountered in the trench, it shall be completely removed for the width of the trench at the pipe and to a depth where acceptable material is encountered. After removal of all muck or other deleterious material, the trench shall be backfilled with bedding material to the bottom of pipe grade.
- I. See the Indian River County's Standards for additional requirements.

3.8 MAINTENANCE OF EXCAVATION

- A. The excavation shall be maintained at a dry condition at all times.
- B. All side slopes shall be such that material will not slide into the bottom of the excavation and any material doing so shall be immediately removed. Trench side slopes shall be in accordance with local codes, OSHA requirements, and the Trench Safety Act.
- C. All excavated material shall be piled in a manner that will not endanger the work and that will avoid obstructing sidewalks and driveways. Hydrants under pressure, valve pit covers, valve boxes, curb stop boxes, fire and police call boxes, or other utility controls shall be left unobstructed and accessible until the work is completed.
- D. Trees, shrubbery, fences, poles, bollards and all other property and surface structures shall be protected unless their removal is shown on the drawings or authorized by the Engineer.

3.9 BACKFILL UNDER STRUCTURES AND PAVEMENT AREAS

- A. Backfilling of excavated areas under, around or over building and structural appurtenances and pavement or pavers shall be performed with clean fill materials which are free of debris, organics, trash or other deleterious substances. Suitable compaction equipment shall be used to obtain density described previously for entire depth of backfilling. Each layer of backfill under structures, pavements, and pavers shall be compacted to a minimum of 98% of the maximum dry density as determined by a modified proctor in accordance with ASTM D-1557. Each layer of

compacted backfill shall not exceed 12-inches in thickness. The completed, compacted surface shall be at the proper final subgrade elevation.

- B. Verify that the specified density extends to 12 inches below the bottom of the structure or pavement base course to be installed.

3.10 TRENCH BACKFILLING

- A. Haunch Backfill: Carefully place Pipe Bedding material so as not to damage the pipe in maximum 6 inch loose lifts and compact to the pipe centerline. Use hand-held compaction equipment.
- B. Pipe Zone: Backfill with Pipe Bedding material in maximum 12 inch loose lifts and compact to a point 12 inches above the pipe crown.
- C. Under Pavement/Paver Areas, and Structures: In areas where backfill settlement must be held to a minimum, backfill above the pipe zone with Pipe bedding material in maximum 12 inch loose lifts and compact to a minimum 98 percent of the maximum dry density (ASTM D 1557) up to the subgrade elevation.
- D. Outside Pavement/Paver Areas: In areas where backfill settlement is not critical, backfill above the pipe zone with earthfill material to a density equal to or greater than the soil adjacent to the pipe trench, but not less than 90 percent of the maximum dry density (ASTM D 1557), to final grade.
- E. No material shall be used for backfill which contains muck or other deleterious material or material with an excessive void content. All backfill shall be composed of select clean granular material.
- F. All trenches and excavation shall be backfilled immediately after all pipe and joints have been investigated and approved by the Engineer or Utility Department, subject to satisfactory pressure and leakage test results, as required.
- G. Backfill, in general, shall be kept up with the rate of pipe laying. No more than 200 feet of pipe trench shall be open at one time at any one project location.
- H. Refer to Indian River County's Standards for additional requirements.

3.11 BACKFILL AROUND STRUCTURES

- A. Obtain Owner/Engineer's acceptance of concrete work and attained concrete strength prior to backfilling.
- B. Backfill with Structural Backfill material placed in maximum 12 inch loose lifts and compacted to a minimum 95 percent of maximum dry density as determined by the modified proctor test (ASTM D 1557).
- C. Compact backfill adjacent to structures with equipment that will not damage the structure.
- D. Backfill with flowable fill or other material shall be only if reviewed and approved by the Engineer.

3.12 SITE GRADING

- A. Fill and contour site areas with Earthfill material to elevations shown and as required to prepare the site for landscape grading and sodding.
- B. Place materials in maximum 12-inch loose lifts and compact as required to limit subsequent settlement.

3.13 COMPACTION TESTING

- A. In-situ compaction testing shall be performed by the Owner's laboratory.

- B. Compaction testing shall be done by nuclear density equipment or other approved methods. (ASTM D-2937, D-1557, D-2922)
- C. Density testing shall be performed as follows:
 - 1. Pipe Trenches: 1 test per lift per 100 feet of pipe.
 - 2. Fill Under Structures: 1 test per lift under pump pad.
 - 3. Fill Under Pavement Areas: 1 test per lift per 2,000 square feet of compacted surface area.
- D. Test results in a specific location are only representative of a larger area if the contractor has used consistent compaction means and methods and the soils are practically uniform throughout. If it is determined by the Owner/Engineer that there are variations in the compaction methods and/or soil uniformity, additional testing may be required.

3.14 FINAL AND FINISH GRADING

- A. Using clean topsoil, perform all final and finish grading in all yard and planting areas indicated on drawings. Topsoil shall be placed to a minimum of 6" thickness, rototilled to a minimum depth of 8", leveled and finish graded in all areas.
- B. Final grading shall be performed and grades shaped to finished elevations indicated. Finish grades (top of the soil) shall be approximately 1-1/2" below edges of pathways, curbs and other paved or concrete slabs. After sod installation, the top of the sod shall not be more than 1/2" below or shall be flush with the grade established by any adjacent paved or curbed surface.
- C. The Contractor shall verify that all finish subgrades are correct prior to beginning installation of sod and planting materials. Upon completion of the project work, the Contractor shall prepare "record drawings" verifying that all finish grades are in accordance with the contract documents and shall submit same to the Owner/Engineer for review and acceptance prior to requesting final inspection of the project. The "record drawings" shall be prepared by a surveyor registered in the State of Florida.
- D. Upon project completion, all areas of site within immediate construction and adjacent areas shall be completely cleaned of all debris occasioned by this construction of this construction. Particular attention is called to any cement, mortar, masonry drippings and plaster which shall be completely removed from planting and lawn areas and shall be disposed of off-site.
- E. All areas adjacent to site and all areas not within contract construction areas shall be left in reasonably same condition as they were found prior to commencement of construction.
- F. Any damage to the existing adjacent facilities including adjacent lakes or roads, and related areas such as, but not limited to, finish grades, slopes, grass sod, structures, pipe, etc. shall be repaired and restored to a proper and appropriate condition acceptable to the Owner/Engineer.

3.15 EXCESS MATERIAL

- A. Remove all excess suitable material from the site and dispose of at Contractor's expense.
- B. Unsuitable materials shall also be removed and disposed of off-site at Contractor's expense.

- END OF SECTION -

SECTION 02270
EROSION AND SEDIMENTATION CONTROL

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The work specified in this Section consists of measures required to control erosion on the project and in areas outside the project area where work is accomplished in conjunction with the project, so as to prevent pollution of water, detrimental effects of public or private property adjacent to the project area and damage to work on the project. These measures will consist of construction and maintenance of temporary erosion control features or, where practical, the construction and maintenance of permanent erosion control features.

1.2 RELATED REQUIREMENTS SPECIFIED ELSEWHERE

- A. Drawings and general provisions of the Contract, including the General and Supplementary Conditions and Division 1 Specification sections, apply to this section.
- B. Section 02016 – Existing Utilities and Underground Structures
- C. Section 02065 – Demolition
- D. Section 02200 – Earthwork Excavation and Backfill
- E. Section 02485 – Grassing

1.3 START OF WORK

- A. Do not start work until erosion control measures are in place.

PART 2 - PRODUCTS

2.1 GENERAL

- A. No testing of materials used in construction of temporary erosion control features will be required.
- B. Materials used for the construction of the temporary erosion and sedimentation control measures not to be incorporated into the completed project may be new or used.

PART 3 - EXECUTION

3.1 GENERAL

- A. Temporary erosion control features shall consist of, but not be limited to, temporary grassing, temporary sodding, temporary mulching, sandbagging, slope drains, sediment basins, artificial coverings, berms, baled hay or straw, floating silt barriers, staked silt barriers and staked silt fences. Design details for some of these items may be found in the Water Quality Section of the applicable edition of the FDOT Roadway and Traffic Design Standards.
- B. Incorporate permanent erosion control features into the project at the earliest practical time. Correct conditions, using temporary measures, that develop during construction to control erosion prior to the time it is practical to construct permanent control features.

- C. Construct temporary and permanent erosion and sediment control measures to prevent the pollution of adjacent water ways in conformance with the laws, rules and regulations of Federal, State and local agencies.

3.2 INSTALLATION

- A. Temporary Grassing: This work shall consist of furnishing and placing grass seed in accordance with Section 02485 – Grassing.
- B. Baled Hay or Straw:
 - 1. This work shall consist of construction of baled hay or straw dams to protect against downstream accumulations of silt. The baled hay or straw dams shall be constructed in accordance with the details shown in FDOT's Roadway and Traffic Design Standards.
 - 2. The dam shall be placed so as to effectively control silt dispersion under conditions present on this project. Alternate solutions and usage of materials may be used if approved.
- C. Temporary Silt Fences and Staked Silt Barriers: This work shall consist of furnishing, installing, maintaining and removing staked turbidity barriers in accordance with the manufacturer's directions, these specifications and the details as shown in FDOT's Roadway and Traffic Design Standards.

3.3 REMOVAL OF TEMPORARY EROSION CONTROL FEATURES

- A. In general, remove or incorporate into the soil any temporary erosion control features existing at the time of construction of the permanent erosion control features in such a manner that there will be no detrimental effect.

3.4 MAINTENANCE OF EROSION CONTROL FEATURES

- A. General: Provide routine maintenance of permanent and temporary erosion control features until the project is completed and accepted.

3.5 PROTECTION DURING SUSPENSION OF CONTRACT TIME

- A. In the event that it is necessary that the construction operations be suspended for any appreciable length of time, shape the top of the earthwork in such a manner as to permit runoff of rainwater and construct earth berms along the top edges of embankments to intercept runoff water. Provide temporary slope drains to carry runoff from cuts and embankments which are located in the vicinity of rivers, streams, canals, lakes, and impoundments. Should such preventive measures fail, immediately take such other action as necessary to effectively prevent erosion and siltation.

- END OF SECTION -

SECTION 02485

GRASSING

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. The Contractor shall furnish all labor, equipment, and materials necessary for grassing all areas disturbed by his operations and any other areas on the plans indicated to receive grassing. It is the intent of this specification that damaged areas are to be replaced in kind, with sod to be used for all maintained yard areas. The Owner/Engineer shall designate those areas to receive seed and those areas to receive sod. Owner/Engineer shall also designate the type of seed/sod to be used in each area. Contractor shall take all steps practical to minimize the area required to be sodded or seeded. All grassing shall be in accordance with Section 570-1 through 570-5 of the 2021 FDOT Standard Specifications for Road and Bridge Construction, except as modified herein.

1.2 STORAGE OF MATERIALS

- A. The Contractor shall provide space for storage of sod prior to placement in a manner that will not endanger or restrict pedestrian or vehicular traffic or interfere with other aspects of the work.

PART 2 - PRODUCTS

2.1 SOD

- A. Types: Sod shall be St. Augustine Floratam, Argentine Bahia, Centipede, or Bermuda, depending on type of existing sod in adjacent area to be matched. Sod shall be well matted with roots. Where sodding will adjoin, or be in sufficiently close proximity to private lawns, types of sod other than those listed above may be used if desired by the affected property owners and approved by the Engineer. Sod shall be delivered in commercial-size rectangles, preferably 12-inch by 24-inch or larger.
- B. Condition: The sod shall be sufficiently thick to secure a dense stand of live grass. The sod shall be live, fresh, and uninjured at the time of planting. It shall have a soil mat of sufficient thickness adhering firmly to the roots to withstand all necessary handling. It shall be reasonably free of weeds and other grasses. It shall be planted as soon as possible after being dug and shall be kept moist from the time it is planted.

2.2 SEED

- A. General: All seed shall meet the requirements of the State Department of Agriculture and Consumer Services and all applicable State laws. The seed shall have been harvested from the previous year's crop. When a low percentage of grass seed or native seed germination causes the quality of the seed to fall below the minimum pure live seed percentage as to specified below, the Contractor may elect, subject to the approval of the Engineer, to increase the rate of application sufficiently to obtain the minimum germination rate specified. No payment will be made for the added seed.

- B. Delivery and Storage: Each of the species or varieties of seed shall be furnished and delivered in separate labeled bags. During handling and storage, the seed shall be cared for in such a manner that it will be protected from damage by heat, moisture, rodents, and other causes. All permanent and temporary grass seed shall have been tested within a period of six months of the date of planting.
- C. Purity and Germination: All permanent and temporary grass seed shall have a minimum percent of purity and germination as follows:
- D. Argentine Bahia Grass Seed shall have a minimum pure seed content of 95 percent, with a minimum germination of 80 percent.
- E. Pensacola Bahia Grass Seed shall have a minimum pure seed content of 95 percent, with a minimum active germination of 40 percent and a total germination of 80 percent, including firm seed.
- F. Bermuda Grass Seed shall be of common variety with a minimum germination of 85 percent.
- G. Annual Type Rye Grass Seed shall have a minimum pure seed content of 95 percent, with a minimum germination of 90 percent.

2.3 MULCH

- A. The mulch material used shall normally be dry mulch. Dry mulch shall be straw or hay, consisting of oat, rye, of wheat straw, or of pangola, peanut, coastal Bermuda, or Bahia grass hay. Only deteriorated mulch which can readily be cut into the soil shall be used.

2.4 GRASSING EQUIPMENT

- A. Seed Spreader: The seed spreader shall be an approved mechanical hand spreader or other approved type of spreader.
- B. Equipment for Cutting Mulch into Soil: The mulching equipment shall be of a type capable of cutting the specified materials uniformly into the soil, and to the required depth. Harrows will not be allowed.
- C. Rollers: A cultipacker, traffic roller, or other suitable equipment will be required for rolling the grassed areas.

PART 3 - EXECUTION

3.1 GENERAL CONSTRUCTION METHODS

- A. Seeding and mulching operations will not be permitted when wind velocities exceed 15 miles per hour. Seed shall be sown only when the soil is moist and in proper condition to induce growth. No seeding shall be done when the ground is frozen, unduly wet, or otherwise not in a tillable condition. Whenever a suitable length of right-of-way or adjacent area has been graded, it shall be made ready, when directed by the Engineer, and grassed in accordance with these specifications. Grassing shall be incorporated into the project at the earliest practical time in the life of the contract.

3.2 SODDING

- A. Preparation of Area to be Sodded: The ground which is to receive sod shall have been graded to proper elevations (2" below sodded grade) to match pre-construction conditions or proposed grades. All disturbed swales and ditches shall have been restored to their pre-construction

condition or better. The pre-construction grade shall be maintained and the prepared soil shall be loose and reasonably smooth. It shall be reasonably free of large clods, roots, patches of existing grass, and other material which will interfere with the sod-laying operations or subsequent mowing and maintenance operations.

- B. Laying of Sod: Sod shall be installed in all areas so designated by Owner/Engineer. Sod shall be carefully placed so that each piece abuts flush to all surrounding sod, regardless of whether surrounding sod is new or existing. Where new sod is to be placed adjacent to existing sod, the new sod must be cut in to match the elevation of the existing sod. Uneven sod which might cause mowing problems will be rejected. New sod laid on top of existing sod will also be rejected. All sod placed on steep slopes (greater than 1:1) shall be pinned with a wooden pin to keep it in place.
- C. Rolling: Immediately after completion of the sod laying, the entire sodded area shall be rolled thoroughly with the equipment specified. At least two trips over the entire area will be required.
- D. Watering: Newly-sodded areas are to be watered by Contractor as necessary to keep sod alive until the Contractor is closed out. Dead sod shall be replaced by Contractor prior to contract closeout.

3.3 SEEDING

- A. Sequence of Operations: The operations involved in the work shall proceed in the following sequence: preparation of the ground, seeding, spreading, and cutting in mulch.
- B. Preparation of Area to be Seeded: The ground over which the seed is to be sown shall be prepared by disk-harrowing and thoroughly pulverizing the soil to a suitable depth. The prepared soil shall be loose and reasonably smooth. It shall be reasonable free of large clods, roots, and other material which will interfere with the work or subsequent mowing and maintenance operations.
- C. Application of Seed: While the soil is still loose, the seed shall be scattered uniformly over the grassing area and immediately mixed into the seed bed to a depth of one-half inch. Unless other types of seed are called for, permanent-type grass seed shall be a mixture of 20 parts of Bermuda seed and 80 parts of Pensacola Bahia seed. Quick-growing type grass seed shall be a species which will provide an early ground cover during the particular season when planting is done and will not later compete with permanent grass. The separate types of seed used shall be thoroughly dry-mixed immediately before sowing. Seed which has become wet shall not be used.
- D. Mulching: When mulching is called for, approximately two inches, loose thickness, of the mulch material shall then be applied uniformly over the seeded area, and the mulch material cut into the soil with the equipment specified, so as to produce a loose mulched thickness of three to four inches. Care shall be exercised that the materials are not cut too deeply into the soil. No artificial watering of the mulch shall be done before it is applied.
- E. Rolling: Immediately after completion of the seeding, the entire grassed or mulched area shall be rolled thoroughly with the equipment specified. At least two trips over the entire area will be required.
- F. Watering: Newly seeded areas are not to be watered to force the seed germination, but only to sustain grass growth. Water will only be used on vegetated areas when permitted by the Engineer.

- G. Operations on Steep Slopes: On steep slopes when mulching is called for, the mulch material may be anchored down in lieu of being cut into the soil by use of a machine. Anchoring may be done by either of the following methods:
 - 1. Placing a layer of soil, approximately two inches thick by nine inches wide, along the upper limits of the mulch, and spotting soil piles over the rest of the area at a maximum spacing of four feet.
 - 2. Spreading a string net over the mulch, using stakes driven flush with the top of the mulch, at six-foot centers, and stringing parallel and perpendicular, with diagonals in both directions.
- H. Maintenance: The Contractor shall, at his expense, maintain the planted areas in a satisfactory condition until final acceptance of the project. Such maintenance shall include the filling, leveling, and repairing of any washed or eroded areas, as may be necessary. The Engineer, at any time, may require replanting of any areas in which the establishment of the grass stand does not appear to be developing satisfactorily. If a planted area must be replanted due to the Contractor's negligence, carelessness, or failure to provide routine maintenance of such areas, such replacement shall be at the Contractor's expense. If replanting is necessary due to factors determined to be beyond the control of the Contractor, payment for replacement will be made under the appropriate contract pay items.

- END OF SECTION -

**SECTION 02510
PAVING AND SURFACING**

PART 1 - GENERAL

1.1 SCOPE

- A. The work covered by this section of the Specifications consists of furnishing all labor, materials, equipment and supplies and performing all operations for the construction of pavements under this Contract.

1.2 RELATED REQUIREMENTS SPECIFIED ELSEWHERE

- A. Section 01010 - Summary of Work
- B. Section 02200 – Earthwork, Excavation and Backfill
- C. Section 02580 – Pavement Markings

1.3 REFERENCED SPECIFICATIONS

- A. It is the intent of these Specifications that the Florida State Department of Transportation "Standard Specifications for Road and Bridge Construction", latest edition, referred to herein and on the construction drawings as "DOT Std. Spec's", be used where applicable for the various items of work, and that where such wording therein refers to the State of Florida and its Department of Transportation and personnel such working is intended to be replaced with that wording which would provide proper terminology; thereby making such "Standard Specifications for Road and Bridge Construction" the standard specifications for this project unless otherwise shown on the construction drawings or indicated in the Contract Documents. Said "DOT STD. Spec's" shall include current Supplemental Specifications issued by the Fla. DOT.

1.4 SUBMITTALS

- A. Submit in accordance with Section 01300.
- B. Submit name of all material sources to the Engineer. Provide materials from the same approved source throughout the project. All material sources shall be Florida DOT approved.
- C. Submit proposed job-mix design to the Engineer for review.
- D. Submit written certifications that each material conforms to these specifications.

PART 2 - PRODUCTS

2.1 BASE MATERIALS

- A. Limerock material shall meet the requirements of Section 911 of the DOT Std. Specs.
- B. Coquina (shell rock) material shall meet the requirements of section 915 DOT Standard Specifications, including an average LBR of not less than 100. A coquina certification specification shall be submitted per Section 01300. Contractor to bid and use only one base material throughout the project.

2.2 PRIME AND TACK COATS

- A. The materials used for prime and tack coats shall meet the requirements of Section 300 of the DOT Std. Specs.

2.3 ASPHALTIC CONCRETE

- A. Type S-I: The material used for Type S-I Asphaltic Concrete shall meet the requirements of the Fla. DOT Std. Specs latest edition.

2.4 EQUIPMENT

- A. All equipment associated with the operations of pavement placement and related work shall be entirely suitable for the applicable operations performed and shall be maintained in good condition.

2.5 QUALITY CONTROL

- A. Quality control of the work shall be the Contractor's responsibility and said Contractor shall make every effort to produce the best quality work as specified on the Plans and in these Specifications.
- B. Density tests on the compacted subgrade and base shall be performed by an independent testing laboratory at locations designated by the Engineer.

PART 3 - EXECUTION

3.1 SUBGRADE AND SHOULDER STABILIZATION (TYPE C)

- A. The pavement subgrade and roadway shoulders shall be prepared, graded, stabilized and compacted to the lines and grades as shown on the Plans in accordance with Type C Stabilization in Section 160 of the DOT Std. Specs. Both shoulder and subgrade to provide minimum 75 lb. Florida Bearing Value or a minimum limerock bearing ratio of 40. Subgrade shall be compacted to not less than 98 percent of the maximum density as determined by AASHTO T-180.
- B. Stabilized subgrade may be substituted using 12" minimum shell or limerock base and as approved by the Engineer.

3.2 BASE

- A. Shell or limerock shall be prepared, graded and compacted to the lines and grades as shown on the Plans and in accordance with Section 200 of the DOT Std. Specs. Base shall be compacted to not less than 98 percent of the maximum density as determined by AASHTO T-180.

3.3 PRIME AND TACK COAT

- A. Base shall receive a prime coat with cover material in accordance with Section 300 of the DOT Std. Specs.
- B. Pavement overlays shall receive a tack coat in accordance with Section 300 of the DOT Std. Specs.

3.4 ASPHALTIC CONCRETE SURFACE COURSE

- A. Asphaltic concrete surface course shall be constructed to a minimum thickness as specified on the Plans.
- B. Asphaltic concrete surface course shall be constructed in accordance with Sections 320 and 330 of the DOT Std. Specs.

- C. All existing exposed edges which abut to new Asphaltic Concrete Surface Course shall be saw cut in a straight and neat appearing line.
- D. All asphaltic concrete surface course pavement replacement shall be placed by mechanical spreading and screeding equipment as specified in Article 320-6.1 of the DOT Std. Specs. unless otherwise indicated. This will require at least an 8 ft. width for surface course placement unless specialty equipment is used which has received prior approval of the Engineer.

- END OF SECTION –

THIS PAGE INTENTIONALLY LEFT BLANK

**SECTION 02580
PAVEMENT MARKINGS**

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. The work included in this Section consists of applying pavement markings as required for new pavement areas and to restore disturbed pavement areas. Work shall adhere to all County and FDOT standards.

1.2 RELATED REFERENCES

- A. All markings shall conform to the requirements of the Manual of Uniform Traffic Control Devices, and FDOT Roadway and Traffic Design Standards.
- B. Thermoplastic shall conform to the requirements of the Florida D.O.T. Standard Specifications for Road and Bridge Construction (Section 711) latest edition.
- C. Paint shall conform to the requirements of the Florida D.O.T. Standard Specifications for Road and Bridge Construction (Section 710) latest edition.

PART 2 - PRODUCTS

2.1 THERMOPLASTIC

- A. Stop bars and centerlines to be Alkyd thermoplastic only.
- B. All other markings to be paint type.

2.2 TEMPORARY MARKINGS

- A. Temporary markings on final asphalt shall be only for backed construction tape. Lower asphalt lifts may be marked with paint or any other approved marking material.

2.3 REFLECTIVE PAVEMENT MARKERS (RPM'S)

- A. RPM'S shall meet FDOT Class B Specifications.
- B. One blue RPM shall be installed in the center of any roadway adjacent to a fire hydrant.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Thermoplastic shall not be installed on roadway until thirty (30) calendar days after final lift of asphalt has been completed.
- B. If existing marking material is not compatible with Alkyd thermoplastic, it shall be removed prior to installation of new markings.

- END OF SECTION -

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 02670
FLUSHING, TESTING AND DISINFECTION

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. Flushing, Pressure Testing, and Disinfection of all piping systems, including:
 - 1. All new piping, valves and pumps to be constructed under this contract including, but not limited to, pre-treated raw water piping, product blend and permeate piping, all process piping, pumps, finished water piping, chemical system piping as described herein
 - 2. Two (2) existing ground storage tanks to be rehabilitated
- B. Contractor shall furnish all necessary pumps, hoses, piping, fittings, meters, gauges, chemicals and labor to conduct specified testing.
- C. Testing shall be repeated at the Contractor's expense until satisfactory results are achieved.
- D. Refer the specific chemical system specification section for additional flushing and testing procedures.

1.2 RELATED REQUIREMENTS SPECIFIED ELSEWHERE

- A. Section 01300 – Submittals
- B. Sections 11000 Series – Chemical Systems
- C. Section 11209 – Membrane Softening System
- D. Section 11936 – Vertical Turbine Pumps
- E. Section 15100 – Piping and Valves

1.3 REFERENCES

- A. ANSI/AWWA C651 Standard for Disinfecting Water Mains.
- B. ANSI/AWWA C652 – Standard for Disinfection of Water Storage Facilities.
- C. ANSI/AWWA C653 – Standard for Disinfection of Water Treatment Plants.

1.4 SUBMITTALS

- A. Test Reports: Indicate results comparative to specified requirements. Submit two (2) copies of test results to Engineer in accordance with Submittal specifications.
- B. Final approval of the bacterial samples shall be received from the Florida Department of Environmental Protection prior to the time that the system is placed into operation. Sampling procedures shall be done in accordance with FDEP requirements.
- C. Bacteriological sampling locations shall meet FDEP requirements and be taken where shown on the drawings and as directed by the Engineer at no additional cost to Owner.

1.5 QUALITY ASSURANCE

- A. Perform work in accordance with ANSI/AWWA C651, C652 and C653.

1.6 REGULATORY REQUIREMENTS

- A. Conform to applicable Florida DEP requirements for performing the work of this Section.
- B. Work shall conform to Indian River County Utility Standards.

PART 2 - PRODUCTS

2.1 DISINFECTION CHEMICALS

- A. Chemicals: The disinfecting agent shall be sodium hypochlorite solution ANSI/AWWA B303 or liquid chlorine ANSI/AWWA B301. Dry hypochlorite, similar to "HTH" or equal may also be used as the disinfecting agent. Bleach or Clorox is not acceptable.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that piping systems have been cleaned, inspected, and tested.
- B. Coordinate scheduling of flushing, pressure testing, and disinfection activities with tie-ins, certifications, and sequence of construction.

3.2 FLUSHING AND PRESSURE TESTING - PIPING

- A. The Contractor shall furnish and install suitable temporary testing plugs or caps for the water lines, all necessary pressure pumps, hose, pipe connections, meters, gauges and other similar equipment, and all labor required, all without additional compensation for conducting pressure and leakage tests and flushing of the piping. Flushing and pressure testing shall be conducted in the following order.
- B. After all piping lines have been installed and before pressure testing and final connections to existing equipment, each run of pipe shall be thoroughly flushed so as to remove all debris and foreign matter from the piping and equipment. Clean and flush all piping using potable water. Pigging of piping systems shall be incorporated into this flushing procedure. Non-abrasive pigs shall be employed to clean the HDPE pipes. Sufficient flushing water and pigging shall be introduced into the piping to produce a discharge that is clear with no evidence of silt or foreign matter is visible. Contractor to provide means of discharging and disposing of water at Contractor's expense.
- C. Pressure testing ductile iron piping systems:
 - 1. The test pressure for the water piping, irrigation quality water piping, and force main piping systems constructed of ductile iron shall be 150 psi and this pressure shall be maintained for a period of not less than two hours. Tests shall be made between valves and as far as practicable and as approved by the Engineer. Potable water from the distribution system shall be used. Pressure shall not vary more than five (5) psi for piping during the test periods or as approved by the Engineer. Allowable leakage shall be computed on the basis of AWWA C-600.
 - 2. All leaks evident at the surface shall be uncovered and repaired regardless of the total leakage as indicated by the test, and all pipes, valves and fittings and other materials found defective under the test shall be removed and replaced at the Contractor's expense. Tests shall be repeated until leakage has been reduced below the allowable amount.
 - 3. In the judgment of the Engineer, should it not be practical to follow the foregoing procedures exactly for any reason, modifications in the procedure shall be made as approved by the Engineer. In any event, the Contractor shall be responsible for the ultimate water tightness of the piping within the preceding requirements.
- D. Pressure Testing HDPE Piping Systems

1. The test pressure for all piping systems shall be 150 psi and this pressure shall be maintained for a period of two hours. Testing procedure shall be as follows.
 - a. Completely fill pipe with clean water and remove all air from pipe to be tested.
 - b. Allow water in pipe to equalize with surrounding ground/groundwater for 24 hours.
 - c. Bring pipe being tested to test pressure.
 - d. Add make-up liquid once per hour to bring pipe back to test pressure over a 3 hour period.
 - e. Immediately following the end of the 3 hour period, begin test of pipe section. Test period is 2 hours. Add make-up fluid at 1 hour and 2 hours to return test section to test pressure. Measure all fluid added. Make-up fluid may not exceed the following:

Nominal Pipe Size (in)	Allowance for Expansion (Gallons per 100 ft.)
12	2.3
14	2.8
16	3.3
18	4.3
20	5.5
22	7.0
24	8.9
 - f. All leaks, visible or not, shall be repaired regardless of the total leakage as indicated by the test, and all pipes, valves and fittings and other materials found defective under the test shall be removed and re placed at the Contractor's expense. Tests shall be repeated until leakage has been reduced below the allowable amount.
 - g. Should, in the judgment of the Engineer, it not be practical to follow the foregoing procedures exactly for any reason, modifications in the procedure shall be made as approved by the Engineer. In any event, the Contractor shall be responsible for the ultimate tightness of the watermain within the preceding requirements.

3.3 DISINFECTION – PIPES AND PUMPS

- A. The Contractor shall furnish and install suitable temporary connections to the piping, all necessary pressure pumps, hose, pipe connections, meters, gauges and other similar equipment, and all labor required, all without additional compensation for the disinfection of all required piping systems. Disinfection shall be conducted on the following systems:
 1. Water main piping and valves.
 2. Finished water transfer piping
 3. High service pumps, supply and discharge piping
 4. Permeate piping
- B. Conform to AWWA Standards and as modified herein.
- C. Maintain disinfectant for a minimum of 8 hours in such a manner that the entire system will be filled with water containing a minimum chlorine concentration of 50 ppm at any point.
- D. After the disinfecting agents have been permitted to remain for the specified contact periods, the water lines, and valves shall be thoroughly flushed with water until the residual chlorine tests are less than 2 PPM in each instance. The determination of the amount of residual chlorine in the system shall be made at such points and in accord with standard tests by means of a standard orthotolodine test set.

3.4 DISINFECTION/PRESSURE TESTING – STORAGE TANKS

- A. All leaks evident at the surface shall be uncovered and repaired regardless of the total leakage as indicated by the test, and all pipes, valves and fittings and other materials found defective under the test shall be removed and replaced at the Contractor's expense. Tests shall be repeated until leakage has been reduced below the allowable amount.
- B. Should, in the judgement of the Engineer, it not be practical to follow the foregoing procedures exactly for any reason, modifications in the procedure shall be made as approved by the Engineer. In any event, the Contractor shall be responsible for the ultimate water tightness of the plant piping within the preceding requirements.
- C. Filling:
 - 1. Water containing 50 PPM of chlorine shall be brought to such a depth that when the tank is filled, the resulting chlorine solution is 2 PPM.
 - 2. The tank shall be filled in approximately eight-foot increments with 8 normal working hours between each increment for observation of possible leaks through ring drains, wall, and wall-footing.
- D. Testing:
 - 1. After filling the tank, the water level shall be held at the overflow for a period of 24 hours.
 - 2. The tank shall then be examined for evidence of leaks.
 - 3. All leaks shall be repaired to the satisfaction of the Engineer.
 - 4. Any area that, in the opinion of the Engineer, are exposed to contamination during the repair work shall be re-chlorinated to the Engineer's satisfaction.

3.5 DISINFECTION – STORAGE TANK

- A. The Contractor shall furnish and install suitable temporary connections to the piping, all necessary pressure pumps, hose, pipe connections, meters, gauges and other similar equipment, and all labor required, all without additional compensation for the disinfection of all required piping systems.
- B. Conform to AWWA Standards and as modified herein.
- C. Water containing 200 ppm of chlorine shall be sprayed on all walls, column inlet and outlet piping, drain piping, and underside of dome roof. This solution shall remain in the tank for a 24-hour period prior to fill testing.
- D. Maintain disinfectant for a minimum of 8 hours in such a manner that the entire system will be filled with water containing a minimum chlorine concentration of 50 ppm at any point.
- E. After the disinfecting agents have been permitted to remain for the specified contact periods, the water lines, and tank shall be thoroughly flushed with water until the residual chlorine tests are less than 2 PPM in each instance. The determination of the amount of residual chlorine in the system shall be made at such points and in accord with standard tests by means of a standard orthotolodine test set.
- F. Replace permanent system devices removed for disinfection.
- G. Once residual chlorine levels are less than 2 ppm and successful bacteriological testing is completed, the water in the tank may be delivered to the distribution system under direction of the Engineer or Owner.

3.6 CHEMICAL LINES – TESTING AND FLUSHING

- A. Flush all chemical lines with potable water. Purge all chemical lines of water using nitrogen gas to remove standing water and moisture from lines. It is the Contractor's responsibility to purge all water from chemical lines prior to filling lines with chemical to prevent heat damage to piping systems.
 - 1. Pressure test all chemical feed lines to 150 psi, for a duration of 2 hours utilizing nitrogen gas. Pressure loss shall not be less than 2% of test pressure.
 - 2. Pump suction lines shall be tested to 25 psi for 30 minutes.
 - 3. Secondary containment piping shall be tested to 15 psi for 30 minutes.
 - 4. Tank fill lines shall be visual leak tested.
- B. Ensure lines are thoroughly cleaned of all debris prior to placing into service. Contractor takes responsibility for repairing chemical systems if not thoroughly flushed out.
- C. Safety procedures should be employed during pressure testing with nitrogen gas, if used.

3.7 MEMBRANE SYSTEM – FLUSHING & BACTERIOLOGICAL SAMPLING

- A. The membrane skid shall be cleaned prior to installation of membranes. Each vessel shall be pigged with glycerin swab prior to membrane installation. Vessels shall be pigged just before installation of membranes. All membranes shall be ready for installation prior to pigging.
- B. The membrane train shall be flushed with pre-treated raw water. No chlorinated water shall be introduced to the membrane train assembly.
 - 1. The contractor shall provide suitable fittings from the NFP permeate cleaning connection to the NFC cleaning concentrate connection to allow for permeated flush water to be disposed of via concentrate main.
 - 2. The contractor is **not** permitted to flow permeated flush water to the final permeate piping without passing bacteriological samples.
- C. Prior to NF system startup and functional testing, two (2) consecutive bacteriological samples shall be taken from the final permeate and successfully pass.
- D. Two (2) samples at each location as required by the Engineers shall be taken.
- E. Permeate piping shall be flushed with finish water and let sit prior to collecting bacteriological samples.

3.8 BACTERIOLOGICAL SAMPLING

- A. It shall be the responsibility of the Contractor under this contract to perform the bacteriological testing required by the Florida Department of Environmental Protection and IRCU to obtain clearance of the water main and process piping. The Contractor shall be responsible to disinfect and repeat testing as needed until clearance is obtained for all required plant systems. The Contractor shall be responsible to pay for additional water needed if the bacteriological testing must be repeated for the clearance of the water mains.
- B. The piping systems require two (2) consecutive daily samples taken from the locations called out on the plans or as determined by the Engineer. The samples shall be taken at all the respective sample point locations.
- C. Sampling must be per drawings and coordinated with Engineer and other construction activities so as to minimize re-sampling.
- D. Contractor shall submit schedule for bacteriological testing and pressure tests.

- E. The Contractor shall incur all costs needed to provide bacteriological clearance of the process components

3.9 QUALITY CONTROL

- A. The laboratory and personnel collecting bacteriological samples shall be Florida State certified in accordance with FDEP requirements and be acceptable to Owner/Engineer.

- END OF SECTION -

SECTION 03100
CONCRETE FORMWORK

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Formwork for cast-in place concrete, with shoring, bracing, and anchorage.
- B. Openings for other work.
- C. Form accessories.
- D. Form stripping.

1.2 RELATED SECTIONS SPECIFIED ELSEWHERE

- A. Section 03200 - Concrete Reinforcement
- B. Section 03300 - Cast-in-Place Concrete

1.3 REFERENCES

- A. ACI 301 - Structural Concrete for Buildings.
- B. ACI 318 - Building Code Requirements for Reinforced Concrete.
- C. ACI 347 - Recommended Practice for Concrete Formwork.
- D. PS 1 - Construction and Industrial Plywood.
- E. 2020 Florida Building Code

1.4 QUALITY ASSURANCE

- A. Perform Work in accordance with ACI 318.
- B. Maintain one copy of each document on site.

1.5 REGULATORY REQUIREMENTS

- A. Conform to applicable code for design, fabrication, erection, and removal of formwork.

1.6 COORDINATION

- A. Coordinate this Section with other Sections of work which require attachment of components to formwork.
- B. Coordinate formwork with reinforcement installation to provide sufficient concrete cover over reinforcement.

1.7 DESIGN

- A. All formwork shall be designed by a Florida Registered structural engineer. Special attention shall be given to the additional hydraulic pressures imparted by concrete containing superplasticizer admixture. The contractor is specifically cautioned that not all of the specified superplasticizer admixtures will cure at the same rate.

PART 2 - PRODUCTS

2.1 WOOD FORM MATERIALS

- A. Form Materials: At the discretion of the Contractor.

- B. All form lumber shall be free from warp, holes, loose knots, dressed to uniform width and thickness. All forming shall conform to ACI 347.
 - 1. Unexposed concrete surfaces: No. 2 common lumber or better lumber
 - 2. Exposed concrete surfaces: commercial standard, moisture resistant, concrete form plywood.

2.2 FORMWORK ACCESSORIES

- A. Wall Form Ties: Removable Snap-off type, 316 stainless steel, fixed length, cone type, with waterproofing rubber washer, 1-1/2 inch back break dimension, free of defects that could leave holes larger than 1-inch in concrete surface.
- B. Form Release Agent: Colorless mineral oil which will not stain concrete, or absorb moisture, or impair natural bonding or color characteristics of coating intended for use on concrete. Diesel oil or motor oil will not be permitted.
- C. Corners Chamfer, wood strip type; 3/4 x 3/4 inch size; maximum possible lengths.
- D. Nails, Spikes, Lag Bolts, Through Bolts, Anchorages: Sized as required, of sufficient strength and character to maintain formwork in place while placing concrete.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify lines, levels, and centers before proceeding with formwork. Ensure that dimensions agree with drawings.

3.2 EARTH FORMS

- A. Earth forms are not permitted.

3.3 ERECTION - FORMWORK

- A. Erect formwork, shoring, and bracing to achieve design requirements, in accordance with requirements of ACI 318.
- B. Provide bracing to ensure stability of formwork. Shore or strengthen formwork subject to overstressing by construction loads.
- C. Arrange and assemble formwork to permit dismantling and stripping. Do not damage concrete during stripping. Permit removal of remaining principal shores.
- D. Align joints and make watertight. Keep form joints to a minimum.
- E. Obtain approval before framing openings in structural members which are not indicated on Drawings.
- F. Provide chamfer strips on external corners of all exposed concrete elements.
- G. Induce camber on existing roof slab structure prior to casting concrete.

3.4 APPLICATION - FORM RELEASE AGENT

- A. Apply form release agent on formwork in accordance with manufacturer's recommendations.
- B. Apply prior to placement of reinforcing steel, anchoring devices, and embedded items.
- C. Do not apply form release agent where concrete surfaces will receive special finishes applied coverings which are affected by agent. Soak inside surfaces of untreated forms with clean water.
- D. Keep surfaces coated prior to placement of concrete.

3.5 INSERTS, EMBEDDED PARTS, AND OPENINGS

- A. Provide formed openings where required for items to be embedded in passing through concrete work.
- B. Locate and set in place items which will be cast directly into concrete.
- C. Coordinate with work of other sections in forming and placing openings, slots, regrets, recesses, sleeves, bolts, anchors, other inserts, and components of other Work.
- D. Install accessories in accordance with manufacturer's instructions, straight, level, and plumb. Ensure items are not disturbed during concrete placement.
- E. Install waterstops continuous without displacing reinforcement. Heat seal joints watertight. Conform to manufacturers recommendations.
- F. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection. Locate openings at bottom of forms to allow flushing water to drain.
- G. Close temporary openings with tight fitting panels, flush with inside face of forms, and neatly fitted so joints will not be apparent in exposed concrete surfaces.

3.6 CONSTRUCTION JOINTS

- A. Construct and locate as indicated on the drawings and so as not to impair the strength of the structure and only at locations approved by the Engineer. Form keys in cold joints shown on the drawings.

3.7 FORM CLEANING

- A. Clean forms as erection proceeds, to remove foreign matter within forms.
- B. Clean formed cavities of debris prior to placing concrete.
- C. Use compressed air to remove remaining foreign matter.

3.8 FORMWORK TOLERANCES

- A. Construct formwork to maintain tolerances required by ACI 318.
- B. Camber slabs and beams 1/4 inch per 10 feet in accordance with ACI 318.

3.9 FIELD QUALITY CONTROL

- A. Inspect erected formwork, shoring, and bracing to ensure that work is in accordance with formwork design, and that supports, fastenings, wedges, ties, and items are secure.
- B. Do not reuse wood formwork more than three times for concrete surfaces to be exposed to view.

3.10 FORM REMOVAL

- A. Do not remove forms or bracing until concrete has gained sufficient strength to carry its own weight and imposed loads. Determination of form removal timing is the Contractor's responsibility and shall be in accordance with ACI 347, except that the Engineer reserves the right to delay form removal for a period not to exceed 14 days after the pour.
- B. Do not remove forms, shores and bracing until concrete has gained sufficient strength to carry its own weight, and construction and design loads which are liable to be imposed upon it. Verify strength of concrete by compressive test results.
- C. Loosen forms carefully. Do not wedge pry bars, hammers, or tools against finish concrete surfaces scheduled for exposure to view.
- D. Store removed forms in manner that surfaces to be in contact with fresh concrete will not be damaged. Discard damaged forms.

- E. Remove formwork progressively and in accordance with code requirements and so that no shock loads or unbalanced loads are imposed on the structure.
- F. Re-shore structural members where required due to design requirements of construction conditions and as required to permit progressive construction.

- END OF SECTION -

SECTION 03200
CONCRETE REINFORCEMENT

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Reinforcing steel bars, wire fabric, and accessories for cast-in-place and precast concrete.

1.2 RELATED SECTIONS SPECIFIED ELSEWHERE

- A. Section 01300 - Submittals
- B. Section 03100 - Concrete Formwork
- C. Section 03300 - Cast-in-Place Concrete

1.3 REFERENCES

- A. ACI 301 - Structural Concrete for Buildings.
- B. ACI 318 – Building Code Requirements for Reinforced Concrete
- C. ACI SP-66 - American Concrete Institute -Detailing Manual.
- D. ANSI/ASTM A82 - Cold Drawn Steel Wire for Concrete Reinforcement.
- E. ANSI/ASTM A185 - Welded Steel Wire Fabric for Concrete Reinforcement.
- F. ANSI/AWS D1.4 - Structural Welding Code for Reinforcing Steel.
- G. ASTM A615 - Deformed and Plain Billet Steel Bars for Concrete Reinforcement.
- H. ASTM A704 - Welded Steel Plain Bar or Rod Mats for Concrete Reinforcement.
- I. AWS D12.1 - Welding Reinforcement Steel, Metal Inserts, and Connections in Reinforced Concrete Construction.
- J. CRSI -Concrete Reinforcing Steel Institute -Manual of Practice.
- K. CRSI 63 -Recommended Practice For Placing Reinforcing Bars.
- L. CRSI 65 - Recommended Practice For Placing Bar Supports, Specifications, and Nomenclature.
- M. 2020 Florida Building Code

1.4 SUBMITTALS

- A. Submit shop drawings under provisions of Section 01300.
- B. Shop Drawings: Indicate bar sizes, spacings, locations, and quantities of reinforcing steel and wire fabric, bending and cutting schedules, and supporting and spacing devices.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with ACI 318.
- B. Maintain one copy of document on site.

1.6 QUALIFICATIONS

- A. Welders' Certificates: Submit under provisions of Section 01300 Manufacturer's Certificates, certifying welders employed on the Work, verifying AWS qualification within the previous 12 months.

1.7 COORDINATION

- A. Coordinate with placement of formwork, formed openings, and other Work.

1.8 STORAGE

- A. Reinforcing steel shall be clean, new stock, properly marked and tagged for identification prior to placing. Store reinforcing to avoid excessive rusting or coating with grease, oil, dirt, or other objectionable materials.

PART 2 - PRODUCTS

2.1 REINFORCEMENT

- A. Reinforcing Steel: ASTM A615, 60-ksi yield grade; deformed billet steel bars, unfinished.
- B. Welded Steel Wire Fabric: ASTM A185 Plain Type; in flat sheets unfinished.
- C. Ties: Shall be No. 16 gauge minimum, fully annealed, black steel wire.
- D. Hooks and Bends in Reinforcement shall conform to ACI 315 unless otherwise noted on the drawings.

2.2 ACCESSORY MATERIALS

- A. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for strength and support of reinforcement during concrete placement conditions including load bearing pad on bottom to prevent vapor barrier puncture.
- B. Special Chairs, Bolsters, Bar Supports, Spacers Adjacent to Weather-exposed Concrete Surfaces: Plastic coated steel or stainless steel type; size and shape as required.

2.3 FABRICATION

- A. Fabricate concrete reinforcing in accordance with ACI 318.
- B. Locate reinforcing splices not indicated on drawings, at point of minimum stress. Review location of splices with Engineer.

PART 3 - EXECUTION

3.1 PLACEMENT

- A. Fabrication, detailing and placement of reinforcing steel shall conform to CRSI Manual of Standard Practice, ACI 315 and ACI 318. Reinforcement shall be carefully placed, rigidly supported and well tied with bar supports and spacers.
- B. Reinforcement shall be accurately placed and securely tied at intersections with 16 gauge black annealed wire. It shall be maintained in proper position by chairs, bar supports, or other devices approved by the Engineer.
- C. All splices and laps shall be as shown on the drawings, or 36 bar diameters, whichever is greater.
- D. Concrete protection of reinforcing shall be not less than the following or as shown on the drawings if greater:
 - 1. Concrete cast against and permanently exposed to earth or exposed to corrosive environment -- 3 inches.
 - 2. Concrete cast against forms, but exposed to earth or weather:
 - a. No. 6 through No. 11 bars -- 2 inches

- b. No. 5 bars, or equivalent, and smaller -- 1-1/2 inches.
- 3. Concrete cast against forms, but not exposed to earth or weather (interior construction):
 - a. Slabs, walls and joists:
 - 1) No. 14 and No. 18 bars -- 1-1/2 inches
 - 2) No. 11 bars and smaller for liquid retaining structures -- 2 inches
 - 3) No. 11 bars and smaller elsewhere -- 3/4 inch
 - b. Beams and Columns, including primary reinforcement, ties, stirrups, and spirals -- 1-1/2 inches.
- E. The clear distance between parallel bars in a layer shall be the nominal diameter of the bar, but not less than one inch. Wherever conduits, piping, inserts or sleeves interfere with the placing of reinforcing steel as shown, the Contractor shall consult with the Engineer before pouring concrete. The bending or field cutting of bars around openings or sleeves will not be permitted.
- F. Clean bars of loose scale, heavy deposits or rust and oil, wax or other coatings that may reduce or destroy bonding, before placing. Check and clean again if necessary before concrete is poured.
- G. Concrete beam sizes may be increased as required for architectural details or to fit block coursing, subject to Engineer approval.
- H. Reinforcing steel in footings shall be assembled as mats with bars equally spaced and wired together at each intersection before concrete is placed.
- I. Center all footings on wall, pier or column above unless otherwise indicated.
- J. Dowel column and wall reinforcing to footing or pile cap with same size and number of dowels as vertical bars above.
- K. Dowels shall be hooked "L" at bottom and shall be lapped 36 bar diameter with the column or wall reinforcing above.
- L. Concrete columns shall be tied columns unless otherwise indicated.
- M. Provide one layer 6 x 6 - W2.9 x W2.9 WWF in slabs on grade including walkways and sidewalks unless otherwise indicated.

3.2 COORDINATION

- A. Coordinate work with other trades in order to eliminate interference before concrete is poured.

3.3 CLEANUP

- A. In accordance with General Conditions.

- END OF SECTION -

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 03300
CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 NOTICE

- A. Engineer shall be given a minimum of 48 hours advance notice to all concrete placements and no concrete shall be placed without approval of Engineer.

1.2 WORK INCLUDED

- A. Cast-in-place concrete foundations, walls, slab-on-grade, equipment pads, underground concrete vaults and structures, pipe supports, curbs, and sidewalks. All cast-in-place concrete for this project shall be ready mix per this specification. Pre-mixed, bagged mixes shall not be utilized for any purpose on the project unless specifically approved by the engineer.

1.3 RELATED SECTIONS SPECIFIED ELSEWHERE

- A. Section 01300 – Submittals
- B. Section 01410 – Testing Laboratory Services
- C. Section 03100 - Concrete Formwork
- D. Section 03200 - Concrete Reinforcement

1.4 REFERENCES

- A. ACI 301 - Specifications for Structural Concrete for Buildings.
- B. ACI 318 - Building Code Requirements for Reinforced Concrete
- C. ASTM C33 - Concrete Aggregates.
- D. FDOT Standard Specifications for Road and Bridge Construction
- E. ASTM C94 - Ready-mixed Concrete.
- F. ASTM C150 - Portland cement.
- G. ASTM C260 - Air Entraining Admixtures for Concrete.
- H. ASTM C494 – Chemical Admixtures for Concrete
- I. ASTM C618 – Pozzolonic Materials.

1.5 QUALITY ASSURANCE

- A. Perform Work: in accordance with ACI 301 and FDOT Standard Specifications.
- B. Obtain materials for same source throughout the Work.
- C. Submit manufacturer's certification that materials meet specification requirements.
- D. Submit ready-mix delivery tickets, ASTM C94-78.

1.6 TESTS

- A. Testing and analysis of concrete will be performed under provisions of this Section and Section 01410.
- B. Submit proposed mix design of each class of concrete to Engineer for review prior to commencement of work in accordance with Submittal Section. Submittal shall include proposed location for each class of concrete.

- C. Independent Testing laboratory shall take cylinders and perform slump and air entrainment tests in accordance with ACI 301.
- D. Provide 5 cylinders per set. Test one at 3 days, one at 7 days, two at 28 days, and hold one.
- E. Slump tests shall be taken for every truck delivery and each set of test cylinders taken.
- F. In general, cylinders shall be taken for each concrete pour event, and every 50 cubic yards placed.
- G. All tests failing minimum specified criteria shall be billed to and paid for by the Contractor.

1.7 SUBMITTALS

- A. Submit product data under provisions of Section 01300 for Fine and Coarse aggregates, admixtures, concrete mix design, joint devices, attachment accessories, and curing compounds.
- B. Field test reports: Submit field test reports for all cylinder tests.

PART 2 - PRODUCTS

2.1 CONCRETE MATERIALS

- A. Cement: ASTM C150 -Type II Cement.
- B. Fine and Coarse Aggregates: ASTM C33.
 - 1. Conform to ASTM C33: Local aggregates not complying with this standard may be used provided it can be shown by special test or a record of past performance these aggregates produce concrete of adequate strength and durability.
 - 2. Fine Aggregate: Clean, washed natural sand of hard, sound, uncoated grains. Manufactured clean, washed, hard sand may be used for structures other than water retention structures.
 - 3. Course Aggregates: Clean, washed, sound and crushed.
 - 4. Aggregate Size Requirements: Use largest practicable aggregate size for each condition of placement subject to limitations stipulated in paragraph 3.3, ACI Code 318.
- C. Water: Clean potable water.

2.2 ADMIXTURES

- A. Air Entrainment: All concrete shall entrain from two to four percent air, whether batched with or without other admixtures. Conform to ASTM C260. Use Darex II AEA or equal.
- B. Water-reducing admixture may be used and must meet ASTM C-494 as a Type A and Type D. Use WRDA 64 or equal. Add in accordance with ACI-350.
- C. Use of calcium chloride is not permitted.
- D. Air entraining agent to normal weight concrete mix if used, shall not exceed 4%.
- E. Superplasticizer: A superplasticizer admixture may be used on all structures if approved by the Engineer. Superplasticizer shall be used on all water retention structures. The superplasticizer shall satisfy the following requirements.
 - 1. Conform to ASTM C494, Type F or Type G.
 - 2. Superplasticizer admixture shall be added to the mix at the batch plant unless otherwise approved by the Engineer.
 - 3. Provide documentation showing, at a 6-inch slump plus or minus 1-inch, the relative durability factors of air entrained concrete as determined in accordance with ASTM C-666, Procedure A, as compared to the same air entrained concrete mix at a 2-inch slump or minus 1-inch without superplasticizer admixture.

4. A qualified concrete technician employed by the manufacturer shall be available to assist in proportioning concrete materials for optimum use, to advise on proper use of the superplasticizer admixture and adjustment of concrete mix proportions to meet job site and climatic conditions.
5. Approved Products:
 - a. Sikament 300, Sika Chemical Corp. or Engineered approved equal.
 - b. Pozzolith 440 N, Master Builders Company, or Engineer approved equal.

2.3 CURING MATERIALS

- A. Chemical Curing: Curing compounds shall be liquid, membrane forming and shall conform to ASTM C309, as approved by the Engineer. The liquid compound shall not reduce the adhesion of tile, paint, roofing, waterproofing or other material to be applied to the concrete. No liquid compound shall be allowed to cure a first pour of concrete that will receive a second pour. The use of a curing compound in lieu of water spray curing is subject to the Engineer's approval and will, generally, not be approved as an alternate to impervious membrane and spray mist curing.
- B. Impervious Membrane Sheeting: Kraft paper or 4 mil polyethylene sheeting, in accordance with ASTM C171 may be used with approval of the Engineer.

2.4 CONCRETE MIX

- A. Mix concrete in accordance with ASTM C94.
- B. Provide concrete to satisfy the following requirements:
 1. Compressive Strength (28 days): 3000 psi for sidewalks and curbs, 4000 psi all other locations.
 2. Water/Cement ratio: maximum 0.45 without admixtures by weight.
 3. Fly Ash Content: maximum 15% of cement content, Type F only.
 4. Slump 4 ± 1 inch regular, 6 ± 1 inch with superplasticizer, 6-8 inch pea rock pump mix.
- C. Use set-retarding admixtures during hot weather only when approved by Engineer.
- D. Air entrainment: Total air content required (air-entrained and entrapped air) shall be as follows, and as measured in accordance with ASTM C231:

Nominal Maximum Size of Coarse aggregate, in.	Total Air Content Percentage by volume
3/8	6 to 10
2	5 to 9
3/4	4 to 8
1	3.5 to 6.5
1-1/2	3 to 6
2	2.5 to 5.5
3	1.5 to 4.5

- E. Superplasticizer shall be used in all reinforced concrete walls that are water holding structures; i.e., clearwell, containment walls, etc.

2.5 ACCESSORIES

- A. Vapor Barrier: 10 mil thick clear polyethylene film, type recommended for below-grade application.
- B. Non-Shrink Grout: Premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents; capable of developing minimum compressive strength of 2,400 psi in 48 hours and 7,000 psi in 28 days.
- C. Water Stop (PVC): 4" x 3/16" water stop, Dumbell polyvinylchloride Greenstreak - Style 741 or approved equivalent.
- D. Water Stop (Other): Bentonite type strips Rx101, or applicable to condition, as manufactured by Volclay, or equal.
- E. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for strength and support of reinforcement during concrete placement conditions including load bearing pad on bottom to prevent vapor barrier puncture.
- F. Special Chairs, Bolsters, Bar Supports, Spacers Adjacent to Weather Exposed Concrete Surfaces: Plastic coated steel or Stainless steel type; size and shape as required. Do not use concrete or clay bricks to support reinforcing.
- G. Backing rod and sealant as indicated on drawings for construction joints.
- H. Sealing Materials: Material for sealing and filling joints and for sealing pre-molded filler strip, shall conform to ASTM D1190 for "Concrete Joint Sealer; Hot-Poured Elastic Type."
- I. Curbs: Construct roadway and sidewalk curbs as shown on the drawings and in accordance with local codes and regulations. Construct all other curbs that support equipment or structural wall systems as indicated on the drawings.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Verify reinforcement and other items to be cast into concrete are accurately placed, positioned securely, and will not cause hardship in placing concrete.
- B. Verify site dewatering conditions. All foundations shall be cast in the dry.
- C. Verify requirements for concrete cover over reinforcement.
- D. Clean forms of trash, wood, excess steel, and deleterious materials.

3.2 PREPARATION

- A. Install vapor barrier under all slabs, footings, and other concrete exposed to earth. Lap joints a minimum of 6 inches. Do not disturb or damage vapor barrier while placing concrete. Repair damaged vapor barrier.
- B. In locations where new concrete is dowelled to existing work, drill holes in existing concrete, clean holes, insert steel dowels and epoxy in accordance with manufacturer's installation instructions keeping the minimum embedment depth specified on drawings.
- C. Coordinate the placement of joint devices with erection of concrete formwork and placement of form accessories.

3.3 PLACING CONCRETE

- A. Notify Engineer and Owner's Representative minimum 48 hours prior to commencement of concreting operations.

- B. Place concrete in accordance with ACI 301 and FDOT Standard Specifications.
- C. Hot Weather Placement ACI 301.
- D. Cold Weather Placement ACI 301.
- E. Ensure reinforcement, inserts, embedded parts, formed joints are not disturbed during concrete placement.
- F. Use Ready-Mixed Concrete: Conform to ASTM C94. Plant and truck mixers subject to examination by Engineer.
- G. Water and Mixing: Mix concrete at least 10 minutes, 5 minutes of which is at the job, after the last addition of water. Retempering in truck is prohibited. Any concrete in truck longer than 1-1/2 hours after the water has been added at the plant, or any that has become harsh or non-plastic, shall be rejected based solely upon the Engineer's discretion.
- H. Load Tickets: Shall include all information required by ASTM C94 and be legible, showing quantities of all constituents in the batch, and bearing signature of plant inspector or bonded weighmaster. Maintain all tickets on file for inspection by the Engineer. All tickets shall show the mix number. Tickets not showing the mix number shall cause the load to be immediately rejected.
- I. Slumps: At point of delivery to forms the concrete slump requirements shall conform to this section of the specifications.
- J. Place concrete continuously between predetermined construction and control joints. Do not break or interrupt successive pours such that cold joints occur.
- K. Contractor shall be responsible for means and methods to ensure concrete is poured in a dry area.
- L. All concrete shall be placed with the aid of mechanical vibrating equipment supplemented by hand forking or spading. Contractor needs to use mechanical vibrating equipment for consolidating concrete and should have a minimum of (2) two operable vibrators on the job. Vibration shall be transmitted directly to the concrete and not through the forms.
- M. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.
- N. Saw cut curb joints within 24 hours after placing. Use 3/16 inch thick blade, cut 1/4 of slab thickness.
- O. Screed floors level, maintaining surface flatness of maximum 1/4 inch in 10 ft.

3.4 FINISHING

- A. Provide formed concrete walls, columns, beams, Class 5 finish above the water line.
- B. Finish building slabs and miscellaneous horizontal concrete surfaces in accordance with ACI 301, steel trowel finish.
- C. Sidewalks shall have a light broom finish.

3.5 CURING AND PROTECTION

- A. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury. Concrete shall be kept moist for fourteen days after pouring. Vertical forms may be left in place and horizontal surfaces continuously moistened with water via spray misting. If forms are removed, impervious membrane sheeting or chemical curing may be used if approved by the Engineer. The Engineer shall have the right to determine

when the forms may be removed and whether a curing compound can be used in lieu of spray misting.

- B. Water cure concrete surfaces in accordance with ACI 301 for 7 days or apply curing compound.
- C. Contractor shall use curing compounds for vertical surfaces.

3.6 PATCHING

- A. Notify Engineer immediately upon removal of forms. No surfaces are to be patched or backfilled prior to being reviewed by the Engineer.
- B. Patch imperfections as requested by the Engineer or his field representative in accordance with ACI 301 and FDOT Standard Specifications.
- C. Excessive honeycomb or embedded debris in concrete is not acceptable. Notify Engineer upon discovery.

3.7 DEFECTIVE CONCRETE

- A. Modify or replace concrete not conforming to required levels, lines, details, elevations, dimensions, tolerances, or specified requirements.
- B. Repair or replace concrete not properly placed will be determined by the Engineer or Owner's Representative.
- C. Unless the removal of a defective slab is required by the Engineer, defective surfaces, such as honeycomb, shall be cut out entirely until homogeneous concrete is met, even if it means going through the slab.
- D. Such areas shall be coated with an approved epoxy bonding material, which shall be applied in accordance with the manufacturer's instruction, before damp packing the area with a mix consisting of one part of Portland cement and two parts of sand and fine gravel, epoxy and sand mix, or any combination of materials and mixes as the situation dictates in the opinion of the Engineer.
- E. The water content of the damp-pack material shall be such that a ball of the mix may be squeezed in the hand without bringing free water to the surface.
- F. Damp-pack material shall be tamped into place and finished to match adjacent concrete surfaces.
- G. Particular care shall be taken that no sagging of the material will occur.
- H. The bond between any two layers of damp-pack shall be improved through the use of an approved epoxy bond agent.
- I. Surfaces which have been damp-packed shall be kept continuously damp during and for a period of not less than seven days after completing the damp-pack operation, by polyethylene coverings thoroughly taped to the original concrete surface in a manner that loss of moisture, evidence by lack of water droplets on the inside surface of the polyethylene, is avoided. If this moisture condition cannot be maintained, a continuous water cure may be required by the Engineer.
- J. Under no circumstances shall Contractor apply a plaster coat over the honeycomb areas to conceal the existence of the honeycomb in the concrete.
- K. Neither Embeco nor calcium chloride shall be used for filling honeycomb areas, nor shall they be mixed with damp-pack material.
- L. Any concrete with excess air entraining agent will be rejected.

3.8 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed under provisions of Section 01410.

- B. Contractor will be required to contact Testing Lab to be present for concrete deliveries.
- C. Maintain records of placed concrete items. Record date, location of pour, quantity, air temperature, and test samples taken.

- END OF SECTION -

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 05120
STRUCTURAL STEEL

PART 1 - GENERAL

1.1 SCOPE

- A. This Section includes the furnishing and installation of Structural steel beams, plates, angles, inserts and anchor bolts.

1.2 RELATED SECTIONS

- A. Section 05500 – Miscellaneous Metals
- B. Section 09900 - Painting

1.3 REFERENCES

- A. ASTM A992 and ASTM A36 - Structural Steel
- B. ASTM A307 - Carbon Steel Externally Threaded Standard Fasteners
- C. ASTM A325 - High Strength Bolts for Structural Steel
- D. ASTM A490 - Quenched and Tempered Alloy Steel Bolts for Structural Steel Joints
- E. AWS A2.0 - Standard Welding Symbols
- F. AWS D1.1 - Structural Welding Code
- G. AISC - Specification for the Design, Fabrication, and Erection of Structural steel for Buildings (latest edition).
- H. SSPC - Steel Structures Painting Council

1.4 SUBMITTALS

- A. Submit shop drawings of all structural steel proposed for fabrication to Engineer for prior approval. The Engineer's approval does not relieve the Contractor of responsibility for accuracy.
- B. Shop Drawings:
 - 1. Indicate sizes, spacing, and locations of structural plates and anchor bolts including openings, attachments, and fasteners.
 - 2. Indicate welded connections with AWS A2.0 welding symbols and net weld lengths.
 - 3. Indicate proposed beam splice locations where applicable including splice connection detailing. All beam splice locations must be approved by the engineer. Where a beam splice is proposed, splice capacity shall match capacity of the beam. Submit calculations for the connection signed and sealed by a Professional Engineer licensed in the State of Florida.
- C. Manufacturer's Mill Certificate: Submit under provisions of Section 01300 certifying that products meet or exceed specified requirements.
- D. Mill Test Reports: Submit under provisions of Section 01300 Manufacturer's Certificates, indicating structural strength, destructive, and non-destructive test analysis.
- E. Welders' Certificates: Submit under provisions of Section 01300 Manufacturer's Certificates, certifying welders employed on the Work, verifying AWS qualifications within the previous 12 months.

1.5 QUALITY ASSURANCE

- A. Fabricate structural steel members in accordance with AISC - Specification for the Design, Fabrication, and Erection of Structural Steel for Buildings.
- B. Maintain one copy of each document on site.

1.6 QUALIFICATIONS

- A. Fabricator: Company specializing in performing the work of this Section with a minimum of five years documented experience.
- B. Erector: Company specializing in performing the work of this Section with a minimum of three years documented experience.

1.7 FIELD MEASUREMENTS

- A. Verify that field measurements are as shown on the Drawings.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Structural Steel Channels: ASTM A36.
- B. Structural Steel W-shape: ASTM A992
- C. Bolts, Nuts, and Washers: ASTM A307, A325, and A490 galvanized to ASTM A153 for galvanized members.
- D. Anchor Bolts: ASTM A307, A325, and A490.
- E. Welding Materials: AWS D1.1; type required for materials being welded. Use Class E-70 series electrodes with a minimum stress capacity of 15,800 psi at the throat of throat area in accordance with ASTM A233.

2.2 FINISH

- A. Prepare structural component surfaces in accordance with SSPC SP-2.
- B. All structural steel members shall be hot dip galvanized.
Areas not shop primed, areas that have been field welded, and all painted areas that have been damaged during erection shall be cleaned, primed, and touch-up painted. Erection marks shall be cleaned

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that field conditions acceptable and are ready to receive work.

3.2 ERECTION

- A. Field weld components indicated on Drawings.
- B. Do not field cut or alter structural members without approval of Engineer.
- C. The Contractor will not construct missing or out-of-position bolt holes by torch cut method. Bolt holes that are needed after fabrication will be constructed by punching or drilling only.
- D. Removal of welds will be by air arc methods only. Contractor shall practice standard of care to avoid damage to parent metal during weld removal.

3.3 ERECTION TOLERANCE

- A. Maximum offset from true alignment: 1/8 inch.
- B. Runway beam tolerances shall be in accordance with crane manufacturer's recommendations.

- END OF SECTION -

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 05500
MISCELLANEOUS METALS

PART 1 - GENERAL

1.1 SCOPE

- A. This Section includes the furnishing and installation of fabricated metal work which applies to all sections, unless otherwise noted.

1.2 REFERENCE SPECIFICATIONS AND STANDARDS ARE REFERRED TO BY ABBREVIATION AS FOLLOWS:

- | | |
|---|-------|
| A. The Aluminum Association | AA |
| B. American Institute of Steel Construction | AISC |
| C. American National Standards Institute | ANSI |
| D. American Society for Testing and Materials | ASTM |
| E. American Welding Society | AWS |
| F. National Association of Architectural
Metal Manufacturers | NAAMM |
| G. Steel Structures Painting Council | SSPC |

1.3 QUALITY ASSURANCE

- A. Portions of the design not shown shall be completed by the fabricator in accordance with the latest edition of Specifications for Design, Fabrication and Erection of Structural Steel for Buildings of the AISC.
- B. Shop fabricated connections may be bolted or welded. Field connections shall be bolted.
- C. Burning/torching for enlarging holes will not be acceptable except with written permission of the Engineer.
- D. Responsibility for all errors in fabrication and correct fitting of structures shown on the shop drawings is the Contractor's responsibility.

1.4 REGULATORY REQUIREMENTS

- A. Metal fabrication materials shall meet the requirements of the following ASTM Standards and Specifications, but limited to.
 - 1. Aluminum Alloy, plate and sheet B209-3003-H14, extruded trim B308-6063-T5 & T6, structure shapes B308-6061-T5, structural pipe and tube B429, castings B214.
 - 2. Structural steel, plates and shapes A36, plate and steel for forming A283 Grade C.
 - 3. Structural bolts, specifically called out on the Plans A-325.
 - 4. Other bolts, unless otherwise noted, A-307.
 - 5. Steel stud anchors for embedded plates, A-108, grade 1020, 60 ksi.
 - 6. Galvanizing, A123.
- B. Comply with the provisions of the following standards except as otherwise shown or specified.
 - 1. AA Specifications for aluminum structures.
 - 2. AISC Specifications for design, fabrication and erection of structural steel for buildings.
 - 3. AWS code for welding in building construction.

1.5 SUBMITTALS

- A. Submit shop drawings and manufacturer's descriptive literature as applicable for all metal fabrications in accordance with Section 01300. No items shall be fabricated prior to reviewing approval by Engineer. Minimum scale of drawings and elevations shall be 3/4 in. equals 1 ft., details enlarged to adequate size for clarity, show anchorage.
- B. Where certain equipment and the like require unique support, provide such members only after careful coordination of shop drawings for the equipment.

1.6 PRODUCT HANDLING

- A. Use all means necessary to protect the Products of this Section before, during, and after installation and to protect the installed work and materials of all other trades.
- B. In the event of damage, immediately make all repairs and replacements necessary to the approval of the Engineer and at no additional cost to the Owner.
- C. Coordinate delivery of metal fabrications with work of other Sections.

1.7 FASTENERS

- A. Provide fasteners for all items under this Section. All nuts, bolts, washers, back up rings, etc. shall be 316 SS unless otherwise called out on the drawings or specified elsewhere herein.

1.8 DIMENSIONS

- A. Verify critical dimensions of the work on the job. Form items to accurate sizes and shapes, with sharp lines and angles. Punch and shear to leave smooth surfaces. Weld permanent connections, grind exposed welds smooth. Avoid screws and bolts where possible unless otherwise noted. When used and where exposed, Countersink heads and draw up tight. Provide holes and connections for work of other trades.

1.9 PAINTING

- A. Shop painting of ferrous items, except those galvanized, shall be as specified in Section 09900 - Painting.

1.10 DISSIMILAR MATERIALS

- A. Protect aluminum in contact with concrete and dissimilar material with 1/4" neoprene, or bitumastic coating.

1.11 PIPE SUPPORTS

- A. Pipe support straps shall be 316 Stainless steel unless otherwise noted.
- B. Metal pipe support fabrication shall be 316 Stainless steel unless otherwise noted.

PART 2 - PRODUCTS

2.1 HANDRAIL & GUARDRAILS

- A. Post spacing shall be a maximum of 5 feet. Post and rails shall be a minimum of 1-1/2" diameter, schedule 40 aluminum pipe, alloy 6063-T6 or 6105-T5.
- B. Hand rail shall be made of pipe and fittings mechanically fastened together with stainless steel hardware.

- C. Toe board shall conform to OSHA standards. Toe board shall be a minimum of 4" high and shall be set ¼" above the walking surface.
- D. Guard rails shall be designed to withstand a uniform horizontal load of 50 pound per foot with a simultaneous vertical load of 100 pound per foot applied to the top rail. In addition, guard rails, handrails, and stair rails shall be designed to withstand a concentrated load of 200 pounds applied in any direction.
- E. Component aluminum handrail system shall be designed and constructed in compliance with the requirements of OSHA and local standard building codes.
- F. All aluminum handrail components shall be clear anodized.

2.2 SHOP FABRICATED PRODUCTS

- A. Provide anchor bolts as shown as well as for fabricated and structural metal items. Do not paint bolts.
- B. Provide inserts and sleeves for concrete as shown and as required.
- C. Provide miscellaneous metal frames and supports fabricated of structural shapes and plates.

2.3 MISCELLANEOUS METALS

- A. Unless noted otherwise on the drawings or specified differently in other sections, all miscellaneous metal fabrications shall be 316 stainless steel.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive work.
- B. Beginning of installation means erector accepts existing conditions.

3.2 PREPARATION

- A. Clean and strip primed steel items to bare metal where site welding is required.

3.3 INSTALLATION

- A. Install items plumb and level, accurately fitted, free from distortion or defects.
- B. Allow for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
- C. Field weld components indicated on shop drawings.
- D. Perform field welding in accordance with AWS D1.1.
- E. Obtain Engineer approval prior to site cutting or making adjustments not scheduled.
- F. Verify that supports and anchors are correctly positioned.
- G. Verify that opening sizes and dimensional variations are acceptable to suit grading, railing, and stairs tolerances.
- H. Perform cutting, drilling, flashing and fitting required for installation of metal fabrications. Set the work accurately, provide temporary bracing and anchors in formwork for items to be built into masonry and concrete. Field weld joints not shop welded because of size limitations.

3.4 TOLERANCES

- A. Conform to ANSI/NAAMM A202.1.

- B. Maximum space between sections: $\frac{1}{4}$ inch.
- C. Maximum variation from top surface plane of sections: $\frac{1}{4}$ inch.

- END OF SECTION -

SECTION 05700
ANCHORS, FASTENERS & INJECTION ADHESIVES

PART 1 - GENERAL

1.1 SCOPE

- A. This Section includes anchors, fasteners, and injection adhesive for general use in securing materials in place and doweling new reinforcement to existing structures. Fasteners and anchors indicated or specified in other sections have precedence over those specified in this Section. It includes the following types of fasteners and adhesives:
 - 1. Screws.
 - 2. Bolts.
 - 3. Expansion anchors (stud anchors, sleeve anchors).
 - 4. Adhesive anchors (stud anchors, reinforcement dowels)
 - 5. Reinforcing bars.
- B. Related Work Specified Elsewhere:
 - 1. Concrete: SECTION 03300.
 - 2. Miscellaneous Metals: SECTION 05500.

1.2 REFERENCES

- A. Applicable Standards:
 - 1. American Society for Testing and Materials (ASTM):
 - a. F436 - Hardened Steel Washers.
 - b. F467 - Nonferrous Nuts for General Use.
 - c. F468 - Nonferrous Bolts, Hex Cap Screws, and Studs for General Use.
 - 2. Expansion Anchor Manufacturers Institute (EAMI).
 - 3. Federal Specifications (FS):
 - a. FF-B-561 - Bolts, (screw), Lag.
 - b. FF-B-575 - Bolts, Hexagon and Square.

1.3 SUBMITTALS

- A. Submit as specified in Section 01300.
- B. Includes, but not limited to, the following:
 - 1. Manufacturer's data indicating strength capabilities of anchors, fasteners, and adhesives to be used.
- C. Sample of type requested by Engineer.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store anchors and fasteners in manufacturer's original packaging, with labels intact and legible.
- B. Store and handle to prevent corrosion or damage prior to installation.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Expansion Anchors:
 - 1. Red Head, Phillips Drill Company.
 - 2. Ramset.
 - 3. Rawl.
 - 4. (WEJ-IT).
 - 5. Hilti
- B. Self-Drilling Fasteners:
 - 1. Buildex, Division of Illinois Tool Work, Inc.
- C. Adhesive Anchors:
 - 1. Hilti
 - 2. Redhead

2.2 GENERAL REQUIREMENTS

- A. Anchors and fasteners indicated or specified are to establish a type, minimum size and spacing.
- B. Determine proper size and length considering the following factors:
 - 1. Weight to be supported.
 - 2. Shear strength of fastener.
 - 3. Material and thickness to which fastener will be inserted.
 - 4. Thickness of item to be fastened.
- C. Expansion anchors shall conform to FF-S-325.
 - 1. Stud Anchors: Group II, Type 4, Class 1, zinc plated.
 - 2. Sleeve Anchors: Group II, Type 3, Class 3.
- D. Self-drilling fasteners shall be one of the following materials:
 - 1. 410 stainless steel that is case hardened and cadmium or zinc plated.
 - 2. Plastic headed on a 410 stainless screw.
 - 3. 302 stainless steel Scots cap on a 410 stainless steel screw.
- E. Washers shall be as a minimum of material compatible with or same material as fastener.

2.3 ANCHORS AND FASTENERS

- A. Based upon material to be fastened, select appropriate fasteners listed below.
 - 1. Framing and Miscellaneous Lumber: including nailers, blocking, sleepers, furring.
 - a. To Concrete Masonry Units, Brick, Concrete:
 - 1) Multi-set or wedge anchors for attachment to concrete.
 - 2) Sleeve anchors for attachment to masonry and tile.
 - 3) Cast-in-Place Bolts.
 - 4) Self-Drilling Fasteners. Hex head, No. 1/4 x 2-3/4 inches, spaced 16 inches o.c.
 - b. To Steel Angles, Plates:
 - 1) Bolts: 3/8-inch diameter minimum, 2 per width, spaced 16 inches o.c., countersink head, 2 washers per bolt.
 - 2) Self-Drilling Screws: Header Teks/4, reamer wings, Phillips flat head No. 12-24 x 2-1/2 inches, spaced 12 inches oc.
 - c. To Steel:

- 1) Structural Steel - Plymetal Teks/3 Self-Drilling Fasteners:
 - a) Reamers wings, pilot point, flat head No. 2 12-24 x 2-1/2 inches for steel to .250-inches, spaced 12 inches oc.
- 2) Light Gauge Steel, Studs - Self-Drilling Fasteners: Pilot point, trumpet head.
- 3) Bolts: 5/16-inch diameter minimum.
- d. To Concrete Masonry Units:
 - 1) Sleeve Expansion Anchors: Hex nut, 5/16-inch diameter minimum, spaced 16 inches oc.
 - 2) Cast-in-Place Bolts: As indicated.
 - 3) Tapcon Concrete Anchors: Hex head, No. 1/4 x 1-3/4-inch.
- e. To Concrete:
 - 1) Stud Expansion Anchors: Size and thickness as required by thickness and size of plywood, but not less than 3/8-inch diameter (see Drawings for size).
2. Steel Angles or Plate:
 - a. To Concrete Masonry Units, Brick, Concrete:
 - 1) Stud Expansion Anchors: Size and thickness as required by thickness and size of steel.
 - 2) Cast-in-Place Bolts: 3/8-inch diameter minimum, threaded one end, length as indicated.
 - 3) Tapcon Concrete Anchors: Hex head, No. 1/4- x 1-3/4-inch.
 - b. To Steel:
 - 1) Bolts and Welding: Specified in SECTION 05120.
 - 2) Teks/5 Self-Drilling Fasteners: Hex head (1/2-inch steel drilling capability), No. 12-24 x 1-1/4-inch or 1-1/2-inch.
3. Sheet Metal:
 - a. To Wood:
 - 1) Common or Box Nails: Length as required to penetrate substance 1 inch minimum.
 - 2) Self-Drilling Fasteners: Slotted, hex head.
 - 3) Wood Screws: Round Head.
 - b. To Steel: Up to 0.175-inch steel.
 - 1) Teks/2 Self-Drilling Sheet Metal Screws: Hex head, 10 - 16 x 3/4-inch hex washer head, spaced 6 inches oc.
 - c. To Steel: Up to 0.25-inch steel.
 - 1) Teks/4 Self-Drilling Sheet Metal Screws: Hex head, 12 - 24 x 7/8-inch hex washer head, spaced 6 inches oc.
 - d. To Concrete Masonry Units, Brick, Concrete:
 - 1) Tapcon Concrete Anchors: Slotted hex head.
 - e. To Sheet Metal:
 - 1) Teks/2 Self-Drilling Sheet Metal Screws: Hex head 10 - 16 x 1/2-inch, spaced 6 inches oc.
4. Miscellaneous Equipment (including mounting clips for conduit and pipe; hanger straps; junction, control and switch boxes; metal furring channels, hanging tie wires):
 - a. To Concrete Masonry Units, Brick, Concrete:
 - 1) Tapcon Concrete Anchors: Slotted hex head.
 - b. To Steel:

- 1) Self-drilling fasteners with wings, pilot point, slotted hex head:
 - a) 12-14 x 3/4-inch Teks/3 (drilling capacity up to 0.210-inch)
 - b) 12-24 x 7/8-inch Teks/4 (drilling capacity up to 0.250-inch)
 - c) 12-24 x 1-1/4-inch Teks/5 (drilling capacity up to 0.500-inch)
5. Fasteners and anchors as specified on the Plans.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Inspect areas to receive anchors or fasteners for defects which would affect proper installation and strength capacities. Correct all the defects.

3.2 INSTALLATION

- A. Install fasteners conforming to manufacturer's recommended procedures.
- B. Space fasteners as indicated and specified. If not indicated, space as required to adequately support loads to be imposed. Space expansion anchors in accordance with EAMI Standards and manufacturer's installation instructions.
- C. Place washers under all bolt heads and nuts, and under lag bolt heads.
- D. Tighten fasteners to proper tension.
- E. Runway beam tolerances shall be in accordance with crane manufacturer's recommendations.

- END OF SECTION -

SECTION 06300
LABORATORY

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. This section includes all work to furnish and install the laboratory base and wall cabinets, worktops, shelves, sink basins, service fixtures, filler panels, moldings required to complete installation, including all other miscellaneous items as listed in the specifications or shown on the plans.
- B. Laboratory furniture shall have all necessary cutouts and openings for plumbing and electrical services, as well as filler panels and scribe strips as required where equipment abuts wall and corner conditions in order to obtain a completely enclosed assembly.

1.2 STANDARD OF QUALITY

- A. All laboratory casework and appurtenances shall be manufactured by a single laboratory furniture company. All wood laboratory furniture must conform to the method of testing and resulting performance requirements as set forth in the Scientific Apparatus Makers Association (SAMA) Standard LF8-1976.
- B. All other materials used and work performed must conform to the laws and ordinances of the state, municipality, or other political subdivision within which work under this contract is performed.

1.3 CASEWORK DESIGN

- A. The door and drawer design shall be square edged full overlay with 1/8-inch reveal horizontal and 1/16-inch vertical reveal on ends of cabinets. The standard grain pattern on end panels is vertical. The grain pattern on cabinet fronts shall be drawers horizontal and doors vertical. Cabinet and end panels exposed to view after installation shall be finished. End panels not visible after installation shall be plywood. All units shall be self-supporting and capable of interchangeable use. Cupboard bottoms and offsets caused by front faced frames are not acceptable. The joining system shall be 32 mm dowels.

1.4 DELIVERY, STORAGE AND INSTALLATION

- A. Schedule delivery of casework and equipment such that spaces are sufficiently complete that material can be installed immediately following delivery. Do not install until doors and windows are installed and building is weather tight. Do not install until ceiling, overhead ductwork and lighting are installed. Do not install until all painting is complete and floor tile adjacent to and beneath the units is installed. Touch up all painting and repair other work damaged during installation of casework when complete. Do not deliver and install wood casework until the building air conditioning is active and maintaining the temperature below 80 degrees F and the relative humidity below 60%.

1.5 ACCEPTABLE MANUFACTURER

- A. Laboratory furniture shall be manufactured by Fisher Hamilton, Division of Fisher Scientific International, Inc. The manufacturer shall supervise or provide the installation of the laboratory furniture.

1.6 SUBMITTALS

- A. Submit all materials and dimensioned shop drawings in accordance with Section 01300.
- B. Submit cabinet and countertop color samples for selection.

PART 2 - PRODUCTS

2.1 DEFINITIONS

- A. The following definitions and descriptions are applicable to the requirements for this section:
 - 1. Exposed surfaces shall include the following:
 - a. Surfaces visible when drawer & solid doors are closed.
 - b. Surfaces visible behind clear glass doors.
 - c. Interior surfaces of open units.
 - d. Bottoms of cabinets of 42" or more above finished floor.
 - e. Tops of cabinets less than 72" above finished floor.
 - f. Front rails
 - 2. Semi-exposed surfaces shall include the following:
 - a. Surfaces which become visible when solid doors are open.
 - b. Bottoms of cabinets more than 30" but less than 42" above floor.
 - c. Tops of cabinets 72" or more above finished floor when visible from an upper level.
 - 3. Concealed Surfaces
 - a. Surfaces not normally visible after installation, with doors open.
 - b. Bottoms of cabinets less than 30" above finished floor

2.2 MATERIALS

- A. The following materials shall be utilized in the manufacture of laboratory furniture:
 - 1. Hardwood: Hardwood lumber shall be clean and free of defects. All lumber shall be kiln dried to a uniform moisture content of six percent. All exposed and semi-exposed material shall be red oak. Unexposed material shall be a sound hardwood suitable for the intended purpose.
 - 2. Plywood: Plywood shall be seven-ply veneer core with a balanced construction glued with water resistant resin glue. Exposed plywood shall be plain sliced red oak veneer. Semi-exposed shall include a face sheet of red oak hardwood veneer. Unexposed plywood shall include a face of sound grade hardwood veneer.
 - 3. Welded Fiberboard: Welded fiberboard shall be fabricated from wood fibers and resin binders formed under heat and pressure.
 - 4. Glass: Glass shall be 3mm clear float without imperfections or marred surfaces.
 - 5. Glue: All glue shall be Type 2 or Type 3.
 - 6. Finish: Finishes shall be highly chemical resistant acrylic urethane finish applied over stain. Engineer shall select stain color from samples provided by the manufacturer.

2.3 FABRICATION

- A. Laboratory furniture shall be fabricated according to the following design criteria:
1. Base Units: Cabinet ends shall be 3/4" thick plywood with 3mm banding on front edges. Bore interior faces, as appropriate, for security panels, rails, and four rows of shelf support holes with levelers. Front top rail shall be 1" x 3" solid hardwood. Attach to cabinet ends with glued 8mm dowel joinery and screws. Vertical back top rail shall be 3/4" x 3-3/4" hardwood. Attach to cabinet ends with glued 8mm dowel joinery and screws. Front hardwood shall be 3-3/4" x 3/4" toe space rail, mounted between end panels, forming a 4" high x 2-1/2" deep toe space, closed to cupboard bottom. Secure rails to cabinet end panels with 8mm dowel joinery. Base unit bottoms shall be 3/4" thick plywood, set flush and joined to cabinet end panels with 8mm dowels on 96mm dowel spacing and metal fasteners. Front edge to be banded with .5mm banding. Cupboard unit backs shall be removable one piece 3/16" hardboard supplied on cupboard units. Provide open back behind drawer units. Vertical dividers shall be full weight, dividers shall be 1-1/2" thick plywood glued and screwed in place, top & bottom. Provide 3mm banding on front edge. Shelves shall be 3/4" thick half depth, 7 ply shelves constructed of veneer core plywood. Provide .5mm banding on front edge of all shelves. Base unit shelves are to be adjustable on 32mm centers. Shelves shall be finished with satin black laboratory grade melamine plastic which is acid and alkali solvent resistant. Drawer construction shall be drawer back, front and sides to be of 12mm 1/2" nominal 9-ply Birch plywood, banded on top edge, finished with a 7-level polyester acrylic finish. Drawer joinery shall be chuck and bore construction on 32mm centers. Drawer construction will be guaranteed lifetime warranty against failure for as long as the original purchaser maintains ownership. The guarantee covers material replacement regarding all aspects of structural integrity and be valid under conditions considered normal wear and usage. Drawer bottom shall be 6mm white PVC clad board. Bottom shall be grooved into the 4-side drawer box and sealed with hot melt glue process around entire drawer bottom perimeter. Drawer suspension shall have 3/4 extension 100# static 75# dynamic load mechanical slides and be self-closing, epoxy coated (Blum 230 series on all drawers except file drawers).
 2. Provide full extension slide with overtravel, 150# static and dynamic load, zinc plated (Accuride 4034 series on all file drawers.) Drawer slides shall be warranted against defects in material or workmanship for as long as the original purchaser maintains ownership. Drawers shall operate quietly and smoothly on a nylon roller channel suspension with front ball bearing rollers set into case channels and rear ball bearing rollers set into drawer channel. The suspension system shall maintain alignment of drawer and be equipped with integral stops to eliminate inadvertent removal of the drawer. All drawers shall have closure sound deadening. Door and drawer heads shall be 3-ply, 3/4" thick solid core with veneer on both sides and 3mm banding on all edges.
 3. Wall Cases: Wall cases shall be manufactured with appropriate materials and joinery methods as specified for base units. Tops shall be 3/4" thick, 7-ply veneer core plywood with .5mm banding on front edge. Wall and upper case bottoms shall be 1" thick plywood with veneer on both sides and with a .5mm banding on the front edge. Bottom kick rail shall be hardwood rail on tall cases 5-1/8" high joined to cabinet sides with 8mm dowels. Backs shall be minimum 3/16" thick with backs recess 7/8" and set into top, bottom and ends and

- sealed with hot melt glue process around entire perimeter. Shelves shall be 3/4" thick, 7-ply veneer core plywood. Provide 5mm banding on front edge of all shelves. Unit shelves are to be adjustable on 32mm centers. Door construction shall be solid doors with 3-ply, 3/4" thick solid core construction with veneer on both sides and with 3mm banding on four edges. Framed-glazed doors shall be solid core construction, 3/4" x 2-3/4" frame stock machined to accept glass. Provide extruded vinyl retaining molding designed so glass can be replaceable without tools. Meeting edges of pairs of doors to include overlapping astragals: right over left. Unframed sliding glass doors shall be glass with edges ground, set in extruded aluminum shoe with integral pulls, nylon wheel assemblies, and top and bottom extruded aluminum track. Provide rubber bumpers at fully opened and closed door position.
4. Hardware: Drawer and hinged door pulls shall be black powder coated wire pulls. All pulls are mounted horizontally on drawers and vertically on doors. Hinges shall be black 5-knuckle institutional type attached with stainless screws. Provide two hinges for doors up to 48" high: three hinges for doors over 48" high. Notch for proper fit. Unit shelf supports shall be metal pin and socket. Door catches shall be adjustable type, spring actuated nylon roller catches. Elbow catches shall be spring type with strike. Locks shall be provided on all file cabinets and center desk type drawers. Locks shall be 5-disc tumbler for master key system. Both lock types feature heavy duty cylinder. Exposed lock nose finish to be dull nickel (satin) plated. 5-disc tumbler lock for master key system (Standard).
 5. Master Key System shall have 5-disc tumbler locks with capacity for 225 primary key changes. Master key one level with the potential of 40 different, non-interchangeable master key groups. Keys shall be stamped brass available from manufacturer or local locksmith and supplied in the following quantities unless otherwise specified:
 - a. 2 for each keyed different lock
 - b. 3 for each group keyed alike locks
 - c. 2 for master keys for each system
 6. Base Molding: Base molding shall be black vinyl, sufficiently plastic to permit cementing tightly against cabinet base and floor line to provide a watertight seal. Molding shall be coved at bottom, shall be 4" high, and shall be applied continuously around base of cabinets and cases after installation and leveling to cover any shims and to effect floor seal. Waterproof cement shall be used as an adhesive. Use of rigid material which does not follow contour of floor or offer a watertight seal and dust- proofing quality will not be accepted.

2.4 TABLE FRAME

- A. Perimeter table frame rails shall be 3/4" x 4-5/16" 7-ply plywood with attached steel corner braces, grooved and screwed into both rails at each corner. Groove rails for "Z" irons or drill for top attachment. Reinforcing cross rails shall be 7-ply plywood doweled and glued into front and back rails and pinned at intervals not more than 33" o.c. in tables without drawers. Separate rails shall be 3/4" x 4-5/16" veneered solid core with attached steel brackets at both ends. Legs shall be 2" x 2" hardwood. Leg shoes shall be black rubber or vinyl with provision for floor clip.

2.5 WOOD FINISH

- A. Preparation shall be by sanding exposed surfaces smooth, free from dirt and defects. Stain application shall be by applying stain of color selected to all exposed casework surfaces. Apply in a manner to achieve a match with the selected color sample upon completion of application of the finish. Finish application shall be by application of finish coats evenly, force dry in a dust-free atmosphere, sand and wipe clean surfaces between coats to produce a smooth, satin luster finish. Surfaces exposed to view shall be water clear and bright. Cloudy, muddy finishes carrying tinting pigments will not be acceptable. Apply an acrylic urethane finish to the following areas according to the following schedule.
- B. Exposed surfaces shall receive multiple coats sanded between coats with final 1.5 dry mil thick, minimum finish.
- C. Semi-Exposed surfaces shall receive multiple coats with sanding between coats with final 1.0 dry mil thick, minimum finish.
- D. Concealed surfaces require no finish.
- E. Manufacturer shall provide verification of resistance to chemical spills and splashes performed by independent testing agency. The test shall adhere to the following procedure. Apply five drops of reagents as noted to vertically oriented test panel. Test duration shall be 2 hours. Observe and record results. Minimum acceptable results of chemical resistance test per following chart.

2.6 PEGBOARDS

- A. Pegboards shall be constructed of chemical-resistant 1" thick black Epoxyn epoxy resin. They shall be suitable for wall-mounting above sink or drainboard. Inverted glassware is supported on removable white polypropylene pegs, 6 inches long X ½-inch diameter. Existing pegboard shall be removed and replaced.

2.7 WORKTOPS

- A. Epoxy resin (Epoxyn*) tops shall be cast of modified thermosetting epoxy resin. Tops shall be a uniform mixture throughout and not depend on a surface coating which is easily removed by physical or chemical abuse. Epoxyn tops will be furnished in black.
- B. Tolerances shall be as follows:
 - 1. Size: Length, plus 0 minus 1/16", width and thickness, plus or minus 1/32".
 - 2. Squareness: Plus or minus 1/64" for each 12". (A tabletop spanning 48" will be held to plus or minus 1/16").
 - 3. Fabrication: Locations of cutouts and drillings--plus or minus 1/16".
 - 4. Sizes of cutouts and drillings--plus 1/16" minus 0.
 - 5. Flatness: Plus or minus 1/16" warpage for each 48" span.

2.8 SERVICE SHELVES

- A. Service shelves shall be 3/4" thick, 3-ply pressed board and shall be finished with a satin-black laboratory-grade melamine plastic to give a durable acid-alkali-solvent resistant finish.
- B. The shelves shall be easily altered on the job site to accommodate existing wall conditions and shall be easily drilled to accommodate service lines. Service shelves shall provide a raceway behind the base units to house the mechanical service piping.

- C. Service shelves shall be supported by angular brackets, capable of being mounted on strut supports or directly off wall providing for fine shelf adjustment.
- D. Service shelf fillers, where shown or called for to enclose open spaces at the end of wall and island assemblies, shall be finished the same as the service shelving. They shall be provided complete with means for attaching to the service shelving and shall cover the piping from the top of the service shelf to the base cabinets.

2.9 SINK BASINS

- A. Epoxy resin sinks shall be completely cured during processing. Sinks shall be non-glaring, black in color, and have generous coving in all corners and bottom and a minimum of 1 degree dishing to outlet in bottom. Sinks shall possess high resistance to mechanical and thermal shock. Sink basins shall be field-bonded to the top to become an integral part of an epoxy resin tops. Epoxy resin sink basins shall successfully meet the same performance specification as Epoxyn tops.

2.10 SERVICE FIXTURES

- A. Specialized laboratory fixtures shall be used on science furniture. Valve bodies shall be of 85% red brass alloy. Handles, ground key cocks, and turrets are brass drop forgings. Assembly components and operating parts shall be made of solid brass bar stock or as specified. Valves shall be made from hot pressed brass. Spouts and pipes shall be made from drawn brass pipe.
 - 1. Laboratory Water Fixtures: All water valves shall incorporate a ceramic disc closure system. Rubber washers are not acceptable. All water valves to have a 180 degree open to close rotation. Spouts shall be furnished in a 110 degree swivel which shall convert easily to either a 360 degree swivel or a fixed position in the field. All spouts shall be interchangeable on all water mixers. All water fixtures shall incorporate an isolating ball valve for shut-off. All fixtures shall have capability of accepting aerators, serrated nozzles or vacuum breakers. Combination mixing faucet shall have capability of being mounted as either a deck mount or panel mount faucet by rotating inlet supplies 180 degrees. All inlet threads shall have a ½" tapered pipe thread connection. Valve bodies shall be factory tested and shall exceed all normal pressure testing for laboratory environments.
 - 2. Traps and Drain Fittings: Traps and drain fittings shall be polyethylene. They shall be included as part of the standard sink assembly unless other material is specifically called for, and shall be 2" in diameter, as indicated. Traps shall be a standard "P" type and shall have a beaded end for connection to the main drain line by use of a coupling or be provided with standard IPS thread. Polyethylene traps shall be furnished for all sink assemblies.
 - 3. Sink Strainer, Tailpiece, and Overflow: Sink strainer, tailpieces, and overflows shall be furnished as a standard part of each sink assembly. Standing beehive-type overflows shall be 6" in height. Sink strainer shall be criss cross-type with a 1-1/2" diameter outlet.
 - 4. Coatings/Colors: All water fixtures shall be provided with a polyester powder enamel finish which is electro-statically applied and baked to assure a uniform, homogeneous surface. Fixture color shall be white. All valve bodies shall be provided in white chemical resistant enamel. Zinc handles shall be color coded with clear text buttons identifying the service being provided. Handles shall have Color designations as follows:

<u>Service</u>	<u>Color</u>	<u>Text</u>
Cold Water	Dark Green	CW

Hot Water

Red

HW

2.11 ELECTRICAL FIXTURES

- A. Electrical fixtures shall be 15A, 115 Volt, 3-wire polarized grounded receptacles. Hubbell #23316. The electrical flush boxes are to be a corrosion-resistant aluminum alloy, polished to a chrome-like finish. All receptacles shall be designed to permit only plugs having the same current characteristics as the service line to be inserted.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install plumb, level, true, and straight with no distortions. Shim as required, using concealed shims. Where metal laboratory furniture abuts other finished work, scribe and apply filler strips for accurate fit with all fasteners concealed where practicable.
- B. Set base cabinets straight, plumb, and level. Adjust within 1/16" of a single plane. Where required, assemble units into one (1) integral unit with joints flush, tight, and uniform. Align similar adjoining doors and drawers to a tolerance of 1/16". Provide holes for mechanical and electrical work as shown or as directed by trades involved.
- C. Securely fasten wall cabinets to solid supporting materials, not plaster, lathe, or wall board. Anchor, adjust, and align wall cabinets as specified for base cabinets. Reinforcement of stud walls to support wall-mounted cabinets will be done during wall erection by the trade involved, working from laboratory furniture shop drawings. Responsibility for accurate location and sizing of reinforcement shall be the Contractor's.
- D. Adjust laboratory equipment and hardware so that doors and drawers operate smoothly without warp or bind. Lubricate operating hardware as recommended by manufacturer. Grout, glue and caulk as recommended by the manufacturer for a complete and fully functional unit.
- E. The manufacturer's representative shall install or oversee the installation of all laboratory furniture.

3.2 FIXTURE INSTALLATION

- A. Conform to Section 15440, Plumbing.

- END OF SECTION -

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 06610
FIBERGLASS FABRICATIONS

PART 1 - GENERAL

1.1 SCOPE

- A. The work under this section of specifications consists of furnishing all materials, labor and appurtenances in connection with various fiberglass fabrications, including, but not limited to fiberglass structural components.

1.2 RELATED SECTIONS

- A. Section 01300 – Submittals

1.3 SUBMITTALS

- A. Contractor shall submit shop drawings for the items under this section in accordance with Section 01300.

PART 2 - PRODUCTS

2.1 FABRICATORS

- A. Fiberglass Grating: Chemgrate or Fibergrate as manufactured by Fibergrate Composite Structures, Inc., or Dura Dek, Dura Grid, or Safplate as manufactured by Strongwell – Chatfield Division, or Seasafe, Inc.
- B. Fiberglass Structural Shapes: Extren Fiberglass Structured Shapes as manufactured by Strongwell, or equal.

2.2 DESIGN CRITERIA

- A. The design of FRP products including connections shall be in accordance with governing building codes and standards as applicable.
- B. Design of FRP live loads on grating shall not be less than 100 pounds per sq.ft. Grating deflection at the center of a simple span not to exceed 0.50 inch.
- C. Structural members shall be designed to support all applied loads. Deflection in any direction shall not be more than L/180 of span for structural members. Connections shall be designed to transfer the loads.

2.3 FIBERGLASS STRUCTURAL SHAPES

- A. Vinyl resin FRP characteristics
 1. Ultimate tensile strength 30,000 psi (longitudinal)
 2. Ultimate compressive strength 30,000 psi (longitudinal)
 3. Modules of Elasticity 2.5×10^6 psi (bending)
 4. Density (ASTM-D792) 0.065 lb/in³
 5. Water Absorption (ASTM-D570) 0.60% Max.

- B. Structural shapes and plate shall be made from a premium grade polyester or vinyl ester resin with fire retardant additives to meet Class 1 flame rating of ASTM E-84 and meet the self-extinguishing requirements of ASTM D-635. All structural shapes shall contain a UV inhibitor.
- C. Structural and miscellaneous FRP members shall be comprised of vinyl ester resin combined with fiberglass reinforcement utilizing longitudinal glass roving and continuous strand mat. A 50% glass to resin ratio shall be used. The shapes shall be pultruded as manufactured by Strongwell, or equal. FRP grade materials shall be Extren Series 525, unless otherwise noted.

PART 3 - EXECUTION

3.1 INSTALLATION & ANCHORING

- A. Installation and anchoring shall be in accordance with the drawings and manufacturers recommendations.

- END OF SECTION -

SECTION 07190
VAPOR BARRIER

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Furnish labor, material and equipment required for the installation of vapor barrier under all reinforced concrete placed against soil.

1.2 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in Section 01300, submit Manufacturer's data and installation instructions.

PART 2 - PRODUCTS

2.1 VAPOR BARRIER

- A. Vapor Barrier: Polyethylene sheets with a minimum tensile strength of 4500 psi in accordance with ASTM D-882, vapor transmission rating of 0.02 and perm. rating of 0.045 in accordance with ASTM E-95, and a puncture resistance of 15 lbs in accordance with ASTM D-2582. Provide "Rufco 400" by Raven Industries, "T -55" by Griffolyn, or equal.
- B. Adhesive/Tape: Type approved by the Manufacturer of the vapor material.

PART 3 - EXECUTION

3.1 VAPOR BARRIER

- A. Place vapor barrier under all slabs on grade; lap edges 12 inches and seal with adhesive tape. Lay with seams perpendicular to and lapped in the direction of placement. Do not penetrate vapor barrier.
- B. Protect from damage until concrete is placed. Punctures and tears in vapor barrier shall be repaired using patches of the material which overlaps puncture or tear a minimum of 12 inches; seal with tape or adhesive.
- C. Fill under vapor barrier shall be compacted, clean, free of debris and protrusions.

- END OF SECTION -

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 07920
JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes sealants for the following applications, including those specified by reference to this Section:
- B. This Section includes sealants for the following applications:
 - 1. Exterior joints in the following vertical surfaces:
 - a. Joints between metal panels.
 - b. Joints between different materials listed above.
 - c. Perimeter joints between materials listed above and frames of doors and windows.
 - d. Other joints as indicated.
 - 2. Interior joints in the following vertical surfaces and horizontal nontraffic surfaces:
 - a. Control and expansion joints on exposed interior surfaces of exterior walls.
 - b. Perimeter joints of exterior openings where indicated.
 - c. Tile control and expansion joints.
 - d. Perimeter joints between interior wall surfaces and frames of interior doors, windows, and elevator entrances.
 - e. Joints between plumbing fixtures and adjoining walls, floors, and counters.
 - f. Other joints as indicated.

1.3 PERFORMANCE REQUIREMENTS

- A. Provide joint sealants for interior applications that establish and maintain airtight and water-resistant continuous joint seals without staining or deteriorating joint substrates.

1.4 SUBMITTALS

- A. Product Data: For each joint-sealant product indicated.
- B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.
- C. Samples for Verification: For each type and color of joint sealant required. Install joint sealants in 1/2-inch- (13-mm-) wide joints formed between two 6-inch- (150-mm-) long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.
- D. Product Certificates: Signed by manufacturers of joint sealants certifying that products furnished comply with requirements and are suitable for the use indicated.
- E. Compatibility and Adhesion Test Reports: From sealant manufacturer indicating the following:
 - 1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.

- 2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.
- F. Product Test Reports: From a qualified testing agency indicating sealants comply with requirements, based on comprehensive testing of current product formulations.
- G. Warranties: Special warranties specified in this Section.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has specialized in installing joint sealants similar in material, design, and extent to those indicated for this Project and whose work has resulted in joint-sealant installations with a record of successful in-service performance.
- B. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration date, pot life, curing time, and mixing instructions for multicomponent materials.
- B. Store and handle materials in compliance with manufacturer's written instructions to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not proceed with installation of joint sealants under the following conditions:
 - 1. When ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer.
 - 2. When ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer or are below 40 deg F (4.4 deg C).
 - 3. When joint substrates are wet.
- B. Joint-Width Conditions: Do not proceed with installation of joint sealants where joint widths are less than those allowed by joint sealant manufacturer for applications indicated.
- C. Joint-Substrate Conditions: Do not proceed with installation of joint sealants until contaminants capable of interfering with adhesion are removed from joint substrates.

1.8 WARRANTY

- A. General Warranty: Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Special Installer's Warranty: Written warranty, signed by Installer agreeing to repair or replace elastomeric joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

PART 2 - PRODUCTS

2.1 PRODUCTS AND MANUFACTURERS

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the products specified in the sealant schedules at the end of Part 3.
- B. Products: Subject to compliance with requirements, provide one of the products indicated for each type in the sealant schedules at the end of Part 3.

2.2 MATERIALS, GENERAL

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
- B. Colors of Exposed Joint Sealants: As selected by Owner from manufacturer's full range for this characteristic.

2.3 ELASTOMERIC JOINT SEALANTS

- A. Elastomeric Sealant Standard: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant in the Elastomeric Joint-Sealant Schedule at the end of Part 3, including those referencing ASTM C 920 classifications for type, grade, class, and uses.
- B. Stain-Test-Response Characteristics: Where elastomeric sealants are specified in the Elastomeric Joint-Sealant Schedule to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.
- C. Suitability for Contact with Food: Where elastomeric sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.

2.4 SOLVENT-RELEASE JOINT SEALANTS

- A. Acrylic-Based Solvent-Release Joint-Sealant Standard: Comply with ASTM C 1311 for each product of this description indicated in the Solvent-Release Joint-Sealant Schedule at the end of Part 3.
- B. Acrylic-Based Solvent-Release Joint-Sealant Standard: Comply with FS TT-S-00230 for each product of this description indicated in the Solvent-Release Joint-Sealant Schedule at the end of Part 3.
- C. Butyl-Rubber-Based Solvent-Release Joint-Sealant Standard: Comply with ASTM C 1085 for each product of this description indicated in the Solvent-Release Joint-Sealant Schedule at the end of Part 3.
- D. Pigmented Narrow Joint Sealant: For each product of this description indicated in the Solvent-Release Joint-Sealant Schedule at the end of Part 3 provide manufacturer's standard, solvent-release-curing, pigmented, synthetic-rubber sealant complying with AAMA 803.3 and formulated for sealing joints 3/16 inch (5 mm) or smaller in width.

2.5 LATEX JOINT SEALANTS

- A. Latex Sealant Standard: Comply with ASTM C 834 for each product of this description indicated in the Latex Joint-Sealant Schedule at the end of Part 3.

2.6 JOINT-SEALANT BACKING

- A. General: Provide sealant backings of material and type that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Cylindrical Sealant Backings: ASTM C 1330, of type indicated below and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance:
 - 1. Type C: Closed-cell material with a surface skin.

2.7 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way and formulated to promote optimum adhesion of sealants with joint substrates.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint sealant manufacturer's written instructions and the following requirements:
 - 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
 - 2. Clean porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining from above cleaning operations by vacuuming or blowing out joints with oil-free compressed air. Porous joint surfaces include the following:
 - a. Concrete.
 - b. Masonry.
 - c. Unglazed surfaces of ceramic tile.
 - 3. Remove laitance and form-release agents from concrete.
 - 4. Clean nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.

- a. Metal.
 - b. Glass.
 - c. Porcelain enamel.
 - d. Glazed surfaces of ceramic tile.
- B. Joint Priming: Prime joint substrates where recommended in writing by joint sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations of ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
- 1. Do not leave gaps between ends of sealant backings.
 - 2. Do not stretch, twist, puncture, or tear sealant backings.
 - 3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
- D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and back of joints.
- E. Install sealants by proven techniques to comply with the following and at the same time backings are installed:
- 1. Place sealants so they directly contact and fully wet joint substrates.
 - 2. Completely fill recesses provided for each joint configuration.
 - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
- 1. Remove excess sealants from surfaces adjacent to joint.
 - 2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
 - 3. Provide concave joint configuration per Figure 5A in ASTM C 1193, unless otherwise indicated.
 - 4. Provide flush joint configuration, per Figure 5B in ASTM C 1193, where indicated.
 - 5. Provide recessed joint configuration, per Figure 5C in ASTM C 1193, of recess depth and at locations indicated.
- a. Use masking tape to protect adjacent surfaces of recessed tooled joints.

3.4 CLEANING

- A. Clean off excess sealants or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.5 PROTECTION

- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from the original work.

3.6 ELASTOMERIC JOINT-SEALANT SCHEDULE

- A. Acid-Curing Silicone Sealant: Where joint sealants of this type are indicated, provide products complying with the following:
 - 1. Products: Available products include the following:
 - a. Chem-Calk 1200; Bostik Inc.
 - b. 999-A; Dow Corning.
 - c. Trademate Glazing; Dow Corning.
 - d. Construction 1200; GE Silicones.
 - e. Contractors SCS1000; GE Silicones.
 - f. SCS1702F; GE Silicones.
 - g. HiFlex 392; NUCO Industries, Inc.
 - h. NuFlex 302; NUCO Industries, Inc.
 - i. HM 270; Ohio Sealants, Inc.
 - j. 860; Pecora Corporation.
 - k. 863; Pecora Corporation.
 - l. PSI-601; Polymeric Systems, Inc.
 - m. OmniPlus; Sonneborn Building Products Div., ChemRex Inc.
 - n. Proglaze; Tremco.
 - o. Tremsil 300; Tremco.
 - 2. Type and Grade: S (single component) and NS (nonsag).
 - 3. Class: 25.
 - 4. Use Related to Exposure: NT (nontraffic).
 - 5. Uses Related to Joint Substrates: G, A, and, as applicable to joint substrates indicated, O.
 - a. Use O Joint Substrates: Coated glass, color anodic aluminum, aluminum coated with a high-performance coating, galvanized steel, and ceramic tile.
 - 6. Applications: General glazing & sealing (not for use on masonry).
- B. Mildew-Resistant Silicone Sealant: Where joint sealants of this type are indicated, provide products formulated with fungicide that are intended for sealing interior ceramic tile joints and other nonporous substrates that are subject to in-service exposures of high humidity and temperature extremes, and that comply with the following:
 - 1. Products: Available products include the following:
 - a. 786 Mildew Resistant; Dow Corning.
 - b. Sanitary 1700; GE Silicones.

- c. NuFlex 302; NUCO Industries, Inc.
- d. 898 Silicone Sanitary Sealant; Pecora Corporation.
- e. PSI-611; Polymeric Systems, Inc.
- f. Tremsil 600 White; Tremco.
2. Type and Grade: S (single component) and NS (nonsag).
3. Class: 25.
4. Use Related to Exposure: NT (nontraffic).
5. Uses Related to Joint Substrates: G, A, and, as applicable to joint substrates indicated, O.
 - a. Use O Joint Substrates: Coated glass, color anodic aluminum, aluminum coated with a high-performance coating, galvanized steel, and ceramic tile.
6. Applications: Use in joints between plumbing fixtures and adjoining walls, floors and counters.
- C. Single-Component Nonsag Urethane Sealant: Where joint sealants of this type are indicated, provide products complying with the following:
 1. Products: Available products include the following:
 - a. Vulkem 116; Mameco International.
 - b. Vulkem 230; Mameco International.
 - c. Sikaflex - 1a; Sika Corporation.
 - d. NP 1; Sonneborn Building Products Div., ChemRex Inc.
 2. Type and Grade: S (single component) and NS (nonsag).
 3. Class: 25.
 4. Use[s] Related to Exposure: NT (nontraffic).
 5. Applications: General exterior sealant for use in active joints and where sealant may be exposed to physical abuse..
- D. Multicomponent Nonsag Urethane Sealant : Where joint sealants of this type are indicated, provide products complying with the following:
 1. Products: Provide one of the following:
 - a. Chem-Calk 2641; Bostik Inc.
 - b. Vulkem 227; Mameco International.
 - c. Vulkem 922; Mameco International.
 - d. Elasto-Thane 920 Gun Grade; Pacific Polymers, Inc.
 - e. Dynatred; Pecora Corporation.
 - f. PSI-270; Polymeric Systems, Inc.
 - g. NP 2; Sonneborn Building Products Div., ChemRex Inc.
 2. Type and Grade: M (multicomponent) and NS (nonsag).
 3. Class: 25.
 4. Use[s] Related to Exposure: NT (nontraffic).
 5. Applications: Concrete tilt wall panel joints

3.7 LATEX JOINT-SEALANT SCHEDULE

- A. Latex Sealant: Where joint sealants of this type are indicated, provide products complying with the following:
 1. Products: Available products include the following:
 - a. Chem-Calk 600; Bostik Inc.
 - b. NuFlex 330; NUCO Industries, Inc.

- c. LC 160 All Purpose Acrylic Caulk; Ohio Sealants, Inc.
 - d. AC-20; Pecora Corporation.
 - e. PSI-701; Polymeric Systems, Inc.
 - f. Sonolac; Sonneborn Building Products Div., ChemRex, Inc.
 - g. Tremflex 834; Tremco.
2. Applications: General purpose interior caulking

- END OF SECTION -

SECTION 09900

PAINTING

PART 1 - GENERAL

1.1 SCOPE

- A. Furnish all labor, surface preparation and coating material, tools, rigging, lighting, ventilation, and other related items of equipment and materials necessary to clean, prepare, coat, cure and cleanup a complete coating system on all interior and exterior exposed items and surfaces throughout the project, except as otherwise specified or shown on the drawings.
 - 1. Surface preparation, priming, and coats of paint specified are in addition to shop priming and surface treatment specified under other sections of the work.
 - 2. The scope of work shall include the coating of existing equipment and surfaces which are modified by this project. Color shall match existing unless otherwise noted and shall not look like patchwork - coating shall be extended to the nearest break-line, corner, etc. as may be necessary.
- B. The work includes field painting of exposed bare and covered pipes and ducts, hangers, exposed steel and iron work, tanks, vessels, and primed metal surfaces of equipment installed, except as otherwise indicated. Work shall also include, but not be limited to, coating/painting of new and existing floors and existing steel framing for crane rail.
- C. Paint all new and existing called out exposed surfaces normally painted in the execution of a new project. Where items or surfaces are not specifically mentioned, or are not specifically excluded from the painting work, paint these the same as adjacent similar materials or areas.
- D. Clean, prepare, coat, and cure all surfaces in strict accordance with the manufacturer's published recommendations and specifications.
- E. Perform all work by the use of skilled workpersons in a safe and productive manner using equipment and procedures consistent with good coating practices.
- F. Colors are indicated on the Painting Schedule in this section or shown on the drawings. If color or finish is not designated, the Engineer will select these from standard colors available for the materials system specified.

1.2 PAINTING NOT INCLUDED

- A. The following categories of work are not included as part of the field-applied finish work, or are included in other sections of these specifications.
 - 1. Shop Priming: Unless otherwise specified, shop priming of ferrous metal items is included under the various sections for structural steel, miscellaneous metal, metal fabrications, hollow metal work, and similar items. Also, for fabricated components such as shop-fabricated or factory-built mechanical and electrical equipment or accessories.
 - 2. Pre-Finished Items: Unless unit is part of an assembly to be painted to match, i.e. - motor, or otherwise shown or specified, do not include painting when factory-finishing or installer finishing is specified.

3. **Concealed Surfaces:** Unless otherwise shown or specified, painting is not required on surfaces such as walls or ceilings in concealed areas and generally inaccessible areas, foundation spaces, furred areas, utility tunnels, pipe spaces, duct shafts and elevator shafts. Painting of galvanized work that will be concealed in the completed work is not required. Do not paint structural steel to be encased in concrete, nor structural steel specified not to be painted elsewhere. Except for touch-up as specified in Part 3, painting of shop primed structural steel and ferrous metals that will be concealed in the completed work is not required.
4. **Finished Metal Surfaces:** Metal surfaces of anodized aluminum, stainless steel, chromium plate, copper, bronze and similar finished materials will not require finish painting, unless otherwise specified.
5. **Operating Parts and Labels:** Moving parts of operating units, mechanical and electrical parts such as valve and damper operators, linkages, sinkages, sensing devices, motor and fan shafts will not require finish painting unless otherwise specified.
 - a. Do not paint over any code-required labels, such as Underwriters' Laboratories and Factory Mutual, or any equipment identification, performance rating, name, or nomenclature plates.
6. **Other Surfaces:** Do not paint sprinkler heads, fire detection heads, integrally colored stucco, brick masonry, cast stone, stone masonry, or architectural precast concrete, unless otherwise specified.

1.3 RELATED SECTIONS SPECIFIED ELSEWHERE

- A. Section 01300 - Submittals

1.4 REFERENCES

- A. ANSI/ASTM D16 - Definitions of terms relating to paint, varnish, lacquer, and related products.
- B. ASTM D2016 - Test method for moisture content of wood.
- C. Steel Structures Painting Council (SSPC).

1.5 DEFINITIONS

- A. Conform to ANSI/ASTM D16 for interpretation of terms used in this section.

1.6 QUALITY ASSURANCE

- A. Furnish all coating materials by a single manufacturer. Solvent, thinners, and other miscellaneous materials can be supplied by the same manufacturer or by a supplier approved by the manufacturer.
- B. Furnish a statement to the Engineer from the coatings manufacturer that materials to be used by the Contractor comply with the manufacturer's recommendations.
- C. The Engineer reserves the right to require qualification of the product manufacturer and applicator, including satisfactory completion of at least two (2) projects of this nature.
- D. **Manufacturer's Inspection Meeting:** After set-up for painting but before commencing work, conduct a meeting at the site among representatives of the paint manufacturer, contractor, painting contractor, and Engineer to inspect the facility and review procedures recommended by the manufacturer for the prevailing conditions.

1.7 REGULATORY REQUIREMENTS

- A. Comply with all federal, state, and local health and fire regulations when handling and applying paint and coating products.

1.8 SUBMITTALS

- A. Manufacturer's Data: Submit manufacturer's technical information including paint label analysis, surface preparation and application instructions for each material proposed for use. Indicate the surfaces to which each material is to be applied.
- B. Samples; Painting: Submit samples for Engineer's review of color and texture only. Provide a listing of material and application for each coat of each finish sample.
- C. Manufacturer's Certificate: Submit a written certification from the paint manufacturer that materials furnished for the work meet or exceed specified requirements.
- D. Prepare a detailed painting schedule. List each Painting System to be used by Painting System Number, define extent and limits of each system and colors (by name and number) where appropriate.

1.9 PRODUCT DELIVERY AND STORAGE

- A. Deliver all materials to the jobsite in original, new and unopened packages and containers bearing manufacturer's name and label, and the following information;
 - 1. Name or title of material.
 - 2. Fed. Spec. number, if applicable.
 - 3. Manufacturer's stock number and date of manufacture.
 - 4. Manufacturer's name.
 - 5. Contents by volume, for major pigment and vehicle constituents.
 - 6. Thinning instructions.
 - 7. Application instructions.
 - 8. Color name and number.
- B. Store paint materials and painting tools and equipment, including solvents and cleaning material, in a well ventilated, dry area away from high heat. Do not store in buildings or structures in use or being constructed, nor leave overnight therein. Follow manufacturer's recommendations for the safe storage of paints and solvents.
- C. Take precautions to prevent fire hazards and spontaneous combustion.

1.10 SAFETY

- A. Make all necessary provisions regarding materials, equipment, personnel, procedures, and practices, to assure that the work is done safely and that the working area is maintained free of all health and safety hazards.
- B. Observe manufacturer's health and safety precautions when storing, handling, and applying coating materials and cleanup materials containing solvents and/or chemical ingredients.
- C. Direct personnel's attention to all product warnings and information given on the labels of all products.
- D. Ensure that personnel mixing and applying coating materials are equipped with adequate protective clothing and devices (including respirators).

- E. Permit no smoking in the working area.
- F. Permit no item which may produce sparks or open flames in the immediate working area.
- G. Post warning signs outside of the work to apprise personnel of the hazards in the area. Erect barriers where necessary.
- H. Return partially used coating materials that are to be retained to their original containers at the completion of each work day. Tightly reseal containers, wipe material spills, clean and return the containers to the designated storage area.
- I. Remove waste coating materials and contaminated disposable items from the job site and dispose of them at the completion of each work day. Dispose of all items and materials in strict accordance with local, state, and federal regulations.

1.11 JOB CONDITIONS

- A. Apply water-base paints only when the temperature of surfaces to be painted and the surrounding air temperatures are between 50 degrees F and 90 degrees F unless otherwise permitted by the paint manufacturers printed instructions.
- B. Apply solvent-thinned paints only when the temperature of surfaces to be painted and the surrounding air temperatures are between 45 degrees F and 95 degrees F unless otherwise permitted by the paint manufacturers printed instructions.
- C. Do not apply paint in rain, fog or mist; or when the relative humidity exceeds 85%; or to damp or wet surfaces; unless otherwise permitted by the paint manufacturer's printed instructions.
- D. Painting may be continued during inclement weather only if the areas and surfaces to be painted are enclosed and heated within the temperature limits specified by the paint manufacturer during application and drying periods.
- E. Exercise caution when attempting to paint in windy conditions. The Contractor is responsible for all damage caused by wind blown paint.

PART 2 - PRODUCTS

2.1 COLORS AND FINISHES

- A. Paint colors, surface treatments, gloss, and finishes are indicated or specified in the "schedules" of the contract documents. Color and gloss not indicated or specified shall match the Owner's existing color scheme.
- B. Final acceptance of colors will be from samples applied on the job.
- C. Paint Coordination: Review other sections of these specifications in which prime paints are to be provided to ensure compatibility of total coatings system for various substrates. Furnish information to manufacturer's, fabricators, suppliers and others where necessary on the characteristics of the finish materials to be used, to ensure compatible prime coats are used. Provide barrier coats over incompatible primers or remove and re-prime as required.

2.2 UNDERCOATS AND THINNERS

- A. Undercoats: Provide undercoat paint produced by the same manufacturer as the finish coats.
- B. Thinners: Use only thinners approved by the paint manufacturer, and use only within recommended limits.

2.3 ACCEPTABLE MANUFACTURER'S

- A. All coating references herein are to Tnemec Co., Inc., or Ameron. All coatings to be in contact with potable water must appear on the current Florida Department of Environmental Protection list of approved paint and protective coatings and be rated NSF approved for potable water.

2.4 PAINTING SYSTEMS

- A. Provide a minimum dry film thickness, noted as D.F.T., for the applications listed in the schedule of finishes.
- B. Touch-up shop-applied and field applied prime coats wherever damaged or bare and keep touched-up as necessary before and after installation or erection of the items, to maintain protection of the metal from rust and corrosion. Clean and touch-up with the same type of primer as initially used.
- C. Note: Color for all surfaces in contact with potable water to be white or ivory to conform to State of Florida, EPA, and FDA Regulations for contact with potable water. All potable water piping shall be Blue.

2.5 SCHEDULE OF FINISHES

- A. Steel, galvanized steel and non-ferrous metal
1. Exterior of pipe, equipment and miscellaneous fabrication for indoor or outdoor exposure:

System:	Epoxy / Polyurethane
First Coat:	Series 69 Polyamidoamine Epoxy Primer
D.F.T. (Mils):	3.0 - 5.0
Second Coat:	Series 69 Polyamidoamine Epoxy Topcoat
D.F.T. (Mils):	3.0 - 5.0
Third Coat:	Series 1074U Color Endura-Shield (Aliphatic Acrylic Polyurethane)
D.F.T. (Mils):	2.0 - 4.0
Min D.F.T. (Mils):	11.0
 2. Exterior of interior structural tanks, pipe, and equipment for indoor

System:	Epoxy
First Coat:	Series 69 Polyamidoamine Epoxy Primer
D.F.T. (Mils):	3.0 - 5.0
Second Coat:	Series 69 Polyamidoamine Epoxy Topcoat
D.F.T. (Mils):	4.0 - 6.0
Total Coats:	2.0
Min D.F.T. (Mils):	9.0
- B. Concrete and Masonry
1. Interior (Concrete Block)

System:	Epoxy
Block Filler:	Series 1254WB Masonry Filler
D.F.T.:	100± SF/Gal

-
- | | |
|---------------------|----------------------------------|
| First Coat: | Series N69 Hi-Build Epoxoline II |
| D.F.T. (Mils): | 4.0 - 6.0 |
| Second Coat: | Series N69 Hi-Build Epoxoline II |
| D.F.T. (Mils): | 4.0 - 6.0 |
| Min. D.F.T. (Mils): | 10.0 |
2. Exterior (Block)
- | | |
|-------------------|-------------------------------|
| System: | Acrylic |
| Block Filler: | Series 54 |
| D.F.T.: | 100± SF/Gal |
| First Coat: | 156 - Color W.B. Enviro-Crete |
| D.F.T. (Mils.): | 4.0 - 8.0 |
| Second Coat: | 156 - Color W.B. Enviro-Crete |
| D.F.T. (Mils): | 4.0 - 8.0 |
| Min D.F.T. (Mils) | 8.0 - 16.0 |
3. Exterior (Concrete and Stucco)
- | | |
|--------------------|-------------------------------|
| System: | High Build Acrylic Emulsion |
| First Coat: | 156 - Color W.B. Enviro-Crete |
| D.F.T. (Mils): | 4.0 - 8.0 |
| Second Coat: | 156 - Color W.B. Enviro-Crete |
| D.F.T. (Mils): | 4.0 - 8.0 |
| Min D.F.T. (Mils): | 10.0 |
4. Flooring
- | | |
|---------------------|------------------------|
| System: | Waterborne Epoxy |
| First Coat: | Enviro-Pox, Series 287 |
| D.F.T. (Mils): | 2.0 - 4.0 |
| Second Coat: | Enviro-Pox, Series 287 |
| D.F.T. (Mils): | 2.0 - 4.0 |
| Total Coats: | 2.0 |
| Total D.F.T. (Mils) | 4.0 - 8.0 |
5. Ceiling (Concrete)
- | | |
|--------------------|----------------------------------|
| System: | Epoxy |
| Primer: | Series 201 Epoxoprime |
| D.F.T.: | 4.0 - 6.0 |
| First Coat: | Series N69 Hi-Build Epoxoline II |
| D.F.T. (Mils): | 4.0 - 6.0 |
| Second Coat: | Series N69 Hi-Build Epoxoline II |
| D.F.T. (Mils): | 4.0 - 6.0 |
| Min D.F.T. (Mils): | 10.0 |
-

C. Plaster and Wallboard

1. Interior Ceiling and Walls

System:	Epoxy-Polyamide
Primer:	Series 51-1204, PVA - Sealer
D.F.T. (Mils):	1.0 - 1.5
First Coat:	Tnemec-Tufcoat, Series 114 H.B.
D.F.T. (Mils):	4.0 - 6.0
Second Coat:	Tnemec-Tufcoat, Series 114 H.B.
D.F.T. (Mils):	4.0 - 6.0
Total Coats:	3.0
Total Min D.F.T. (Mils):	9.0

D. Plastic Pipe and Fiberglass Fabrications

1. Interior

System:	Polyamide Epoxy Topcoat / Aliphatic Acrylic Polyurethane
First Coat:	Series N69 Hi-Build Epoxoline II
D.F.T. (Mils):	2.0 - 3.0
Second Coat:	Series 1074U Endura-Shield
D.F.T. (Mils):	2.0 - 3.0
Total Coats:	2.0
Total D.F.T. (Mils)	4.0

2. PVC and CPVC pipes, valves, conduits, and accessories (exterior):

System:	Polyamide Epoxy Topcoat / Aliphatic Acrylic Polyurethane
First Coat:	Series N69 Hi-Build Epoxoline II
D.F.T. (Mils):	2.0 - 3.0
Second Coat:	Series 1074U Endura-Shield
D.F.T. (Mils):	2.0 - 3.0
Total Coats:	2.0
Total D.F.T. (Mils):	6.0

E. Wood

1. Exterior (Clean and Dry)

System:	Acrylic Latex
First Coat:	Series 10-99W Tnemec Primer
D.F.T. (Mils.):	2.0 - 3.5
Second Coat:	Series 6, Tneme-Cryl
D.F.T. (Mils.):	2.0 - 3.0
Third Coat:	Series 6, Tneme-Cryl
D.F.T. (Mils.):	2.0 - 3.0
Total Coats:	3.0

Min D.F.T. (Mils): 7.0

F. Existing Exterior Surfaces (Previously Painted)

1. Exterior Metal

System:	Epoxy/Polyurethane
Spot Primer:	Series 135 Chembuild
D.F.T. (Mils.):	3.0 – 5.0
Tie Coat:	Series 135 Chembuild
D.F.T. (Mils.):	3.0 – 5.0
Topcoat:	Series 1074U Endura-Shield
D.F.T. (Mils.):	2.0 – 3.0
Min D.F.T. (Mils.):	6.5

2. Exterior (Concrete, Block, and Stucco)

System:	Acrylic
First Coat:	Series 6 Tneme-Cryl
D.F.T. (Mils.):	2.0 – 3.0
Second Coat:	Series 6 Tneme-Cryl
D.F.T. (Mils.):	2.0 – 3.0
Min D.F.T. (Mils.):	5.0

2.6 SCHEDULE OF COLORS:

- A. These colors are provided for painting of piping, which has modified and furnished and installed. Not all piping listed may require painting. Building colors are to match existing.

1. Liquid Piping:

- a. Acid – Yellow with red band
- b. Air – dark green
- c. Permeate and permeate service water - medium blue, to match existing
- d. Potable water (finished) - safety blue
- e. Scale Inhibitor -green
- f. Caustic – yellow with green band
- g. Fluoride – light blue with red band
- h. Membrane cleaning solution - orange
- i. Wastewater and Drains – dark Grey
- j. Concentrate - brown
- k. Raw Water - olive green
- l. Pretreated Feedwater – No painting
- m. Electrical Conduits—Color to match background.

PART 3 - EXECUTION

3.1 FIELD OBSERVATION

- A. Verify that surfaces are ready to receive work as instructed by the product manufacturer. Do not paint over conditions detrimental to the formation of a durable paint bond and film.
- B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application. Do not proceed with the work until unsatisfactory conditions have been corrected.
- C. Provide all necessary equipment, labor, rigging, lighting and other equipment to facilitate inspections.
- D. The Engineer may inspect the Work at any time for compliance with the requirements of the specifications.
- E. The Engineer reserves the right to approve each phase of the Work before further work is done, to halt all Work deemed to be improper or not in compliance with the specification, and to require the Contractor to promptly correct all improper practices or deficient Work.
- F. The Contractor is responsible for any expenses incurred in association with corrective measures required as the result of improper practices and/or defective or deficient work.

3.2 GENERAL REQUIREMENTS

- A. Provide adequate explosion – proof lighting sufficient to illuminate clearly the working area without shadows during all surface preparation and coating operations.
- B. Maintain adequate and continuous explosion – proof ventilation in confined areas during all surface preparation and coating operations and during all recoat and curing periods. Provide ventilation of sufficient capacity to maintain a clear atmosphere that is well below explosive and toxic limits. Arrange the ventilation system, including all fans and temporary duct work, so that no still air spaces exist in any area.
- C. Heating devices used to create and/or maintain temperature conditions in compliance with the specification requirements are to be explosion proof and of the type that do not exhaust sooty or oily residues or any other contaminants into the air. Heating devices are not to be used when existing temperature and humidity conditions may create dew point conditions.
- D. Use equipment that is explosion proof and non-sparking. Spray equipment must be recommended by or acceptable to the coatings manufacturer.
- E. Apply caulking material only after the last coat of paint has been applied and has dried hard. Caulking material used must be of a type that is compatible with the specified coating system.

3.3 SURFACE PREPARATION

- A. Perform preparation and cleaning procedures in strict accordance with the paint manufacturer's instructions and as herein specified, for each particular substrate conditions.
- B. Surface preparation shall be conducted to prevent material from contaminating the existing water treatment process.
- C. Fiberglass and PVC materials shall be solvent cleaned according to SSPC-SP1 and scarified by best practical means. Every precaution should be taken to ensure that NO sanding dust is drawn into

the degasifiers. Painting contractor to furnish all necessary barrier, drapes, etc. to prevent contamination of the Finish Water.

3.4 MATERIAL PREPARATION

- A. Mix and prepare painting materials in accordance with manufacturer's direction.
- B. Store materials not in actual use in tightly covered containers. Maintain containers used in storage, mixing and application of paint in a clean condition, free of foreign materials and residue.
- C. Stir materials before application to produce a mixture of uniform density, and stir as required during the application of the materials. Do not stir surface film into the materials. Remove the film and if necessary, strain the material before using.

3.5 APPLICATION

- A. General
 - 1. Conform to articles "General Requirements" and "Surface Preparation" prior to beginning coating application.
 - 2. Apply paint as specified and in accordance with the manufacturer's printed instructions. Unless otherwise recommended in the manufacturer's printed instructions or specified elsewhere (e.g. Bid Form, Painting System) use brushes for applying first coat on wood and use standard industrial spray equipment, either airless or conventional for applying first coat on metals other than sheetmetal and items fabricated from sheetmetal. For other coats on wood, metal and other substrates, use applicators and techniques best suited for the type of material being applied.
 - 3. Apply additional coats when undercoats, stains or other conditions show through the final coat of paint, until the paint film is of uniform finish, color and appearance. Give special attention to insure that all surfaces, including edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.
 - 4. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces.
 - 5. Paint surfaces behind permanently-fixed equipment or furniture with prime coat only before final installation of equipment.
 - 6. Paint interior surfaces of ducts, where visible through registers or grilles, with a flat, non-specular black paint.
 - 7. Paint the back sides of access panels, and removable or hinged covers to match the exposed surfaces.
 - 8. Finish exterior doors on tops, bottoms and side edges the same as the exterior faces, unless otherwise indicated or specified.
 - 9. Sand lightly between each succeeding enamel or varnish coat.
 - 10. Omit the field prime coat on shop-primed and touch-up painted metal surfaces which are not to be finish painted and which will not be exposed to view in the completed work. Do not omit primer on metal surfaces specified to be finish coated or on metal surfaces that will be exposed to view in the completed work.
 - 11. Putty nail holes and joints after prime coat is dry.

12. Change colors at corner of stop where colors differ between adjoining rooms or spaces and where door frames match wall colors.
 13. Provide a finished coating system free of all runs, sags, cracks, blisters, pinholes, excessive or deficient fill thickness, or any other defects. Correct any such deficiencies by proper removal of the defect and/or recoating.
 14. Apply the first-coat material to surfaces that have been cleaned, pretreated or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration. Sandblasted surfaces are not to be left uncoated overnight.
 15. Allow sufficient time between successive coatings to permit proper drying. Do not recoat until paint has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure, and the application of another coat of paint does not cause lifting or loss of adhesion of the undercoat.
 16. Provide minor tinting to each coat of paint in order to differentiate between coats.
- B. Minimum Coating Thickness
1. Apply each material at not less than the manufacturer's recommended spreading rate, to establish a total dry film thickness as specified or, if not specified, as recommended by the coating manufacturer.
 2. Painting of Mechanical and Electrical Work
 - a. Limit painting of mechanical and electrical work to those items exposed in equipment rooms and occupied spaces, and on the exterior of buildings or structures.
- C. Mechanical items to be painted include, but are not limited to, the following:
- a. Piping, pipe hangers, and supports
 - b. Heat exchangers
 - c. Tanks
 - d. Ductwork and insulation
 - e. Motor mechanical equipment and supports
 - f. Accessory items
1. Prime Coats
 2. Apply a prime coat of material, which is required to be painted or finished, and which has not been prime coated by others.
 3. Clean and prime unprimed ferrous metals as soon as possible after delivery of the metals to the job site.
 4. Recoat primed and sealed surfaces where there is evidence of suction spots or unsealed areas in first coat, to assure a finish coat with no burn-through or other defects due to insufficient sealing.
 5. Completed Work
 6. Match approved samples for color, texture and coverage.
 7. Remove, refinish or repaint work not in compliance with specified requirements.
- D. Dry Film Gauge
1. Provide "Noroson Magnetic Dry Film Thickness Gauge" as supplied by the coatings manufacturer.

3.6 CLEAN-UP AND PROTECTION

- A. Clean-up
 - 1. During the progress of the work, remove from the site all discarded paint materials, rubbish, cans and rags at the end of each work day.
 - 2. Upon completion of painting work, clean window glass and other paint – spattered surfaces. Remove spattered paint by proper methods of washing and scraping, using care not to scratch or damage finished surfaces.
- B. Protection
 - 1. Protect open water holding tanks and basins of the existing water treatment plant.
 - 2. Protect work of other trades, whether to be painted or not, against damage from painting and finishing work.
 - 3. Protect surfaces that might otherwise be damaged by dripping, splashing, or spraying of paint. Correct any damage by cleaning, repairing or replacing and repainting as acceptable to the Engineer.
 - 4. Provide “Wet Paint” signs as required to protect newly-painted finishes. Remove temporary protective wrappings provided by others for protection of their work, after the completion of paint operations.
 - 5. At the completion of work of other trades, touch-up and restore all damaged or defaced painted surfaces.
 - 6. Repair of damage caused by overspray is the contractor’s responsibility.

3.7 WARRANTY

- A. If within one year after the date of Substantial Completion, any Work is found to be defective, CONTRACTOR shall promptly, without cost to OWNER and in accordance with OWNER’S written instructions, either correct such defective Work, or, if it has been rejected by OWNER, remove it from the site and replace it with nondefective Work. If CONTRACTOR does not promptly comply with terms of such instructions, or in an emergency where delay would cause serious risk of loss or damage, OWNER 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, will be charged to the CONTRACTOR.

- END OF SECTION –

SECTION 10400
IDENTIFYING DEVICES

PART 1 - GENERAL

1.1 SCOPE

- A. Furnish and install identification devices. This work includes all services, materials, labor, tools and appliances as required. This includes interior and exterior piping and equipment. Provide identification devices for the following:
 - 1. Pipe
 - 2. Mechanical and Electrical Components
 - 3. Valves
 - 4. Instrumentation and Instrument Panels
- B. All new equipment and piping as shown on the PID drawings shall have identifying devices as described herein.

1.2 RELATED REQUIREMENTS SPECIFIED ELSEWHERE

- A. Section 01300 - Submittals
- B. Section 09900 – Painting
- C. Section 11209 – Reverse Osmosis System
- D. Section 11212 – Liquid CO2 Storage Tank
- E. Section 11280 – Control Valve
- F. Section 11504 – Sulfuric Acid System
- G. Section 11506 – Membrane Cleaning System
- H. Section 11507 – Caustic Equipment
- I. Section 11508 – Scale Inhibitor Equipment
- J. Section 11930 - Pumps – General
- K. Section 11931 – Horizontal End Suction Pumps
- L. Section 11932 – FRP Horizontal End Suction Pump
- M. Section 11936 – Vertical Turbine Pumps
- N. Section 15000 – Basic Mechanical Requirements
- O. Section 15100 – Piping and Valves

1.3 SUBMITTALS

- A. Submit sample of each type identification of device per Section 01300. Submit manufacturer's detailed technical data for materials, fabrication and installation, including catalog of anchors, hardware, fasteners and accessories.
- B. Submit complete schedule of labels, including quantity, lettering text, size, color, per Section 01300.

PART 2 - PRODUCTS

2.1 PIPE IDENTIFIERS

- A. Paint all pipe as specified in Section 09900 or Construction Drawings.

- B. Provide wrap type identifiers similar to Seton "Setmark" on all process pipe equal to or smaller than 6" diameter.
- C. Provide identifying decals similar to Seton "Roll Form" on all process pipe larger than 6" diameter.
- D. Label pipe at maximum 20' spacing, or at least one label visible in runs of less than 20'.
- E. Provide flow direction arrows on all pipe labels.
- F. Provide labels on both sides of pipeline, unless label on back side of pipe would not be visible.

2.2 MECHANICAL AND ELECTRICAL COMPONENTS

- A. Provide engraved laminated identifying labels for all types of components scheduled below. Label to be similar to "Seton Setonite". For single line of text: 1-1/2" label height, 5/8" legend letter height, 1/16" stroke. For double line: 2" high, 5/8" letter. Provide identifying numbers in 1/4" high letters below legend.
- B. Switch labels to be similar, 3/4" high, 1/2" lettering.

2.3 VALVES

- A. Provide engraved 316 stainless steel valve tags similar to Seton Style SBT for all valves.
- B. Attach with stainless steel jack chain.
- C. Conform to P & ID drawings for identifying numbers.
- D. Buried valves shall have a 3" brass disc brazed to the top of the valve box cover. The disc shall be engraved to indicate open direction, the number of turns, and the valve identifying number as referenced on the P&IDs, (i.e. open 282 turns CCW V-120).

2.4 TANK LABELS

- A. Plastic tanks - apply mylar labels with adhesive backing, similar to Seton Standard Chemical Signs, with precautionary measures, statement of hazards, emergency instructions. Alternately, make-up custom signs for special chemicals, similar to Seton Setonsign.
- B. Label to be 3" yellow with black 2" lettering.
- C. Label shall identify specific contents of tank.
- D. NFPA labels shall be provided on each tank per local fire code requirements for the appropriate liquid which is stored.

PART 3 - EXECUTION

3.1 SCHEDULES

- A. Provide labels on all new piping, control valves, mechanical and electrical components and vessels.
- B. Provide pipe identifiers on all new piping for the following pipelines (as a minimum). Field verify all pipe sizes:
 - 1. Floridan Raw Water
 - 2. NF Pretreatment
 - 3. NF Feedwater
 - 4. NF Interstage
 - 5. NF Concentrate
 - 6. NF Permeate
 - 7. Product Water

8. Finish Water
9. Plant Water
10. Permeate Service Water
11. Cleaning System Supply
12. Cleaning System Return
13. Cleaning System Waste
14. Sulfuric Acid
15. Scale Inhibitor
16. Sodium Hydroxide (Caustic)
- C. Provide identifying labels for the following mechanical components, as a minimum. All rotating equipment shall be included.
 1. High Service Pumps
 2. Feedwater Pumps
 3. Train Control Panel
 4. Train Sample Panel
 5. Sulfuric Acid Pumps
 6. Cleaning Pump
- D. Mechanical and Electrical Components
 1. All pumps, motorized valves and other major equipment.
 2. All interior and exterior control panels, (electrical, hydraulic, chemical, instrument, annunciation, control, lighting).
 3. All switches except lighting.

- END OF SECTION -

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 11209 MEMBRANE SOFTENING SYSTEM

PART 1 - GENERAL

1.1 SCOPE

- A. This section specifies the design parameters for the membrane treatment system. Work in this section should be the responsibility of the membrane system integrator (OEM), including supervision and direction. The scope of work includes all work necessary to furnish, install and test the nanofiltration (NF) membrane system, as shown on the drawings and specified herein.
- B. The membrane assemblies shall consist of membrane elements, pressure vessels, piping and valves, instruments and panel, sample panel, and other appurtenances from the feed water pump up to and including connection to feed, permeate and concentrate headers.
- C. **The construction drawings depicting the membrane train assemblies illustrate the general configuration and design intent of the NF system. Alternate configurations may be considered, however, performance, materials, and general configuration shall meet the specifications described herein and be subject to engineer approval. General footprint shall not increase in size and feed pump size (HP) shall not change.**

1.2 RELATED REQUIREMENTS SPECIFIED ELSEWHERE

- A. Section 05500 – Miscellaneous Metals
- B. Section 10400 – Identifying Devices
- C. Section 11280 – Control Valves
- D. Section 11931 – Horizontal End Suction Pumps
- E. Section 13441 – Instrumentation Components
- F. Section 13442 – Field Instrument Panels
- G. Section 15100 – Piping and Valves
- H. Section 16000 – Electrical General Requirements

1.3 QUALITY ASSURANCE

- A. Owner and Engineer shall be provided access at any time to inspect or observe all equipment prior to shipment on-site. On-site inspections shall be at the Owner's expense.
- B. A qualified representative of the membrane manufacturer shall supervise membrane loading and shall be on-site during the acceptance testing.
- C. The Membrane System OEM shall provide mechanical drawings and data submittals as required by the specifications. It is required that the OEM furnish, install, provide supervision, start-up, training, and services of the NF system.
- D. The Contractor shall provide software, operational and development of the control system integration, testing and startup of the SCADA System hardware, which includes PLC driven control systems with PC interface. NF system supplier and Contractor shall coordinate all interface testing, debugging and operation testing of the complete system with Engineer's control systems integrator, Mark Biehl with Control Systems Design (941)-907-8815 (refer to summary of work).

- E. Membrane system OEM shall have minimum ten (10) years' experience designing, constructing, and operating membrane systems similar in size to the ones proposed for this project.
- F. All furnished OEM equipment shall be the standard product of the following approved membrane OEMs. No exceptions to the listed manufacturers will be accepted without pre-approval by addendum.
 1. Aerex Industries, Inc. – 772-448-5800
 2. Harn R/O Systems, Inc. – 941-488-9671
 3. Biwater, Inc. – 909-599-4129

1.4 RAW WATER QUALITY

- A. The following design water quality is provided for information. Units are mg/l unless otherwise noted.
 1. Design Raw Water Quality:

Constituent	Unit	Historical Average	Design	Future - Worst Case
NH ₄	mg/L	0.40	0.40	0.39
K	mg/L	16.27	14.10	20.7
Na	mg/L	169.93	194.00	228.5
Mg	mg/L	48.10	48.50	49
Ca	mg/L	61.79	51.80	83
Sr	mg/L	9.41	8.63	9.6
Ba	mg/L	0.02	0.02	0.02
CO ₃	mg/L	0.51	5.00	0.306
HCO ₃	mg/L	243.55	171.00	275.33
NO ₃	mg/L	0.01	0.025	0.5
Cl	mg/L	312.50	379.00	425
F	mg/L	0.97	0.95	0.97
SO ₄	mg/L	106.16	98.00	110
SiO ₂	mg/L	22.75	20.80	23
Boron	mg/L	0.23	0.23	0.23
CO ₂	mg/L	15.01	20.43	32.99
TDS	mg/L	993	1022	1225
pH	s.u.	7.32	7.30	7.3
Cations	meq/L	15.09	15.60	18.86
Anions	meq/L	15.08	15.75	18.86

2. Startup Feedwater Quality: During the required 3-day performance test (Section 3.3), the OEM shall coordinate with the Owner for collection of feedwater samples taken after pretreatment and have them analyzed. The feedwater sample results shall be the basis by which acceptance of the permeate water quality shall be determined. Two feedwater

samples and permeate samples taken concurrently throughout each 4-day performance test as directed by the Engineer shall be taken of the parameters listed above. Membrane projections submitted by the OEM to the engineer shall be the basis of determining whether the NF system meets system requirements as specified herein.

3. Membrane projections shall be the basis of determining whether the NF system meets system requirements as specified herein.

1.5 NF SYSTEM REQUIREMENTS

- A. The NF System shall be constructed to operate with the following guaranteed requirements:

MAXIMUM 1ST STAGE FEEDWATER PRESSURE	=	110 PSI
PERMEATE FLOW PER TRAIN	=	1.875 MGD
DESIGN PERMEATE BACKPRESSURE	=	15 PSI
MAXIMUM 1 ST STAGE PERMEATE BACKPRESSURE	=	40 PSI
NUMBER OF TRAINS	=	4
DESIGN RECOVERY	=	85%
ELEMENTS PER PRESSURE VESSEL	=	6
NUMBER OF STAGES	=	2
MAXIMUM AVERAGE FLUX PER STAGE	=	17 GFD
MAXIMUM 1ST STAGE PERMEATE FLOW	=	1100 GPM
CONCENTRATE BACKPRESSURE (NORMAL)	=	30 PSI

All requirements listed refer to 3-year conditions. The concentrate backpressure refers to downstream of the concentrate control valve. The Concentrate Backpressure Normal conditions should be 30 psi.

1.6 PERFORMANCE SYSTEM TESTING

- A. In addition to performance testing requirements in other specifications, a continuous 4-day acceptance test shall be completed using all the proposed equipment functionally operating under this contract. The test shall be conducted with the OEM and Contractor and witnessed by the Engineer and Owner. Successful completion of this test as described herein, is considered substantial completion.
- B. If the NF System fails to continuously meet each performance requirements listed above during the 4-day performance test, the system shall be determined to be unacceptable and the 4-day test shall be repeated. If the test is interrupted for reasons beyond the control of the Contractor, the test may be resumed rather than restarted.
- C. The 4-day test must be satisfactorily completed as a condition for substantial completion to be achieved.
- D. The 4-day test must be satisfactorily completed prior to commencement of work on subsequent NF train replacement.
- E. Operating data taken during the acceptance test shall be adjusted to reflect performance at design water quality and provided to the Engineer.
- F. Projections of performance based on startup water quality as defined herein, shall be made prior to the acceptance test. These projections should become the basis against which the test performance is measured.

1.7 WARRANTY

- A. The membrane system OEM shall provide to the Owner a direct written warranty for membrane performance for a period of one year. The warranty period for each NF train shall start upon the date of final acceptance for the respective train by the Owner. The warranty shall require that the membrane element manufacturer (MEM) replace, at no cost to the Owner, any and all membranes necessary to restore the performance of each train to at least that predicted by the membrane suppliers as defined herein. Replacement shall take place within 30 days of written notification by Owner that a decline in performance has occurred. Decline in performance is defined as failure of any train to meet the time-based water quality and quantity projections, after data normalization submitted by membrane supplier.

PART 2 - PRODUCTS

2.1 MEMBRANES

- A. Furnish equivalent nanofiltration membrane elements for installation in four (4) 1.875 MGD reverse osmosis treatment train with a desired array of 36x14x6M.
- B. Membranes shall be non-cellulosic composite membranes, 8" in diameter 40" long, 400 sq. ft. area minimum, 440 sq. ft. maximum.
- C. All membranes must be from one manufacturer.
- D. The use of a hybrid array is not acceptable and will not be permitted at this facility.
- E. All membranes supplied shall have a minimum nominal salt rejection of 98.7% (per membrane manufacturer listed rejection), and nominal permeate flow of 10,000 gallons per day per membrane manufacturers specification under manufacturers standard test conditions. The permeate flow for individual element selection shall NOT vary more than the manufacturers listed specifications, nor greater than +15/-15%.
- F. Each membrane element shall be individually wet-tested in accordance with manufacturers standard published test conditions and permanently marked with a factory serial number. A test report for each element shall include the following information.
 - 1. Membrane Serial Number
 - 2. Test Conditions:
 - a. Feed and Differential pressures
 - b. Temperature, degrees-C
 - c. Feedwater composition, ppm
 - d. Recovery, %
 - 3. Test Results:
 - a. Salt rejection
 - b. Membrane productivity (gpd)
 - c. Specific flux (GFD/psi net)
- G. Standard Test Conditions
 - 1. 2000 ppm MgSO₄ solution
 - a. Recovery - 15%
 - b. Applied pressure - 150 psig
 - c. Temperature – 25 degrees-C
 - d. Run time before data collection - 0.5 hours

- 1) pH = 6.5 – 7.0
- H. Seal Materials
 1. Brine seals and O-Rings shall be manufactured from Viton or EPDM. BUNA-N is not acceptable.
- I. Operating Experience
 1. Membrane element manufacturer shall demonstrate in writing 2 years or more of successful operation on similar Feedwater for analogous facility. Only operating history in full-scale water plant installations shall be considered and must be demonstrated for the elements proposed to be installed under this contract.
 2. Membrane element manufacturer shall submit in writing membrane projections that will demonstrate the membrane selection and system will perform as specified, using appropriate safety factors, flow factors, and beta values.
- J. The approved membrane system OEM shall supply all membrane elements under this contract from an approved Membrane Element Manufacturer (MEM). Acceptable Membrane Element Manufacturer (MEM) believed to be compliant with the specifications are DuPont Filmtec, or Hydranautics. Allowable membrane elements which may be used that are required to meet the specifications herein are:
 1. DuPont Filmtec NF90-400/34i
 2. Hydranautics ESNA4-LD
- K. The use of a hybrid array is not acceptable and will not be permitted at this facility.
- L. The Membrane Element Manufacturer (MEM) shall be defined as the person, firm, or corporation with whom the membrane system OEM has executed an agreement to supply the membrane elements. In the performance of the work, the membrane system OEM shall coordinate services and work with the selected MEM. The various responsibilities and services of the MEM which impact the performance of the membrane system OEM are defined herein, in Section 11209.
- M. The MEM shall be responsible for the performance of the membrane elements and their ability to meet the stated water quality goals and performance criteria including, but not limited to, feed pressures, differential pressures, and permeate water quality.

2.2 PRESSURE VESSELS

- A. Pressure vessels shall be constructed of filament-wound fiberglass reinforced plastic (FWFRP). Tube dimensions shall be suitable for six (6) membrane elements of 8" diameter x 40" length, without the use of brine seal adapters to take up diameter, or spacers to take up length.
- B. Each tube shall be equipped with two end closures constructed of type 316L stainless steel. The bearing plate shall have a sealing plate that is constructed of PVC or some other inert plastic that is resistant to corrosion. The bearing plate assembly shall be secured to the vessel with Type 316L stainless steel snap/quick release rings with finger pull.
- C. Each pressure vessel shall have an insert ring (or shear ring) that is constructed of type 316L stainless steel that secures the quick release ring to the bearing plate assembly.
- D. Each pressure vessel shall be equipped with an engineered thermoplastic thrust cone located on the concentrate side of the pressure vessel.
- E. Each head assembly shall have 1-1/2" diameter permeate ports fabricated from PVC or other plastic material which must be NSF approved. The feed side of each pressure vessel must be equipped with PVC quarter turn ball valves. The permeate side of each pressure shall be

equipped with Sch. 80 PVC J-bends to connect to the train permeate header piping. End plugs and retaining devices shall be designed as a unit to form a drip-tight seal.

- F. The feed/concentrate port stub tubes shall be 4", side-entry type fabricated from 316L stainless steel. The feed and concentrate ports shall be located at 180-degree angle from each other when viewed from the vessel end section.
- G. The pressure vessels must be designed in accordance with ASME Code, Section X. Vessels do not have to be code stamped but must be constructed under conditions where code stamping is provided.
- H. Pressure Vessels shall have a smooth exterior surface that has been coated with a two-part polyurethane enamel for superior gloss retention, and to block light. Color shall be white.
- I. Pressure vessels shall be secured to the train support structure with saddle assemblies. The saddle must be constructed of an engineered thermoplastic with PVC cushion. Strap screws shall be 316L stainless steel.
- J. Acceptable pressure vessel is Codeline-Pentair W.T. and model 80U30.
- K. The pressure tubes shall be rated for a working pressure of 300 PSI at 75 deg. F, and each tube shall be factory-tested at 1.1 times rated pressure and be in compliance with ASME Section X, but not code stamped.

2.3 PRESSURE VESSEL SUPPORTS

- A. The pressure vessels shall be supported on a structure fabricated from 304 or 316/316L dual grade stainless steel as shown on the drawings. Material test reports must be submitted for all structural stainless steel and filler materials.
- B. All structural stainless-steel welding shall be written and qualified per AWS D1.6 or ASME Section IX. Welding procedures must be submitted and approved before fabrication can begin.
- C. The structure will be a rigid frame design, fully factory assembled, and designed to hold at a minimum all vessels pre-loaded at the factory. Design should be configured to minimize assembly in the field.
- D. The structure may be fabricated in two or more sections, to facilitate transportation, and installation constraints. The sections must be installed in the process building to simulate a single assembly. No field welding permitted.
- E. All mounting hardware, for pressure tubes, manifolds, instrument panels and sample boards shall be 316SS. Bolts and washers shall be 316SS.
- F. Support structures shall be anchored to existing concrete foundations using 316 Stainless steel expansion bolts. Expansion bolts to be drop-in type, 5/8" diameter as manufactured by Hilti, Red Head, or equal. Structural calculations and drawings shall be signed/sealed by a Florida registered engineer.

2.4 FEED, CONCENTRATE AND PERMEATE PIPING

- A. All stainless-steel pipe, fittings and appurtenances shall be furnished by a single manufacturer who is fully experienced, reputable, and qualified. The manufacturer shall be qualified to perform work in accordance with the ASME Code Standards and shall hold one or all of the following ASME accredited code stamps ("U", "S", "PP"). The stainless-steel pipe, fittings and appurtenances shall be designed and fabricated in accordance with ASME B31.3. Welding procedures must be submitted and approved before fabrication can begin.

- B. Each piping manifold shall be designed to distribute and/or collect flow while minimizing head loss on the process fluid and flow imbalances. Stainless steel piping connections shall be welded, except as required for connection to valves and equipment or to avoid pipe spools longer than 20 feet, in which case, the joints shall have flanged joints, or split couplings.
- C. Feed, interstage, concentrate and permeate piping shall be provided by the OEM, and shall be an integral part of the membrane assemblies.
- D. Piping sizes shall be based on the drawings. Stainless steel piping shall be designed for a velocity of five (5) to eleven (11) feet per second and PVC piping shall be designed for a maximum velocity of 7 feet per second (fps) for process and cleaning flows. Alternate sizes and configuration must be approved by Engineer.
- E. Feed and concentrate piping shall be fabricated from 316/316L dual certified stainless-steel piping, schedule 10S, ASTM A312. Finished assemblies shall be thoroughly cleaned inside and out, and all scale and welding slag removed. Finished assemblies shall be stress-relieved and passivated by full emersion. Passivation shall be in accordance with ASTM A380 and continued to produce a bright metal finish. Completed assemblies shall be pressure-tested to 300 psi prior to final assembly.
- F. The feed, interstage, concentrate and permeate manifolds must be designed and manufactured in accordance with ASME B31.3 Extruded Outlets. Welded branch connections are prohibited.
- G. The feed, interstage and concentrate manifolds shall be connected to the pressure vessel ports with 316 stainless steel or duplex grooved end couplings, with 316 stainless steel bolts, nuts, and washers. Refer to Section 15100 for more information.
- H. Each train shall be equipped with a manually operated 1st stage permeate throttling valve. Refer to Section 15100 for more information.
- I. Permeate J-bend piping shall be 1½" fabricated from Schedule 80 PVC. Permeate manifold shall be fabricated of 316L stainless steel.
- J. Connection between permeate manifolds and pressure vessels shall be 1½" PVC J-bends. The J-bends shall have quick-connect Victaulic style fittings on each end to allow for easy removal. The pressure vessel permeate stub which is not attached to the permeate manifold shall include a PVC ball valve for profiling. Sample tubing for the sample panel shall be connected at the permeate stub that is attached to the permeate manifold.
- K. Cleaning connections shall be provided on the NF trains. Rigid pipe supports shall be provided on manifold piping to prevent movement when connecting cleaning piping. Quick-connect Victaulic style fittings shall be provided where cleaning piping connections are proposed. Refer to drawings for other cleaning system details.

2.5 TRAIN INSTRUMENT PANEL

- A. The System Supplier shall provide train instrument panels for mounting near each train as shown on the drawings.
- B. The panel shall be fabricated from 1/4-inch FRP and shall be mounted on the train structure or shall be floor-mounted. The panel shall be equipped with the instrumentation described below, as a minimum.
 - 1. Pressure Gauge – 5-way valve to indicate 1st stage feed pressure, 1st stage concentrate pressure/2nd stage feed pressure, 2nd stage concentrate pressure.
 - 2. 1st Stage feed, 1st stage concentrate/2nd Stage Feed, 1st stage permeate Pressure Transmitters (3)

3. 1st Stage and 2nd Stage Differential Pressure Transmitters (2)
 4. 2nd Stage and Total Permeate Flow Transmitters (2)
 5. 2nd Stage Concentrate Flow Transmitter (1)
 6. 2nd Stage and Total Permeate Conductivity Indicating transmitters (2)
 7. Pressure Gauge – 4-way valve to indicate 1st stage permeate, combined permeate and final concentrate (post concentrate control valve).
- C. Wiring, conduit and connections from source to panel shall be by system supplier. Wiring and connections from panel to control room shall be under Division 16. Refer the instrumentation component specification section and to the Process and Instrumentation Diagrams (P&IDs) for details.

2.6 SAMPLE PANEL

- A. The System Supplier shall provide sample panels, to be mounted near the NF trains. The panels shall be free-standing as depicted on the drawings. Samples to be taken where permeate port exits pressure vessel to provide representative sample of vessel permeate
- B. The panel shall be fitted with sample valves. There shall be one (1) sample valve for each pressure vessel on the train, plus valves for 1st stage feed, 1st stage concentrate/2nd stage feed, 1st stage permeate and 2nd stage permeate, total permeate, and 2nd stage concentrate. The sample panel shall also be equipped with a 6" deep by 6" wide trough, of the same material, which will be drained through a 2" PVC pipe. Provide slope in trough to properly drain sample water.
- C. Sample valves shall be arranged in horizontal rows, with the rows staggered so that the upper valves discharge between the lower valves. Each valve will be fitted with a 1/4" ss tube discharge spout, to prevent splashing. Bottom elevation of discharge spout shall be similar for all valves.
- D. Sample valves are to be Whitey 1/4 turn plug valves, 316 stainless steel.
- E. Male connectors shall be Swagelok model SS-600-1-4KN for connection to high-pressure sample ports, and model NY-600-1-4 for connection to low pressure ports, or equal.
- F. Plastic sample tubing shall be 3/8" OD. High-pressure tubing shall have a minimum working pressure of 300 psi at 75 deg. F. Low-pressure tubing shall have a minimum working pressure of 100 psi @ 75 deg. F. Sample tubing shall be black. Tubing shall be manufactured by Imperial Eastman Division, Imperial Clevite, Inc., or equal.
- G. Tubing shall be neatly arranged and bundled where possible. Bundles shall be retained with nylon "Tywraps" or grouped in PVC conduit with properly arranged openings for tubing and labeled as specified in Section 10400.

2.7 SPARE PARTS

- A. Provide two spare grooved coupling assemblies, including gasket and hardware for each size supplied. Victaulic caps of 316 ss of each size shall also be provided.
- B. Provide sufficient brine seals, inter connector O-rings and outboard connector o-rings for 3 pressure vessels.
- C. Provide 6 pressure vessel repair kits, consisting of all O-rings, head gaskets, seals and clips required for the rebuilding of the end closure assembly.
- D. Provide cleaning system spool connections to facilitate cleaning of NF train. Provide flexible hosing with necessary bushings and couplings to connect from NF permeate to NF concentrate (cleaning connections) to facilitate flushing of train during startup.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Membrane assemblies shall be installed in accordance with manufacturer's recommendations, and the final shop drawings.
- B. Coordinate work with work by others to assure a complete functional system.

3.2 FIELD TESTING

- A. Pressure test all piping and pressure tubes in accordance with Section 2670, flushing, testing, and disinfection.
- B. Vessels shall not leak when properly installed. If leaking occurs, vessel manufacturer and OEM shall be responsible for the repair and/or replacement of the vessel, if deemed necessary by the Engineer.

- END OF SECTION -

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 11212
LIQUID CARBON DIOXIDE STORAGE TANKS

PART 1 - GENERAL

1.1 SCOPE

- A. This section provides for the supply, installation and placing in service one (1) ~ 30-ton, skid-mounted, horizontal steel storage tank for liquefied carbon dioxide (CO₂) and ancillary equipment, piping, fittings, instruments, panels, and any other items needed for a complete and functional CO₂ storage system. The tanks shall be single compartment, welded steel pressure vessels, with urethane foam insulation and an aluminum jacket. The tank shall be designed per ASTM for a maximum allowable working pressure of 350 psig @ 200°F and have a minimum design metal temperature range of (-) 40°F. The storage tank shall be new and shall be equipped with a refrigeration unit, an electric vaporizer, and vapor heater housed in a prefabricated aluminum control cabinet.

1.2 RELATED SECTIONS

- A. Drawings and general provisions of the Contract, including the General and Supplementary Conditions and Division 1 Specification sections, apply to this section.
- B. Section 01300 Submittals
- C. Section 01730 Operating and Maintenance Manuals
- D. Section 09900 Painting
- E. Section 15100 Piping and Valves

1.3 QUALITY ASSURANCE

- A. All components must be products of qualified manufacturers regularly engaged in the manufacturer of carbon dioxide storage equipment.
- B. The manufacturer operates an ASME Pressure Vessel Shop and employs certified welders to produce the pressure vessel to ASME standards, inspection and testing as required.
- C. The manufacturer has working experience designing liquefied compressed gas systems and has successful experience with similar type systems for at least 10 years.
- D. The manufacturer maintains qualified technical engineering staff and can provide qualified service personnel to service the equipment.

1.4 SUBMITTALS

- A. Shop Drawings
 - 1. Submit to the Engineer as provided in Section 01300, shop drawings, details of construction and erection for each tank as follows:
 - a. Dimensioned Tank Drawings showing dimension of tank, fittings, openings, equipment, vents and attachments, molded-in lifting lugs for lifting and tank restrain system, with bolt, fitting and gasket material. Details, location and orientation of openings, equipment, fittings, accessories, restraints, vents, and supports shall be included.
 - b. Wall thickness calculations per ASTM "Code for Unfired Pressure Vessels" Section VIII Division 1 demonstrating a minimum 350-psig design maximum allowable working

- pressure @ 200°F. The calculations shall be signed and sealed by a professional engineer licensed in the state of Florida.
- c. Wind load calculations per Florida Building Code, 2020 (or latest edition)
 - d. Base frame/support skid structural calculations
 - e. Weight of tanks.
 - f. Statement that fabrication is in accordance with these Specifications.
 - g. Certificate of Compliance from the tank manufacturer stating:
 - 1) All fittings, heat tracing, insulation, etc. have been installed by the tank manufacturer.
 - 2) Hydrostatic tests have been performed by the manufacturer and all fittings were installed prior to the tests.
 - h. Samples of a representative tank wall.
 - i. Details on packaging.
 - j. Instructions for handling, storage and installation of tank.
 - k. Statement that materials used are suitable for intended service.
 - l. Manufacturer's warranty
 - m. Supporting documentation of Manufacturer's certification to NSF/ANSI Standard 61 – Drinking Water System Components for water treatment chemicals.
2. Bill of Materials.
- B. Operation and Maintenance data, including test reports, maintenance and schedules, and spare parts list shall be provided in accordance with Section 01730.

PART 2 - PRODUCTS

2.1 STORAGE TANK

- A. The Bulk Liquid Carbon Dioxide Storage Tank shall be 30-ton, skid-mounted, horizontal carbon dioxide steel pressurized storage tanks. The tank shall be single compartment, welded ASME SA612, Grade B carbon steel pressure vessels, with a 6-in minimum polyurethane foam insulation and 0.063-in pre-painted white aluminum jacket.
- B. The welded steel pressure vessel shall be designed and constructed in accordance with ASTM E Section VIII, Division 1 demonstrating a minimum 350-psig design maximum allowable working pressure @ 200°F and minimum design metal temperature of (-) 40 °F.
- C. The thermal conductivity for the insulated wall shall not be greater than 0.040 Btu per hour per square foot per degree Fahrenheit.
- D. Tank shall be marked to identify the manufacturer date of manufacture and serial numbers must be permanently embossed into the tank. Tank shall be manufactured by TOMCO₂ Equipment Company, Carbo Tech, Inc., The Wittemann Company, or approved equal.
- E. Provide fittings for safety relief valves, bleeder valves, fill/drains, nozzles, gauges, manway, lifting lugs and as indicated on the construction drawings.
- F. Lifting lugs for restraint shall be placed every around the top of the tank as shown on the drawings. Lugs shall be designed for lifting the tank when empty.
- G. Tank Piping, Fittings, and Equipment
 - 1. Fitting, gasket and bolt material shall be a material that is compatible with the product being stored.

2. Storage tank shall be protected from being subjected to pressures greater than the maximum allowable working pressure by means of two ASME approved safety relief valves and two bleeder type relief valves, complete with three way switching valves.
3. Tank shall be provided with a pressure switch to sound an alarm automatically in the event of excessive high or low pressure in the tank. The alarm horn and indicating lights shall be mounted on the refrigeration control panel located on the storage tank. The panel shall be complete with an alarm silence circuit to shut off the audible alarm. Contacts shall be provided for remote indication of high and low tank pressure alarms.
4. All nozzles on the vessels shall be schedule 80 stainless steel. All piping and fittings provided internal to the storage tank system shall be Schedule 80 carbon steel. All piping and fittings provided external to the vessel and supplied as part of the storage system shall be Schedule 80 type 304 stainless steel, with 2,000 psi rated threaded fittings. Type 316 Stainless steel ball valves shall be provided where the connections for the liquid fill, vapor return, vaporizer and vapor process lines connect to the tank, and where needed to remove and service the vaporizer, vapor heater, etc., without emptying the tank. 1-1/2" Liquid CO₂ and 1" Vapor Balance fill couplings shall be standard CGA brass threaded connections for CO₂ service complete with hose blow down valves and pressure relief valves.
5. A liquid level gauge calibrated to read pounds CO₂ shall be provided and installed for each CO₂ storage vessel.
6. A 0-600 psig pressure psig pressure gauge shall be provided and installed for each CO₂ storage vessel.

2.2 PIPES AND FITTINGS

- A. All tank piping and pipe fittings associated with the CO₂ storage system shall be in the appropriate diameters, in accordance with the piping section of this specification and the drawings.
 1. Stainless steel pipe shall conform to ASTM A312, Austenitic steel pipe, welded, seamless, grade TP 304L as a minimum
 2. Size shall be nominal pipe size (NPS) designation as shown with Schedule 40-wall thickness (min) as indicated on the drawings, or specified herein.
 3. Pipe flanges and fittings to meet ASME B16.5-1996.
 4. Flanges to be Class 300, depending on service, raised face, serrated finish, forged A182 Grade F3046L, weldneck type. Dimensions shall meet ANSI/ASME B16.5 (latest edition).
 5. Flange bolts and nuts shall be ASTM A193 and ASTM A194, Type 316, respectively. Never Seize shall be used on all stainless steel threaded fasteners. Flange gaskets shall be full faced, elastomeric type rubber (neoprene or EPDM), and meet the requirements of ANSI/AWWA C207.

2.3 PREFABRICATED ALUMINUM CONTROL CABINET

- A. Each storage tank unit shall be provided with an enclosure at one end which shall provide weather protection for the vaporizer, vapor heater, and refrigeration unit. The enclosure shall consist of a structural frame, which shall be covered with aluminum sheet, minimum thickness 0.04 inches (1 mm). The storage tank, enclosure, frame, and other exposed metal surfaces shall be painted in accordance with painting specs.
- B. Adequate vent area shall be provided to allow cooling air circulation for the refrigeration system. Two lockable, hinged door shall be provided on the enclosure.

2.4 REFRIGERATION UNIT

- A. A complete environmentally safe refrigeration system shall be provided for the storage tank that will automatically maintain the storage tank at 0°F and 300 psig. The evaporator coil of the refrigeration unit shall be located inside of the top portion of the storage tank, with the compressor and air-cooled condensing coil mounted on the frame at the end of the tank. The refrigeration unit shall be equipped with a condensing unit driven by a 3 HP, 480 volt, 60 cycle, 3-phase compressor and provided with a NEMA 4X stainless steel fused disconnect switch, motor starter, and a 120-volt control voltage transformer. The condensing unit will include a sight glass, refrigerant line, solenoid valve, expansion valve and a refrigeration coil mounted internally in the storage tank. Automatic controls shall be provided to start and stop the compressor, thereby controlling the temperature of the CO₂ in order to maintain the proper operating pressures.

2.5 PRESSURE BUILD VAPORIZER

- A. CO₂ tank shall be provided with one complete electric vaporizer unit, capable of vaporizing 325 lbs of liquid carbon dioxide per hour at 300 psig. Automatic controls shall be provided to control the vaporizer to maintain the tank pressure above 245 psig. An adjustable differential pressure switch shall activate the vaporizer at 245 psig and shall deactivate the unit at 255 psig. Liquid carbon dioxide shall be drawn off of the bottom tank, with the resulting vapor returning to the top of the tank. A purging valve for easy removal of accumulated impurities, safety controls consisting of a safety relief valve, a thermostat for overheat protection and a fused control circuit for coil protection shall be provided. Electrical requirements shall be 12 kW, 480-volt, 3-phase, 60-Hz, and shall be provided with a NEMA 4X stainless steel fused disconnect switch. The vaporizer shall be supplied as an integral part of the storage tank; pre-piped, pre-wired and pre-insulated and located in the equipment enclosure.

2.6 VAPOR HEATER

- A. One 4 kW carbon dioxide vapor heater shall be provided for the CO₂ tank to heat the 0°F CO₂ gas to near room temperature. The vapor heater shall be rated for operation at 480 volts single-phase, 60 Hz. The vapor heater shall be supplied complete with electronic temperature control. Operating control range shall be adjustable from 30° to 110°F. Solid high conductivity aluminum pressure castings containing the electrical resistance heaters and aluminum castings containing the stainless steel tubing for the CO₂ vapor shall be provided. An overheat device shall be supplied to shut off the heating element should the temperature reach 200°F. A manual reset button shall be supplied for restarting the heater after the overheat temperature controller has tripped out. The vapor heater shall be pre-piped and pre-wired in a stainless enclosure with a through the door disconnect switch, inside the storage tank aluminum control house.

2.7 FIRST STAGE PRESSURE REGULATOR

- A. For the CO₂ storage tank, one carbon dioxide pressure reducing regulator will be supplied, pre-installed in the CO₂ pipeline after the carbon dioxide vapor heater. The regulator shall be used to reduce the pressure from approximately 300 psig to 120 psig. The regulator shall have a malleable iron body, aluminum spring case and lower case, nitrile and aluminum valve disc and holder, nylon fabric coated with nitrile diaphragm, stainless steel valve stem and valve stem guide. The outlet pressure of the regulator shall be easily adjusted through the use of an adjustment screw.

- B. One pressure gauge, 2-1/2" dial, 0 to 600 psig range, complete with isolation valve, shall be provided for indication of the CO₂ pressure downstream of the regulator.
- C. One (1) pressure relief valve shall be provided installed in the pipeline prior to the pressure regulator. Relief valve shall be set for 450 psig.
- D. One (1) Electronic indicating pressure transmitter shall be provided for remote monitoring of the pressure of the CO₂ gas after the vapor heater and first stage pressure regulator.

PART 3 - EXECUTION

3.1 TESTING

- A. Tank shall be thoroughly flushed out of all debris at least twice, or hand swabbed before placing into service in order to ensure tank is clean.
- B. All piping, fittings, valves shall be visual leak tested where pressure testing cannot occur. All piping to be completely purged from any foreign material prior to filling and testing.
- C. Bulk tank shall be hydrotested and cleaned, and all piping pressure tested, prior to filling the bulk tank.
- D. Contractor is responsible for filling both tanks with carbon dioxide for the first time so the systems can be placed into operation and observed for proper operation.

3.2 CARBON DIOXIDE SUPPLY

- A. Contractor shall supply a total of one (1) – 30-ton fill of carbon dioxide required for piping, filling, start-up and performance testing. Bulk tank shall be hydrotested and cleaned, and all piping pressure tested, prior to filling the bulk tank.

- END OF SECTION -

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 11280 CONTROL VALVE

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. This section includes control valves and operators for various throttling and open/close valves including but not limited to the feedwater control valves, concentrate control valves, and the raw water bypass control valves, and any other process related control valves.
- B. Other control valves shall be provided as shown on the drawings and specified herein.

1.2 RELATED REQUIREMENTS SPECIFIED ELSEWHERE

- A. Section 11209 – Membrane Softening System
- B. Section 11504 – Sulfuric Acid Equipment
- C. Section 11506 – Membrane Cleaning System
- D. Section 15100 – Piping and Valves

1.3 QUALITY CONTROL

- A. Coordinate electrical power requirements with applicable systems to assure adequate support for equipment. Ensure power supply type is compatible with actuators prior to ordering equipment.
- B. Coordinate with instrumentation and control supplier to assure proper control signals.

1.4 SUBMITTALS

- A. Provide data on valve performance data for all valves and CV curves for all modulating valves including sizes, complete material breakdown of components, type and noise levels at various flows for all valves, and complete electrical schematics which depict specific field wiring requirements.

PART 2 - PRODUCTS

2.1 FEEDWATER CONTROL VALVES

- A. The feedwater pump feed valves shall be lug-style butterfly valves designed to fit between 150# ANSI rated flanges. The valves will be operated by an electric actuator, and the valve shall be constructed of 316 stainless steel. The valves will be located on the spare feedwater piping prior to connection to each NF train's respective dedicated feedwater piping.
- B. Materials
 - 1. Body - 316 stainless steel
 - 2. Disc - 316 stainless steel
 - 3. Stem - 316 stainless steel
 - 4. Seat – TFE
 - 5. Stem Seal – TFE

- C. The valve shall mount between ANSI Class 150 raised face flanges. The valve shall be as manufactured by Keystone, Model K-Lock, Flow Seal or equal. Valve shall be bubble tight, rated for 150 PSI on both sides of valve.
- D. Actuators shall contain motor, gearing, manual override, limit switches, torque switches, drive coupling, integral motor controls mechanical dial position indicator (where required). The motor shall be specifically designed for actuator service. The motor will be of the induction type with class F insulation and protected by means of thermal switches imbedded in the motor windings. Motor enclosure will be totally enclosed, non-ventilated. Motors will be capable of operating on 120 Volt - 1 phase - 60 hertz power. Actuator enclosure shall be minimum NEMA 4 (watertight). All external fasteners on the electric actuator will be stainless steel. Fasteners on limit switch and terminal compartments shall be captured to prevent loss while covers are removed. All gearing shall be grease lubricated and designed to withstand the full stall torque of the motor. Manual override shall be by handwheel. Manual operation will be via power gearing to minimize required rimpull and facilitate easy change-over from motor to manual operation when actuator is under load. Return from manual to electric mode of operation will be automatic upon motor operation. A seized or inoperable motor shall not prevent manual operation. Limit switches shall be furnished at each end of travel. Limit switch adjustment shall not be altered by manual operation. Limit switch drive shall be by countergear. Limit switches must be capable of quick adjustment requiring no more than five (5) turns of the limit switch adjustment spindle. One set of normally open and one set of normally closed contacts will be furnished at each end of travel where indicated. Contacts shall be of silver and capable of reliably switching low voltage DC source from the control system furnished by others. Mechanically operated torque switches shall be furnished at each end of travel. Torque switches will trip when the valve load exceeds the torque switch setting. The torque switch adjustment device must be calibrated directly in engineering units of torque. All wiring shall be terminated at a plug and socket connector. Quarterturn actuators will be furnished with mechanical stops that restrict the valve/actuator travel. Actuators will be capable of operating in an ambient temperature range of -40 to +160 degrees F (with or without motor controls. All actuators in open/close service will be furnished with integral motor controls consisting of reversing starters, control transformer, monitor relay (to signal fault conditions such as thermal switch trip, torque switch tripped in mid-travel), "open-stop-close" pushbuttons, "local-off-remote" selector switch in addition to red and green indicating lights. An interface with the control system must be furnished with optical isolators to separate incoming voltage signals from the internal motor controls. All actuators shall be model SQ manufactured by AUMA Actuators, Inc. of Canonsburg, Pennsylvania, Group 11 actuators by Harold Beck & Sons, Inc. of Newtown Pennsylvania, or approved equal. Actuator shall be sized for the spare feedwater valves size and model and coordinated with the valve manufacturer.

2.2 CONCENTRATE CONTROL VALVES

- A. The concentrate control valve shall be 4" full port v-port ball valve with type 316 stainless steel body, bonnet and 150 lb rated flanges. Valve shall be equipped with live loaded packing sets for valve stem. Valve shall be equipped with anti-cavitation trim and designed to meet the conditions listed below. The valve shall be designed as the control valve for the NF train, modulating service to maintain recovery through inducing backpressure on the NF system. Final valve sizing shall be confirmed by the membrane system supplier.
- B. Materials

1. Body, Bonnet, and Flange –ASTM A351 gr. CF8M
 2. Valve Ball – AISI 329 (duplex)
 3. Seat – 316 Stainless Steel
 4. Stem - Inconel 718
 5. Anti-cavitation Trim - Gr 4A Duplex Steel
 6. Packing - PTFE V-Ring, Std. Live-Loaded
- C. The valve shall be a Neles Q-RE v-port trim design to meet conditions listed below or approved equal. Conditions shall be confirmed by NF system supplier.

Conditions

Conc. Flow (gpm)	Conc Press (psi)	Final Press - high (psi)	Final Press- low (psi)	dP High (psi)	dP low (psi)	Cv High	Cv low
230.2	87	30	17	57	70	30.5	27.5
230.8	95	30	17	65	78	28.6	26.1
326.5	81.5	30	17	51.5	64.5	45.5	40.7
326.8	82.1	30	17	52.1	65.1	45.3	40.5
260.5	68.8	30	17	38.8	51.8	41.8	36.2
260.4	75	30	17	45	58	38.8	34.2
183.5	74.1	30	17	44.1	57.1	27.6	24.3
184.5	83.1	30	17	53.1	66.1	25.3	22.7
347.3	75	30	17	45	58	51.8	45.6
347.2	81.6	30	17	51.6	64.6	48.3	43.2
244.8	89.9	30	17	59.9	72.9	31.6	28.7
245	98.7	30	17	68.7	81.7	29.6	27.1

- D. Valve actuator shall conform to the requirements of AWWA Standard C540-93. Actuators shall contain motor, gearing, manual override, limit switches, torque switches, drive coupling, integral motor controls, position feedback transmitter and mechanical dial position indicator. Motors to be capable of operating on 120 volt - 1 phase - 60 hertz power. Actuator enclosure shall be minimum NEMA 4 (watertight). All external fasteners on the electric actuator will be stainless steel. Fasteners on limit switch and terminal compartments shall be captured to prevent loss while covers are removed. All gearing shall be grease lubricated and designed to withstand the full stall torque of the motor. Manual override shall be by handwheel. Manual operation will be via power gearing to minimize required rimpull and facilitate easy change-over from motor to manual operation when actuator is under load. Return from manual to electric mode of operation will be automatic upon motor operation. A seized or inoperable motor shall not prevent manual operation. Limit switches shall be furnished at each end of travel. Limit switch adjustment shall not be altered by manual operation. Limit switch drive shall be by countergear. Limit switches must be capable of quick adjustment requiring no more than five (5) turns of the limit switch adjustment spindle. One set of normally open and one set of normally closed contacts will be furnished at each end of travel where indicated. Contacts shall be of silver and capable of reliably switching low voltage DC source from the control system furnished by others.

Mechanically operated torque switches shall be furnished at each end of travel. Torque switches will trip when the valve load exceeds the torque switch setting. The torque switch adjustment device must be calibrated directly in engineering units of torque. All wiring shall be terminated at a plug and socket connector. Quarterturn actuators will be furnished with mechanical stops that restrict the valve/actuator travel. Actuators will be capable of operating in an ambient temperature range of -40 to +160 degrees F (with or without motor controls). Actuators in modulating service will be selected such that the required dynamic valve torque is no more than 60% of the electric actuator's maximum rated breakaway torque. Power gearing in modulating actuators shall have zero backlash between the motor and actuator output. All actuators in modulating service will be furnished with a feedback potentiometer in addition to the following motor controls: reversing starters, control transformer, phase discriminator, monitor relay, positioner, "open-stop-close" pushbuttons, "local-off-remote" selector switch in addition to red and green indicating lights. The positioner shall be capable of accepting a 4-20mADC command signal and positioning the valve by comparing the command signal with the present valve position as indicated by the feedback potentiometer mounted inside the actuator. The positioner shall be field adjustable to fail to the "open", "closed" or "last" position on loss of 4-20mADC command signal. All actuators shall be model SQR manufactured by AUMA Actuators, Inc. of Canonsburg, Pennsylvania, Group 11 actuators by Harold Beck & Sons, Inc. of Newtown Pennsylvania, or approved equal. Actuator shall be sized for the control valve size and model and coordinated with the valve manufacturer.

2.3 RAW WATER BLEND VALVE

- A. The raw water blend control valve shall be 6" full port v-port ball valve with schedule 80 duplex stainless steel body, bonnet and 150 lb rated flanges. Valve shall be equipped with live loaded packing sets for valve stem. Valve shall be equipped with anti-cavitation trim and designed to meet the conditions listed below. The valve shall be designed as the control valve for blending raw water with nanofiltration permeate, modulating service to maintain desired flow rate or blend ratio.
- B. Materials
 - 1. Body, Bonnet, and Flange –ASTM A351 gr. CF8M
 - 2. Valve Ball – AISI 329 (duplex)
 - 3. Seat – 316 Stainless Steel
 - 4. Stem - Inconel 718
 - 5. Anti-cavitation Trim - Gr 4A Duplex Steel
 - 6. Packing - PTFE V-Ring, Std. Live-Loaded
- C. The valve shall be a Neles Q-RE 6-inch v-port trim design to meet conditions listed below or approved equal.

Conditions				
Flow (gpm)	Inlet Pressure (psi)	Outlet Pressure (psi)	Differential Pressure (psi)	Cv
260	35	10	25	52.0
260	50	10	40	41.1
520	35	10	25	104.0
520	50	10	40	82.2
780	35	10	25	156.0
780	50	10	40	123.3
1040	35	10	25	208.0
1040	50	10	40	164.4

- D. Valve actuator shall conform to the requirements of AWWA Standard C540-93. Actuators shall contain motor, gearing, manual override, limit switches, torque switches, drive coupling, integral motor controls, position feedback transmitter and mechanical dial position indicator. Motors to be capable of operating on 120 volt - 1 phase - 60 hertz power. Actuator enclosure shall be minimum NEMA 4 (watertight). All external fasteners on the electric actuator will be stainless steel. Fasteners on limit switch and terminal compartments shall be captured to prevent loss while covers are removed. All gearing shall be grease lubricated and designed to withstand the full stall torque of the motor. Manual override shall be by handwheel. Manual operation will be via power gearing to minimize required rimpull and facilitate easy change-over from motor to manual operation when actuator is under load. Return from manual to electric mode of operation will be automatic upon motor operation. A seized or inoperable motor shall not prevent manual operation. Limit switches shall be furnished at each end of travel. Limit switch adjustment shall not be altered by manual operation. Limit switch drive shall be by countergear. Limit switches must be capable of quick adjustment requiring no more than five (5) turns of the limit switch adjustment spindle. One set of normally open and one set of normally closed contacts will be furnished at each end of travel where indicated. Contacts shall be of silver and capable of reliably switching low voltage DC source from the control system furnished by others. Mechanically operated torque switches shall be furnished at each end of travel. Torque switches will trip when the valve load exceeds the torque switch setting. The torque switch adjustment device must be calibrated directly in engineering units of torque. All wiring shall be terminated at a plug and socket connector. Quarterturn actuators will be furnished with mechanical stops that restrict the valve/actuator travel. Actuators will be capable of operating in an ambient temperature range of -40 to +160 degrees F (with or without motor controls). Actuators in modulating service will be selected such that the required dynamic valve torque is no more than 60% of the electric actuator's maximum rated breakaway torque. Power gearing in modulating actuators shall have zero backlash between the motor and actuator output. All actuators in modulating service will be furnished with a feedback potentiometer in addition to the following motor controls: reversing starters, control transformer, phase discriminator, monitor relay, positioner, "open-stop-close" pushbuttons, "local-off-remote" selector switch in addition to red

and green indicating lights. The positioner shall be capable of accepting a 4-20mADC command signal and positioning the valve by comparing the command signal with the present valve position as indicated by the feedback potentiometer mounted inside the actuator. The positioner shall be field adjustable to fail to the "open", "closed" or "last" position on loss of 4-20mADC command signal. All actuators shall be model SQR manufactured by AUMA Actuators, Inc. of Canonsburg, Pennsylvania, Group 11 actuators by Harold Beck & Sons, Inc. of Newtown Pennsylvania, or approved equal. Actuator shall be sized for the trim valve size and model and coordinated with the valve manufacturer.

2.4 SULFURIC ACID ISOLATION VALVE

- A. The acid isolation valve shall be a one inch flanged ball valve. The valve shall be operated by a quarter-turn electric actuator.
- B. Materials
 - Body PVDF
 - Ball PVDF
 - Ball Seat Teflon
 - Seal Protector Ring Viton
 - Shaft Stainless Steel
- C. The valve shall be manufactured by ASAHI/America, Model DUOB10C or equal.
- D. The valve actuator shall be an electric type, 120 VAC, 60 Hz single phase, brush less, capacitor-run, reversing type motor with travel-stop limit switches. It shall include thermal overload protection with auto-reset, 100% duty cycle for high cycle applications with a permanently lubricated gear train and be mounted directly to the valve. The housing shall be corrosion proof, waterproof, NEMA 4X rated and constructed of thermoplastic with stainless steel trim. It shall include a position indicator with a manual override handle. The actuator shall be manufactured by Quarter Master, Series 94, or equal.

2.5 PERMEATE SERVICE WATER

- A. The permeate service water valve shall be a three-inch threaded tru-union ball valve. The valve shall be operated by a quarter-turn electric actuator.
- B. Materials
 - Body PVDF
 - Ball PVDF
 - Ball Seat Teflon
 - Seal Protector Ring Viton
 - Shaft Stainless Steel
- C. The valve shall be manufactured by ASAHI/America, Model DUOB10C or equal.
- D. The valve actuator shall be an electric type, 120 VAC, 60 Hz single phase, brush less, capacitor-run, reversing type motor with travel-stop limit switches. It shall include thermal overload protection with auto-reset, 100% duty cycle for high cycle applications with a permanently lubricated gear train and be mounted directly to the valve. The housing shall be corrosion proof, waterproof, NEMA 4X rated and constructed of thermoplastic with stainless steel trim. It shall include a position indicator with a manual override handle. The actuator shall be manufactured by Quarter Master, Series 94, or equal.

2.6 SOLENOID VALVES

- A. Solenoid valves shall be two-way pilot operated type for general service, normally open (energize to close). Valve shall be standard enclosure, Type 1 general service, brass body, $\frac{3}{4}$ " FNPT size (unless otherwise noted on drawings), Buna N seal and disc, 120 VAC, continuous duty molded Class F coil. Valves shall be catalog number 8210 G35 Red-Hat Series as manufactured by Asco, or equal.
- B. Adjust all valve actuator settings to the field conditions of the service conditions of the specific valve. Factory settings are not acceptable for all service conditions.
- C. Provide documentation from the actuator manufacturer for each valve actuator type to certify installation of valve actuator with valve type.
- D. Provide adequate bracing and support for actuators to prevent undue stress on piping systems. Supports shall be designed for operating conditions of valve and actuators.

PART 3 - EXECUTION

3.1 SPARE PARTS

- A. Furnish the following spare parts to Owner:
 - 1. One (1) solenoid valve assembly
 - 2. Processor control board for modulating valve actuator.
 - 3. Motor for each type actuator
 - 4. One complete internal actuator board assembly as recommended by valve manufacturer.
 - 5. Two spare gaskets for actuator body for each type frame

- END OF SECTION -

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 11504
SULFURIC ACID EQUIPMENT

PART 1 - GENERAL

1.1 SCOPE

- A. This section provides for the supply, installation, and placing in service the new sulfuric acid pre-engineered metering pump skid, piping replacement within the existing process building, new feedwater acidification injection assembly and improvements associated with the existing sulfuric acid system.
- B. The components within this specification shall be compatible with 93% concentration, by weight, sulfuric acid.

1.2 RELATED REQUIREMENTS SPECIFIED ELSEWHERE

- A. Section 02670 – Flushing, Testing & Disinfection
- B. Section 10400 – Identifying Devices
- C. Section 11280 – Control Valves
- D. Section 13441 – Instrumentation Components
- E. Section 15100 – Piping and Valves
- F. Section 16050 – Basic Materials and Methods

1.3 SUBMITTALS

- 1. Provide a complete shop drawing submittal under this section for proposed metering pump skid, isolation valve for injector, injector, and chemical feed piping

1.4 QUALITY ASSURANCE & WARRANTY

- A. Provide quality control in accordance with Section 01400.
- B. All components must be products of qualified manufacturers regularly engaged in the manufacturer of these components.
- C. All components must comply with the applicable codes and standards, as described elsewhere in this specification.
- D. All components shall be made available for inspection at the manufacturer's facility by the Owner or his representative prior to shipment.

PART 2 - PRODUCTS

2.1 ACID PIPING AND FITTINGS

- A. All piping and pipe fittings that are in continuous contact with sulfuric acid (carrier piping) shall be in the appropriate diameters, in accordance with the piping section of this specification and the drawings.
- B. Carrier pipe, fittings, and valves shall be manufactured from E-CTFE (HALAR), OR PVDF (Polyvinylidene fluoride). All fittings material must be compatible with 93% - 98% sulfuric acid. All gaskets associated with the acid system shall be Viton.

- C. All piping and pipe fittings associated with the acid system shall be in the appropriate diameters, of similar manufacturer, and in accordance with the piping section of this specification and the drawings.
- D. E-CTFE, "HALAR" PIPING
 - 1. All plastic pipe and fittings if used, shall be compatible with 93%-98% sulfuric acid and be made of E-CTFE (Halar) resin.
 - 2. E-CTFE Pipe and Fittings shall be based on a Standard Dimensional Ratio (SDR) of 21, 1" through 4" (20-110mm). Pipe and fittings shall be from the Ultra Proline Piping Systems as supplied by Asahi/America, Inc. or equal. Pressure rating based on water conveyance for pipe and fittings shall be 150 psi (10 bar) for sizes up to 1 1/2" (50mm) and 120 psi (8.3 bar) for sizes 2" (63mm) and above.
 - 3. Pipe Restraint – All pipe restraint in buried systems are accomplished using the Dogbone fitting. All pipe hung aboveground will be restrained using a restraint style Dogbone fitting with locking shoulder in combination with an approved hanger.
 - 4. All Halar (E-CTFE) Systems require all personnel to be trained by factory Field Technicians only, without variation. Any systems or welds conducted by personnel not trained by Asahi/America Factory Field Technicians shall not be accepted.
- E. PVDF (Polyvinylidene Fluoride)
 - 1. Pipe made from PVDF shall be thermoplastic material that is assembled using heat fusion welding, have high impact and abrasion resistance, be UV resistant, and be compatible with 93% sulfuric acid.

2.2 HALAR/PVDF VALVES

- A. All 1-inch valves shall be flanged true union ball valves, fabricated from PVDF or Halar. Seats shall be Teflon, and seals shall be Viton. Connections shall be flanged. Valves shall be as manufactured by Chemtrol or Asahi America
- B. PVDF True Union Ball Valves: 2" Tru-union ball valves are to be Kynar PVDF Tru-Bloc true union ball valves with Viton seal and seat, and PVDF body stem, and ball. 2" true union ball valves are to be Kynar PVDF Tru-Bloc Model C as manufactured by Chemtrol or Type 21 as manufactured by Asahi America.
- C. PVDF Diaphragm Valves: Valve body shall be PVDF with durable corrosion resistant PPG bonnet, and PVDF diaphragm. Diaphragm valves are to be Kynar True Union Diaphragm PVDF.
- D. Halar Diaphragm Valves: diaphragm valves shall have flanged connections. The valve body shall be fabricated from ECTFE, with a Teflon diaphragm and have stem position indicators. The diaphragm shall be polytetrafluoroethylene (PTFE) backed EPDM. The valves shall be as manufactured by Asahi, or equal.

2.3 FEEDWATER ACIDIFICATION VALVE

- A. Refer to control valve specification Section 11280

2.4 SULFURIC ACID METERING PUMPS

- A. The Contractor shall provide two sulfuric acid metering pumps each to provide 100% of the total requirement of 93% - 98% sulfuric acid to acidify the feed water at 4 RO train operation. The pumps will be located in the acid room and drawing suction from a common acid header. The pumps shall be selected to provide the required volume of 93% - 98% sulfuric acid for 4

train operation at 80% of full stroke. Each metering pump shall have capacity of 88 gph at maximum discharge pressure of 100 psi.

B. Pump Specification

1. The acid metering pumps shall be positive displacement, mechanically actuated, diaphragm type pumps with heavy duty cast aluminum body, as manufactured by Prominent Fluid Controls, Pittsburgh, PA, SIGMA series. Maximum stroke frequency shall be 180 strokes/min. The following materials shall be provided:
 - a. Fluid head, seals -PVDF
 - b. Diaphragm -PTFE faced EPDM
 - c. Check Valves -PVDF single ball check
 2. The pumps shall be capable of adjusting the stroke rate directly proportional to a 4-20 mA input signal. The pump shall have a NEMA 4 rated enclosure with manual / automatic selector, mechanical stroke length indicator, and spring return switch for manual stroke length adjustment. The motor shall be TEFC, single phase with thermal overload protection.
 3. The pumps shall have an internal AC inverter integral to the control and function of the pump's motor.
 4. Pump shall be Sigma/3 Motor Diaphragm Metering Pumps by Prominent or approved equal.
- C. The two metering pumps shall be provided with a pre-engineered, fully enclosed, free-standing metering pump skid and frame complete with calibration column, pressure relief valves, pulsation dampener, backpressure valve, isolation valves, and all other components necessary to provide a fully functional system.**
1. Specifications for the equipment is described within this specification.
 2. Refer to process and instrumentation diagrams for further information on required components.

2.5 CALIBRATION COLUMN

- A. Clear armored glass calibration tubes with an acrylic outer shield shall be provided and installed between the acid day tank and the metering pump suction manifolds, as shown on the drawings. The calibration tubes shall be graduated with engraved mL calibrations, and shall be valved so that the tubes may be filled by gravity flow from the day tank, isolated, and used as a suction chamber for the pumps. The calibration tubes will have stainless steel NPT connections and be firmly mounted to an FRP support anchored to the sulfuric acid pump bench. The devices shall be manufactured by Milton Roy, or equal, and shall have a minimum capacity of 4,000 mL of acid. Calibration column overflow shall be piped to within 2" of bottom of pre-engineered pump skid.**

2.6 TUBING

- A. Tubing used to connect the pump ports to the suction and discharge headers shall be manufactured from Teflon. Pipe, fittings, dampeners, pressure relief and pressure sustaining valves shall be manufactured from ECTFE, "HALAR". All fittings material must be compatible with 93% - 98% sulfuric acid. All gaskets associated with the acid system shall be Viton. S.S. piping to be SDR.**

2.7 PULSATION DAMPENER

- A. A pulsation dampener shall be provided and installed on the pump discharge header, to provide a 5% to 10% dampening. The dampener shall be a nitrogen-charged diaphragm type device, fabricated from ECTFE. The dampener shall be equipped with a nitrogen gas fill valve, and pressure gauge. The gas capacity of the dampener shall be selected to match the displaced volume per pump stroke.

2.8 ACID INJECTOR

- A. The acid injector shall be located as shown on the drawings. The injectors shall be inserted into a threaded boss incorporated into the body of the pipe. The injectors shall be located on the pipe and shall project into the pipe a minimum of 6 inches. The injectors shall be fabricated from a single piece of Teflon and shall have outlet jets located at the end of the injector.

2.9 PRESSURE SUSTAINING VALVE

- A. See plans for injection point location
- B. A back pressure valve shall be provided, mounted immediately before the injection location. The back pressure valve body shall be fabricated from PVDF, with a Teflon diaphragm seal. The valve shall be manufactured by Prominent, Milton Roy, Pulsafeeder, or equal.

2.10 PRESSURE RELIEF VALVES

- A. A 3-port pressure relief valve shall be provided after the pump's discharge isolation valve and before the pressure gauge. The pressure relief valve body shall be fabricated from PVDF, Teflon diaphragm seal and an adjustable relief pressure setting. The valve shall be manufactured by Prominent, Pulsafeeder, or equal.

PART 3 - EXECUTION

3.1 TESTING

- A. All piping, fittings, valves shall be visual leak tested where pressure testing cannot occur. All piping to be completely purged (nitrogen gas purging recommended) from any foreign material prior to filling and testing.
- B. Any defects are to be repaired by the Contractor at no additional cost to the Owner. In the event that field repairs are inadequate, the Contractor shall replace the defective tank/fitting as approved by the Engineer.
- C. Filling of the new system with acid indicates acceptance of system. If leaks develop after filling, contractor is fully responsible for any costs associated with removing spent acid and disposing of properly.
- D. If leaks develop after filling the tanks and piping with sulfuric acid, the Contractor is fully responsible for any costs associated with removing spent acid and disposing of properly. The Contractor will also be responsible for all repairs necessary, as directed by the Owner and/or the Engineer, to restore the system to "new" condition.

3.2 SPARE PARTS

- A. Proposed metering pump wetted parts:

1. Complete diaphragm/plunger wetted parts assembly including dual check valve assembly

- END OF SECTION -

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 11506
MEMBRANE CLEANING SYSTEM

PART 1 - GENERAL

1.1 SCOPE

- A. This section describes the membrane cleaning system, consisting of tanks, pump, mixer, heating coil, cartridge filter vessel, piping, valves, instrumentation and control.

1.2 RELATED REQUIREMENTS SPECIFIED ELSEWHERE

- A. Division 1 - General Requirements
- B. Section 11930 - Pumps – General
- C. Section 11932 – FRP Horizontal End Suction Pumps
- D. Section 13441 - Instrumentation Components
- E. Section 16 – Electrical

1.3 QUALITY ASSURANCE

- A. All components must be products of qualified manufacturers regularly engaged in the manufacture of these components.
- B. All components must comply with the applicable codes and standards, as described elsewhere in this specification.
- C. All components shall be made available for inspection and standards, as described elsewhere in this specification.

1.4 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. ASTM C581 - Chemical Resistance of Thermosetting Resins Used in Glass Fiber Reinforced Structures
- B. ASTM C582 – Reinforced Plastic Laminates for Self-supporting Structures in a Chemical Environment
- C. ASTM D3299 – Filament Wound Reinforced Polyester Chemical-Resistant Tanks
- D. ASTM D4097 – Contact Molded Glass Fiber Reinforced Thermoset Resin Chemical-Resistant Tanks
- E. Shall be designed and manufactured in accordance with the standards set forth in ASME RTP-1

1.5 SUBMITTALS

- A. Shop Drawings
 - 1. Manufacturers literature, illustrations, specifications and engineering data including:
 - a. Dimensions
 - b. Materials
 - c. Weight
 - d. Motor Information
 - e. Performance Curves
 - 2. Assembly drawings, showing pipe and conduit routing and support detail, equipment locations, etc.

3. Submit on assembly layout with approximate dimensions for CIP system. The proposed layout for the CIP system is supported via structural supports located in the chemical rooms below. The shop drawing submittal shall indicate approximate locations to ensure structural support system provided will function as intended.
- B. Operation and Maintenance data, including maintenance requirements, and spare parts list.
- C. The Contractor shall be responsible for coordinating all interfaces with related mechanical, structural, electrical and instrumentation and control work. The Contractor shall be responsible for providing all accessory equipment and all work associated with installation of the equipment.
- D. Contractor shall submit manufacturer's catalog information, descriptive literature, specifications, and materials of construction and chemical resistance. Include complete resin system information.
- E. Contractor shall submit detailed fabrication drawings including design calculations for structural design of tanks, tank support legs and tank tie-down and anchor system, signed and sealed by a registered professional civil or structural engineer. Design calculations shall be submitted with the shop drawing. Submission of design calculations is intended to indicate that the equipment was designed by a qualified individual. Design calculations will not be reviewed by the Engineer for completeness or correctness. The design of the tanks shall be the responsibility of the manufacturer.
- F. Certification: Prior to installation, the Contractor shall furnish an Affidavit of Compliance certified by the tank manufacturer that the tanks furnished under this Contract comply with all applicable provisions of this specification. No tank will be accepted for use in the Work on this project until the affidavit has been submitted and accepted in accordance with Section 01300 – Submittals.
- G. Contractor shall submit fabricator's detailed requirements for tank foundations and recommended bolt torques for all bolted FRP connections

1.6 QUALITY ASSURANCE

- A. The supply and installation of the cleaning system shall be the responsibility of the Contractor. Installation includes all equipment, piping, valves, electrical and instrumentation unless otherwise noted.
- B. Tank Manufacturer – The materials covered by these specifications are intended to be standard equipment of proven reliability and as manufactured by reputable manufacturers having experience in the production of such equipment. The equipment furnished shall be designed, constructed and installed in accordance with the best practices and methods and shall operate satisfactorily when installed as shown on the drawings and operated per manufacturer's recommendations. The following tank fabricators are approved for use:
 1. Xerxes-Heil
 2. Justin Tanks, LLC
 3. Ershigs, Inc.

PART 2 - PRODUCTS

2.1 CLEANING SOLUTION TANKS

- A. Two (2) 1,500 gallon cleaning solution tanks of identical size shall be provided and installed as shown. The tank size shall provide for sectional cleaning of each train, as required. The sizing of each tank shall be based on the volume of cleaning solution required to fill the cleaning system, the pressure tubes to be cleaned, and maintain a sufficient level in the tank during circulation to ensure a flooded suction for the cleaning pump. Each tank shall be of the diameter and height called for on the construction drawings. Each tank shall comply with the following requirements.
 - 1. Construction
 - a. The tank shall be "contact molded", or filament wound FRP construction as per ASTM D-3299 (Filament-Wound Glass-Fiber-Reinforced Thermoset Resin Chemical-Resistant Tanks) or ASTM D-4097-88 (Standard Specification for Contact-Molded Glass-Fiber-Reinforced Thermoset Resin Chemical-Resistant Tanks). The finished laminate shall be a Type I, Grade 1 construction, using a single generic type of thermoset vinylester resin throughout and shall not contain colorants, dyes, fillers, or pigments unless otherwise specified.
 - b. The inner surface layer of the tank shall consist of a resin rich layer reinforced with surfacing mat and having a total finished thickness of not less than 120 mils.
 - c. Each tank shall be insulated with 2-inches of polyurethane foam and contain 120 mils of fiberglass coating
 - d. The top of the tank shall be a removable lid with a hinged cover. The tank wall shall terminate at the top with an outward projecting stiffening flange to which the top shall be bolted. A suitable elastomeric gasket and 316 stainless steel bolts with washers shall be provided for attachment of the top. The hinge shall be 316 ss.
 - 2. Connections
 - a. All connections shall be flanged in accordance with ANSI B16.5 Class 150 and provided with flanged gaskets. Flanged connections, nozzles and openings shall be FRP gusseted and flat face
 - 3. Nozzles
 - a. All nozzles shall project into the tank a minimum of 2" or one half the diameter of the nozzle, whichever is greater.
 - 4. Fill Lines
 - a. Tank fill piping shall be as shown on the drawings. All pipe supports, hardware shall be provided as necessary. Vertical piping into the tanks shall be supported every 5 feet and shall be parallel to the tank wall and not less than 6-inches from the tank wall.
 - 5. Pump Suctions
 - a. The bottom outlet to the cleaning pump shall contain a siphon leg.
 - 6. Lifting Lugs
 - a. Suitable lifting lugs shall be provided as required for handling. The lugs shall be constructed of 316 stainless steel. Lifting lugs shall be capable of withstanding weight of an empty tank with a safety factor of 3 to 1.
 - 7. Hold-down Lugs

- a. Suitable hold-down lugs shall be provided for anchoring the tank to the concrete floor or base. They should be placed on the tank in such a way that they do not protrude below the bottom surface of the tank.
- 8. Accessories
 - a. Accessories shall be provided on the tank as indicated on the drawings and as specified herein.
- 9. Hinged Cover
 - a. The tanks shall be provided with sections of the top hinged for access to the interior. The tank top shall be partitioned and hinged so that no section is heavier than 10 lbs. for lifting by 1 person. The inactive sections shall be bolted to the tank shell. The active sections shall be hinged from the inactive sections with a piano type hinge, shall be provided with a lifting handle, and shall be suitably supported on the tank shell when closed. All exposed metal parts shall be 316 stainless steel.
- 10. Flanged Nozzles
 - a. Nozzles for connecting piping and accessories shall be provided on the tank at the locations required by the drawings and as described herein.
 - b. Each nozzle shall be flanged, with flange diameter and drilling conforming to ANSI Class 150. Nozzles shall extend at least 4 inches from outside face of tank to back face of flange.
 - c. Flanged nozzles shall be fabricated from and on the same material as the tank and shall be gusseted to the tank using specification of conical type gussets in accordance with the governing specification.

Tank Wall Fittings

6" FL CIP Pump Supply
4" FL Overflow/tank drain
6" FL Heater Element
2-1" NPT Level

Cover Fittings

3" NPT Permeate Fill
6" FL Return
4" FL Tank Level Monitoring
18" Mixer opening

2.2 CLEANING TANK WATER HEATING COIL

- A. A heating coil with a heat load rating of 220-250 kW shall be supplied for the main cleaning room tank. The coil elements shall be made of 316 ss, shall be brazed to flange and shall be inserted through a nozzle seated 5 feet from the bottom of the tank. The coil shall be single phase, with standard terminal enclosures. The tank shall be oriented so as to allow plant operators to remove or reinsert the coil while standing on the mezzanine.
- B. The heating coil shall be angled such that the end of the coil (heated end) sits on the internal fiberglass bottom coil support bracket, which shall be built as part of the tank. A sufficiently long cold section for the coil shall be included so as to prevent direct contact between the heated section of the coil and the tank. In sizing this, the manufacturer needs to consider the coil section seated in the nozzle, as well as the cold section outside the nozzle. A separation distance of 10" (or as suggested by tank vendor) between the tank wall(s) and the heated section of the coil should be sufficient. The contractor shall confirm this distance with the tank vendor.
- C. As part of the heating system, a temperature control mechanism shall be included. The control mechanism shall allow a temperature reading minimum of no more than 15° C (approximately 59° F) and a reading maximum of no less than 60° C (140° F). The temperature control mechanism shall be wired to the heating coil and will allow tight temperature control, + 1° C of desired temperature.

- D. All exposed (wetted) parts must be able to resist pH ranges of 2.5-11, and temperature ranges of 20° C (68° F) to 55° C (130° F).

2.3 CLEANING TANK MIXER

- A. A cleaning tank mixer shall be supplied for the main cleaning room tank. The mixer shall have the following characteristics.
 - 1. The agitator will be driven by a ¾ horsepower, 1750 RPM, TEFC motor.
 - 2. 60 Hz, single phase, 115/230 Volts.
 - 3. The gear reducer shall be a single helical gear reducer with the proper gear ratio to produce a final output of 400 RPM.
 - 4. The agitator shall be mounted via a heavy-duty clamp onto a fixed metal structure provided by tank vendor. The clamp and housing will have a ball and socket attachment to permit rotation of mixer.
 - 5. The shaft shall be constructed of 316 ss, 1¼" diameter (or as specified by vendor) and be of sufficient length to provide adequate exposure to cleaning solution.
- B. All parts to cleaning solution (wetted parts) must be able to resist pH ranges of 2.5-11, and temperature ranges of 20° C (68° F) to 55° C (130° F).
- C. The mixer shall be inserted through cut out area on active half of tank cover and shall be angled such that there is no contact with heating coil. When considering shaft length, liquid level during cleaning (there will be a level drop) needs to be considered.

2.4 CLEANING PUMP

- A. Specified in Section 11932 – FRP Horizontal End Suction Pump

2.5 CARTRIDGE FILTER VESSEL

- A. The membrane clean-in-place system shall be furnished with a horizontally configured cartridge filter vessel, complete with filter cartridges and all specified or required accessories and appurtenances.
- B. Materials of Construction
 - 1. Vessel (all wetted parts): 316L Stainless steel
 - 2. Base support, legs: 316L Stainless steel
 - 3. Tie rods, bolts: 316L stainless steel (stress relieved and passivated)
 - 4. Nuts, washers: 316L stainless steel (stress relieved and passivated)
 - 5. Gasket: EPDM
- C. Vessel Design
 - 1. Number of units: 1
 - 2. Design flow rate: 810 gpm
 - 3. Maximum flow rate: 1,040 gpm
 - 4. Design flow per 10" length: 3.89 gpm/10" length
 - 5. Max. flow per 10" length: 5 gpm/10" length
 - 6. Mounting: Horizontal, pedestal supported
 - 7. Inlet Nozzle, ANSI 150#: 6" Flanged
 - 8. Outlet Nozzle, ANSI 150# 6" Flanged
 - 9. Design pressure: 150 psi
 - 10. Test pressure: 180 psi

11. Temperature, deg. F: 75
12. Cartridge length: 40 inches
13. Pressure drop, clean: 3 psi
14. Filter-material: Polypropylene
15. Filter-Core: Polypropylene
16. Filter-rating: 5-micron
- D. Design and Fabrication
 1. Vessel shall be 150 psi rated, have a heavy-duty lifting device/davit for easy removal and placement of sealing plate, 2" threaded drain ports (dirty and clean), air vent, ½" FNPT gauge connections, pedestal legs to allow support to trench supports. Filter vessel to be designed to accept different manufactured cartridge filters without modification of design.
 2. Cleaning vessel shall be Model MP52H-4-8FK1 as manufactured by Commercial/Parker Hannifin.
 3. Filter elements shall be one-piece units, rated for 5-micron filtration, as manufactured by Parker Hannifin. Elements supplied for operational testing and start-up shall be single open end, double o-ring type 5-micron size supplied by the vessel manufacturer.
- E. Spare parts:
 1. Furnish two (2) head plate gaskets as spares

2.6 CLEANING HEADERS

- A. The cleaning system shall include a cleaning header on each end of the train that enables the hard piped 6" feed and return piping to be through the removal of grooved pipe couplings and universal 6" sch. 80 PVC pipe and 90 degree bend to connect to the cleaning supply and return piping. The permeate return shall be connected to the 6" cleaning system return as depicted on the plans. The headers shall be strategically placed so that the cleaning of each tree is possible without reconfiguring the flexible piping on each end. Also, the valves shall enable such that each tree can be isolated without draining the cleaning fluid from the trees. The cleaning header shall be fabricated from PVC Sch. 80, with PVC, lever handle, butterfly valves, grooved end couplings and 150 psi flex piping. Complete with all necessary grooved end couplings with a spare for each size provided.
- B. Contractor shall supply one (1) temporary piping spool to connect from total NF permeate to final NF concentrate via cleaning connection grooved end couplings.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Cartridge Filter Vessel
 1. Install in accordance with manufacturer's recommendations. Special care must be taken to assure no foreign material enters the downstream piping system.
 2. Provide two (2) complete sets of filter elements for the cleaning system for system startup and acceptable performance of system.
 3. Confirm upstream piping has been thoroughly flushed and cleaned prior to installation of filter elements.
 4. Record initial pressure loss through the filters on initial startup; report to operator.

5. spare elements only after permanent storage space and shelving is available. Store elements in original shipping containers and protect from damage by crushing, water, and other hazards.
- B. Cleaning Tank
 1. The bases for the tanks shall be constructed as an integral part of the tank. The tanks shall be installed by the Contractor in accordance with the fabricator's recommendation, the requirements of the applicable governing standard, and to the satisfaction of the Engineer, and made ready for the installation of piping and other appurtenances as indicated on the drawings and specified under other sections. Grouting under the hold down lugs, if recommended by the tank fabricator, shall be done with non-shrinking grout as specified in the grouting section.
 2. After completion of installation, the tanks shall be filled with water to the overflow elevation and allowed to stand full for a period of not less than 48 hours. During testing, connections may be plugged by the installation of temporary blind flanges or threaded plugs, as appropriate, on the outside of the tanks but shall not be blocked or plugged on the inside. All leaks or indications of leaks shall be repaired by the Contractor and made completely watertight. A leaking tank, upon repair, shall be retested to the satisfaction of the Engineer.
 3. Water required for testing will be provided as stipulated under the temporary facilities section. Water used for testing shall be wasted and disposed of as directed by the Engineer.
 4. When installation has been completed and all connections have been made, all tank surfaces, interior and exterior, shall be thoroughly cleaned as recommended by the fabricator and to the satisfaction of the Engineer. Abrasive cleaning agents shall not be used.
- C. Cleaning Pump Unit
 1. The pumping unit shall be leveled, plumbed, and placed into position to fit connecting piping and aligned prior to operating. Installation procedures shall be as recommended by the pump manufacturer, the Hydraulic Institute Standards, and as required herein. Grouting shall be as specified in the grouting section.
 2. Special care shall be taken to maintain alignment of pumping unit components. No stresses shall be transmitted to the pipe flanges. After final alignment and bolting, pump connections shall be tested for applied piping stresses by loosening the flange bolts. If any movement or opening of the joints is observed, piping shall be adjusted to proper fit.
 3. Refer to Specification section 11932 for more information.
- D. Control Station
 1. The cleaning system will be controlled from a local control station. The cleaning pump will be started manually by push button. The tank low level switch will be interlocked with the pump starter, to shut off the pump on low level, and display a red indicator light on the control station. Cleaning fluid pH and temperature shall also be locally displayed. The cleaning control station shall be located as shown on the Drawing.
- E. Drawing and Data
 1. Complete fabrication drawings, details and specifications covering the cleaning system shall be submitted as required by these specifications.
 2. The data shall contain full information required to properly evaluate compliance with specifications and drawings.

3.2 TESTING

- A. Upon completion of the installation, the cleaning system shall be tested by the Contractor and approved by the Engineer.
- B. The piping system shall be thoroughly flushed to remove dirt, grit, PVC shavings, etc., and hydrostatically tested in accordance with the appropriate section of these specifications.
- C. Prior to loading membranes, the cleaning system operation shall be demonstrated by the System Supplier and approved by the Engineer. The train section to be used for this purpose shall be equipped with orifice end plugs in the pressure tubes to simulate the membranes' resistance to flow, for both permeate and concentrate outlets or an alternate form of testing using temporary piping which is acceptable to the Engineer. The cleaning system shall be operated, using clean water without chlorine or any other chemicals incompatible with membrane material, to demonstrate that the flow and head requirements have been met.

- END OF SECTION -

SECTION 11507
CAUSTIC EQUIPMENT

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. This section provides for the supply, installation and placing in service 4,000 gallon bulk storage tank and associated piping, valves, fittings, and appurtenances. The components shall be compatible with 50% concentration, by weight, sodium hydroxide.

1.2 RELATED SECTIONS

- A. Section 01000 – Summary of Work
- B. Section 02670 – Flushing, Testing and Disinfection
- C. Section 09900 - Painting

1.3 SUBMITTALS

- A. Submit to the ENGINEER, shop drawings, details of construction and erection for tank, piping, and valves as follows:
 - 1. Dimensions of tank, fittings and attachments, with bolt and gasket material.
 - 2. Wall thickness calculations per ASTM D 1998-97 using 600-psi design hoop stress at 100 degrees F.
 - 3. Statement from the Tank manufacturer that the tank has been fabricated in accordance with ASME Boiler and Pressure vessel Code Section VIII-1-2017
 - a. Include design calculations signed and sealed by an engineer licensed in the State of Florida.
 - 4. Locations of fittings and attachments and size of manway openings.
 - 5. Resin used and a complete manufacturer specification of the resin used.
 - 6. Weight of tanks.
 - 7. Statement from tank manufacturer that fabrication and structural design is in accordance with these Specifications.
 - a. Include design calculations for structural design of tank walls, tank support legs, and tank tie-down and anchor system, signed and sealed by an engineer licensed in the State of Florida.
 - 8. Statement from coating manufacturer that proposed internal tank coating is suitable to be submerged in 25-50% strength sodium hydroxide.
 - 9. Certificate of Compliance from the tank manufacturer stating:
 - a. All fittings, heat tracing, insulation, etc. have been installed by the tank manufacturer.
 - b. Hydrostatic tests have been performed by the manufacturer and all fittings were installed prior to the tests.
 - 10. Samples of a representative tank wall.
 - 11. Details on packaging.
 - 12. Instructions for handling, storage and installation of tanks.
 - 13. Statement that materials and resin used is suitable for intended service.
- B. Bill of Materials.

1. Operation and Maintenance data, including test reports, maintenance and schedules.

1.4 QUALITY ASSURANCE & WARRANTY

- A. The tank manufacturer shall be fully responsible for the structural design, integrity, water tightness of the tanks including anchorage and connections. The tank manufacturer shall provide materials and workmanship warranty for a period no less than two (2) years after completion of the project. The warranty shall be submitted with the shop drawings.
- B. The tank manufacturer shall replace defective tanks within the warranty period at no cost to the Owner.

1.5 ACCEPTABLE TANK MANUFACTURERS

- A. The following manufacturers are approved for use:
 1. Dixie Southern, Inc.
 2. Modern Welding Company of Florida
 3. Tampa Tank Incorporated
 4. Miami Filter, Inc.

PART 2 - PRODUCTS

2.1 BULK STORAGE TANK

- A. The bulk caustic storage tank shall be a nominal 4,000 gallon horizontal storage tank of nominal dimensions as shown on the drawings, for the storage of 25-50% sodium hydroxide by weight sized to fit within the bulk containment area. The tank shall be constructed of ¼" minimum ASTM A-285, Grade C Steel, with the following fittings as a minimum:
 1. Fill – 2-inch 150# flange (FL) located top of tank w/ drop pipe
 2. Supply to feed pumps – 2-inch 150# FL located at bottom of dished end, flush with bottom of tank
 3. Day tank overflow – 2-inch 150# FL located on top of dished end, flush with top of tank
 4. Drain – 2-inch 150# FL located at bottom of tank
 5. Level Transmitter – 4-inch 150# FL (top of tank) for future installation. Install 4" blind flange
 6. Vent – 2-inch 150# FL
 7. Overflow – 3-inch 150# FL located on top of tank
 8. Liquid Level Sight Glass – (2) 1-inch 150# FL located on dished end of tank, top and bottom
 9. Manhole/access - (1) 24-inch opening access
 10. Lifting eyes - as required
- B. Tank exterior to be coated in accordance with Section 09900, green urethane on exposed carbon steel.
- C. The tank interior shall be coated to be suitable for immersion in 25-50% sodium hydroxide and have high temperature resistance. Surface preparation shall meet SSPC-SP10 near white finish and be in accordance with manufacturers' requirements. Coating shall be a minimum 12 mil DFT, and be ChemLINE High Solids, as manufactured by Advanced Polymer Coatings, Avon, OH, or equal.
 1. DFT from surface prep is not included in the minimum 12 mil DFT for the coating on the inside of the tank

- D. Provide fittings for vent, supply/drain, manway, level sensor, overflow, day tank overflow, lifting lugs and as indicated on the construction drawings.
- E. Tank shall be sized to provide 4,000 gallons of available volume with adequate freeboard to achieve minimum blanking distance for future level transducer. Refer to the construction drawings for clarification.

2.2 HEAT TRACING AND INSULATION

- A. Heat tracing system shall be of self-regulating type. The self-regulating heating cable shall vary its power output relative to the temperature of the surface of the pipe/tank. The cable shall be designed such that it can be crossed over itself and cut to length in the field. Cable shall be rated for a maximum maintain temperature of 150 degrees F and a power density of 8 watts per foot.
- B. Tank exterior shall be insulated with 2" of closed cell sprayed-in place urethane insulation with Gaco Western white acrylic finish.
- C. The proposed bulk storage tank shall be heat traced and insulated.
 - 1. Bulk storage tank shall have polyurethane spray foam insulation.
- D. All new, exterior, aboveground supply piping from the bulk storage tank located outside shall be heat traced and insulated.
 - 1. Pipe insulation and jacketing shall be molded type pipe covering made of fibrous glass. Joints between sections of insulation shall be covered with woven glass fiber type. Insulation shall be covered with smooth PVC jacketing. Piping insulation and PVC jacket shall be as manufactured by Johns Manville, or approved equivalent.
 - 2. Valves and flanges shall not be insulated.
- E. Electrical heat tracing on tank and piping as shown on drawings to be designed to maintain 50% sodium hydroxide @ 70 degrees, no heat up, Class I, Div 2 application, Thermostat, 240 Volt, Minimum ambient temp 20° F,
- F. Heating circuit shall be operated by thermostat controls. Ambient temperature sensing thermostats shall be provided
 - 1. Thermostats shall be UL listed, heavy duty, industrial ambient type housed in a watertight NEMA 4X stainless steel enclosure. Thermostat shall be provided with independently adjustable dual switches for control and low temperature alarm.
 - 2. Temperature switch shall be Type 55A by United Electric or approved equal.
 - 3. Conduit shall be:
 - a. Rigid conduit shall be schedule 80 PVC
 - b. Non-rigid, nonmetallic, flexible conduit shall have a PVC core with fused flexible PVC jacket. Conduit shall be UL 1660 listed for:
 - 1) Dry conditions: 80 degrees C insulated conductors
 - 2) Wet conditions: 60 degrees C insulated conductors
 - 3) Conduit shall be Carflex or X-flex by Carlon or approved equal.

2.3 FILL PIPING

- A. Fill valve for the caustic tank shall be flanged, 2-inch, Alloy 20 ball valve with Teflon seats and seals.
- B. Fill piping connection into the tank shall extend from the flanged connection at the top of the tank to within 12-inches of the bottom of the tank. The pipe shall have a 45-degree mitered end.
- C. Fill piping shall be Sch. 80 CPVC, per section 2.7 within this specification.

2.4 FLANGED NOZZLES

- A. Flanged nozzles shall be designed for a minimum torque of 2,000 ft-pounds and a minimum bending moment of 1,500 pounds.
- B. Nozzles shall be flanged
- C. Flange dimensions shall conform to ANSI B16.5, class 150

2.5 SIGHT INDICATOR

- A. Tank shall be equipped with visual liquid level indicator. Housings and floats shall be constructed of type 316 stainless steel.
- B. Length of level indicators shall be in accordance with the contract documents and shall be coordinated by the tank manufacturer.
- C. Visual liquid level indication shall be mounted such that they are readily visible from outside of the bulk chemical containment area.
- D. Top and bottom connections to tank shall be provided with flanged or solvent welded CPVC ball valves to allow for isolation of tank from visual sight indicator.
- E. Sight indicator shall be SureSite model by Gems Sensors or approved equivalent.

2.6 SUPPORT SADDLES AND ANCHORAGE

- A. The proposed tank shall be installed within cast-in-place reinforced concrete support saddles with 316 stainless steel hold down straps. Neoprene shall be installed between the tank and all other surfaces (concrete, straps, etc.).
- B. Should contractor desire, steel support saddles may be used, but must be installed on concrete support pedestals to match elevation of new bulk caustic tank with existing.
 - 1. Support saddles shall include two (2) Grade A36 carbon steel support saddles complete with base plate, stiffener plates, bands, and webs to sufficiently support the tank with full load of 25-50% strength sodium hydroxide. The tank manufacturer shall include support saddle information within the tank shop drawing for approval.
 - 2. Spacing of the support saddles for the proposed tank shall match spacing of the support saddles for the existing caustic bulk storage tank.
- C. Anchor bolts, nuts, washers, etc. shall be type 316 stainless steel.
 - 1. Bolts shall conform to ASTM A 193, Grade B8M
 - 2. Nuts shall conform to ASTM B 194, Grade 8M
 - 3. Provide washer for each nut of same material (316 stainless steel)

2.7 CPVC PIPING AND VALVES

- A. Piping and valves for caustic system shall be schedule 80 CPVC.
- B. Schedule 80 CPVC Pipe:
 - 1. Rigid CPVC (chlorinated polyvinyl chloride) compound used in the manufacture of schedule 80 pipe shall be Type IV, grade 1 as identified in ASTM D1784. The pipe shall be NSF rated for potable water.
 - 2. CPVC schedule 80 shall meet the requirements of ASTM standard D1785 for physical dimensions and tolerances.
 - 3. The marking on CPVC Schedule 80 pipe shall meet the requirements of ASTM D1785 and state the material designation code, nominal pipe size, schedule of pipe, pressure rating in psi for

water at 200-degrees F., the ASTM designation number D1785 and the NSF seal for potable water.

4. Fittings used shall be CPVC Schedule 80 and solvent welded in accordance with ASTM D1785.
 5. CPVC Flanges shall be schedule 80 Vanstone style. Flanged gaskets shall be manufactured from EPDM. All hardware, bolts, washers, nuts, and etc. shall be Hastelloy. Provide washers for each nut, washer material shall be of same material as the nut.
 6. Small Diameter CPVC Pipe: CPVC pipe smaller than 4-inch shall be schedule 80 CPVC plastic pipe with solvent weld fittings in accordance with ASTM F-441.
 7. Solvent cement shall be EP42 Gray Industrial Cement.
 8. Threaded fittings are not permitted for the caustic system.
- C. Ball valves
1. Ball valves shall be Sch. 80 CPVC socket construction with PTFE backed with EPDM seats and EPDM seals. The ball valves shall have a 230psi pressure rating. Ball valves to be manufactured by ASAHI/AMERICA or approved equal.
- D. Ball Check Valves
1. Ball check valve shall be installed on the desiccant air supply piping to the proposed caustic tank. The ball check valve shall CPVC and be Chemtrol BC series, single union

2.8 TANK SIGNAGE

- A. The bulk storage tank shall be provided with two (2) NFPA placards to identify chemical that is being stored.

2.9 ACCESS LADDER

- A. The bulk caustic tank shall be equipped with 316 stainless steel access ladder on side of tank to provide access to the connections and manway located on the top of the tank.
- B. The ladder design shall meet all applicable regulatory requirements

PART 3 - EXECUTION

3.1 TESTING

- A. Tank shall be thoroughly flushed out of all debris at least twice, or hand swabbed before placing into service in order to ensure tank is clean.
- B. All piping, fittings, valves shall be visual leak tested where pressure testing cannot occur. All piping to be completely purged (nitrogen gas purging recommended) from any foreign material prior to filling and testing.
- C. Refer to Specification 02670 for pressure testing and flushing requirements.
- D. Filling of the new system with caustic indicates acceptance of system. If leaks develop after filling, contractor is fully responsible for any costs associated with removing spent caustic and disposing of properly.
- E. The Owner will provide chemical for the initial caustic tank fill. Contractor shall coordinate fill delivery schedule with the Owner.

- END OF SECTION -

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 11508
SCALE INHIBITOR FEED EQUIPMENT

PART 1 - GENERAL

1.1 SCOPE

- A. This section provides for the piping and injection assembly replacement for the existing scale inhibitor feed system. The equipment shall consist of piping, valves, and injection assembly.

1.2 RELATED REQUIREMENTS SPECIFIED ELSEWHERE

- A. Section 10400 - Identifying Devices
- B. Section 13441 - Instrumentation Components
- C. Section 15100 - Piping and Valves
- D. Section 16050 - Basic Materials and Methods

1.3 QUALITY ASSURANCE

- A. All components must be products of qualified manufacturers regularly engaged in the manufacturer of these components.
- B. All components must comply with the applicable codes and standards, as described elsewhere in this specification.
- C. All components shall be made available for inspection at the manufacturer's facility by the Owner or his representative prior to shipment.

1.4 SUBMITTALS

- A. Shop Drawings
 - 1. Manufacturers literature, illustrations, specifications and engineering data including:
 - a. Dimensions
 - b. Materials
 - c. Weight

PART 2 - PRODUCTS

2.1 PIPE TUBE AND FITTINGS

- A. Scale inhibitor feed piping shall be SDR-11 HDPE rated for 150 psi and made of black polyethylene resin. Piping shall be Chem Proline by Asahi America or approved equal.
- B. All piping and pipe fittings shall be HDPE in the appropriate diameters, in accordance with the piping section of these specifications and the drawings.

2.2 VALVES

- A. All valves not listed below shall be true union ball valves, fabricated from PVC. Seats shall be Teflon, and seals shall be EPDM. Connections shall be solvent welded. Valves shall be as manufactured by Chemtrol-Nibco.
- B. Drain and inlet valves shall be diaphragm valves with flanged connections. Diaphragm to be EPDM and manufactured by Asahi, or equal.

2.3 PRESSURE SUSTAINING VALVE

- A. See the plans for injection point.
- B. A backpressure valve shall be provided, mounted immediately before the injection location.
- C. The backpressure valve body shall be fabricated from PVC, with a Teflon diaphragm seal.
- D. The valve shall be as manufactured by Prominent, Milton Roy, Pulsafeeder, or equal.

PART 3 - EXECUTION

3.1 TESTING, FILLING AND SUPPLY

- A. All piping, fittings, valves shall be visual leak tested where pressure testing cannot occur. All piping to be completely purged from any foreign material prior to filling and testing.
- B. Pressure testing of new piping shall be at 150 psig for 1-hour without any drop in pressure (less than 2%). Any leaks (visual or testing failure) shall be corrected at not cost to Owner.

- END OF SECTION -

SECTION 11930
PUMPS - GENERAL

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. The work covered by this section and the related sections consists of providing all labor, material, equipment and performing all construction required to install pumps and motors, including all accessories as specified and shown on the drawings.

1.2 RELATED REQUIREMENTS SPECIFIED ELSEWHERE

- A. Section 01300 - Submittals
- B. Section 01730 – Operation and Maintenance Manuals
- C. Section 02670 – Flushing and Testing
- D. Section 11931 – Horizontal End Suction Pumps
- E. Section 11932 – FRP Horizontal End Suction Pumps
- F. Section 11936 – Vertical Turbine Pumps
- G. Section 13080 – Vibration and Alignment

1.3 PUMP PERFORMANCE DATA

- A. Certified pump performance data (curves) are to be submitted to the Engineer for all pumps prior to pump delivery and installation, unless noted otherwise. Performance data must be the results of the actual pump assemblies with drivers before shipment. Also report amperage and voltage of each power leg, efficiency and horsepower.

1.4 QUALITY ASSURANCE

- A. Provide shop drawings in maintenance material in accordance with Section 01300.
- B. Provide operation and maintenance material and record drawings in accordance with Section 01730.
- C. Provide manufacturer's certification of correct installation after manufacturer's inspection.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

3.1 PUMPS

- A. Install all equipment in strict conformance with the manufacturer's specifications and industry standards. Perform all work in a workmanlike manner. Manufacturer's representative for pumps shall inspect installation for correctness and compliance with manufacturer's specifications.
- B. No piping connecting any of the equipment will be jacked, pried or forced into position in any way. All piping must mate perfectly with the equipment it is attaching prior to installation of flange bolts or other connecting devices.

- C. Store spare parts in strict accordance with manufacturer's recommendations. Notify the owner in writing of any special storage maintenance required and provide such maintenance until final acceptance of contract.
- D. Pump and piping installed shall be disinfected in accordance with Indian River County Utility requirements, and AWWA standards, and Section 02670 Pressure Testing and Disinfection prior to being placed in service.
- E. Field test pumps for conformance to specified operating conditions. Record initial flow, head, voltage and amperage for each power leg, ramp time to speed, full load speed. Adjust tolerances, if necessary and retest. Test pump and motor for amplitude and frequency of vibration. Measure noise (dBA) adjacent, at 10 ft., at 50- ft. Pump shall be tested at the shut-off pressure, the design point and other points as required by the Engineer. Tests shall be performed to the satisfaction of the Engineer and results included in the Operations and Maintenance Manual.

- END OF SECTION -

SECTION 11931
HORIZONTAL END SUCTION PUMPS (MOTORS ONLY)

PART 1 - GENERAL

1.1 SCOPE

- A. Furnish all labor, materials, equipment and incidentals required to replace four (4) of the five (5) existing feedwater pump 150-hp motors and shaft couplings as shown on the contract drawings.
- B. In general, feedwater pump motor replacement must be done during the respective phase of construction where the respective/dedicated NF train is taken out of service for replacement. No more than one feedwater pump may be removed from service at any a given time. Rehabilitation and successful startup testing shall be the basis of acceptance and shall be accepted by Engineer prior to subsequent phase of demolition and feedwater pump rehabilitation.
- C. These Specifications are intended to give a general description of what is required, but do not cover all details which will vary in accordance with the requirements of the equipment application. It is, however, intended to cover the furnishing, the shop testing, the delivery and complete installation and start up (including field testing) of all materials, equipment and appurtenances for the complete pumping unit as herein specified, whether specifically mentioned in these specifications or not.

1.2 RELATED REQUIREMENTS SPECIFIED ELSEWHERE

- A. Section 01300 - Submittals
- B. Section 11930 – Pumps - General
- C. Section 16690 – Electric Motors

1.3 PERFORMANCE DATA & CERTIFIED TEST RESULTS

- A. The new motors shall be furnished with certified test results. The motors shall be subjected to a complete factory test consisting of full load heat run, percent slip, running light current, locked rotor current, breakdown torque (calculated), starting torque, winding resistance, high potential, efficiencies at 100, 75 and 50 percent of full load, and bearing inspection. The Engineer/Owner reserves the right to witness these tests and shall be informed prior to tests to allow for travel time.

1.4 OPERATION

- A. The feedwater pumps elevate pressure of pre-treated raw water to the nanofiltration trains. The pumps will take suction from a manifold suction header and will discharge pre-treated raw water towards the respective dedicated NF train. Each pump will be equipped with inverter duty rated motors and variable frequency drives designed to fluctuate speed to maintain the permeate flow rate from the respective NF train that is in operation.

1.5 SUBMITTALS

- A. Provide submittals in accordance with Section 01300.
- B. Provide O & M manuals in accordance with Section 01730.

- C. Provide manufacturer's certification of correct installation after manufacturer's inspection and start up.

1.6 REFERENCES AND STANDARDS

- A. Electric motors shall conform to the latest standards of IEEE, ANSI, and NEMA except as otherwise specified herein

1.7 SPARE PARTS

- A. The following spare parts shall be furnished:
 - 1. One (1) complete spare 150-hp motor with all necessary appurtenances for the feedwater pumps
 - 2. Two motor couplings
- B. Spare parts shall be suitably packaged, labeled precisely as to the contents, and delivered to the Owner as directed.

PART 2 - PRODUCTS

2.1 GENERAL

- A. The equipment covered by these Specifications is intended to be standard pumping equipment of proven ability as manufactured by reputable manufacturers having at least five (5) years of experience in the production of such equipment. The equipment furnished shall be designed, constructed, and installed in accordance with the best practice and methods, and shall operate satisfactorily when installed as shown on the Drawings.
- B. All parts shall be so designed and proportioned as to have liberal strength and stiffness and to be especially adapted for the work to be done. Ample room and facilities shall be provided for inspection, repairs and adjustment.
- C. The Manufacturer shall be fully responsible for the design, arrangement, and operation of all connected rotating components of the assembled pumping unit to ensure that neither harmful nor damaging vibrations occur at any speed within the specified operating range. Design shall include all supporting sole plates and fabricated steel base plate for mounting the units.
- D. Pumps and motors shall be rigidly and accurately anchored into position, precisely leveled and aligned, so that the completed installation is free from stress or distortion. All necessary foundation bolts, plates, nuts and washers shall be furnished and installed by the Contractor and conform to the recommendations and instructions of the equipment Manufacturer. Anchor bolts, nuts, and washers shall be of Type 316 stainless steel. Grouting under bases after the equipment is set is included as work under this Section.
- E. Stainless steel nameplates giving the name of the Manufacturer, the rated capacity, head, speed, and any other pertinent data shall be attached to each pump.
- F. Stainless steel nameplates giving the name of the Manufacturer, serial number, model number, horsepower, speed, voltage, amperes and all other pertinent data shall be attached to each motor.
- G. All pumps and motors shall be designed and built for 24-hour continuous service at any and all points within the specified range of operation, without overheating, without cavitation, and without excessive vibration or strain.

- H. Mechanical equipment, including drives and electric motors shall be supplied and installed in accordance with applicable OSHA regulations. Type 316 stainless steel coupling guards shall be installed on all rotating assemblies.
- I. All lubrication fittings shall be brought to the outside of all equipment so that they are readily accessible from the outside without the necessity of removing covers, plates, housings, or guards. Fittings shall be buttonhead type. Lubrication fittings shall be mounted together wherever possible. Pressure grease lubricated fittings shall be the "Zerk Hydraulic" type or the "Alemite" type. Housings of grease lubricated bearings shall be automatically exhausted to the atmosphere to prevent excessive greasing.

2.2 MOTORS

- A. The motors are to be IEEE, Part 31, INVERTER DUTY RATED, premium efficiency, suitable for VFD operation. Motors shall be provided such that the motor shall be sufficient to operate the pump anywhere on its performance curve without operating in its service factor. The motor nameplate horsepower rating must not be exceeded at any head-capacity point on the pump curve.
- B. Drive motor must be designed, manufactured, and tested in accordance with the latest revised edition of NEMA MG1. The motor will be the squirrel-cage induction, NEMA Design B, single speed type. The motor nameplate horsepower rating must not be exceeded at any head-capacity point on the pump curve. The motors must conform to the following:
 - a. Synchronous Speed 1,785 rpm
 - b. Horsepower: 150 HP (Maximum)
 - c. Voltage, Phase & Frequency: 460 volts, 3-phase, 60 Hz
 - d. Mounting: Horizontal
 - e. Enclosure: TEFC
 - f. Design: NEMA B
 - g. Service Factor: 1.15 For continuous duty
 - h. Duty Cycle: Continuous
 - i. Ambient Temperature Rating: 40 degrees C
 - j. Winding Insulation: Class F
 - k. Temperature Rise: Class B
 - l. Starting Method: Variable Frequency Drive
 - m. Starting Current: Manufacturers' standard
 - n. Bearing Lubrication: Sealed bearing
 - o. Bearing Life: 150,000 hours rating life is defined by AFBMA standard
- C. Provide motor modifications as follows:
 - 1. Space heaters to prevent moisture condensation, rating 120 volts, 200 watt maximum, ac.
 - 2. Stainless steel screens over all air openings.
 - 3. Stainless steel nameplate.
 - 4. Motor must be premium efficiency type with minimum guaranteed efficiency of 93% as determined by NEMA test mg 1-12.53d (IEEE-112 test Method B).
 - 5. The terminal housing for the motor is to be substantial fabricated steel or cast ferrous construction, and be rotatable in 90 degree steps, or suitable to receive a conduit from above, below or either side. The terminal housing is to be gasketed between frame and box. Grounding provisions must be made inside the terminal box by means of clamp type wire terminal.

6. The heater leads must be clearly identified with permanent tags.
7. Commercial test must be made on motor provided, including no-load current at rated voltage, high potential, and locked rotor current.
8. Provide three (3) temperature sensors embedded in the motor windings to sense excessive motor temperatures.

2.3 COUPLINGS

- A. The shaft coupling between the motor shaft the pump shaft is to be an elastomeric spacer coupling similar to the Rexnord Omega Spacer Orange Coupling. The coupling must have a drop out center spacer to allow the shafts to be disconnected without disturbing the pump or motor. Coupling hubs are to be keyed into position on both shafts. The flexible runner insert is to be EPDM. The coupling must be selected properly by horsepower rating and shaft size for the pump and motor combination specified.
- B. An OSHA approved stainless steel coupling guard shall be furnished over the coupling for protection

PART 3 - EXECUTION

3.1 GENERAL

- A. The pump and its components will be complete with a manufacturer's warranty for defects in materials and workmanship for a period of one year from the time the pump is placed into operation.

3.2 PRODUCT HANDLING

- A. All parts shall be properly protected so that no damage or deterioration will occur during a prolonged delay from the time of shipment until installation is completed and the units and equipment are ready for operation.

3.3 PERFORMANCE

- A. The manufacturer will warrant that the performance of all pumps will conform with manufacturer's certified pump performance curves. The pumps must operate within the tolerances of the Standards of the Hydraulic Institute. Curves published for similar pumps by another manufacturer will not be acceptable for this purpose.

3.4 SHOP PAINTING

- A. Before exposure to weather and prior to shop painting, all surfaces shall be thoroughly cleaned, dry and free from all mill-scale, rust, grease, dirt and other foreign matter. All nameplates shall be properly protected during painting. Motor shall be painted per specifications.

3.5 INSTALLATION

- A. Install all equipment in strict conformance with the manufacturer's specifications and industry standards. Perform all work in a workmanlike manner.
- B. Manufacturer's representative for pumps and valves shall inspect installation for correctness and compliance with manufacturers specifications and submit written certification that equipment is ready to be placed in service.

- C. No piping connecting any of the equipment will be jacked, pried or forced into position in any way. All piping must mate perfectly with the equipment it is attaching prior to installation of flange bolts or other connecting devices.

3.6 START-UP

- A. The pump manufacturer will have a qualified representative mate the pump to the motor and align the assembly. Manufacturer must provide a qualified representative to certify the pump performance.
- B. After initial start-up under the supervision of a qualified representative of the pump manufacturer, a preliminary running-in period will be provided for the Contractor to make field tests and necessary adjustments. The pumps will then operate for a period concurrent with the NF train acceptance test.
- C. Field test pumps for conformance to specified operating conditions. Record initial flow, head, voltage and amperage for each power leg. Adjust tolerances, if necessary and retest. Confirm that the amplitude and frequency of vibration during pump operation is within the tolerances of the Standards of the Hydraulic Institute. Measure noise (dBA) adjacent to pump, and at 10 feet and 50 feet away.
- D. At the end of the specified period of operation, the pumps will be accepted if, in the opinion of the Engineer/Owner, the pumps have operated satisfactorily without excessive power input, wear, lubrication, or undue attention required for this operation, and if all rotating parts operate without excessive vibration or noise at any operating head.
- E. Pump and piping installed shall be disinfected in accordance with Section 02670 Pressure Testing and Disinfection prior to being placed in service.

3.7 OPERATIONS AND MAINTENANCE TRAINING

- A. The Contractor shall provide the services of qualified factory service representatives to instruct the Owner's personnel in the operation and maintenance of the pump and motor units, including step-by-step troubleshooting with necessary test equipment. Instruction shall be specific to the model of equipment furnished. This service shall consist of a one-day visit for each type of similar pump and motor.
- B. The technical representative shall have at least two years of experience in pump equipment training and instruction. Training sessions shall be scheduled not less than two weeks in advance. Training materials shall be provided to each of the Owner's personnel in attendance and shall remain with the trainees.
- C. All costs for transportation, lodging, subsistence, and other incidental costs for the manufacturer's representative during the installation, testing, and instruction shall be borne by the Contractor at no cost to the Owner.

- END OF SECTION -

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 11932
FRP HORIZONTAL END SUCTION PUMP

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Furnish all labor, materials, equipment and incidentals required and install, place in operation, and start up constant speed electric motor driven, ANSI FRP horizontal end suction pump for the membrane clean-in-place as specified herein and shown on the Drawings.
- B. These Specifications are intended to give a general description of what is required, but do not cover all details which will vary in accordance with the requirements of the equipment application. It is, however, intended to cover the furnishing, the shop testing, the delivery and complete installation and start up (including field testing) of all materials, equipment and appurtenances for the complete pumping units as herein specified, whether specifically mentioned in these specifications or not.

1.2 RELATED REQUIREMENTS SPECIFIED ELSEWHERE

- A. Section 01300 – Submittals
- B. Section 11506 – Membrane Cleaning System
- C. Section 11930 – Pumps - General
- D. Section 16690 – Electric Motors

1.3 REFERENCE STANDARDS

- A. Design, manufacture and assembly of elements of the equipment herein specified shall be in accordance with, but not limited to, published standards of the following, as applicable:
 - 1. American Gear Manufacturers Association (AGMA)
 - 2. American Institute of Steel Construction (AISC)
 - 3. American Iron and Steel Institute (AISI)
 - 4. American Society of Mechanical Engineers (ASME)
 - 5. American National Standards Institute (ANSI)
 - 6. American Society for Testing Materials (ASTM)
 - 7. American Welding Society (AWS)
 - 8. American Bearing Manufacturers Association (ABMA)
 - 9. Hydraulic Institute Standards (current edition)
 - 10. Institute of Electrical and Electronics Engineers (IEEE)
 - 11. National Electric Code (NEC)
 - 12. National Electrical Manufacturers Association (NEMA)
 - 13. Occupational Safety and Health Administration (OSHA)
 - 14. Steel Structures Painting Council (SSPC)
 - 15. Underwriters Laboratories, Inc. (UL)
- B. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.4 QUALITY ASSURANCE

- A. To assure unity of responsibility, the motor and base plate shall be furnished and coordinated by the pump manufacturer.
- B. The equipment covered by these specifications is intended to be standard pumping equipment of proven ability as manufactured by companies having experience in the production of such equipment. The equipment furnished shall be designed, constructed and installed to operate satisfactorily when installed as shown on the Contract Drawings and as specified herein.
- C. Pump shall be manufactured in accordance with the Hydraulic Institute Standards, except where otherwise specified herein.
- D. The manufacturer shall be fully responsible for the design, arrangement and operation of all connected rotating components, of the assembled pumping unit mounted on a fabricated steel baseplate, to ensure that neither harmful nor damaging vibrations occur anywhere within the specified operating range.

1.5 PUMP PERFORMANCE DATA & CERTIFIED TEST RESULTS

- A. Factory testing in accordance with the standards of the Hydraulic Institute shall be required for each pump.
- B. Certified pump performance curves shall be submitted for approval by the Engineer on the cleaning pump prior to shipment. The certified pump performance curve shall be submitted, including head, capacity, brake horsepower, and pump efficiency for each pump supplied. Certified data shall be provided to indicate the NPSH required by the pump at the design point as specified.
- C. The pump shall be tested through the specified range of flow, and head/capacity/efficiency curves plotted at maximum output speed. During each test, the pump shall be run at each head condition for sufficient time to accurately determine discharge, head, power input, and efficiency. The pump will be tested with a suction head (including vapor pressure, velocity head friction loss and static suction head) as required to demonstrate the NPSH required by the pump at the design point as specified.
- D. If any pump tested fails to meet any specification requirement it will be modified until it meets all specification requirements. If any pump tested fails to meet the efficiency requirements at any of the listed flow or head conditions as specified and all reasonable attempts to correct the inefficiency are unsuccessful, the pump(s) shall be replaced with unit(s) which meet the specified requirements. Performance data must be the results of project pump and motor assemblies. Also report amperage and voltage of each power leg, efficiency, horsepower and NPSH.

1.6 OPERATION

- A. The pump will recirculate cleaning solution as part of the membrane cleaning system.

1.7 SUBMITTALS

- A. The pump manufacturer will submit data and specifications for the pumping unit and will include but not be limited to the following.
 - 1. Name of Manufacturer
 - 2. Type and Model
 - 3. Design Rotative Speed
 - 4. Type of Bearings

5. Size of Shafting
 6. Size of Suction Connection
 7. Size of Discharge Connection
 8. Certified dimensional drawings of each item of equipment and auxiliary apparatus to be furnished.
 9. Certified foundation, pump support and anchor bolt plans and details.
 10. Schematic electrical wiring diagram and other data as required for complete pump installation.
 11. Literature and drawings describing the equipment in sufficient detail, including parts list and materials of construction, to indicate full conformance with the detail specifications.
 12. Total weight of pumping unit.
 13. Pump performance curves showing capacity versus head, NPSHR, pump efficiency, and pump BHP plotted to scales consistent with performance requirements.
- B. Provide submittals in accordance with Section 01300.
 - C. Provide O & M manuals in accordance with Section 01730.
 - D. Provide manufacturer's certification of correct installation after manufacturer's inspection and start up.

1.8 OPERATING INSTRUCTIONS

- A. Operating and maintenance manuals shall be furnished. The manuals shall be prepared specifically for this installation and shall include all required cuts, drawings, equipment lists, descriptions, etc. that are required to instruct operation and maintenance personnel unfamiliar with such equipment. The number and special requirements shall be as specified in Section 01730.

1.9 TOOLS & SPARE PARTS

- A. The following spare parts shall be furnished:
 1. One mechanical seal assembly
 2. One set of gaskets
- B. Store spare parts, drivers, etc. in strict accordance with manufacturer's recommendations. Notify the owner in writing of any special storage maintenance required and provide such maintenance until final acceptance of contract.

1.10 PRODUCT HANDLING

- A. All parts shall be properly protected so that no damage or deterioration will occur during a prolonged delay from the time of shipment until installation is completed and the units and equipment are operational.
- B. All equipment and parts must be properly protected against any damage during a prolonged period at the site.
- C. Factory assembled parts and components shall not be dismantled for shipment unless permission is received in writing from the Engineer.
- D. Finished surfaces of all exposed pump openings shall be protected by wooden blanks, strongly built and securely bolted thereto.
- E. Finished iron or steel surfaces not painted shall be properly protected to prevent rust and corrosion.

- F. After hydrostatic or other tests, all entrapped water shall be drained prior to shipment and proper care shall be taken to protect parts from the entrance of water during shipment, storage and handling.
- G. Each box or package shall be properly marked to show its net weight in addition to its contents.

1.11 MANUFACTURER'S REPRESENTATIVE

- A. The Contractor shall provide the services of one or more qualified manufacturer's technical representatives who shall adequately supervise and certify the installation, conduct field testing of the pumping equipment furnished under this Contract, and instruct the Contractor's personnel and the Owner's personnel in its maintenance and operation of the units. The services of the manufacturer's representative shall provide for at least two days as follows:
 - 1. One day trip shall be for the review of the pump installation.
 - 2. One day trip shall be for time on-site for start-up and for operational assistance and training.

1.12 WARRANTY

- A. The equipment shall be warranted to be free of defects in workmanship, design or material for a period of one year from date of startup or 18 months from delivery, whichever occurs first. If the equipment should fail during the warranty period due to a defective part(s), it shall be replaced in the machine and the unit(s) restored to service at no expense to the Owner.

PART 2 - PRODUCTS

2.1 MATERIAL AND EQUIPMENT

- A. The pumping units required under this section shall be complete including pump, motor, and baseplate with proper alignment and balancing of the individual unit. All parts shall be so designed and proportioned as to have liberal strength, stability, and stiffness and to be especially adapted for the work to be done. Ample room shall be provided for inspection, repairs, and adjustment.
- B. Pump bases shall be rigidly and accurately anchored into position, precisely leveled and aligned, so that the completed installation is free from stress or distortion. All necessary foundation bolts, plates, nuts and washers shall be furnished and installed by the Contractor and conform to the recommendations and instructions of the equipment Manufacturer. Anchor bolts, nuts, and washers shall be of Type 316 stainless steel. Grouting under bases after the equipment is set is included as work under this Section. Pumps and pump bases shall have adequate provisions to collect drainage and conduct it away to the nearest drain.
- C. A stainless steel nameplate giving the name of the manufacturer, the rated capacity, head, speed, and all other pertinent data shall be attached to the pump and motor.
- D. The pumping unit and electric motor shall be designed and constructed to withstand the maximum turbine run-away speed of the unit due to back flow through the pump. A statement of compliance and calculations demonstrating the ability of the units to meet this requirement shall be supplied with initial shop drawing submission.
- E. All pumps shall be designed and built for 24-hour continuous service at any and all points within the specified range of operation, without overheating, without cavitation, and without excessive vibration or strain.

- F. Mechanical equipment, including drives and electric motors shall be supplied and installed in accordance with applicable OSHA regulations. Type 316 stainless steel guards shall be installed on all rotating assemblies.
- G. All lubrication fittings shall be brought to the outside of all equipment so that they are readily accessible from the outside without the necessity of removing covers, plates, housings, or guards. Fittings shall be buttonhead type. Lubrication fittings shall be mounted together wherever possible. Pressure grease lubricated fittings shall be the "Zerk Hydraulic" type or the "Alemite" type. Housings of grease lubricated bearings shall be automatically exhausted to the atmosphere to prevent excessive greasing.

2.2 PUMP

- A. The cleaning pump shall be horizontal end suction type in conformance to ANSI B73.1
- B. The cleaning pump shall be Fybroc Series 1500 or approved equivalent.
- C. The pump shall meet the following conditions at full speed:
- D. Performance Requirements
 - 1. When operating at the maximum output speed of the motor, the pump shall have a characteristic performance curve, which meets all the minimum conditions listed in Table 11932-1. The pump and drive motor shall be capable of operating satisfactorily under the full range of conditions as defined by Table 11932-1. The secondary pump capacity, head and efficiency defined in Table 11932-1 shall be the "design point".
 - 2. Maximum motor speed shall not exceed that listed herein to satisfy the specified hydraulic duty requirements. The pump "design speed" shall be the maximum output speed of the motor when operating at the pump "secondary" capacity and head.
 - 3. With the pumping unit operating at full speed, the maximum brake horsepower required by the pump shall not exceed the maximum horsepower listed herein.
 - 4. Pump Design Requirements

FLOW (GPM)	HEAD (FT)	EFFICIENCY (%)	HORSEPOWER (HP)	Notes:
0	225	N/A	N/A	Deadhead Condition
720	195	70	64	Low Cleaning Flow
810	180	66	70	Duty Condition
1,040	120	50	75	High Cleaning Flow

- E. Certified Factory Tests:
 - 1. Factory testing in accordance with the standards of the Hydraulic Institute shall be required for each pump. The performance test acceptance grade shall be 1UE as defined by HI 14.6. Certified pump performance curves shall be submitted, including head, capacity, brake horsepower, and pump efficiency for the pump supplied. Certified data shall be provided to indicate the NPSH required by the pump at the primary operating point listed in Table 11932-1. Prior to conducting a pump test, notification of such test and a list of test equipment and test procedures shall be forwarded to the Owner and Engineer at least ten (10) working days before the scheduled test date. All electronic transducers, meters, gauges, and other test instruments shall be calibrated within forty-five (45) days of the scheduled test and certified calibration data shall be provided to the Engineer at least ten days prior to the Factory test. Differential pressure type flow meters, such as venturis shall have been calibrated within 5

years. Mechanical variation of the meter throat diameter will be accepted as verification of calibration validity.

2. Each pump shall be tested through the specified range of flow, and head/capacity/efficiency with curves plotted at speeds of 70%, 80%, 90% and 100% rated speed. During each test, the pump shall be run at each head condition for sufficient time to accurately determine discharge, head, power input, and efficiency. The pump will be tested with a suction head (including vapor pressure, velocity head friction loss and static suction head) as required to demonstrate the NPSH required by the pump at the primary operating point listed in Table 11932-1. If the pump fails to meet any specification requirement it will be modified until it meets all specification requirements.

3.

2.3 PUMP CASING

- A. The pumps shall be FRP horizontal, end suction pumps in complete conformance with the latest version of ANSI Standard B-73.1.
- B. The casing shall be end suction, top centerline discharge. The casing shall be of reinforced fiberglass vinyl ester resin construction. The suction and discharge connections shall be flanged, rated at 150 pounds.

2.4 IMPELLER

- A. The impeller shall be semi open with integral shaft sleeve and will be made of reinforced fiberglass vinyl ester resin.

2.5 PUMP BEARINGS

- A. The bearings shall be steel, oil lubricated and protected from dust and moisture. All bearings shall be rated in accordance with ANSI B-1 0 continuous-duty life of not less than 17,500 hours at the most severe loads imposed by the specified conditions.

2.6 SHAFTING

- A. Shaft shall be of solid one-piece, constructed of 316 stainless steel

2.7 MECHANICAL SEAL

- A. Mechanical seal shall be a single bellows cartridge seal that utilizes an internal flush.
- B. Mechanical seal shall be constructed with carbon and ceramic faces, 316 stainless steel metal parts and viton secondary seals.

2.8 COUPLINGS AND ACCESSORIES

- A. The shaft coupling between the motor shaft and the pump shaft is to be a flexible spacer coupling similar to the Woods Sure-Flex Spacer Coupling. The coupling must have a drop out center spacer to allow the shafts to be disconnected without disturbing the pump or motor. Coupling hubs are to be keyed into position on both shafts. The flexible rubber insert is to be EPDM. The coupling must be selected properly by horsepower rating and shaft size for the pump and motor combination specified.
- B. An OSHA approved 316 stainless steel coupling guard shall be furnished over the coupling for protection.

2.9 BEARING FRAME

- A. Bearing Frame shall be of cast iron construction and epoxy to prevent corrosion. It shall include a thrust bearing to absorb axial loads and radial bearings to absorb radial loads through the shaft from the impeller. Impeller adjustment shall be accomplished at the bearing frame through the use of jack screws and while the pump is completely assembled and installed.

2.10 BASE PLATES

- A. The pump and driver shall be mounted on a common FRP base with drip rim. Pump and driver shall be aligned and bolted in place prior to factory shipment. Final alignment must be performed at the jobsite in accordance with the standards of the Hydraulic Institute and the pump installation, operation and maintenance instructions. Base is to be grouted to eliminate vibration.
- B. The baseplate must incorporate an integral slopped drip pan. The baseplate must conform to ANSI/ASME Standard Dimensions and have pre-drilled holes for pump and motor mounting as well as grout holes. The baseplate design must provide sufficient rigidity to maintain alignment between pump and motor. Baseplate shall be equipped with jack bolts for alignment of pump and driver.

2.11 MOTORS

- A. Drive motor must be designed, manufactured, and tested in accordance with the latest revised edition of NEMA MG1.
- B. The motor will be the squirrel-cage induction, NEMA Design B, single speed, premium efficiency type.
- C. Operation of the cleaning pump shall not exceed the motor rating at any discharge head and flow condition.
- D. The motor nameplate horsepower rating must not be exceeded at any head-capacity point on the pump curve.
- E. The motors must conform to the following:
 - 1. Synchronous Speed 3,600 rpm
 - 2. Horsepower 75 HP (Maximum)
 - 3. Voltage, Phase & Frequency 460 volts, 3-phase, 60 Hz
 - 4. Mounting Horizontal
 - 5. Enclosure TEFC
 - 6. Design NEMA B
 - 7. Service Factor 1.15 For continuous duty
 - 8. Duty Cycle Continuous
 - 9. Ambient Temperature Rating 40 degrees C
 - 10. Winding Insulation Class F
 - 11. Temperature Rise Class B
 - 12. Starting Method Soft Starter
 - 13. Starting Current Manufacturers' standard
 - 14. Bearing Lubrication Sealed bearing
 - 15. Bearing Life 150,000 hours rating life is defined by AFBMA standard
- F. Provide motor modifications as follows:
 - 1. Space heaters to prevent moisture condensation, rating 120 volts, 200 watt maximum, ac.

2. Stainless steel screens over all air openings.
3. Stainless steel nameplate.
4. Motor must be premium efficiency type with minimum guaranteed efficiency of 93% as determined by NEMA test mg 1-12.53d (IEEE-112 test Method B).
5. The terminal housing for the motor is to be substantial fabricated steel or cast ferrous construction, and be rotatable in 90-degree steps, or suitable to receive a conduit from above, below or either side. The terminal housing is to be gasketed between frame and box. Grounding provisions must be made inside the terminal box by means of clamp type wire terminal.
6. The heater leads must be clearly identified with permanent tags.
7. Commercial test must be made on motor provided, including no-load current at rated voltage, high potential, and locked rotor current.
8. Provide three (3) temperature sensors embedded in the motor windings to sense excessive motor temperatures.

PART 3 - EXECUTION

3.1 GENERAL

- A. The pump and its components will be complete with a manufacturer's warranty for defects in materials and workmanship for a period of one year from the time the pump is placed into operation.

3.2 PERFORMANCE

- A. The manufacturer will warrant that the performance of all pumps will conform with manufacturer's certified pump performance curves. The pumps must operate within the tolerances of the Standards of the Hydraulic Institute. Curves published for similar pumps by another manufacturer will not be acceptable for this purpose.

3.3 SHOP PAINTING

- A. Before exposure to weather and prior to shop painting, all surfaces shall be thoroughly cleaned, dry and free from all mill-scale, rust, grease, dirt and other foreign matter. All nameplates shall be properly protected during painting. Motor shall be painted per specifications.

3.4 INSTALLATION

- A. Install all equipment in strict conformance with the manufacturer's specifications and industry standards. Perform all work in a workmanlike manner.
- B. Manufacturer's representative for pumps and valves shall inspect installation for correctness and compliance with manufacturers specifications and submit written certification that equipment is ready to be placed in service.
- C. No piping connecting any of the equipment will be jacked, pried or forced into position in any way. All piping must mate perfectly with the equipment it is attaching prior to installation of flange bolts or other connecting devices.

3.5 START-UP

- A. The pump manufacturer will have a qualified representative mate the pump to the motor and align the assembly. Manufacturer must provide a qualified representative to certify the pump performance.
- B. After initial start-up under the supervision of a qualified representative of the pump manufacturer, a preliminary running-in period will be provided for the Contractor to make field tests and necessary adjustments. The pumps will then operate for a period concurrent with the plant acceptance test.
- C. Field test pumps for conformance to specified operating conditions. Record initial flow, head, voltage and amperage for each power leg. Adjust tolerances, if necessary and retest. Confirm that the amplitude and frequency of vibration during pump operation is within the tolerances of the Standards of the Hydraulic Institute. Measure noise (dBA) adjacent to pump, and at 10 feet and 50 feet away.
- D. At the end of the specified period of operation, the pumps will be accepted if, in the opinion of the Engineer/Owner, the pumps have operated satisfactorily without excessive power input, wear, lubrication, or undue attention required for this operation, and if all rotating parts operate without excessive vibration or noise at any operating head.
- E. Pump and piping installed shall be disinfected in accordance with Section 02670 Pressure Testing and Disinfection prior to being placed in service.

3.6 OPERATIONS AND MAINTENANCE TRAINING

- A. The Contractor shall provide the services of qualified factory service representatives to instruct the Owner's personnel in the operation and maintenance of the pump and motor units, including step-by-step troubleshooting with necessary test equipment. Instruction shall be specific to the model of equipment furnished. This service shall consist of a one day visit for each type of similar pump and motor.
- B. The technical representative shall have at least two years of experience in pump equipment training and instruction. Training sessions shall be scheduled not less than two weeks in advance. Training materials shall be provided to each of the Owner's personnel in attendance and shall remain with the trainees.
- C. All costs for transportation, lodging, subsistence, and other incidental costs for the manufacturer's representative during the installation, testing, and instruction shall be borne by the Contractor at no cost to the Owner.

- END OF SECTION -

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 11936
VERTICAL TURBINE PUMPS AND MOTORS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Furnish all labor, equipment and materials necessary to furnish two (2) 150-hp can-style vertical turbine high service pumping units. The unit will be complete with pump, discharge head, bowl assembly, column pipe, discharge head, sole plate, pump can, mechanical seal, inverter duty, vertical solid shaft electric motor, all nuts, bolts, fasteners, guards, and all other appurtenances including necessary field time to perform start-up services to provide a complete and operable system.
- B. Furnish all labor, equipment and materials necessary to furnish two (2) 50-hp totally enclosed fan-cooled (TEFC) inverter duty rated transfer pump motors. The unit will be complete with electric motor, all nuts, bolts, fasteners, guards, and all other appurtenances including necessary field time to perform start-up services to provide a complete and operable system.

1.2 RELATED REQUIREMENTS SPECIFIED ELSEWHERE

- A. Section 01300 - Submittals
- B. Section 01730 – Operation and Maintenance Manuals
- C. Section 09900 - Painting
- D. Section 11930 – Pumps - General
- E. Section 13080 – Vibration and Alignment
- F. Section 15100 – Piping and Valves
- G. Section 16050 – Electrical Materials and Methods
- H. Section 16681 – Variable Frequency Drives
- I. Section 16690 – Electric Motors

1.3 MANUFACTURER

- A. The approved manufacturer is required to have a minimum of 5 years' experience with vertical turbine pumps.
- B. The Contractor shall provide for the presence of competent personnel representing the manufacturer of the pump to check the installation, adjust the impeller setting, place the installation in service and instruct the Owner's personnel in the operation and maintenance thereof. The Engineer shall be given 7 days' advance written notice of the desired start-up date and time. Start-up for each installation shall be scheduled consecutively on the same day. A start-up report shall be submitted to the Engineer and accepted prior to attainment of substantial completion.

1.4 PUMP PERFORMANCE DATA

- A. Non-witnessed factory testing in accordance with the standards of the Hydraulic Institute shall be required for each pump.
- B. Certified pump performance curves are to be submitted for approval by the Owner/Engineer on all pumps prior to shipment. The certified pump performance curves shall be submitted,

including head, flow capacity, brake horsepower, and pump efficiency for each pump supplied. Certified historical data shall be provided to indicate the NPSH required by the pump at the design point specified.

- C. The pump shall operate at not less than the efficiencies stipulated in this specification for the corresponding head and flow conditions. Certified performance curves based on the testing of the actual pump assembly to be shipped shall be prepared and submitted to the Engineer for acceptance prior to shipment. The motor used for factory testing shall be as set forth in Section 16690. All submittals shall be in accordance with the requirements of Section 01300. A minimum of three test points shall be plotted for each curve. These points shall coincide with the specified flow requirements by actual test point, as opposed to being by interpolation or extrapolation. At a minimum, the head, flow, brake horsepower and pump efficiency shall be shown at each specified point. In addition, the head, flow, and brake horsepower shall be measured at a minimum of seven points with the pump operating at speeds ranging from 30 Hz to 60 Hz in 5 Hz increments, with one of the points being the critical frequency (which shall be identified in the shop drawing submittal). The submitted curves shall show the date, time and location of the test and be signed by the person in responsible charge of performing the test. In the event the pump does not meet the specified efficiency, the Contractor shall make the necessary modifications, repairs, or replacements to make the unit conform with the specifications and re-test the unit in accordance with the above criteria to demonstrate conformance. The modifications shall include, but not be limited to polishing the impellers and/or bowls, porcelain lining the bowls, and/or enamel coating the bowls. The inability to satisfy the specified conditions may result in the need, fully at the Contractor's expense, to provide a larger motor, make associated electrical modifications, provide a larger generator, and reimburse the Owner for higher power consumption over the life cycle of the pump, all subject to the Engineer's approval. The Contractor is specifically cautioned there will be no tolerance on the required head, flow, and efficiency conditions and that some of the criteria contained herein may be more stringent than Hydraulic Institute requirements.

1.5 VIBRATION

- A. Perform vibration testing in accordance with part 3.4, C. of this specification and Section 13080.

1.6 OPERATION

- A. The pumps will serve as high service pumps, discharging potable water in to the distribution system. The pumping units shall be located and arranged as shown on the drawings.
- B. All working parts of the pump, motor and drive such as bearings, wearing rings, shaft sleeves, motor windings, etc., shall be of standard dimensions built to limit gauges or formed to templates, such that parts will be interchangeable between like units, and such that the Owner may at any time in the future obtain replacement and repair parts for those furnished in the original machine. All parts shall be properly stamped for identification and location in the machine as shown on the assembly drawings in the instruction books furnished.

1.7 REFERENCE STANDARDS

- A. Design, manufacture, and assembly of elements of the equipment herein specified shall be in accordance with, but not limited to, published standards of the following, as applicable:
 - 1. American Gear Manufacturers Association (AGMA)

2. American Institute of Steel Construction (AISC)
 3. American Iron and Steel Institute (AISI)
 4. American Society of Mechanical Engineers (ASME)
 5. American National Standards Institute (ANSI)
 6. American Society for Testing Materials (ASTM)
 7. American Welding Society (AWS)
 8. American Bearing Manufacturers Association (ABMA)
 9. Hydraulic Institute Standards (current edition)
 10. Institute of Electrical and Electronics Engineers (IEEE)
 11. National Electric Code (NEC)
 12. National Electrical Manufacturers Association (NEMA)
 13. Occupational Safety and Health Administration (OSHA)
 14. Steel Structures Painting Council (SSPC)
 15. Underwriters Laboratories, Inc. (UL)
- B. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.8 SUBMITTALS

- A. The pump manufacturer will submit data and specifications for the pumping unit and will include, but not be limited to, the following information:
1. Name of Manufacturer
 2. Type and Model
 3. Design Rotative Speed
 4. Number of stages
 5. Type of Bowl Bearings
 6. Size of Shafting
 7. Size of Pump Column
 8. Size of Discharge Outlet
 9. O.D. of Pump Bowls
 10. Weight of Pump
 11. Shop test performance curve showing capacity versus head, NPSHR, pump efficiency, and pump BHP plotted to scales consistent with performance requirements. Curve must be certified by the pump manufacturer.
 12. Overall pump column dimensions.
 13. Nameplate data
 14. Motor efficiency
 15. Motor torque speed curves from zero to full speed load
 16. Pump and can dimensions
 17. Pump parts list and materials list
- B. Provide submittals in accordance with Section 01300.
- C. Provide O&M manuals in accordance with Section 01730.
- D. Provide manufacturer's certification of correct installation after manufacturer's inspection and start-up.

1.9 OPERATION AND MAINTENANCE DATA

- A. Complete operating and maintenance instructions shall be furnished for all equipment included under these specifications as provided in Section 01730. The maintenance instructions shall include troubleshooting data and full preventative maintenance schedules and complete spare parts lists with ordering information.
- B. The manuals shall be prepared specifically for this installation and shall include all required cuts, drawings, equipment lists, descriptions, etc. that are required to instruct operation and maintenance personnel unfamiliar with such equipment. The number and special requirements shall be as specified in Section 01730.
- C. A factory representative of all major component manufacturers, who has complete knowledge of proper operation and maintenance, shall be provided for one (1) day to instruct representatives of the Owner and the Engineer on proper operation and maintenance in accordance with Section 01730. With the Owner's permission, this work may be conducted in conjunction with the inspection of the installation and test run as provided under PART 3. If there are difficulties in operation of the equipment due to the manufacturer's design or fabrication, additional service shall be provided at no cost to the Owner.

1.10 QUALITY ASSURANCE

- A. To assure unity of responsibility, the motor and base plate shall be furnished and coordinated by the pump manufacturer.
- B. The equipment covered by these specifications is intended to be standard pumping equipment of proven ability as manufactured by concerns having extensive experience in the production of such equipment. The equipment furnished shall be designed, constructed and installed to operate satisfactorily when installed as shown on the Drawings and as specified herein.
- C. Pump shall be manufactured in accordance with the Hydraulic Institute Standards, except where otherwise specified herein.
- D. The MANUFACTURER shall be fully responsible for the design, arrangement and operation of all connected rotating components, of the assembled pumping unit mounted on a fabricated steel baseplate, to ensure that neither harmful nor damaging vibrations occur anywhere within the specified operating range.
- E. For all variable speed units, the Manufacturer shall perform both lateral and torsional critical speed analyses to identify and ensure that (a) the first lateral critical speed shall be at least 25 percent above the maximum pump speed, (b) the first torsional critical speed shall be at least 25 percent above the maximum pump speed, and that, (c) any blade excited resonant frequency shall be no closer than plus or minus 25 percent of the natural frequency of any part of the installed assembled pumping unit. Prior to manufacture, a statement must be forwarded to the Engineer indicating that the required analyses have been made and that the specified limitations will be met.

1.11 PRODUCT HANDLING

- A. All parts shall be properly protected so that no damage or deterioration will occur during a prolonged delay from the time of shipment until installation is completed and the units and equipment are operational.

- B. All equipment and parts must be properly protected against any damage during a prolonged period at the site.
- C. Factory assembled parts and components shall not be dismantled for shipment unless permission is received in writing from the Engineer.
- D. Finished surfaces of all exposed pump openings shall be protected by wooden blanks, strongly built and securely bolted thereto.
- E. Finished iron or steel surfaces not painted shall be properly protected to prevent rust and corrosion.
- F. After hydrostatic or other tests, all entrapped water shall be drained prior to shipment and proper care shall be taken to protect parts from the entrance of water during shipment, storage and handling.
- G. Each box or package shall be properly marked to show its net weight in addition to its contents.

1.12 MANUFACTURER'S SERVICE REPRESENTATIVE

- A. The Contractor shall provide the services of one or more qualified manufacturer's technical representatives who shall adequately supervise and certify the installation and testing of all equipment furnished under this Contract and instruct the Contractor's personnel and the Owner's operating personnel in its maintenance and operation. The services of the manufacturer's representative shall provide for at least three days as follows:
 - 1. One trip which includes one (1) day of time on-site during installation of the new pump and motor.
 - 2. One trip which includes one (1) day of time on-site for start-up and for operational assistance and training.
 - 3. Upon completion of installation and start-up testing, the pump and motor manufacturer's service representative shall prepare and submit a certificate of proper installation to the Owner and Engineer and include in the Operation and Maintenance manuals submitted per Section 01730.

1.13 WARRANTY

- A. The equipment shall be warranted to be free of defects in workmanship, design or material for a period of one (1) year from date of startup. If the equipment should fail during the warranty period due to a defective part(s), it shall be replaced and the unit(s) restored to service at no expense to the Owner.

PART 2 - PRODUCTS

2.1 HIGH SERVICE PUMP PERFORMANCE

- A. The pumps shall be a model:
 - 1. Model MPV as manufactured by Afton (2-stage), or
 - 2. Model 16GM as manufactured by Layne (2-stage)
- B. The pumps shall meet the following design conditions at full speed:

Flow (GPM)	Head (FT)	Minimum Efficiency (%)	RPM (maximum)	Horsepower (HP)
0	240	0	1800	110
1600	195	60	1800	135
2800	166	78	1800	148
3250	148	81	1800	148 (Design)
4000	90	70	1800	125

- C. At 100% speed, the high service pumps shall not be capable of achieving the same TDH value at different flow rates. "Dips" in pump performance curves to yield desired motor 150-hp requirement will be rejected.

2.2 HIGH SERVICE PUMP CANS

- A. The suction cans for the pumps shall be supplied by the Manufacturer as shown on the plans. The can design shall meet all requirements of the Hydraulic Institute Standard for Pump Intake Design, latest edition
- B. The pump can shall be fabricated of 316 stainless steel and be designed to mount on the concrete pedestal and set in a caisson, encased as shown on the drawings. The suction flange shall be 150# ANSI R.F. flanged.
- C. The wall thickness of the can shall be not less than 3/8 inch designed for a maximum pressure of 150 psi.
- D. The can support plate dimensions shall be determined by the pump Manufacturer but shall not be less than 1-1/2 inches in thickness, drilled and tapped ANSI B16 B2 standard flanged dimensions to attach the pump discharge head base to the can support plate. The can support plate shall be mounted to the concrete pad with Type 316 stainless steel anchor bolts, as shown on the drawings, with a 1-1/2 inch grout pad beneath the plate. The anchor bolts to be used to mount the discharge head to the can support plate shall be 316 stainless steel.
- E. The suction can assembly shall be hydrostatically pressure tested at 150 psi.
- F. An internally mounted, vertical flow splitter or other approved device shall be installed within the pump suction can to prevent the possibility of fluid circulation around the pump bowl assembly. The dimensions of the device shall be as recommended by the pump Manufacturer.
- G. The pump can shall be equipped with a 1/2-inch NPT tapped vent in the support plate with a 1/2-inch 316 stainless steel nipple, ball valve, and J-tube for the removal of air.
- H. The can support plate shall be grooved to accept O-ring for seal between discharge head. The diameter of this O-ring shall be a standard size.
- I. Pump can shall be constructed with straightening vanes, if required, in accordance with current Hydraulic Institute Standards.

2.3 HIGH SERVICE PUMP DISCHARGE HEADS

- A. The pump shall be furnished with a suitable, integral fabricated ASTM A-53 steel mounting ring of adequate design with registered fit to match the mounting dimensions of the drive motor.
- B. The discharge head shall be fabricated steel construction of ASTM A 53 steel, 3/8-inch minimum thickness and of the above base type with a 150 lb. flat faced flanged discharge connection. Discharge size will be provided as shown on the plans. The head shall be thermally stress relieved

after fabrication. The head shall be grit blasted to an even matte finish to remove all tool marks. All cut edges will be ground smooth.

- C. Incorporated in the fabrication of the discharge head shall be a suitable pump support base not less than 1 ½ -inch in thickness of standard ANSI B16 B2 flanged dimensions to support both the pump and the motor. The flange bolting shall be in accordance with the requirements of ANSI B16 B2.
- D. The pump top shaft shall be constructed of ASTM A 276 416 or 17 4 P.H. Stainless Steel Alloy. The pump top shaft shall be two-piece design for connection to a vertical solid shaft motor. The Shaft diameter shall be determined by ANSI B58.1 standards for Deep Well Vertical Turbine Pump, Section A4.3.3.
- E. The discharge head shall contain a stuffing box with a standard single cartridge type mechanical seal. The seal shall be Crane 8B1 with 316L stainless steel gland, sleeve and drive collar, or approved equivalent.
- F. The base of the discharge head shall be a machined surface and match the drilling pattern of the can support plate.
- G. The discharge head shall have eyes or dog ears to allow lifting of the pump assembly out of the can.
- H. The discharge head shall have the following threaded taps:
 - 1. 1-1/4" NPT tap for discharge vent
 - 2. ½" NPT tap for seal drain
 - 3. ½" NPT tap for discharge pressure gauge

2.4 HIGH SERVICE PUMP COLUMN ASSEMBLIES

- A. The pump column shall be constructed of ASTM A 53 steel not less than schedule 40, flanged at each end. The flanges shall mate with the pump bowl assembly and the discharge head with babbitted fits to assure correct alignment. Bolts used to attach column flanges shall be constructed of 316L stainless steel.
- B. The pump line shaft shall be constructed of ASTM A 276 416 or 17 4 P.H. Stainless Steel Alloy to operate the pump without distortion or vibration. Shaft diameter shall be determined by the AWWA Standard for Vertical Turbine Pumps Line Shaft and Submersible Types, ANSI/AWWA E101 (latest), Section A4.1.5.
- C. The line shaft couplings shall be of the threaded type constructed of ASTM A-276 416 or 17 4 P.H. Stainless Steel Alloy.
- D. Line shaft bearings, if any, shall be removable self-flushing rubber type, mounted in bronze bearing spiders located at discharge column flanges. Bearing spacing shall follow Hydraulic Institute and API standards.

2.5 HIGH SERVICE PUMP BOWLS

- A. The A48 Class 30 cast iron pump bowls shall accommodate the maximum pressure produced by the pump, and supported by a combination of water lubricated, fluted rubber and bronze bearings in each stage. The water passages shall have a porcelain enamel coating to produce optimum efficiency during operation. The pump bowl shall be free from blow holes, sand holes and other faults and have a minimum tensile strength of 30,000 psi.
- B. The impeller shall be of the enclosed type, constructed of C952 aluminum-nickel-bronze, accurately machined and finished, and mechanically balanced. Bowl and impeller wear ring shall

be constructed of same material as impeller. Impeller shall be securely fastened to the impeller shaft with type 416 stainless steel taper lock bushings.

- C. The bowl shaft and couplings shall be 416 stainless steel and shall be sized of adequate diameter to withstand the maximum torque and tensile forces imposed upon it and shall be heat straightened to within .005" total indicated run out. The shaft shall be furnished in sections to match the column with interchangeable intermediate sections. The size of the lineshaft shall not be less than required by ASA Specification B58, Section 4.3 per Table 5.6, AIS C-1045 Lineshaft Selection, and shall be such that elongation due to hydraulic thrust will not exceed the axial clearance of the impellers in the pump bowls. The bearings shall be water lubricated, fluted type, spread at intervals not to exceed 10 feet and fabricated of a resilient rubber composition.
- D. The suction bell shall be A48 Class 30 cast iron with a 316 stainless steel basket strainer. The bowl shaft will terminate inside a bearing housing cavity to allow grease packing of the bronze suction bearing. The bottom side of the reservoir will be sealed with a cast iron plug.
- E. All pump material shall be NSF, or food grade compliant materials, rated for use in contact with potable water.

2.6 HIGH SERVICE PUMP MOTORS

- A. The motors shall be vertical frame, solid shaft motors, high thrust design with a minimum efficiency of 95%. The motor shall be for use with a VFD and be inverter duty rated. Guaranteed minimum efficiency for each unit shall be furnished by the motor manufacturer to the Owner.
- B. The motors shall be 1800 rpm, 150 HP (**Maximum**), TEFC motor, non-reverse ratchet, premium efficiency with a 1.15 service factor. Available power will be 460V, 3ph, 60Hz. Pump shall not exceed the motor full load rating at any head or discharge condition. Unless otherwise specified, the motors shall meet the following requirements. The motors shall be manufactured by US Motors, or equal.
 - 1. For use with a VFD
 - 2. Rated for continuous duty @ 40 deg. C ambient temperature.
 - 3. Class F insulation with Class B temperature rise.
 - 4. External conduit boxes shall be oversized at least one size larger than NEMA standard.
 - 5. Clamp type grounding terminal shall be located inside conduit box.
 - 6. 120 volt space heater.
 - 7. Motor thermal protection in accordance with Electrical Specifications.
- C. All motors shall be built in accordance with latest NEMA, IEEE, ANSI and AFBMA standards where applicable. Motors shall conform to all requirements stipulated in Division 16 – Electrical.
- D. Bearings shall be anti friction, oil lubricated with external reservoirs. Bearings shall have an ABMA L 10 life of 100,000 hours. Motors must be designed to accept all upthrust loads imposed by pump during starting and running.
- E. The driven equipment supplier shall be responsible for selecting and supplying the electric motor; the supplier shall further coordinate system requirements between the motor and VFD manufacturer and obtain written approval of the proposed combination from both manufacturers.
- F. Motor shall be guaranteed by the manufacturer for a period of two years from date of acceptance by the Owner against defects in workmanship or materials.

2.7 TRANSFER PUMP MOTORS

- A. The motors shall be vertical frame, solid shaft motors, high thrust design with a minimum efficiency of 95%. The motor shall be for use with a VFD and be inverter duty rated. Guaranteed minimum efficiency for each unit shall be furnished by the motor manufacturer to the Owner.
- B. The motors shall be 1800 rpm, 50 HP, TEFC motor, non-reverse ratchet, premium efficiency with a 1.15 service factor. Available power will be 460V, 3ph, 60Hz. Pump shall not exceed the motor full load rating at any head or discharge condition. Unless otherwise specified, the motors shall meet the following requirements. The motors shall be manufactured by US Motors, or equal.
 - 1. For use with a VFD
 - 2. Rated for continuous duty @ 40 deg. C ambient temperature.
 - 3. Class F insulation with Class B temperature rise.
 - 4. External conduit boxes shall be oversized at least one size larger than NEMA standard.
 - 5. Clamp type grounding terminal shall be located inside conduit box.
 - 6. 120 volt space heater.
 - 7. Motor thermal protection in accordance with Electrical Specifications.
- C. All motors shall be built in accordance with latest NEMA, IEEE, ANSI and AFBMA standards where applicable. Motors shall conform to all requirements stipulated in Division 16 – Electrical.
- D. Bearings shall be anti friction, oil lubricated with external reservoirs. Bearings shall have an ABMA L 10 life of 100,000 hours. Motors must be designed to accept all upthrust loads imposed by pump during starting and running.
- E. The driven equipment supplier shall be responsible for selecting and supplying the electric motor; the supplier shall further coordinate system requirements between the motor and VFD manufacturer and obtain written approval of the proposed combination from both manufacturers.
- F. Motor shall be guaranteed by the manufacturer for a period of two years from date of acceptance by the Owner against defects in workmanship or materials.

2.8 SHOP PAINTING

- A. Before exposure to weather and prior to shop painting, all surfaces shall be thoroughly cleaned, dry and free from all mill-scale, rust, grease, dirt and other foreign matter.
- B. Interior and exterior of pump column piping, interior of pump head assembly, and exterior of the bowl assembly shall be coated with 9-11 mils total D.F.T. Pota-Pox Series 20 epoxy coating as specified in Division 09900.
- C. Exterior of all pump discharge heads and motors shall be shop primed with primer compatible with field painting as specified in Division 9.
- D. All nameplates shall be properly protected during painting.
- E. Gears, bearing surfaces, and other similar surfaces obviously not to be painted shall be given a heavy shop coat of grease or other suitable rust resistant coating. This coating shall be maintained as necessary to prevent corrosion during periods of storage and erection and shall be satisfactory to the Owner/Engineer up to the time of the final acceptance test.

PART 3 - EXECUTION

3.1 GENERAL

- A. The pump and its components will be complete with a manufacturer's warranty for defects in materials and workmanship for a period of one year from the time the pump is placed into operation.
- B. All pumps motors and equipment shall be set, leveled, plumbed, and aligned before being permanently anchored. All wedges shall be stainless steel, placed not more than 12 in. on centers. All equipment shall be anchored as recommended by the manufacturer. Anchor bolts, nuts and washers shall be epoxy type and fabricated from 316 SS. All transfer pumps shall be set on 1-inch of non-shrink grout.
- C. Unless it is specifically permitted by the equipment manufacturer, piping connected to pumps shall be assembled so that no pipe stress or weight is transferred to the equipment. Flanged pipe fittings attached to equipment shall remain aligned with flange bolts removed.
- D. All equipment shall be installed and connected in strict accordance with the manufacturer's installation instructions.
- E. All equipment shall be mounted and installed in a neat manner. The edges of brackets cut in the field shall be filed smooth. The areas of brackets covered by equipment or by contact, with a structure shall be painted prior to the installation. Tubing runs shall be vertical or horizontal and secured with the necessary clips.

3.2 INSTALLATION

- A. Install all equipment in strict conformance with the manufacturer's specifications and industry standards. Perform all work in a workmanlike manner.
- B. Manufacturer's representative for pumps shall inspect installation for correctness and compliance with manufacturer's specifications and submit written certification that equipment is ready to be placed in service.
- C. No piping connecting any of the equipment will be jacked, pried or forced in to position in any way. All piping must mate perfectly with the equipment it is attaching prior to installation of flange bolts or other connecting devices.

3.3 PERFORMANCE

- A. The manufacturer will warrant that the performance of the pump will conform with manufacturer's certified pump performance curve. The pump must operate within the tolerances of the Standards of the Hydraulic Institute. Curves published for similar pumps by another manufacturer will not be acceptable for this purpose.

3.4 START-UP

- A. Contractor to coordinate pump manufacturer to have a qualified representative mate the pump to the motor. Manufacturer must provide a qualified representative to certify the pump performance. This service shall consist of a one 8-hour visit for each type of similar pump and motor.
- B. After initial start-up under the supervision of a qualified representative of the pump manufacturer, a preliminary running-in period will be provided for the Contractor to make field tests and necessary adjustments.

- C. Coordinate field tests for pumps in conformance to specified operating conditions with pump manufacturer. Record initial flow, head, voltage and amperage for each power leg. Adjust tolerances, if necessary and retest. Confirm that the amplitude and frequency of vibration during pump operation is within the tolerances of the Standards of the Hydraulic Institute. Measure noise (dBA) adjacent to pump, and at 10 feet and 50 feet away.
- D. At the end of the specified period of operation, the pumps will be accepted if, in the opinion of the Owner/Engineer, the pumps have operated satisfactorily without excessive power input, wear, lubrication, or undue attention required for this operation, and if all rotating parts operate without excessive vibration or noise at any operating head.
- E. Pump and piping installed shall be disinfected in accordance with Martin County Utilities and Solid Waste Department requirements, and AWWA standards, and Section 02670 Pressure Testing and Disinfection prior to being placed in service.

3.5 SPARE PARTS

- A. The following spare parts will be furnished for each pump provided:
 - 1. One set of spare mechanical seals shall be provided.
 - 2. Impeller wear ring for each stage.
 - 3. Two complete sets of gaskets, o-rings, etc.
- B. Store spare parts, drivers, etc. in strict accordance with manufacturer's recommendations. Notify the Owner in writing of any special storage maintenance required and provide such maintenance until final acceptance of contract.

3.6 OPERATIONS AND MAINTENANCE TRAINING

- A. The Contractor shall coordinate the services of qualified factory service representatives to instruct the Owner's personnel in the operation and maintenance of the pump and motor units, including step-by-step troubleshooting with necessary test equipment. Instruction shall be specific to the model of equipment furnished. This service shall consist of a one 8-hour visit for each type of similar pump and motor.
- B. Training sessions shall be scheduled not less than two weeks in advance. Training materials shall be provided to each of the Owner's personnel in attendance and shall remain with the trainees.
- C. All costs for transportation, lodging, subsistence, and other incidental costs for the manufacturer's representative during the installation, testing, and instruction which exceeds the time furnished by the pump manufacturer's representative as stated in the vendor quotes shall be borne by the Contractor at no cost to the Owner.

- END OF SECTION -

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 13080
VIBRATION AND ALIGNMENT

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. It is the intent of this section to set forth the testing required to be performed to ensure that alignment and vibration is within the specified tolerances. The testing shall be performed and corrective action taken for all equipment/motor installations which equal or exceed 20 horsepower. The Contractor will be fully responsible for all costs associated with the testing, corrective action and re-testing whether or not the initial tests prove the installation was within specified tolerances. If the testing indicates that the equipment does not meet specified tolerances, corrective action shall be taken and the equipment re-tested until acceptable results are obtained.

1.2 TOLERANCES:

- A. The vibration due to unbalance does not exceed hydraulic institute (maximum velocity of 0.4 inch/second) NEMA standards.
- B. The vibration shall not be destructive to the equipment in any way. Velocity due to any factor other than unbalance shall not exceed 0.08 inch/second velocity.

1.3 TESTING FIRM REQUIREMENTS

- A. One firm shall perform the vibration test, alignment, and corrective action. Multiple firms to perform this work will not be acceptable. The qualifications of the company to perform the testing shall be submitted to the Engineer for approval. Qualifications shall include the following.
 - 1. Names, experience, and individual qualifications.
 - 2. List of previous customers, (last two years), including telephone numbers.
 - 3. References for similar work.

PART 2 - PRODUCTS

2.1 VIBRATION AND ALIGNMENT

- A. Vibration analysis shall be performed on all installed pumps and motors (20 horsepower or larger only). The report of the analysis will include the following:
 - 1. Vibration Profiles (vibration profile shall be generated by a recorder. Handheld recorders used to hand generate charts or graphs are not acceptable).
 - 2. Machine generated vibration tolerance nomograms and severity charges shall provide a visual hard record copy of all frequencies. Charges for velocity and displacement shall be submitted.
 - 3. Instructions for reading the report data.
 - 4. List problem areas, etc., due to heat, vibration, and alignment.

PART 3 - EXECUTION

3.1 VIBRATION AND ALIGNMENT REPORTS

- A. Vibration reports will be submitted before substantial completion or pump/motor service start-up which ever occur first. All vibration profiles are to be submitted irrespective of results. Vibration profiles will be repeated until the equipment/motor conform to Part I requirements.

3.2 VIBRATION TEST

- A. The Engineer shall witness all vibration tests. The Contractor shall give the Engineer seven days written notice prior to a vibration test. Vibration reports shall be submitted in accordance with Section 01300, Submittals.

3.3 CORRECTION OF VIBRATIONS PROBLEMS INDICATED BY VIBRATION REPORT

- A. All on site corrective action in the form of balancing, alignment shall be performed by the personnel performing the vibration testing and are subject to the approval of the Engineer.

- END OF SECTION -

SECTION 13441
INSTRUMENTATION COMPONENTS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. This section provides information for instrumentation system components. The instrumentation components shall be furnished, installed, tested and calibrated complete, as described in this section, relevant other sections and as shown on the drawings. The Contractor shall calibrate all transmitters located at the ground storage tank.

1.2 RELATED SPECIFICATIONS

- A. Section 11930 – Pumps – General
- B. Section 15100 – Piping and Valves
- C. Section 16050 – Basic Materials and Methods

1.3 QUALITY CONTROL

- A. Instrumentation components shall conform to ISA standards.

1.4 SUBMITTALS

- A. Submittals shall conform to Section 01300.
- B. Provide component mounting and/or installation details as per manufacturers requirements.

1.5 MANUFACTURER CONTINUITY

- A. Wherever possible, all components shall be furnished from one manufacturer in order to facilitate installation, calibration, system function and Owner operation and maintenance.
- B. All components furnished herein shall be compatible with other portions of the control system specified elsewhere.

PART 2 - PRODUCTS

2.1 FLOW DEVICES

- A. Instrument Flow Meters
 - 1. Flow meters used to monitor flow through conductivity, pH and turbidity measuring devices shall be acrylic-bodied, variable area flow meters with the appropriate range for the instrument. Flow meters shall be equipped with removable stainless steel float and guide assembly. Flow meters shall be designed for panel mounting and shall be equipped with an integral 316 SS flow rate adjustment valve. The flow meters shall have 1" MNPT PVC connections, EPR elastomers O-rings. The flow meters shall be manufactured by King Instrument Company, Model 7530 series, or equal.
- B. Process Flow Meter
 - 1. The flow meter shall be an insertable electromagnetic averaging flow meter suitable for water conditions. The sensor shall be furnished with a remote transmitter and enclosure,

NEMA 4X. The enclosure shall include a keypad and display that can be used to access and change all set up parameters. In addition, the enclosure shall display engineering units, velocity, totalizer, alarm status, and flow rate expressed as percent of full scale, one flow proportional contact closure or frequency output, one 4-20 mA output of flow rate. All water meters not located inside of a building shall be equipped with a factory provided sun shield. The source voltage shall be 120 VAC/60 Hz.

2. Flow shall be in English Standard or Metric units. The flow meter shall consist of five pairs of carbon sensor electrodes located across a fiberglass sensor which spans the entire diameter of the pipe.
3. The flow meter shall be designed to install in a 2" ductile iron tapping saddle on ductile iron pipe, in a 2" PVC tapping saddle on PVC piping or a 2" welded half-coupling on stainless steel piping, with either a full port corporation stop, ball valve or gate valve. The valve shall be 316 stainless steel unless located in a finish water pipe. The insertion hardware exposed to flows shall be 316 stainless steel with silicone rubber compression seals. The cable shall have a polyurethane outer jacket. The meter shall have an accuracy of $\pm 1\%$ of reading from 0 to ± 20 ft/s. Repeatability for the meter must be .20% of range. The flow meter shall be Model No. 395L as manufactured by McCrometer.

C. Flow Switches

1. The eyewash flow switches shall have a lower body which holds a flow vane and one magnet and shall actuate a separate magnet housed in an adjoining electrical housing above. The upper and lower housing shall be constructed of stainless steel with NPT threads. The electrical housing shall be removable for inspection or replacement without shutting down the pipeline, and be constructed of stainless steel.
2. The flow switch shall be a normally open contact and shall be actuated with a minimum flow of 2.0 gpm. The vane shall be stainless steel 11/16" wide by .020" thick. The switch shall be mountable in any position.
3. The electrical switches shall be an SPDT single snap action microswitch rated for 5 amp, 120/250 VAC, 60 Hz. Switches shall be W.E. Anderson, Model No. V4, or approved equal.
4. The flow switch shall be a normally open contact and shall be actuated with a minimum flow of 200 gpm. The vane shall be stainless steel 11/16" wide by .020" thick. The switch shall be mountable in the horizontal position in a 2½" PVC tapping saddle.
5. The electrical switches shall be an SPDT single snap action microswitch rated for 5 amp, 120/250 VAC, 60 Hz. Switches shall be W.E. Anderson, Model No. V4, or approved equal.

D. Cleaning System Flow Meter

1. The meters furnished under these specifications shall comply with the applicable provisions of American Water Works Association Standard No. C704-91 for cold water meter.
2. Corrosion resistant materials shall be used throughout the mechanical enclosure. Except for the register assembly, no aluminum materials shall be used. Surfaces of all other parts shall be treated with a fusion-bonded impervious coating. Except for members in the register assembly, all rotating members shall either be jewel or ball bearing mounted.
3. The impeller shall be made of a plastic or other corrosion resistant material of a rigid but resilient nature that will not flex or otherwise change in dimension when subjected to a high flow of water and be capable of withstanding temperatures of 160-degrees F without slumping or warping. The impeller shall be factory tested, calibrated and adjusted to

maintain accuracy of $\pm 2\%$ over the normal flow range and remain accurate without the use of change gears.

4. The impeller shall be mounted on a non-corrosive shaft and bearing assembly and shall have a provision for sustaining thrust at maximum flows. The impeller shall be magnetically coupled to connecting shafts through a sealed housing to eliminate corrosion and friction.
5. The drive mechanism from the impeller coupling to the register shall be a flexible driveline. The drive mechanism shall be lubricated and sealed at the factory.
6. The meter instrument shall be driven by axial alnico magnets located on the impeller shaft and on the same axis and shall be completely sealed from water pressure.
7. The flanged flow meter shall be constructed of carbon steel with fusion-bonded epoxy coating, equipped with 150# flanges. Flow meter shall be installed with sufficient upstream and downstream pipe diameter lengths. Straightening vanes shall be provided as necessary to ensure reliable flow readings.
8. The register shall be on a common axis with the impeller support and shall be rigidly supported by the housing support plate or drop pipe. The register shall consist of an instantaneous indicator and totalizer which shall be mounted perpendicular to the direction of flow and can be viewed through a transparent cover. The totalizer shall be six-digit, straight reading, driven by a positive direct drive mechanism from the impeller coupling, and shall register gallons. Meter shall be McCrometer Model No. MW500, or equal.

2.2 PRESSURE DEVICES

A. Pressure Gauges

1. Pressure gauges shall be liquid-filled, bourdon tube gauges for line or panel mounting, as required. Gauges shall have bourdon tubes of 316 stainless steel, and 316SS connectors. Cases shall be stainless steel, with acrylic or shatter proof glass windows. Gauges shall be 4-1/2" diameter, with 1/2" MNPT bottom mount connections. Scales will be black on white background, 270 deg. span, appropriate to the application. Normal reading shall be at 1/2-2/3 of full scale. Gauge range shall be 0-160 psi, 0-10 psi, 0-30 psi, as required by the stream which it is monitoring.
2. Gauges requiring an isolation diaphragm as called for and as indicated on the drawings shall be supplied with an internal isolator, or external diaphragm seal. In either case, the bourdon tube shall be evacuated and filled with oil prior to assembly of the gauge with the isolator. Gauges and isolators shall be factory assembled and shipped as a unit.
3. All gauges shall be installed with snubbers, isolation tees for testing, isolation ball valves and be connected with 316 stainless steel tubing unless otherwise noted.
4. Pressure gauges shall be as manufactured by Ashcroft, or U.S. Gauge.

B. Pressure Switches

1. Pressure switches shall be watertight die cast aluminum enclosures, NEMA 4, with Teflon/stainless steel actuator seals applicable to its exposed environment. Switching elements shall be narrow dead band type SPDT, 125 VAC, 15A. Switches shall be manufactured by United Electric.

2.3 TRANSMITTERS

A. Differential Pressure Transmitters

1. The differential pressure transmitters used to monitor pressure losses across the NF trains shall have solid state circuitry and shall be of the two-wire type. Transmitters shall be suitable for operation in ambient temperatures from -40° to 185° F, process temperature -40° to 250° F and relative humidity from 0 to 100%. All transmitters shall be constructed of corrosion-resistant 316L Stainless Steel including isolating diaphragms, drain/vent valves, flanges and adapters. O-rings shall be Viton material. The transmitter shall be silicone oil filled and have an aluminum NEMA 4X housing. Transmitter shall have overrange protection up to 2,320 psig on both ports. The transmitters shall be equipped with a 2" scale meter for local indication. Accuracy shall be .04% of calibrated range with repeatability of 0.1 percent. The transmitter output shall have 4 – 20 mA dc analog signal user selectable linear or square root, with a superimposed digital signal, using HART protocol. The analog output shall be adjustable remotely with a field communicator or control system. Zero and span adjustments shall also be available on the transmitter. Transmitter shall include stainless steel panel mounting brackets and 3-valve manifold. The transmitter shall have zero elevation and suppression regardless of output specified. The transmitters shall be factory calibrated from 0-100 psi. Transmitters shall be 266 DSH as manufactured by ABB.
 2. Each transmitter shall be provided with a 316SST process shutoff valves, and ½" 316 SST. tubing and bracket for mounting as required. Each transmitter shall be supplied with power and signal surge protector (120 VAC and analog) in NEMA 4X enclosure, Edco model SLAC-12036 or approved equal. Transmitters shall be factory calibrated to the required range.
- B. Pressure Transmitters
1. Transmitters used to measure process pressure shall have all solid-state electronic circuitry and shall be of the 2-wire type, which requires no direct power connection to the transmitter. Transmitters shall be suitable for operation in ambient temperatures from -40° to 185° F, process temperature -40° to 250° F and relative humidity from 0 to 100%. All transmitters shall be constructed of corrosion-resistant 316L Stainless Steel including isolating diaphragms, drain/vent valves, flanges and adapters. O-rings shall be Viton material. The transmitter shall be silicone oil filled and have an aluminum NEMA 4X housing. Transmitter shall have overrange protection up to 8,700 psig on both ports. The transmitters shall be equipped with a 2" scale meter for local indication as indicated and required on the drawings. Local indication shall not be included unless specifically called for. Accuracy shall be .04% of calibrated range with repeatability of 0.1 percent. The transmitter output shall have 4 – 20 mA dc analog signal user selectable linear or square root, with a superimposed digital signal, using HART protocol. The analog output shall be adjustable remotely with a field communicator or control system. Zero and span adjustments shall also be available on the transmitter. Transmitter shall include stainless steel panel mounting brackets and single valve manifold. The transmitter shall have zero elevation and suppression regardless of output specified. The transmitters shall be factory calibrated from 0-100 psi. Transmitters shall be Model 266GST as manufactured by ABB. Range shall be 0-300 psig for the NF trains.
 2. Each transmitter shall be provided with a 316SS process shutoff valve, and ½" S.S. tubing and bracket for mounting as required. Each transmitter shall be supplied with power and signal surge protector (120 VAC and analog) in NEMA 4X enclosure, Edco model SLAC-12036 or approved equal. Transmitters shall be factory calibrated to the required range.

2.4 CONDUCTIVITY ANALYZER/TRANSMITTER

- A. The conductivity sensor and transmitter shall be products of the same manufacturer. The cable between the sensor and the transmitter shall be supplied by the manufacturer. The conductivity equipment shall be as manufactured by Hach Company.
- B. The sensor shall be of a corrosion resistant construction. The sensor assembly shall be designed for flow application with $\frac{3}{4}$ or 1-inch NPT process connections. The sensor assembly shall be designed for automatic temperature compensation. Each sensor shall be provided with a maintenance kit, which shall include a spare conductivity electrode and other spare parts as recommended by the manufacturer.
- C. The transmitter shall be enclosed in a fiberglass NEMA 4 housing. The transmitter shall contain an indicator with a 4- inch scale engraved in conductivity units (micro-mhos/cm²). The analyzer shall be powered by a 120 VAC, 1 \emptyset source. The transmitter shall have an isolated 4-20 mA dc signal which is linearly proportional to the measured conductivity range. The analyzer shall be model sc1000 with model 3422 compression fitting sensor and a Variopol (VP) watertight connector and 10-foot cable as manufactured by Rosemount.

2.5 TANK LEVEL DEVICES

- A. Level Transducer/Transmitter
 - 1. A continuous ultrasonic level transducer/transmitter with non-contacting sensor shall be provided for the bulk tanks and cleaning tanks as shown on the drawings. The sensor/transmitter shall be installed on the tank fitting.
 - 2. The sensor shall be manufactured of PVDF construction, have an 8° beam angle, and be mounted in the center of the tank for each respective tank. A pipe extension and necessary threaded coupling/bushings shall be provided should the sensor dead band require space between high liquid level and sensor face.
 - 3. The transducer/transmitter shall be mounted so that it will have a clear path perpendicular to the liquid surface. The path should not intersect the fill path, rough walls, seams rungs, etc.
 - 4. The transducer/transmitter shall have all solid-state circuitry and shall be of the two-wire type. The transmitter shall be suitable for operation in ambient temperatures from -40° to 140° F. The transmitter shall be NEMA 4X rated, have a 4-20 mA dc signal, one normally closed contact relay rated at 5A at 250 VAC non-inductive or 24 V dc, and shall have Hart protocol communication capability. Level transmitter shall be Sitrans Model LR1000 manufactured by Siemens, or equal.

2.6 PH ANALYZER/TRANSMITTER

- A. The pH sensor and transmitter shall be products of the same manufacturer. The cable between the sensor and the transmitter shall be supplied by the manufacturer. The pH equipment shall be as manufactured by Emerson Process Mgmt., Rosemount Analytical.
- B. The sensor shall consist of a glass pH electrode and a fouling resistant reference electrode. The reference electrode shall be self-contained and shall not require an external electrolyte reservoir. The sensor assembly shall be of the flow through design with 1-inch NPT process connections. The sensor assembly shall contain a preamplifier and shall be designed for automatic temperature compensation. Each sensor assembly shall be provided with a maintenance kit which shall include a spare pH electrode, a spare reference electrode, and

other spare parts as recommended by the manufacturer. Sensor shall be 399VP as manufactured by Rosemount Analytical.

- C. The transmitter shall be enclosed in a fiberglass NEMA 4 housing. The transmitter shall contain a back-lit LCD display with fully diagnostic messages and interface (English) in pH units. The transmitter range shall be 4 to 10 pH. The analyzer shall have automatic temperature compensation over a range of +32 to 100° deg F. The analyzer shall be powered by a 120 VAC source. The transmitter shall have an isolated 4-20 mA DC signal which is linearly proportional to the measured pH range. Analyzer shall be microprocessor based, Model 54e pH/ORP, as manufactured by Rosemount Analytical.

2.7 RUPTURE DISKS AND FLOW SWITCH

- A. Rupture disk shall be impervious graphite type disk which mates between class 150 ANSI flanges. Disk shall be rated for 50 psi pressure rating and shall be steel armored Teflon coated disk with armor ring. Disks shall be TD type as manufactured by Zook and shall conform to ASME Section VIII code.
- B. Flow indication as a result of rupture disk failure shall be provided using a flow switch or sensor integrally mounted with disk. Flow switch shall be mounted to pipe with welded boss, be 24VDC, low flow type as manufactured by GEMS, Inc. or equal. Flow sensor strip shall be SVT01A type as manufactured by OXECO compatible with rupture disk assembly.

2.8 CHLORINE ANALYZER

- A. The chlorine analyzer/transmitter shall operate with a continuous sample flow through the analyzer. The analyzer shall have a detection range from 0-5 mg/l of either free or total residual chlorine with an accuracy of +/-5% and have a sample period of 2.5 minutes. The analyzer shall have a six-character, 3-1/2" digit LCD readout. The sample temperature range shall be 41° to 104° F.
- B. The enclosure shall be IP-62 rated with a latchable gasketed door. The analyzer shall be powered by 120 VAC, 60 Hz with a 2.5-amp fuse. The analyzer shall have an output signal and two SPDT relays rated at 5A resistive load at 240 VAC.
- C. The chlorine analyzer shall be furnished with two bottles of each free chlorine reagent as spares. The analyzer shall be manufactured by the HACH Company, CL-17sc model.

2.9 FLUORIDE ANALYZER

- A. The fluoride analyzer/transmitter shall operate with a continuous sample flow through the analyzer. The analyzer shall have a detection range from 0.1 – 10 mg/L with an accuracy of +/- 10% and have a sample period of 4.2 minutes. The analyzer shall utilize an ion-selective, replaceable lanthanum fluoride crystal tip. The unit shall come complete including two calibration standards, mounting brackets, and two additional replaceable tips as spares.
- B. The analyzer shall have an LCD display, a corrosion resistant IP62 enclosure. The analyzer shall be powered by 120 VAC, 60 Hz and have a 4-20 mA dc output signal programmable over any portion of the 0.1-10 mg/L range. It should also include two SPDT relays with contacts rated at 5A resistive load at 230 VAC.
- C. The analyzer shall be manufactured by HACH Company, Model CA 610.

2.10 TEMPERATURE INDICATOR (TI-901)

- A. The temperature indicator shall be a bimetal thermometer, constructed of stainless steel and be hermetically sealed. The thermometer shall have an external screw to facilitate field calibrations. The thermometer shall be capable of rotating 360° and tilted in a 180° arc. It shall have a 3" dial face with ½" NPT Process Connection and have a 4" stem. The thermometer shall have an accuracy of +/-1% over the full scale. The thermometer shall be installed in a 316 S.S. thermowell.

PART 3 - EXECUTION

3.1 DRAWINGS AND DATA

- A. Complete fabrication, assembly, and installation drawings; wiring and schematic diagrams; and details, specifications, and data covering the materials used parts, devices, and accessories forming a part of the equipment furnished shall be submitted in accordance with submittals section. Submittal data shall be grouped and submitted in three separate stages. Each stage submittal shall be substantially complete. Individual drawings and data sheets submitted at random intervals will not be accepted for review. Instrument tag numbers indicated on the contract drawings shall be referenced where applicable.

3.2 INSTALLATION

- A. Installation shall be in complete accordance with manufacturer's instructions and recommendations.
- B. All electrical connections shall be made in conformance with the requirements of Division 16, Electrical.
- C. Once installation is complete, touch up damaged paint with manufacturer supplied paint.

3.3 START-UP AND TEST

- A. Contractor shall make adjustments required to place system in proper operating condition. Contractor shall field test and calibrate the equipment to assure that the system operates in accordance with these Specifications and to the satisfaction of the Engineer. The instruments shall be calibrated using standards whose accuracies are traceable to the National Institute of Standards Technology.
- B. Manufacturer's representative shall check and approve the installation before operation and assist Contractor in performing field tests and in calibration of the equipment.
- C. Contractor and system supplier shall provide the services of a factory-trained operating specialist for an eight-hour period for the instruction of the Owner's operating personnel.
- D. Unless otherwise noted, all instrumentation shall be coupled to the specific process with ½", 316 S.S. tubing.

- END OF SECTION -

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 15000
BASIC MECHANICAL REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. The general provisions of the Contract, including conditions of the Contract and Division 1 of the Specifications, apply to this Section.

1.2 SCOPE OF WORK

- A. The work of this Section consists of all labor, materials, equipment, transportation, and facilities necessary to provide a complete and satisfactory system ready to use. Whenever the words "Contractor" appears in this division, they refer to the Contractor for work specified in that Section. The Contractor shall examine all drawings and all sections of the specifications and shall be responsible for ascertaining to what extent other drawings and sections affect work herein specified. All errors, omissions, or code violations shall be reported to Engineer and Owner prior to commencement of work.

1.3 DEFINITION OF THE WORK

- A. Heating, Ventilation, Air Conditioning, work is specified in the applicable portions of Division 15.
- B. DEFINITIONS
 - 1. PIPING: As used herein, is defined as pipe, fittings, valves, flanges, unions, specialties and accessories and appurtenances necessary for, or incidental to, a complete system.
 - 2. DUCTWORK: As used herein, is defined as all air delivery and recirculation and exhaust ducts whether of sheet metal or other material, and includes all connections, accessories and appurtenances necessary for and incidental to a complete system.
 - 3. PROVIDE: As used herein, is defined as to furnish and install.
 - 4. CONCEALED WORK: As used herein refers to piping, ductwork, and accessories above ceilings and within walls, partitions, shafts or service spaces, not normally exposed to view and enclosed on all sides by finish materials. Access to piping and ductwork would demolish finish materials.
 - 5. CONCEALED BUT ACCESSIBLE: As used herein refers to piping, ductwork and accessories accessible above or through suspended ceilings, in walls at access panels or in chases with access door.
 - 6. EXPOSED WORK: Refers to piping or equipment normally exposed to view within rooms or open areas.

1.4 QUALITY ASSURANCE

- A. Codes and Standards: All work must be performed in accordance with the requirements of all pertinent federal and state codes; but if in contradiction to the plans or specifications, the proposed changes must first be referred to the Architect/Engineer for review and approval. Base bid shall include the more stringent of the contradicting methods.
- B. All work shall comply with but not limited to the latest edition codes as the followings:
 - 1. Standard Mechanical Code

2. Standard Plumbing Code
3. Standard Gas Code
4. SMACNA -Sheet Metal and Air Conditioning Contractors National Association
5. ASHRAE -American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.
6. OSHA - Occupational Safety Hazards Act
7. NEC - National Electric Code
8. NFPA - National Fire Protection Association
9. NFPA - Life Safety Code
10. ARI - Air Conditioning and Refrigeration Institute
11. ANSI - American National Standards Institute

1.5 COORDINATION OF WORK AND DRAWINGS

- A. Each contractor and subcontractor shall be responsible for coordinating the installation of his equipment/labor with the general contractor and work of other trades.
- B. The layout on the drawings is necessarily diagrammatic but shall be followed as closely as actual construction and as other work will permit. Changes from these drawings required to make this work conform to the building construction or other work of other trades shall be made by the Contractor without additional cost to the Owner but only with the prior approval of the Architect/Engineer and Owner. All major changes shall be shown on the shop drawings and submitted before changes are made.
- C. Contractor shall check all electrical supply and control connections of his equipment furnished under this Section of the specifications to insure proper operation of the equipment.
- D. Submittal of bid shall indicate the Contractor has included all required allowances in his bid. No allowances shall be made for any error resulting from Contractor's failure to visit job site and to review drawings.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Materials and equipment shall be new, unused, standard current products from manufacturers regularly engaged in the production of such equipment and shall bear label of the Underwriters' Laboratory for the intent use or shall be materials approved by the code enforcing agent.
- B. All hardware and accessory fittings shall be a type designed, intended or appropriate for use and compliment item with which they are used. They shall have corrosion protection suitable for atmosphere in which they are installed. All such hardware shall be U.S. standard size.
- C. Store and protect all materials from injury. Materials and equipment shall be kept clean and dry, free from deterioration by elements. Damaged materials shall not be installed.
- D. Follow installations directions and recommendations of material and equipment manufacturers.
- E. Equipment of a similar nature shall be identical (same manufacturer) throughout entire project and shall fit in the allocated spaces provided, complying with all clearances and codes.
- F. Finishes on equipment which have been scratched or marred shall be touched-up to match original finish or shall be completely refinished.

2.2 SUBSTITUTIONS

- A. All proposed substitutions will be in accordance with Section 01600.

PART 3 - EXECUTION

3.1 JOB CONDITIONS

- A. The Contractor shall provide drop cloths, or any other materials necessary to protect floors, walls, furniture, equipment, etc. from soil or damage.
- B. Any damage to the building or its contents incurred by the installation and/or testing of the systems installed shall be repaired promptly at no charge to the Owner.

3.2 EXECUTION

- A. Any air conditioning system component installed by Contractor that does not meet specification performance shall be replaced with no additional charge to Owner.
- B. When selecting a system component such as, pumps, fans that are less than 5% of design a next larger size must be secured.
- C. Each component shall meet or exceed performance specifications listed in the contract documents. Components with a lesser degree of performance documented in the final Test and Balance Report will not be accepted.
- D. A standard wiring color code shall be established for each electrical and control component of the system and all similar devices shall be wired identical maintaining the established coloring throughout the entire project.
- E. Air conditioning system components shall conform to federal, state and local sound emission guidelines. Any component which proves to be in violation shall be replaced or properly attenuated to comply with codes at no additional cost to Owner.
- F. Complete control wiring & pneumatic diagrams shall be included in accordance with Section 01700.
- G. Provide a schematic wiring diagram for each component of HVAC system including controls (pneumatic/electronic) located in mechanical room shall be mounted on wall at eye level in each mechanical room.

3.3 WARRANTY

- A. The warranty for all mechanical equipment (whether manufacturer's or contractor's warranty) shall comply with Section 01700 in the General Conditions.
- B. The mechanical contractor shall repair or replace any component of the HVAC system which proves to be defective.
- C. The contractor shall respond the same day after being notified and repairs shall be completed in a timely manner.

- END OF SECTION -

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 15100
PIPING AND VALVES

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. Furnish and install all piping, fittings, and valves as shown on the drawings and specified herein. In general, include all piping from tie-ins to and from equipment as shown on the drawings, including all piping appurtenances for a complete, operating piping system as specified herein.

1.2 RELATED REQUIREMENTS SPECIFIED ELSEWHERE

- A. Section 01300 – Submittals
- B. Section 01720 – Project Record Drawings
- C. Section 01730 – Operating and Maintenance Manuals
- D. Section 02200 – Earthwork
- E. Section 02670 – Flushing, Testing and Disinfection
- F. Section 05500 – Miscellaneous Metals
- G. Section 09900 – Painting
- H. Section 11209 – Membrane Softening System
- I. Section 11280 – Control Valves

1.3 REFERENCES

- A. AASHTO T180 - Moisture Density Relations of Soils Using a 10 lb Rammer and an 18 in. Drop.
- B. ANSI/ASTM D2466 Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
- C. ANSI/AWWA C104 – Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
- D. ANSI/AWWA C105 – Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems
- E. ANSI/AWWA C110 – Standard for Ductile-Iron and Gray-Iron Fittings, 3 In. Through 48 In. for Water and Other Liquids.
- F. ANSI/AWWA C111 – Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
- G. ANSI/AWWA C115 – Standard for Flanged Ductile-Iron Pipe with Ductile-Iron or Gray Iron Treaded Flanges.
- H. ANSI/AWWA C150 – Standard for the Thickness Design of Ductile-Iron Pipe.
- I. ANSI/AWWA C151 – Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids.
- J. ANSI/AWWA C153 – Standard for Ductile-Iron Compact Fittings, 3 In. Through 24 In. and 54 In. Through 64 In. for Water Service.
- K. AWWA C210 – Standard for Liquid-Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines.
- L. AWWA C220 – Standard for Stainless-Steel Pipe, 1/2 In. and Larger.
- M. AWWA C226 – Stainless-Steel Fittings for Waterworks Service, Sizes 1/2 In. Through 72 In.
- N. AWWA C228 – Stainless-Steel Pipe Flange Joints for Water Service—Sizes 2 In. Through 72 In.
- O. AWWA C504 – Standard for Rubber-Seated Butterfly Valves.
- P. AWWA C508 – Standard for Swing-Check Valves for Waterworks Service, 2 In. Through 24 In.

- Q. AWWA C509 – Standard for Resilient-Seated Gate Valves for Water Supply Service.
- R. AWWA C511 – Standard for Reduced-Pressure Principle Backflow-Prevention Assembly.
- S. AWWA C512 – Standard for Air-Release, Air/Vacuum, and Combination Air Valves for Waterworks Service.
- T. AWWA C600 – Standards for Installation of Ductile-Iron Water Mains and Their Appurtenances.
- U. AWWA C605 – Standard for Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water.
- V. AWWA C606 – Standard for Grooved and Shouldered Joints.
- W. AWWA C900 – Standard for Polyvinyl Chloride (PVC) Pressure Pipe, 4 In. Through 12 In. for Water Distribution.
- X. AWWA C901 – Standard for Polyethylene (PE) Pressure Pipe and Tubing, ½ In. Through 3 In. for Water Services.
- Y. ASTM D1785 Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
- Z. ASTM D2855 Making Solvent Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings.
- AA. ASTM D2922 - Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
- BB. ASTM D3139 - Joints for Plastic Pressure Pipes using Flexible Elastomeric Seals.
- CC. ASTM F437-82 - Threaded Chlorinated Poly Vinyl Chloride (CPVC) Plastic Pipe Fittings, Schedule 80.
- DD. ASTM F439-87 - Standard Specification for Socket - Type Chlorinated Poly Vinyl Chloride (CPVC) Plastic Pipe Fittings, Schedule 80.
- EE. ASTM 493-85 - Solvent Cements for Chlorinated Poly Vinyl Chloride (CPVC) Plastic Pipe and Fittings.
- FF. ASTM A182 – Standard Specification for Forged or Rolled Alloy and Stainless-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service.
- GG. ASTM A240 – Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
- HH. ASTM A312 – Standard Specification for Seamless and Welded Austenitic Stainless-Steel Pipes.
- II. ASTM A380 – Standard Practice for Cleaning, Descaling, and Passivation of Stainless-Steel Parts, Equipment, and Systems.
- JJ. ASTM A403 – Standard Specification for Wrought Austenitic Stainless-Steel Piping Fittings.
- KK. ASMT A774 – Standard Specification for As-Welded Wrought Austenitic Stainless-Steel Fittings for General Corrosive Service at Low and Moderate Temperatures.
- LL. ASTM A778 – Standard Specification for Welded, Unannealed Austenitic Stainless-Steel Tubular Products.
- MM. ASME SEC IX – Welding and Brazing Qualifications
- NN. ASME B16.5 – Pipe Flanges and Flanged Fittings.
- OO. ASME B1.20.1 – Pipe Threads, General Purpose (inch)
- PP. ASME B16.9 – Factory Made Wrought Butt-Welding Fittings
- QQ. ASME B16.11 – Forged Steel Fittings, Socket Welding and Threaded
- RR. ASME B 31.3 – ASME Code for Pressure Piping
- SS. ASME B36.19 – Stainless Steel Pipe
- TT. MSS SP-43 – Wrought and Fabricated Butt-Welding Fittings for Low Pressure, Corrosion Resistant Applications

1.4 SUBMITTALS

- A. Submit under provisions of Section 01300.
- B. Product Data: Provide data on pipe fittings, valves, and accessories.
- C. Manufacturer's Certificate: Certify that pipe, fittings, and valves meet or exceed respective ANSI, AWWA, and/or NSF Standards.
- D. Shop drawings including piping layouts and schedules, including dimensioning, fittings, expansion joints, locations of valves and appurtenances, joint details, wall penetration details, methods and locations of supports and all other pertinent technical specifications for all piping to be furnished. Shop drawings shall include all data and information required for the complete piping systems. All dimensions shall be based on the actual equipment to be furnished. Types and locations of pipe hangers and/or supports shall be shown on the piping layouts for each pipe submittal. Not all dimensions will be checked by the Engineer, nor will detailed review be performed. CONTRACTOR shall be responsible for accurate dimensioning of piping systems.
- E. Submit copies of all material test reports (MTR) for all stainless steel used to construct the piping system. Material test reports must show compliance with applicable ASTM specifications.
- F. Complete piping design pressure calculations shall be submitted to the Engineer. The calculations shall be in conformance with the ASME B31.3 standards and the requirements specified herein.
- G. All welding procedures to be used, Welding Procedure Specifications (WPS), Qualification Test Records (PQR) and Welding Procedure Qualifications (WPQ), shall be submitted as a complete package for engineers' approval prior to the start of work.
- H. Submit copies of Visual Inspection procedures, reports and qualifications for personnel performing visual inspections.
- I. Submit Certificate of Conformance for completed piping spools.

1.5 PROJECT RECORD DOCUMENTS

- A. Accurately record actual locations of piping mains, valves, connections, top of pipe and/or invert elevations.
- B. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.6 QUALITY ASSURANCE

- A. Perform Work in accordance with Indian River County Utilities Minimum Design and Construction Standards, where applicable.
- B. Fabricated piping shall meet all ASME code requirements as specified herein.
- C. Valves: Manufacturer's name and pressure rating marked on valve body.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store valves in shipping containers with labeling in place.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Although they may not be specifically shown on the drawings or called for elsewhere in the Technical Provisions, the Contractor shall include the cost of all fittings, piping supports, and miscellaneous appurtenances needed to provide a secure, workable pipe and valve system. Equipment suction and discharge piping and other exposed piping shall be supported by reinforced concrete pedestals, piers, adjustable pipe supports, thrust restraints, hangers, and tie rods as necessary to insure a stable installation. Adjustable pipe supports or piers shall be arranged to relieve attached equipment of all strain due to the weight of the pipe, fittings, valves, and the contents of the pipe.

2.2 PRODUCT LIST

- A. All products shall conform to the Approval Product List, of the Indian River County Utilities minimum Design and Construction Standards, latest edition, unless specifically specified herein.

2.3 PIPING SCHEDULE – SEE TABLE 15100-1

2.4 DUCTILE IRON PIPE: DUCTILE IRON PIPE AND FITTINGS SHALL CONFORM TO AWWA C150, C151 AND C153, CLASS 250 (MINIMUM).

- A. Joints: Buried pipe shall be AWWA approved push-on or mechanical joint pipe (AWWA/ANSI C111/A21.11). Exposed joints shall be AWWA approved flanged joint pipe, in accordance with ANSI/AWWA C115, or as detailed on the drawings. Victaulic joints shall be grooved in accordance ANSI/AWWA C606 and shall utilize Victaulic Style 31 ductile iron couplings with EPDM gaskets.
- B. Fittings: Buried fittings shall be AWWA approved mechanical joint fittings. Exposed fittings shall be flanged fitting or as detailed on the drawings. Conform to AWWA C153.
- C. The internal surface of all piping and fittings shall be cement mortar lined and seal coated in accordance with AWWA C104, A21, unless other noted on plans.
- D. Restrained joint pipe shall be ductile iron Class 53, American Cast Iron Pipe Co., “Flex-Ring”, “Lok-Ring”, or mechanical joint coupled as manufactured by American Cast Iron Pipe Company, “Mega-Lug”, Star Grip Series 3000/4000 or approved equal. Restrained joint pipe shall be constructed on all new watermains adjacent to all bends, crosses, tees, etc., where a change in direction occurs. Refer to manufacturer’s Design Standards for restrained pipe lengths. All fittings 16" and larger shall be restrained and shall include 3 full pipe lengths of restrained pipe and beyond fittings.
- E. Grooved pipe couplings for ductile iron piping shall be ductile iron AWWA cast fittings with rigid radius grooves in accordance with AWWA C110 for center-center dimensions and AWWA C153 or ANSI 21.1 for wall thickness. Fittings shall be interior coated with NSF listed coating with a SSPC-SPA equivalent surface preparation prior to coating. Fittings which need to be tapped shall meet ANSI B16.1 dimension locations.
- F. Couplings shall be ductile iron grooved end couplings suitable for performance on steel, stainless steel, and PVC schedule pipe. Couplings shall be galvanized style 31 flexible couplings, as manufactured by Victaulic, or equal.
- G. All gaskets to be manufactured from EPDM. Flanged gaskets to be Toruseal as manufactured by American Ductile Iron Company.
- H. All hardware, bolts, washers, nuts and etc. for aboveground joints to be 316 stainless steel.

2.5 PVC PIPING

A. AWWA C900

1. All PVC pipe shall meet AWWA C-900 and AWWA C-905 Standards and NSF requirements for potable water application. PVC pipe 4" through 12" shall be class 150, DR 18 pipe conforming to AWWA C900. Pipe greater than 12" shall conform to AWWA C905, DR 18 or better.
2. Fittings used in conjunction with the C900 PVC pipe shall be ductile iron, or PVC push-joint pressure rated fittings (SDR-35 min) as detailed on pipe schedule, mechanical joint.
3. PVC for potable watermains shall be blue in color. Raw water and wastelines shall white in color.
4. Markings on pipe shall be in accordance with Indian River County Standards.

B. Schedule 80 PVC Piping

1. Rigid PVC (polyvinyl chloride) compound used in the manufacturer of schedule 80 pipe shall be Type I, grade 1 as identified in ASTM D1784. The pipe shall be NSF rated for potable water.
2. PVC schedule 80 shall meet the requirements of ASTM standard D1785 for physical dimensions and tolerances.
3. The marking on PVC Schedule 80 pipe shall meet the requirements of ASTM D1785 and state the material designation code, nominal pipe size, schedule of pipe, pressure rating in psi for water at 73 degrees-F., the ASTM designation number D1785 and the NSF seal for potable water.
4. Fittings used shall be PVC Schedule 80 and solvent welded in accordance with ASTM D1785.
5. Small Diameter PVC Pipe: PVC pipe smaller than 4-inch shall be schedule 80 PVC plastic pipe with solvent weld fittings in accordance with ASTM D-1785.

2.6 STAINLESS STEEL PIPE: ANSI/ASTM A312, SCHEDULE 10S, 10, 40

A. Piping

1. Stainless steel pipe shall be designed per ASME B31.3.
2. Stainless steel piping shall be type 316/316L dual grade.
3. Stainless steel piping shall conform to ASTM A312, Austenitic steel pipe, welded, seamed, grade TP 316L with a minimum yield of 25,000 psi and AMSE allowable design stress of 16,700 psi at temperatures less than 200-degrees F. All pipe shall have a weld quality factor of 0.8.
4. Only seamless or one (1) longitudinal seam shall be permitted unless otherwise required for fabrication of pipe in accordance with ASTM A778 or A312.
5. Welded joints in piping 3-inches in diameter or larger shall be full penetration butt welds, unless otherwise shown on the Contract Drawings. Joints in piping less than 3-inch diameter shall be threaded, unless otherwise shown on the Contract Drawings.
6. Pipe threads shall conform to ANSI/ASME B1.20.1, NPT, and shall be full and cleanly cut with sharp dies. Not more than three threads at each pipe connection shall remain exposed after installation. Ends of pipe shall be reamed, after threading and before assembly, to remove all burrs.
7. Size shall be nominal pipe size (NPS) designation as shown with Schedule 10S, 10, or 40-wall thickness per ANSI B36.19 and as indicated on the drawings or specified herein.

B. Pipe Fittings

1. Fittings ranging from three (3) inch to twenty-four (48) inches shall be manufactured in accordance with ASTM A403, All fittings are made from the same material and wall thickness as the pipe unless a thicker wall is required per ASME B31.3.
 2. Fittings smaller than 3-inch(es) shall be threaded, unless otherwise specified in the Contract Drawings, materials shall conform to ASTM A-182 forged, Class 150 lb or 3000 lb WP, dimensions conforming to ANSI B16.11 and shall be the same material as the pipe.
 3. All fittings 3-inch through 24-inch in size will have dimensional tolerances in accordance with MSS SP-43 for wall thickness schedules 10s and less, and with ANSI B16.9 for schedules heavier than 10s.
 4. All piping manifolds shall be shop fabricated in accordance with ASME B31.3 using only extruded outlets.
- C. Outlets and Branches
1. Outlets of size 3 inches and smaller in piping 4 inches and larger shall be 3,000-pound WOG manufactured in accordance with ASTM A182 for materials, ANSI B16.11 for dimensional and threads shall comply with ASME B1.20.1.
 2. Tees shall be used where outlets larger than 3-inches are proposed. As an alternate, fabricate branched or extruded outlets from specified pipe designed in accordance with B31.3.
 - a. Where fabricated extruded branches (pull tees) are used, pressure rating calculations shall be furnished and submitted to the Engineer for review, demonstrating that the fabrication meets the specifications herein. All calculations shall be based on ASME B31.3 Section 304.
- D. Pipe Flanges
1. Flanges shall be made from the same material as the pipe. Pressure class must be suitable for the design pressure and defined by the manufacturers calculations and shown on the piping drawings.
 2. Pipe flanges shall conform to ASTM A182, Class 150 per ANSI B16.5 (latest version). Flanges to be Class 150 or class 300, depending on service, raised face, serrated finish, forged A182 Grade F316L, slip-on or weldneck type. Class 150 and 300 flanges shall be rated for 230 psi and 600 psi, respectively, at a temperature less than 600 psi. Dimensions shall meet ANSI/ASME B16.5
 3. Pipe flanges shall match the connecting flanges on the adjacent fitting, valve, or piece of equipment
- E. Flange bolts and nuts shall be ASTM A193 and ASTM A194, Type 316, respectively. Never Seize shall be used on all stainless steel threaded fasteners.
- F. Flange gaskets shall be full faced, elastomeric type rubber (neoprene or EPDM), and meet the requirements of ANSI/AWWA C207. High pressure gaskets shall be fiber-reinforced type. Gaskets shall carry an NSF-61 or food grade rating for contact with potable water.

2.7 STAINLESS STEEL TUBING

1. Tubing for sizes 1-inch and smaller shall be seamless austenitic stainless, grade TP 316L conforming to ASTM MA-632. Furnish Swagelok 316 stainless compression fittings, or equal.

2.8 HIGH-DENSITY POLYETHYLENE PIPING

- A. Polyethylene pipe and fittings shall be high-density polyethylene (HDPE) ASTM PE 3408/4710 ductile iron pipe (DIP) size for municipal piping systems. Pipe shall be DIP size SDR 11 or as otherwise noted on the plans and conform to AWWA C906 standards.
- B. Pipe shall meet NSF requirements for POTABLE WATER APPLICATIONS.
- C. Polyethylene pipe and fittings shall be joined by the heat butt fusion process to produce a homogenous, sealed, leak tight joint unless otherwise noted as a flanged connection. Fusion process shall meet the requirements of ASTM D-3261. At the point of fusion, the outside diameter and minimum wall thickness shall meet the outside diameter and minimum wall thickness specifications of ASTM F-714. Polyethylene fittings shall be made from the material meeting the same requirements as the pipe. Polyethylene fittings shall be fabricated by the same manufacturer of the pipe. The piping shall be homogenous throughout and free of visible cracks, holes, voids, foreign inclusions, fillers or other deleterious defects and shall be identical in color, density, melt index, and other physical properties throughout.
- D. All flanged connections shall be installed with performance pipe Back-up Rings and shall be AWWA C207 Class D. Back-up rings shall be constructed of 316 stainless steel. All flanged connections shall have a full-face EPDM flange gasket. Bolts shall be standard steel for underground applications and 316 Stainless Steel for above ground applications.
 - 1. HDPE spacers shall be provided at flanged connections to valves so as to not impede path of disc travel (open/close).
- E. All HDPE MJ Adapters (DIPS) shall be a DIPS Bell MJ Adaptor with a retaining gland, stainless steel reinforcing collar, gland ring, standard MJ gasket, and extra-long Tee-head bolts. The gland ring shall be ductile iron, C110, heavy body gland ring. Twist-off nuts, sized same as tee-head bolts, and shall be used to insure proper actuating of restraining devices.
- F. The manufacturer shall certify that samples of the manufacturers' production pipe have been tested in-house, in accordance with ASTM D-2837, and validated in accordance with the latest revisions of PPI ASTM D-2837 and validated in accordance with the latest revisions of PPI TR-3.

2.9 BUTTERFLY VALVES

- A. Butterfly valves in ductile pipelines shall be ductile iron body, bronze disc, resilient replaceable seat, lug style unless otherwise specified in Construction Drawings, and in conformance with AWWA C504 and rated for 150 psi working pressure. Buried valves shall be mechanical joint with 2-inch square nut. Exposed valves shall be lug style or flanged joint with operator as specified. Valve shall open when the stem is turned counterclockwise.
- B. Butterfly valves in stainless steel or PVC process pipelines which are rated for 150 psi or less shall be lug style with "O" ring shaft seal. Valve body inner lining and shaft seals shall be EPDM. Disc, shaft and bearings shall be 316 stainless steel. Valve body shall be epoxy coated (Rilsan coated) ductile iron. Valve shall be manufactured by Keystone or Durco, Inc.
- C. Butterfly valves in stainless steel piping which are rated for greater than 150 psi shall be stainless steel body conforming to ANSI B16.34. Valve body inner lining shall be TFE, seat shall be Viton. Disc, shaft and bearings shall be 316 stainless steel. Valve shall be lug style, unless otherwise indicated on drawings.
- D. Butterfly valves in PVC piping systems, including membrane cleaning and supply piping system, scrubber system, etc., shall be wafer style for ANSI flanges. Valve body and disc shall be PVC.

Seats and seals shall be EPDM. The disc shaft be stainless steel and have full engagement with the disc so as to be a non-wetted part isolated from the media by double "O" ring seals on top and bottom tru-unions of disc. The valve shall be capable of providing bubble-tight seating. The valve shall have a geared operator capable of providing adequate opening torque at the design 150 psi pressure rating. Valve shall be manufactured by ASAH/ America or approved equal.

- E. Under no circumstances shall flange seals or other materials be installed to butterfly valves to achieve bubble tight conditions.
- F. Actuators:
 - 1. Valves 6" and below not used for throttling - notched plate and handle.
 - 2. Valves larger than 6" on for throttling - gear unit with handwheel.
- G. Valves shall be manufactured by Keystone, Durco, ASAH/ America or equal.

2.10 GATE VALVES

- A. Resilient seated gate valves shall be non-rising stem (NRS) type, conforming to the latest revision of AWWA Standard C-509. The gate valves shall be mechanical joint type, fully enclosed, and suitable for buried service complete with a cast bronze 2" operating nut that is independent of the stem and wedge. The body shall be of cast iron and fully encapsulated inside and outside with a fusion bonded epoxy coating conforming to the latest revision of AWWA Standard C-550. The wedge shall be cast iron and completely encapsulated with a resilient EPDM elastomer permanently bonded to the wedge and have a rubber-tearing bond that meets ASTM D429. The stem shall be cast bronze and have an integral thrust collar with a Delrin thrust bearing above and below the collar. The gate valve shall have two O-rings set in machined grooves in the seal plate. The stem seal plate shall have an O-ring gasket to seal against the bonnet secured with bolts and nuts. The body, bonnet, and seal plate shall have a factory-applied thermoplastic epoxy coating on all interior and exterior surfaces. All internal parts shall be accessible for repair or maintenance without removing the body from the line. Valve shall be Style 4067 as manufactured by M&H Valve Co., Metroseal 250 as manufactured by U.S. Pipe, American-Darling or Clow.
- B. A geared side-mounted actuator with 2" operating shall be used where a top mount operator will not have adequate cover. Contractor to confirm prior to ordering valve.

2.11 PLASTIC BALL VALVES

- A. Ball valves 1/2 " through 2" shall be double true union type, CPVC, or PVC (same material as pipe) fitted for intended service unless otherwise noted. Valves shall be solvent welded to piping system unless otherwise noted. Valves shall be Nibco Chemtrol, style TU.
- B. Ball check valves shall be Chemtrol BC series, double true union

2.12 STAINLESS STEEL VALVES (LESS THAN 2" SIZE)

- A. Ball valves used for sulfuric acid service shall be Carpenter-20 S.S. alloy body, ball and stem with Teflon seats and seals.
- B. Regulating valves for throttling service for air Whitey Forged body regulating and shutoff valve, 316 stainless steel.
- C. Ball valves for gas services, Whitey Series 60, swing out style, 316 stainless steel body and ball, viton fitted cadmium plated handle.
- D. Shut off cocks for seal water, gauges, instruments, etc. Nupro plug valve, 316 stainless.

- E. Ball valves used for hydrofluorosilicic acid shall be Alloy C276 body, ball and stems with Teflon seats and stems.

2.13 1ST STAGE PERMEATE THROTTLING VALVE

- A. The 1st stage permeate throttling valve shall be 10" full port v-port ball valve with type 316 stainless steel body, bonnet and 150 lb rated flanges. Valve shall be equipped with live loaded packing sets for valve stem. Valve shall be equipped with anti-cavitation trim and designed to meet the conditions listed below. The valve shall be designed as the control valve for the NF train 1st stage permeate flow rates which can be manually throttled to impose back pressure on the 1st stage permeate to balance the flux rates of the 1st and 2nd stage. Final valve sizing shall be confirmed by the membrane system supplier.
- B. Materials
 - 1. Body, Bonnet, and Flange –ASTM A351 gr. CF8M
 - 2. Valve Ball – AISI 329 (duplex)
 - 3. Seat – 316 Stainless Steel
 - 4. Stem - Inconel 718
 - 5. Anti-cavitation Trim - Gr 4A Duplex Steel
 - 6. Packing - PTFE V-Ring, Std. Live-Loaded
- C. The valve shall be a Neles Q-RE v-port trim design to meet conditions listed below or approved equal. Conditions shall be confirmed by NF system supplier.

2.14 CHECK VALVES

- A. High Service Pump Check Valves
 - 1. Check valves shall be flanged, globe style, silent check valves. The valve shall be cast-iron body, bronze seat, bronze disc and stainless steel spring and screws. Valve seat shall be Viton. The silent check valve shall be fully automatic, spring loaded and double guided. The valve shall be class 150, 600 Series manufactured by APCO or approved equivalent
- B. Feedwater Pumps
 - 1. Check valves shall be flanged, globe style, silent check valves. The valve shall be 316 stainless steel body, 316 stainless steel seat, 316 stainless steel disc and 316 stainless steel spring and screws. Check valve shall have FKM (viton) resilient seat. The silent check valve shall be fully automatic, spring loaded and double guided. The valve shall be class 150, 600 Series manufactured by APCO or approved equivalent
- C. Membrane Clean-in-Place Pump Check Valve
 - 1. Check valve shall be dual-door, 150# rated for intended service, wafer style with 316 stainless steel body and valve plates. Valve shaft, shaft support and accessories to be 316 stainless steel. Springs shall be 316 stainless steel. Valve seal shall be EPDM. Valve must be installed with shaft in vertical position for horizontal flow application. Valve to be Technocheck, Duo-Chek, APCO series 300, or equal.

2.15 AIR RELEASE VALVES

- A. Air release valves shall be the type to automatically exhaust large quantities of air during filling and allow air to re-enter when draining or subject to a negative pressure.
- B. Valve shall be 2" with N.P.T. threaded inlet and outlet. The valve body shall be cast iron. The float, internal float guides and trim shall be 316 stainless steel. The seat shall be EPDM.

- C. Valve shall be manufactured by Crispin, Valmatic or approved equal.

2.16 TAPPING SLEEVE & VALVE

- A. Tapping sleeve shall be 304 stainless steel with flanged outlet and 304 stainless steel bolts. Sleeve shall be JCM #432, Smith/Blair (Rockwell) #662, Ford Fast, or equal. All sleeves shall have a minimum working pressure of 150 psi. All taps shall be machine drilled, no burned taps will be allowed.
- B. Tapping valves shall be resilient seat type with a flanged joint on the inlet side and a mechanical joint on the discharge side of the valve. Tapping valves shall have a 2-inch operating nut. Working pressure rating shall not be less than 200 psi. Gaskets between the flange faces of the tapping sleeve and tapping valve shall be 1/8" minimum thickness of neoprene rubber. Tapping valves shall be M&H Style #3751, American #865, Mueller #687, Clow or equal.

2.17 PIPE COUPLINGS

- A. Couplings shall be EPDM gasketed, sleeve-type, with diameter to fit existing pipe. Coupling shall include a steel middle ring, follower rings, wedge-section gaskets and truck head type steel bolts. Couplings shall be manufactured by Dresser, or equal.

2.18 THRUST RESTRAINT

- A. All bends, tees, crosses, reducers and dead ends shall be restrained through an approved means of mechanical joint restraint. All branch valves shall be restrained with MEGALUGS or approved equal or anchor tees. Any line terminated as a construction phase that is a known future extension shall have a plugged valve placed at the end and restrained with MEGALUGS or approved equal. Thrust restraints shall be placed in accordance with the detail shown in the construction plans.

2.19 SAMPLE POINTS

- A. All sample points shall be 316 stainless steel construction with smooth nose.

2.20 EXPANSION JOINTS

- A. Expansion joints shall be constructed of EPDM with 316 stainless steel split retaining ring, 316 stainless steel gussets, and 316 stainless steel control rods with compression sleeves. Expansion joint pressure rating shall be 250psi rated. Expansion joints shall be Invincible 501 as manufactured by Mercer Rubber Co. or approved equal.

2.21 HOSE BIBBS

- A. Hose bibbs for potable water shall be ¾" hose thread, similar to NIBCO, with screw on backflow or vacuum breaker device.

2.22 TRACER WIRE

- A. On all pipe construction 10 gauge, THHN insulated, solid copper wire shall be laid and secured on top of pipe. Wire shall be continuous from valve box to valve box, wrapped two times around each joint of pipe and extended inside each valve box to enable location devices to be attached without digging up the valve box.

- B. Service wire shall be laid in the trench with all services, connected to the main wire and wrapped around the service piping or tubing. Wire for raw water mains shall be white in color. Wire for water mains shall be blue in color.
- C. All wire connections shall be made with Dri-Splice wire connectors, Imperial Snip-Snap fittings filled with waterproof silicone sealant or approved equal. All splices shall be inspected and tested before burial.

2.23 VALVE BOXES

- A. All valve boxes shall be cast iron construction with 5" shafts, equal to Tyler pipe 6850 series. Valve box lids shall have a 1" deep skirt and shall have the words "RAW WATER", "WATER", "SEWER", "CHEMICAL", where appropriate, cast in the top. Valve operating nuts shall be brought to within 30" of the surface using valve extension rods if required.

2.24 TAPPING SADDLES

- A. Tapping Saddles shall be double strap saddles for ductile iron pipe in accordance with Indian River County Utilities standards. If pipe is PVC, use stainless steel wide band. Saddles shall have a heavy duty gasket. Saddles to be by Ford Meter Box, or equal.

2.25 HOSE BIBBS

- A. Hose bibbs for potable water shall be ¾" hose thread, similar to NIBCO, with screw on backflow or vacuum breaker device.

2.26 RUPTURE DISKS AND FLOW SWITCH

- A. Rupture disk shall be impervious graphite type disk which mates between class 150 ANSI flanges. Disk shall be rated for 50 psi pressure rating and shall be steel armored Teflon coated disk with armor ring. Disks shall be TD type as manufactured by Zook, and shall conform to ASME Section VIII code.
- B. Flow indication as a result of rupture disk failure shall be provided using a flow switch or sensor integrally mounted with disk. Flow switch shall be mounted to pipe with welded boss, be 24VDC, low flow type as manufactured by GEMS, Inc. or equal. Flow sensor strip shall be SVT01A type as manufactured by OXECO compatible with rupture disk assembly.

2.27 SHOWER/EYEWASH STATION

- A. The combination eye wash/shower wash station shall be floor mounted with 1¼" IPS supply lines. The combination models shall be certified by CSA to meet the ANSI Z358.1 – 2014 Standard for Emergency Eyewash and Shower Equipment. The units shall have flow switches.
- B.
- C. The eye wash stay-open ½" valve shall operate by push-plate only. The minimum flow shall be 0.4 gpm at 20 psi. The drench shower valve shall be a 1" IPS stay-open ball valve operated by a stainless steel pull rod with triangular handle. The drench shower shall exceed a minimum water flow of 20 gpm at 30 psi.
- D. Interior combination units shall be PVC. All exterior units shall be stainless steel. The units shall be manufactured by HAWS, Bradley, or equal.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that building service connection and municipal utility water main size, location and invert are as indicated.

3.2 PREPARATION

- A. Where applicable, ream pipe and tube ends and remove burrs.
- B. Remove scale and dirt, on inside and outside, before assembly.
- C. Prepare pipe connections to equipment with flanges or unions.

3.3 BEDDING

- A. Excavate trench and install pipe bedding as specified in Section 2200, Earthwork.

3.4 SURFACE CONDITIONS

- A. Inspection
 - 1. Prior to all Work of this Section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this work may properly commence.
 - 2. Verify that all equipment may be installed in accordance with all pertinent codes and regulations, the original design, shop drawings, and the reference standards.
- B. Discrepancies
 - 1. In the event of discrepancy, immediately notify the Engineer.
 - 2. Do not proceed with installation in area of discrepancy until all such discrepancies have been fully resolved.

3.5 PIPE INSTALLATION - GENERAL

- A. Take all precautions necessary to insure that pipe, valves, fittings, and other accessories are not damaged in unloading, handling, and installation. Examine each piece of material just prior to installation to determine that no damage has occurred. Remove any damaged material from the site and replace with undamaged material.
- B. Exercise care to keep foreign material and dirt from entering pipe during storage handling and installation. Close ends of in-place at the end of any work period to preclude the entry of animals and foreign material.
- C. All pipe shall be laid in a dry trench.
- D. Use only those tools specifically intended for cutting the size and material and type pipe involved. Make cut to prevent damage to pipe or lining and to leave a smooth end at right angles to the axis of the pipe.

3.6 TAPPING WATERMAINS

- A. Tapping sleeves shall not be installed within 3' of any joint or fitting. Before installation of tapping tee, the area to be tapped and the tapping tee shall be cleaned with potable water. After all sand, dirt, and debris have been removed from the main, the tapping tee, the tapping valve and the area where the tapping tee is to be installed on the existing main shall be swabbed with a chlorine or bleach solution with at least 100 ppm of chlorine. After the tapping tee is attached to the main, the gate valve shall be closed and tapping tee and gate valve assembly shall be pressured tested at 150 psi for a minimum of 15 minutes with water. The Engineer or Owner's

representative shall witness the pressure test. No visible leaks or loss of pressure shall be evident. After pressure testing, the main may be tapped. Only shell type cutters shall be used. The coupon from the hole that is cut shall be delivered to the Owner.

3.7 VALVES AND VALVE BOXES

- A. Install valves with operator stems in the vertical plane through the pipe axis and out of the plane of flow. Locate valves where shown on Drawings. Thoroughly clean before installation. Check valves for satisfactory operation.
- B. Equip all underground valves without gearing or operator switch valve boxes. Set box in alignment with valve stem centered on valve nut. Set the valve box to prevent transmitting shock or stress to the valve. Set the box cover flush with the finished ground surface or pavement.

3.8 PIPE PENETRATIONS

- A. Use sleeves where pipes, valve stem extensions, or equipment parts pass through poured in place concrete or masonry walls or slabs. Sleeves shall be either cast iron or fabricated steel wall pipe with intermediate flange seep ring of sufficient size to allow sealing around pipe and clearance for valve stems or equipment. Extend vertical sleeves through slabs 1-inch above top surface.
- B. Provide "Link Seal" pipe to wall closures manufactured by Thunderline Corporation, Wayne, Michigan, where shown on drawings or otherwise required. Seals shall be modular mechanical type, consisting of interlocking synthetic rubber links shaped to fill annular space between pipe and wall opening.
- C. Where new pipe must penetrate existing concrete walls of water bearing structures or into the top slab of potable water bearing structures, core drill to smooth inside finish and install with Link Seal. Seal any rebar exposure.
- D. Where new pipe must penetrate concrete wall on non-water bearing concrete structures, drill penetration in neat, workmanlike manner, install pipe, grout in place with non-shrink grout, and refinish surface to match adjacent.

3.9 THRUST RESTRAINT

- A. Provide reaction anchors of concrete blocking, metal harness, retainer gland type or restrained joint type at all changes in direction of pressure pipelines and as shown on drawings.
- B. Concrete reaction anchors shall bear against undisturbed earth and shall be of the size and shape necessary to resist service conditions of the pipe.
- C. Use metal harness restraints as shown on drawings.
- D. Where retainer glands are used, extreme care shall be taken so that each set screw is tightened as recommended by the manufacturer before the pipe is backfilled and tested. Retainer glands shall not be used on non-metallic pipe, or on any pipe 10-inch or smaller.

3.10 STAINLESS STEEL PIPE FABRICATION

- A. Stainless steel pipe shall be fabricated by Aerex Industries, Douglas Brothers, Felker Brothers Corp., or approved equal, which shall be the minimum standard of fabrication quality for this project. The shop shall carry ASME certifications for performing pipe fabrication and be able to provide pickling of all piping systems.
- B. Field Joints
 1. Field welding of stainless steel piping will not be permitted.

C. Flanged Joints

1. The diameter and drilling of flanges furnished in the piping shall be coordinated with the flanges for the valves and other equipment to be installed in the piping and conform to the standards specified herein. Blind flanges shall conform in diameter, drilling, and thickness to the flanges to which they attach and shall be reinforced as required to produce an airtight joint.

D. Threaded joints

1. Pipe threads shall conform to ANSI/ASME B1.20.1, NPT, and shall be full and cleanly cut with sharp dies. Not more than three threads at each pipe connection shall remain exposed after installation. Ends of pipe shall be reamed, after threading and before assembly, to remove all burrs.
2. Threaded joints shall be made up with Teflon threaded tape applied to all male threads.

E. Welded joints

1. All welds shall be sound and free from embedded scale or slag, shall have tensile strength across the weld not less than that of the thinner of the connected sections, and shall be airtight. Butt welds shall be used for all welded joints in line pipe assemblies.
2. All welding shall be in accordance with the Process Piping Code", ANSI B31.3
3. Beveled ends for butt-welding shall conform to ANSI B16.25. Beveled ends shall be free of paint, oil, rust, scale and other material that could negatively impact welding.
4. Welders for all piping shall be qualified per ASME Code Section IX for welding carbon steel and stainless steel piping, positions 2G and 5G. All welders will be required to present current qualification papers.
5. The Engineer shall have the right to perform any additional inspection of shop or field welds, at not additional cost to the Contractors, provided the welds pass the inspection. The Contractor shall repair all welds that fail inspection and burden the cost of retesting of any failed welds.

F. Acid Treatment (Pickling)

1. After shop fabrication, all stainless steel pipe, fittings, and appurtenances shall be pickled and passivated in accordance with ASTM A380.
2. All pipe and fittings shall be completely immersed for a minimum of 15 minutes in a pickling solution of 6 percent nitric acid and 3 percent hydrofluoric acid at 140 F. Parts shall be free from iron particles or other foreign material. A complete neutralizing operation, by immersion in a continuous fresh water bath, shall be required after the pickling operation. Passivate to uniform finish free of defects and scratches or pipe will be rejected. Electropolishing is not required.
3. Field pickling will not be permitted.

G. Inspection and Testing

1. Inspection and testing by an independent laboratory will not be required at the fabricating or coating shop; however, the pipe manufacturer shall furnish an affidavit of compliance certifying that all materials used and work performed comply with the specified requirements. Affidavits shall be furnished in accordance with the submittal section.

H. Cleaning

1. All pipelines shall be clean and free of dirt, rocks, debris, or other foreign material of any kind when placed in service.

2. The interior of all pipe and fittings shall be thoroughly cleaned of all foreign matter, grease, oil, or other hydrocarbons before being installed and shall be kept clean until the work has been accepted.
- I. Drawings and Data
 1. Drawings, specifications, and other data showing complete details of the fabrication, construction, verification that pickling will be performed, weld locations, and installation of pipe, fittings, specials, and connections, together with complete data covering all materials proposed for use, shall be submitted in accordance with the submittals section.
- J. Pressure Testing
 1. Pressure testing of piping system shall be conducted prior to connection to the NF trains and tested at 1.5 times its design operating pressure. Testing at design operating pressure shall be conducted with RO train operational.

3.11 PRESSURE TESTING AND DISINFECTION

- A. Flush, test, and disinfect system in accordance with Section 02670.

3.12 FIELD QUALITY CONTROL

- A. Compaction testing shall be performed in accordance with Section 2200.
- B. If tests indicate Work does not meet specified requirements, remove work, replace, and retest at no cost to Owner.
- C. Frequency of Tests: Minimum of one test per pipe branch.

**TABLE 15100-1
PIPING SCHEDULE**

Service & Location	Material	Schedule	Working Press (PSIG)	Type of Joints	Type of Fittings	Protective Coating		Remarks
						Interior	Exterior	
Feedwater Piping - Feed pump room, Process Room & NF Train	316/316L SST	10S	150	FLG, VIC	316/316L SST	-	-	See Specs
Interstage - NF Train	316/316L SST	10S	150	FLG, VIC	316/316L SST	-	-	See Specs
Concentrate - NF Train, Pipe Trench, Concentrate Treatment Facility	316/316L SST	10S	150	FLG, VIC	316/316L SST	-	-	See Specs
Permeate - NF Train, Pipe Trench, Permeate-Blend Water Connection	316/316L SST	10S	30	FLG, VIC	316/316L SST	-	-	See Specs
Concentrate - Buried	HDPE	DR-11	30	FUSION	HDPE	-	-	See Specs
Permeate Below - Buried	HDPE	DR 17	15	FUSION	HDPE	-	-	See Specs
Cleaning Supply & Return	PVC	80	60	SW, VIC	PVC	-	Paint	See Specs
Transfer Piping and Finished Water								
Piping Trench and above ground	DI	Class 53	100	FLG	DI	Cement Lined	Paint	
Below Ground	DI	Class 53	100	RJ	DI	Cement Lined	-	RJ as Required
Below Ground	HDPE	DR-11	100	FUSION	DI OR HDPE	Cement Lined	-	HDPE Piping w/ DI fittings to have fused MJ adapters
Fluoride	CPVC	80	15	SW	CPVC	-	Paint	

NaOH	HDPE, CPVC	80	50	FUS, SW	HDPE, CPVC	-	Paint if CPVC	
Air	316/316L SST	N/A	200					
Scale Inhibitor	HDPE	80	100	FUSION	HDPE	-	-	From pump skid to injection
Sulfuric Acid	ECTFE/ PVDF	SDR-21	60	FUS	ECTFE/ PVDF	-	Paint	Pre-engineered pump skid, feed piping to injection points

LEGEND

FLG	=	Flanged
MJ	=	Mechanical Joint
THD	=	Threaded
DI	=	Ductile Iron
RJ	=	Restrained Joint
SW	=	Solvent Weld
FUS	=	Fusion
SS	=	Stainless Steel
TF	=	Tube Fittings

- END OF SECTION -

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 15260
PIPING INSULATION

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Piping insulation.
- B. Jackets and accessories.

1.2 REFERENCES

- A. ANSI/ASTM C195 Mineral Fiber Thermal Insulation Cement.
- B. ANSI/ASTM C547 Mineral Fiber Preformed Pipe Insulation.
- C. ASTM B209 Aluminum and Aluminum alloy Sheet and Plate.
- D. ASTM C449 Mineral Fiber Hydraulic setting Thermal Insulating and Finishing Cement.
- E. ASTM E84 Surface Burning Characteristics of Building Materials.
- F. NFPA 255 Surface Burning Characteristics of Building Materials.
- G. UL 723 Surface Burning Characteristics of Building Materials.

1.3 QUALITY ASSURANCE

- A. Applicator: Company specializing in piping insulation application with three years minimum experience.
- B. Materials: Flame spread/fuel contributed/smoke developed rating in accordance with NFPA 255 and UL 723.

1.4 SUBMITTALS

- A. Submit product data under provisions of Section 01300.
- B. Include product description, list of materials and thickness for each service, and locations.
- C. Submit manufacturer's installation instructions under provisions of Section 01300.
- D. Correlate design requirements and manufacturer's applicable model capabilities.

PART 2 - PRODUCTS

2.1 THICKNESS

- A. In compliance with Florida Energy Efficiency Code.

2.2 JACKETS

- A. Exterior Applications:
 - 1. Aluminum Jackets: ASTM B209; 0.020 inch thick; smooth finish.

2.3 ACCESSORIES

- A. Insulation Bands: 3/4 inch wide; 0.015 inch thick aluminum. Bands and jackets shall be coordinated so metals are compatible.
- B. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum.
- C. Insulating Cement: ANSI/ASTM C195; hydraulic setting mineral wool.
- D. Finishing Cement: ASTM C449.

- E. Fibrous Glass Cloth: Untreated; 9 oz/sq yd weight.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Install materials after piping has been tested and approved.

3.2 INSTALLATION

- A. Install materials in accordance with manufacturer's instructions.
- B. Continue insulation with vapor barrier through penetrations with sleeves.
- C. In exposed piping, locate insulation and cover seams in least visible locations.
- D. Do not apply insulation until piping has been leak tested.
- E. On insulated piping with vapor barrier, insulate fittings, valves, unions, flanges, strainers, flexible connections, and expansion joints maintaining full thickness of insulation.
- F. On insulated piping without vapor barrier and piping conveying fluids 140 degrees F or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation at such locations.
- G. Provide an insert, not less than 6 inches long, of same thickness and contour as adjoining insulation, between support shield and piping, but under the finish jacket, on piping 2 inches diameter or larger, to prevent insulation from sagging at support points. Inserts shall be cork or other heavy density insulating material suitable for the planned temperature range. Factory fabricated inserts may be used.
- H. Neatly finish insulation at supports, protrusions, and interruptions.
- I. Jackets:
 - 1. Indoor, Concealed Applications: Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass cloth and adhesive.
 - 2. Indoor, Exposed Applications: For pipe exposed in mechanical equipment rooms or in finished spaces, insulate as for concealed applications. Finish with canvas jacket; size for finish painting.
 - 3. Exterior Applications: Provide vapor barrier jackets. Cover with aluminum jacket with seams located on bottom side of horizontal piping. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor barrier cement.
 - 4. Buried Piping: Provide factory fabricated assembly with inner all purpose service jacket with self-sealing lap, and asphalt impregnated open mesh glass fabric, with one mil thick aluminum foil. Shall be steel insulated with cellular glass maintaining a vapor seal and sandwiched between three layers of bituminous compound; outer surface faced with a polyester film.

– END OF SECTION –

SECTION 15410
PLUMBING PIPING

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Pipe and pipe fittings.
- B. Valves.
- C. Sanitary sewer piping system.
- D. Domestic water piping system.

1.2 REFERENCES

- A. ANSI/ASME B16.3 Malleable Iron Threaded Fittings Class 150 NS 300.
- B. ANSI/ASME Sec. 9 Welding and Brazing Qualifications.
- C. ANSI/ASTM B32 Solder Metal.
- D. ANSI/ASTM D2466 Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
- E. ANSI/AWS D1.1 Structural Welding Code.
- F. ASME Boiler and Pressure Vessel Code.
- G. ASTM A74 Cast Iron Soil Pipe and Fittings.
- H. ASTM B88 Seamless Copper Water Tube.
- I. ASTM B306 Copper Drainage Tube (DWV).
- J. ASTM D1785 Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
- K. ASTM D2729 Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
- L. ASTM D2855 Making Solvent Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings.
- M. ASTM D3033 Type PSP Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
- N. ASTM D3034 Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
- O. AWS A5.8 Brazing Filler Metal.
- P. AWWA C601 Standard Methods for the Examination of Water and Waste Water.
- Q. CISPI 301 Cast Iron Soil Pipe and Fittings for Hubless Cast Iron Sanitary Systems.

1.3 QUALITY ASSURANCE

- A. Valves: Manufacturer's name and pressure rating marked on valve body.
- B. Welding Materials and Procedures: Conform to ASME Code and applicable state labor regulations.
- C. Welders Certification: In accordance with ANSI/ASME Sec 9.

1.4 SUBMITTALS

- A. Submit product data under provisions of Section 01300.
- B. Include data on pipe materials, pipe fittings, valves and accessories.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Deliver products to site under provisions of Section 01600.
- B. Store and protect products under provisions of Section 01600.

- C. Deliver and store valves in shipping containers with labeling in place.

PART 2 - PRODUCTS

2.1 SANITARY SEWER PIPING, BURIED BEYOND 5 FEET OF BUILDING

- A. PVC Pipe: ASTM D3033 or D3034, SDR 35. Fittings: PVC. Joints: ASTM F477, elastomeric gaskets.

2.2 SANITARY SEWER PIPING, BURIED WITHIN 5 FEET OF BUILDING

- A. PVC Pipe: ASTM D2729. Fittings: PVC. Joints: ASTM D2855, solvent weld.

2.3 SANITARY SEWER PIPING, ABOVE GRADE

- A. PVC Pipe: ASTM D2729. Fittings: PVC. Joints: ASTM D2855, solvent weld.

2.4 WATER PIPING, BURIED BEYOND 5 FEET OF BUILDING

- A. Copper tubing: ASTM B88, Type K, hard drawn. Fittings: ANSI/ASME B16.29, wrought copper. Joints: ANSI/ASTM B52, solder, Grade 95TA.

2.5 WATER PIPING, BURIED WITHIN 5 FEET OF BUILDING

- A. Copper Tubing: ASTM B88, Type K, hard drawn. Fittings: ANSI/ASME B16.29, wrought copper. Joints: ANSI/ASTM B32, solder, Grade 95TA.

2.6 WATER PIPING, ABOVE GRADE

- A. Copper Tubing: ASTM B88, Type L, hard drawn. Fittings: ANSI/ASME B16.23, cast brass, or ANSI/ASME B16.29, wrought copper. Joints: ANSI/ASTM B32, solder, Grade 95TA.

2.7 FLANGES, UNIONS, AND COUPLINGS

- A. Pipe Size 2 Inches and under: 150 psig malleable iron unions for threaded ferrous piping; bronze unions for copper pipe, soldered joints.
- B. Pipe Size over 2 Inches: 150 psig forged steel slip on flanges for ferrous piping; bronze flanges for copper piping; neoprene gaskets for gas service; 1/16 inch thick preformed neoprene bonded.
- C. Grooved and Shouldered Pipe End Couplings: Malleable iron housing clamps to engage and lock, designed to permit some angular deflection, contraction, and expansion; "C" shape composition sealing gasket; steel bolts, nuts, and washers; galvanized couplings for galvanized pipe.
- D. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

2.8 GATE VALVES

- A. Up to 2 Inches: Bronze body, non rising stem and handwheel, inside screw, single wedge or disc, threaded ends.

2.9 SWING CHECK VALVES

- A. Up to 2 Inches: Bronze 45 degree swing disc, screwed ends.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt, on inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

3.2 INSTALLATION

- A. Provide non conducting dielectric connections wherever jointing dissimilar metals.
- B. Route piping in orderly manner and maintain gradient.
- C. Install piping to conserve building space and not interfere with use of space.
- D. Group piping whenever practical at common elevations.
- E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- F. Provide clearance for installation of insulation and access to valves and fittings.
- G. Provide access where valves and fittings are not exposed. Coordinate size and location of access doors with Section 08305.
- H. Slope water piping and arrange to drain at low points.
- I. Establish elevations of buried piping outside the building to ensure not less than 30 inches of cover.
- J. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
- K. Prepare pipe, fittings, supports, and accessories not prefinished, ready for finish painting. Refer to Section 09900.
- L. Establish invert elevations, slopes for drainage to 1/8 and 1/4 inch per foot as noted on drawing. Maintain gradients.
- M. Install valves with stems upright or horizontal, not inverted.
- N. Install a shutoff valve on one lavatory minimum per group restroom.

3.3 APPLICATION

- A. Install unions downstream of valves and at equipment or apparatus connections.
- B. Install brass male adapters each side of valves in copper piped system. Sweat solder adapters to pipe.
- C. Install gate valves for shut off and to isolate equipment, part of systems, or vertical risers.

3.4 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

- A. Prior to starting work, verify system is complete, flushed and clean.
- B. Ensure PH of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).
- C. Inject disinfectant, free chlorine in liquid, powder, tablet or gas form, throughout system to obtain 50 to 80 mg/L residual.
- D. Bleed water from outlets to ensure distribution and test for disinfectant residual at minimum 15 percent of outlets.
- E. Maintain disinfectant in system for 24 hours.
- F. If final disinfectant residual tests less than 25 mg/L, repeat treatment.

- G. Flush disinfectant from system until residual equal to that of incoming water or 1.0 mg/L.
- H. Take samples no sooner than 24 hours after flushing, from 5 percent of outlets and from water entry, and analyze in accordance with AWWA C601.

3.5 SERVICE CONNECTIONS

- A. Before commencing work verify invert elevations required for sewer connections, confirm inverts and ensure that these can be properly connected with slope for drainage and cover.
- B. Provide water service with backflow preventer.

– END OF SECTION –

SECTION 15430
PLUMBING SPECIALTIES

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Floor drains.
- B. Cleanouts.
- C. Backflow preventors.
- D. Water hammer arrestors.
- E. Hose bibbs.

1.2 REFERENCES

- A. ANSI/ASSE 1012 Backflow Preventers with Immediate Atmospheric Vent.
- B. ANSI/ASSE 1011 Hose Connection Vacuum Breakers.
- C. ANSI/ASSE 1013 Backflow Preventers, Reduced Pressure Principle.
- D. ANSI A112.21.1 Floor Drains.
- E. ANSI A112.26.1 Water Hammer Arresters.
- F. PDI WH 201 Water Hammer Arresters.

1.3 QUALITY ASSURANCE

- A. Manufacturer: For each product specified, provide components by same manufacturer throughout.

1.4 SUBMITTALS

- A. Submit shop drawings and product data under provisions of Section 01300.
- B. Include component sizes, rough in requirements, service sizes, and finishes.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Plumbing specialties are specified on drawing except the following.

2.2 BACKFLOW PREVENTERS

- A. Double Check Valve Assemblies: ANSI/ASSE 1012; Bronze body with corrosion resistant internal parts and stainless steel springs; two independently operating check valves with intermediate atmospheric vent. Backflow preventer shall be approved by Building Official.

2.3 WATER HAMMER ARRESTORS

- A. ANSI A112.26.1; sized in accordance with PDI WH 201, precharged suitable for operation in temperature range -100 to 300 degrees F and maximum 250 psig working pressure.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Coordinate cutting and forming of roof and floor construction to receive drains to required invert elevations.

3.2 INSTALLATION

- A. Install specialties in accordance with manufacturer's instructions to permit intended performance.
- B. Install a trap primer on each floor drain not receiving indirect waste.
- C. Install traffic type round covers on a grease interceptor serving food service areas.
- D. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Ensure clearance at cleanout for rodding of drainage system.
- E. Encase exterior cleanouts in 24 x 24 x 4 inches concrete flush with grade.
- F. Install cleanouts at the base of each vertical stack.
- G. Install cleanout at each change of direction of horizontal run.
- H. Install cleanouts at 50 foot intervals of horizontal runs.
- I. Install water hammer arrestors complete with accessible isolation valve.
- J. Install 3/4 inch hose bibbs/hydrants with vacuum breaker and gate valve on the exterior of all buildings with a maximum spacing of 150 feet.

– END OF SECTION –

SECTION 15440
PLUMBING FIXTURES

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Sinks
- B. Showers

1.2 REFERENCES

- A. ANSI A112.6.1 Supports for Off the Floor Plumbing Fixtures for Public Use.
- B. ANSI A112.18.1 Finished and Rough Brass Plumbing Fixture Fittings.
- C. ANSI A112.19.1 Enameled Cast Iron Plumbing Fixtures.
- D. ANSI A112.19.2 Vitreous China Plumbing Fixtures.
- E. ANSI A112.19.3 Stainless Steel Plumbing Fixtures (Designed for Residential Use).
- F. ANSI A112.19.4 Porcelain Enameled Formed Steel Plumbing Fixtures.
- G. ANSI A112.19.5 Trim for Water Closet Bowls, Tanks, and Urinals.
- H. ARI 1010 Drinking Fountains and Self Contained Mechanically Refrigerated Drinking Water Coolers.

1.3 QUALITY ASSURANCE

- A. Fixtures: By same manufacturer for each product specified throughout.
- B. Trim: By same manufacturer for each product specified throughout.

1.4 SUBMITTALS

- A. Submit product data under provisions of Section 01300.
- B. Include fixtures, sizes, [rough in dimensions,] utility sizes, trim, and finishes.

1.5 OPERATION AND MAINTENANCE DATA

- A. Submit operation and maintenance data under provisions of Section 01700.
- B. Include fixture trim exploded view and replacement parts lists.

1.6 WARRANTY

- A. Provide one year manufacturer's warranty under provisions of Section 01700.
- B. Warranty: Include coverage of electric water cooler compressor.

PART 2 - PRODUCTS

2.1 PLUMBING FIXTURES

- A. Plumbing fixtures are specified on drawing.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Review millwork shop drawings. Confirm location and size of fixtures and openings before rough in and installation.
- B. Verify adjacent construction is ready to receive rough in work of this Section.

3.2 INSTALLATION

- A. Install each fixture with trap, easily removable for servicing and cleaning.
- B. Provide chrome plated rigid or flexible supplies to fixtures with loose key stops reducers, and escutcheons.
- C. Install components level and plumb
- D. Install and secure fixtures in place with [wall supports] [wall carriers] and bolts.
- E. Seal fixtures to wall and floor surfaces with sealant as specified in Section 07900, color to match fixture.

3.3 ADJUSTING AND CLEANING

- A. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.
- B. At completion clean plumbing fixtures and equipment.

– END OF SECTION –

SECTION 16000
ELECTRICAL GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. The general provisions of the Contract, including General Conditions, apply to all the Work specified in the Electrical 16000 Sections.
- B. Under control specifications towards the rear of this specification section tables describing PLC control panels I/O listing are included. Contractor shall coordinate with CSD personnel and provide hardware listed to accomplish upgrades and equipment improvements.

1.2 LAWS, PERMITS, FEES AND NOTICES

- A. Secure and pay all permits, fees and licenses necessary for the proper execution of the Work. Submit all notices and comply with all laws, ordinances, rules and regulations of any public agency bearing on the Work. CONTRACTOR shall be licensed electrical CONTRACTOR in the county of construction.

1.3 DEPARTURES

- A. If any departures from the Contract drawings or specifications are deemed necessary, details of such departures and the reasons therefore shall be submitted to the ENGINEER for advance written approval, prior to departure.

1.4 GUARANTEES

- A. Furnish written guarantee covering all materials, workmanship, labor and equipment for a period of one (1) year from the date of acceptance as described in the Contract General Conditions.
- B. The OWNER reserves the right to operate and use all materials and equipment failing to meet the requirements of the Contract documents until such unacceptable materials and equipment are replaced or repaired to the satisfaction of the ENGINEER.

1.5 AS-BUILT INFORMATION

- A. A set of "red-lined" electrical drawings shall be carefully maintained at the job site. Actual conditions are to be put on the drawings in red on a daily basis so the drawings will continuously show locations and routes of cable trays, conduits, pull-boxes, circuit numbers, and other information required by the ENGINEER.

1.6 JOB SITE VISIT

- A. Visit the project site before submitting a bid. Verify all dimensions shown and determine the characteristics of existing facilities which will affect performance of the Work, but which may not be shown on drawings or described within these specifications.

1.7 CLEANUP

- A. Maintain a continuous cleanup during the progress of the Work and use appointed storage areas for supplies. The premises shall be kept free from accumulations of waste materials and rubbish.

1.8 CUTTING AND PATCHING

- A. Cut and prepare all openings, chases and trenches required for the installation of equipment and materials. Repair, remodel and finish in strict conformance with the quality of workmanship and materials in the surroundings. Obtain written permission from the ENGINEER for any alterations to structural members before proceeding.

1.9 MAINTENANCE

- A. Render all necessary measures to ensure complete protection and maintenance of all systems, materials and equipment prior to final acceptance. Any materials or equipment not properly maintained or protected to assure a factory new condition at the time of final acceptance shall be replaced immediately at no additional cost to the OWNER.

1.10 WATERPROOFING

- A. Whenever any Work penetrates any waterproofing, seal and render the Work waterproof. All Work shall be accomplished so as not to void or diminish any waterproofing bond or guarantee.

1.11 TESTS

- A. Conduct an operating test of equipment prior to the ENGINEER's approval. The equipment shall be demonstrated to operate in accordance with the requirements of these specifications. The tests shall be performed in the presence of the ENGINEER or an authorized representative. The electrical CONTRACTOR shall furnish all instruments, electricity and personnel required for the tests.

1.12 SUMMARY OF ELECTRICAL WORK

- A. Provide all labor, materials, tools, supplies, equipment and temporary utilities to complete the Work shown on the drawings and specified herein. All systems are to be completely installed and fully operational. Specifically, the Work includes, but is not necessarily limited to:
 - 1. Electrical and I&C equipment associated with the water plant improvements.
 - 2. Provide coordination with owner and engineer for scheduled system shutdowns and phasing of major pieces of mechanical and electrical equipment.
 - 3. Provide new power equipment and new branch feeder off existing 480V switchgear to feed proposed 480V PDP panel.
 - 4. Provide VFD equipment for new High Service Pumps and existing Feed Water Pumps from soft starts to VFD equipment.
 - 5. Provide raceways, Ethernet communications between existing PLC equipment and VFD equipment.
 - 6. Provide raceways, wires and cables for Power, hard wired signals, and Ethernet communications between electrical equipment and PLC equipment, including, discrete and analog signal cables for field instruments, motor operator valves. Provide equipment grounding per vendor requirements.

7. Provide temporary power and signal wires as needed at existing SMP panels as new RO skid and field instruments are phased in per the recommended phasing of equipment, see drawings and other specifications.
8. Provide FO raceways as indicated on drawings, including FO cable runs between plant and existing well sites S1, S2, S3, S5, and S6. Provide At each of these well sites the replacement of the existing RTU panels for new PLC based Panels.
9. At we S6 provide new electrical equipment like starter control panel, field instruments, racks and the like motors to existing transfer pumps as indicated on drawings (alternate Bid).
10. Provide power, and control wiring and installation of RO trains RIO PLC panels, RIO Status panel, and wiring of RO train mounted instruments and controls.
11. Relocated existing compressor equipment, extend power and controls as required.
12. Provide power and controls to CIP cleaning pump system and related instruments and control panel (alternate Bid).
13. Provide Chemical system upgrades, including relocated chemical skid equipment, as indicated on the drawings, and provide related power and controls signal wires and raceways, see drawings (caustic Bulk tank is alternate Bid).
14. Provide power, grounding, and signals to CO2 vendor equipment (alternate Bid).
15. Coordinate and provide installation support to control systems and I&C Sub Contractor for the proper operation of control panels, field instruments, terminal jboxes, and vendor furnished equipment.

1.13 CODES AND STANDARDS

- A. General Applicable provisions of the following codes and standards and other codes and standards required by the State of Florida and local jurisdictions are hereby imposed on a general basis for electrical Work (in addition to specific applications specified by individual Work sections of these specifications):
 1. U.L.: Electrical materials shall be approved by Underwriters' Laboratories, Inc. This applies to materials which are covered by U.L. standards. Factory applied labels are required.
 2. National Electrical Code.
 3. OSHA: Standards of the Occupational Safety and Health Administration are to be complied with.
 4. NEMA: National Electrical Manufacturers Association Standards are to be met wherever standards have been established by that agency and proof is specifically required with material submittals for switchboards, motor control centers, panelboards, cable trays, motors, switches, circuit breakers and fuses.
 5. ANSI: America National Standards Institute.
 6. NESC: National Electrical Safety Code
 7. Any and all local codes.

1.14 ELECTRICAL TEMPORARY FACILITIES

- A. The electrical CONTRACTOR shall include in his bid the cost of furnishing, installing, maintaining and removing all materials and equipment required to provide temporary light and power to perform his Work during construction and until Work is completed.
- B. Safety

1. All reasonable safety requirements shall be observed to protect workers and the public from shock and fire hazards. Ground fault interrupters shall be employed in accordance with codes.
2. Ground wires are required in all circuits. Ground poles are required on all outlets. All metallic cases shall be grounded.
3. Raintight cabinets shall be used for all equipment employed in wet areas.

1.15 EXCAVATING FOR ELECTRICAL WORK

- A. General – Not needed

1.16 ELECTRICAL SUBMITTALS

- A. Submittals for Approval

1. Refer to Contract General Conditions for additional instructions on the General Conditions and this section, the more stringent requirements shall apply.
2. Shop Drawings and Manufacturer's data sheets are required for all electrical materials.
3. Submittals will not be accepted for partial systems. Submit all materials for each specification section at one time. Submittals must be arranged, correlated, indexed and bound in orderly sets for ease of review.
4. Samples are to be supplied for any substitute as requested by the ENGINEER.
5. The following numbers of copies are required:

Shop Drawings	6 sets
Samples	1 each
Manufacturer's Data	6 sets
Certifications	6 sets
Test Reports	6 sets
Warranties/Guarantees	6 sets
6. Submit shop drawings, Manufacturer's data and certifications on all items of electrical Work prior to the time such equipment and materials are to be ordered. Order no equipment or materials without approval from the ENGINEER. Submittals will not be accepted for partial system submittals; submit all data at one time. Submittals will be promptly returned, approved, approved as noted, or not approved. Items "approved as noted" must be changed to comply with the ENGINEER's comments and need not be resubmitted for "approved" status. Items "not approved" are not suitable, requiring complete new submittals.
7. Time delays caused by rejection of submittals are not cause for extra charges to OWNER or time extensions. CONTRACTOR shall be responsible for investigating existing systems or shop drawings in order to fully integrate the new equipment into the system. Adequate shop drawings may or may not exist for all existing systems.

- B. Operation and Maintenance Manuals

1. Submit to the ENGINEER five (5) copies of all Manufacturer's service installation and operation manuals, instructions and bulletins. These manuals shall be subject to review of the ENGINEER. If acceptable they shall be forwarded to the OWNER. If not acceptable they shall be returned to the CONTRACTOR for revision and resubmittal. Manuals shall contain, but not be limited to, the following:
 - a. Brief description of system and basic features.

- b. Manufacturer's name and model number for all components in the system.
- c. List of local factory authorized service companies.
- d. Operating instructions.
- e. Maintenance instructions
- f. Trouble shooting instructions
- g. Manufacturer's literature describing each piece of equipment.
- h. Power and control wiring diagrams
- i. Parts lists

1.17 ELECTRICAL PRODUCTS

- A. Standards Products
 - 1. Unless otherwise indicated in writing by the ENGINEER, the products to be furnished under this specification shall be the Manufacturer's latest design. Units of equipment and components of the same purpose and rating shall be interchangeable throughout the project. All products shall be newly manufactured. Defective equipment or equipment damaged in the course of installation or test, shall be replaced or repaired in a manner meeting with the approval of the ENGINEER at no additional expense to the OWNER.
- B. Delivery, Storage and Handling
 - 1. Deliver products to project properly identified with names, model numbers, types, grades, compliance labels and similar information needed for distinct identification; adequately packaged or protected to prevent deterioration during shipment, storage and handling. Store in a dry, well ventilated, indoor space, except where prepared and protected by the Manufacturer specifically for exterior instructions for storage locations.
- C. Substitutions
 - 1. Comply with instructions in the Contract General Conditions and Special Conditions and obtain pre-approval of the ENGINEER regarding substitutions.

1.18 SKILLED ELECTRICAL CRAFTSMEN

- A. CONTRACTOR shall employ and staff the project with skilled Craftsmen experienced in the project requirements.
- B. As a minimum, a Licensed Journeyman Electrician shall be present on the project at all times.
- C. Other skilled persons shall be present as the project requirements dictate including Manufacturers representatives, start-up technicians, ENGINEERS, etc.

1.19 DRAWINGS AND SPECIFICATIONS

- A. Refer to the drawings for additional requirements. There are requirements indicated on the drawings which are not noted in the specification.
- B. Bidders, suppliers, equipment vendors, General CONTRACTOR, Sub Contractors and other similar entities are required to read all the Contract documents including drawings and specifications.

1.20 SCHEMATIC NATURE

- A. Plan views are schematic in nature and meant to show the schematic arrangement of equipment and conduit.

- B. CONTRACTOR shall provide the OWNER/ENGINEER with an 11 x 17 (min) drawing (to scale) of the final layout of the equipment and conduit routing for approval. This drawing shall include measurements for all NEC required clearances and separations for equipment and conduit. Refer to other spec sections for conduit routing requirements.

1.21 APPROVED SHOP DRAWINGS

- A. Use approved shop drawings for lay out of equipment. The Contract documents will vary from the shop drawings. Inform the ENGINEER immediately if there are lay out issues or inadequate space for equipment or clearances. Land conduits in openings of enclosures per the approved shop drawings, do not use the Contract drawings.
- B. Housekeeping pads, equipment racks and the like shall be based on the approved shop drawings.

1.22 CLEARANCES

- A. It shall be the CONTRACTOR's responsibility to meet N.E.C. clearances about equipment.

1.23 ROUTING

- A. Conduit routing is schematic in nature. Conduit routing is shown for clarity on the Contract drawings. See other spec sections for additional conduit routing requirements.

1.24 FUTURE FACILITIES

- A. Where future facilities are indicated, conduit routing shall account for such facilities.

1.25 DRAWINGS FURNISHED BY CONTRACTOR

- A. OWNER shall be provided all CONTRACTOR furnished drawings. Such drawings include, but are not limited to: Control panels, MCC.s, VFD.s, switch boards, instrumentation details, panelboards, redline mark-up of the Contract drawing and the like.
- B. Drawings shall be furnished for review and approval. No materials shall be provided without the ENGINEER's approval.
- C. Final drawings shall be furnished or as field modified accounting for any changes made during start up.

1.26 HOMERUNS

- A. CONTRACTOR shall coordinate home runs between plan views. Where any conduit is shown in any plan view it shall be installed the entire length may be required.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

Not used.

- END OF SECTION -

SECTION 16001
ELECTRICAL DEMOLITION

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- A. Contractor shall take precautionary and safety measures to assure the safety of his personnel. All wires shall be identified and disconnected from power sources before removal.
- B. Contractor shall coordinate with the Owner, Engineer and Vendors.
- C. The general demolition scope shall also include the following minimum requirements whether indicated on drawings or not.
 - 1. Before demolition, Contractor shall verify that the equipment is no longer needed or that the demolition will not adversely affect plant operation.
 - 2. Removal of all exposed conduit. Removal of all wire within raceways, cabinets, outlet boxes, trenches and the like associated with equipment shown to be removed on plans.
 - 3. Removal of all hangers and support systems which are not needed as a result of the demolition.
 - 4. Contractor shall cover all openings as a result of demolition and removals including but not limited to the following:
 - a. Cabinets and enclosures
 - b. Wall and masonry openings.
 - c. Cut conduit, instrumentation line, etc. flush with slab, fill with concrete, patch and paint holes in walls.
- D. Operational Systems
 - 1. To the fullest extent possible, all required systems shall remain operational. Contractor shall replace and/or repair existing facilities which may be damaged due to equipment removals.
 - 2. Where required wiring passes through or uses enclosures or raceways shown for demolition. Contractor shall provide raceways and wire as required to keep those systems operational.
 - 3. Contractor shall remove existing equipment in an orderly, planned and coordinated fashion. All replacement equipment shall be on site and ready to install immediately after the removal of existing equipment.
 - 4. Where indicated by drawings the Contractor may reuse portions of existing raceways as long as these are in good shape to be reused and provide same path to equipment.
 - 5. Where demolition interrupts the normal automatic control of the station, Contractor shall provide full time manual control until automatic control is restored unless otherwise directed by the Owner. Contractor shall obtain permission of the Owner before removing automatic control.
 - 6. Existing power and control wires for existing Feed Water Pumps 1, 2, and 3 are to be reused as new VFD equipment replaces former soft starters sections in MCC-3. The Contractor may reuse all or a portion of these existing power wires and control status wires from the pump motor to the new VFD equipment. Provide additional wires and splices where needed to reach new VFD equipment locations, see drawings.

- E. Contractor shall be required to visit the site before bid to ascertain the magnitude of the Work. The drawings indicate the minimal effort. Any electrical raceway associated with any equipment being demolished may be demolished also – unless the existing wire is being reused, or the existing raceway or cable tray may be used for new wires. The drawings do not call out every item of work. All the building electrical equipment called out in the drawings to be installed or replaced shall be replaced with new, unless otherwise indicated by the drawings or noted elsewhere by the specifications.
- F. The Contractor shall provide to the Owner first choice of removed equipment in the event the Owner wants to salvage the equipment. In the event the Owner wants removed equipment, the Contractor shall provide this equipment to the Owner; all other equipment not wanted by the Owner shall become the responsibility of the Contractor to properly disposed of and pay all disposal costs and fees.
- G. Provide demolition in support of any civil or mechanical Work as may be required. See civil and mechanical documents.
- H. Demolish field instruments like magmeter flow tube, former pressure transmitters, probes, and former panels and other field instruments and electronics.

1.2 INCLUDED WORK

- A. Demo each of four NF skids and their related electrical and control equipment, including field instruments, disconnects, control panels,
- B. MCC buckets, MCC sections with soft starters, power correction capacitors, disconnects.
- C. SMP control panels, after the full upgrade and replacement of each pair of NF skids tied to one of the two SMP control panels, and all new NF skid instruments and controls are operating properly, then demolition of the former SMP control panels may begin. The demo of this existing equipment is to be carried out after any existing PLC equipment in these panels has been removed – coordinate with the Owner and CSD personnel
- D. Demolition of existing motor actuators and related equipment.
- E. Demolition and replacement of existing transfer pump motors as called out on drawings.
- F. Demolition and replacement of FWP motors for inverter duty rated motors, as indicated on drawings.
- G. Demolition and replacement of RTU well panels for PLC well panels, as indicated on drawings.
- H. Demolition (and replacement) of well S6 field instruments, starter control panel, racks, main, meter, jboxes and the like – this all falls under Bid Alternate, see drawings.

1.3 DISPOSITION OF EQUIPMENT

- A. Provide materials to the Owner as the Owner may require.
- B. Except as otherwise indicated, all removed or demolished electrical equipment shall become the property of the Contractor. All rubble shall be disposed of by the Contractor.
- C. Contractor shall load, transport, and dispose of all or demolished equipment including all enclosed gear, cabinets, raceways, wire and cable, supports, MCC sections, starters, circuit breakers, buckets, panel covers, light fixtures, rigid galvanized steel conduit and the like.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

Not used.

- END OF SECTION -

SECTION 16050

BASIC MATERIALS AND METHODS

PART 1 - GENERAL

1.1 SUBMITTALS

- A. Submit data sheets on all items per Section 16000.

1.2 CODES AND STANDARDS

- A. General applicable provisions of the following codes and standards and other codes and standards required by the State of Florida and local jurisdictions are hereby imposed on a general basis for electrical Work (in addition to specific applications specified by individual Work sections of these specifications):
 - 1. U.L.: Electrical materials shall be approved by the Underwriters' Laboratories, Inc. This applies to materials which are covered by U.L. standards. Factory applied labels are required.
 - 2. NEC: National Electrical Code
 - 3. OSHA: Standard of the Occupational Safety and Health Administration are to be complied with.
 - 4. NEMA: National Electrical Manufacturers Association Standards are to be met wherever standards have been established by that agency, and proof is specifically required with material submittals for switchboards, motor control centers, panelboards, cable trays, motors, switches, circuit breakers, and fuses.
 - 5. ANSI: American National Standards Institute
 - 6. NESC: National Electrical Safety Code

PART 2 - PRODUCTS

2.1 GROUNDING MATERIALS

- A. All ground rods shall be 20 foot 5/8" copperclad, unless otherwise indicated.
- B. Ground wires shall be soft drawn copper sized per National Electrical Code, unless otherwise indicated.

2.2 CONDUIT

- A. PVC Conduit
 - 1. PVC conduit shall be Schedule 80 or Schedule 40 unless otherwise noted and shall be U.L. approved. Comply with Federal Spec WC-1094 and NEMA TC-1.
- B. Flexible Conduit
 - 1. All flexible conduits shall be liquidtight, made of corrosion resistant plated steel with extruded polyvinyl covering and watertight connectors.
- C. Refer to schedule in drawing for location requirements.

2.3 CABLE, WIRE AND CONNECTORS

- A. 600 Volt Power Wiring

1. Individual conductors shall be rated for 600 volts and shall meet the requirements below:
 - a. Conductors shall be stranded.
 - b. All wire shall be brought to the job in unbroken packages and shall bear the date of manufacturing; not older than 12 months.
 - c. Type of wire shall be THWN except where required otherwise by the Contract drawings.
 - d. No wire smaller than No. 12 gauge shall be used unless specifically indicated.
 - e. Conductor metal shall be copper.
 - f. All conductors shall be meggered after installation. Megger testing shall exceed 50 mega ohms.
2. Multi-conductor cables shall be type TC UL 1277 THWN, PVC jacketed 600V with conductor and quantities as indicated.
- B. Instrumentation and Control Cable
 1. Process instrumentation wire shall be 16 gauge, single twisted pair, 600V., aluminum tape shielded, polyvinyl chloride jacketed, as manufactured by Houston Wire and Cable HW 106 or an approved equal.
- C. Control Cable
 1. Multi-conductor control cable shall be stranded copper 14 gauge, 600V. THWN insulated overall shielded with PVC jacket, as manufactured by Houston Wire and Cable HW 153 or an approved equal.
- D. Cable Tray cables and wiring that meets NEMA and NEC code requirement for class and designation.

2.4 TERMINATIONS AND SPLICES (600 VOLTS AND LESS)

- A. Terminations of power cable shall be by means of U.L. approved connectors. All connectors shall meet U.L. 486B and shall be compatible with the conductor material.
- B. Terminate all control and instrumentation cable with screw-clamp type terminal blocks.
- C. Splicing of power, control, or instrumentation wiring will not be allowed except by written approval of the ENGINEER. Where splicing is allowed, splices shall be made with approved compression connectors, and splices shall be made waterproof regardless of location.

2.5 BOXES

- A. Boxes for wiring devices, switches and receptacles installed outdoors shall be weatherproof fiberglass with polycarbonate cover plates.

2.6 PULL BOXES AND SPLICE BOXES

- A. Location
 1. Units used outdoor or in a damp or corrosive environment shall be 316 ss or fiberglass unless otherwise indicated on plans.
 2. Units used indoors in dry and clean A/C environments shall be NEMA 1.
- B. Size
 1. Units shall be sized per NEC as minimum.
- C. Required Units
 1. Plans depict minimum requirements. Additional units shall be provided as may be required to complete raceway systems.

2.7 MOUNTING AND SUPPORTING ELECTRICAL EQUIPMENT

- A. Furnish and install all supports, hangers, and inserts required to mount fixtures, conduits, cables, pull boxes, and other equipment.
- B. Support system used indoors in clean, dry and air conditioned areas shall be galvanized steel. All other areas shall be 316 ss with ss fasteners.
- C. Perforated straps and wires are not permitted for supporting electrical devices. Anchors shall be of approved types.
- D. All supports, hangers, hardware, etc. used outdoors or in in non-air conditioned indoor areas or in hazardous areas shall be non-ferrous, corrosion resistant or 316 stainless steel. Supports shall be selected to avoid galvanic reactions. Support devices shall be submitted for approval.
- E. Provide trapeze, bridge systems or wall bracketed cantilevered system to support the raceway system.
- F. Spacing of support systems shall be per NEC. Provide spacing of conduits according to the NEC and the materials used. For PVC conduit, refer to NEC table 347-8.
- G. Plans depict minimum requirements. Provide additional units as required to complete raceway system.
- H. Pipe stands shall be 316 stainless steel.

2.8 DUCT SEAL

- A. Provide Garvin Industries' duct seal or an approved equal
- B. Provide and install duct seal at all conduit ends for all new conduit installations.
- C. Duct seal shall be used to seal around junction boxes, control panels and the like. It shall be a permanently soft, nontoxic compound. It shall also not affect other plastic materials or corrode metals.

PART 3 - EXECUTION

3.1 GROUNDING

- A. Provide ground system as indicated on the drawings and as required by the National Electrical Code.
- B. All raceways require grounding conductors. Metallic raceways are not adequate grounding paths. Bonding conductors through the raceway systems shall be continuous from main switch ground buses to panel ground bars of the panelboards, and from panel grounding bars of panelboards and motor control centers to branch circuit outlets, motors, lights, etc. THESE GROUND CONDUCTORS ARE REQUIRED THROUGHOUT THE PROJEC REGARDLESS OF WHETHER CONDUIT RUNS SHOW GROUND CONDUCTORS ON THE DRAWINGS.
- C. All connections made below grade shall be of the exothermic type.
- D. The grounding system test shall not exceed a 48 hour span dry resistance of 10 ohms. Additional grounding to meet this requirement shall be installed at no extra cost. Grounding and bonding connections shall not be painted.

3.2 CONDUIT

- A. Locations:
Conduits shall be used as follows:
 - 1. Refer to schedule on drawings.

B. Installation

1. Conduits subjected to rough handling or usage shall be removed from the premises.
2. Conduits must be kept dry and free of water or debris with approved pipe plugs or caps. Care shall be given that plugs or caps be installed before pouring of concrete.
3. Where conduits pass through exterior concrete walls or fittings below grade, the entrances shall be made watertight.
4. Infurred ceilings, conduit runs shall be supported from structure, not furring.
5. Conduits entering panelboards, pull boxes, or outlet boxes shall be secured in place by galvanized locknuts and bushings, one (1) locknut outside and one (1) locknut inside of box with bushing on conduit end. The locknuts shall be tightened against the box without deforming the box. Bushings shall be of the insulating type.
6. Field conduit bends shall be made with standard tools and equipment manufactured especially for conduit bending.
7. Where embedded conduits cross expansion joints, furnish and install offset expansion joints or sliding expansion joints. Sliding expansion joints shall be made with straps and clamps.
8. Exposed runs of conduits shall be installed with runs parallel or perpendicular to walls, structural members or intersections of vertical planes and ceilings, with right angle turns consisting of symmetrical bends. No attempts are made in plans to show required pull boxes, gutters, etc. necessary for the construction of the raceway system but the CONTRACTOR shall provide these raceways as may be required.
9. Conduits in structural slabs shall be placed between the upper and the lower layers of reinforcing steel, requiring careful bending of conduits. Conduits embedded in concrete slabs shall be spaced not less than eight (8) inches on centers or as widely spaced as possible where they converge at panels or junction boxes. Conduits running parallel to slab supports, such as beams, columns and structural walls shall be installed not less than 12 inches from such supporting elements. To prevent displacement during concrete pour, saddle supports for conduit, outlet boxes, junction boxes, inserts, etc., shall be secured.
10. Conduit runs shall always be concealed except where indicated on plans.
11. Pull lines shall be installed in all empty conduits. All pull wires shall be identified with conduit number at each end.
12. Where conduits are run individually, they shall be supported by approved pipe straps secured by means of toggle bolts or tapcons on hollow masonry; tapcons on concrete or solid masonry; machine screws or bolts on metal surfaces and wood screws on wood construction. The use of perforated straps or wires will not be permitted.
13. Wire shall not be installed until all Work of any nature that may cause damage is completed, including pouring of concrete. Mechanical means shall not be used in pulling in wires No. 8 or smaller.
14. Underground conduits not under concrete slabs are to be buried at least two (2) feet below finished grade for circuits rated 600 volts or less, except under traffic areas where motor vehicles may cross. Under traffic areas, conduits are to be buried at least three (3) feet below finished grade.
15. All conduits shall be cleaned by pulling a brush swab through before installing cables.

16. All conduits shall be sealed at each end with electrical putty. Special care shall be taken at all equipment where entrance of moisture could be detrimental to equipment. Approved backing gauze is required prior to the installation of conduit putty.
17. A maximum of two (2) feet of flexible conduit shall be used at connections of all motors, transformers, motor operated valve and gates, instruments and other items of equipment where vibration is present. It shall be supported where required with stainless steel bands.
18. PVC conduit shall be supported to walls and slabs using carlon snap strap conduit wall hangers. Two hole PVC conduit clamps shall not be permitted.

3.3 WIRES, CABLES AND CONNECTIONS

- A. Cables pulled into conduits shall be pulled using pulling eyes attached to conductors.
- B. Shields shall be grounded at only one termination point.

3.4 BOXES

- A. Installation of boxes shall be in accordance with the National Electrical Code requirements.
- B. Boxes shall be mounted plumb and level in accessible locations and mounting shall be secure, vibration resistant and galvanically compatible. Hardware shall be used that is specifically intended for the purpose. When mounted in corrosive, damp or wet locations, stainless steel hardware shall be utilized.

3.5 WIRING DEVICES

- A. Wiring devices shall be installed in device boxes approved for the application. All connections shall be made with screw terminals. Wiring devices shall be Leviton or approved equal.
- B. Wire devices on UPS systems shall be isolated ground, colored orange.
- C. Cover plates shall be provided as follows except as otherwise noted.
 1. Interior finished area – brushed aluminum
 2. Wet areas – gasketed plastic with flip cover.
- D. Receptacles installed outdoors, below grade, or in areas other than clean and dry environments shall be GFI and weatherproof. Receptacles shall be weatherproof with cords plugged in.
- E. All receptacles shall be GFI protected.

3.6 SUPPORTING DEVICES

- A. All items shall be supported from the structural portion of the building and studs, except standard ceiling mounted lighting fixtures and small devices may be supported from ceiling system where permitted by the ENGINEER. However, no sagging of the ceiling will be permitted. Supports and hangers shall be types approved by Underwriters' Laboratories.
- B. All floor-mounted devices (switchboards, motor control centers, transformers, etc.) shall be securely anchored to the floors. Where recommendations are made by Manufacturer, these recommendations shall be followed.

3.7 CLEANING

- A. All electrical equipment enclosures shall be thoroughly cleaned before acceptable by the OWNER. As a minimum, CONTRACTOR shall remove all debris including stripped wire insulation, dirt, and debris.

- END OF SECTION -

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 16110
LIGHTNING PROTECTION

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. The Contractor shall furnish all labor and materials and items of service required for the completion of an all functional and unobtrusive system of grounds, conductors and air terminals for protection against damage by lightning of designated structures as approved by the Engineer. Complete installation shall conform in all respects to the current requirements of L.P.I. certified system program and all legal, labor, insurance or other authorities having jurisdiction. The installing Contractor shall have a minimum of five (5) years experience in this specialized work and be a certified master installer of the Lightning Protection Institute. All materials used shall be furnished and recommended for their intended use by a reputable lightning protection manufacturer who is a Manufacturer Member of the Lightning Protection Institute. All materials shall be provided by Thompson Lightning Protection or an equal. Installer shall be Bonded Lightning Protection System, Inc., Jupiter, Florida or equal.
- B. As a minimum, the following structures and or buildings shall be provided with lightning protection systems.
 - 1. CO2 tank
 - 2. Existing and proposed Caustic Bulk storage tanks
 - 3. New pole mounted area lighting

1.2 SUBMITTALS

- A. Submittals for Approval
 - 1. Refer to Contract General Conditions for additional instructions on submittals and substitutions. Where conflicts occur between the General Conditions and this Section, the more stringent requirements shall apply.
 - 2. Shop drawings and manufacturer's data sheets are required for all materials.
 - 3. Samples are to be supplied for any substitute as requested by the Engineer.
 - 4. The following numbers of copies are required:

Shop Drawings	6 sets
Samples	1 each
Manufacturer's Data	6 sets
Certifications	6 sets
Test Reports	6 sets
Warranties/Guarantees	6 sets
 - 5. Submit shop drawings, manufacturer's data and certifications on all items prior to the time such equipment and materials are to be ordered. Order no equipment or materials without approval from Engineer. Submittals will not be accepted for partial system submittals; submit all data at one time. Submittals will be promptly returned, approved, approved as noted, or not approved. Items "approved as noted" must be changed to comply with the

Engineer's comments and need not be resubmitted for "approved" status. Items "not approved" are not suitable, requiring complete new submittals.

6. Time delays caused by rejection of submittals are not cause for extra charges to Owner or time extensions.
7. Provide scaled plan and elevation views of all structures for which lightning protection shall be provided. These plans shall show the proposed location of all air terminals, typical air terminals, size and location for ground rods, cable, connectors and proposed methods of bonding. Bond to telephone and power service ground systems.

1.3 SITE VISIT

- A. Site visit before bid to evaluate existing conditions is recommended.

1.4 SUPPLIER

- A. Supplier shall be Bonded Lightning Protection of Jupiter or an approved equal.

PART 2 - PRODUCTS

2.1 TERMINALS

- A. Provide terminals as per material vendor shop drawings. Terminal materials shall be as follows, bronze saddle and pressure plate, nickel tip highly polished, pure copper point. Provide mounting type and cable connections as required.

2.2 CABLE AND ACCESSORIES

- A. Provide stranded copper cable per material vendor. Provide braces, saddle, fittings and connectors as required compatible with materials.

2.3 GROUND RODS

- A. Provide copper clad ground rods, 5/8" x 20' minimum. Provide bronze compression clamps as required.

2.4 MATERIALS

- A. The Contractor is responsible to adjust lightning protection materials in order to avoid any dissimilar metal interaction.

PART 3 - EXECUTION

3.1 INSTALLATION REQUIREMENTS

- A. Locate terminals per vendor shop drawings. All points shall be a minimum of 2" of outside building edges, corners, and ridge ends. Maximum spacing shall be 20'. Maximum protection above object to be protected shall be 10".
- B. Maintain horizontal and downward coursing of main conductor and ensure that all bends have at least an 8" radius and do not exceed 90 degrees.
- C. Support all exposed roof, downlead and bonding cables at 3' intervals.
- D. Ground electrodes shall be installed per Vendor shop drawings but install at least 1' below final grade.

- E. Interconnect Lightning Protection ground to electric, telephone and other building ground systems per codes.
- F. System shall be installed per Vendor shop drawings to insure proper code compliance and system certification. Any variance shall entail resubmittal and re-approval and all costs shall be paid by the Contractor.
- G. As built drawings shall be provided and submitted by the Material Vendor in accordance with certification procedures.
- H. All materials shall be U.L. approved with "A" labels on conductors at 10' intervals and "B" labels on air terminals.
- I. Provide Aluminum stranded conductors, sized per the drawings for all above ground and tops of structures and buildings. Fastening hardware shall also be aluminum or 316SS. Copper stranded conductors shall be used for all below ground and in walls installations. Provide PVC conduit for long vertical runs along exterior walls, from the ground to the top of a building or structure
- J. Complete installation shall bear U.L. Master Label "C" to be secured by the system installer per U.L. 96A.
- K. Installation shall comply in all respects L.P.I. Code 175. Installation shall be made by or under the supervision of an L.P.I. Certified Master Installer. The completed installation shall receive system certification including submittal of forms L.P.I. CI-01, 02, and 03.
- L. Restoration to existing conditions. Contractor is responsible for restoring all areas which are disturbed by electrical work to original conditions.

- END OF SECTION -

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 16681
VARIABLE FREQUENCY DRIVE

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Provide a complete U.L. listed Variable Frequency Drive (VFD) systems as specified within and as indicated on the drawings. System shall be provided complete with all necessary accessories and appurtenances as required for a completely functional system ready for immediate use.
- B. Units shall be provided as specified below and with certain safety control requirements as indicated on drawings, including safety parameters with pressure switches high and low, and on the HSP pumps 4,5, and two of the three existing HSP VFD controls, HSP 1, and 2 provide a "Backup ON" circuitry that calls for these drives to run in the event that the system pressure (or discharge pressure) reaches A 'low' or 'low low' level condition, see the drawings.
- C. Like items of equipment provided hereunder shall be the end products of one manufacturer in order to achieve standardization for appearance, operation and maintenance.
- D. See CONDITIONS OF THE CONTRACT and Division 1, GENERAL REQUIREMENTS, which contain information and requirements that apply to the Work specified herein and are mandatory for this project.
- E. Drive shall have ampacity to serve the motor requirements. Coordinate with motor.
- F. Drives shall be limited to the enclosure dimensions shown on plan and due to limited room space drive technology specified shall meet the enclosure size restrictions of no more than 32" wide and 21" deep.
- G. Drives shall be provided by Howard Woodrow and integrated into the pump control system, including work with hard wire remote control stations with on/off switches, and safety parameters hard wire from pressure and flow switches by the pump, see the control schematic drawings for specifics to the FWP and the HPS VFD equipment.
- H. Provide modifications to existing HSP 1 and 2 VFD equipment controls to turn on these drives as a 'backup on' based on low system discharge pressure signal as indicated on the drawings. This shall include provide relays, wiring, and "backup on" pilot light and a reset push button to break seal in circuit.
- I. Provide drives that operate and communicate with PLC via Ethernet communications. Additionally, provide hard wired signals for the pump protective circuits described herein and on the drawings.
- J. Include pump vendor, or motor vendor protective devices as may be needed into the controls of the drive.

1.2 SUBMITTALS

- A. Submittals shall be made in accordance with the requirements of Section 01300 – Submittals.
- B. Fully Engineered shop drawings specific for this project shall be submitted to the Engineer for review and comment. Vendor shall clearly indicate his conformance to the requirements of this specification. Along with standard literature, a detailed schematic and assembly drawings shall

be provided. A recommended statement shall be provided. Vendor shall not release the unit for manufacture without approved shop drawings.

- C. Complete set of Operation and Maintenance Manuals shall be submitted.
- D. Warranty information shall be submitted.

1.3 QUALITY ASSURANCE

- A. All equipment furnished under this specification shall be new and unused, shall be the product of a manufacturer having a successful record of manufacturing and servicing the equipment specified herein for a minimum of five (5) years.

1.4 WARRANTIES

- A. Provide a full warranty covering labor, materials, the services of a factory authorized technician including all expenses for a period of one year, to begin after Owner's start-up and acceptance of the drive. During this period, manufacturer shall repair any failures associated with the drive.

1.5 NAMED MANUFACTURERS

- A. Eaton, provided by Howard Woodrow
- B. No other vendors

PART 2 - PRODUCTS

2.1 VARIABLE FREQUENCY DRIVE (VFD)

- A. Provide a separate fully engineered Variable Frequency Drive (VFD) system for use with the pump/motor shown on plans. Power input shall be 480 volts, 3 phase; the drive shall include.
 - 1. Minimum drive inverter amps of output shall not be less than the amps as listed in Table 430-150 of the latest issue of the National Electrical Code.
 - 2. Minimum drive overload capability shall not be less than 110% of the output rated amps for 60 seconds.
 - 3. Coordinate with pump vendor requirements to verify speed and torque requirements
 - 4. Coordinate with vendors and equipment suppliers regarding constant or variable torque applications and RPM of the driven loads. Provide units per applications.
 - 5. Include pump protective equipment as may be required.
 - 6. See the drawings for additional requirements.
- B. As a minimum, include the following features:
 - 1. Exterior front cabinet door mounted equipment shall be as follows:
 - a. Hand-Off-Auto selector switch.
 - b. Programmer/Monitor/Display Module and required appurtenances. Display shall indicate speed in percent.
 - c. Pad lockable outside handle connected to disconnect the power supply to the unit before opening door. A defeater shall be provided.
 - d. Provide a pilot light indicating when HSP 1,2,4,5 is running under "Backup" condition (low discharge system pressure). This shall include modifications to existing VFD drive controls and front panel for VFD HSP 1 and 2 to add this control parameter – see the drawings.

- e. Engraved legend plate shall be provided for all devices.
- f. Run time meter hours, non-resettable, Electro-Mechanical Engler 200 Series or an approved equal.
- g. Interface with discrete input from remote ON/OFF switch at the HSP and feed water pumps, and discrete signal from flow switches at the output of the pump.
- 2. Main disconnect with current limiting fuses or circuit breaker connected to the pad lockable door handle. Interrupting ratings shall match or exceed the values indicated in the main power service equipment. Min. valve shall be 65,000 AIC or as otherwise indicated.
- 3. Control power transformer with control circuitry and control logic as specified and as indicated on plans. Control power transformer shall be oversized for motor heat.
- 4. Drive shall be provided with the capabilities to ride through brown outs and to restart on power loss and return after time delay.
- 5. Discrete output contacts shall be provided and wired to labeled terminal strip. Contacts shall be required as indicated per plans; one form "C" contact shall be provided. Additional slave relays shall be provided as required. The VFD drives shall be Ethernet connected for information exchange and control.
- 6. Provisions to receive hardwired 4-20 mADC signal for remote speed reference. Signal isolation shall be provided in the drive shall be handled via ethernet communications.
- 7. Joslyn lightning arrestors, Surgitron, 1454-01 or an approved equal wired to the line side of the disconnect.
- 8. 6-spares fuses of each size and type used shall be provided.
- 9. Provide drives with Network I/O as indicated
- 10. Provide output filters, Transcoil or an approved equal.
- 11. Units shall meet or exceed the requirements of IEEE 519. Provide additional labor and materials as may be required. Submit calculations for review and approval.
- 12. VFD controls shall include special equipment as may be required by pump and motor supplier including but not limited to sensor and additional pilot devices as required to fully implement, motor overtemp signals into the drive.
- C. Operation
 - 1. Hand-Off-Auto mode selector
 - a. Discrete control, see the drawings
 - 1) Hand: The drive ramps up to the speed reference per the local potentiometer or keypad setting.
 - 2) Off: Drive ramps down and no power is applied to the motor. While in the off position, the drive is not permitted to run.
 - 3) Auto: Drive start/stop control is from the remote device. Upon receiving a start command, the drive ramps up to the remote speed reference. Upon receiving the stop command, the drive shall ramp down to zero output.
 - b. Speed control, see the drawings
 - 1) The speed reference shall be from the local potentiometer or keypad while the local H-O-A is in the hand mode and from speed command signal while in the automatic mode.
 - 2) Adjustable minimum and maximum speed settings shall be provided.

- 3) Separate adjustable ramp slopes settings shall be provided for both acceleration and deceleration.
- D. Enclosure
 - 1. Dimensions are critical. Drawings indicate maximum space requirements. Unit shall fit in allowed enclosure.
- E. Technology
 - 1. VFD units shall use 6 pulse with 5% input line reactors and Dv/Dt Trans coil output filters for units 100 hp and greater.
 - 2. VFD units shall use 6 pulse with 3% input line reactors and Trans coil output filters for units less than 100 hp.

2.2 INTERFACING

- A. Units shall be connected with the Ethernet TCP/IP communication cable. See the drawings.
- B. Proposed HSP and three existing Feed Water pumps or Booster Pumps being converted from Soft Starter in MCC 3 to VFD equipment shall be provided with Ethernet network interface card and miscellaneous Ethernet communication hardware and software drivers to provide Ethernet communications via TCP/IP ethernet cables to the plant's PLC equipment, see drawings
- C. Only pump protective circuits shall be hard wired inputs to the drives from pressure switches and flow switches, see the drawings.

PART 3 - EXECUTION

3.1 GENERAL

- A. Install equipment in a workmanlike manner utilizing craftsmen skilled in the particular trade. Provide work which has a neat and finished appearance.
- B. Coordinate work with the Owner, the Contractor and work of other trades to avoid conflicts, errors, delays and unnecessary interference with operation of the existing plant during construction.
- C. Coordinate work with the Owner, the Contractor and work of other trades to avoid conflicts, errors, delays and unnecessary interference with operation of the existing plant during construction.

3.2 MANUFACTURER'S SERVICES

- A. Provide the services of a Howard Woodrow to configure, program and to start up, test and place in service each unit. This service shall be extended, as required, at the manufacturer's expense, if problems arise with the drive unit.
- B. Provide separate from the start up, one (8) hour on site training. This time shall be at the convenience of the Owner. Minimum training instructions shall include the following:
 - 1. Routine Maintenance
 - 2. Programming, including entering the programming mode, changing set points interpreting fault information.
 - 3. Trouble shooting
 - 4. Fault corrections and resetting actions.
- C. Programming

1. Program VFD features per project requirements, coordinate with Engineer and plant personnel. HSP pump equipment and Feed Water Pump equipment shall operate in similar manner as existing HSP and Feed Water pump VFD equipment.
2. Provide running status to be used by PLC/SCADA to maintain the maximum number allowed of running HSP and Feedwater pump drives at any one time under generator power. No more than three HSP VFD drives and three Feedwater VFD pumps shall run simultaneous at any one time under generator power.
3. Provide typewritten listing of final parameter setting with O&M manuals.

3.3 CLEAN-UP

- A. Keep the premises free from accumulation of waste material or rubbish. Upon completion of work, remove materials, scraps and debris from premises and from interior and exterior of all devices and equipment. Touch-up scratches, scrapes, or chips in interior and exterior surfaces of devices and equipment with finishes matching as nearly as possible the type, color, consistency and type of surface of the original finish.

- END OF SECTION -

SECTION 16690
ELECTRIC MOTORS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Contractor shall provide all equipment required for a complete and functional system. Contractor shall receive, handle, install and assist in checkout of the units. Contractor shall coordinate all furnished equipment.
- B. This Section specifies the quality criteria, design standards, materials and installation procedures not otherwise specified, required for electric motors furnished under these Contract Documents.
- C. Units shall be provided by the pump manufacturer.

1.2 CONTRACTOR'S RESPONSIBILITY

- A. Furnish and submit shop drawings, operation and maintenance manuals, etc. as per the general conditions. In addition, the submission shall include the following technical information:
 - 1. Motor Efficiency
 - 2. Motor Torque Speed Curves from zero to full load speed.
 - 3. Nameplate data
- B. The above information shall be supplied as part of the submittal on the equipment which the motor drives.
- C. Contractor shall coordinate with motor and VFD suppliers. Motor full load amps shall be provided to VFD supplier.

1.3 STANDARDS

- A. Electric motors shall conform to the latest standards of IEEE, ANSI and NEMA except as otherwise specified herein.

1.4 CONDITIONS OF SERVICE

- A. Electric motors shall be designed and manufactured to operate under the following conditions except for specific variations stated in other sections of these specifications.
 - 1. Continuous Duty
 - 2. Altitude below 3300 feet.
 - 3. Ambient temperature 0 to 40°C maximum.
 - 4. Voltage variation plus or minus 10 percent.
 - 5. Unit shall be suitable for starting and running with power and control equipment provide for it.

1.5 TESTING

- A. Motors less than 50 hp: Each motor shall be subjected to a standard short commercial test including the following:
 - 1. Running light current

2. Locked rotor current
 3. Secondary voltage at collector rings (wound rotor motors).
 4. High potential
 5. Winding resistance
 6. Bearing inspection
- B. Motors 50 through 100 hp: Each motor shall be subjected to the above tests and shall be furnished with certified test results.
- C. Efficiency: Motors rated 25 through 100 hp shall be individually tested for efficiency.
- D. Test Reports: Seven (7) copies of all certified test results shall be submitted to the Engineer for approval. Single copies of witnessed test raw data shall be submitted to the Engineer immediately upon completion of such tests.

1.6 TOOLS AND SUPPLIES

- A. Furnish all special tools necessary to disassemble, service and adjust the equipment.

1.7 APPLICATION

- A. This Section applies to pump/motor assembly, not specifically submersible pumps.

PART 2 - PRODUCTS

2.1 GENERAL

- A. The driven equipment manufacturer shall be responsible for supplying the motor and shall factory mount the motor to ensure proper coordination.
- B. Review plans and other specifications. Provide motor suitable for starting method.
- C. Where motors are used with Variable Frequency Drive systems, they shall be provided as inverter duty, premium efficiency.

2.2 MANUFACTURER

- A. The motor shall be a Totally Enclosed Fan Cooled, TEFC, Inverter duty, US Motors, TECO/Westinghouse.

2.3 DESIGN OF MOTORS

- A. Horsepower: The driven equipment manufacturer shall be responsible for sizing the motors in coordination with the driven equipment so that the nameplate rated horse powers are not exceeded and motors are not required to operate within their service factor at any point within the driven equipment operating range. For variable speed application, the motor shall be designed for operation at the rated maximum speed and at reduced speeds down to 30% without overloading. The Engineer reserves the right to reject driven equipment which requires motors larger than the minimums specified in the other Sections of these Specifications or to require the Contractor to bear additional costs if larger electrical equipment is required.
- B. Temperature Rise: Motors shall conform to standards of NEMA Class F Insulation System with a Class B rise unless otherwise listed in the other parts of these Specifications.
- C. Voltage and Current: Fractional horsepower motors (less than ½ hp) shall be 115/208V or 115/230V, 60 hz single phase. Motors ½ horsepower through 600 horsepower shall be 460 volts, 60hz, 3-phase.

- D. Service Factor: Unless otherwise specified, service factor shall be a minimum of 1.15.
- E. Speed: As specified with equipment.
- F. Torque: At least 20 percent greater than the maximum full load torque requirements of the driven equipment throughout the full operating range of the driven equipment from start to full load.
- G. Efficiency:
 - 1. Motors in the range of 1 hp to 200 hp, inclusive shall be designed specifically for energy efficiency and high power factor. In accordance with NEMA Standard MG 1-12.53b, each motor shall meet the minimum guaranteed efficiency for specified nameplate efficiency. All motor efficiency test shall be performed utilizing the NEMA preferred test method IEEE 112 Method B, Dynameter.
 - 2. Motors 200 hp and larger shall have a minimum efficiency, at full load, of 95% and a minimum power factor of 85%.
 - 3. Motors above 20 hp shall be "premium efficiency motors": U.S. Electric Motors, General Electric or an approved equal.
- H. Inverter Duty
 - 1. Motor used on VFD systems shall be inverter duty and be provided with 1200 volt insulation as a minimum.

2.4 MATERIALS AND CONSTRUCTION

- A. Enclosure
 - 1. The enclosure shall be the type as specified in respective parts of equipment specifications and shall be constructed of cast iron or fabricated steel components in proper position. Fans may form part of the rotor and shall be of non-sparking material on totally enclosed motors. Enclosures for motors not specified elsewhere, shall be TEFC, unless otherwise stated. Fractional horsepower motor enclosures shall be totally enclosed non-ventilated.
- B. Insulation
 - 1. Motors shall have inorganic, non-hygroscopic insulation unless otherwise noted in other parts of these specifications. Insulation shall be Class F rating.
- C. Stator
 - 1. The stator shall be assembled from high grade electrical sheet steel laminations adequately secured together.
 - 2. The stator windings shall consist of materials such as polyester film, synthetic varnish or glass cloth. Windings shall be random or from wound, adequately insulated and securely braced to resist failure due to electrical stress and vibrations.
 - 3. Any junction in motor insulation, such as coil connections or between slot and end winding sections, shall have protection equivalent to that of the slot sections of coils. The entire winding of all motors when finished, shall be epoxy encapsulated, after subjecting to a process which removes all moisture and ensures freedom of air pockets.
- D. Rotor
 - 1. The shaft shall be made of high grade machine steel or steel forging of size and design adequate to withstand the load stresses. The rotor shall be fabricated of high grade electrical sheet steel laminations adequately fastened together and to the shaft. Squirrel cage windings may be cast aluminum or bar-type construction with brazed end rings.

- E. Bearings shall be ball or roller
1. Motors up to 1,000 horsepower shall have oil bath and grease-lubricated, sealed bearings. Above 1,000 horsepower, lubrication shall be oil. Unless specified otherwise, the bearings shall have a B-10 life as follows:

<u>MOTOR HP</u>	<u>B-10 Life (hrs)</u>
Less than 50	24,000
50 to 200	40,000
Greater than 200	100,000
 2. For vertical motors, thrust bearings shall be Kinsbury type, ball or roller bearings as required for the design thrust load. Guide bearings shall be radial type ball bearing.
- F. Space Heaters, motors 20 hp and greater
1. Unless otherwise indicated, 120-volt, single phase, space heaters shall be provided to maintain a motor temperature of approximately 10°C above a 40°C ambient. Maximum wattage shall be 200W.
- G. Temperature switches, motors 20 hp and greater
1. Provide motor winding thermostatic-controlled switch. The switch shall be normally closed and shall open upon high temperature condition.
- H. Leads and Terminals
1. Leads shall be suitably marked and identified. Terminal housing locations, which are not shown on the Contract Drawings, shall be NEMA Assembly F-1.
- I. Motor Terminal Boxes
1. Motor terminal boxes shall be provided separately for the power connections.
 2. The thermal switches and heater connections shall be in a common separate terminal box.
 3. All terminal boxes shall be provided with threaded hubs.
 4. See the Electrical drawings.
- J. Grounding Means
1. Each motor shall have adequate means for attaching #4/0 AWG copper grounding conductor to the motor frame near the base. It shall be a mechanical clamp terminal connector located on the same side as the stator lead junction box.
- K. Direction of Rotation
1. Motors shall be designed and manufactured for operation in a direction as required for driven equipment. The phase sequence, at the specification rotation, shall be marked permanently and plainly inside the stator lead junction box.
- L. Noise
1. All motors shall have an equivalent A-weighted sound level of 80 dp A as determined in accordance with IEEE Standard No. 85. In no case shall the noise levels exceed those levels established as maximum values in the Town of Jupiter Code of Ordinances.
- M. Nameplates
1. Each motor shall have a stainless steel nameplate including the following minimum amount of information:
 - a. Manufacturer's type designation
 - b. Frame number
 - c. Output horsepower rating
 - d. Duty (time rating)

- e. Rated load speed (rpm)
- f. Temperature rise in degrees centigrade at rated load, rotor and stator.
- g. Stator voltage rating
- h. Stator full load amperes
- i. Service factor (marked for operation at 40°C ambient)
- j. Frequency
- k. Number of Phases
- l. Inrush of locked rotor KVA
- m. Code letter designation
- n. Efficiency
- o. Bearing type, size, lubricant

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Motors shall be mounted in accordance with the motor manufacturer's drawings and instructions. Field installation of the unit shall include final alignment.
- B. Installation shall also include furnishing necessary oil and grease for initial operation and making final adjustments to place the equipment in operable condition.

3.2 FIELD TESTS

- A. Motors, their driven equipment and speed controllers (if applicable), shall be tested together after installation as described in the applicable sections of these specifications.

3.3 PAINTING

- A. Motors shall be assembled with pu1mp at pump manufacturer's plant and shipped to the site with manufacturer's standard finishes. After installation and before being placed in final operation, the motors shall be with Corro- Duty or an approved equal.

- END OF SECTION -

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 16901

I&C SYSTEMS

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. The Contractor shall furnish all instrumentation control equipment.
- B. A list of tables is presented at the end of this specification section; these tables list the I/O list per control panel, Contractor is to coordinate with CSD personnel and provide the PLC and network upgrade parts listed in the tables
- C. Field instruments are specified here or elsewhere and/or indicated on drawings.
- D. The equipment control panels shall be provided by the I&C system supplier.
- E. Provide PLC RIO control panels for each of the four RO skids being replaced. Coordinate specific panel and PLC equipment requirements with NF skid vendor, and provide PLC based RIO control panel and status control panel based on the specifics of the NF Skid instruments and functionality requirements.
- F. Refer to VFD equipment specifications for VFD equipment.
- G. Interface status and open/close signals from motor actuated valves to control panels or PLC equipment.
- H. Contractor shall provide complete fiber systems including fiber breakout boxes, patch panels and patch cords where called out on drawings.
- I. Provide drawing identifying patch panel locations. Land each fiber pair including spares. Identify each patch panel location including spares.
- J. Identify all intermediate terminals in loop shop drawings.
- K. Provide complete loop drawings for each point per ISA standards or approved equal.
- L. Provide temporary power and/or signals for the two existing SMP panels while RO skids are replaced (per the phasing installation plans-see drawings and other specifications).
- M. Provide material and labor to support RO train skid replacement and maintain controls and signals currently going through existing panels, like the SMP panels. Maintain the RO trains operational while one train is taken down and is replaced
- N. Some of the equipment will fall under the base bid package while other equipment like the CIP cleaning system, the well S6 starter and S6 field instruments, the CO2 system, Bulk Chemical Storage tank are part of separate alternate bid packages, see drawings and other specification sections.
- O. Provide fiber optics and fiber optic related components for well to plant communications, see drawings.
- P. Provide PLC well panels, see the drawings.

1.2 SINGLE INSTRUMENT SUPPLIER

- A. The Contractor shall assign to the Single Instrument and Control (I&C) supplier full responsibility for the functional operation of all new instrumentation systems. The Contractor shall have said supplier perform all engineering necessary to select, to furnish, to supervise

installation, connection, to calibrate, to place into operation all sensors, instruments, alarm equipment, control panels, accessories and all other equipment as specified herein.

- B. The foregoing shall enable the Contractor and the Owner to be assured that the full responsibility for the requirements of this section will reside in an organization which is qualified and experienced in the water treatment field and its process technology on a functional system basis.
- C. Contractor shall review all specifications and plans. Contractor shall be sure all control panels are included in the bid. The following are suggested to be in the plant wide I&C Contractor's package. Major pieces of equipment include:
 - 1. Well 6S starter panel as well as the well PLC control panels for five well sites, see drawings.
 - 2. Provide RIO PLC panel for NF or Nano Filtration skid RIO-PLC Control Panel and STATUS Control Panel for each of four (4) NF skids as indicated on drawings and other specification sections.
 - 3. Chemical systems control panel per the drawings
 - 4. CIP Cleaning system Area Control Panel (alternate Bid)
 - 5. Replacement finish water status panel
 - 6. Provide status and control signals and interfacing with new vendor CO2 system
 - 7. Provide interfacing of I/O signals at existing Main PLC equipment, and existing RIO PLC panels per the drawings. Provide PLC equipment, network equipment and I/O cards where required at Main PLC panel, and existing CP1, CP2, CP3 RIO panels, as indicated on the drawings. Refer to lists and BOM tables in the drawings in reference to PLC and Network equipment.
 - 8. Provide Field instruments and field signal surge suppression devices for analog and Ethernet communications cables.
 - 9. Fiber systems
 - 10. Field terminal boxes, control stations.
 - 11. Sun shields, stanchion mounts and the like
 - 12. PLC and network components as listed on tables at the end of this specification.

1.3 NAMED MANUFACTURER

- A. CC Control
- B. Curry Controls
- C. Revere Controls
- D. No equal

1.4 INSTALLATION WORK

- A. Nothing in this part of the specifications shall be construed as requiring the Contractor to utilize personnel supplied by his assigned instrument manufacturer's organization or any division thereof, to accomplish the physical installation of any elements, instruments, accessories or assemblies specified herein. However, the Contractor shall employ installers who are skilled and experienced in the installation and connection of all elements, instruments, accessories and assemblies; portions of their work shall be supervised or checked as specified herein.

1.5 PREPARATION OF SUBMITTAL OF DRAWINGS AND DATA

- A. It is incumbent upon the Contractor to coordinate the work specified in these Sections so that a complete instrumentation and control will be provided and will be supported by accurate shop and record drawings. As part of the responsibility as assigned by the Contractor, the Single I&C supplier shall prepare and submit through the Contractor, complete and organized shop drawings, as specified herein. Interface between instruments, motor starters, flow meters, and existing instruments shall be included in his shop drawing submittal.
- B. In order to provide a fully coordinated system, shop drawings by other equipment vendors associated with the I&C control panel systems shall be reviewed and approved by the Contractor before submittal to the Engineer for approval.
- C. During the period of preparation of this submittal, the Contractor shall authorize direct informal liaison between his single I&C Supplier and the Engineer for exchange of technical information. As a result of this liaison certain minor refinements and revisions in the systems as specified may be authorized informally by the Engineer, but these shall not alter the scope of the work or cause increase or decrease in the contract price. During this informal exchange no oral statement by the Engineer shall be construed to give formal approval of any component or method, nor shall any statement be construed to grant formal exception to, or variation from these specifications.
- D. Operation and Maintenance Manual
 - 1. Submit one preliminary O&M for review and comment by the Engineer. Provide five final O&M.s, bound in a three ring binder. O&M shall include the requirements of I&C materials and minimally include the following: approved submittal data, start-up corrected as built shop drawings. O&M shall be neatly and logically arranged with a contents page followed by tabbed sections.

1.6 ADDITIONAL TECHNICAL SERVICES

- A. At no additional cost to the Owner, the Contractor shall provide the services of qualified technical representatives of the Single I&C supplier:
 - 1. To supervise installation and connection of all instruments, elements and components of every system, including connection of instrument signals to primary measurement elements and to final control elements such as pumps;
 - 2. To make all necessary adjustments, calibrations and tests;
 - 3. To instruct plant operating and maintenance personnel on instrumentation. This time shall be in addition to whatever time is required for other facets of work at the site and shall be during the Owner's normal working days and hours.

1.7 GUARANTEE

- A. The Contractor shall guarantee all equipment and installation, as specified herein, for a period of one (1) year following the date of completion of the work. To fulfill this obligation, the Contractor shall utilize technical service personnel designated by the Single I&C supplier to which the Contractor originally assigned project responsibility for instrumentation.

1.8 ADDITIONAL PROVISIONS

- A. The applicable provisions of the following sections under Electrical Work shall apply the work and equipment specified herein, the same as if stated in full herein:

1. Codes and Standards
2. Equipment Materials and Workmanship
3. Testing
4. Grounding
5. Equipment Anchoring
6. Conductor and Equipment Identification
7. Terminal Cabinets and Control Compartments
8. Process Control Devices

1.9 NEWEST MODEL COMPONENTS

- A. All meters, instruments and other components shall be the most recent field proven models marketed by their manufacturers at the time of the submittal of shop drawings unless otherwise specified to match existing equipment. All technical data publications included with the submittal shall be the most recent issue.

1.10 COORDINATION

- A. I&C supplier shall coordinate with his supplier and other Contractors on the project. Where large subsystems are provided, the I&C supplier shall coordinate before the bid to be certain all equipment, engineering and labor are provided. Coordination item minimally includes: equipment dimensions, heat rejection, power requirements, control and signal requirements, and interconnection requirements.

1.11 TEST PROCEDURE DEVELOPMENT AND DOCUMENTATION

- A. I&C subcontractor shall prepare and submit to the Engineer for review a detailed description of the test procedures that he proposed to perform to demonstrate conformance of the complete system of instrumentation and controls to this Specification.
- B. It is recommended that the I&C subcontractor develop the test procedures in two steps by first submitting general descriptions and outlines of the tests and then, upon receipt of approval, submit the required detailed procedures and forms.
- C. Operational Acceptance Tests
 1. The I&C subcontractor shall prepare check-off sheet(s) for each loop and an instrument calibration sheet for each active I&C element (except simple hand switches, lights, etc.). These check-off and data sheets shall form the basis for these operational tests and this documentation.
 2. Each loop check-off sheet shall cite the following information and shall provide spaces for sign-off on individual items and on the completed loop by the I&C subcontractor.
 - a. Project name
 - b. Loop number
 - c. For each elements: Tag number, description, manufacturer and model number, installation bulletin, and Specification sheet number.
 - d. Loop description
 - e. Installation check
 - f. Termination check
 - g. Calibration check
 - h. Adjustment check

- i. Space for comments
 - j. for loop sign-off I&C subcontractor and date.
- 3. Each instrument calibration sheet shall provide the following information and a space for sign-off on individual items and on the completed unit by Owner Representative and the I&C subcontractor.
 - a. Project name
 - b. Loop number
 - c. Tag number
 - d. Manufacturer
 - e. Model number
 - f. Serial number
 - g. Calibration range
 - h. Calibration data: Input, output and error at 0, 25, 50, 75, and 100% of span.
 - i. Switch setting, contact action and dead band for discrete elements.
 - j. Space for comments
 - k. Space for sign-off by I&C subcontractor and date.
- D. Functional Acceptance Tests
The I&C subcontractor shall prepare two types of test forms as follows:
 - 1. For those functions that can be demonstrated on a loop-by-loop basis, the form shall include:
 - a. Project name
 - b. Loop number
 - c. Loop description
 - d. Test procedure description
 - e. For each component: Tag number, description, manufacturer and data sheet number.
 - f. Space for sign-off and date by both I&C subcontractor and Owner Representative.
 - 2. For those functions that cannot be demonstrated on a loop-by-loop basis, the test form shall be a listing of the specific tests to be conducted. With each test description, the following information shall be included:
 - a. Spec page and paragraph of function demonstrated
 - b. Description of function
 - c. Space for sign-off and date by both I&C subcontractor and Engineer.

PART 2 - PRODUCTS

2.1 TECHNICAL MANUALS

- A. One preliminary O&M manual shall be submitted to the Engineer for review and comment. Assuming a favorable review the I&C supplier shall incorporate comments and forward the five final copies to the Engineer. If the preliminary O&M is not acceptable, the I&C supplier shall resubmit.
- B. Five (5) final sets of technical manuals shall be supplied for the Owner as a condition for final acceptance of the project. Each set shall consist of one (1) or more volumes, each of which shall be bound in a standard size, 3-ring, loose leaf, vinyl plastic hard cover binder suitable for bookshelf storage. Binder ring size shall not exceed 3 inches.

- C. In addition to updated shop drawing information to reflect actual existing conditions, each set of technical manuals shall include installation, connection, operating, trouble-shooting, maintenance and overhaul instructions in complete detail. This shall provide the Owner with comprehensive information on all systems and components to enable operation, service, maintenance and repair. Exploded or other detailed views of all instruments, assemblies, and accessory components shall be included together with the complete parts lists and ordering instructions.
- D. Shop drawing files shall be provided in the latest version of AutoCAD with each O&M manual. Provide ACAD files on disk.

2.2 SPARE PARTS

- A. The Contractor shall include, as part of the bid package, a list of recommended spare parts covering items required under these specifications.
- B. Minimum spare parts shall be provided boxed and identified including the following:
 - 1. 3-control relays of each type used.
 - 2. 3-timing relays of each type used.
 - 3. 4-fuses of each size and type used.
 - 4. 2-pilot lights of each size and type use.
 - 5. 3-signal field surge arrester of each type used.
 - 6. 2-signal panel surge arrester of each type used.
 - 7. 2-incoming power lightning arrester of each type used.
 - 8. 3-surge capacitor of each type used.Also provide other spares as noted by the particular sections and paragraphs of other-specifications.

2.3 CONTROL PANELS

- A. General
 - 1. I&C supplier shall construct the control panel to properly control internal and external equipment. No attempt is made to specify or indicate on plans, all required equipment but rather to set forth the minimum requirements.
- B. Engineering
 - 1. I&C supplier shall provide system engineering and produce detailed fully engineered, coordinated and completed drawings.
- C. Construction
 - 1. Control panel construction shall be per these specification and plans.
- D. Signal and Control Circuit Wiring
 - 1. Wire Type and Sizes: Conductors shall be flexible stranded copper wire; these shall be UL listed TFFN, THWN, THHN and shall be rated 600v. Wire for control signal circuits shall be #16 AWG unless otherwise noted. All instrumentation cables shall be shielded #18 AWG with a copper drain wire unless otherwise noted. All special instrumentation cable such as between sensor and transmitter shall be supplied by the I&C supplier. Contractor shall increase wire size per load or impedance requirements.
- E. Wiring Instrumentation
 - 1. All wires shall be run in plastic wireways except (1) field wiring, (2) wiring between mating blocks in adjacent sections, (3) wiring run from components on a swing-out panel to

- components on a part of the fixed structure, (4) wiring run to panel mounted components on the door and the like. Wiring run on a swing out panel to other components on a fixed panel shall be made up in nylon wire ties bundles and secured so that bundles are not strained at the terminals.
2. Wiring run to control devices on the front panels shall be tied together at short intervals with nylon ties and secured to the inside face of the panel using adhesive mounts and adhesive strips.
 3. Wiring to rear terminals on panel mounted instruments shall be run in plastic wares secured to horizontal brackets run above or below the instruments in the same plane as the rear of the instruments.
 4. Shields of instrument cable shall only be grounded on one side of each circuit. The side to be grounded shall be nearest the source of excitation.
 5. Care shall be exercised to properly insulate the ungrounded side of the loop to prevent ground loops from occurring.
 6. Conformance to the above wiring installation requirements shall be reflected by details shown on the shop drawings for the Engineer's review.
- F. Wire Marking
1. Each signal, alarm, control, and indicating circuit conductor connected to a given electrical point shall be designated by a single unique number which shall be shown on all shop drawings. These numbers shall be marked on all conductors using white plastic heat shrink sleeves with typewritten characters. Instrument signal conductors shall be tagged with unique multiple digit numbers. Wires from the circuit breaker panelboard shall be tagged indicating the branch circuit breaker number.
- G. Terminal Blocks
1. Compression type terminal blocks shall be molded plastic with barriers and box lug terminals, and shall be rated 15 amps at 600v and mounted securely to DIN rails. White marking strips fastened to the molded sections shall be provided and wire numbers and circuit identifications shall be marked thereon with machine printed marker on top. Terminal blocks shall be IEC style by Allen Bradley or an approved equal.
 2. Provide field terminal boxed with each terminal identified. Provide Panduit. The field terminals shall be included with the loop drawings and be identified.
- H. Wire Color
1. Wire color shall be, Line Power – Black; Neutral or common – White; AC Control – Red; DC Control – Blue; Equipment or Chassis Ground – Green; specified externally powered circuits – Orange.
- I. Enclosures
1. Unless otherwise indicated, all enclosures shall be provided with the following.
 - a. Modified NEMA 3R, 316 stainless steel, gasketed, freestanding or wall mounted, bolted to concrete base.
 - b. Subplate for mounting equipment.
 - c. Pad lockable, pocketed exterior doors.
 - d. Where required, provide stainless steel piano hinged dead fronts with quarter turn latches.
- J. Identification

1. All components shall be identified using Limacoid labels or an approved equal.

2.4 CONTROL PANEL EQUIPMENT

A. General Purpose Relays

1. General purpose relays in the control panel shall be the plug-in type with contacts rated 10 amps at 120 vac as a minimum. The quantity and type of contacts shall be as required to accomplish the desired control task. Each relay shall be enclosed in a clear plastic heat and shock resistant dust cover. Relays shall be Potter and Brumfield or an approved equal. Differing mounting sockets shall be used to prohibit improper relay installations. Provide tube type base, 8 PIN or 11 PIN.

B. Time Delay Relays

1. Time delay relay shall be Diversified with digital settings or an approved equal. Timers shall be time delay on, interval on or time delay off relays, as required and shall be Diversified or an approved equal. Instantaneous contacts or auxiliary slave relays shall be provided as required. Provide tube type base, 8 PIN or 11 PIN.

C. Signal Isolators

1. Additional slave or interposing relays and signal isolators and signal converters shall be installed as required.

D. Circuit Breakers

1. Circuit breakers shall be single pole, 120vac, 15 amp rating or as required to protect wires and equipment; mounted on the inside of the enclosure or equipment remote from the enclosure.

E. Name Plates

1. Name plates shall be supplied for identification of control panels and all field mounted elements, including flowmeters and their transmitters. These name plates shall identify the instrument or meter, descriptively as to the function of the system. Nameplates shall be fabricated from black faced, white centered, laminated engraving plastic. A nameplate shall be provided for each signal transducer, signal converter, signal isolator, each electronic trip, and the like, mounted inside the control panels. These shall uniquely identify each control component. Adhesives shall be acceptable for attaching nameplates. Painted surfaces must be prepared to allow permanent bonding of adhesives. Nameplates shall be provided for instruments, function titles for each group of instruments and other components mounted on the front of the control panels as shown. Proposed colors, styles, height and text shall be submitted for approval.

F. LED panel Light

1. Provide panel light. Provide sub plate mounted light switch. Provide receptacle.

G. Vapor Guard

1. Moisture absorbing vapor guard shall be provided in each control panel.

H. Power Supplies

1. Power supplies shall be provided as required for loop power or other requirements for special equipment. Loop power supplies shall be Square D or an approved equal.

I. Circuit Breakers

1. Square D
2. Amperage ratings shall be indicated on drawings.

J. Fuses

1. Fuses and fuse holders 5 x 20mm, IEC style, with blown fuse indicating light.
- K. Ground Fault Interrupting Receptacle
 1. Leviton Duplex Receptacle or equal.
 2. AC receptacle box shall be Steel City 58351-1/2 or equal.
 3. Covers shall be Steel City 58-C-5, or equal.
- L. Selector Switches and Push Buttons
 1. Square D, Class 9001, Type K, or equal.
 2. Operators shall be black knob type or key switch, 3-position or 2-position, push button or as noted.
 3. Selector switches shall be spring return where noted.
 4. Pushbuttons inserts

<u>Label</u>	<u>Color</u>
On	Green
Off	White
Start	Green
Stop	White
Reset	Black
Acknowledge	Yellow
 5. Selector Switch Operator

<u>Label</u>	<u>Color</u>	<u>Text</u>
All	Black	White
- M. Indicator Lights
 1. Square D, Class 9001, type K. Units shall be press to test, transformer type.
 2. Lens color shall be as noted.

<u>Label</u>	<u>Color</u>
On	Green
Off	White
Open	Green
Closed	White
Hand	Yellow
Auto	Green
Local	White
Remote	Green
Alarm	Red
Power Available	White
- N. Surge and Lightning Arrestors
 1. All control panels shall be provided with surge and lightning arrestors as specified.
 2. TVSS
 - a. Lightning surge suppressors shall be Innovative Technology PTX-160 Series, unless otherwise indicated.
 3. Signal
 - a. Panel surge arrestors shall be Joslyn, 1800 Series.
 - b. Field surge arrestors shall be Joslyn, 1660-06.

- 4. Ethernet Surge Protection
 - a. Atlantic Scientific, 240040P, plug in surge arrestor, via FB Suppressors, Inc., (305) 247-3477.
- O. Starters
 - 1. Provide FVNR SQ D or equal NEMA sized starters for conventional across the line applications.
 - 2. Provide Electronic Soft Starters, Eaton, SQ D or equal.

2.5 FIELD INSTRUMENTS

- A. Refer to drawings or other specifications, including specification section 13441 for most of the instruments, besides what is listed under this section.
- B. Pressure Switches
 - 1. Unless otherwise specified or indicated, pressure switches shall be A-B 836 Series with ranges and process connections as required.
 - 2. Provide all labor and materials for a complete installation, including impulse piping valves, etc.
- C. Floats
 - 1. Floats shall be non-mercury Anchor Scientific or equal.
 - 2. Provide all labor and materials for a complete installation, including J-boxes, connectors and the like.
- D. Sunshields
 - 1. Sunshields shall be provided for all electronic instrumentation located outside.
 - 2. Contractor may use manufacturer standard product line such as Marsh McBirny. Where no standard product line exists, Contractor shall provide custom units 316ss sized as required. Provide all installation hardware. Submit details for approval.
 - 3. Examples include flowmeters, analytical equipment and the like, see other specification sections and drawing details.

2.6 NAMEPLATES, NAME TAGS AND SERVICE LEGENDS

- A. All components provided under this section, both field and panel mounted, shall be provided with permanently mounted name tags bearing the entire IA tag number of the components. Panel mounted tags shall be plastic; field mounted tags shall be stamped stainless steel.
- B. The panel drawings refer to nameplates and service legends: nameplates are defined as inscribed laminated plastic plates mounted under or near a panel face mounted instrument. Service legends are defined as inscribed laminated plastic integrally mounted on a panel face mounted instrument.
- C. Service legends and nameplates shall be engraved, rigid, laminated plastic. Service legends and nameplates shall be fastened to the panel by screws or with a specially applied adhesive. Fastening shall not depend only on the adhesive.

2.7 UPS SYSTEM

- A. Provide best model APC, Allen Bradley, or Sola Heavy Duty UPS sized to run the PLC, I&C, operator interface (if equipped) and field I&C equipment.

PART 3 - EXECUTION

3.1 INSTALLATION, CALIBRATION, TESTING, START UP AND INSTRUCTION

A. General

1. Under the supervision of a Single I&C supplier, all systems specified in this section shall be installed, connected, calibrated and tested and in coordination with the Owner and Engineer shall be started to place the process in operation. This shall include final calibration in concert with equipment specified elsewhere in these specifications as well as equipment provided by the Owner.

B. Installation and Connection

1. The Contractor shall install and connect all field mounted components and assemblies under the criteria imposed in 1.3, herein. The installation personnel shall be provided with a final reviewed copy of the shop drawings and data.
2. The instrument process lines, impulse piping lines and air signal tubing shall, in general, be installed in a similar manner to the installation of conduit specified under Section 16000.
3. Bends shall be formed with the proper tools and to uniform radii and shall be made without deforming or thinning the walls of the tubing.
 - a. Unless otherwise indicated, all fittings, adapters, impulse piping, valves, etc. shall be 316 stainless. Valves shall be Whitey Series 40 or an approved equal.
4. The Contractor shall have a technical field representative of the I&C supplier to instruct these installation personnel on any and all installation requirements; thereafter the technical field representatives shall be readily available by telephone to answer questions and to provide clarification when needed by installation personnel.
 - a. Where primary elements (supplied by the I&C supplier) will be part of a mechanical system, the I&C supplier shall coordinate the installation of the primary elements with the mechanical system manufacturer.
5. After all installation and connection work has been completed, the technical field representatives shall check all for correctness, verifying polarity of electric power and signal connections making sure all process connections are free of leaks and all such similar details. The technical field representative shall certify in writing to the Contractor that for each loop or system he has completed such check out and that any discrepancies have been corrected by the installation personnel.
6. The field representative of the I&C supplier shall coordinate all work required to interface the new equipment, including all required modifications to the existing equipment and related devices.

C. Calibration

1. All new instruments shall be calibrated.
 - a. All instruments and systems shall be calibrated after installation, in accordance with the component manufacturer's written instructions. This shall provide that those components having adjustable features are set carefully for the specific conditions and applications of this installation and that the components and/or systems are within the specified limits of accuracy. Defective elements which cannot achieve proper calibration or accuracy, either individually or within the system shall be replaced. This calibration work shall be accomplished by the I&C Supplier.

- b. Proof of Conformance – The burden of proof of conformance to the specified accuracy and performance is on the Contractor using his designated I&C supplier. The Contractor shall supply necessary test equipment and technical personnel if called upon to prove accuracy and performance at no additional cost to the Owner, wherever reasonable doubt or evidence of malfunction or poor performance may appear within the guarantee period.
- D. Testing
 - 1. All systems shall be exercised through operational tests in the presence of the Engineer in order to demonstrate achievement of the specified performance. Operational tests depend upon completion of work specified elsewhere in these specifications. The scheduling of the test shall be coordinated by the Contractor among all parties involved so that the tests may proceed without delays or disruption by incomplete work.
 - 2. All functional/loop tests shall be witnessed and signed off by the Owner's representative and the I&C subcontractor.
 - 3. Contractor shall provide testing service in conjunction with the PLC/SCADA program developer (CSD). Contractor shall include a maximum of 30 man hours for this service. If problems are found as a result of I&C equipment additional time shall be provided as may be required. Reference Section 16910-Programmable Logic Controller.
- E. Training
 - 1. Plant operating personnel shall be provided with training prior to start-up.
 - 2. Two 4 hour training sessions shall be provided. Training shall be at a time convenient to the Owner.
 - 3. Operating and maintenance personnel shall be instructed in the functions and operation of each system and shall be shown the various adjustable and set point features which may require readjustment, resetting or checking, recalibration or maintenance by them from time to time. This instruction shall be scheduled at a time arranged with the Owner at least two (2) weeks in advance. Instruction shall be given by qualified persons employed by the I&C supplier.
- F. Start Up
 - 1. When all systems are assessed by the Contractor to have been successfully carried through complete operational tests with a minimum of simulation, and the Engineer concurs in his assessment, start up by the plant operating personnel can follow.

I/O TABLES LISTED IN THE FOLLOWING PAGES FOR THE PLC CONTROL PANELS AND THEIR RESPECTIVE I/O EQUIPMENT. COORDINATE ALL PLC WORK AND NEW PARTS FURNISHED BY I&C CONTRACTOR FOR THE PLC EQUIPMENT IMPROVEMENTS TO BE CARRIED OUT BY THE I&C CONTRACTOR AND CSD PERSONNEL.

MAIN PLC PANEL (MPP)

Rack 1

Slot 2	1771-OW16 Contact Output	Relocated
O:012/0	Not Used	
O:012/1	Not Used	
O:012/2	Not Used	
O:012/3	Not Used	
O:012/4	Not Used	
O:012/5	Not Used	
O:012/6	Not Used	
O:012/7	Not Used	
O:012/10	Not Used	
O:012/11	Not Used	
O:012/12	Not Used	
O:012/13	Not Used	
O:012/14	Not Used	
O:012/15	Not Used	
O:012/16	Not Used	
O:012/17	Not Used	
Slot 3	1771-IFE/C Analog Input	Relocated
N7:914	Not Used	
N7:915	Not Used	
N7:916	Not Used	
N7:917	Not Used	
N7:918	Not Used	
N7:919	Not Used	
N7:920	Not Used	
N7:921	Not Used	
Slot 4	1771-IFE/C Analog Input	Relocated
N7:305	AIT-2150 Raw Water Turbidity	To CP-4
N7:306	AIT-2120B Raw Water pH Low	To CP-4
N7:307	AIT-2120C Raw Water pH High	To CP-4
N7:308	PT-2110 Raw Water Pressure	To CP-4
N7:309	Not Used	
N7:310	Not Used	
N7:311	CIT-2130 Raw Water Conductivity	To CP-4
N7:312	Not Used	

Slot 5	1771-OFE Analog Output	Relocated
N7:960	Degas No.1 NaOCl Feed Pump Speed Command	To CP-4
N7:961	No.2 NaOCl to Post Feed Pump Speed Command	To CP-4
N7:962	No.3 NaOCl Feed Pump Speed Command	To CP-4
N7:963	Not Used	
Slot 6	1771-IAD Digital Input	Relocated
I:016/0	Raw Water High Temp Alarm	To CP-4
I:016/1	Not Used	
I:016/2	Not Used	
I:016/3	RX-2801 Booster Pump No.1 Running	To Ethernet
I:016/4	RX-2802 Booster Pump No.2 Running	To Ethernet
I:016/5	RX-2803 Booster Pump No.3 Running	To Ethernet
I:016/6	RX-4501 HSP No.1 Running	To Ethernet
I:016/7	RX-4502 HSP No.2 Running	To Ethernet
I:016/10	RX-4503 HSP No.3 Running	To Ethernet
I:016/11	Plant AC Power Normal	To CP-4
I:016/12	RX-2804 Booster Pump No.4 Running	To Ethernet
I:016/13	RX-2805 Booster Pump No.5 Running	To Ethernet
I:016/14	Not Used	
I:016/15	Not Used	
I:016/16	Not Used	
I:016/17	Not Used	
Slot 7	1771-OAD Digital Output	Relocated
O:017/0	Not Used	
O:017/1	CR2000B Plant Shutdown CR-2	To CP-4
O:017/2	CR-4501 HSP No.1 Run CR-3	To Ethernet
O:017/3	CR-4502 HSP No.2 Run CR-4	To Ethernet
O:017/4	CR-4503 HSP No.3 Run CR-5	To Ethernet
O:017/5	CR-2801 Booster Pump No.1 Run CR-6	To Ethernet
O:017/6	CR-2802 Booster Pump No.2 Run CR-7	To Ethernet
O:017/7	CR-2803 Booster Pump No.3 Run CR-8	To Ethernet
O:017/10	MCL Annunciator Horn	To CP-4
O:017/11	Not Used CR-9	
O:017/12	CR-2804 Booster Pump No.4 Run CR-10	To Ethernet
O:017/13	CR-2805 Booster Pump No.5 Run CR-11	To Ethernet
O:017/14	Not Used	

O:017/15	Not Used	
O:017/16	Not Used	
O:017/17	Not Used	

SMP 1
Rack 2

Slot 0	1771-IFE Analog Input	Relocated
N7:5	Skid No.1 Feed Flow 0-1600 GPM	
N7:6	Skid No.1 Reject Flow 0-325 GPM	
N7:7	Skid No.1 First Stage Product Flow 0-1000 GPM	
N7:8	Skid No.1 2nd Stage Product Flow 0-465 GPM	
N7:9	Skid No.1 Product Pressure 0-200 PSIG	
N7:10	Skid No.1 Feed Pressure 0-200 PSIG	
N7:11	Skid No.1 Interstage Pressure 0-200 PSIG	
N7:12	Skid No.1 Reject Pressure 0-200 PSIG	
Slot 1	1771-IFE Analog Input	Relocated
N7:55	Skid No.1 Product Conductivity 0-1000 uS	
N7:56	Skid No.1 Reject Conductivity 0-10000 uS	
N7:57	Skid No.1 Feed Valve Position 0-100 %	
N7:58	Skid No.2 Feed Valve Position 0-100 %	
N7:59	Not Used	
N7:60	Not Used	
N7:61	Not Used	
N7:62	Not Used	
Slot 2	1771-IFE Analog Input	Relocated
N7:105	Skid No.2 Feed Flow 0-1600 GPM	
N7:106	Skid No.2 Reject Flow 0-325 GPM	
N7:107	Skid No.2 First Stage Product Flow 0-1000 GPM	
N7:108	Skid No.2 2nd Stage Product Flow 0-465 GPM	
N7:109	Skid No.2 Product Pressure 0-300 PSIG	
N7:110	Skid No.2 Feed Pressure 0-200 PSIG	
N7:111	Skid No.2 Interstage Pressure 0-200 PSIG	
N7:112	Skid No.2 Reject Pressure 0-200 PSIG	
Slot 3	1771-IFE Analog Input	Relocated
N7:155	Skid No.2 Product Conductivity 0-1000 uS	
N7:156	Skid No.2 Reject Conductivity 0-20000 uS	
N7:157	Skid No.1 Reject Valve Position 0-100 %	

N7:158	Skid No.2 Reject Valve Position 0-100 %	
N7:159	Not Used	
N7:160	Not Used	
N7:161	Not Used	
N7:162	Not Used	

Slot 4	1771-OFE Analog Output	Relocated
N7:201	Skid No.2 Feed Flow 0-1600 GPM To SMP Panel Indicator	
N7:202	Skid No.2 Reject Flow 0-325 GPM To SMP Panel Indicator	
N7:203	Skid No.2 First Stage Product Flow 0-1000 GPM To SMP Panel Indicator	
N7:204	Skid No.2 2nd Stage Product Flow 0-465 GPM To SMP Panel Indicator	
Slot 5	1771-OFE Analog Output	Relocated
N7:221	Skid No.1/2 Product Pressure 0-300 PSIG To SMP Panel Indicator	
N7:222	Skid No.1/2 Feed Pressure 0-300 PSIG To SMP Panel Indicator	
N7:223	Skid No.1/2 Interstage Pressure 0-300 PSIG To SMP Panel Indicator	
N7:224	Skid No.1/2 Reject Pressure 0-300 PSIG To SMP Panel Indicator	
Slot 6	1771-OFE Analog Output	Relocated
N7:241	Skid No.1/2 Total Product Flow 0-1000 GPM To SMP Panel Indicator	
N7:242	Skid No.1/2 Product Conductivity 0-1000 uS To SMP Panel Indicator	
N7:243	Skid No.1/2 Reject Conductivity 0-1000 mS To SMP Panel Indicator	
N7:244	Not Used	
Slot 7	1771-OFE Analog Output	Relocated
N7:261	Skid No.1/2 Reject Valve Position 0-100 % To SMP Panel Indicator	
N7:262	Skid No.1/2 Feed Valve Position 0-100 % To SMP Panel Indicator	
N7:263	Not Used	
N7:264	Not Used	

Rack 3

Slot 8	1771-OFE Analog Output	Relocated
---------------	-------------------------------	------------------

N7:281	ZC-2501 Skid No.1 Feed Valve Open Command 0-100 %	
N7:282	ZC-2502 Skid No.2 Feed Valve Open Command 0-100 %	
N7:283	ZC-3510 Skid No.1 Reject Valve Close Command 0-100 %	
N7:284	ZC-3520 Skid No.2 Reject Valve Close Command 0-100 %	
Slot 9	1771-IAD Digital Input	Relocated
I:031/0	PSL-2801 Booster Pump No.1 Suction Pressure 0=Low, 1=Normal	
I:031/1	PSH-2801 Booster Pump No.1 Discharge Pressure 0=High, 1=Normal	
I:031/2	PSL-2802 Booster Pump No.2 Suction Pressure 0=Low, 1=Normal	
I:031/3	PSH-2802 Booster Pump No.2 Discharge Pressure 0=High, 1=Normal	
I:031/4	PSL-2803 Booster Pump No.3 Suction Pressure 0=Low, 1=Normal	
I:031/5	PSH-2803 Booster Pump No.3 Discharge Pressure 0=High, 1=Normal	
I:031/6	Not Used	
I:031/7	Not Used	
I:031/10	PSL-4501 High Service Pump No.1 Suction Pressure 0=Low, 1=Normal	To HSP Panel
I:031/11	PSH-4501 High Service Pump No.1 Discharge Pressure 0=High, 1=Normal	To HSP Panel
I:031/12	PSL-4502 High Service Pump No.2 Suction Pressure 0=Low, 1=Normal	To HSP Panel
I:031/13	PSH-4502 High Service Pump No.2 Discharge Pressure 0=High, 1=Normal	To HSP Panel
I:031/14	PSL-4503 High Service Pump No.3 Suction Pressure 0=Low, 1=Normal	To HSP Panel
I:031/15	PSH-4503 High Service Pump No.3 Discharge Pressure 0=High, 1=Normal	To HSP Panel
I:031/16	Not Used	
I:031/17	Not Used	
Slot 10	1771-IAD Digital Input	Relocated
I:032/0	Skid No.1/2 Local Control 0=Bypass, 1=Remote	
I:032/1	SMP Panel No.1 Skid No.1 Start	
I:032/2	SMP Panel No.1 Skid No.2 Start	
I:032/3	SMP Panel No.1 Skid No.1 Stop Off	
I:032/4	SMP Panel No.1 Skid No.2 Stop Off	
I:032/5	Skid No.1/2 SMP Panel No.1 Skid No.2 Selected	

I:032/6	ZS-2501A Skid No.1 Feed Valve Fully Closed (Disconnected)	
I:032/7	ZS-2502A Skid No.2 Feed Valve Fully Closed (Jumpered)	
I:032/10	ZS-3510B Skid No.1 Reject Valve Fully Open (Jumpered)	
I:032/11	ZS-3520B Skid No.2 Reject Valve Fully Open (Jumpered)	
I:032/12	Not Used	
I:032/13	Not Used	
I:032/14	Not Used	
I:032/15	Not Used	
I:032/16	Not Used	
I:032/17	Not Used	
Slot 11	1771-OAD Digital Output	Relocated
O:033/0	SMP Panel No.1 Skid No.1 Running Light	
O:033/1	SMP Panel No.1 Skid No.2 Running Light	
O:033/2	SMP Panel No.1 Annunciator Horn Output	
O:033/3	Not Used	
O:033/4	Not Used	
O:033/5	Not Used	
O:033/6	Not Used	
O:033/7	Not Used	
O:033/10	Not Used	
O:033/11	Not Used	
O:033/12	Not Used	
O:033/13	Not Used	
O:033/14	Not Used	
O:033/15	Not Used	
O:033/16	Not Used	
O:033/17	Not Used	

RIO-NF1

	Digital Input	Relocated
PAH-212	Feed Water Pump #1 High Pressure Switch	
ZSO-213	Feed Water Valve Open Limit Switch	
ZSC-213	Feed Water Valve Closed Limit Switch	
FA-313	Rupture Disk	
PAH-312	Permeate High Pressure Switch	
ZSC-312	Interstage Valve Closed Limit Switch	
ZSC-317	Permeate Valve Closed Limit Switch	
	Digital Output	Relocated
ZI-213	Feed Water Valve Open Command	

	Analog Input	Relocated
PI-310	Feed Water First Stage Pressure	
PDI-311	Feed Water First Stage Differential Pressure	
PDI-312	Feed Water Second Stage Differential Pressure	
PI-311	First Stage Concentrate Pressure	
PI-312	First Stage Permeate Pressure	
FI-311	Second Stage Permeate Flow	
CI-311	Second Stage Permeate Conductivity	
FI-312	Final Permeate Flow	
CI-312	Final Permeate Conductivity	
FI-313	Final Concentrate Flow	
ZI-316	Concentrate Valve Position	
	Analog Output	Relocated
ZC-316	Concentrate Valve Position Command	

RIO-NF2

	Digital Input	Relocated
PAH-222	Feed Water Pump #2 High Pressure Switch	
ZSO-223	Feed Water Valve Open Limit Switch	
ZSC-223	Feed Water Valve Closed Limit Switch	
FA-323	Rupture Disk	
PAH-322	Permeate High Pressure Switch	
ZSC-322	Interstage Valve Closed Limit Switch	
ZSC-327	Permeate Valve Closed Limit Switch	
	Digital Output	Relocated
ZI-223	Feed Water Valve Open Command	
	Analog Input	Relocated
PI-320	Feed Water First Stage Pressure	
PDI-321	Feed Water First Stage Differential Pressure	
PDI-312	Feed Water Second Stage Differential Pressure	
PI-311	First Stage Concentrate Pressure	
PI-312	First Stage Permeate Pressure	
FI-311	Second Stage Permeate Flow	
CI-311	Second Stage Permeate Conductivity	
FI-312	Final Permeate Flow	
CI-312	Final Permeate Conductivity	

FI-313	Final Concentrate Flow	
ZI-316	Concentrate Valve Position	
	Analog Output	Relocated
ZC-316	Concentrate Valve Position Command	

SMP 2
Rack 4

Slot 0	1771-IFE/C Analog Input	Relocated
N7:505	Skid No.3 Feed Flow 0-1700 GPM	
N7:506	Skid No.3 Concentrate Flow 0-500 GPM	
N7:507	Skid No.3 Product Flow 0-1500 GPM	
N7:508	Skid No.3 Second Stage Product Flow 0-500 GPM	
N7:509	Skid No.3 Product Pressure 0-300 PSIG	
N7:510	Skid No.3 Feed Pressure 0-300 PSIG	
N7:511	Skid No.3 Interstage Pressure 0-300 PSIG	
N7:512	Skid No.3 Concentrate Pressure 0-300 PSIG	
Slot 1	1771-IFE/C Analog Input	Relocated
N7:585	Skid No.4 Feed Flow 0-1700 GPM	
N7:586	Skid No.4 Concentrate Flow 0-500 GPM	
N7:587	Skid No.4 Product Flow 0-1500 GPM	
N7:588	Skid No.4 Second Stage Product Flow 0-500 GPM	
N7:589	Skid No.4 Product Pressure 0-300 PSIG	
N7:590	Skid No.4 Feed Pressure 0-300 PSIG	
N7:591	Skid No.4 Interstage Pressure 0-300 PSIG	
N7:592	Skid No.4 Concentrate Pressure 0-300 PSIG	
Slot 2	Blank	Relocated
Slot 3	Blank	Relocated
Slot 4	1771-OFE Analog Output	Relocated
N15:800	FI-3200 Skid No.3/4 Feed Flow 0-1700 GPM To SMP Panel Indicator	
N15:801	FI-3500 Skid No.3/4 Concentrate Flow 0-500 GPM To SMP Panel Indicator	
N15:802	FI-3400C Skid No.3/4 Product Flow 0-1500 GPM To SMP Panel Indicator	
N15:803	FI-3400B Skid No.3/4 Second Stage Product Flow 0-500 GPM To SMP Panel Indicator	
Slot 5	1771-OFE Analog Output	Relocated
N15:240	PI-3400A Skid No.3/4 Product Pressure 0-300 PSIG To SMP Panel Indicator	
N15:241	PI-3300A Skid No.3/4 Feed Pressure 0-300 PSIG To SMP Panel Indicator	

N15:242	PI_3300B Skid No.3/4 Interstage Pressure 0-300 PSIG To SMP Panel Indicator	
N15:243	PI_3300C Skid No.3/4 Concentrate Pressure 0-300 PSIG To SMP Panel Indicator	
Slot 6	1771-OFE Analog Output	Relocated
N15:260	FI-3400A Skid No.3/4 Product Flow 0-1500 GPM To SMP Panel Indicator	
N15:261	CI-3400 Skid No.3/4 Product Conductivity 0-500 uS To SMP Panel Indicator	
N15:262	CI-3500 Skid No.3/4 Concentrate Conductivity 0-1000 mS To SMP Panel Indicator	
N15:263	Not Used	
Slot 7	1771-OFE Analog Output	Relocated
N15:280	ZI-3500 Skid No.3/4 Concentrate Valve Position 0-100 % To SMP Panel Indicator	
N15:281	ZI-3200 Skid No.3/4 Feed Valve Position 0-100 % To SMP Panel Indicator	
N15:282	Not Used	
N15:283	Not Used	

Rack 5

Slot 8	1771-OFE Analog Output	Relocated
N15:300	ZC-3230 Skid No.3 Feed Valve Open Command 0-100 %	
N15:301	ZC-3240 Skid No.4 Feed Valve Open Command 0-100 %	
N15:302	ZC-3530 Skid No.3 Reject Valve Close Command 0-100 %	
N15:303	ZC-3540 Skid No.4 Reject Valve Close Command 0-100 %	
Slot 9	1771-IAD Digital Input	Relocated
I:051/0	HS-3230A Skid No.3 Feed Control SMP2 Switch in Manual	
I:051/1	HS-3530A Skid No.3 Concentrate Control SMP2 Switch in Manual	
I:051/2	HS-3240A Skid No.4 Feed Control SMP2 Switch in Manual	
I:051/3	HS-3540A Skid No.4 Concentrate Control SMP2 Switch in Manual	
I:051/4	Not Used	
I:051/5	Not Used	
I:051/6	Not Used	
I:051/7	Not Used	
I:051/10	Not Used	
I:051/11	Not Used	
I:051/12	Not Used	
I:051/13	Not Used	

I:051/14	Not Used	
I:051/15	Not Used	
I:051/16	Not Used	
I:051/17	Not Used	
Slot 10	1771-IAD Digital Input	Relocated
I:052/0	Skid No.3/4 Local Control 0=Bypass, 1=Remote	
I:052/1	Skid No.3 SMP 2 Panel Start	
I:052/2	Skid No.4 SMP 2 Panel Start	
I:052/3	Skid No.3 SMP 2 Panel Stop Off	
I:052/4	Skid No.4 SMP 2 Panel Stop Off	
I:052/5	Skid No.3/4 SMP 2 Panel Metering Skid No.4 Selected	
I:052/6	ZS-3230A Skid No.3 Feed Valve Fully Closed	
I:052/7	ZS-3240A Skid No.4 Feed Valve Fully Closed	
I:052/10	ZS-3530B Skid No.3 Concentrate Valve Fully Open	
I:052/11	ZS-3540B Skid No.4 Concentrate Valve Fully Open	
I:052/12	Not Used	
I:052/13	Not Used	
I:052/14	Not Used	
I:052/15	Not Used	
I:052/16	Not Used	
I:052/17	Not Used	
Slot 11	1771-OAD Digital Output	Relocated
O:053/0	Skid No.3 SMP 2 Panel Running Light	
O:053/1	Skid No.4 SMP 2 Panel Running Light	
O:053/2	Not Used	
O:053/3	FCV-3230M Skid No.3 Feed Valve SMP 2 Panel Local Manual	
O:053/4	FCV-3240M Skid No.4 Feed Valve SMP 2 Panel Local Manual	
O:053/5	FCV-3530M Skid No.3 Reject Valve SMP 2 Panel Local Manual	
O:053/6	FCV-3540M Skid No.4 Reject Valve SMP 2 Panel Local Manual	
O:053/7	Not Used	
O:053/10	Not Used	
O:053/11	Not Used	
O:053/12	Not Used	
O:053/13	Not Used	
O:053/14	Not Used	

O:053/15	Not Used	
O:053/16	Not Used	
O:053/17	Not Used	

RIO-NF3

	Digital Input	Relocated
PAH-232	Feed Water Pump #3 High Pressure Switch	
ZSO-233	Feed Water Valve Open Limit Switch	
ZSC-233	Feed Water Valve Closed Limit Switch	
FA-333	Rupture Disk	
PAH-332	Permeate High Pressure Switch	
ZSC-332	Interstage Valve Closed Limit Switch	
ZSC-337	Permeate Valve Closed Limit Switch	
	Digital Output	Relocated
ZI-233	Feed Water Valve Open Command	
	Analog Input	Relocated
PI-330	Feed Water First Stage Pressure	
PDI-331	Feed Water First Stage Differential Pressure	
PDI-332	Feed Water Second Stage Differential Pressure	
PI-331	First Stage Concentrate Pressure	
PI-332	First Stage Permeate Pressure	
FI-331	Second Stage Permeate Flow	
CI-331	Second Stage Permeate Conductivity	
FI-332	Final Permeate Flow	
CI-332	Final Permeate Conductivity	
FI-333	Final Concentrate Flow	
ZI-336	Concentrate Valve Position	
	Analog Output	Relocated
ZC-336	Concentrate Valve Position Command	

RIO-NF4

	Digital Input	Relocated
PAH-242	Feed Water Pump #4 High Pressure Switch	
ZSO-243	Feed Water Valve Open Limit Switch	
ZSC-243	Feed Water Valve Closed Limit Switch	
FA-343	Rupture Disk	
PAH-342	Permeate High Pressure Switch	
ZSC-342	Interstage Valve Closed Limit Switch	
ZSC-347	Permeate Valve Closed Limit Switch	
	Digital Output	Relocated
ZI-243	Feed Water Valve Open Command	

	Analog Input	Relocated
PI-340	Feed Water First Stage Pressure	
PDI-341	Feed Water First Stage Differential Pressure	
PDI-342	Feed Water Second Stage Differential Pressure	
PI-341	First Stage Concentrate Pressure	
PI-342	First Stage Permeate Pressure	
FI-341	Second Stage Permeate Flow	
CI-341	Second Stage Permeate Conductivity	
FI-342	Final Permeate Flow	
CI-342	Final Permeate Conductivity	
FI-343	Final Concentrate Flow	
ZI-346	Concentrate Valve Position	
	Analog Output	Relocated
ZC-346	Concentrate Valve Position Command	

CP-4 (EMCO)

Rack 6

Slot 0	1771-IFE Analog Input	Relocated
N7:654	Not Used	
N7:655	FT-104 Raw Water Flow 0-8000 GPM	
N7:656	AIT-2150 Raw Water Turbidity	From MPP
N7:657	AIT-2120B Raw Water pH Low	From MPP
N7:658	AIT-2120C Raw Water pH High	From MPP
N7:659	PT-2110 Raw Water Pressure	From MPP
N7:660	CIT-2130 Raw Water Conductivity	From MPP
N7:661	Not Used	
N7:662	Not Used	
N7:663	Not Used	
N7:664	FIT-2301 Cartridge Filter No.1 Flow 0-1500 GPM	
N7:665	FIT-2302 Cartridge Filter No.2 Flow 0-1500 GPM	
N7:666	FIT-2303 Cartridge Filter No.3 Flow 0-1500 GPM	
N7:667	FIT-2304 Cartridge Filter No.4 Flow 0-1500 GPM	
N7:668	PIT-2800 Skid Header Pressure	
N7:669	Not Used	
Slot 1	1771-IFE Analog Input	Relocated
N7:739	Not Used	
N7:740	Not Used	
N7:741	Not Used	
N7:742	FIT-3600 Total Reject Flow 0-1500 GPM	
N7:743	CIT-3610 Total Reject Conductivity 0-4000 uS	

N7:744	PIT-3620 Total Reject Pressure 0-30 PSIG	
N7:745	AIT-3640 Total Reject ORP 500-500	
N7:746	AIT-3650 Total Reject CL2 Residual 0-5 PPM	
N7:747	Not Used	
N7:748	Not Used	
N7:749	Not Used	
N7:750	Not Used	
N7:751	FIT-4600 Potable Water Flow 0-6000 GPM	
N7:752	AIT-4700 Potable Water pH 4-10 pH	
N7:753	AIT-4710 Potable Water Conductivity 0-1000 uS	
N7:754	PIT-4720 Potable Water Pressure 20-80 PSIG	
Slot 2	1771-IFE Analog Input	Relocated
N7:809	AIT-4730 Potable Water CL2 Residual 0-4 PPM	
N7:810	Not Used	
N7:811	FIT-8241 Antiscalant Flow 0-100 ML/MIN	
N7:812	LIT-8101 Acid Bulk Tank 0-6.5 FT	
N7:813	Not Used	
N7:814	Not Used	
N7:815	Not Used	
N7:816	Not Used	
N7:817	Not Used	
N7:818	Not Used	
N7:819	Not Used	
N7:820	Not Used	
N7:821	Not Used	
N7:822	Not Used	
N7:823	Not Used	
N7:824	Not Used	
Slot 3	1771-OFE Analog Output	Relocated
N15:1	FIR-2410 Cartridge Filters Total Flow MCP Chart Recorder Pen 3	
N15:2	SIC-BMP5 Booster Pump No.5 Speed Command to VFD	
N15:3	SIC-BMP4 Booster Pump No.4 Speed Command to VFD	
N15:4	FIR-3920 Combined Water Flow To Main Panel Chart Recorder	
Slot 4	1771-OFE Analog Output	Relocated
N15:20	FFIC-8231 Antiscalant Feed Pump No.1 Speed Command	
N15:21	FFIC-8232 Antiscalant Feed Pump No.2 Speed Command	
N15:22	Antiscalant Feed Pump No.3 Speed Command (Future)	

N15:23	FFIK-8331A NaOH Feed Pump No.1 Speed Command	
Slot 5	1771-OFE Analog Output	Relocated
N15:40	FFIK-8332A NaOH Feed Pump No.2 Speed Command	
N15:41	FFIK-8333A NaOH Feed Pump No.3 Speed Command	
N15:42	PHT-104-3 Raw Water Acid Feed Pump No.1 Stroke Command	
N15:43	SK-8133 Acid Feed Pump No.3 Speed Command	
Slot 6	1771-OFE Analog Output	Relocated
N15:60	Degas No.1 NaOCl Feed Pump Speed Command	From MPP
N15:61	No.2 NaOCl to Post Feed Pump Speed Command	From MPP
N15:62	No.3 NaOCl Feed Pump Speed Command	From MPP
N15:60	PI-3620 Total Reject Pressure 0-30 PSIG To MCP Panel Indicators (Delete)	
N15:60	SK-8134 Acid Feed Pump No.4 Speed Command	
N15:61	AI-3640 Total Reject ORP 0-12 MV To MCP Panel Indicators	
N15:62	AI-3650 Total Reject CL2 Residual 0-10 PPM To MCP Panel Indicators	
N15:63	PI-2110B Raw Water Pressure 0-100 PSIG To MCP Panel Indicators	
Slot 7	1771-OFE Analog Output	Relocated
N15:80	AI-2150 Raw Water Turbidity 0-10 NTU MCP Panel Indicator	
N15:81	RS-104A Permeate Acid Feed Pump No.2 Speed Command	
N15:82	Blend Water Flow 0-1400 GPM To MCP Panel Recorder	
N15:83	Potable Water Flow 0-6000 GPM To MCP Panel Ind/Rec	

Rack 7

Slot 8	1771-IAD Digital Input	Relocated
I:070/0	RY-1001 Raw Well Pump No.1 Running	
I:070/1	PFT-1001 Raw Well Pump No.1 Fault	
I:070/2	RY-1002 Raw Well Pump No.2 Running	
I:070/3	PFT-1002 Raw Well Pump No.2 Fault	
I:070/4	RY-1003 Raw Well Pump No.3 Running	
I:070/5	PFT-1003 Raw Well Pump No.3 Fault	
I:070/6	RY-1004 Raw Well Pump No.4 Running	
I:070/7	PFT-1004 Raw Well Pump No.4 Fault	
I:070/10	RY-1005 Raw Well Pump No.5 Running	
I:070/11	PFT-1005 Raw Well Pump No.5 Fault	
I:070/12	RY-1006 Raw Well Pump No.6 Running	
I:070/13	PFT-1006 Raw Well Pump No.6 Fault	
I:070/14	Raw Water High Temp Alarm	From MPP

I:070/15	Emergency Shutdown In Progress	
I:070/16	Emergency Shutdown Timed	
I:070/17	Plant AC Power Normal	From MPP
Slot 9	1771-IAD Digital Input	Relocated
I:071/0	UPS Battery Low Signal	
I:071/1	UPS AC Failed Signal	
I:071/2	PSL-251 Low Pressure Alarm	
I:071/3	PSH-252 High Pressure Alarm	
I:071/4	ZSO-215 Open Limit Switch	
I:071/5	ZSC-215 Closed Limit Switch	
I:071/6	RY-8131 Raw Water Acid Feed Pump No.1 Running	
I:071/7	XY-8131 Raw Water Acid Feed Pump No.1 Failed	
I:071/10	RY-8132 Permeate Acid Feed Pump No.2 Running	
I:071/11	XY-8132 Post Acid Feed Pump No.2 Failed	
I:071/12	Acid Feed Pump No.3 Running (Future)	
I:071/13	Acid Feed Pump No.3 Failed (Future)	
I:071/14	RY-8231 ATSC Feed Pump No.1 Running Disconnected Prominent Pump	
I:071/15	XY-8231 ATSC Feed Pump No.1 Failed	
I:071/16	RY-8232 ATSC Feed Pump No.2 Running Disconnected Prominent Pump	
I:071/17	XY-8232 ATSC Feed Pump No.2 Failed	
Slot 10	1771-IAD Digital Input	Relocated
I:072/0	ATSC Feed Pump No.3 Running (Future)	
I:072/1	ATSC Feed Pump No.3 Failed (Future)	
I:072/2	RY-8331 NAOH Feed Pump No.1 Running	
I:072/3	XY-8331 NAOH Feed Pump No.1 Failed	
I:072/4	RY-8332 NAOH Feed Pump No.2 Running	
I:072/5	XY-8332 NAOH Feed Pump No.2 Failed	
I:072/6	ZSO-225 Open Limit Switch	
I:072/7	ZSC-225 Closed Limit Switch	
I:072/10	ZSO-235 open Limit Switch	
I:072/11	ZSC-235 Closed Limit Switch	
I:072/12	ZSO-245 Open Limit Switch	
I:072/13	ZSC-245 Closed Limit Switch	
I:072/14	FA-901 Eyewash Flow Alarm	
I:072/15	ZS-2420A Dump Valve Fully Open	
I:072/16	ZS-2420B Dump Valve Fully Closed	
I:072/17	CL2 Leak Check	

Slot 11	1771-IAD Digital Input	Relocated
I:073/0	FS-8195 Acid Bulk Tank Shower Flowing	
I:073/1	FS-8196 Acid Day Tank Shower Flowing	
I:073/2	LSL-8200 Antiscalant Day Tank Low Level	
I:073/3	PSH-8240 Antiscalant High Pressure	
I:073/4	FSLL-8241 Antiscalant Low Flow	
I:073/5	LSL-8311 NAOH Day Tank Low Level	
I:073/6	FS-8395 NAOH Bulk Tank Shower Flowing	
I:073/7	Not Used	
I:073/10	Not Used	
I:073/11	Not Used	
I:073/12	Not Used	
I:073/13	Not Used	
I:073/14	Not Used	
I:073/15	Not Used	
I:073/16	Not Used	
I:073/17	Not Used	
Slot 12	1771-OAD Digital Output	Relocated
O:074/0	HS-1001 Raw Water Well Pump No.1 Run Output CR-1	
O:074/1	Raw Water Well Pump No.1 MCP OFF Light LT-2	
O:074/2	HS-1002 Raw Water Well Pump No.2 Run Output CR-2	
O:074/3	Raw Water Well Pump No.2 MCP OFF Light LT-4	
O:074/4	HS-1003 Raw Water Well Pump No.3 Run Output CR-3	
O:074/5	Raw Water Well Pump No.3 MCP OFF Light LT-6	
O:074/6	HS-1004 Raw Water Well Pump No.4 Run Output CR-4	
O:074/7	Raw Water Well Pump No.4 MCP OFF Light LT-8	
O:074/10	HS-1005 Raw Water Well Pump No.5 Run Output CR-5	
O:074/11	Raw Water Well Pump No.5 MCP OFF Light LT-10	
O:074/12	HS-1006 Raw Water Well Pump No.6 Run Output CR-6	
O:074/13	Raw Water Well Pump No.6 MCP OFF Light LT-12	
O:074/14	CR2000B Plant Shutdown CR-2	From MPP
O:074/15	MCL Annunciator Horn	From MPP
O:074/14	Booster Pump No.1 MCP Off Light LT-13 (Delete)	
O:074/15	Booster Pump No.2 MCP Off Light LT-14 (Delete)	
O:074/16	Booster Pump No.3 MCP Off Light LT-15 (Delete)	
O:074/17	Booster Pump No.4 MCP Off Light LT-16 (Delete)	
Slot 13	1771-OAD Digital Output	Relocated
O:075/0	Booster Pump No.5 MCP Off Light LT-17 (Delete)	

O:075/1	High Service Pump No.1 MCP Off Light LT-18 (Delete)	
O:075/2	High Service Pump No.2 MCP Off Light LT-19 (Delete)	
O:075/3	High Service Pump No.3 MCP Off Light LT-20 (Delete)	
O:075/3	HS-8134 Acid Feed Pump No.4 Run Output	
O:075/4	HS-8131 Raw Water Acid Feed Pump No.1 Run Output CR-7	
O:075/5	Raw Water Acid Feed Pump No.1 MCP Off Light LT-22	
O:075/6	HS-8132 Permeate Acid Feed Pump No.2 Run Output CR-8	
O:075/7	Permeate Acid Feed Pump No.2 MCP Off Light LT-24	
O:075/10	HS-8133 Acid Feed Pump No.3 Run Output CR-9	
O:075/11	Acid Feed Pump No.3 MCP Off Light LT-26 (Future)	
O:075/12	HS-8231 ATSC Feed Pump No.1 Run Output CR-10	
O:075/13	ATSC Feed Pump No.1 MCP Off Light LT-28	
O:075/14	HS-8232 ATSC Feed Pump No.2 Run Output CR-11	
O:075/15	ATSC Feed Pump No.2 MCP Off Light LT-30	
O:075/16	HS-8233 ATSC Feed Pump No.3 Run Output CR-12 (Future)	
O:075/17	ATSC Feed Pump No.3 MCP Off Light LT-32 (Future)	
Slot 14	1771-OAD Digital Output	Relocated
O:076/0	HS-8331 NAOH Feed Pump No.1 Run Output CR-13	
O:076/1	NAOH Feed Pump No.1 MCP Off Light LT-34	
O:076/2	HS-8332 NAOH Feed Pump No.2 Run Output CR-14	
O:076/3	NAOH Feed Pump No.2 MCP Off Light LT-36	
O:076/4	ZI-215 Valve Open Command	
O:076/5	ZI-225 Valve Open Command	
O:076/6	HS-8561 NaOCl To Degasifier Pump No.1 Run Output CR-16	
O:076/7	NaOCl To Degasifier Pump No.1 MCP Off Light LT-40	
O:076/10	HS-8562 NaOCl To Degasifier Pump No.2 Run Output CR-17	
O:076/11	NaOCl To Degasifier Pump No.2 MCP Off Light LT-42	
O:076/12	HS-8563 NaOCl To Degasifier Pump No.3 Run Output CR-18	
O:076/13	NaOCl To Degasifier Pump No.3 MCP Off Light LT-44	
O:076/14	Dump Valve Open Output CR-44	
O:076/15	Dump Valve Close Output CR-45	
O:076/16	ZI-235 Valve Open Command	
O:076/17	ZI-245 Valve Open Command	
Slot 15	1771-OAD Digital Output	Relocated
O:077/0	System Shutdown Relay SR-1	
O:077/1	Not Used CR-25	
O:077/2	HS-2801F Booster Pump No.1 MCP Fail LT-54	
O:077/3	HS-2802F Booster Pump No.2 MCP Fail LT-55	

O:077/4	HS-2803F Booster Pump No.3 MCP Fail LT-56	
O:077/5	HS-2804F Booster Pump No.4 MCP Fail LT-57	
O:077/6	HS-2805F Booster Pump No.5 MCP Fail LT-58	
O:077/7	HS-4101F High Service Pump No.1 MCP Fail LT-59	
O:077/10	HS-4102F High Service Pump No.2 MCP Fail LT-60	
O:077/11	HS-4103F High Service Pump No.3 MCP Fail LT-61	
O:077/12	Not Used CR-23	
O:077/13	Not Used CR-24	
O:077/14	Not Used CR-21	
O:077/15	Not Used CR-22	
O:077/16	Not Used CR-20	
O:077/17	Not Used CR-19	

SLC5 CP-1

Rack 10

Slot 1	1746-IA16 Digital Input (SLC5 I/O)	Relocated
I:100/0	YR-P401 Clearwell Transfer Pump No.1 Ready	
I:100/1	YL-P401 Clearwell Transfer Pump No.1 Running	
I:100/2	YF-P401 Clearwell Transfer Pump No.1 Failed	
I:100/3	Not Used	
I:100/4	YR-P402 Clearwell Transfer Pump No.2 Ready	
I:100/5	YL-P402 Clearwell Transfer Pump No.2 Running	
I:100/6	YF-P402 Clearwell Transfer Pump No.2 Failed	
I:100/7	Not Used	
I:100/10	YR-P403 Clearwell Transfer Pump No.3 Ready	
I:100/11	YL-P403 Clearwell Transfer Pump No.3 Running	
I:100/12	YF-P403 Clearwell Transfer Pump No.3 Failed	
I:100/13	Not Used	
I:100/14	YR-B401 Degasifier No.1 Blower Ready	
I:100/15	YL-B401 Degasifier No.1 Blower Running	
I:100/16	YF-B401 Degasifier No.1 Blower Failed	
I:100/17	YR-B402 Degasifier Standby Blower Ready	
Slot 2	1746-IA16 Digital Input (SLC5 I/O)	Relocated
I:101/0	YL-B402 Degasifier Standby Blower Running	
I:101/1	YF-B402 Degasifier Standby Blower Fail	
I:101/2	YR-B403 Degasifier No.3 Blower Ready	
I:101/3	YL-B403 Degasifier No.3 Blower Running	
I:101/4	YF-B403 Degasifier No.3 Blower Failed	

I:101/5	YR-451 Scrubbers Permeate Booster Pump Ready	
I:101/6	YL-451 Scrubbers Permeate Booster Pump Running	
I:101/7	YF-451 Scrubbers Permeate Booster Pump Failed	
I:101/10	YR-1801 Scrubber No. 2 Recirc Pump Ready	
I:101/11	YL-1801 Scrubber No. 2 Recirc Pump Running	
I:101/12	YF-1801 Scrubber No. 2 Recirc Pump Fail	
I:101/13	YR-1802 Scrubbers Standby Recirc Pump Ready	
I:101/14	YL-1802 Scrubbers Standby Recirc Pump Running	
I:101/15	YF-1802 Scrubbers Standby Recirc Pump Fail	
I:101/16	YR-1803 Scrubber No. 1 Recirc Pump Ready	
I:101/17	YL-1803 Scrubber No. 1 Recirc Pump Running	
Slot 3	1746-IA16 Digital Input (SLC5 I/O)	Relocated
I:102/0	YF-1803 Scrubber No. 1 Recirc Pump Fail	
I:102/1	Hydac Unit Differential Pressure High	
I:102/2	Hydac Unit in Backwash	
I:102/3	Hydac Unit System Status 1 - Ready 0 - Alarm	
I:102/4	P1151-FLT Service Water Pump Local Fail	
I:102/5	P1151-LRDY Service Water Pump Local Ready	
I:102/6	P1151-ON Service Water Pump Run Status to HMI	
I:102/7	P1152-FLT Service Water Pump Local Fail	
I:102/10	P1152-LRDY Service Water Pump Local Ready	
I:102/11	P1152-ON Service Water Pump Run Status to HMI	
I:102/12	Not Used	
I:102/13	Not Used	
I:102/14	Not Used	
I:102/15	Not Used	
I:102/16	Not Used	
I:102/17	Not Used	
Slot 4	Blank	Relocated
Slot 5	Relay Output 1746-OW16 (SLC5 I/O)	Relocated
O:104/0	P1151_CALL P-1151 Service Water Pump Call to Run	
O:104/1	P1152_CALL P-1152 Service Water Pump Call to Run	
O:104/2	M420_CALL M-420 Clearwell Mixer Call to Run (Future)	
O:104/3	Not Used	
O:104/4	Not Used	
O:104/5	Not Used	
O:104/6	Not Used	
O:104/7	Not Used	

O:104/10	Not Used	
O:104/11	Not Used	
O:104/12	Not Used	
O:104/13	Not Used	
O:104/14	Not Used	
O:104/15	Not Used	
O:104/16	Not Used	
O:104/17	Not Used	
Slot 6	Relay Output 1746-OW16 (SLC5 I/O)	Relocated
O:105/0	YC-105C Scrubber No.1 Caustic Feed Pump Run Output	
O:105/1	YC-105D Scrubber No.2 Caustic Feed Pump Run Output	
O:105/2	YC-411 Scrubber No. 2 NaOCl Feed Pump Run Output	
O:105/3	YC-P401 Clearwell Transfer Pump No.1 Output	
O:105/4	YC-P402 Clearwell Transfer Pump No.2 Output	
O:105/5	YC-P403 Clearwell Transfer Pump No.3 Output	
O:105/6	YC-B401 Degasifier No.1 Blower Run Output	
O:105/7	YC-B402 Degasifier Standby Blower Run Output	
O:105/10	YC-B403 Degasifier No.2 Blower Run Output	
O:105/11	YC-451 Scrubbers Permeate Pump Run Output	
O:105/12	YC-1801 Scrubber No.2 Recirc Pump Run Output	
O:105/13	YC-1802 Scrubbers Standby Recirc Pump Run Output	
O:105/14	YC-1803 Scrubber No.1 Recirc Pump Run Output	
O:105/15	Raw Water Acid Injection Valve Open Output	
O:105/16	YC-610 Scrubber Sequestering Agent Pump Run Output	
O:105/17	Not Used	
Slot 7	1746sc-INO4I Analog Output (SLC5 I/O)	Relocated
O:106.0	High Service Pump No.3 Speed Output	
O:106.1	Not Used	
O:106.2	Not Used	
O:106.3	Not Used	
Slot 8	1746sc-INI4I Analog Input (SLC5 I/O)	Relocated
I:107.0	Chlorine Bulk Tank Level 0-25 Ft	
I:107.1	Hydac Unit Differential Pressure 0-36 PSI	
I:107.2	Clearwell Transfer Pump No.1 Speed Feedback	
I:107.3	Clearwell Transfer Pump No.2 Speed Feedback	
Rack 11		
Slot 9	1746sc-INI4I Analog Input (SLC5 I/O)	Relocated
I:110.0	Clearwell Transfer Pump No.3 Speed Feedback	

I:110.1	LI-106 Caustic Day Tank Level 0-4 Ft	
I:110.2	LI-101 Caustic Bulk Tank 1 Level 0-6 Ft	
I:110.3	LI-102 Caustic Bulk Tank 2 Level	
Slot 10	1746sc-INO4I Analog Output (SLC5 I/O)	Relocated
O:111.0	SK-105C Scrubber Stage 1 Caustic Feed Pump Speed Output	
O:111.1	SK-105D Scrubber Stage 2 Caustic Feed Pump Speed Output	
O:111.2	SK-411 Scrubber Stage 2 NaOCl Feed Pump Speed Output	
O:111.3	SK-401 Clearwell Transfer Pump No.1 Speed Output	
Slot 11	1746sc-INO4I Analog Output (SLC5 I/O)	Relocated
O:112.0	SK-402 Clearwell Transfer Pump No.2 Speed Output	
O:112.1	SK-403 Clearwell Transfer Pump No.3 Speed Output	
O:112.2	High Service Pump No.1 Speed Output	
O:112.3	High Service Pump No.2 Speed Output	

New CLX CP-1

Slot 1	1756-IA16 Digital Input (CLX I/O)	Relocated
0	YR-P401 Clearwell Transfer Pump No.1 Ready	
1	YL-P401 Clearwell Transfer Pump No.1 Running	
2	YF-P401 Clearwell Transfer Pump No.1 Failed	
3	YR-B401 Degasifier No.1 Blower Ready	
4	YL-B401 Degasifier No.1 Blower Running	
5	YF-B401 Degasifier No.1 Blower Failed	
6	P1151-FLT Service Water Pump Local Fail	
7	P1151-LRDY Service Water Pump Local Ready	
8	P1151-ON Service Water Pump Run Status to HMI	
9	YR-1803 Scrubber No. 1 Recirc Pump Ready	
10	YL-1803 Scrubber No. 1 Recirc Pump Running	
11	YF-1803 Scrubber No. 1 Recirc Pump Fail	
12	Hydac Unit Differential Pressure High	
13	Hydac Unit in Backwash	
14	Hydac Unit System Status 1 - Ready 0 - Alarm	
15	Not Used	
Slot 2	1756-IA16 Digital Input (CLX I/O)	Relocated
0	YR-P402 Clearwell Transfer Pump No.2 Ready	
1	YL-P402 Clearwell Transfer Pump No.2 Running	
2	YF-P402 Clearwell Transfer Pump No.2 Failed	
3	YR-B403 Degasifier No.3 Blower Ready	
4	YL-B403 Degasifier No.3 Blower Running	
5	YF-B403 Degasifier No.3 Blower Failed	

6	YR-1801 Scrubber No. 2 Recirc Pump Ready	
7	YL-1801 Scrubber No. 2 Recirc Pump Running	
8	YF-1801 Scrubber No. 2 Recirc Pump Fail	
9	YR-451 Scrubbers Permeate Booster Pump Ready	
10	YL-451 Scrubbers Permeate Booster Pump Running	
11	YF-451 Scrubbers Permeate Booster Pump Failed	
12	Not Used	
13	Not Used	
14	Not Used	
15	Not Used	
Slot 3	1756-IA16 Digital Input (CLX I/O)	Relocated
0	YR-P403 Clearwell Transfer Pump No.3 Ready	
1	YL-P403 Clearwell Transfer Pump No.3 Running	
2	YF-P403 Clearwell Transfer Pump No.3 Failed	
3	YR-B402 Degasifier Standby Blower Ready	
4	YL-B402 Degasifier Standby Blower Running	
5	YF-B402 Degasifier Standby Blower Fail	
6	YR-1802 Scrubbers Standby Recirc Pump Ready	
7	YL-1802 Scrubbers Standby Recirc Pump Running	
8	YF-1802 Scrubbers Standby Recirc Pump Fail	
9	P1152-FLT Service Water Pump Local Fail	
10	P1152-LRDY Service Water Pump Local Ready	
11	P1152-ON Service Water Pump Run Status to HMI	
12	Not Used	
13	Not Used	
14	Not Used	
15	Not Used	
Slot 4	1756-OW16I Relay Output (CLX I/O)	Relocated
0	YC-P401 Clearwell Transfer Pump No.1 Output	
1	YC-P403 Clearwell Transfer Pump No.3 Output	
2	YC-105C Scrubber No.1 Caustic Feed Pump Run Output	
3	YC-B401 Degasifier No.1 Blower Run Output	
4	YC-B402 Degasifier Standby Blower Run Output	
5	YC-1803 Scrubber No.1 Recirc Pump Run Output	
6	YC-1802 Scrubbers Standby Recirc Pump Run Output	
7	P1151_CALL P-1151 Service Water Pump Call to Run	
8	YC-451 Scrubbers Permeate Pump Run Output	
9	Not Used	

10	Not Used	
11	Not Used	
12	Not Used	
13	Not Used	
14	Not Used	
15	Not Used	
Slot 5	1756-OW16I Relay Output (CLX I/O)	Relocated
0	YC-P402 Clearwell Transfer Pump No.2 Output	
1	YC-105D Scrubber No.2 Caustic Feed Pump Run Output	
2	YC-B403 Degasifier No.2 Blower Run Output	
3	YC-1801 Scrubber No.2 Recirc Pump Run Output	
4	P1152_CALL P-1152 Service Water Pump Call to Run	
5	YC-411 Scrubber No. 2 NaOCl Feed Pump Run Output	
6	Raw Water Acid Injection Valve Open Output	
7	YC-610 Scrubber Sequestering Agent Pump Run Output	
8	M420_CALL M-420 Clearwell Mixer Call to Run (Future)	
9	Not Used	
10	Not Used	
11	Not Used	
12	Not Used	
13	Not Used	
14	Not Used	
15	Not Used	
Slot 6	1756-IF16 Analog Input (CLX I/O)	Relocated
0	Chlorine Bulk Tank Level 0-25 Ft	
1	Hydac Unit Differential Pressure 0-36 PSI	
2	Clearwell Transfer Pump No.1 Speed Feedback	
3	Clearwell Transfer Pump No.3 Speed Feedback	
4	Caustic Bulk Tank Level 0-6 Ft	
5	Not Used	
6	Not Used	
7	Not Used	
Slot 7	1756-IF16 Analog Input (CLX I/O)	Relocated
0	Clearwell Transfer Pump No.2 Speed Feedback	
1	Caustic Day Tank Level 0-4 Ft	
2	Not Used	
3	Not Used	
4	Not Used	

5	Not Used	
6	Not Used	
7	Not Used	
Slot 8	1756-OF6CI Analog Output (CLX I/O)	Relocated
0	SK-105C Scrubber Stage 1 Caustic Feed Pump Speed Output	
1	SK-401 Clearwell Transfer Pump No.1 Speed Output	
2	SK-403 Clearwell Transfer Pump No.3 Speed Output	
3	High Service Pump No.1 Speed Output	
4	High Service Pump No.3 Speed Output	
5	Not Used	
Slot 9	1756-OF6CI Analog Output (CLX I/O)	Relocated
0	SK-105D Scrubber Stage 2 Caustic Feed Pump Speed Output	
1	SK-402 Clearwell Transfer Pump No.2 Speed Output	
2	SK-411 Scrubber Stage 2 NaOCl Feed Pump Speed Output	
3	High Service Pump No.2 Speed Output	
4	Not Used	
5	Not Used	

SLC5 CP-2
Rack 12

Slot 1	1746-IA16 Digital Input (SLC5 I/O)	Relocated
I:120/0	YR-V401 Degasifier No.1 Permeate Valve Ready	
I:120/1	ZSO-401 Degasifier No.1 Permeate Valve Full Open	
I:120/2	ZSC-401 Degasifier No.1 Permeate Valve Full Closed	
I:120/3	Blend Acid Valve is Open	
I:120/4	ZSO-411 Degasifier No.1 Off Gas Damper Full Open	
I:120/5	ZSC-411 Degasifier No.1 Off Gas Damper Full Closed	
I:120/6	YR-V402 Degasifier No.2 Permeate Valve Ready	
I:120/7	ZSO-402 Degasifier No.2 Permeate Valve Full Open	
I:120/10	ZSC-402 Degasifier No.2 Permeate Valve Full Closed	
I:120/11	Not Used	
I:120/12	ZSO-412 Degasifier No.2 Off Gas Damper Full Open	
I:120/13	Blend Acid Valve is Closed	
I:120/14	FSH-401 Permeate Line to Clearwell Rupture Disk is Flowing	
I:120/15	Not Used	
I:120/16	Not Used	
I:120/17	Not Used	
Slot 2	1746-IA16 Digital Input (SLC5 I/O)	Relocated
I:121/0	ZSO-421 Degasifier No.1 Blower Damper Full Open	
I:121/1	ZSC-421 Degasifier No.1 Blower Damper Full Closed	

I:121/2	Not Used	
I:121/3	ZSO-422 Degasifier Standby Blower Damper Full Open	
I:121/4	ZSC-422 Degasifier Standby Blower Damper Full Closed	
I:121/5	Not Used	
I:121/6	ZSO-431 Degasifier No.2 Blower Damper Full Open	
I:121/7	ZSC-431 Degasifier No.2 Blower Damper Full Closed	
I:121/10	LSL-1812 Scrubber No.1 Liquid Level Low (Timed) Add Water	
I:121/11	LSL-1801 Scrubber No.1 Liquid Level High (Timed)	
I:121/12	LSL-1822 Scrubber No.2 Liquid Level Low (Timed) Add Water	
I:121/13	LSL-1821 Scrubber No.2 Liquid Level High (Timed)	
I:121/14	CP-2 Control Panel Power Fail	
I:121/15	FAL-401 Clearwell Transfer Pump No.1 Low Flow (Timed)	
I:121/16	FAL-402 Clearwell Transfer Pump No.2 Low Flow (Timed)	
I:121/17	FAL-403 Clearwell Transfer Pump No.3 Low Flow (Timed)	
Slot 3	1746-IA16 Digital Input (SLC5 I/O)	Relocated
I:122/0	Clearwell Level High (Timed)	
I:122/1	Clearwell Level Low (Timed)	
I:122/2	Scrubber Area Shower Flowing Alarm	
I:122/3	GST MOV-24I Open	
I:122/4	GST MOV-24I Closed	
I:122/5	GST MOV-24I Remote	
I:122/6	GST MOV-12I Open	
I:122/7	GST MOV-12I Closed	
I:122/10	GST MOV-12I Remote	
I:122/11	Not Used	
I:122/12	Not Used	
I:122/13	Not Used	
I:122/14	Not Used	
I:122/15	Not Used	
I:122/16	Not Used	
I:122/17	Not Used	
Slot 4	Blank	Relocated
Slot 5	1746-NI4 Analog Output (SLC5 I/O)	Relocated
N9:130	FIT-12I FLOW	
N9:131	MOV-12I POSTION %	
N9:132	FIT-12I FLOW SCALED FOR PID (Relocate)	
N9:133	Not Used	
Slot 6	1746-OW16 Relay Output (SLC5 I/O)	Relocated

O:125/0	YV-401 Degasifier No.1 Permeate Valve Open Command	
O:125/1	YV-411 Degasifier No.1 Off Gas Damper Open Command	
O:125/2	YV-402 Degasifier No.2 Permeate Valve Open Command	
O:125/3	YV-412 Degasifier No.2 Off Gas Damper Open Command	
O:125/4	YV-421 Degasifier No.1 Blower Damper Open Command	
O:125/5	YV-422 Degasifier Standby Blower Damper Open Command	
O:125/6	YV-423 Degasifier No.2 Blower Damper Open Command	
O:125/7	Blend Valve Open Command 1=Open 0=Close	
O:125/10	YC-V1801 Scrubber No.1 Makeup Water Valve Open Command	
O:125/11	YC-V1802 Scrubber No.2 Makeup Water Valve Open Command	
O:125/12	GST MOV-24I Open Command	
O:125/13	GST MOV-24I Closed Command	
O:125/14	Not Used	
O:125/15	Not Used	
O:125/16	Not Used	
O:125/17	Not Used	
Slot 7	1746-NO4I Analog Output (SLC5 I/O)	Relocated
N9:380	Blend Valve Position Command 0-100%	
N9:381	GST MOV-12I Position Command	
N9:382	Not Used	
N9:383	Not Used	
Slot 8	1746sc-INI4I Analog Input (SLC5 I/O)	Relocated
N9:320	Blend Water Cartridge Filter Differential PSI 0-100	
N9:321	Clearwell Bay 1 pH 0-14	
N9:322	Combined Water Conductivity 0-1000 uS	
N9:323	Combined Water pH 0-14	

Rack 13

Slot 9	1746sc-INI4I Analog Input (SLC5 I/O)	Relocated
N9:330	Raw Water Blend Flow 0-1400 GPM	
N9:331	Clearwell Level 0-8 Ft	
N9:332	Potable Water Turbidity 0-10 NTU	
N9:333	Potable Water Conductivity 0-1000 uS	
Slot 10	1746sc-INI4I Analog Input (SLC5 I/O)	Relocated
N9:340	Potable Water pH 0-14	
N9:341	Potable Water CL2 Residual 0-5 PPM	
N9:342	Scrubber Stage No.1 pH 0-14	
N9:343	Scrubber Stage No.2 pH 0-14	

Slot 11	1746sc-INI4I Analog Input (SLC5 I/O)	Relocated
N9:350	Scrubber Stage No.2 ORP 0-10 PPM	
N9:351	GST No.1 Tank Level 0-20 Ft	
N9:352	GST No.2 Tank Level 0-20 Ft	
N9:353	Blend Valve Position 0-100 %	

New CLX CP-2

Slot 1	1756-IA16 Digital Input (CLX I/O)	Relocated
0	YR-V401 Degasifier No.1 Permeate Valve Ready	
1	ZSO-401 Degasifier No.1 Permeate Valve Full Open	
2	ZSC-401 Degasifier No.1 Permeate Valve Full Closed	
3	ZSO-411 Degasifier No.1 Off Gas Damper Full Open	
4	ZSC-411 Degasifier No.1 Off Gas Damper Full Closed	
5	ZSO-421 Degasifier No.1 Blower Damper Full Open	
6	ZSC-421 Degasifier No.1 Blower Damper Full Closed	
7	LSL-1812 Scrubber No.1 Liquid Level Low (Timed) Add Water	
8	LSL-1801 Scrubber No.1 Liquid Level High (Timed)	
9	FAL-401 Clearwell Transfer Pump No.1 Low Flow (Timed)	
10	FAL-403 Clearwell Transfer Pump No.3 Low Flow (Timed)	
11	GST MOV-12I Open	
12	GST MOV-12I Closed	
13	GST MOV-12I Remote	
14	PSL-1001 Carbon Dioxide Tank Low Pressure Switch	
15	PSH-1001 Carbon Dioxide Tank High Pressure Switch	
Slot 2	1756-IA16 Digital Input (CLX I/O)	Relocated
0	YR-V402 Degasifier No.2 Permeate Valve Ready	
1	ZSO-402 Degasifier No.2 Permeate Valve Full Open	
2	ZSC-402 Degasifier No.2 Permeate Valve Full Closed	
3	ZSO-412 Degasifier No.2 Off Gas Damper Full Open	
4	ZSO-431 Degasifier No.2 Blower Damper Full Open	
5	ZSC-431 Degasifier No.2 Blower Damper Full Closed	
6	LSL-1822 Scrubber No.2 Liquid Level Low (Timed) Add Water	
7	LSL-1821 Scrubber No.2 Liquid Level High (Timed)	
8	FAL-402 Clearwell Transfer Pump No.2 Low Flow (Timed)	
9	Clearwell Level High (Timed)	
10	Clearwell Level Low (Timed)	
11	GST MOV-24I Open	
12	GST MOV-24I Closed	
13	GST MOV-24I Remote	

14	Not Used	
15	Not Used	
Slot 3	1756-IA16 Digital Input (CLX I/O)	Relocated
0	ZSO-422 Degasifier Standby Blower Damper Full Open	
1	ZSC-422 Degasifier Standby Blower Damper Full Closed	
2	Blend Acid Valve is Open	
3	Blend Acid Valve is Closed	
4	FSH-401 Permeate Line to Clearwell Rupture Disk is Flowing	
5	Scrubber Area Shower Flowing Alarm	
6	Not Used	
7	Not Used	
8	Not Used	
9	Not Used	
10	Not Used	
11	Not Used	
12	Not Used	
13	Not Used	
14	Not Used	
15	CP-2 Control Panel Power Fail	
Slot 4	1756-OX8I Relay Output (CLX I/O)	Relocated
0	YV-401 Degasifier No.1 Permeate Valve Open Command	
1	YV-411 Degasifier No.1 Off Gas Damper Open Command	
2	YV-421 Degasifier No.1 Blower Damper Open Command	
3	YV-422 Degasifier Standby Blower Damper Open Command	
4	YC-V1801 Scrubber No.1 Makeup Water Valve Open Command	
5	Blend Valve Open Command 1=Open 0=Close	
6	Not Used	
7	Not Used	
Slot 5	1756-OX8I Relay Output (CLX I/O)	Relocated
0	YV-402 Degasifier No.2 Permeate Valve Open Command	
1	YV-412 Degasifier No.2 Off Gas Damper Open Command	
2	YV-423 Degasifier No.2 Blower Damper Open Command	
3	YC-V1802 Scrubber No.2 Makeup Water Valve Open Command	
4	GST MOV-24I Open Command	
5	GST MOV-24I Closed Command	
6	Not Used	
7	Not Used	

Slot 6	1756-IF16 Analog Input (CLX I/O)	Relocated
0	Scrubber Stage No.1 pH 0-14	
1	GST No.1 Tank Level 0-20 Ft	
2	Blend Water Cartridge Filter Differential PSI 0-100	
3	Blend Valve Position 0-100 %	
4	Raw Water Blend Flow 0-1400 GPM	
5	Clearwell Bay 1 pH 0-14	
6	Not Used	
7	Not Used	
Slot 7	1756-IF16 Analog Input (CLX I/O)	Relocated
0	Scrubber Stage No.2 pH 0-14	
1	Scrubber Stage No.2 ORP 0-10 PPM	
2	GST No.2 Tank Level 0-20 Ft	
3	Combined Water Conductivity 0-1000 uS	
4	Combined Water pH 0-14	
5	Clearwell Level 0-8 Ft	
6	Not Used	
7	Not Used	
Slot 8	1756-IF16 Analog Input (CLX I/O)	Relocated
0	Potable Water Turbidity 0-10 NTU	
1	Potable Water Conductivity 0-1000 uS	
2	Potable Water pH 0-14	
3	Potable Water CL2 Residual 0-5 PPM	
4	PI-1001 Carbon Dioxide Tank Vapor Pressure	
5	LI-1001 Carbon Dioxide Tank Liquid Level	
6	Not Used	
7	Not Used	
Slot 9	1756-OF6CI Analog Output (CLX I/O)	Relocated
0	Blend Valve Position Command 0-100%	
1	GST MOV-12I Position Command	
2	FIT-12I FLOW	
3	MOV-12I POSTION %	
4	Not Used	
5	Not Used	

SLC 5 CP-3
Rack 14

Slot 1	1746-IA16 Digital Input (SLC5 I/O)	Relocated
I:140/0	PSL-1000 CO2 Storage Tank Low Pressure Switch	
I:140/1	PSH-1000 CO2 Storage Tank High Pressure Switch	

I:140/2	PSL-1141 Feed Panel 1 Service Water Low Pressure Switch	
I:140/3	PSL-1142 Feed Panel 2 Service Water Low Pressure Switch	
I:140/4	Not Used	
I:140/5	Not Used	
I:140/6	Not Used	
I:140/7	Not Used	
I:140/10	Not Used	
I:140/11	Not Used	
I:140/12	Not Used	
I:140/13	Not Used	
I:140/14	Not Used	
I:140/15	Not Used	
I:140/16	Not Used	
I:140/17	Not Used	
Slot 2	Blank	Relocated
Slot 3	Blank	Relocated
Slot 4	1746-OA16 Digital Output (SLC5 I/O)	Relocated
I:143/0	SV-1001 Feed Panel 1 PSF System Auto Start	
I:143/1	SV-1002 Feed Panel 2 PSF System Auto Start	
I:143/2	Not Used	
I:143/3	Not Used	
I:143/4	Not Used	
I:143/5	Not Used	
I:143/6	Not Used	
I:143/7	Not Used	
I:143/10	Not Used	
I:143/11	Not Used	
I:143/12	Not Used	
I:143/13	Not Used	
I:143/14	Not Used	
I:143/15	Not Used	
I:143/16	Not Used	
I:143/17	Not Used	
Slot 5	Blank	Relocated
Slot 6	1746-NIO4I Analog 2 In/2 Out (SLC5 I/O)	Relocated
N36:32	Input Not Used	
N36:33	Input Not Used	

N36:40	Y-1001 Feed Panel 1 CO2 Gas/Vapor Control Valve Position Command	
N36:41	Y-1002 Feed Panel 2 CO2 Gas/Vapor Control Valve Position Command	
Slot 7	1746-NI8 Analog Input (SLC5 I/O)	Relocated
N36:0	PI-1000 CO2 Tank Vapor Pressure 0-150 PSI	
N36:1	FIT-1001 CO2 Feed Rate Panel 1 0-500 PPH	
N36:2	PIT-1111 CO2 Gas Vapor Feed Pressure Panel 1 0-150 PSI	
N36:3	PIT-1121 CO2 Solution Feed Pressure Panel 1 0-150 PSI	
N36:4	PIT-1101 CO2 Feed Panels Service Water Pressure Clearwell Bay 1 0-150 PSI	
N36:5	Not Used	
N36:6	Not Used	
N36:7	Not Used	
Slot 8	1746-NI8 Analog Input (SLC5 I/O)	Relocated
N36:16	LI-1000 CO2 Tank Liquid Level 0-94 IN	
N36:17	FIT-1002 CO2 Feed Rate Panel 2 0-600 PPH	
N36:18	PIT-1112 CO2 Gas Vapor Feed Pressure Panel 2 0-150 PSI	
N36:19	PIT-1122 CO2 Solution Feed Pressure Panel 2 0-150 PSI	
N36:20	PIT-1102 CO2 Feed Panels Service Water Pressure Clearwell Bay 2 0-150 PSI	
N36:21	LIT-610 Acid Tank Level 0-?? Ft (Not Used in Program)	
N36:22	Not Used	
N36:23	Not Used	

New CLX CP-3

Slot 1	1756-IA16 Digital Input (CLX I/O)	Relocated
0	PSL-1000 CO2 Storage Tank Low Pressure Switch	
1	PSH-1000 CO2 Storage Tank High Pressure Switch	
2	PSL-1141 Feed Panel 1 Service Water Low Pressure Switch	
3	PSL-1142 Feed Panel 2 Service Water Low Pressure Switch	
4	Not Used	
5	Not Used	
6	Not Used	
7	Not Used	
8	Not Used	
9	Not Used	
10	Not Used	
11	Not Used	
12	Not Used	

13	Not Used	
14	Not Used	
15	Not Used	
Slot 2	1756-OA8 Digital Output (CLX I/O)	Relocated
0	SV-1001 Feed Panel 1 PSF System Auto Start	
1	SV-1002 Feed Panel 2 PSF System Auto Start	
2	Not Used	
3	Not Used	
4	Not Used	
5	Not Used	
6	Not Used	
7	Not Used	
Slot 3	1756-IF16 Analog Input (CLX I/O)	Relocated
0	PI-1000 CO2 Tank Vapor Pressure 0-150 PSI	
1	FIT-1001 CO2 Feed Rate Panel 1 0-500 PPH	
2	PIT-1111 CO2 Gas Vapor Feed Pressure Panel 1 0-150 PSI	
3	PIT-1121 CO2 Solution Feed Pressure Panel 1 0-150 PSI	
4	PIT-1101 CO2 Feed Panels Service Water Pressure Clearwell Bay 1 0-150 PSI	
5	Not Used	
6	Not Used	
7	Not Used	
Slot 4	1756-IF16 Analog Input (CLX I/O)	Relocated
0	LI-1000 CO2 Tank Liquid Level 0-94 IN	
1	FIT-1002 CO2 Feed Rate Panel 2 0-600 PPH	
2	PIT-1112 CO2 Gas Vapor Feed Pressure Panel 2 0-150 PSI	
3	PIT-1122 CO2 Solution Feed Pressure Panel 2 0-150 PSI	
4	PIT-1102 CO2 Feed Panels Service Water Pressure Clearwell Bay 2 0-150 PSI	
5	LIT-610 Acid Tank Level 0-?? Ft (Not Used in Program)	
6	Not Used	
7	Not Used	
Slot 5	1756-OF6CI Analog Output (CLX I/O)	Relocated
0	Y-1001 Feed Panel 1 CO2 Gas/Vapor Control Valve Position Command	
1	Y-1002 Feed Panel 2 CO2 Gas/Vapor Control Valve Position Command	
2	Not Used	
3	Not Used	

4	Not Used	
5	Not Used	

New HSP Panel

	Digital Input	Relocated
PSH-1700	HSP 1-3 Finished Water High Pressure Switch	
PSL-1700	HSP 1-3 Finished Water Low Pressure Switch	
PSH-1701	HSP 4-5 Finished Water High Pressure Switch	
PSL-1701	HSP 4-5 Finished Water Low Pressure Switch	
PSL-1641	HSP 4 Low Suction Pressure Switch	
PSL-1651	HSP 5 Low Suction Pressure Switch	
	Analog Input	Relocated
PIT-1700	HSP 1-3 Finished Water Pressure	
PIT-1701	HSP 4-5 Finished Water Pressure	
AIT-1702	HSP 1-3 Finished Water CL2 Residual	
AIT-1703	HSP 1-3 Finished Water pH	
CIT-1704	HSP 1-3 Finished Water Conductivity	
AIT-1705	HSP 1-3 Finished Water Fluoride	
AIT-1706	HSP 4-5 Finished Water CL2 Residual	
FIT-1707	HSP 1-3 Finished Water Flow Rate	
FIT-1708	HSP 4-5 Finished Water Flow Rate	

- END OF SECTION -

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 16910
PROGRAMMABLE LOGIC CONTROLLER

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. The Contractor shall furnish, install and place into service the Programmable Logic Control (PLC) systems.
- B. Provide complete I/O system including all racks, power supplies, cables, connectors, terminals, interposing relays, signal conditioners, signal isolators and the like.
- C. All hardware and cables shall be provided. All field debugging and testing shall be provided. Field testing shall be provided concurrent with Owner's separately provided programmer.
- D. In order to establish sole source responsibility of the Instrumentation and Control (I&C) system, the I&C vendor shall be responsible for all systems and subsystems provided.
- E. Like items of equipment provided hereunder shall be the end products of one manufacturer in order to achieve standardization for appearance operation and maintenance.
- F. See CONDITIONS OF THE CONTRACT and Division 1, GENERAL REQUIREMENTS, which contain information and requirements that apply to the Work specified herein and are mandatory for this project.
- G. Refer to the drawings and the tables listed under 16901 I&C Systems. Provide all labor materials for a complete and functional system.
- H. PLC programming shall not be provided by Contractor.
- I. PLC systems, hardware and store-bought software shall be provided as part of the I&C system.
- J. Provide fiber system improvements where required.

1.2 SUBMITTALS

- A. Submittals shall be made in accordance with the General Requirements.
 - 1. During the period of preparation of this submittal, the Contractor shall authorize direct informal liaison between his single I&C Supplier and the Engineer for exchange of technical information. As a result of this liaison certain minor refinements and revisions in the systems as specified may be authorized informally by the Engineer, but these shall not alter the scope of the work or cause increase or decrease in the Contract price. During this informal exchange no oral statement by the Engineer shall be construed to give formal approval of any component or method, nor shall any statement be construed to grant formal exception to, or variation from these specifications.
- B. Six complete sets of Operation and Maintenance Manuals shall be provided.
- C. Warranty information shall be submitted in accordance with general conditions.

1.3 QUALITY ASSURANCE

- A. All equipment furnished under this specification shall be new and unused, shall be the product of a manufacturer having a successful record of manufacturing and servicing the equipment specified herein for a minimum of five (5) years.

1.4 WARRANTY

- A. The Contractor shall warrant all equipment for a period of one (1) year from the date of Owner acceptance of the system.

1.5 PROGRAMMING

- A. None required.

PART 2 - PRODUCTS

2.1 GENERAL

- A. The programmable logic controller and all related equipment including I/O cards shall be of the Allen Bradley family for all applications. See drawings.
- B. PLC systems manufactured into control panels and assemblies shall contain a minimum of 25% spare I/O connected and ready to use.

2.2 POWER SUPPLY

- A. Provide a battery backed power supply sized to power all PLC equipment.

2.3 UPS SYSTEM

- A. Provide a U.L. labeled UPS system with 30 min. runtime.
- B. 1000 va minimum.
- C. DOUBLE CONVERSION ONLINE UPS for the PLC, I/O, and communication related devices.
- D. Provide N1 Critical Technologies, no equal.

2.4 RACKS

- A. Provide racks as may be required.

2.5 PLC EQUIPMENT

- A. Processor
 - 1. Provide Allen Bradley control logix family, also see drawings.
 - 2. Coordinate during shop drawings with Engineer and CSD for the PLC equipment.
 - 3. No substitutions shall be accepted.
- B. MODULES
 - 1. Provide the following I/O modules as a minimum including all terminals, surge arrestors and other equipment wired and ready for immediate use.
 - a. 1-discrete input module
 - b. 1-discrete output module
 - c. 1-analog input module
 - d. 1-analog output module
 - 2. Discrete output modules. Provide slave relays for control of remote equipment as may be required.
 - 3. Analog input modules shall be as a minimum, 24 vDC, 4-20 mADC, isolated.
 - 4. Analog output modules shall be 24 vDC, 4-20 mADC, isolated, self powered.
 - 5. Provide base rack or DIN rail.
 - 6. Provide Ethernet/IP communications.
 - 7. Provide the named materials and systems only.

- C. Miscellaneous PLC Equipment
 - 1. Provide all power supplies, cable and miscellaneous equipment for a complete and functional PLC system.
- D. PROGRAMMING SOFTWARE, not required
- E. PLC SPARES
 - 1. 1 – I/O modules of each type and point count used.
 - 2. 1 – Processor module of each type.
 - 3. Submit spares bill of material for review and approval.

2.6 ETHERNET SWITCHES

- A. Units shall Extreme or an approved equal. Units shall use ring topography and shall be fault tolerant.
- B. Provide fiber and metallic ports; 16 port E-switch as needed.
- C. Provide all cables and connectors.
- D. Provide Cat. 7a Ethernet cable for all uses on the project.
 - 1. Include cables and connectors.
 - 2. Include cables and connectors extending beyond the control panel to the VFD.s or other similar devices.
- E. Ethernet spares
 - 1. Provide 1 unit as spare.

2.7 LOCAL HMI OR OPERATOR INTERFACE TERMINAL

- A. Shall not be provided.
- B. The separate computer shall provide the interface.

2.8 ETHERNET FIBER OPTIC MEDIA CONVERSION MODULES

- A. Units shall be NTRON Fiber to Ethernet 10/100 base T fiber converters. Match existing units shall be compatible to the existing systems.

2.9 FIBER OPTIC CABLE

- A. Fiber optic systems and connectors shall be Optical Cable Corp. or an approved equal.
- B. Type of fiber shall be selected by the control panel manufacturer and shall be based on the lengths of transmission losses, connector losses, ease of handling, terminating connectors, etc. The following shall be used as a basis for bid and minimum requirements.
 - 1. Fiber type shall be single mode.
 - 2. 12 strand, 6 pair fiber cable.
 - 3. Heavy duty, installed in duct.
 - 4. Connectors shall be field terminated by I&C Contractor.
 - 5. Contractor shall provide field testing and documentation to document all terminations light system work according to manufacturer's requirements.
- C. Cable lengths shall be field measured and specified by the Installation Contractor with a minimum of 10% spare. Cable lengths shall not be scaled from drawings.
- D. Provide fiber optic patch panel at each end of run.
- E. Provide factory made fiber optic jumpers. Jumpers shall include units 10 feet or less.
- F. Provide field splicing.

2.10 FIBER OPTIC CONNECTORS AND SPLICES

- A. Provide connectors and splices.
- B. Provide and install all connectors for a complete and functional system.
- C. Provide no spares.

2.11 ETHERNET EQUIPMENT

- A. Provide Ethernet equipment as may be required for a complete and functional system including communication modules, fiber patch cords, metallic Ethernet cables, connectors and the like.

2.12 PATCH PANELS AND FIBER BREAKOUT BOXES

- A. Provide and install breakout boxes, fiber enclosures, compact design by Fiber Instrument Sales or an approved equal.
- B. Identify panel connections.

2.13 FIBER OPTIC PATCH CORDS

- A. Fiber optic patch cord shall be manufactured store bought unit with lengths as required by Fiber Instrument Sales or an approved equal.

PART 3 - EXECUTION

3.1 PLC I/O SCHEDULE

- A. Provide an I/O schedule identifying all I/O used and spares.

3.2 PROVIDE LOOP TESTING SPREADSHEET

- A. Provide spreadsheet with separate rows to identify each I/O point.
- B. Test each I/O point with the calibrated device.

3.3 START UP MODIFICATIONS

- A. Modifications shall be required during start up per the Owner/Engineers requirements. Contractor shall coordinate with the Owner's programmer during start up.

3.4 GUARANTEE

- A. Contractor shall guarantee the hardware through the service of his appointed I&C supplier for a period of one year.

- END OF SECTION -

SECTION 16913

PLC AND SCADA PROGRAMMING

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- A. Contractor Responsibilities
 - 1. Install and configure all hardware.
 - 2. Test and demonstrate all hardware.
 - 3. Provide assistance during testing and demonstration of hardware, as may be required.
 - 4. Provide no PLC and SCADA programming.
 - 5. Provide assistance to CSD personnel tracking down issues with hardware
While the PLC and SCADA programming is tested. Contractor shall set aside 16 hours
Of troubleshooting assistance to CSD personnel.
- B. Owner's Responsibilities
 - 1. All PLC and SCADA programming.
 - 2. Unless otherwise noted or indicated, all PLC and SCADA programming shall be provided by Control Systems Design.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

Not used.

- END OF SECTION -

THIS SECTION INTENTIONALLY LEFT BLANK