

SECTION 13440INSTRUMENTATION AND PROCESS CONTROLPART 1 - GENERAL1.1 DESCRIPTION

A. General Requirements and Definitions:

1. Provide all labor, materials, equipment, operations, methods and procedures as indicated in the Contract Documents, together with all items necessary for or incidental to the completion of the work.
2. All systems indicated in the Contract Documents shall mean all necessary supervision, labor, equipment and materials required to provide complete, properly functioning systems.
3. All systems shall be adjusted, tested, inspected and turned over to the Owner in perfect working order.
4. The words "provide", "supply", "supply and install", "install", "furnish" or "furnish and install" shall mean a complete and properly functioning installation performed by the Contractor.
5. Refer to Electrical and Process Drawings to coordinate material and equipment locations.

B. Work Included:

1. New Instrumentation:

- a. Furnish and install the instrumentation as shown on the Instrumentation Drawings and listed in the Instrumentation Schedule at the end of this Section.
- b. Provide a new Hypochlorite Fill Panel (HFP) and a new Bisulfite Fill Panel (BFP) along with exterior horn and strobe light to be located adjacent to each chemical fill station.

2. Equipment Control:

- a. Provide equipment control or connection to control, status indication and alarm annunciation of equipment as shown in the Instrumentation Drawings.
- b. Provide a new Hypochlorite Chemical Pump VFD panel. Eight (8) variable speed drives will be provided by the pump manufacturer as described in Section 11235. New panel, provided under this Division, shall house all eight (8) drives and provide front mounted HIM's and elapsed time meters for each.
- c. Local control stations will be provided under Division 16.

3. Control Panels:

- a. Furnish and install new PLC-based Control Panels as described under Subsection 2.2. Programming of the PLC and operator terminal in each control panel will be provided by the Owner under a separate contract.

- b. Furnish and install a PLC-based control system for the Temporary Dechlorination System as described in Division 11 and under Specification Section 01010.
 - c. All control panel hardware shall be pre-tested prior to being received by the Engineer for programming and commissioning.
 - d. Each of the three (3) PLC-based panels shall be delivered to the Engineer for download of programs to PLC and Operator Terminal, and for subsequent factory acceptance tests. Upon completion of these tests, the instrumentation supplier shall pick-up and receive control panels and deliver to the jobsite for installation. Instrumentation supplier shall be responsible for correcting any noted deficiencies uncovered during factory acceptance tests at no additional cost to the Owner or Engineer.
4. SCADA System:
- a. Programming and configuration of the existing SCADA system will be provided by the Owner.
5. Network:
- a. Provide an Ethernet/DH+ network consisting of industrial Ethernet switches and fiber optic, wireless and Category 5 (CAT5) media for communications. A network diagram is shown on the Instrumentation Drawings. Conduits and CAT5 cable are provided under Division 16. All other network equipment is described in Section 13445.
 - b. Provide a new Ethernet/DH+ Gateway including a Allen Bradley Control Logix Chassis and power supply with one (1) Ethernet communication module and one (1) dual DH+ communication module in a new communication panel (COM-1). The gateway will be configured by the Owner.
6. Miscellaneous.
- a. Furnish and install all transducers, converters, terminals, transformers, interposing or pilot relays (for both new and existing equipment), signal transmitters, signal splitters/boosters, power supplies, power supply connections and other miscellaneous instrumentation required to make a complete system.
 - b. Furnish and install all vendor or manufacturer wires and appurtenances between primary instruments and the transmitters, receiving instruments or destination terminals. All methods, materials and supplies will meet the requirements of Division 16.
 - c. Furnish and install all sleeves, bolts, inserts, equipment mounting hardware and other items to be attached to or imbedded in concrete and masonry work.
7. Demolition.
- a. Remove and/or relocate existing equipment as indicated on the Drawings.
 - b. Deliver items not reused to Owner.
8. Coordination:
- a. Coordinate electrical requirements between the control panel and instrumentation provided by the systems integrator and the electrical

- subcontractor. The System Integrator shall provide point to point wiring diagrams for the control panels.
- b. As noted above, programming of the PLC and Operator Terminal shall be by Engineer. System integrator, under this Division, shall be responsible for reviewing and understanding the control loop descriptions for equipment being provided under this contract. A copy of the Control Loop Descriptions is provided in Appendix A of these documents.
- C. Related Work Specified Elsewhere:
1. Coordination is specified in Division 1.
 2. Earthwork is specified in Division 2.
 3. Control Valve Actuator is specified in Section 15117.
 4. Chemical Pump Controls are specified in Section 11235.
 5. Panels/enclosures required by Section 13440 and the instrumentation drawings shall be furnished in accordance with Section 16160.
 6. Panel control components, including switches, lights, relays, etc. not specifically detailed in Section 13440 are to be provided in accordance with Section 16900.
 7. Power distribution devices and other electrical work are specified in Division 16.
- D. Related Work by Others under this Contract:
1. Conduit and wiring between panels (except for vender furnished wiring).
 2. Local control stations (including E-stops, local hand switches and local indicating lights) and equipment control panels (i.e. MCCs, VFDs, except as noted within) as indicated on Electrical Drawings.
- E. Tests and Procedures Prior to Start-up
1. The Contractor shall coordinate the work of the system manufacturer's service personnel as necessary. This shall include the installation, interconnection, testing, and calibration of the instruments, and the scheduling of the manufacturer's service personnel.
 2. The supervisory services of a factory-trained service engineer/technician who is specifically trained on the type of equipment herein specified, shall be provided during construction to assist the Contractor in the location of sleeves; methods of installing conduit and special cable; mounting, piping, and wiring of one of each type of device, and the methods of protecting all of the equipment prior to placing it into service. Upon completion of the installation, the services a trained service engineer/technician calibration and startup the equipment in the presence of the ENGINEER, and provide instruction and training for the operating personnel. A sufficient number of service days shall be provided to place the system in satisfactory operation. One additional service call of one 8-hour working day (not including travel time) shall be included for use upon demand of the Owner within the first year's operation.
- F. Demonstration of Instrumentation System
1. Demonstrate to the Engineer that each piece of equipment is satisfactorily installed, configured, calibrated and functioning. Laboratory tests shall be preformed to confirm the calibration of analyzing type instruments. Secondary

measurement devices shall be used to confirm measurement type instruments such as pressure, temperature and level.

2. If any system or piece of equipment within a system fails to function properly, rectify such defects or inadequacies and make a final demonstration as directed by the Engineer.
3. Provide the services of authorized manufacturers' representatives to instruct the Owner's representatives in the proper operation of each instrument installed under this Contract.
4. Pay all charges or fees, including the cost of any special test equipment, factory engineers, etc., necessary for the proper performance of the specified tests, demonstrations and instructions.
5. All demonstrations and instructions referred to shall be scheduled at the convenience of the Engineer and the Owner and in no case shall be scheduled without at least seventy- two (72) hours written notice.

G. Identification

1. All panels, instruments, and control devices shall have identifying nameplates of engraved Lamicoid.

H. Removals, Relocations and Rearrangements.

1. Examine the existing site for the work of all trades, which will influence the cost of the work under Division 13. This work shall include removals, relocations and rearrangements relating to the work of all trades which may interfere with, disturb or complicate the performance of the work under Division 13; and relating to the work involving systems, equipment and related service lines which shall continue to be utilized as part of the finished project.
2. Provide in the bid a sufficient amount to include all removals, relocations, rearrangements and reconnections herein specified, necessary or required to provide approved operation and coordination of the combined new and existing systems and equipment.

1.2 QUALITY ASSURANCE

- A. All materials provided under this Contract shall be equal or better in quality, appearance and performance to that specified herein and shall be subject to the approval of the Engineer. Verify the availability of all materials proposed to be used in the execution of the work prior to submitting same for the Engineer's approval. The discontinuance of production of any material or product after approval has been granted shall not relieve the Contractor from furnishing an Engineer approved alternate of comparable quality and design without additional cost.
- B. Materials and equipment furnished under this Contract shall be standard products of manufacturers regularly engaged in manufacture of such products and shall be manufacturer's latest standard design that complies with Specification requirements. Products shall essentially duplicate material and equipment that have been in satisfactory local use at least three years.
- C. The Systems Integrator shall have supplied comparable systems to those specified herein and shall maintain engineering and service departments capable of designing and maintaining these systems. Provide, for a period of twelve (12) months from

the date of final acceptance of the work, all necessary supervision, labor, materials, and equipment, in order to correct any defects in any system due to faulty materials, equipment, installation methods, or workmanship and consequent damage resulting from such defects. This work shall be scheduled during normal working hours and at the convenience of the Owner.

D. Instrumentation Supplier:

1. The Contractor's attention is directed to the fact that the instrumentation is an integrated system and as such, shall be furnished by one supplier, who shall provide all of the equipment and appurtenances regardless of manufacture, and be responsible to the Contractor for satisfactory operation of the system.
2. The exception shall be where instrumentation and control packages are furnished by respective equipment manufacturers as required in Division 11. All necessary provisions will be made to ensure a proper interface between the main process instrumentation and control packages specified within this section and those provided under Division 11.

E. All completed instrument and control panels furnished shall be UL 508 listed. All control panel devices shall meet the requirements of specification section 16160 and 16900.

F. Acceptable Suppliers:

1. AEC, Freeport, ME
2. R.E. Erickson, Walpole, MA
3. Electrical Installations, Inc, Center Harbor, NH
4. Or equivalent having a minimum of 5 years experience in supplying comparable systems.

1.3 SUBMITTALS TO THE ENGINEER

A. Shop Drawings and Samples:

1. Submit Shop Drawings in accordance with General Conditions Section 01340 and as indicated herein.
2. Shop Drawings shall be thoroughly checked by the Contractor for compliance with the Contract Documents. Verify that all equipment and materials he proposed to be furnished will fit into available space and maintain specified clearances, and that all equipment is compatible with the system operation. The submittal of any Shop Drawing implies that the Contractor has reviewed this Shop Drawing and that the above requirements have been met.
3. Shop Drawings Shall Consist Of:
 - a. Project name and location
 - b. Contractor's name
 - c. Index Sheet - Listing the equipment being submitted utilizing equipment designations, or symbols, indicated on the Contract Documents together with the proposed manufacturer, style/ type and catalog number.
 - d. Manufacturer's scale or dimensioned drawings along with standard catalog number.
 - e. Equipment ratings, service clearances and configuration.

- f. Listing of accessories to be furnished
 - g. Single-line and schematic diagrams of all required piping and electrical work.
- 4. All material shall be contained in one submission; partial submissions will not be accepted.
 - 5. Submissions shall be in the form of individual binders, of the quantity indicated in the General Conditions. Each equipment type shall be separated by index tabs with typewritten titles.
 - 6. Provide samples of instruments, devices, graphics, etc., within ten (10) days upon receipt of request from the Engineer.
- B. Maintain properly documented and witnessed test and checkout reports and submit these to the Engineer. No form of energy shall be applied to any part of the instrumentation system prior to receipt by the Engineer, from the contractor, of the supplier's certified statement of approval of the installation and containing his authorization to energize the system, except that the supplier's serviceman may do so for the purpose of check-out as described herein.
 - C. Upon completion of the work and before request for final payment, deliver to the Engineer six (6) bound sets of full and complete directions pertaining to the operation and maintenance of all equipment and systems installed under this Contract. These directions shall be typewritten on 8-1/2" x 11" sheets neatly bound with index tabs, and shall be accompanied by plans, diagrams, etc., of the work installed, parts lists, etc., necessary for the guidance of the Owner in operating, altering or repairing the installation. In addition to the foregoing, furnish the Engineer with a written statement from the Owner indicating that he is satisfied with the operating instructions given.
 - D. Provide the Owner with a list of local service departments of duly authorized distributors of materials and equipment of the type installed, which will stock the manufacturer's standard parts, etc.
 - E. At the completion of the installation, provide six (6) copies of reproducible Record Drawings on sheets no less than 11"x17", indicating the final configuration of all systems as they were installed. Symbols, equipment designations, etc., shall be consistent with the Contract Documents. Provide exact locations of all work which has been concealed in concrete, masonry or underground.
 - F. CADD generated wiring diagrams and schematics shall be provided showing the interface between field hardware and I/O, showing specific wiring for each analog loop, electrical drive schematic and control panel wiring.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Coordinate material and equipment delivery with the project schedule. Notify the Engineer immediately, in writing, if material or equipment delivery will adversely affect the project schedule, include documentation from equipment suppliers indicating the revised delivery dates and the reason for the delay.
- B. Coordinate delivery of equipment directly to other vendors where instrumentation supplied under this section has to be installed in panels supplied under other specification sections.

- C. Exercise care during loading, transporting, unloading and handling of materials to prevent damage.
- D. Check for defective or damaged materials, and for incomplete equipment shipments within seven (7) days after equipment delivery to the project site.
- E. Store materials and equipment on the construction site in enclosures or under protective covering in order to assure that materials and equipment are kept undamaged, clean and dry.
- F. Replace or repair, to the satisfaction of the Engineer, all materials and equipment that are defective or that have been damaged during installation, at no additional cost to the Owner.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General

1. All of the equipment shall be the manufacturer's latest proven design. Specifications and drawings call attention to certain features, but do not purport to cover all details entering into the design of the instrumentation system. The completed system and the equipment furnished by the contractor shall be compatible with the functions required.
2. Components shall be finished to the manufacturer's standard for the service intended unless otherwise indicated in the specifications or on the drawings.
3. All electrical components of the system shall operate on 120-volt, single-phase, 60-Hertz current, except as otherwise noted in the specifications. Power shall be supplied from local electrical distribution panels with breakers for each circuit.
4. All controls for electrically operated or motor-driven equipment (including electrically actuated valves, small pumps and chemical feed equipment, etc.) shall be completed, including all necessary auxiliary relays, so as to require only wiring and connections to the equipment control circuit. All contacts for control of motor-operated or electrically operated equipment shall be rated not less than 10 amperes on 120 volts unless otherwise specified herein.
5. All motor-operated or electrically operated equipment shall have separate 120-volt control circuits.
6. Control wiring for externally operated motors shall be No. 12 AWG, minimum and in accordance with Section 16160.
7. All necessary fuses or switches required by the instrumentation manufacturer for his equipment requiring a 120V power supply shall have a labeled ON-OFF breaker switch. Refer to Electrical Drawing for instruments requiring power from the control panel.
8. Control panels shall be furnished and installed in accordance with Section 16160, and as indicated on the Drawings and in the Specifications. All transducers, converters, terminals, transformers, relays, signal transmitters, power supply connections and other miscellaneous equipment required to

- make a complete system in accordance with the intent of this Section shall be furnished and installed in the control panels.
9. Panel components including switches, relays, instrumentation, etc. supplied by the various process equipment manufacturers, but indicated to be installed within panels furnished by the Instrumentation Supplier, shall be furnished to the Instrumentation Supplier for incorporation into his panels. Instrumentation Supplier shall install these items within his panel and shall produce a complete, functional, pre-wired system for installation requiring only external power and instrumentation connections. The General Contractor shall coordinate this requirement and shall ensure that equipment manufacturers provide all necessary installation instructions and requirements to the Instrumentation Supplier.
 10. Provide all required piping, connections, hangers, supports, etc. required for the Instrumentation and Process Control Systems and equipment.
 11. The drawings and specifications indicate the energy sources that will be provided. Any other devices necessary to obtain proper operation of the instrument system from these energy sources shall be furnished with the instrumentation.
 12. Each alarm-actuating circuit shall contain a simple means for disconnecting the alarm function during normal maintenance or standby of the equipment, which actuates the alarm.
 13. All equipment mounted outdoors that requires heating during winter conditions shall be provided with heaters, thermostats, enclosures and associated accessories as necessary in accordance with Section 16160.
 14. Instrumentation equipment supplier shall provide and install all "vendor furnished cable" between instrumentation system equipment components, unless otherwise indicated. Conduit shall be provided under Division 16 and is shown on the Electrical Drawings.
 15. Transient voltage protection shall be provided for analog instrumentation, field sensor devices, field loop transmitter devices, PLC analog inputs, PLC to PLC communication interfaces, VFD/RVSS interfaces, and all other locations susceptible to lightning and transient over voltage. The surge arrester shall be adequate for the intended function and shall be by a nationally recognized manufacturer with a minimum of 3-years experience in the manufacturer of such devices. The technology shall be silicon avalanche diode technology. MOV technology shall not be acceptable. Submit selected model and backup information for review and acceptance by the Engineer.
 16. Provide sample conditioning equipment for all analyzers as required by the manufacturer for the intended service. This includes but is not limited to filters, basket strainers, pressure reducing valve, flow control valves, rotameter and pressure gauges.
 17. Relays integral to instrumentation equipment shall be Form C and rated 5A at 120 VAC.
 18. Identification:

- a. All panels, and panel mounted instruments and control devices shall have identifying nameplates in accordance with Section 16160. Equal quality nameplates shall be attached to all field-installed units.
 - b. Each field transmitter shall have an attached manufactures tag with the Manufactures name, model number, serial number, power requirements, and scaled range of the instrument.
19. Provide suitable lamacoid labels for each process measurement element and transmitter. Label will identifying each media being measured, type and units of measurement and indicating transmitter/element ID No., for example:

Sodium Hypochlorite Pump No. 1 (GPM)
FE/FIT-719A

- B. Instrumentation Equipment (Refer to Instrumentation Schedule at the end of this Section)
1. Magnetic Flow Meters and Indicating Transmitters: FE/FIT 719A thru 719F and FE/FIT 727A thru 727F.
 - a. Provide electromagnetic type flow meters in locations as indicated on the Drawings. Material of construction shall be suitable for the use with sodium hypochlorite (15%) and sodium bisulfite (38%) at a maximum pressure of 30 psi and temperature range of 40-90°F.
 - b. Power: 120V AC, 60 Hz single phase. The indicating transmitter shall provide power to the flow tube. The manufacturer shall provide a suitable length of vendor furnished cable to reach from the flow tube to the indicating transmitter.
 - c. Electrode: Obstructionless design with self cleaning, platinum electrodes suitable for the intended service noted above.
 - d. Liner Material: non-conductive, abrasion resistant aluminum oxide or Teflon liner.
 - e. Material of Construction: Stainless steel body with external stainless steel grounding rings.
 - f. The flow transmitters will be indicating/totalizer type with LCD display, calibrated to read in GPM for the range of flows as indicated in the instrumentation schedule and designed specifically for magnetic flow meter applications.
 - g. Transmitters Mounting: The flow indicating transmitter will be wall mounted in a NEMA 4X enclosure. The flow tube will be IP67 rated.
 - h. Output: The transmitter will output a 4-20 mA signal corresponding to flow rate.
 - i. Maximum measurement range: 0.3 to 40 feet per second with 100:1 turndown ratio.
 - j. Accuracy: +/- 0.5% of actual flow over entire range of instrument.
 - k. Magnetic flow meter schedule: Refer to Instrumentation Schedule at the back of this section.
 - l. Acceptable Manufacturer:

- 1) Profiflux IFS 5000 with IFC 090 signal converter by KRONE, Sewel, N.J.
2. Ultrasonic Level Measurement: LE/LIT 710A thru 710D and LE/LIT 720A and 720B.
 - a. Provide a non-contacting, ultrasonic systems to measure liquid level in the locations as shown on the Drawings. Chemicals to be measured are sodium hypochlorite at 15% and sodium bisulfite at 38%.
 - b. Power: 120 VAC (Transmitter). The transmitter will supply power to the transducer. Provide vendor furnished cable from the transducer to the indicating transmitter without splicing.
 - c. Accuracy: 0.25% of full range.
 - d. Range: 0-12 feet.
 - e. Output: The acoustic sensor/transducers shall continuously monitor tank levels and transmit a proportional signal to a transmitter. The transmitter shall transmit an optically isolated 4-20 mA signals proportional to tank liquid levels.
 - f. The transducer will be rated for indoor/outdoor use and shall be fully submersible. The transducer shall be Teflon faced and be the XRS-5 transducer by Milltronics.
 - g. Mounting: Provide a 6" blind flange for mounting the transducer to the top of a tank. Blind flange shall be drilled to allow transducer face to be flush with underside of the flange. Transducer to be epoxy sealed to flange. Teflon sheet to be applied to bottom face of flange covering entire transducer/flange assembly. The indicating transmitter shall be locally mounted on unistrut.
 - h. The sensor/transducers shall be functional over an ambient temperature range of -40 degrees F to 200 degrees F with an internal temperature sensor for temperature compensation.
 - i. Display: Backlit LCD display with level shown graphically from 0 to 100% and numerically in feet (depth) and gallons (volume). The unit will be capable of converting depth of liquid to volume for cylindrical tanks.
 - j. The transmitter shall include two (2) programmable Form C type relays rated 5A at 120 V.
 - k. The transmitter shall provide a loss of echo (LOE) alarm signal. Transmitter shall not change status of loss of echo alarm condition during a power outage and/or transfer.
 - l. The transmitter shall not require a battery to protect stored data. Parameters shall be stored in non-volatile memory.
 - m. The transmitter shall be programmed by entering operational data via keys on the transmitter. The programming module shall allow the complete calibration of the transmitter and review of operational parameters.
 - n. Acceptable Manufacturer:
 - 1) MiniRanger Plus by Milltronics, Arlington, Texas.

3. Chlorine Residual Analyzer AE/AIT 740E
 - a. Analyzer shall measure total chlorine residual using a gas phase amperometric type cell with integral temperature compensation.
 - b. Power: 120 V AC, provide a minimum 4 ft long power cord with 120V grounded socket.
 - c. Output: 4-20 mA DC signal proportional to chlorine residual measured in the range of 0.00 to 20.00 mg/L. Measurement range shall be field selectable.
 - d. Accuracy: +/- 5%
 - e. Display: Analyzer shall provide a LCD display for free chlorine residual and instrument setup.
 - f. Enclosure: Plastic or fiberglass NEMA 4X enclosure, wall mounted
 - g. Alarms: Separate high and low set point selection shall be provided for alarm signals.
 - h. Analyzer shall utilize buffering reagents for analysis.
 - i. Provide all required sample conditioning equipment as recommend by the manufacturer including filters, flow regulation valves, shutoff valves.
 - j. Equivalent to:
 - 1) Model A15/79 by ATI, Colleagueville, PA
 - 2) or equal
 - k. Spare Parts:
 - 1) Provide one set of sample pump replacement tubing.
 - 2) Provide 6 months worth of reagents.
4. Flow Switch: FS - 740A, 740B, 740C, 740D, FS-728A, 728B
 - a. Provide a thermal flow switch with integral relay.
 - b. Wetted Materials Polypropylene, PVDF and PVC
 - c. Enclosure: PVC or polycarbonate
 - d. Setpoint: 0.2 fps adjustable with potentiometer
 - e. Power: 120/240 VAC @ 50-60 Hz
 - f. Rating: NEMA 4X, IP65.
 - g. Contact: SPDT relay rated 10A at 120 VAC
 - h. Contact delay: 0-60 seconds
 - i. LED indication for Power, relay and sensor status
 - j. Pressure Rating: 150 psi
 - k. Electrical Connection: 1/2" NPT
 - l. Mounting 1/2" to 3/4" NPT into a 1/2" though 1 1/2" PVC TEE
 - m. Equivalent to:
 - 1) Flowline Switch Pro with compact relay
 - 2) Or equivalent.
5. Temperature Element and Indicating Transmitter: TE/TIT 710A, 720A
 - a. Provide a RTD type temperature probe with temperature transmitter mounted in a painted aluminum NEMA 4X wall mounted enclosure with LED/LCD display in Deg F. The transmitter will send a 4-20mA signal to the control panel. Electrode shall be a 100 ohm RTD in an attached

- thermowell. The unit will be 24 VDC line powered. Equal to Foxboro RTT20.
6. Eyewash Station Flow Switch: FS - 710A, 710B, 720A, 720B
 - a. Provide a flow switch on the water supply line to each emergency shower. Switch will be set to activate whenever the shower is in use.
 - b. Wetted Materials: Stainless steel body with stainless steel vane and Buna-N or Teflon seals and orings.
 - c. Temperature Limits: -4 to 220°F (-20 to 105°C)
 - d. Service: Potable Water
 - e. Pressure Limit: 1000 psig
 - f. Process Connection: 1/2" male NPT
 - g. Orientation: Switch can be installed on horizontal pipe runs.
 - h. Enclosure Rating: NEMA 4X weatherproof
 - i. Switch Type: SPDT snap switch standard rated at 5A @ 125/250 VAC
 - j. Switch shall activate at a low flow of 0.3 gpm in a 1/2" line
 - k. Electrical Connections: 3/4" male NPT conduit connection with terminal block.
 - l. Agency Approvals: UL and CSA
 - m. Equivalent to:
 1. Flowtech Series 6V by Dwyer
 2. or equal
 7. Control Panels:
 - a. Control panels shall meet the requirements of Section 16160.
 - b. Provide control panels as listed in 2.2 of this section
 8. Alarm Horn and Strobe:
 - a. Weatherproof alarm horn mounted in a cast aluminum NEMA 4X enclosure with 3/4" electrical conduit connection. Horn shall be 120 V AC powered with adjustable volume of 78 to 103 dba. Equal to Adaptahorn by Edwards.
 - b. Provide a 120 VAC weatherproof red strobe light to be wall mounted.
 9. Miscellaneous Hand Switches and Indicator Lights: HS, YL, AL
 - a. Size: 30 mm
 - b. All indicator lights shall be 120V AC, LED with push to test option.
 - c. Reference Section 16900 for specifications.
 - d. Number of positions and nameplate legends shall be as indicated in Section 13441 and on the Drawings.
 - e. Normal-Test switches shall be spring-loaded return to center type.
 - f. Allen-Bradley or equivalent.
 10. Programmable Logic Controller: PLC-703, PLC-704
 - a. See Programmable Logic Controllers - Section 13442
 11. Operator Terminal: OPT-703, OPT-704
 - a. See Programmable Logic Controllers - Section 13442
 12. UPS Power Supply Backup System:
 - a. See Programmable Logic Controllers - Section 13442

13. PLC Network:
 - a. See Communication Network - Section 13445
14. Surge Suppressor: Transtector, Ditek Model # DTK -120/240CM or equal
15. Fuses and Fuse Blocks: refer to Section 16900
16. Terminals: refer to Section 16900
17. Isolated Flow Signal Current Splitter/Repeater/Booster: I/I
 - a. Provide flow signal isolators/boosters as shown on the Instrumentation Drawings.
 - b. DIN Rail mounted, 120VAC/24 VDC powered as required
 - c. Signal Input: 4-20 mA
 - d. Signal Output: Two channels, optically isolated, 4-20 mA each.
 - e. Adjustability: Front Accessed potentiometer for zero and span with LED Indicator.
 - f. Acceptable Manufacturer:
 - 1) Acromag Series 653T
 - 2) or equal.
18. Special Tools:
 - a. The Contractor shall provide all required tools for instrumentation.
19. Spare Parts and Test Equipment:
 - a. The Contractor shall furnish the following spare parts, in addition to the manufacturer's standard spare parts kit, with each part packed in a container and labeled:
 - 1) 10 of each type lamp, unless otherwise specified herein
 - 2) 1 of each color indicator light lens.
 - 3) 1 relay of each type
 - 4) 1 complete selector switch of each type.
 - 5) 1 complete push-button of each type.
 - 6) 1 of each different contact block for control units.
 - 7) 2 of every type of fuse.
 - 8) 1 N.O. and 1 N.C. contact for each type of switch.

2.2 CONTROL PANEL DESCRIPTION (refer to Instrumentation Drawings)

- A. General.
 1. The control of each new control system will be similar in operation.
 2. Run time totalizers (KQI) for each piece of equipment will be located on the front of the motor starter cubicle or variable speed drive for each piece of equipment as specified in Division 16. The PLCs will also totalize the run times for each piece of equipment in hours.
- B. Control Panels
 1. Control Panels and their NEMA ratings provided under this Division include:
 - a. Communications Panels (COM-1): NEMA 4X
 - b. Chlorination Control Panel (CCP): NEMA 4X
 - c. Dechlorination Control Panel (DCP): NEMA 4X
 - d. Temporary Dechlorination Control Panel (TDCP): NEMA 4X

- e. Hypochlorite and Bisulfite Fill Panels (HFP and BFP): NEMA 4X FRP (outside panels)
 - f. Chlorination VFD Panel: NEMA 4X stainless steel
2. Control Panels by Others:
 - a. none
 3. **Communication Panel (COM-1):** Provide a communication panel (COM-1) as shown in the Network Diagram and as located on the Electrical Drawings. The communication panel will be 120 VAC powered and will include network equipment as described in section 13445. The communication panel is used to network each of the new PLCs and Operator terminals along with providing a communication gateway to the existing Allen Bradley DH+ network.
 4. **Chlorination and Dechlorination Control Panels (CCP and DCP):** Each control panel will include a PLC and operator terminal interface to control the chlorination/dechlorination equipment and instrumentation as shown on the Instrumentation Drawings. The operator terminal and PLC functions will be programmed by the Owner through a separate contract. Coordinate the control requirements of all existing and new instrumentation and process equipment.
 5. **Hypochlorite and Bisulfite Fill Panels (HFP and BFP):** Each chemical fill panel will include a fiberglass NEMA 4X panel mounted near the chemical fill station. The panel will include a high level alarm indicator light for each of the storage tanks. The PLC will be programmed by others to flash the indicator light on a "High Tank X Level" alarm condition and also activate a horn and strobe light. A Normal-Test (spring loaded, return to center type) selector switch will be located on the front of the panel to turn the strobe/horn on and to test the strobe/horn. A silence pushbutton shall also be located on this panel to silence the audible alarm.
 6. **Chlorination VFD Panel:** Provide a NEMA 4X stainless steel panel to house the eight (8) Toshiba VFDs provided by the pumping equipment manufacture for the each hypochlorite chemical pump. The panel will be 480 VAC, 3 phase powered with disconnect and individual breakers for each VFD drive. The HMI for each VFD will be mounted through the front face of the panel along with a separate run time meter. The local control station will interface with the VFD panel to control the pumps manually or from a start contact in the Chlorination Control Panel.
 7. In general, each piece of equipment will have a LOCAL-OFF-REMOTE type hand switches (HS) mounted in a Local Control Station adjacent to the equipment. In the LOCAL position, the equipment will run continuously. The equipment will be capable of running properly without the PLC. In the OFF position, the equipment will not be allowed to run. In the REMOTE position, the equipment will be activated and controlled by a PLC.
 8. All alarms shall activate a general alarm light (red) at the associated control panel where indicated on the Instrumentation Drawing. Each alarm will be latching unless otherwise indicated. Interlocked alarms and equipment/safety devices (i.e. ESTOPS, Safety pull cables) shall be wired in a manner

considered fail safe. Each control panel will include a RESET pushbutton, mounted to the front of the panel, which will reset all latched alarms circuits and programmed alarms. Alarms that are latched by a relay in the control panel will require the operator to RESET the control panel.

9. All motor drives, including motor starters, soft starts and variable speed drives, will be activated based on a START command from the PLC or LOR switch. The START command will be developed by the control panel circuitry driving an auxiliary control relay in the control panel. The control circuitry will include all permissive conditions, interlocks and run commands (PLC and HOR/LOR switches).
10. A return RUN contact from the drive will activate a RUN light mounted to the front of the motor control center (MCC) or variable speed drive (VFD) for each piece of equipment. The PLC will activate a FAIL alarm if the equipment is in REMOTE and the PLC attempts to activate the equipment but the RUN contact does not indicate that the equipment is running after a 15 second delay time. This time may vary based on the type of equipment and drive.
11. Drive equipment and instrumentation, which contain self-diagnostics, overload relay (O/L) or faults relay (FAULT) contacts, will be connected to the PLC to produce an O/L or FAULT alarm.
12. The PLCs and operator terminals will be connected to a new Ethernet PLC network for data communication with the exiting SCADA System, other PLCs and operator terminals.
13. Each Control Panel will be powered from a 120V power source. An uninterruptible power supply (UPS) will be provided for each panel.
14. Each panel will include indicator lights on the front of the panel indicating POWER (green) and UPS POWER (amber). A POWER FAIL alarm will be activated through SCADA if the normal 120V power fails. A UPS FAIL alarm (red) will be activated by the UPS, if the UPS battery should run low or the UPS should fail.
15. A relay will be provided off each PLC, which will be energized by the PLC under normal operating conditions. The relay will activate a cumulative alarm signal or a PLC Fail, which will activate a SYSTEM ALARM (red) light on the front of the Control Panel.
16. All analog control signals will be 4-20 mA and powered from power supplies within the process control panel, unless otherwise indicated or required.
17. All inputs to the PLC shall be dry isolated contacts. All outputs from the PLC shall have interposing relays. All outgoing power (120V and 24V) to field devices shall be fused.
18. All wiring in and out of the panels will be connected to terminal strips for ease of installation and maintenance. All connections will be made in such a way as to preserve the NEMA rating of the panel. The supplier will label the terminal strips and provide a complete wiring diagram for each system control panel.
19. All control panels will use the following light color convention:
 - a. Alarm/Run Red
 - b. Power/Stop Lights Green

- c. Warning Lights Amber
 - d. Enable Lights White
 - e. Position Lights Blue
20. The Control Panel shall be furnished and installed in the locations as shown on the Electrical Drawings.
 21. All transducers, converters, terminals, transformers, relays, signal transmitters, signal boosters, power supply connections, remote instrumentation/equipment surge protection devices, and other miscellaneous equipment required to make a complete system in accordance with the intent of this section of the Specifications shall be furnished and installed in each panel.
 22. The Instrumentation supplier shall review the control section of the submittal for each Division 11 and 16 specifications where equipment drive controls are to be provided and interfaced with the new control systems.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:

1. The specifications and drawings do not attempt to fully indicate the degree of assembly, subassembly, shipped condition, extent of field work, or degree of accuracy required to install the equipment or materials. The Contractor shall be required to rely on his prior experience or to otherwise inform himself of the amount of field work required to assemble, erect, and install the equipment or material, as received, to produce a finished installation ready for use or operation.
2. All equipment installed as part of the work shall be positioned, assembled, aligned, doveled, and otherwise set to the tolerances required by the equipment manufacturer. Where tolerances and methods are not specifically indicated, they shall be in accordance with best millwright practice.
3. All materials incorporated in the work shall be installed in accordance with the Drawings and specifications. Where detailed drawings or technical specifications are not provided, the materials shall be installed in accordance with the manufacturer's preferred recommendations and conforming to the best practice of the trade involved. Installation shall include all accessories required to produce a completed installation ready for use.

B. Piping, Valves and Fittings:

1. All instrument tubing, except as otherwise noted on the drawings or in the specifications, shall be 304L stainless steel tubing (for use with Solder-Flared or Compression-Type Fittings). Tubing sizes shall be as indicated on the drawings. Tubing thickness shall be suitable for the maximum operating pressure. All instrument takeoff connections from headers shall be taken off the top of the header. Headers shall grade back to the compressor receiver. Outlying ends of headers shall be terminated with bronze ball valves having Teflon seats and seals and stainless steel balls. All connections to instruments,

either hydraulic or pneumatic, shall be made with separable fittings. Stainless steel tubing fittings shall be compression or flared type.

2. All air supply lines to all instruments shall have individual diaphragm packless shutoff valves mounted adjacent to the instruments.
 3. Vertical or horizontal runs of tubing in close proximity shall be bundled in an acceptable manner. All concealed runs shall run continuously without joints. Installation of tubing to instruments shall be in accordance with the manufacturer's recommendations.
 4. All hydraulic tubing shall be tested and made tight to the satisfaction of the Engineer.
 5. All pneumatic tubing shall be tested in accordance with ISA Procedure, RP7.1, Pneumatic Control Circuit Pressure Test, Tentative Recommended Practice, latest edition.
- C. Electrical Work:
1. All electrical work shall conform to the requirements indicated in Division 16.
- D. Field Calibration:
1. All instrumentation shall be calibrated in the presence of the Engineer.
 2. All pressure, flow and level transmitters shall be factory calibrated and set up to the extent possible at the factory. Span, range, and operating parameter adjustment shall be made at the factory or in the field by a factory trained personnel. Each system shall meet the manufacturer's standard accuracy.
 3. Analyzing instruments shall be field calibrated by a factory-trained engineer or technician using procedures recommended by the manufacturer. Provide all materials required for proper calibration. Calibration shall be done in the presence of the Engineer.
 4. Secondary functions such as alarm actuations and pacing shall be adjusted during initial calibration and demonstrated after the system is placed in service. Range adjustments shall be sealed by colored lacquer in the presence of the Engineer immediately following calibration.
 5. Process calibration, such as volumetric drawdown tests on flows and level measurements, shall be conducted on all measuring systems as requested by the Engineer.

INSTRUMENTATION SCHEDULE
EAST END WWTF DISINFECTION AND DECHLORINATION SYSTEMS UPGRADE
PORTLAND WATER DISTRICT

TAG	TYPE/ SIZE	DESCRIPTION	LOCATION	ACTUAL RANGE	UNITS	SERVICE	POWER	SPEC. SECTION
<i>FE/FIT-700</i>	<i>MAG</i>	<i>Existing Secondary Electromagnetic Flow Meter</i>	<i>Pipe Tunnel</i>	<i>0 to 50</i>	<i>MGD</i>	<i>Secondary Effluent</i>	<i>120 VAC</i>	<i>Existing</i>
FS-710A	½"	Flow Switch	Eyewash Station Water Supply	-	-	Water	-	13440 2.1 B.6
FS-710B	½"	Flow Switch	Eyewash Station Water Supply	-	-	Water	-	13440 2.1 B.6
TE/TIT-710A	-	Temperature Probe and Transmitter	Hypochlorite Storage Tank Room	0 to 150	Deg F	NEMA 4X	24 VDC	13440 2.1 B.5
LE/LIT-710A	ULT	Ultrasonic Level Transducer and Indicating Transmitter	Hypochlorite Storage Tank No. 1	0.0 to 15.0	feet	NEMA 4X Intrinsically Safe	120 VAC	13440 2.1 B.2
LE/LIT-710B	ULT	Ultrasonic Level Transducer and Indicating Transmitter	Hypochlorite Storage Tank No. 2	0.0 to 15.0	feet	NEMA 4X Intrinsically Safe	120 VAC	13440 2.1 B.2
LE/LIT-710C	ULT	Ultrasonic Level Transducer and Indicating Transmitter	Hypochlorite Storage Tank No. 3	0.0 to 15.0	feet	NEMA 4X Intrinsically Safe	120 VAC	13440 2.1 B.2
LE/LIT-710D	ULT	Ultrasonic Level Transducer and Indicating Transmitter	Hypochlorite Storage Tank No. 4	0.0 to 15.0	feet	NEMA 4X Intrinsically Safe	120 VAC	13440 2.1 B.2
FE/FIT 719A	¼"	Chemical Electromagnetic Flow Meter	HYP-1 Discharge Pipe	0.00 - 5.00	GPM	Sodium Hypochlorite	120 VAC	13440 2.1 B.1
FE/FIT 719B	¼"	Chemical Electromagnetic Flow Meter	HYP-2 Discharge Pipe	0.00 - 5.00	GPM	Sodium Hypochlorite	120 VAC	13440 2.1 B.1
FE/FIT 719C	¼"	Chemical Electromagnetic Flow Meter	HYP-3 Discharge Pipe	0.00 - 5.00	GPM	Sodium Hypochlorite	120 VAC	13440 2.1 B.1
FE/FIT 719D	¼"	Chemical Electromagnetic Flow Meter	HYP-4 Discharge Pipe	0.00 - 5.00	GPM	Sodium Hypochlorite	120 VAC	13440 2.1 B.1
FE/FIT 719E	¼"	Chemical Electromagnetic Flow Meter	HYP-5 Discharge Pipe	0.00 - 5.00	GPM	Sodium Hypochlorite	120 VAC	13440 2.1 B.1

TAG	TYPE/ SIZE	DESCRIPTION	LOCATION	ACTUAL RANGE	UNITS	SERVICE	POWER	SPEC. SECTION
FE/FIT 719F	¼"	Chemical Electromagnetic Flow Meter	HYP-6 Discharge Pipe	0.00 - 5.00	GPM	Sodium Hypochlorite	120 VAC	13440 2.1 B.1
FS-720A	½"	Flow Switch	Eyewash Station Water Supply	-	-	Water	-	13440 2.1 B.6
FS-720B	½"	Flow Switch	Eyewash Station Water Supply	-	-	Water	-	13440 2.1 B.6
TE/TIT-720A	-	Temperature Probe and Transmitter	Bisulfite Storage Tank Room	0 to 150	Deg F	NEMA 4X	24 VDC	13440 2.1 B.5
LE/LIT-720A	ULT	Ultrasonic Level Transducer and Indicating Transmitter	Bisulfite Storage Tank No. 1	0.0 to 15.0	feet	NEMA 4X Intrinsically Safe	120 VAC	13440 2.1 B.2
LE/LIT-720B	ULT	Ultrasonic Level Transducer and Indicating Transmitter	Bisulfite Storage Tank No. 2	0.0 to 15.0	feet	NEMA 4X Intrinsically Safe	120 VAC	13440 2.1 B.2
FE/FIT 727A	1/10"	Chemical Electromagnetic Flow Meter	DEC-1 Discharge Pipe	0 to 1	GPM	Sodium Bisulfite	-	13440 2.1 B.1
FE/FIT 727B	1/10"	Chemical Electromagnetic Flow Meter	DEC-2 Discharge Pipe	0 to 1	GPM	Sodium Bisulfite	-	13440 2.1 B.1
FE/FIT 727C	1/10"	Chemical Electromagnetic Flow Meter	DEC-3 Discharge Pipe	0 to 1	GPM	Sodium Bisulfite	-	13440 2.1 B.1
FE/FIT 727D	1/10"	Chemical Electromagnetic Flow Meter	DEC-4 Discharge Pipe	0 to 1	GPM	Sodium Bisulfite	-	13440 2.1 B.1
FE/FIT 727E	1/10"	Chemical Electromagnetic Flow Meter	DEC-5 Discharge Pipe	0 to 1	GPM	Sodium Bisulfite	-	13440 2.1 B.1
FE/FIT 727F	1/10"	Chemical Electromagnetic Flow Meter	DEC-6 Discharge Pipe	0 to 1	GPM	Sodium Bisulfite	-	13440 2.1 B.1
FS-728A	1 ½"	Carrier Water Flow Switch	Sec. Dechlorination Carrier Water Line	-	-	NEMA 4X	120 VAC	13440 2.1 B.4
FS-728B	1 ½"	Carrier Water Flow Switch	Primary Dechlorination Carrier Water Line	-	-	NEMA 4X	120 VAC	13440 2.1 B.4
<i>FE/FIT-730</i>	<i>MAG</i>	<i>Existing Bypass Electromagnetic Flow Meter</i>	<i>Vault</i>	<i>0 to 50</i>	<i>MGD</i>	<i>Primary Effluent</i>	<i>120 VAC</i>	<i>Existing</i>
FS-740A	1"	Sample Water Flow Switch CRS-1	Sample Water Line	-	-	NEMA 4X	120 VAC	13440 2.1 B.4
FS-740B	1"	Sample Water Flow Switch CRS-2	Sample Water Line	-	-	NEMA 4X	120 VAC	13440 2.1 B.4

TAG	TYPE/ SIZE	DESCRIPTION	LOCATION	ACTUAL RANGE	UNITS	SERVICE	POWER	SPEC. SECTION
FS-740C	1"	Sample Water Flow Switch CRS-3	Sample Water Line	-	-	NEMA 4X	120 VAC	13440 2.1 B.4
FS-740D	1"	Sample Water Flow Switch CRS-4	Sample Water Line	-	-	NEMA 4X	120 VAC	13440 2.1 B.4
AE/AIT-740A	CL	<i>Existing Chlorine Residual Analyzer</i>	<i>Hypochlorite Building</i>	<i>0 to 5</i>	<i>ppm</i>	<i>NEMA 4X Bypass CCT Influent</i>	<i>120 VAC</i>	<i>Existing</i>
AE/AIT-740B	CL	<i>Existing Chlorine Residual Analyzer</i>	<i>Hypochlorite Building</i>	<i>0 to 5</i>	<i>ppm</i>	<i>NEMA 4X Bypass CCT Effluent</i>	<i>120 VAC</i>	<i>Existing</i>
AE/AIT-740C	CL	<i>Existing Chlorine Residual Analyzer</i>	<i>Hypochlorite Building</i>	<i>0 to 5</i>	<i>ppm</i>	<i>NEMA 4X Secs CCT Influent</i>	<i>120 VAC</i>	<i>Existing</i>
AE/AIT-740D	CL	<i>Existing Chlorine Residual Analyzer</i>	<i>Hypochlorite Building</i>	<i>0 to 5</i>	<i>ppm</i>	<i>NEMA 4X Sec CCT Effluent</i>	<i>120 VAC</i>	<i>Existing</i>
AE/AIT-740E	CL	Chlorine Residual Analyzer	Hypochlorite Building	0 to 20	ppm	NEMA 4X Primary Influent	120 VAC	13440 2.1 B.3

ISR - Intrinsically Safe Relay

END OF SECTION