SECTION 11 30 00 – CONTAINERIZED HOLLOW FIBER MEMBRANE EQUIPMENT MEMBRANE TREATMENT SYSTEM

PART 1 -- GENERAL

1.01 DESCRIPTION

A. Description of Work:

1. This Section specifies the requirements for the design and fabrication of a containerized or trailer mounted membrane filtration (MF) treatment system. It describes the work to be performed by both the MF equipment manufacturer (Seller) to supply containerized membrane treatment systems to the City of Sandy (City) for future installation at the Alder Creek WTP (WTP). The WTP shall have 2 mgd firm capacity.

2. This Specification covers the containerized membrane filtration (MF) treatment system consisting of feed pumps, strainers, membrane filtration units, membrane cleaning and neutralization systems, membrane backwash pumps, excess feed recirculation equipment (if deemed necessary by the Seller for the operation of their system), air supply systems, piping, valves, controls and instrumentation for the complete system.

3. Additive Bid Item. If any container is not completely filled to meet the firm design capacity of 2 mgd, Seller should provide the additional cost for providing full buildout of all required containers. The purposed may be to increase capacity, lower the overall flux rate, or implement future backwash recycle.

4. The Special Engineering Services are to be provided under this contract and include project related activities including: shop drawings submittals and other engineering services.

5. The Special Services are provided under this contract and include project related activities including: O&M manuals, installation, commissioning and acceptance testing field services and operator training necessary for the installation of the System as described within the Contract Documents.

B. Reference Specifications

1. Section 01 08 00, Identification and Tagging

2. Section 01 33 17, Structural Design, Support and Attachment

3. Section 01 34 00, Shop Drawing Procedures

4. Section 01 61 00, Transportation and Handling of Goods

5. Section 01 61 10, Protection of Goods

6. Section 01 62 00, Installation of Membrane Equipment

7. Section 01 66 00, Commissioning of Membrane Equipment

8. Section 01 67 00, Acceptance Testing of Membrane Equipment

9. Section 01 73 00, Installation, Operation and Maintenance Manuals

10. Section 01 74 00, Membrane System and Module Warranty

C. Coordination

1. The design of a membrane filtration system requires considerable coordination between the Buyer, Engineer and Seller. The Seller will provide assistance to the Engineer and Buyer and provide the information needed to coordinate the design of the membrane filtration system and the ancillary equipment designed by the Engineer but not provided by the Seller.

2. The Seller shall provide all parts, equipment, materials, and components including instrumentation and controls. Equipment will be installed and interconnections made by the Contractor under a separate installation contract.

3. The Contractor shall be responsible for installation of equipment furnished under a separate contract and for provision of interconnecting piping and electrical power supply and connections. The Contractor shall assume responsibility for the satisfactory installation of the MF system. Upon completion of system installation will be reviewed and a Notice of Completed Installation shall be issued.

D. Special Considerations

1. Definitions

a. Seller: Containerized Membrane Filtration System Manufacturer

b. Hollow Fiber Membrane: an engineered self-supporting non-woven porous media of polymeric material with an outside diameter of 0.2 to 2.0 mm and an absolute pore size of less than 0.5 micron. Absolute pore size is defined as obtaining greater than 6-log removal (99.9999 percent) of particles or microorganisms of a known size.

c. The Containerized Membrane System pertains to the fiber membrane filtration equipment. The System shall contain at a minimum the following components:

1) 2 Membrane Units

2) Cleaning system

3) Compressed air system

4) Backwash tank and pump

5) Feed pumps and automatically backwashing strainers

6) HVAC system

7) Controls system

d. Air Scrub (AS) – Use of air during backwashing to dislodge contaminants from the membrane module.

e. Backwash - The periodic reversal of flow through a filter which may be accompanied by water in conjunction with air or oxidants at a low concentration (less than 10 mg/L of total chlorine) generally associated with the intermittent waste stream from an ultrafiltration or microfiltration membrane system used to remove particulate matter. Same as Reverse Filtration or Backpulse.

f. Container – The structure that houses the containerized membrane system shall be a shipping container or shipping trailer able to be placed by crane or truck, manufactured of corten steel and contain all system components integral to the containerized unit described in this specification.

g. Chemical Washing / Maintenance Cleaning - The periodic application of a concentrated chemical solution at high concentration (i.e. more than 10 mg/L of free chlorine or the addition of an acid which results in a pH of less than 4 or the addition of a base that results in a pH of greater than 10) to the membrane for a short duration of time (two times per day maximum for a total duration of less than 60 minutes) for the intended purpose of maintaining membrane permeability or reducing membrane fouling by a factor of less than 33 percent of the total amount of fouling that may be observed by the membrane.

h. Clean In Place - The periodic application of a concentrated chemical solution at high concentration (i.e. more than 10 mg/L of free chlorine or the addition of an acid which results in a pH of less than 4 or the addition of a base that results in a pH of greater than 10, or a surfactant or enzymatic cleaning agent) a membrane for an extended, duration of time (more than 60 minutes per day) for the intended purpose of reducing membrane fouling by a factor of more than 33 percent of the total amount of fouling that may be observed by the membrane.

i. Module - A membrane module is a complete unit composed of the membrane fibers, a housing, feed inlet, and filtrate outlet.

j. Train - A group of membrane modules arranged together and that share common feed and filtrate piping. Modules arranged such that the following are performed on all modules in a Train (Backwash, Clean In Place Chemical washing / Maintenance Clean)

k. Unit - The water production entity of a membrane system. A unit consists of a number of membrane modules that share feed and filtrate valving, and the units can usually be isolated from the rest of the system for testing, cleaning, or repair. Also called racks, trains (in conflict with the above definition), or skids

2. Design or Performance Requirements

a. It is the intent of this Specification and the Drawings to identify major components of the System and to establish minimum equipment and quality standards for these components. It is the Seller’s responsibility to provide all parts, equipment, materials, and components required for a complete and functional System.

b. Acceptable Sellers: Based on the Buyer's review, the following MSS's have demonstrated competent and are accepted by the Buyer to propose on this project:

1) PALL Water

~~2) WesTech~~ [Addendum #1]

3) H2O Innovation

c. Based on the Buyer's review, the following membrane modules and membrane element manufacturers are pre-qualified are accepted by the Buyer:

1) PALL (ASAHI) UNA-620A Microfiltration Membrane Module

2) Toray HFUG2020AN Ultrafiltration Membrane Module

~~3) DuPont IntegraTec XP 77 IG~~ [Addendum #1]

4) Membrane modules shall be positive-pressure type, PVDF hollow fiber construction, using an outside-in flow path. The membrane shall nominal pore size shall not exceed 0.1 micron.

3. Alternatives:

a. Alternative Sellers, Membrane Element Manufacturers, and membrane modules will not be considered.

4. Drawings:

a. The Seller shall furnish all components identified on the Drawings and as specified in this Section. If an item is shown to be furnished by either the Drawings or the Specifications, it shall by furnished whether or not shown on both.

b. The Seller shall furnish all components for complete and operatable containerized systems. The scope of supply is as follows:

1) Membrane containers (includes steel supports, HVAC, insulation, and piping within container)

2) Membrane modules

3) Feed pumps

4) Automatically backwashing strainers

5) Backwash pumps

6) Control and isolation valves

7) Clean-in-Place equipment for each containerized membrane system

8) Compressed air systems

9) Feed and filtrate turbidimeters

10) Backwash supply tanks

11) Electrical panels

12) Variable Frequency Drives for feed, backwash, and CIP pumps

13) Custom programming and components as needed to interface with plant feed and finished water equipment, as well as existing process equipment.

14) Start-up and training services

15) All other appurtenances listed herein, as required or shown on the drawings

c. The Seller is responsible for monitoring and controlling the MF System and other equipment shown on the Process and Instrumentation drawings and for interfacing any other plant controls or systems identified.

d. The MSS's shall supply a remote monitoring system, which combines early detection of any issues that may arise, system optimization, remote troubleshooting and accessibility of systems, and common data storage all into one, simple platform.

e. Drawings have been prepared for the purpose of obtaining a Proposal for the supply of goods and special services and are presented as a suggested system layout. Exact system details may differ per manufacturer.

f. The equipment type shall be reviewed by the Seller to assure that it satisfies the minimum requirements deemed appropriate for the intended service.

g. Final pipe sizing shall be by the Seller during detailed design after the Seller has been selected.

h. The Seller shall review equipment and line sizing for equipment that is to be provided by the Seller for consistency with their particular process.

i. General Systems Drawings are shown on I-001 to I-007. These drawings may differ from the installed system depending on the selected Seller. Systems integral to each containerized unit such as the backwash system and CIP system are not shown but included in the scope of supply by the Seller.

1.02 QUALITY CONTROL/QUALITY ASSURANCE (QA/QC)

A. Manufacturer's Qualifications: All equipment furnished under this specification shall be new and shall be the standard product of a manufacturer who is fully experienced, reputable, qualified and regularly engaged for at least 5 years in the manufacture of the equipment to be furnished.

B. Reference Standards: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified:

1. American Society of Mechanical Engineers (ASME)

    a. ASME Boiler and Pressure Vessel Code

2. American Society for Testing and Materials (ASTM)

    a. ASTM A 193 - Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service

    b. ASTM A 36, Standard Specification for Structural Steel

3. American National Standards Institute (ANSI)

    a. ANSI B16.5 - Pipe Flanges and Flanged Fittings

    b. AWS D1O.9, Standard for Qualification of Welding Procedures and Welders for Piping and Tubing

4. American Welding Society (AWS)

    a. AWS A5.9 - Specification for Bare Stainless Steel Welding Electrodes and Rods

    b. AWS D1.1 - Structural Welding Code - Steel

    c. AWS D1O.9 - Standard for Qualification of Welding Procedures and Welders for Piping and Tubing

5. Institute of Electrical and Electronic Engineers (IEEE)

6. National Electric Code (NEC) National Electrical

7. Manufacturers Association (NEMA)

8. Standards of National Electrical Manufacturers Association

9. Standards of American Water Works Association (AWWA)

10. National Electric Code (NEC)

11. National Sanitation Foundation (NSF)

C. Manufacturer's Quality Assurance/Quality Control Program

1. The manufacturer shall have in place a dedicated quality control/quality Assurance program.

1.03 SUBMITTALS

A. Shop Drawings

1. Coordination Meetings

a. Within fourteen 14 days after execution of the Agreement, the Seller shall meet with the Engineer at the Engineer's location to address any issues related to the project. The Seller shall prepare and submit a project specific process and instrumentation diagram (P&ID) of the proposed containerized membrane systems, and neutralization system for discussion.

2. Drawings and Samples:

   a. The Seller shall submit for review and approval in accordance with the Shop Drawing Procedures the following First Shop Drawing Submittals in accordance with Section 01 34 00, Shop Drawing Procedures. All drawings shall be submitted electronically in pdf format. Electronic drawings shall also be submitted in 3-D format compatible with the Revit design model. The Seller shall submit the following information:

      1) Schematics Drawings:

         a) P&IDs of the System, including hydraulic and pneumatic schematics detailing the equipment supplied by the Seller and showing equipment provided by others that will interface with the System.

         b) Provide a P&ID of a typical membrane unit including hydraulic and pneumatic schematics detailing the equipment supplied by the Seller.

         c) The Engineer, Buyer and Seller are responsible for establishing the P&ID tag numbering for the units and the system. The identification and tag numbering shall be in accordance with Section 01 08 00, Identification and Tagging.

         d) Electrical schematic diagrams including motor horsepower and other electrical load information and identification of external wiring (panel) connections and for coordination with the Contractor supplied VFDs.

      2) Containerized System Drawings: The Seller shall coordinate production and submit each of the following Arrangement drawings for approval:

         a) Provide plan and elevation views of containerized membrane system and all equipment to be included in container.

         b) Clearly identify the termination points and physical location for hydraulic, pneumatic and electrical connections where interfacing of the Seller supplied equipment and equipment to be installed by the Contractor exists

         c) Once submitted and approved the "physical envelope" of the Seller supplied equipment or termination points shall not change without approval of the Engineer

         d) A bill of materials for all tagged devices and components supplied with the Unit including component original part numbers identifying each furnished component

3) Containerized Neutralization System Drawings: The Seller shall coordinate production and submit each of the following Arrangement drawings for approval:

a) Provide plan and elevation views of skid mounted neutralization system. The CIP tank does not need to be mounted on the skid, it will be shipped loose for installation and connection to the Neutralization skid by the contractor.

b) Clearly identify the termination points and physical location for hydraulic, pneumatic and electrical connections where interfacing of the Seller supplied equipment and equipment to be installed by the Contractor exists

c) Once submitted and approved the “physical envelope” of the Seller supplied equipment or termination points shall not change without approval of the Engineer

d) A bill of materials for all tagged devices and components supplied with the Unit including component original part numbers identifying each furnished component

4) The Seller shall attend a meeting with the Buyer within 10 days after the submittal of the first shop drawing for coordination and review.

b. The Seller shall submit for review and approval in accordance with Section 01 34 00, Shop Drawing Procedures.

1) Manufacturer’s literature, illustrations, specifications, weights, pump curves, and engineering data for project engineered equipment including dimensions, materials, sizes, and performance data.

2) Piping Fabrication and Assembly Drawings: For all MF system piping, provide double-line scaled drawings showing all fittings, valves, instruments and supports.

a) Provide fabrication details for piping and structures elevation views of all major components and subsystems, detailing orientation of equipment, piping, fittings and valves (including valve actuators).

b) Identify piping materials and fabrication details as required by Section 15 06 20, Stainless Steel Pipe and Tubing.

c) Each support shall be identified by catalog number or shop drawing detail number.

3) Containerized membrane system:

a) A bill of materials for all tagged devices and components supplied with the containerized membrane system including component original part numbers identifying each furnished component. For all tagged devices supplied, the Seller shall develop a “Cross Reference Schedule” that matches the Tag to the appropriate equipment manual. The equipment schedule shall include the pertinent information associated with the equipment including tag number, description, functional name location, component equipment model, part number, size, materials, accessories and range. The Cross-Reference Schedule shall be provided in the form of a Microsoft Excel (.XLS) spreadsheet.

4) Design Calculation:

a) Design calculations related to sizing of key components, including the overall System, pumps, valves, Units, process air system, backwash system, CIP system, chemical transfer pumps, CIP pumps, and electrical controls and instrumentation supplied by the Seller. Calculations for the piping system shall be sufficient to demonstrate that the system is hydraulically stable (balanced) under normal and backwash operation within the Seller’s and/or good engineering practice limits. Submittals for pump(s) and throttling and modulating valve(s) shall also include calculations to show that cavitation does not occur over the intended minimum and maximum operating range.

b) Other submittals and/or shop drawings as required under the Contract Documents

c) Submit data as required by the applicable components of Section 11 00 00, General Equipment Provisions.

5) Information as specifically requested by the Engineer or Buyer in support of this Project.

6) The Seller shall attend a meeting with the Buyer within 10 days after the submittal of the second shop drawing for coordination and review.

B. Factory Test Reports

1. Quality Control Reports

a. Factory Test and Seller Quality Control Reports for all equipment provided including the Factory Test Report for the PLC/HMI system functional performance test reports

b. Factory Test Reports for all Control Panels

C. Installation Instructions: Refer to Section 01 62 00, Installation of Membrane Equipment.

D. Commissioning Plan: Refer to Section 01 66 00, Commissioning of Membrane Equipment.

E. Operation and Maintenance Manuals: Refer to Section 01 73 00, Installation, Operation and Maintenance Manuals.

F. Training Manuals: Refer to Section 01 73 10, Training of Operations and Maintenance Personnel.

G. Record Drawings: In accordance with Section 01 73 00, Installation, Operation and Maintenance Manuals, after completion of Acceptance Testing the Seller shall revise and submit to the Buyer revised O&M Manuals using As Installed information.

H. Certificates, Warranties and Guarantees

1. Refer to Section 01 74 00, Membrane System and Module Warranty

2. Seller “Acceptance of Installation” following equipment installation.

3. Regulatory Agencies: The Seller shall supply hydraulic calculations and drawings for the System and any other system performance data specifically required by regulatory agencies.

PART 2 -- PRODUCTS

2.01 SYSTEM DESIGN AND PERFORMANCE REQUIREMENTS

A. Process Description

1. The Alder Creek Raw Water Pump Station (RWPS) intake pumps will provide source water for treatment. The feed stream will receive chemical addition by aluminum chlorohydrate coagulant, sodium hypochlorite (optional), and sodium hydroxide followed by mixing and storage in the membrane filtration feed tank. These system components can be found on Drawing I-004.

2. Process and Instrumentation Drawings (P&IDs) for the membrane filtration system including the associated chemical feed systems have been developed to detail the equipment to be provided. The Drawings have legend sheets that describe the symbols and abbreviations used on the P&IDs.

3. The requirements for the equipment type are cross-referenced in the specifications. The equipment type identified should be reviewed by the Seller to assure that it satisfies the minimum requirements deemed appropriate for the intended service.

4. The feed stream shown on Drawing I-001 may have undergone pre-treatment via coagulation and chlorination and pH control prior to entering the membrane feed tank. Flow from the feed tank will be split between one of two or three containerized membrane systems, as determined by the containerized system capacity.

5. Membrane feed pumps (located inside each containerized unit) will discharge water through automatically backwashing strainers and to the membrane filtration units, both located within the containerized unit.

6. Feed pressure will be used to backwash the automatic backwashing strainers. The feed system is controlled using the pressure transmitter located downstream of the strainers. Backwash flow from the strainers will be measured and routed to a manhole where it combines with other waste streams and then discharged to existing backwash ponds. Clarified water from the backwash ponds is not expected to be recycled to the head of the WTP at the time of installation of the containerized units but may be recycled in the future.

7. A spare or standby membrane filtration rack will provide redundancy to the membrane to achieve an (N+1) system design. A rack is considered redundant if it has the following components:

    a. Dedicated feed pump

    b. Dedicated strainer

8. Drawing I-002 shows the arrangement of interconnecting piping for the containerized membrane treatment units. Note that the design of the interconnecting piping is to be prepared by the Seller.

9. The feed shall be designed with an air/vacuum relief located at the highest point of the membrane unit to relieve air that may have accumulated during the air scour sequence or relieve vacuum conditions during draining of the unit. Prior to discharge, the filtrate flow is measured and the turbidity is also monitored.

10. The common filtrate discharge pipe will have chemical addition for disinfection and pH control. Filtrate discharge piping and pH control equipment will be supplied by the contractor. pH control equipment will be supplied by the plant control system and does not need to be controlled by the Sellers equipment.

11. The filtrate will enter a chlorine contact tank that will be constantly full and then will discharge to distribution through a high service pump station.

12. Water for backwashing membrane modules should be supplied by filtered water produced by the containerized units. Each containerized unit should be equipped with a filtrate tank to provide water for backwashing. The backwash pumps will be driven by VFDs for flow control.

13. The CIP system will be integral to each containerized unit and be supplied by the Seller including air diaphragm metering pumps and instrumentation for chemical addition during the CIP process.

14. Spent cleaning and chemical maintenance cleaning waste are collected, pH-neutralized, and dechlorinated in the neutralization tank prior to discharge. The neutralization system is shown on Drawing I-004. The neutralization system, shall be skid mounted and all necessary equipment including pumps, instrumentation and the neutralization tank should be supplied by the Seller. Neutralized CIP waste solution will discharge to a holding tank at the WTP site. Neutralized chemical maintenance clean solution will discharge to the Backwash pond.

15. Citric Acid (50%) will be delivered in totes or drums, located outside of the containerized membrane systems, and will be transfer-pumped to the acid CIP tank or Neutralization tank as needed by pumps supplied by the Seller.

16. Sodium Hydroxide (25%) will be delivered in bulk and will be transfer-pumped to the Caustic CIP tank or Neutralization tank as needed as shown on Drawing I-005. Transfer pumps needed for containerized system operation to be provided by seller.

17. Sodium Hypochlorite (12.5%) will be delivered in bulk and will be transfer-pumped to the Caustic CIP tank as needed as shown on Drawing I-006. Transfer pumps needed for containerized system operation to be provided by seller.

18. Aluminum Chlorohydrate coagulant will be dosed to the raw water and equipped will be supplied by Contractor.

19. Calcium thiosulfate will be delivered in liquid form by 55 gal drums and will be transfer-pumped to the neutralization tank as needed as shown on Drawing I-004. Transfer pumps will be supplied by the Seller.

20. Each containerized system shall have a dedicated PLC or Remote I/O module(s) which shall report back to the centralized PLC. The seller shall also supply a master PLC to control communications between each trailer and the neutralization system.

21. The master PLC shall be complete with a secondary standby, hot-swappable PLC system that shall be capable of taking over system operation in the event of a failure to the primary PLC.

22. A compressed air system shown will supply control air including air for daily integrity testing, air scour cleanings during backwash, pneumatically controlled valves, and supply any pressurized air required by the neutralization system. Each containerized unit will be equipped with a compressor, dryer, receiver and filters.

B. Service Conditions

1. Ambient Environment. The equipment furnished under this section will be installed at the locations shown on the Drawings. The site conditions are expected to be as follows:

    a. Ambient Air Temperatures: 25°F to 105°F

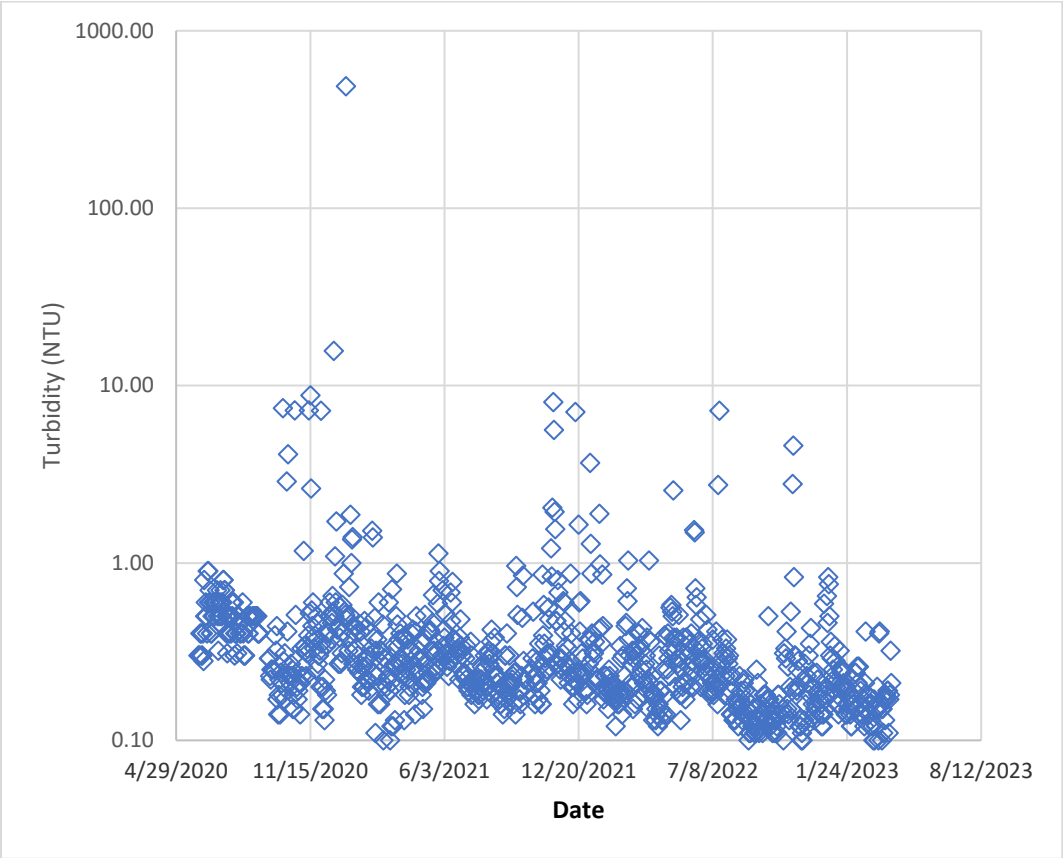
    b. Relative Humidity: 0 to 100 percent noncondensing

    c. Altitude: 1,078 feet above Mean Sea Level

    d. Environment: Rural area west of the City of Sandy, approximately 38 percent sunny days, annual rainfall approximately 78 inches, winds up to 42 mph and potential for wildfire smoke.

2. Feedwater Quality: Historical Water Quality information is somewhat limited from the existing WTP but is as follows:

    a. Turbidity: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100.00
10.00
1.00
0.10
Turbidity (NTU)
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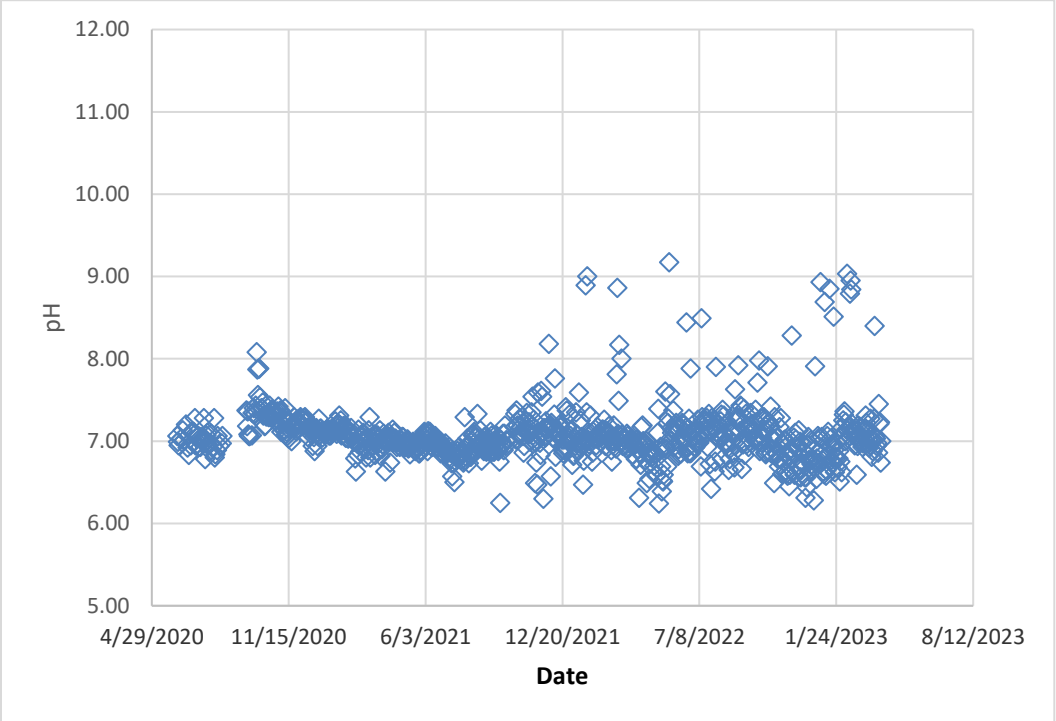
11/15/2020
6/3/2021
12/20/2021
7/8/2022
1/24/2023
8/12/2023
Date

b. pH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11.00
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9.00
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6.00
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pH
4/29/2020
11/15/2020
6/3/2021
12/20/2021
7/8/2022
1/24/2023
8/12/2023
Date

c. Raw water temperature: 5 deg C to 15 deg C

d. Additional sampling data was performed on 11/17/23 and is listed below:

1) Iron – non-detect

2) Manganese – non-detect

3) Alkalinity – 26 mg/L as $CaCO_3$

4) Total Organic Carbon – 0.63 mg/L

5) Ammonia – non-detect

6) Nitrate/Nitrate – Non-detect

7) Total Suspended Solids – non-detect

3. Process Design Requirements: Raw water will receive coagulant injection, mixing, with reaction time in the membrane feed storage tank. Sodium hypochlorite and sodium hydroxide and could be added to the raw water for disinfection, and pH increase.

4. Estimated design elevations to be refined during fnal design:

a. Process Inlet Water Level

1) ~1078.0 ft EL

b. Plant Site

1) ~1076.0 ft EL

c. Filter Discharge Water level

1) CT Tank High water level – ~1077.0 ft EL

C. Process Design Requirements

1. Overall System Design Philosophy

a. The facility consists of coagulation, feed tank storage reaction time, containerized membrane filtration systems (including feed pumps, automatically backwashing strainers, backwash, process air, CIP and provisions for chemical maintenance cleaning), a neutralization system, Chlorine disinfection, filtered water storage, and a high service pump station. Membrane backwash waste will be coagulated and sent to a solids holding pond. CIP waste shall be pH-neutralized, dechlorinated, and discharged to a holding tank for future disposal. Chemical maintenance cleaning waste shall be pH-neutralized, dechlorinated and discharged to the solids holding ponds.

b. The design philosophy for the facility is that the Seller shall provide enough containerized membrane systems to provide redundancy such that N+1 membrane racks are provided between all containerized units.

c. The membrane filtration system for the Alder Creek WTP shall be capable of producing 2.0 mgd of water (net) for drinking. The capacity shall be calculated using the net filtrate with one membrane rack out of service.

2. Membrane System Design Criteria: The Seller shall list guaranteed design and operating criteriaThe selected Seller shall demonstrate the guaranteed design and operating criteria during a proof pilot test per Section 11 30 20, Performance Pilot Testing of Membrane Equipment. If design and operating criteria cannot be demonstrated, the Seller shall adjust the pilot test and full-scale system accordingly at no additional cost to the Buyer per Section 00 52 00, Procurement Agreement.

   a. Membrane Flux:

      1) The average membrane design flux shall not exceed 50 gfd instantaneous with one train out of service on the maximum day achieving the net filtrate capacities listed above. The flux shall be in units of gallons per day per square foot of membrane surface area using the feed side of the membrane.

   b. Design Capacity and Design Temperature:

      1) Design Capacity/Temperature

         a) 2.0 mgd @ temperatures 5 deg C and greater

   c. Number of Containerized Membrane Systems

      1) Minimum: 2

   d. For the purpose of determining membrane surface area required .and maintaining the provisions of membrane warranty for CIP interval, the maximum design capacity of 1.8 MGD for the membrane facility will not be adjusted for water temperatures above 5 deg C.

      1) The Buyer may operate the membrane facility at any capacity up to the amount maximum permitted by the Oregon Health Authority or at 1.5 times the maximum presented turbidity conditions without invalidating the membrane warranty.

   e. Excess Capacity / Redundancy:

   f. Recovery: The system shall operate at or above the Seller's design recovery at all times during operation. Design recovery values shall be calculated as follows:

      [Net filtered water (mgd)/Net feed (mgd)] x 100 percent

Where the quantity: net filtered water (mgd) is equal to the total amount of filtered water produced (mgd) less any amount used for backwashing of the membrane filters (mgd) on a time weighted average. Net facility capacity is based on the amount of water discharged from the membrane minus water supplied to the backwash system. Net feed is the amount of water that enters the treatment facility. The facility capacity includes the amount of filtrate that is required for backwash and water that is used as part of a chemical maintenance cleaning process. Strainer losses or recovery of backwashing waste through clarification / recycle are not considered as part of the recovery calculation. Water used for CIP or CIP rinsing is not included in the calculation of recovery.

Minimum Recovery for Membrane System 95%

g. Minimum Chemical In Place Interval: 30 days*

* Refer to Section 01 74 00, Membrane System and Module Warranty for language regarding the criteria for Clean-in-Place interval

h. Minimum maintenance cleaning interval: 72 hrs frequency

i. Filtered Water Quality Requirements: Filtered water quality shall meet the following water quality requirements:

1) Turbidity

a) Maximum filtered water turbidity (ntu): 0.15

b) Maximum filtered water turbidity 95% of time (ntu): 0.10

2) Microbiological Removal Efficiency

a) Minimum *Giardia* Removal: >4-log (99.99 percent)

b) Minimum *Cryptosporidium* Removal: >4-log (99.99 percent)

2.02 EQUIPMENT DESIGN AND FABRICATION REQUIREMENTS

A. General System Requirements

1. The System shall be suitable for installation in an outdoor environment maintained between 25 degrees F and 105 degrees F.

2. Miscellaneous

a. Lifting Lugs: All equipment items or component assemblies weighing in excess of 100 pounds shall be furnished with lifting lugs.

b. Miscellaneous Fasteners: Bolts, nuts, washers, flange backing rings, and other miscellaneous metal components not specifically addressed elsewhere in these specifications shall be Type 316 stainless steel.

c. Pumps, compressors and. Ancillary equipment shall be sized using the Seller design criteria established during pilot testing and will accommodate the maximum number of membrane modules per membrane unit assembly as indicated in the Proposal Pricing Form.

3. Cross Connection Control

a. The Seller shall design the membrane process with cross-connection control (block and bleed) to assure that chemical solutions used as part of a Chemical Maintenance Clean or Clean in Place process do not come in contract with raw or filtered water. Any chemical solution that does not fit the criteria defined as backwash shall be deemed as a cleaning solution. If a block and bleed system is not able to be installed within the container, the Seller shall include a block and bleed system to be installed at the filtrate connection of each container to be controlled by the containerized unit.

b. Any cleaning process, other than backwashing, must use a cross connection control strategy. Cross connection control shall be automated.

c. The cross-connection control strategy shall segregate the supply of the cleaning solution (chemical maintenance clean or Clean In Place solution) from the backwash solution.

d. The cross-connection control strategy shall isolate the individual membrane unit from the membrane train during the chemical maintenance clean or Clean in Place process. The cleaning solution shall be adequately rinsed from the membrane unit using raw or filtered water. Analytical instrumentation shall be used to confirm that the cleaning solution has been adequately rinsed.

e. The cross-connection control strategy shall be structured and interlocked such that the supply or discharge of cleaning chemicals remain segregated from the backwash.

f. If a common manifold is used for the delivery or discharge of two or more cleaning solutions, the common manifold shall be flushed and drained before a change in chemicals is made.

g. As a minimum, the cross-connection control strategy shall incorporate “double block and bleed” physical isolation for the filtrate for each containerized unit and at other locations as shown on the Drawings. Backwash supply shall be protected by a check valve located on the common line to the units.

4. Piping System Design

a. The Seller shall use piping materials that are suitable for the intended service inside the containerized units. “L” (Low carbon) grade 300 series stainless steel is required for welded pipe and fittings.

b. Rack Interconnecting Piping: Sch 80 PVC, HDPE, or 316 SS

c. All piping (including flanges), valves and components that comprise the permanent piping system on the membrane unit shall be pressure rated for a minimum of 150 psi.

d. Unless stated otherwise or approved by the Engineer, a maximum fluid velocity of 10 feet per second shall be used for the design of the pressure piping systems.

e. Unit piping shall be arranged in order to assure that a straight run of pipe is used for the flow meters. If not possible, the vendor shall use 0D (Zero Diameter) flow meters or submit a letter of acceptable use from manufacturer. For the purposes of determining the length of a straight run, the length is determined by the length of the spool piece of pipe used before or after the flow meter. Flow meter lay length shall comply with the flow meter manufactures installation requirements or have manufacturer acceptance of installed straight lengths. The flow from each Unit shall be measured directly or through addition or subtraction of two or more flow meters.

f. 2-1/2", 3-1/2" and 5" pipe sizes are not permitted unless approved in writing by the Engineer.

g. Unit piping of 1-inch or less in diameter may utilize SCH 80 PVC or a suitable material.

h. Tubing and other wetted sensing lines shall use type 316 Stainless Steel or poly tubing.

5. Pneumatic System:

a. When used, pneumatic solenoid valves shall have a pilot indicator and a manual override.

b. Pneumatic lines shall be of 304 or 316 stainless steel, HDPE, or polyurethane construction.

c. Plastic valves, check valves and other appurtenances are not permitted on compressed air lines.

d. Seller shall install flow controls as required to regulate valve actuation in order to prevent hydraulic shock.

e. The inlet to the membrane unit process shall include a check valve to prevent contamination of the air supply.

6. The Seller shall submit calculations to the Engineer that verify that valve or pump cavitation does not occur over the intended operating range.

B. System Design Requirements

1. P&IDs for each system have been developed. The purpose of these Drawings is to provide the Seller information for the project and define the scope of equipment to be provided. Equipment and appurtenances not specifically shown on these Drawings but required for operation of the system shall be provided by the Seller.

2. The P&IDs show the process design intent for the project and provides the necessary equipment, valves, and instrument necessary to control the process based on the MF Pilot Testing.

a. The proprietary control is not shown on the drawings and is to be developed by the Seller in accordance with the Contract Requirements. The Seller is solely responsible for establishing the control of the MF System shown on the P&IDs and for interfacing with the plant control system.

b. The Seller shall develop P&IDs using the three-layer format identifying all I/O (analog discrete and digital) at the PLC and HMI levels as shown on the Drawings. Refer to Drawing PI-3 for the minimum typical instrumentation and control requirements. PLC and HMI operations shall be indicated on the Seller drawings and include ranges, alarms, set-points, control, primary interlocks and trending functions detailed at a sufficient level of indicate the intended operation of the system.

c. Typical P&ID drawings will only be accepted for identical membrane filtration units.

3. Membrane Filtration Units

a. Each unit shall consist of hollow fiber membrane modules.

b. The modules shall be connected in manifolded blocks and supported by the MF unit framework. Modules for each block shall be tested at the factory.

c. Each containerized system shall be provided with horizontal end suction pumps.

d. The membrane modules shall be supported by a steel framework in a vertical orientation. The modules shall be connected to their manifolds with Victaulic and slip joint connectors. All seals shall be EPDM.

e. Each containerized system shall be divided into identical Units. Identical consists of functionally independent (independent electrical and hydraulic control), and of the same hydraulic capacity. Differences in what appears to be unit symmetry (hand) are not acceptable. Each membrane, including the spare, shall be of identical design and shall accommodate the same maximum number of membrane modules. The spare shall be equipped with the same number of modules as the primary membrane units.

f. Functionally independent means that each membrane unit shall be capable of independent operation for its process sequences upon initiation. It is not acceptable 1) to share valves or instrumentation that perform similar internal functions between membrane units or 2) require that all membrane units be removed from normal filtration and backwashing to perform a function or sequence.

g. Unit support frames shall be designed to resist gravity and seismic forces of the pressure vessels, piping and other related equipment supported by the frame. These supported items shall not be considered as structural members of the support frame. The frame shall be designed in conformance with the latest edition of the International Building Code (IBC) design criteria per Section 01 33 17, Structural Design, Support, and Attachment, and signed by a Registered Professional Structural Engineer currently licensed in the State of Oregon.

4. Backwash and Air Scrub (AS) System:

    a. The backwash system shall be designed for the number of membrane Units, as shown on the Drawings. General Requirements for the backwash System are as follows:

        1) Spent backwash water exiting the Unit shall be discharged in a controlled manner. Intermittent backwashes will be discharged to the solids handling ponds.

        2) The backwash sequence shall be designed so that the same volume (amount of water in gallons) of backwash water is produced per Unit backwash irrespective of the degree of membrane fouling (resistivity or permeability) or variation in water temperature (viscosity effect).

        3) Control programming shall be configured with appropriate software time delays to avoid rapid pump or membrane flow cycling in response to transient dynamic hydraulic effects caused by backwash; or chemical maintenance cleaning cycles. “Deadheading” or any operation of any pump under a “zero-flow” or “flow condition below the pump manufacturers acceptable limits” is not acceptable. Interlocks shall be provided to prevent operation of the any pump under a “dead-headed” condition.

        4) The MF units shall utilize a reverse flow back flush (backwash) to remove accumulated particulates and maintain the design filtrate production rate. Filtrate shall be introduced into the filtrate side of the fibers flushing dislodged solids to waste.

        5) The units shall incorporate an AS sequence to periodically agitate the exterior fiber surface. Dislodged solids shall be diverted to waste.

        6) The backwash and AS cycles shall be initiated through the process control system using totalized volume. The backwash and AS processes shall be carried out automatically through the PLC.

        7) The compressed air system supplying low-pressure air for the AS cycle will be provided by the Seller and integral to each containerized membrane system.

5. Clean-In-Place (CIP) and Chemical Maintenance Clean (MC)

    a. Each containerized membrane system shall be provided with a CIP tank and accessories. The CIP system will include a CIP circulation pump, a CIP drain pump, valving, and instrumentation as shown on the Drawings. Circulation and drain pumping can be performed by one pump if suggested by manufacturer. A single pump shall be installed in each containerized unit with one shelf spare provided for the project.

    b. The Seller shall supply equipment and appurtenances as shown on the P&ID Drawings.

c. There shall be a shared tank for acid and caustic CIP solutions. The system shall include accessories, tank heater control panel, heaters and controls, and analyzers as shown on the Drawings.

d. Spent CIP solution shall be discharged in a controlled manner. Intermittent CIP solutions will be discharged to the neutralization tank for pH-neutralization, dechlorination, and equalization. The neutralization system shall include a neutralized waste pump that can be used to mix the tank contents or discharge the tank contents to either the sanitary sewer for CIP wastes or the solids drying beds for maintenance clean wastes.

e. There will be one citric acid dose transfer system, one sodium hydroxide transfer system, and one sodium hypochlorite transfer system provided to supply concentrated chemicals to the CIP tanks.

f. Heaters shall be provided for heating of CIP solutions. The heaters shall be sized to elevate the water temperature to the desired level and maintain the temperature during the CIP cycle. Heaters shall meet the following requirements:

General	Heater with thermocouple, Type K, NEMA 4X
Sheath	Incology 800 / Titanium
Flange	304 SS
Gasket	Fiber
Seal type	Epoxy
Power requirements	460 V, 3 ph, 60 Hz
Minimum energy demand (kW)	80

g. Recommended Manufacturers for Tank Heaters:

   1) Indeeco, or approved equal.

h. Seller shall provide the necessary interlocking logic to assure that a Unit being chemically cleaned is isolated from the MF System as shown on the P&ID Drawings.

i. The design of the chemical cleaning system shall incorporate automatic safety features to assure that cleaning solution is adequately rinsed from the MF System and will not contact filtered water.

j. When not in operation, each Unit shall be capable of being stored in a CIP solution or other suitable storage solution.

k. The cleaning pumps shall be per vertical in-line centrifugal type.

6. Chemical Maintenance Clean (MC)

    a. General: The maintenance clean system will utilize the CIP system described above with similar control system requirements.

        1) The Seller shall provide the chemical transfer and solution mixing equipment and controls to batch the maintenance clean solution that is used for chemical cleaning of the Units as shown on the P&ID Drawings.

        2) Spent maintenance cleaning solution shall be discharged in a controlled manner. Intermittent chemical cleaning solutions will be discharged to the CIP neutralization system and then to the solids drying bed.

        3) Heaters shall be provided for heating of maintenance cleaning solutions. The heaters shall be sized to elevate the water temperature to the desired level and maintain the temperature during the maintenance clean cycle. Heaters shall meet the same requirements mention above for the CIP system.

        4) The Seller shall provide the necessary interlocking logic to assure that a Unit being cleaned is isolated from the MF System as shown on the P&ID Drawings.

        5) The design of the chemical cleaning system shall incorporate automatic safety features to assure that cleaning solution is adequately rinsed from the MF System and will not contact filtered water.

7. Each containerized system shall be equipped a Membrane Filtrate Monitoring System consisting of a Membrane Filtrate Sample System and a Membrane Integrity Test System.

    a. Membrane Filtrate Sampling System

        1) An automatic sample valve located on the filtrate (permeate) discharge line on each membrane rack.

        2) The sample valve shall open when the unit is producing water. The sample line shall be connected to a turbidity meter provided by the Seller. Power for the turbidity meter will be sourced from the Unit control panel. The analog signal from the turbidity meter shall be routed into the Unit PLC or Remote I/O.

        3) An automatic sample valve located on the common filtrate (permeate) discharge line connecting each containerized unit and provided by the Contractor.

    b. Membrane Integrity Test system to verify the integrity of membrane modules:

        1) The membrane integrity test system shall use air pressure to verify the integrity of the membranes.

2) The applied test pressure of the membrane integrity test system shall be established so that passage of particles greater than 3.0 microns or larger can be detected.

3) The un-pressurized side of the membrane unit will be vented to atmospheric pressure.

4) The Seller shall provide documentation of methodology used to establish the integrity test pressure.

5) The integrity test system shall be manually or automatically initiated and automatically sequenced by the PLC system, and complete daily in conformance with the US EPA Long Term 2 Enhance Surface Water Treatment Rule and the Membrane Filtration Guidance Manual.

6) The integrity test system shall verify the integrity of the membrane and upon successful completion of the integrity verification, return the Unit to service.

7) If the integrity test does not pass the integrity verification, the Unit shall be removed from service and an alarm shall be annunciated from the Unit PLC / Remote I/O to the System PLC.

8) Refer to Section 01 74 00, Membrane System and Module Warranty for additional requirements of the Membrane Integrity Test System.

C. Fabrication Requirements

1. All welding shall be in accordance with the latest applicable codes of the American Welding Society and/or ASME Boiler Code.

2. Piping

a. Schedule 10S Type 316L stainless steel pipe assemblies may be used.

b. Refer to Section 15 06 20, Stainless Steel Pipe and Tubing for stainless steel fabrication.

c. Threaded fittings shall not be used for pipe diameters exceeding 2 inches IPS.

d. Each membrane valve or piping assembly shall be tested at the Seller's facility using dummy module. This testing shall incorporate a leak check to verify the integrity of the welded and bolted connections and will be repeated in the field using the actual modules. If the Seller elects to forgo this test and a weld failure is discovered during the field rest, the Seller shall be responsible for all costs associated with the requisite repairs and associated delays.

3. Unit Frame Construction

a. The unit support frames and miscellaneous brackets shall be fabricated from ASTM A36 hot rolled steel structural members and ASTM-A500, Grade B welded steel structural tubing.

1) The method of fabrication shall be continuous fillet and bevel welds. The strength of these welds shall meet or exceed the strength of the structural shape or tubing material. All welding operators shall be qualified in accordance with the current AWS requirements. All exterior welds shall be ground flush and smooth prior to sandblasting. Metal Inert Gas (MIG) welding techniques shall not be used in the frame fabrication. Stitch and spot welding will not be accepted. Bolt holes, mounting holes, etc., shall be drilled prior to painting wherever possible.

b. Painting

1) Refer to Section 09 90 00, Painting.

2.03 EQUIPMENT AND COMPONENTS

A. Component Equipment Requirements

1. Component equipment provided by the Seller shall conform to the requirements of the Contract Documents.

2. The Seller may use NSF / FDA / USDA approved plastic material for module assemblies that are replaced with the membrane modules. All materials of construction shall use NSF / FDA / USDA approved materials for contact with water.

3. Centrifugal Pumps

a. Process Design Requirements

1) Pump sizing and calculations shall be finalized with submittal drawings for the membrane system.

2) Pumps shall be sized using the Seller design criteria and will accommodate the maximum number of membrane modules per membrane unit assembly as indicated in the Proposal Pricing Form.

b. Service Condition

1) Membrane feed pumps

2) Backwash pumps

3) CIP recirculation pump

c. Design Criteria

1) Process Design Requirements

a) Pump sizing and calculations shall be finalized with submittal drawings for the membrane system.

b) Pumps shall be sized using the Seller design criteria and will accommodate the maximum number of membrane modules per membrane unit assembly as indicated in the Proposal Pricing Form.

d. PUMP REQUIREMENTS

1) Construction: Construction of centrifugal pumps shall conform to the following requirements:

2) All elastomeric materials such as O-rings and gaskets shall be compatible with the fluid.

3) Coating: Interior water passages of cast iron and ductile iron casing shall be coated with 10- to 12-mils DFT vitreous enamel or 10- to 12-mils DFT fusion bonded epoxy per Section 09 96 00, Painting. All external surfaces of cast iron and carbon steel materials shall be coated in accordance with Section 09 90 00, Painting. Stainless steels shall not be coated.

e. MOTOR

1) Motor shall operate on 460 VAC, 3 PH, 60 Hz power supply.

2) Motor shall be TEFC-type with worm gear reducer.

3) Motors shall have a 1.15 service factor and shall be NEMA Design B, with Class F insulation. Motors shall have space heaters to prevent condensation in the motor. Conduit boxes to be two times NEMA standard. Provide separate boxes for motor leads and for space heater and temperature switch wiring.

4) Each pump and motor shall be furnished with a stainless steel nameplate securely mounted to the body of the equipment which will list manufacturer and model details, and relevant design criteria.

5) VARIABLE FREQUENCY DRIVE

a) Requirements:

(a) The power and control electronics shall be housed in a UL Type 3 enclosure and the combined motor/VFD rating shall be IP55 (protection against dust and nozzle directed water from any direction) or be NEMA 4 rated.

(b) The VFD shall be of the PWM (Pulse Width Modulation) design using IGBT (Insulated Gate Bipolar Transistor) technology.

(c) The VFD shall convert incoming fixed frequency three-phase AC power into a variable frequency and voltage for controlling the speed of motor. The motor current shall closely approximate a sine wave. Motor voltage shall be varied with frequency to maintain desired motor current suitable for centrifugal pump control and to eliminate the need for motor de-rating.

(d) The VFD shall automatically reduce the switching frequency and/or the output voltage and frequency to the motor during periods of sustained ambient temperatures that are higher than the normal operating range. The switching frequency shall be reduced before motor speed is reduced.

(e) An integral RFI filter shall be standard in the VFD.

(f) The VFD shall have a minimum of two skip frequency bands which can be field adjustable.

(g) The VFD shall have internal solid-state overload protection designed to trip within the range of 105-110% of rated current.

(h) The integrated VFD motor shall include protection against input transients, phase imbalance, loss of AC line phase, over-voltage, under-voltage, VFD over-temperature, and motor over-temperature. Three-phase integrated VFD motors shall be capable of providing full output voltage and frequency with a voltage imbalance of up to 10%.

(i) The VFD motor shall have, as a minimum, the following input/output capabilities:

(j) Speed Reference Signal: 0-10 VDC, 4-20mA or Ethernet

(k) Digital remote on/off, or Ethernet

(l) Fault Signal Relay (NC or NO), or Ethernet

(m) Fieldbus communication port (Ethernet IP)

f. APPROVED MANUFACTURER

1) Grundfos

2) Goulds ESH

3) or approved equal

4. Air diaphragm pumps

a. Air diaphragm pumps will be designed for the following services:

1) 12.5% Sodium Hypochlorite

2) 1% Caustic Soda

3) 2% Citric Acid

4) Calcium Thiosulfate

b. Pump Construction:

1) General: The pump shall be of the air-operated double diaphragm type and conform to the following requirements:

Pump base	cast iron / steel / aluminum
Pump casing (wetted)	PVDF
Pump casing (dry)	Polypropylene
Pump construction	clamped
Diaphragms	Santoprene / PTFE / Buna-N
Check valves	ball checks
Check valve material	PTFE
Valve seats	PVDF / Polypropylene
Valve seat O-rings	Santoprene / PTFE / Buna-N
Pump shaft	316 stainless steel / nitrided carbon steel
Air control valve	self-lubricated or oil-lubricated

c. MANUFACTURERS OR EQUAL

1) Wilden / PSG, or approved equal

5. Compressed Air System

a. Air Compressors:

1) Compressors shall be Oil Lubricated Rotary Screw type, direct driven complete with inlet filter / silencer, discharge check valve, motor, and automatic pressure unloader, providing no load starting.

2) Each compressed air module shall consist of, but not necessarily be limited to, the following: compressor, drive motor, oil system, air system; electronic regulating controls, sound attenuating enclosure, starter cubicle and integrated refrigerant air dryer.

3) Compressors of oil type shall use food grade lubricants if used in direct contact with potable water, such as air scour or integrity testing. The oil lubrication system installed with each module shall be of the differential pressure type consisting of an ASME approved air/oil separator unit including, but not limited to, the following: separator element; oil fill tube; oil level indicator; oil filter of the spin-on type rated at 10 microns; oil cooler; and thermostatic oil cooler bypass valve.

4) Air handling systems installed with each module shall consist of the following: dry type air intake filter rated at 3 microns; pneumatically operated air intake valve/unloader assembly; minimum pressure/check valve; air/oil separation system; discharge air shutoff valve; and motor driven compressor cooling fan.

5) Each air compressor module shall have a compact welded aluminum combination cooler, and a moisture separator/trap including both automatic and manual drain lines.

6) The compressor shall be enclosed by sound attenuated panels designed to limit noise to a maximum of 76 dB(A).

7) Compressors shall use an air-cooled heat exchanger.

8) Provide compressed air equipment from one of the following manufacturers:

   (a) Atlas Copco Series GA

   (b) Atlas Copco Series ZT

   (c) Ingersoll Rand SSR

   (d) Ingersoll Rand 2340L5

   (e) Kaeser

b. Refrigerated Air Dryers:

1) An integral refrigerated dryer shall be furnished with each compressor module. Each dryer shall Include the following pre-cooler/reheater, refrigerant compressor; liquid separator; press-o-stat regulator of condenser fan operation; expansion valve; R22 refrigerant; and pressure dew-point indicator monitored through the control module.

2) Rate air dryers in accordance with the standard rating conditions of the National Fluid Power Association for class H dryers, i.e., 33 to 39 degrees F pressure dewpoint range at the specified minimum discharge pressure and 100 degrees F inlet air with a maximum pressure drop of 5 psi.

3) Under this rating, provide the dryers with a capacity not less than 20 percent above the maximum total free air delivery of each dedicated air compressor,

4) Equip each refrigerated air dryer with a condensing unit, refrigerant evaporator, mechanical separator automatic condensate discharge valve, high discharge air temperature alarm light, and switch for actuating a remote alarm, prefilter, and afterfilter. The air dryer shall be integrated into the compressor design and part of the compressor enclosure.

5) After-filter: Equip dryers with filters to remove oil, carryover, oil aerosols and other foreign matter. Install a prefilter near the dryer inlet and install an afterfilter near the dryer discharge. Design the prefilter for mechanical removal of solid and liquid particles, equipped with a porous bronze filter element with a 5 micron rating. Provide an afterfilter of the coalescing type with a 0.5 micron rating.

6) Acceptable Manufactures: Provide refrigerated air dryers from one of the following manufactures:

a) Atlas Copco

b) Ingersoll Rand

c) Kaeser

c. Air Receivers and Air Surge Tank:

1) The air receiver shall be a vertical tank of all welded, carbon steel construction with semi-ellipsoidal heads and leg supports for mounting on a concrete base. The receiver shall be designed and constructed in accordance with the ASME Code for Unfired Pressure Vessels and shall bear a code stamp.

2) Receivers shall be complete with a pressure transmitter, pressure, gage, pressure relief valve, automatic drain valve, and appurtenances. Receivers and surge tank shall be provided with an internal factory applied epoxy lining.

3) The minimum receiver size is 60 gallons. The minimum pressure rating is 200 psig.

4) The receiver shall be provided with piping connections for an inlet, outlet, drain, pressure relief valve, and cleanout opening.

5) The receiver shall be suitable for installation outdoors on a concrete pad. The manufacturer shall submit calculations documenting compliance of vessel support and recommended anchorage according to Section 01 33 17, Structural Design, Support, and Attachment.

6) Manufacturer

a) Hanson

b) Manchester

c) Brunner

d. Coalescing Filters:

1) Coalescing type oil removal filters shall be provided. The filters shall remove 99.995% of the solids and liquids 0.3 micron or larger in size with replaceable filter elements. Filters and housings shall be sized and selected by the Seller to meet requirements of the system.

2) Supply air filter assemblies shall be provided by the Seller for each compressor. Each assembly shall include the following: filters (3); filter support bracket; outlet ball valve; auto drain valve assemblies (3).

3) The Seller shall provide support brackets with cutouts to the filter housings. The support brackets shall be constructed of Type 304 stainless steel and shall contain labels for the filter housings as well as inlet and outlet sides of the assemblies.

4) Differential pressure indicators shall be provided for the filter assembly.

5) Manufacturer

a) Pall - Filterite

b) Ingersoll Rand

c) Zeks

d) Atlas Copco

e. Particulate or Membrane Air Filters:

1) For air that is in intimate contact with filtered water, hydrophobic membrane particulate filters with an absolute range of 0.02-micron removal shall be provided. The filters shall have replaceable cartridges. Filters and housings shall be sized and selected by the Seller to meet requirements of the system.

2) Air filters with a 1-micron removal rating instrument air and valve actuation.

3) Differential pressure indicators shall be provided for the filter assembly.

4) Manufacturer

a) Pall - Filterite

b) Millipore

c) Parker

d) Zeks

e) Atlas Copco

f. Air Regulator Assembly:

1) Provide an air regulator assembly consisting of inlet valves, pressure relief valve, air muffler, pressure indicator, and outlet valve at the receiver outlet. Provide an installed spare air regulator assembly identical to the above.

2) Air regulators at each air source is acceptable in lieu of a regulator assembly.

3) Individual control air regulator assemblies shall be installed as shown on the Drawings.

4) Air filters shall be furnished complete with housing, support bracket, and removable filter cartridge. The support bracket and associated hardware shall be Type 304 stainless steel. Filters and housings shall be sized and selected by the Seller to meet requirements of the system.

5) Manufacturer

a) SMC

b) Norgren

c) Cashco

g. Fabrication Requirements (Materials of Construction)

1) All mounting hardware shall be Type 304 Stainless Steel.

6. Automatic Self-Cleaning Strainers

a. Strainers shall be of the motorized automatic self-cleaning type. The equipment shall be designed to continuously remove suspended particles from the pumped raw water.

b. Construction

1) Strainer shall be of the self-cleaning type, on-line style. It shall consist of an outer carbon steel with potable grade interior epoxy coating, cast-iron or ductile iron body, an internal 316 stainless steel screen element sealed with an upper and lower seal ring, and a rotating, backwash arm that discharges the backwash water through an outlet nozzle.

2) The use of carbon steel for any wetted strainer surfaces is not acceptable under any circumstance.

3) Backwash cleaning of the screen is accomplished by utilizing the pressure differential between strained water discharge pipe and atmospheric pressure. Backwash cycles can be initiated on an operator adjustable differential pressure set point or on a time cycle. Process flow shall remain completely uninterrupted during the backwash cycle.

4) The Seller is responsible for verifying the membrane system design will have adequate backpressure to achieve the minimum backwash supply pressure as required by the selected strainer manufacturer.

5) The unit shall be designed so that the entire operating assembly, motor, gear reducer, cover, backwash and assembly, screen element, and bearing housing, lift from the filter body as a complete unit.

6) The strainer shall be rated for service at 150 psi @ 100°F and ASME code stamped. Inlet and outlet connection shall be flanged and designed and constructed in accordance with both ANSI and ASME Section VIII, Division 1.

7) An inspection port shall be provided to permit visual inspection of filter element without removing drum.

8) A drain opening shall be provided in the lower part of the strainer body to permit drainage without removing drum.

9) The straining element shall be 316 stainless steel with 300 micron screen size. The Seller may require a smaller retention efficiency of the strainer for protection of downstream equipment. Wedge wire or slotted screens are not acceptable.

10) If the raw water pressure is not sufficient to backwash the strainer, the strainer shall be modified to use filtered water for backwashing of the strainer. The design and operating capacity of the membrane system shall be increased by 1 percent to account for strainer backwash water losses.

11) The motor shaft shall be sealed by a drip-proof mechanical seal. The use of packing or any other sealing arrangement is not acceptable under any circumstance.

c. Motor:

1) Motor shall operate on 460 VAC, 3 PH, 60 Hz power supply.

2) Motor shall be TEFC-type with worm gear reducer.

d. Spare Parts:

1) The following spare parts shall be furnished:

2) One set of replacement filter media for strainer.

e. Manufacturers:

1) Amiad

2) Fluid Engineering.

3) Kinney.

4) Forsta

7. Containerized membrane system control system

a. A master control panel in a NEMA 4 painted mild steel wall mounted enclosure shall be furnished by the manufacturer of the ultrafilter system for each containerized unit provided. The control panel shall be wired to accept a 120 volt power feed. The filter control system shall be manufactured in a UL508A/ 698 certified panel shop.

b. The control panel shall be capable of communicating with the main Water Treatment Plant's GE/Emerson PLC system through a suitable protocol converter. All process data, alarms, operator controls, and process setpoints shall be made available to be read and written by either the Alder Creek Main PLC or the Alder Creek SCADA system.

c. A master control panel in a NEMA 4 painted mild steel enclosure shall be furnished to provide communication between each supplied containerized unit and the neutralization system.

d. The control panel shall incorporate an Allen Bradley CompactLogix Programmable Logic Controller (PLC) for accomplishing the control logic. The PLC shall be connected to the plant network via an Ethernet communication link. Communication protocol shall be Ethernet I/P. The panel shall have the capability to be accessed remotely via the plant Ethernet network through an integrated VPN connection.

e. A 19" Allen Bradley AdvanTech Panel PC with Factory Talk View ME color touchscreen graphical operator interface shall be provided in the PLC panel for viewing system status and entering operator selected functions and operating variables.

f. The PLC shall be supplied with a minimum of 20% spare I/O that is to be prewired out to the terminal strip for future for plant integration. The PLC shall incorporate the proper quantities of the following components to make a complete operational system.

g. I/O can be from Allen Bradley, Numatics or Wago as per the vendor's preference.

h. The control panel shall be provided with all necessary fuses, relays, circuit breakers, power distribution blocks, 24 vdc power supplies, and Ethernet VPN router to make a complete and operational system.

i. All wiring shall be brought to a terminal strip for interface with external devices. Terminals shall be cage type with screw terminal connection. No more than two wires shall be connected to one terminal. Multi-level terminals are acceptable. Terminals shall be manufactured by Phoenix Contact or equivalent.

j. The control system shall allow for automatic control of all functions of the ultrafilter process. There shall also be manual control of all equipment via the operator interface.

k. The control system shall be designed to allow for integration with the existing equipment onsite and shall have the ability to interface with the existing level instrumentation and feed water supply pumps.

l. The control panel shall be provided with a properly sized control power transformer. This transformer is to have both primary legs and one secondary leg fused.

m. Local distributed I/O panels or NEMA 4 integrated blocks (without panel) shall be provided for the ultrafiltration trains and CIP skid. The panels/blocks shall be NEMA 4 painted mild steel and will be skid mounted. The control panels will house Allen Bradley Flex I/O or Emerson Numatics integrated racks to interface back to the master control panel. The panels will be supplied with a manifold system to distribute the required service air to the appropriate skid mounted automated valves. This manifold shall be provided with the proper quantities of solenoid valves rated for control of the skid mounted control valves. A combination regulator / filter shall be provided within the control panel to ensure that clean air is supplied to the manifold at the proper pressure.

8. Valves

a. Automated Butterfly Valves

1) For valves that are in locations where reliability is a consideration, or for automated valves that automatically modulate for flow control or actuate with periodic backwashing or other Seller- designated terminology describing the reversal of periodic flow through the membrane system that occur at design intervals of less than 2 hours, the Seller will provide resilient seated valves.

2) Valves shall provide ANSI Class VI shutoff

3) Materials of Construction

a) Body: 316 Stainless Steel

b) Disc: 316 Stainless Steel

c) Shaft: 17-4PH SS or 316 Stainless Steel

d) Pins: 316 Stainless Steel

e) Seats and Seals:

(a) Water Service-EPDM

f) Compressed Air - Teflon - PTFE

g) Process Air - Fluorocarbon (Viton, RTFE, or Fluorinated Hydrocarbon Elastomer - ASTM D1418) rated for 300 degrees minimum or higher if required by process.

h) Backing Ring: Stainless Steel

i) Bushing / Bearings: EPDM or RTFE

j) Packing: PTFE

4) Throttling or rate of flow control valves may be of the butterfly type. The Seller shall submit calculations to verify that valve cavitation does not occur over the operating range of the valve.

5) Bolting Pattern - Lugged valves shall be used.

6) Acceptable manufacturers:

a) Keystone - K-Loc High Performance Butterfly Valve - F362

b) DeZurik- High Performance Butterfly Valve

c) Flowseal (John Crane) - Soft Seat High Performance Butterfly Valve

d) Jamesbury - Wafersphere - High Performance Butterfly Valve

e) Fisher - PosiSeal

f) Masoneilon Dresser - High Performance Butterfly Val

g) Bray, 31 Series

b. General Service

1) Service Conditions - General Service – less than 30 inches in diameter:

a) One Piece Body

(a) Unless otherwise specified or approved by the Engineer, all valves shall be lugged style.

(b) Body: 1 piece cast iron or ductile iron body

(c) Disc: 316 Stainless Steel

(d) Stem: 316 or 416 Stainless Steel

(e) Bushings: PTFE

(f) Pins: Stainless Steel

(g) Seats and Seals:

(i) Water Service – EPDM, Viton

(ii) Compressed Air - Teflon – PTFE, Viton

(iii) Process Air - Fluorocarbon (Viton, RTFE, or Fluorinated Hydrocarbon Elastomer - ASTM D1418) rated for 350 degrees minimum or higher if required by process.

(h) All valves shall be furnished with two upper and one lower bearings/bushings of PTFE material. Shaft seals shall be provided to prevent leakage and to protect bearings from internal or external corrosion.

(i) Valve seats shall be of the reinforced resilient type and shall be field replaceable. Seats shall also act as a body liner to prevent flow from contacting the body casting. Seats shall have flange sealing to provide a positive seal without use of flange gaskets.

(j) Valves shall have a dead-end shutoff differential pressure rating equal to or greater than 50 psig (with flanges installed on each valve face). Valves to be suitable for and rated for full vacuum service.

(k) Body wall shall exceed requirement for AWWA C504 Class 150 standard.

(l) The disc shall be secured to the shaft using at least two Type 316 stainless steel pins or self- locking setscrews.

(m) Valves shall have the ability to be installed with the disc in the closed position.

(n) Valves shall be suitable for process air or vacuum service.

(o) Factory Testing: Test shall be conducted on each valve in accordance with manufacturer's Quality Control procedures.

(p) Acceptable Manufacturer

(i) DeZurik –Type BRS.

(ii) Centerline Model 200/225

(iii) Keystone 602.

(iv) Bray Series 70

(v) Bray Sries 92

b) Two Piece Body

(a) Butterfly valves 2-inch to 12-inch shall be flange, lugged style, 150 psi class butterfly valves using a 2-piece cast iron body and 316 stainless steel paddle.

(b) Valve seats shall be of the reinforced resilient type and shall be field replaceable. Seats shall have flange sealing to provide a positive seal without use of flange gaskets.

(c) Valves shall be 316 stainless steel. Shaft diameter shall be suitable for 150 psi service (2 to 12 inch valves).

(d) Discs shall be 316 stainless steel and use a thin profile disk. The disc-to-shaft connections shall be Type 316 stainless steel.

(e) Pins, shaft, and disc of all valves shall be individually machined and completely interchangeable.

(f) Valves shall be compatible with the fluids in contact with the valve at a maximum temperature of 110°F.

(g) Factory Testing: Test shall be conducted on each valve in accordance with manufacturer's Quality Control procedures.

(h) Acceptable Manufacturer

(i) Keystone – Resilient Seated Valve Type 920

(ii) Or-Equal will not be accepted (use 1 piece body valve).

c. Type 3 Butterfly Valve

1) Service Conditions - Backwash chlorine solution and other concentrated chemical or cleaning solution in contact with the valve.

2) Valves 1" and above in contact with chlorine solution above 50 ppm or other cleaning solution where stainless steel is not appropriate for contact shall use a flanged, lugged style, 150 psi butterfly valves using cast iron body and Teflon coated disc with a replaceable valve seat.

3) Acceptable manufacturers and models.

a) Keystone - Resilient Seated Valve Types 920

b) DeZurik - Resilient Seated Valve Type BGS

c) Bray Series 22/23

d. Stainless Steel Isolation Ball Valves

1) Stainless steel isolation ball valves are required for pressure gauges, pump casing drains and other locations as shown on the Drawings.

2) The Ball Valve shall consist of a type 316 stainless steel body, a polished stainless steel ball and a Teflon seat. The valve shall be equipped with a lever type handle. The valve shall have a minimum working pressure of 800 psi WOG (Water-Oil-Gas)

3) Ball valve of 2 inches or less shall have NPT threads, Ball valves used in caustic service or in applications larger than 2-inches shall have flanged end connections.

4) Provide double acting pneumatic actuators using the same manufacturer of the valve, if required for valves less than 1-inch in size.

5) Acceptable Manufacturers

a) Apollo Type 76

b) Watts Type S-8100 and S-8000

c) Whitey (Swagelok) Series 40

d) Parker H-series

e) Flow-Tek

f) John Guest

e. PVC Plastic Ball Valves

1) PVC or CPVC Plastic Ball valves shall use a True Union Design.

2) The elastomer shall be compatible with the chemical service.

3) Acceptable Manufacturers·

a) Spears

b) Nibco - Chemtrol

c) Asahi -Duo Block

f. Brass Ball Valves

1) Description: Three-piece brass ball valve, in sizes up to 2-inches

2) Operating Conditions: Install where noted or shown

3) Design Requirements:

4) Maximum Operating Pressure: 600 psig

5) Rated Operating Temperature: 200°F

6) End Connections: 600 WOG, conforming to MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends

7) Actuator: Manual, lever type

8) Materials:

a) Body: Brass, ASTM B30 - Standard Specification for Copper Alloys in Ingot Form

b) Ball: Hard Chrome plated brass ball

c) Stem: Brass, ASTM B30 - Standard Specification for Copper Alloys in Ingot Form

d) Seats: Glass reinforced Durafil

e) Seals: PTFE

f) Bolting: Type 316 stainless steel

9) Manufacturers:

a) Watts Series B-6000

b) Apollo

g. V-Notch Ball Valves

1) Ball valves suitable for throttling are required for general water service as shown on the Drawings,

2) Materials:

a) Body: 316 Stainless Steel

b) Ball: 316 Stainless Steel

c) Shaft (Stem): 17-4 PH or 316 stainless steel.

d) Actuator: The ball valves shall have provisions for mounting an actuator, positioner, and valve position feedback module.

3) Acceptable Manufacturers

a) Worcester Controls V-Seat

b) DeZurik VPB

c) Fisher Vee-Ball

h. Type 1 Check Valve – Globe Style

1) Size and Extent: Membrane Raw Water Pump Discharge, as shown on Drawings.

2) Working Pressure: 150 psi

3) Silent operation check valves. The operation of the valve shall not be affected by the position in the pipeline. The valve disk shall be concave to the flow in the pipeline and guided by center shaft. The globe style check valve shall have an open area equal to or greater than the pipe diameter. Valves 10- inch and smaller shall be capable of mounting directly to a butterfly valve.

4) Check valve shall be spring loaded, normally closed by means of a heavy-duty center guided, stainless steel springs. Flow from the pumps shall cause the valve to open and upon pump shut down, the spring will shut the valve before reverse flow starts and at a point of zero velocity of non-slam closure.

5) Valve body shall be cast or ductile iron. Valve seat and disk will be Bronze. Seating shall be resilient and watertight. The sealing element shall be EPDM or Viton (Buna-N is not acceptable) and provide zero leakage. The torsion spring shall be stainless steel. All component parts shall be field-replaceable.

6) Manufacturers:

a) Valmatic, Type 1800

b) Apco, Model 600

c) Golden Anderson, Model 280 or 288

i. Double Disc or Double Door Style Check Valves

1) Service Conditions: Pump Discharges

2) Body: 316 Stainless Steel if in contact with crp

3) Body: Ductile iron if not in contact with crp

4) Seat and Bushings: 316 Stainless Steel

5) Spring and Screws: 316 Stainless Steel

6) Seals:

a) Water: Viton, EPDM (Buna-N is not acceptable)

b) Process Air: Fluorocarbon (Viton, RTFE, or Fluorinated Hydrocarbon Elastomer ASTM D1418) rated for 350 degrees minimum or higher if required by process.

7) Manufacturers:

a) Valmatic, Model Dual Disc

b) Centerline, Model 800

c) APCO, Model 900

j. Check Valve

1) Service: as indicated on Drawings

2) Style: Plastic Ball Check Valve

3) Manufacturers

a) Nibco - Chemtrol

b) Asahi

c) Spears

k. Check Valve

1) Service: Instrumentation and Sample Lines

2) Style: Diaphragm Check Viton Elastomer

3) Material: PVC

4) Manufacturer

a) Plastomatic

l. Check Valve

1) Service: Vacuum Line

2) Style: Swing Check, Threaded End Connections

3) Material: Stainless Steel Type 316

4) Manufacturer

a) Truline

b) Sure-Flow

m. Check Valve

1) Service: Water/Air, I-inch

2) Style: Poppet Check, Tube or NPT fittings

3) Material: Stainless Steel Type 316

4) Manufacturer

5) Swagelok C Series

6) Check Valve

7) Service: Water/Air, I-inch

8) Style: Poppet Check, Tube or NPT fitting

9) Material: Brass Type 360/316

10) Manufacturer

a) Swagelok C Series

9. Valve Actuators

a. Pneumatic Valve Actuator Operators

1) Service Conditions: General Service Quarter Turn Butterfly and Ball Valves

2) Cylinder actuators shall have working mechanism fully enclosed, and shall be sized for operation using 80 psig pneumatic supply. Cylinder actuators shall have pilot valves where indicated on the drawings. Units shall have adjustable end position stops. All valve actuators shall include proximity type limit switches. Limit switches shall be programmed to register the open and closed positions. Tubing connecting valve mounted solenoids to the actuator shall be type 316 stainless steel.

3) Pneumatic actuators shall be capable of producing a minimum of 1.5 times the required operating torque.

4) Materials of Construction:

a) Actuator Body and End Caps: Aluminum

b) Piston: Aluminum

c) Seals: Nitrile or EPDM

d) Pinion Shaft: Stainless Steel

5) Special Valve Actuator Finish: The exterior finish of the valve actuation shall be provided with a special corrosion resistant finish to resist unanticipated or accidental spray of acid, base or oxidants. Acceptable finishes include:

a) epoxy coating

b) electro-less nickel. Anodized aluminum shall not be used for the exterior finish of the valve actuator.

6) Provide valve disc position indicator on operator.

7) Acceptable Manufacturers

a) Keystone 1Morin Type MRP

b) DeZurik - Compak II

c) John Crane - Centerline Series 33000/38000

d) Jamesbury - Type ST or SP

e) EL-O-Matic

f) Bray Series 70

b. Electric Valve Actuator:

1) General: Electric motor operators shall be furnished complete with motor, extension bonnet, torque tube, position indicator, integral reversing starter, and controls specified herein. All components shall be entirely suitable for outdoor service.

2) Electric motor operators shall conform to AWWA C504, except as specified herein.

3) Electric motor operators shall be capable of producing a minimum of 1.5 times the required operating torque.

4) Voltage: 110 VAC, 60 Hz, 1 phase. Provide for 110 volt control power or 24VDC, 4-20 mA control signal as required and as shown on drawings.

5) Enclosure: NEMA 6 (IP 68)

a) Non-intrusive entry with no mechanical parts penetrating the control enclosure of the actuator.

b) Double O-ring seals

c) Separately sealed terminal compartment.

6) Mounting Hardware: Provide extension bonnet, torque tube and bonnet supported floor stand for mounting each electric operator on valve with shaft vertical in horizontal pipeline.

7) Controls:

a) Provide dry contacts for remote indication of:

b) Ready to operate-control voltage available, fuses and overloads intact

c) Valve full open

d) Valve full closed

8) Display: Provide LCD Display of valve position, calibration and diagnostics.

9) Starter: Provide reversing contactor III NEMA 4 enclosure integrally mounted on operator.

10) Thermal Protection: Provide winding thermal protection.

11) A feedback position transmitter shall be supplied with each modulating service valve.

12) Provide valve disc position indicator on operator

13) Manufacturer:

a) Rotork IQ

b) Limitorque MX

10. Flexible connections shall be provided at piping terminations as shown on the Drawings. Use materials approved for potable water. Buna-N elastomers are not acceptable. The stainless steel expansion retaining rings shall be supplied with stainless steel control rod assemblies.

a. Manufacturers

1) Red Valve Type J-1

2) Proco

3) Mercer Rubber

4) Uniroyal

11. NEUTRALIZATION SYSTEM

a. Neutralization Container: One neutralization system shall be provided that is sufficiently sized for neutralization of chemicals used in the maintenance clean and clean-in-place processes. The container shall include a neutralization pump, tank, chemical metering pumps, pH transmitter, electrical junction box, and all valves and piping necessary for operation. The system components shall be mounted in either a shipping container or skid mounted.

1) Neutralization Recirculation Pump: The neutralization recirculation pump shall be a vertical multi-stage centrifugal pump with a stainless steel housing impeller and shaft as manufactured by Goulds, Grundfos, or equal. The pump shall be supplied with pressure gauges and valves as required.

2) Neutralization Chemical Metering Pumps: All necessary metering pumps shall be supplied for feeding liquid sodium bisulfite and sodium hydroxide from chemical totes into the neutralization skid recirculation piping. The pumps shall be solenoid or motor driven, positive displacement pumps as manufactured by Prominent. Pumps shall be supplied with heads, diaphragms, check valves, foot-valves and isolation valves all compatible with the solution being pumped. The pumps shall be controlled by the UF electrical panel. A shelf shall be supplied on this skid to support the metering pumps above the chemical storage totes (by others).

3) Neutralization Tank: The neutralization tank shall be a closed top, white translucent HDPE tank of sufficient size to contain the chemical waste from any chemically enhanced backwashes, maintenance cleans, or clean-in-place cycles, with sufficient volume to capture and neutralize all chemical waste. The tank shall be supplied with inlet, outlet, and overflow connections. Tank shall have level transmitter and drain connections.

b. In lieu of a containerized or skid mounted neutralization system, a neutralization system located inside the containerized unit will be also be sufficient with all components listed in 11.1.a. Those system components can also be used for other system uses when not performing neutralization of CIP and other waste streams.

2.04 SPARE PARTS

A. Spare Parts for Membrane Filtration Equipment shall be in accordance with Section 01 75 00, Spare Parts.

2.05 SPECIAL TOOLS

A. The Seller shall provide special tools required for disassembly and reassembly or analysis of membrane modules.

B. The Seller shall provide all lifting assemblies, hooks, straps, cables and accessories for removing the membrane modules from the rack assemblies.

2.06 LUBRICANTS

A. Refer to Section 01 73 00, Installation, Operation and Maintenance Manuals for Safety Data Sheet submittal requirements.

PART 3 -- EXECUTION

3.01 INSTALLATION

A. Refer to Section 01 62 00, Installation of Membrane Equipment.

3.02 COMMISSIONING

A. The Seller is responsible for the complete commissioning of the MF system after the Notice of Completed Installation.

B. Refer to Section 01 66 00, Commissioning of Membrane Equipment.

3.03 TRAINING

A. Refer to Section 01 73 10, Training of Operations and Maintenance Personnel.

3.04 ACCEPTANCE TESTING

A. Refer to Section 01 67 00, Acceptance Testing of Membrane Equipment.

3.05 OPERATIONAL ASSISTANCE

A. Refer to Section 01 68 00, Operational Assistance.

END OF SECTION