

CITY OF TRACY
TRACY WASTEWATER TREATMENT PLANT
SOLIDS HANDLING FACILITIES IMPROVEMENTS

SECTION 40 90 01
INSTRUMENTATION AND CONTROL FOR PROCESS SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

- A. Work Includes:
1. Engineering, furnishing, installing, calibrating, adjusting, testing, documenting, starting up, and Owner training for complete Process Instrumentation and Control Systems (PICS) for City of Tracy WWTP Solids Processing Facilities Improvements.
 2. Major parts are:
 - a. Primary elements, transmitters, and control devices.
 - b. One support-mounted control panel.
 - c. One freestanding control panel.
 - d. Two programmable logic controllers.
 - e. Interfaces with existing control systems.
- B. Detailed Design: PIC as shown and specified includes functional and performance requirements and component specifications. Complete detailed PICS design.

1.02 DEFINITIONS

- A. Abbreviations:
1. AFD: Adjustable Frequency Drive.
 2. CP: Control Panel (typically includes PLC.)
 3. DAFT: Dissolved Air Flotation Thickener.
 4. LCP: Local Control Panel.
 5. MCC: Motor Control Center.
 6. OIT: Operator Interface Terminal.
 7. PAT: Performance Acceptance Test.
 8. PIC: Process Instrumentation and Control.
 9. PLC: Programmable Logic Controller.
 10. UPS: Uninterruptible Power Supply.
- B. Rising/Falling: Terms used to define actions of discrete devices about their setpoints.

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1. Rising: Contacts close when an increasing process variable rises through setpoint.
2. Falling: Contacts close when a decreasing process variable falls through setpoint.

C. Signal Types:

1. Analog Signals, Current Type:
 - a. 4 mA to 20 mA dc signals conforming to ISA S50.1.
 - b. Unless otherwise indicated for specific PIC Subsystem components, use the following ISA 50.1 options:
 - 1) Transmitter Type: Number 2, two-wire.
 - 2) Transmitter Load Resistance Capacity: Class L.
 - 3) Fully isolated transmitters and receivers.
2. Analog Signals, Voltage Type: 1 to 5 volts dc within panels where a common high precision dropping resistor is used.
3. Discrete signals, two-state logic signals using dc or 120V ac sources as indicated.
4. Pulse Frequency Signals:
 - a. Direct current pulses whose repetition rate is linearly proportional to process variable.
 - b. Pulses generated by contact closures or solid state switches as indicated.
 - c. Power source less than 30V dc.
5. Special Signals: Other types of signals used to transmit analog and digital information between field elements, transmitters, receivers, controllers, and digital devices.

D. Instrument Tag Numbers:

1. A shorthand tag number notation is used in the Loop Specifications. For example: 13FIT1482.

Notation	Explanation
13	Unit Process Number
FI1	ISA designator for Analysis Indicator
1482	Loop and unit number

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1.03 SUBMITTALS

A. Action Submittals:

1. General:
 - a. Shop Drawings, full-scaled details, wiring diagrams, catalog cuts, and descriptive literature.
 - b. Identify proposed items and options. Identify installed spares and other provisions for future work (for example, reserved panel space; unused components, wiring, and terminals).
 - c. Legends and Abbreviation Lists: Complete definition of symbols and abbreviations used on this Project (for example, engineering units, flow streams, instruments, structures, and other process items used in nameplates, legends, and data sheets).
2. Bill of Materials: List of required equipment.
 - a. Group equipment items by enclosure and field, and within an enclosure, as follows:
 - 1) I&C Components: By component identification code.
 - 2) Other Equipment: By equipment type.
 - b. Data Included:
 - 1) Equipment tag number.
 - 2) Description.
 - 3) Manufacturer, complete model number, and all options not defined by model number.
 - 4) Quantity supplied.
 - 5) Component identification code where applicable.
3. Catalog Cuts: I&C Components, Electrical Devices, and Mechanical Devices:
 - a. Catalog information, mark to identify proposed items and options.
 - b. Descriptive literature.
 - c. External power and signal connections.
 - d. Scaled drawings showing exterior dimensions and locations of electrical and mechanical interfaces.
4. Component Data Sheets: Data sheets for I&C components.
 - a. Format and Level of Detail: In accordance with ISA-S20.
 - b. Include component type identification code and tag number on data sheet.
 - c. Specific features and configuration data for each component:
 - 1) Location or service.
 - 2) Manufacturer and complete model number.
 - 3) Size and scale range.
 - 4) Setpoints.
 - 5) Materials of construction.

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- 6) Options included.
 - d. Name, address, and telephone number of manufacturer's local office, representative, distributor, or service facility.
- 5. Sizing and Selection Calculations:
 - a. Primary Elements: Complete calculations plus process data used. Example, for flow elements, minimum and maximum values, permanent head loss, and assumptions made.
 - b. Controlling, Computing and Function Generating Modules: Actual scaling factors with units and how they were computed.
- 6. Panel Construction Drawings:
 - a. Scale Drawings: Show dimensions and location of panel mounted devices, doors, louvers, and subpanels, internal and external.
 - b. Panel Legend: List front of panel devices by tag numbers, nameplate inscriptions, service legends, and annunciator inscriptions.
 - c. Bill of Materials: List devices mounted within panel that are not listed in panel legend. Include tag number, description, manufacturer, and model number.
 - d. Construction Details: NEMA rating, materials, material thickness, structural stiffeners and brackets, lifting lugs, mounting brackets and tabs, door hinges and latches, and welding and other connection callouts and details.
 - e. Construction Notes: Finishes, wire color schemes, wire ratings, wire and terminal block, numbering and labeling scheme.
- 7. Panel Control Diagrams: For discrete control and power circuits.
 - a. Diagram Type: Ladder diagrams, include devices, related to discrete functions that are mounted in or on the panel and that require electrical connections. Show unique rung numbers on left side of each rung.
 - b. Item Identification: Identify each item with attributes listed.
 - 1) Wires: Wire number and color. Cable number, if part of multiconductor cable.
 - 2) Terminals: Location (enclosure number, terminal junction box number, or MCC number), terminal strip number, and terminal block number.
 - 3) Discrete Components:
 - a) Tag number, terminal numbers, and location ("FIELD", enclosure number, or MCC number).
 - b) Switching action (open or close on rising or falling process variable), setpoint value and units, and process variable description (for example, Sump Level High).
 - 4) Relay Coils:

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- a) Tag number and its function.
- b) On right side of run where coil is located, list contact location by ladder number and sheet number.
Underline normally closed contacts.
- 5) Relay Contacts: Coil tag number, function, and coil location (ladder rung number and sheet number).
- c. Show each circuit individually. No "typical" diagrams or "typical" wire lists will be permitted.
- d. Ground wires, surge protectors, and connections.
- 8. Panel Wiring Diagrams: Show point-to-point and terminal-to-terminal wiring within panel.
- 9. Panel Plumbing Diagrams: For each panel containing piping and tubing. Show type and size for: Pipes and Tubes: Thickness, pressure rating, and materials.
 - a. Components: Valves, regulators, and filters.
 - b. Connections to panel mounted devices.
 - c. Panel interface connections.
- 10. Loop Diagrams: Individual wiring diagram for each analog or pulse frequency loop.
 - a. Conform to the minimum requirements of ISA S5.4.
 - b. Under Paragraph 5.3 of ISA S5.4, include the information listed under subparagraphs 2 and 6.
 - c. Drawing Size: Individual 11-inch by 17-inch sheet for each loop.
 - d. Divide each loop diagram into areas for panel face, back-of-panel, and field.
 - e. Show:
 - 1) Terminal numbers, location of dc power supply, and location of common dropping resistors.
 - 2) Switching contacts in analog loops and output contacts of analog devices. Reference specific control diagrams where functions of these contacts are shown.
 - 3) Tabular summary on each diagram:
 - a) Transmitting Instruments: Output capability.
 - b) Receiving Instruments: Input impedance.
 - c) Loop Wiring Impedance: Estimate based on wire sizes and lengths shown.
 - d) Total loop impedance.
 - e) Reserve output capacity.
 - 4) Circuit and raceway schedule names.
- 11. Installation Details: Include modifications or further details required to adequately define installation of I&C components.
- 12. List of spares, expendables, test equipment and tools.

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13. Additional Equipment Recommended: List of, and descriptive literature for, additional spares, expendables, test equipment and tools recommended. Include unit prices and total costs as specified in Section 01 29 00, Payment Procedures.
- B. Informational Submittals: For PIC equipment, provide Manufacturer's Certificate of Proper Installation and readiness for operation.
 1. Owner Training Plan. Reference Section 01 43 33, Manufacturers' Field Services.
 2. Operation and Maintenance (O&M) Manuals: In accordance with Section 01 78 23, Operation and Maintenance Data, unless otherwise specified in this section.
 - a. Content and Format:
 - 1) Complete sets O&M manuals.
 - 2) Sufficient detail to allow operation, removal, installation, adjustment, calibration, maintenance and purchasing replacements for each PIC component.
 - 3) Final versions of Legend and Abbreviation Lists.
 - 4) Manual format in accordance with Section 01 78 23, Operation and Maintenance Data.
 - b. Include:
 - 1) Process and Instrumentation Diagrams: One reproducible copy of revised P&ID to reflect as-built PIC design.
 - 2) Refer to paragraph Shop Drawings for the following items:
 - a) Bill of Materials.
 - b) Catalog Cuts.
 - c) Component Data Sheets.
 - d) Panel Control Diagrams.
 - e) Panel Wiring Diagrams, one reproducible copy.
 - f) Panel Plumbing Diagrams, one reproducible copy.
 - g) Loop Diagrams, one reproducible copy.
 - h) Interconnecting Wiring Diagrams, one reproducible copy.
 - i) Application Software Documentation.
 - 3) Device O&M manuals for components, electrical devices, and mechanical devices include:
 - a) Operations procedures.
 - b) Installation requirements and procedures.
 - c) Maintenance requirements and procedures.
 - d) Troubleshooting procedures.
 - e) Calibration procedures.
 - f) Internal schematic and wiring diagrams.

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- g) Component Calibration Sheets from field quality control calibrations.
- 4) List of spares, expendables, test equipment and tools provided.
- 5) List of additional spares, expendables, test equipment and tools recommended.
- 3. Performance Acceptance Tests (PAT) Submittals:
 - a. Preliminary Test Procedures: Outlines of proposed tests, forms, and checklists.
 - b. Final Test Procedures: Proposed test procedures, forms, and checklists.
 - c. Test Documentation: Copy of signed off test procedures when tests are completed.

1.04 QUALITY ASSURANCE

- A. Calibration Instruments: Each instrument used for calibrating PIC equipment shall bear the seal of a reputable laboratory certifying that instrument has been calibrated within the previous 12 months to a standard endorsed by the NIST.
- B. Coordination Meetings:
 - 1. In accordance with Section 01 31 13, Project Coordination.
 - 2. Location: City of Tracy, Wastewater Treatment Plant.
 - 3. Attended By: Engineer, Owner, and Contractor.
 - 4. Minimum of two are required. Specific dates will be established in Progress Schedule.
 - 5. First Meeting: Within 60 days after Notice to Proceed.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Provide Site and warehouse storage facilities for PIC equipment.
- B. Prior to shipment, include corrosive-inhibitive vapor capsules in shipping containers, and related equipment as recommended by the capsule manufacturer.
- C. Prior to installation, store items in dry indoor locations. Provide heating in storage areas for items subject to corrosion under damp conditions.
- D. Cover panels and other elements that are exposed to dusty construction environments.

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1.06 ENVIRONMENTAL REQUIREMENTS

- A. Standard Environmental Requirements: Unless otherwise noted, design equipment for continuous operation in these environments:
 - 1. Freestanding Panel and Consoles:
 - a. Inside: NEMA 12.
 - 2. Smaller Panels and Assemblies (that are not Freestanding):
 - a. Inside, Air Conditioned: NEMA 12.
 - b. All Other Locations: NEMA 4X.
 - 3. Field Elements: Outside.
- B. Environmental Design Requirements: Following defines the types of environments referred to in the above.
 - 1. Inside:
 - a. Temperature: 20 to 110 degrees F.
 - b. Relative Humidity: 10 to 100 percent.
 - c. NEC Classification: Nonhazardous.
 - 2. Outside:
 - a. Temperature: Minus 20 to 120 degrees F.
 - b. Relative Humidity: 10 to 100 percent, rain.
 - c. NEC Classification: Nonhazardous.

1.07 SEQUENCING AND SCHEDULING

- A. Activity Completion: The following is a list of key activities and their completion criteria:
 - 1. Shop Drawings: Reviewed and approved.
 - 2. Quality Control Submittals: Reviewed and accepted.
 - 3. Hardware Delivery: Hardware delivered to Site and inventoried by Owner.
 - 4. PAT: Completed and required test documentation accepted.
- B. PIC Substantial Completion: When Engineer issues Certificate of Substantial Completion.
 - 1. Prerequisites:
 - a. All PIC Submittals have been completed.
 - b. PIC has successfully completed PAT.
 - c. Owner training plan is on schedule.
 - d. All spares, expendables, and test equipment have been delivered to Owner.

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- C. PIC Acceptance: When Engineer issues a written notice of Final Payment and Acceptance.
1. Prerequisites:
- a. Certificate of Substantial Completion issued for PIC.
 - b. Punch-list items completed.
 - c. Final revisions to O&M manuals accepted.
 - d. Maintenance service agreements for PIC accepted by Owner.
- D. Prerequisite Activities and Lead Times: Do not start the following key Project activities until the prerequisite activities and lead times listed below have been completed and satisfied:

Activity	Prerequisites and Lead Times
Submittal reviews by Engineer	Engineer acceptance of Submittal breakdown and schedule.
Hardware purchasing, fabrication, and assembly	Associated shop drawing Submittals completed.
Shipment	Completion of PIC Shop Drawing Submittals and preliminary O&M manuals.
Owner Training	Owner training plan completed.
PAT	Startup, Owner training, and PAT procedures completed; notice 4 weeks prior to start.

PART 2 PRODUCTS

2.01 GENERAL

- A. PIC functions as shown on Drawings and as required for each loop. Furnish equipment items as required. Furnish all materials, equipment, and software, necessary to affect required system and loop performance.
- B. First Named Manufacturer: PIC design is based on first named manufacturers of equipment and materials.
1. If an item is proposed from other than first named manufacturer, obtain approval from Engineer for such changes in accordance with Article Submittals.

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2. If using proposed item requires other changes, provide work and equipment to implement these changes. Changes that may be required include, but are not limited to: different installation, wiring, raceway, enclosures, connections, isolators, intrinsically safe barriers, software, and accessories.

C. Like Equipment Items:

1. Use products of one manufacturer and of the same series or family of models to achieve standardization for appearance, operation, maintenance, spare parts, and manufacturer's services.
2. Implement all same or similar functions in same or similar manner. For example, control logic, sequence controls, and display layouts.

2.02 LOOP SPECIFICATIONS

A. Location: Article Supplements.

B. Organization: By unit process and loop number.

C. Functional Requirements for Control Loops:

1. Shown on Drawings, in Panel Control Diagrams, and Process and Instrumentation Diagrams (P&ID). P&ID format and symbols are in accordance with ISA S5.1, except as specified or shown on Drawings.
2. Supplemented by Loop Specifications.

2.03 I&C COMPONENTS

A. Components for Each Loop: Major components for each loop are listed under in Instrument List referenced in Article Supplements. Furnish all equipment that is necessary to achieve required loop performance.

B. Component Specifications: Generalized specifications for each type of component are located in Article Supplements.

2.04 NAMEPLATES AND TAGS

A. Panel Nameplates: Enclosure identification located on the enclosure face.

1. Location and Inscription: As shown.
2. Materials: Laminated plastic attached to panel with stainless steel screws.
3. Letters: 1/2-inch white on black background, unless otherwise noted.

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- B. Component Nameplates—Panel Face: Component identification located on panel face under or near component.
 - 1. Location and Inscription: As shown.
 - 2. Materials: Laminated plastic attached to panel with stainless steel screws.
 - 3. Letters: 3/16-inch white on black background, unless otherwise noted.
- C. Component Nameplates—Back of Panel: Component identification located on or near component inside of enclosure.
 - 1. Inscription: Component tag number.
 - 2. Materials: Adhesive backed, laminated plastic.
 - 3. Letters: 3/16-inch white on black background, unless otherwise noted.
- D. Legend Plates for Panel Mounted Pushbuttons, Lights, and Switches.
 - 1. Inscription: Refer to:
 - a. Table under paragraph Standard Pushbutton Colors and Inscriptions.
 - b. Table under paragraph Standard Light Colors and Inscriptions.
 - c. P&IDs in Drawings.
 - 2. Materials: Stainless steel, keyed legend plates. Secured to panel by mounting nut for pushbutton, light, or switch.
 - 3. Letters: Black on gray or white background.
- E. Service Legends: Component identification nameplate located on face of component.
 - 1. Inscription: As shown.
 - 2. Materials: Adhesive backed, laminated plastic.
 - 3. Letters: 3/16-inch white on black background, unless otherwise noted.
- F. Nametags: Component identification for field devices.
 - 1. Inscription: Component tag number.
 - 2. Materials: 16-gauge, Type 304 stainless steel.
 - 3. Letters: 3/16-inch imposed.
 - 4. Mounting: Affix to component with 16- or 18-gauge stainless steel wire or stainless steel screws.

2.05 ELECTRICAL TRANSIENT PROTECTION

A. General:

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1. Function: Protect elements of PIC against damage due to electrical transients induced in interconnecting lines by lightning and nearby electrical systems.
2. Implementation: Provide, install, coordinate, and inspect grounding of surge suppressors at:
 - a. Connection of ac power to PIC equipment including panels, consoles assemblies, and field mounted analog transmitters and receivers.
 - b. At the field and panel, console, or assembly connection of signal circuits that have portions of the circuit extending outside of a protective building.
3. Construction: First-stage high energy metal oxide varistor and second-stage bipolar silicon avalanche device separated by series impedance. Includes grounding wire, stud, or terminal.
4. Response: 5 nanoseconds maximum.
5. Recovery: Automatic.
6. Temperature Range: Minus 20 degrees C to plus 85 degrees C.

B. Suppressors on 120V ac Power Supply Connections:

1. Occurrences: Tested and rated for a minimum of 50 occurrences of IEEE 587 Category B test waveform.
2. First-Stage Clamping Voltage: 350 volts or less.
3. Second-Stage Clamping Voltage: 210 volts or less.
4. Continuous Operation: Power supplies for one four-wire transmitter or receiver: 5 amps minimum at 130V ac. All other applications: 30 amps minimum at 130V ac.

C. Suppressors on Analog Signal Lines:

1. Test Waveform: Linear 8 microsecond rise in current from 0 amps to a peak current value followed by an exponential decay of current reaching one half the peak value in 20 microseconds.
2. Surge Rating: Tested and rated for 50 occurrences of 2,000-amp peak test waveform.
 - a. dc Clamping Voltage: 20 to 40 percent above operating voltage for circuit.
 - b. dc Clamping Voltage Tolerance: Less than plus or minus 10 percent.
 - c. Maximum Loop Resistance: 18 ohms per conductor.

D. Physical Characteristics:

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1. Mounted in Enclosures: Encapsulated inflame retardant epoxy.
 2. For Analog Signals Lines: EDCO PC-642 or SRA-64 series.
 3. For 120V ac Lines: EDCO HSP-121.
 4. Field Mounted at Two-Wire Instruments: Encapsulated in stainless steel pipe nipples. EDCO SS64 series.
 5. Field Mounted at Four-Wire Instruments: With 120V ac outlet, ac circuit breaker, and 10-ohm resistors on signal lines, all in enclosure.
 - a. Enclosure: NEMA 4X fiberglass or Type 316 stainless steel with door.
 - 1) Maximum Size: 12 inches by 12 inches by 8 inches deep.
 - b. Manufacturer and Product: EDCO; SLAC series.
- E. Installation and Grounding of Suppressors: As shown. See Surge Suppressor Installation Details. Grounding equipment, installation of grounding equipment, and terminations for field mounted devices are provided under Division 26, Electrical.

2.06 ELECTRICAL REQUIREMENTS

- A. In accordance with Division 26, Electrical.
- B. I&C and electrical components, terminals, wires, and enclosures: UL recognized or UL listed.
- C. Wires within Enclosures:
1. ac Circuits:
 - a. Type: 300-volt, Type MTW stranded copper.
 - b. Size: For current to be carried, but not less than 18 AWG.
 2. Analog Signal Circuits:
 - a. Type: 300-volt stranded copper, twisted shielded pairs.
 - b. Size: 18 AWG, minimum.
 3. Other dc Circuits.
 - a. Type: 300-volt, Type MTW stranded copper.
 - b. Size: For current carried, but not less than 18 AWG.
 4. Special Signal Circuits: Use manufacturer's standard cables.
 5. Wire Identification: Numbered and tagged at each termination.
 - a. Wire Tags: Machine printed, heat shrink.
 - b. Manufacturers:
 - 1) Brady PermaSleeve.
 - 2) Tyco Electronics.
- D. Wires entering or leaving enclosures, terminate and identify as follows:

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1. Analog and discrete signal, terminate at numbered terminal blocks.
2. Special signals, terminated using manufacturer's standard connectors.
3. Identify wiring in accordance with Section 26 05 05, Conductors.

E. Terminal Blocks for Enclosures:

1. Quantity:
 - a. Accommodate present and spare indicated needs.
 - b. Wire spare PLC I/O points to terminal blocks.
 - c. One wire per terminal for field wires entering enclosures.
 - d. Maximum of two wires per terminal for 18-WG wire for internal enclosure wiring.
 - e. Spare Terminals: 20 percent of all connected terminals, but not less than 10 per terminal block.
2. General:
 - a. Connection Type: Screw compression clamp.
 - b. Compression Clamp:
 - 1) Complies with DIN-VDE 0611.
 - 2) Hardened steel clamp with transversal grooves that penetrate wire strands providing a vibration-proof connection.
 - 3) Guides strands of wire into terminal.
 - c. Screws: Hardened steel, captive and self-locking.
 - d. Current Bar: Copper or treated brass.
 - e. Insulation:
 - 1) Thermoplastic rated for minus 55 to plus 110 degree C.
 - 2) Two funneled shaped inputs to facilitate wire entry.
 - f. Mounting:
 - 1) Standard DIN rail.
 - 2) Terminal block can be extracted from an assembly without displacing adjacent blocks.
 - 3) End Stops: Minimum of one at each end of rail.
 - g. Wire preparation: Stripping only permitted.
 - h. Jumpers: Allow jumper installation without loss of space on terminal or rail.
 - i. Marking System:
 - 1) Terminal number shown on both sides of terminal block
 - 2) Allow use of preprinted and field marked tags.
 - 3) Terminal strip numbers shown on end stops.
 - 4) Mark terminal block and terminal strip numbers as shown on Panel Control Diagrams and Loop Diagrams.
 - 5) Fuse Marking for Fused Terminal Blocks: Fuse voltage and amperage rating shown on top of terminal block.
3. Terminal Block, General-Purpose:

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- a. Rated Voltage: 600V ac.
 - b. Rated Current: 30 amp.
 - c. Wire Size: 22 AWG to 10 AWG.
 - d. Rated Wire Size: 10 AWG.
 - e. Color: Grey body.
 - f. Spacing: 0.25 inch, maximum.
 - g. Test Sockets: One screw test socket 0.079-inch diameter.
 - h. Manufacturer and Product: Entrelec; Type M4/6.T.
4. Terminal Block, Ground:
- a. Wire Size: 22 AWG to 12 AWG.
 - b. Rated Wire Size: 12 AWG.
 - c. Color: Green and yellow body.
 - d. Spacing: 0.25 inch, maximum.
 - e. Grounding: Ground terminal blocks electrically grounded to the mounting rail.
 - f. Manufacturer and Product: Entrelec; Type M4/6.P.
5. Terminal Block, Blade Disconnect Switch:
- a. Rated Voltage: 600V ac.
 - b. Rated Current: 10-amp.
 - c. Wire Size: 22 AWG to 12 AWG.
 - d. Rated Wire Size: 12 AWG.
 - e. Color: Grey body, orange switch.
 - f. Spacing: 0.25 inch, maximum.
 - g. Manufacturer and Product: Entrelec; Type M4/6.SN.T.
6. Terminal Block, Fused, 24V dc:
- a. Rated Voltage: 600V dc.
 - b. Rated Current: 16-amp.
 - c. Wire Size: 22 AWG to 10 AWG.
 - d. Rated Wire Size: 10 AWG.
 - e. Color: Grey body.
 - f. Fuse: 0.25 inch by 1.25 inches.
 - g. Indication: LED diode 24V dc.
 - h. Spacing: 0.512 inch, maximum.
 - i. Manufacturer and Product: Entrelec; Type M10/13T.SFL.
7. Terminal Block, Fused, 120V ac:
- a. Rated Voltage: 600V ac.
 - b. Rated Current: 16-amp.
 - c. Wire Size: 22 AWG to 10 AWG.
 - d. Rated Wire Size: 10 AWG.
 - e. Color: Grey body.
 - f. Fuse: 0.25 inch by 1.25 inches.
 - g. Indication: Neon Lamp 110V ac.
 - h. Leakage Current: 1.8 mA, maximum.

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- i. Spacing: 0.512 inch, maximum
 - j. Manufacturer and Product: Entrelec; Type M10/13T.SFL.
 - 8. Terminal Block, Fused, 120V ac, High Current:
 - a. Rated Voltage: 600V ac.
 - b. Rated Current: 35 amps.
 - c. Wire Size: 18 AWG to 8 AWG.
 - d. Rated Wire Size: 8 AWG.
 - e. Color: Grey.
 - f. Fuse: 13/32 inch by 1.5 inches.
 - g. Spacing: 0.95 inch, maximum.
 - h. Manufacturer and Product: Entrelec; Type MB10/24.SF.
- F. Grounding of Enclosures:
 - 1. Furnish isolated copper grounding bus for signal and shield ground connections.
 - 2. Ground bus grounded at a common signal ground point in accordance with National Electrical Code requirements.
 - 3. Single Point Ground for Each Analog Loop:
 - a. Locate at dc power supply for loop.
 - b. Use to ground wire shields for loop.
 - c. Group and connect shields in following locations:
 - 1) CP-07
 - 2) CP-08
 - 4. Ground terminal block rails to ground bus.
- G. Analog Signal Isolators: Furnish signal isolation for analog signals that are sent from one enclosure to another. Do not wire in series instruments on different panels, cabinets, or enclosures.
- H. Power Distribution within Panels:
 - 1. Feeder Circuits:
 - a. One or more 120V ac, 60-Hz feeder circuits as shown on Drawings.
 - b. Make provisions for feeder circuit conduit entry.
 - c. Furnish terminal board for termination of wires.
 - 2. Power Panel: Furnish main circuit breaker and a circuit breaker on each individual branch circuit distributed from power panel.
 - a. Locate to provide clear view of and access to breakers when door is open.
 - b. Breaker sizes: Coordinate such that fault in branch circuit will blow only branch breaker but not trip the main breaker.

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- i) Branch Circuit Breaker: 15 amps at 250V ac.
 - c. Breaker Manufacturers and Products: Square D, Type QO.
 - 3. Circuit Wiring: P&IDs and Control Diagrams on Drawings show function only. Use following rules for actual circuit wiring:
 - a. Devices on Single Circuit: 20, maximum.
 - b. Multiple Units Performing Parallel Operations: To prevent failure of any single branch circuit from shutting down entire operation, do not group all units on same branch circuit.
 - c. Branch Circuit Loading: 12 amperes continuous, maximum.
 - d. Panel Lighting and Service Outlets: Put on separate 15-amp, 120V ac branch circuit.
 - e. Provide 120V ac plugmold for panel components with line cords.
- I. Signal Distribution:
 - 1. Within Panels: 4 mA to 20 mA dc signals may be distributed as 1 to 5V dc.
 - 2. Outside Panels: Isolated 4 mA to 20 mA dc only.
 - 3. All signal wiring twisted in shielded pairs.
- J. Signal Switching:
 - 1. Use dry circuit type relays or switches.
 - 2. No interruption of 4 mA to 20 mA loops during switching.
 - 3. Switching Transients in Associated Signal Circuit:
 - a. 4 mA to 20 mA dc Signals: 0.2 mA, maximum.
 - b. 1 to 5V dc Signals: 0.05V, maximum.
- K. Relays:
 - 1. General:
 - a. Relay Mounting: Plug-in type socket.
 - b. Relay Enclosure: Furnish dust cover.
 - c. Socket Type: Screw terminal interface with wiring.
 - d. Socket Mounting: Rail.
 - e. Provide holddown clips.
 - 2. Signal Switching Relay:
 - a. Type: Dry circuit.
 - b. Contact Arrangement: 2 Form C contacts.
 - c. Contact Rating: 0 to 5 amps at 28V dc or 120V ac.
 - d. Contact Material: Gold or silver.
 - e. Coil Voltage: As noted or shown.
 - f. Coil Power: 0.9 watts (dc), 1.2VA (ac).

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- g. Expected Mechanical Life: 10,000,000 operations.
 - h. Expected Electrical Life at Rated Load: 100,000 operations.
 - i. Indication Type: Neon or LED indicator lamp.
 - j. Seal Type: Hermetically sealed case.
 - k. Manufacturer and Product: Potter and Brumfield;
Series KH/KHA.
3. Control Circuit Switching Relay, Nonlatching:
- a. Type: Compact general-purpose plug-in.
 - b. Contact Arrangement: 3 Form C contacts.
 - c. Contact Rating: 10A at 28V dc or 240V ac.
 - d. Contact Material: Silver cadmium oxide alloy.
 - e. Coil Voltage: As noted or shown.
 - f. Coil Power: 1.8 watts (dc), 2.7VA (ac).
 - g. Expected Mechanical Life: 10,000,000 operations.
 - h. Expected Electrical Life at Rated Load: 100,000 operations.
 - i. Indication Type: Neon or LED indicator lamp.
 - j. Push to test button.
 - k. Manufacturer and Product: Potter and Brumfield; Series KUP.
4. Control Circuit Switching Relay, Latching:
- a. Type: Dual coil mechanical latching relay.
 - b. Contact Arrangement: 2 Form C contacts.
 - c. Contact Rating: 10A at 28V dc or 120V ac.
 - d. Contact Material: Silver cadmium oxide alloy.
 - e. Coil Voltage: As noted or shown.
 - f. Coil Power: 2.7 watts (dc), 5.3VA (ac).
 - g. Expected Mechanical Life: 500,000 operations.
 - h. Expected Electrical Life at Rated Load: 50,000 operations.
 - i. Manufacturer and Product: Potter and Brumfield; Series KB/KBP.
5. Control Circuit Switching Relay, Time Delay:
- a. Type: Adjustable time delay relay.
 - b. Contact Arrangement: 2 Form C contacts.
 - c. Contact Rating: 10A at 240V ac.
 - 1) Contact Material: Silver cadmium oxide alloy.
 - d. Coil Voltage: As noted or shown.
 - e. Operating Temperature: Minus 10 to 55 degrees C.
 - f. Repeatability: Plus or minus 2 percent.
 - g. Delay Time Range: Select range such that time delay setpoint fall between 20 to 80 percent of range.
 - h. Time Delay Setpoint: As noted or shown.
 - i. Mode of Operation: As noted or shown.
 - j. Adjustment Type: Integral potentiometer with knob external to dust cover.
 - k. Manufacturer and Products: Potter and Brumfield:

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- 1) Series CB for 0.1 second to 100 minute delay time ranges.
- 2) Series CK for 0.1 to 120 second delay time ranges.

L. Power Supplies:

1. Furnish to power instruments requiring external dc power, including two-wire transmitters and dc relays.
2. Convert 120V ac, 60-Hz power to dc power of appropriate voltage(s) with sufficient voltage regulation and ripple control to assure that instruments being supplied can operate within their required tolerances.
3. Provide output over voltage and over current protective devices to:
 - a. Protect instruments from damage due to power supply failure.
 - b. Protect power supply from damage due to external failure.
4. Enclosures: NEMA 1 in accordance with NEMA 250.
5. Mount such that dissipated heat does not adversely affect other components.
6. Fuses: For each dc supply line to each individual two-wire transmitter.
 - a. Type: Indicating.
 - b. Mount so fuses can be easily seen and replaced.

M. Internal Panel Lights for Freestanding Panels:

1. Type: Switched 100-watt incandescent back-of-panel lights.
2. Quantity: One light for every 4 feet of panel width.
3. Mounting: Inside and in the top of back-of-panel area.
4. Protective metal shield for lights.

N. Service Outlets for Freestanding Panels:

1. Type: Three-wire, 120-volt, 15-ampere, GFCI duplex receptacles.
2. Quantity:
 - a. For panels 4 feet wide and smaller: One.
 - b. For panels wider than 4 feet: One for every 4 feet of panel width, two minimum per panel.
3. Mounting: Evenly spaced along back-of-panel area.

O. Internal Panel Lights and Service Outlets for Smaller Panels:

1. Internal Panel Light: Switched 100-watt incandescent light.
2. Service Outlet: Breaker protected 120-volt, 15-amp, GFCI duplex receptacle:

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- P. Standard Pushbutton Colors and Inscriptions: Use following color code and inscriptions for pushbuttons, unless otherwise noted in Instrument List, Article Supplements.

Tag Function	Inscription(s)	Color
OO ON	OFF	Green Red
OC OPEN	CLOSE	Green Red
OCA OPEN	CLOSE AUTO	Green Red White
OOA ON	OFF AUTO	Green Red White
MA MANUAL	AUTO	Yellow White
SS START	STOP	Green Red
RESET RESET		Red
EMERGENCY STOP	EMERGENCY STOP	Red

- a. Lettering Color:
- 1) Black on white and yellow buttons.
 - 2) White on black, red, and green buttons.

- Q. Standard Light Colors and Inscriptions: Use following color code and inscriptions for service legends and lens colors for indicating lights, unless otherwise noted in Instrument List, Article Supplements.

Tag Function	Inscription(s)	Color
ON ON		Green
OFF OFF		Red
OPEN OPEN		Green
CLOSED CLOSE	D	Red

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Tag Function	Inscription(s)	Color
LOW LOW		Amber
FAIL FAIL		Amber
HIGH HIGH		Red
AUTO AUTO		White
MANUAL MANUAL		Yellow
LOCAL LOCAL		White
REMOTE REMOTE		Yellow

1. Lettering Color:
 - a. Black on white and amber lenses.
 - b. White on red and green lenses.

2.07 MECHANICAL SYSTEMS

A. Manifold, Three-Valve Equalizing:

1. Type: For isolation and equalization of differential pressure transducers.
2. Materials: Stainless steel.
3. Manufacturers and Products:
 - a. Anderson, Greenwood and Co.; Type M1.
 - b. Evans.

B. Pressure Gauge: For other than process variable measurement.

1. Dial Size: Nominal 2-inch dial size.
2. Accuracy: 2 percent of span.
3. Scale Range: Such that normal operating pressure lies between 50 and 80 percent of scale range.
4. Connection: 1/4-inch NPT through bottom, unless otherwise noted.
5. Manufacturers and Products:
 - a. Ashcroft Utility; Gauge Series 1000.
 - b. Marsh; Standard Gauge Series.
 - c. Ametek U.S.; Gauge Series P500.
 - d. Acculite; Series 2000.

C. Test Tap:

1. Manufacturers and Products:

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- a. Imperial-Eastman; quick-disconnect couplings No. 292-P and caps No. 259-P.
- b. Crawford Fitting Co.; Swagelok quick-connects Series QC4 and caps QC4-DC.
- c. Parker; CPI Series precision quick couplings.

2.08 TEST EQUIPMENT AND TOOLS

Item	Qty.	Options and Model
Digital Multimeter	2	Fluke Model 87V/E Industrial Electrician Combo Kit with test leads, removable test probes, long reach alligator clips, magnetic hanger, temperature probe, and carrying case.
Clamp-on Ammeter	1	3-1/2-digit display unit with protective case; TES Model 3040 or Fluke Model 337E.
Small Tool Kit	1	Kit of instrument maintenance tools in soft, zipper case; Jensen Tools Model JTK-47CG Field Engineer's Kit.

2.09 SPARE PARTS

Description	Percent of Each Type and Size Used	No Less Than
dc power supplies	20	1 of each type
Fuses	20	5 of each type
Indicating light bulb	20	5 of each type
Relays	20	3 of each type
Terminal Blocks	10	10 of each type

2.10 EXPENDABLES

Item	Quantity
Corrosion-inhibiting vapor capsules	Manufacturer's recommended 2-year supply

2.11 FABRICATION

A. General:

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1. Panels with external dimensions and instruments arrangement as shown on Drawings.
 2. Panel Construction and Interior Wiring: In accordance with the National Electrical Code, state and local codes, NEMA, ANSI, UL, and ICECA.
 3. Fabricate panels, install instruments, wire, and plumb, at the PIC factory.
 4. Electrical Work: In accordance with Division 26, Electrical.
- B. Factory Assembly: Assemble panels at the manufacturer's factory. No fabrication other than correction of minor defects or minor transit damage shall be done on panels at Site.
- C. UL Listing Mark for Enclosures: Mark stating "Listed Enclosed Industrial Control Panel" per UL 508A.
- D. Wiring Within PIC Panels:
1. Restrain by plastic ties or ducts or metal raceways.
 2. Hinge Wiring: Secure at each end so that bending or twisting will be around longitudinal axis of wire. Protect bend area with sleeve.
 3. Arrange wiring neatly, cut to proper length, and remove surplus wire.
 4. Abrasion protection for wire bundles which pass through holes or across edges of sheet metal.
 5. Connections to Screw Type Terminals:
 - a. Locking-fork-tongue or ring-tongue lugs.
 - b. Use manufacturer's recommended tool with required sized anvil to make crimp lug terminations.
 - c. Wires terminated in a crimp lug, maximum of one.
 - d. Lugs installed on a screw terminal, maximum of two.
 6. Connections to Compression Clamp Type Terminals:
 - a. Strip, prepare, and install wires in accordance with terminal manufacturer's recommendations.
 - b. Wires installed in a compression screw and clamp, maximum of one for field wires entering enclosure, otherwise maximum of two.
 7. Splicing and tapping of wires, allowed only at device terminals or terminal blocks.
 8. Terminate 24V dc and analog signal circuits on separate terminal block from ac circuit terminal blocks.
 9. Separate analog and dc circuits by at least 6 inches from ac power and control wiring, except at unavoidable crossover points and at device terminations.

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10. Arrange wiring to allow access for testing, removal, and maintenance of circuits and components.
11. Plastic Wire Ducts Fill: Do not exceed manufacturer's recommendation.

E. Temperature Control:

1. Freestanding Panels:
 - a. Nonventilated Panels: Size to adequately dissipate heat from equipment mounted inside panel or on panel.
 - b. Ventilated Panels:
 - 1) Furnish with louvers and forced ventilation as required to prevent temperature buildup from equipment mounted inside panel or on panel.
 - 2) For panels with backs against wall, furnish louvers on top and bottom of panel sides.
 - 3) For panels without backs against wall, furnish louvers on top and bottom of panel back.
 - 4) Louver Construction: Stamped sheet metal.
 - 5) Ventilation Fans:
 - a) Furnish where required to provide adequate cooling.
 - b) Create positive internal pressure within panel.
 - c) Fan Motor Power: 120V ac, 60-Hz, thermostatically controlled.
 - 6) Air Filters: Washable aluminum, Hoffman Series A-FLT.
2. Space Heaters: Thermostatically controlled to maintain internal panel temperatures above dew point.

F. Freestanding Panel Construction:

1. Materials: Sheet steel, unless otherwise shown on Drawings with minimum thickness of 10-gauge, unless otherwise noted.
2. Panel Fronts:
 - a. Fabricated from a single piece of sheet steel, unless otherwise shown on Drawings.
 - b. No seams or bolt heads visible when viewed from front.
 - c. Panel Cutouts: Smoothly finished with rounded edges.
 - d. Stiffeners: Steel angle or plate stiffeners or both on back of panel face to prevent panel deflection under instrument loading or operation.
3. Internal Framework:
 - a. Structural steel for instrument support and panel bracing.
 - b. Permit panel lifting without racking or distortion.

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4. Lifting rings to allow simple, safe rigging and lifting of panel during installation.
5. Adjacent Panels: Securely bolted together so front faces are parallel.
6. Doors: Full height, fully gasketed access doors where shown on Drawings.
 - a. Latches: Three-point, Southco Type 44.
 - b. Handles: "D" ring, foldable type.
 - c. Hinges: Full length, continuous, piano type, steel hinges with stainless steel pins.
 - d. Rear Access Doors: Extend no further than 24 inches beyond panel when opened to 90-degree position.
 - e. Front and Side Access Doors: As shown on Drawings.

G. Nonfreestanding Panel Construction:

1. Based on environmental design requirements required and referenced in Article Environmental Requirements, provide the following:
 - a. For panels listed as inside:
 - 1) Enclosure Type: NEMA 12 in accordance with NEMA 250.
 - 2) Materials: Steel.
 - b. For all other panels:
 - 1) Enclosure Type: NEMA 4X in accordance with NEMA 250.
 - 2) Materials: Type 316 stainless steel.
2. Metal Thickness: 14-gauge, minimum.
3. Doors:
 - a. Rubber-gasketed with continuous hinge.
 - b. Stainless steel lockable quick-release clamps.
4. Manufacturers:
 - a. Hoffman Engineering Co.
 - b. Rittal.

H. Factory Finishing:

1. Enclosures:
 - a. Stainless Steel and Aluminum: Not painted.
 - b. Nonmetallic Panels: Not painted.
 - c. Steel Panels:
 - 1) Sand panel and remove mill scale, rust, grease, and oil.
 - 2) Fill imperfections and sand smooth.
 - 3) Paint panel interior and exterior with one coat of epoxy coating metal primer, two finish coats of two-component type epoxy enamel.
 - 4) Sand surfaces lightly between coats.

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- 5) Dry Film Thickness: 3 mils, minimum.
- 6) Color: Gray
2. Manufacturer's standard finish color, except where specific color is indicated. If manufacturer has no standard color, finish equipment with light gray color.

2.12 CORROSION PROTECTION

- A. Corrosion-Inhibiting Vapor Capsule Manufacturers:
 1. Northern Instruments; Model Zerust VC.
 2. Hoffmann Engineering Co; Model A-HCI.

2.13 SOURCE QUALITY CONTROL

- A. Scope: Inspect and test entire PIC to ensure it is ready for shipment, installation, and operation.
- B. Location: Manufacturer's factory or Engineer approved staging Site.
- C. Test: Exercise and test all functions.
- D. Temporary PLC software configuring to allow PLC testing.

PART 3 EXECUTION

3.01 EXAMINATION

- A. For equipment not provided by PIC, but that directly interfaces with the PIC, verify the following conditions:
 1. Proper installation.
 2. Calibration and adjustment of positioners and I/P transducers.
 3. Correct control action.
 4. Switch settings and dead bands.
 5. Opening and closing speeds and travel stops.
 6. Input and output signals.

3.02 INSTALLATION

- A. Material and Equipment Installation: Retain a copy of manufacturers' instructions at Site, available for review at all times.
- B. Electrical Wiring: As specified in Division 26, Electrical.

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- C. Enclosure Lifting Rings: Remove rings following installation and plug holes.
- D. Removal or Relocation of Materials and Equipment:
 - 1. Remove from Site materials that were part of the existing facility but are no longer used, unless otherwise directed by Engineer to deliver to Owner.
 - 2. Repair affected surfaces to conform to type, quality, and finish of surrounding surface.

3.03 FIELD FINISHING

- A. Refer to Section 09 90 00, Painting and Coating.

3.04 FIELD QUALITY CONTROL

- A. Startup and Testing Team:
 - 1. Thoroughly inspect installation, termination, and adjustment for components and systems.
 - 2. Complete onsite tests.
 - 3. Complete onsite training.
 - 4. Provide startup assistance.
- B. Operational Readiness Inspections and Calibrations: Prior to startup, inspect and test to ensure that entire PIC is ready for operation.
 - 1. Loop/Component Inspections and Calibrations:
 - a. Check PIC for proper installation, calibration, and adjustment on a loop-by-loop and component-by-component basis.
 - b. Prepare component calibration sheet for each active component (except simple hand switches, lights, gauges, and similar items).
 - 1) Project name.
 - 2) Loop number.
 - 3) Component tag number.
 - 4) Component code number.
 - 5) Manufacturer for elements.
 - 6) Model number/serial number.
 - 7) Summary of functional requirements, for example:
 - a) Indicators and recorders, scale and chart ranges.
 - b) Transmitters/converters, input and output ranges.
 - c) Computing elements' function.
 - d) Controllers, action (direct/reverse) and control modes (PID).

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- e) Switching elements, unit range, differential (fixed/adjustable), reset (auto/manual).
 - 8) Calibrations, for example:
 - a) Analog Devices: Actual inputs and outputs at 0, 10, 50, and 100 percent of span, rising and falling.
 - b) Discrete Devices: Actual trip points and reset points.
 - c) Controllers: Mode settings (PID).
 - 9) Space for comments.
 - c. These inspections and calibrations will be spot checked by Engineer.
 - 2. Leak Test: In accordance with Section 40 80 01, Process Piping Leakage Testing.
- C. Performance Acceptance Tests (PAT): These are the activities that Section 01 91 14, Equipment Testing and Facility Startup, refers to as Performance Testing.
- 1. General:
 - a. Test all PIC elements to demonstrate that PIC satisfies all requirements.
 - b. Test Format: Cause and effect.
 - 1) Person conducting test initiates an input (cause).
 - 2) Specific test requirement is satisfied if correct result (effect) occurs.
 - c. Procedures, Forms, and Checklists:
 - 1) Conduct tests in accordance with, and documented on, Engineer accepted procedures, forms, and checklists.
 - 2) Describe each test item to be performed.
 - 3) Have space after each test item description for sign off by appropriate party after satisfactory completion.
 - d. Required Test Documentation: Test procedures, forms, and checklists. All signed by Engineer and Contractor.
 - e. Conducting Tests:
 - 1) Provide special testing materials, equipment, and software.
 - 2) Wherever possible, perform tests using actual process variables, equipment, and data.
 - 3) If it is not practical to test with real process variables, equipment, and data, provide suitable means of simulation.
 - 4) Define simulation techniques in test procedures.
 - f. Coordinate PIC testing with Owner and affected Subcontractors.
 - 1) Excessive Test Witnessing: Refer to Supplementary Conditions.
 - 2. Test Requirements:

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- a. Once facility has been started up and is operating, perform a witnessed PAT on complete PIC to demonstrate that it is operating as required. Demonstrate each required function on a paragraph-by-paragraph and loop-by-loop basis.
- b. Perform local and manual tests for each loop before proceeding to remote and automatic modes.
- c. Where possible, verify test results using visual confirmation of process equipment and actual process variable. Unless otherwise directed, exercise and observe devices supplied by others, as needed to verify correct signals to and from such devices and to confirm overall system functionality. Test verification by means of disconnecting wires or measuring signal levels is acceptable only where direct operation of plant equipment is not possible.
- d. Make updated versions of documentation required for PAT available to Engineer at Site, both before and during tests.
- e. Make one copy of O&M manuals available to Engineer at the Site both before and during testing.
- f. Refer to referenced examples of PAT procedures and forms in Article Supplements.

3.05 TRAINING

A. General:

1. Provide an integrated training program to meet specific needs of Owner's personnel.
2. Include training sessions, classroom and field, for managers, engineers, operators, and maintenance personnel.
3. Provide instruction on two working shift(s) as needed to accommodate the Owner's personnel schedule.
4. Owner reserves the right to make and reuse video tapes of training sessions.

B. Operations and Maintenance Training:

1. Include a review of O&M manuals and survey of spares, expendables, and test equipment.
2. Use equipment similar to that provided or currently owned by Owner.
3. Provide training suitable for instrument technicians with at least a 2-year associate engineering or technical degree, or equivalent education and experience in electronics or instrumentation.

C. Operations Training:

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1. Training Session Duration: 2 4-hour instructor days.
2. Number of Training Sessions: Two.
3. Location: Site.
4. Content: Conduct training on loop-by-loop basis.
 - a. Loop Functions: Understanding of loop functions, including interlocks for each loop.
 - b. Loop Operation: For example, adjusting process variable setpoints, AUTO/MANUAL control transfer, AUTO and MANUAL control, annunciator acknowledgement and resetting.
 - c. Interfaces with other control systems.

D. Maintenance Training:

1. Training Session Duration: 2 4-hour instructor days.
2. Number of Training Sessions: Two.
3. Location: Project Site.
4. Content: Provide training for each type of component and function provided.
 - a. Loop Functions: Understanding details of each loop and how they function.
 - b. Component calibration.
 - c. Adjustments: For example, controller tuning constants, current switch trip points, and similar items.
 - d. Troubleshooting and diagnosis for components.
 - e. Replacing lamps, chart paper, fuses.
 - f. Component removal and replacement.
 - g. Periodic maintenance.

3.06 CLEANING/ADJUSTING

- A. Repair affected surfaces to conform to type, quality, and finish of surrounding surface.
- B. Cleaning:
 1. Prior to closing system using tubing, clear tubing of interior moisture and debris.
 2. Upon completion of Work, remove materials, scraps, and debris from interior and exterior of equipment.

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3.07 PROTECTION

- A. Protect enclosures and other equipment containing electrical, instrumentation and control devices, including spare parts, from corrosion through the use of corrosion-inhibiting vapor capsules.
- B. Periodically replace capsules in accordance with capsule manufacturer's recommendations. Replace capsules just prior to Final Payment and Acceptance.

3.08 SUPPLEMENTS

- A. Supplements listed below, following "End of Section," are part of this Specification.
 - 1. Component Specifications.
 - 2. Instrument List.
 - 3. Loop Specifications.
 - 4. PLC Input and Output List.
 - 5. Control Panel Schedule
 - 6. PLC Equipment List
 - 7. Instrument Calibration Sheet: Provides detailed information on each instrument (except simple hand switches, lights, and similar items).
 - 8. Performance Acceptance Test Sheet: Describes the PAT for a given loop. The format is mostly free form.
 - a. List the requirements of the loop.
 - b. Briefly describe the test.
 - c. Cite expected results.
 - d. Provide space for check off by witness.

END OF SECTION

SUPPLEMENT 1 COMPONENT SPECIFICATIONS**A. F4 Flow Element and Transmitter, Electromagnetic:**

1. General:
 - a. Function: Measure, indicate, and transmit the flow of a conductive process liquid in a full pipe.
 - b. Type:
 - 1) Electromagnetic flowmeter, with operation based on Faraday's Law, utilizing the pulsed dc type coil excitation principle with high impedance electrodes.
 - 2) Full bore meter with magnetic field traversing entire flow-tube cross section.
 - 3) Unacceptable are insert magmeters or multiple single point probes inserted into a spool piece.
 - c. Parts: Flow element, transmitter, interconnecting cables, and mounting hardware. Other parts as noted.
2. Service:
 - a. Stream Fluid:
 - 1) As noted.
 - 2) Suitable for liquids with a minimum conductivity of 5 microS/cm and for demineralized water with a minimum conductivity of 20 microS/cm.
 - b. Flow Stream Descriptions: If and as described below.
3. Operating Temperature:
 - a. Element:
 - 1) Ambient: Minus 5 to 140 degrees F, typical, unless otherwise noted.
 - 2) Process: Minus 5 to 140 degrees F, typical, unless otherwise noted.
 - b. Transmitter:
 - 1) Ambient: Minus 5 to 140 degrees F, typical, unless otherwise noted.
 - 2) Storage: 15 to 120 degrees F, typical, unless otherwise noted.
4. Performance:
 - a. Flow Range: As noted.
 - b. Accuracy: Plus or minus 0.5 percent of rate for all flows resulting from pipe velocities of 2 to 30 feet per second.
 - c. Turndown Ratio: Minimum of 10 to 1 when flow velocity at minimum flow is at least 1 foot per second.
5. Features:

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- a. Zero stability feature to eliminate the need to stop flow to check zero alignment.
- b. No obstructions to flow.
- c. Very low pressure loss.
- d. Measures bi-directional flow.
- 6. Process Connection:
 - a. Meter Size (diameter inches): As noted.
 - b. Connection Type: 150-pound ANSI raised-face flanges; AWWA C207, Table 2 Class D; or wafer style depending on meter size, unless otherwise noted.
 - c. Flange Material: Carbon steel, unless otherwise noted.
- 7. Power (Transmitter): 120V ac, 60-Hz, unless otherwise noted.
- 8. Element:
 - a. Meter Tube Material: Type 304 or 316 stainless steel, unless otherwise noted.
 - b. Liner Material:
 - 1) Neoprene or polyurethane, unless otherwise noted.
 - 2) For potable water service, must have appropriate approvals.
 - c. Liner Protectors: Covers (or grounding rings) on each end to protect liner during shipment.
 - d. Electrode Type: Flush or bullet nose as recommended by the manufacturer for the noted stream fluid.
 - e. Electrode Material: Type 316 stainless steel or Hastelloy C, unless otherwise noted.
 - f. Grounding Ring:
 - 1) Required, unless otherwise noted.
 - 2) Quantity: Two, unless otherwise noted.
 - 3) Material: Type 316 stainless steel, unless otherwise noted.
 - g. Enclosure: NEMA 4X, minimum, unless otherwise noted.
 - h. Submergence:
 - 1) Temporary: If noted.
 - 2) Continuous (up to 10 feet depth), NEMA 6P/IP68: If noted.
 - i. Direct Buried (3 to 10 feet): If noted.
 - j. Hazardous Area Certification:
 - 1) Class I, Division 2, Groups A, B, C, D: If noted.
 - 2) Class I, Division 1, Groups A, B, C, D, and FM approved: If noted.
 - 3) Class I, Division 1, Groups C, D, and FM approved: If noted.
- 9. Transmitter:
 - a. Mounting: Surface (wall), unless otherwise noted.
 - b. Display: Required, unless otherwise noted.
 - 1) Digital LCD display, indicating flow rate and total.

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- 2) Bi-directional Flow Display: Required, unless otherwise noted.
 - a) Forward and reverse flow rate.
 - b) Forward, reverse and net totalization.
 - c. Parameter Adjustments: By keypad or non-intrusive means.
 - d. Enclosure: NEMA 4X, minimum, unless otherwise noted.
 - e. Empty Pipe Detection:
 - 1) If noted.
 - 2) Drives display and outputs to zero when empty pipe detected.
10. Signal Interface (at Transmitter):
 - a. Analog Output:
 - 1) Isolated 4 mA to 20 mA dc for load impedance from 0 ohm to at least 500 ohms minimum for 24V dc supply.
 - 2) Supports Superimposed Digital HART protocol: If noted.
 - b. Discrete Outputs: If noted.
 - 1) Two discrete outputs, typical, rated for up to 30 volts, typical.
 - 2) Programmable as noted for the following typical parameters:
 - a) Totalizer pulse, high/low flow rates, percent of range, empty pipe zero, fault conditions, forward/reverse, etc.
 - c. Discrete Input: If noted.
 - 1) Contact closure, configured as noted for the following typical parameters: reset totalizer, change range, hold output constant, drive output to zero, and low flow cutoff, etc.
 - d. Other: As noted.
11. Cables:
 - a. Types: As recommended by manufacturer.
 - b. Lengths: As required to accommodate device locations.
12. Built-in Diagnostic System:
 - a. Features:
 - 1) Field programmable electronics.
 - 2) Self-diagnostics with troubleshooting codes.
 - 3) Ability to program electronics with full scale flow, engineering units, meter size, zero flow cutoff, desired signal damping, totalizer unit digit value, etc.
 - 4) Initial flow tube calibration and subsequent calibration checks.
13. Factory Calibration:
 - a. Calibrated in an ISO 9001 and NIST certified factory.

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- b. Factory flow calibration system must be certified by volume or weight certified calibration devices.
 - c. Factory flow calibration system shall be able to maintain calibration flow rate for at least 5 minutes for repeatability point checks.
14. Manufacturers:
- a. ABB Automation MagMaster (includes Transmitter):
 - 1) 10D1475 Mini-Mag (size: 1/10 to 4 inches).
 - 2) MFE (size: 1/2 to 24 inches).
 - 3) Plus MFF (size: 8 to 84 inches).
 - b. Emerson Process Management, Rosemount Division:
 - 1) Model 8705 (flanged) and Model 8711 (wafer) flow tubes.
 - 2) Model 8712 (surface) and Model 8732 (integral) transmitters.
 - c. Invensys Foxboro (includes IMT 25 Series Intelligent Magnetic Flow Transmitter):
 - 1) 8000A Series Wafer Body (size: 1/16 to 16 inches).
 - 2) 9100A Series Flanged Body Flow Tubes (size: 1 to 78 inches).
 - 3) 9200A Series Flanged Body Flow Tubes (size: 8 to 48 inches).
 - 4) 9300A Series Flanged Body Flow Tubes (size: 8 to 16 inches).
 - d. Krohne [includes IFC 020K/IFC 090K (integral) or IFC 020F/IFC 090F (remote) signal converter].
 - 1) Aqua Flux Flowmeter (size: 3/8 to 120 inches).
 - 2) EnviroMag, IFS 4000 Flowmeter (size: 2 to 60 inches).
 - 3) IFS 1000 EcoFlux Flowmeter (size: 1/10 to 8 inches).

B. L23 Level Element and Switch, Thermal:

- 1. General:
 - a. Function: Monitor process fluid level and provide contact closure at setpoint.
 - b. Type: Thermal dispersion level switch using a heated active RTD and a reference RTD temperature sensor to detect contact with process fluid by measuring temperature difference between the two sensors.
- 2. Service: Process Fluid: Water, unless otherwise noted.
- 3. Performance:
 - a. Accuracy: Greater of plus or minus 5.0 percent of reading or plus or minus 0.04 sfps (liquid) or plus or minus 2 sfps (gas).

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- b. Repeatability: Plus or minus 0.5 percent of reading, at constant temperature and pressure.
- c. Temperature, Operating: Sensor Element: Minus 40 degrees F to plus 350 degrees F.
- d. Pressure, Operating: To 3,500 psig at 70 degrees F, to 2,350 psig at 500 degrees F.
- 4. Features:
 - a. Wetted Surfaces Materials: Type 316 stainless steel, unless otherwise noted.
 - b. Temperature Compensation: Via factory calibration.
 - c. Sensor Style: Spherical probe tip.
- 5. Process Connections:
 - a. Type: 3/4-inch MNPT, unless otherwise noted.
 - b. Connection Type: Insertion.
- 6. Conduit Connection: 1-inch FNPT.
- 7. Element Insertion Length: 2 inches from tip of probe to process connection, unless otherwise noted.
- 8. Electronics:
 - a. Location: Integral, unless otherwise noted.
 - b. Operating Temperature: Minus 40 degrees F to 140 degrees F.
 - c. Calibration Circuit: Built in for field adjustment of setpoint.
- 9. Signal Interface Contact: DPDT, rated 6 amps at 115V ac, 220V ac or 24V dc.
- 10. Enclosure:
 - a. Type: NEMA 4X.
 - b. Enclosure: Aluminum, unless otherwise noted.
 - c. Approval: Hazardous locations, Class I and Class II, Division 1 and Division 2, Groups B, C, D, E, F, and G.
- 11. Ancillaries:
 - a. Furnish interconnecting cable if remote electronics specified:
 - 1) Cable Jacket: PVC, unless otherwise noted.
 - 2) Cable Length: 10 feet, unless otherwise noted.
- 12. Power: 120V ac, 60-Hz, unless otherwise noted.
- 13. Identifying Tag: Stainless steel.
- 14. Manufacturer and Product:
 - a. Magnetrol ThermoTel; Model TD2.
 - b. Fluid Components, Inc.; Model FLT93S.

C. M12 Hand Switch and Light, Oiltight, Round:

- 1. General:
 - a. Function: Select, initiate, and display discrete control functions.
 - b. Type: Heavy-duty, oiltight, industrial.

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2. General Features:
 - a. Mounting: 30.5 mm single round hole. Panel thickness 1/16 inch to 1/4 inch.
 - b. Legend Plate: Standard size square style aluminum field and black markings, unless otherwise noted. Markings as shown.
 - c. Configuration: Light, pushbutton, or switch as noted or shown.
 3. Light Features:
 - a. Lights: 6V ac lamps and integral transformer for operation from 120V ac, unless otherwise noted.
 - b. Lens Color: Color as specified under PANEL, STANDARD LIGHT COLOR AND INSCRIPTIONS, or as noted.
 4. Pushbutton and Switch Features:
 - a. Guard: Full guard with flush button, unless otherwise noted.
 - b. Operator: Black pushbutton, black nonilluminated knob on switch, unless otherwise noted.
 - c. Boot: None, unless otherwise noted.
 5. Signal Interface:
 - a. Contact Block:
 - 1) Type: Silver-coated butting, unless otherwise noted.
 - 2) Rating: 10 amps continuous at 120V ac or as noted.
 - 3) Sequence: Break-before-make, unless otherwise shown.
 - 4) Arrangement: Normally open or normally closed as shown, or perform functions noted.
 - 5) Terminals: Screw with strap clamp, unless otherwise noted.
 6. NEMA Rating: NEMA 4, watertight and dust-tight and NEMA 13, oiltight.
 7. Manufacturers/Models:
 - a. Allen-Bradley; Bulletin 800T.
 - b. Eaton Corp.; Cutler-Hammer, Type 10250T.
 - c. Square D Co.; Class 9001, Type K.
- D. M30 Horn, Indoor/Outdoor:
1. General:
 - a. Function: Audible alarm.
 2. Performance:
 - a. Temperature, Operating: Minus 65 to 150 degrees F.
 - b. Sound Output Level: 100 dB nominal at 10 feet.
 3. Features:
 - a. Dimensions: 4-3/8 inches in height and width, and 2.5 inches in depth, for horn and enclosure.
 - b. Diaphragm: Stainless steel.
 - c. Projector: None, unless otherwise noted.
 - d. Listings: UL listed, FM, CSA approved.

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4. Enclosure:
 - a. Type: Cast aluminum neoprene-gasketed weatherproof housing.
 - b. Mounting: Surface mount.
 - c. Optional panel mounting gasket kit for flush panel mounting, when noted.
5. Power: 120V ac, 50/60-Hz, unless otherwise noted.
6. Manufacturer: Federal Signal Corp.; Model 350WB; Model 31X for explosion proof installations.

E. P4 Pressure Gauge:

1. General:
 - a. Function: Local pressure indication.
 - b. Type: Bourdon tube element.
2. Performance:
 - a. Scale Range: As noted.
 - b. Accuracy: Plus or minus 0.50 percent of full scale.
3. Features:
 - a. Dial: 4-1/2-inch diameter.
 - b. Pointer Vibration Reduction: Required, unless otherwise noted. Use the following method.
 - 1) Liquid filled gauge front, unless otherwise noted.
 - a) Glycerine fill, unless otherwise noted.
 - c. Case Material: Black thermoplastic, unless otherwise noted.
 - d. Materials of Wetted Parts (including element, socket/process connection, throttling device (if specified) and secondary components):
 - 1) Stainless steel, unless otherwise noted.
 - e. Pointer: Adjustable by removing ring and window.
 - f. Window: Glass or acrylic, unless otherwise noted.
 - g. Threaded reinforced polypropylene front ring.
 - h. Case Type: Solid front with blow-out back.
4. Process Connection:
 - a. Mounting: Lower stem, unless otherwise noted.
 - b. Size: 1/2-inch MNPT, unless otherwise noted.
5. Accessories:
 - a. Throttling Device: Required, unless otherwise noted.
 - 1) Type suitable for the intended service.
 - 2) Install in gauge socket bore.
6. Manufacturers and Products:
 - a. Ashcroft; Duragauge Model 1259/Model, 1279/Model, 1279 PLUS!
 - b. Ametek U.S. Gauge; Solfrunt Model 19XX/1981 Advantatge.

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- c. WIKA, Type 2XX.34.
- F. P8 Pressure Switch, Fixed Deadband:
 - 1. General:
 - a. Function: Monitor pressure.
 - b. Type: Diaphragm actuated switch.
 - 2. Performance:
 - a. Setpoint:
 - 1) As noted.
 - 2) Repeatability: Plus or minus 1 percent.
 - b. Range: Noted setpoint shall fall between 20 percent and 80 percent of range.
 - c. Overpressure Proof Pressure: At least 400 percent of rated maximum static pressure.
 - d. Operating Temperature Range:
 - 1) Dependent on actuator seal materials.
 - 2) For Buna-N seal, 0 degrees F to 150 degrees F.
 - 3. Features:
 - a. Actuator Seal: Buna-N, unless otherwise noted.
 - b. Differential (deadband): Fixed.
 - c. Reset: Automatic, unless otherwise noted.
 - d. Mounting: Surface, unless otherwise noted.
 - 4. Process Connection:
 - a. 1/4-inch NPT female connections, unless otherwise noted.
 - b. Materials: Nickel-plated brass, unless otherwise noted.
 - 5. Enclosure: NEMA 4X.
 - 6. Signal Interface:
 - a. Contact Type:
 - 1) SPDT, unless otherwise noted.
 - 2) Rated for 10 amps minimum at 120V ac.
 - b. Hermetically Sealed Switch: If noted.
 - 7. Manufacturers and Products:
 - a. Ashcroft; Type 400, B Series.
 - b. United Electric; 400 Series.
- G. P15 Pressure Seal, Annular:
 - 1. General:
 - a. Function: Sense pressure in a process line and transfer to a pressure monitoring device(s), such as a pressure gauge or switch.
 - b. Type: Annular fluid-filled device that measures pressure around the full inside circumference of the pipeline.
 - 2. Performance:

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- a. Operating Conditions: Suitable for line pressures up to pipe flange rating.
 - 3. Features:
 - a. Materials:
 - 1) Body: Carbon steel, unless otherwise noted.
 - 2) Flanges: Carbon steel, unless otherwise noted.
 - 3) Flexible Liner: Buna-N, unless otherwise noted.
 - 4) Sensing Fluid: 50 percent ethylene glycol and water, unless otherwise noted.
 - b. Factory Filled System: Locked-in and sealed sensing fluid which is factory filled and assembled to the pressure device(s).
 - 4. Process Connections:
 - a. ANSI 125-pound flanges, unless otherwise noted.
 - b. Pipe Size: As noted.
 - 5. Manufacturers:
 - a. Red Valve Company; Series 40, Series 42.
 - b. Ronningen-Petter; Iso-Spool or Iso-Ring.
- H. Y40 Uninterruptible Power Supply System:
- 1. General:
 - a. Function: Provides isolated, regulated uninterrupted ac output power during a complete or partial interruption of incoming line power. True online, double conversion.
 - b. Major Parts: Inverter, battery charger, sealed battery, external maintenance bypass switch, and relay adapter board.
 - 2. Performance:
 - a. Capacity: As noted in Instrument List.
 - b. Input Power:
 - 1) 120V ac single-phase, 60-Hz, unless otherwise noted.
 - 2) Connections: Manufacturer's standard, unless otherwise noted.
 - c. Output Power:
 - 1) 120V ac single-phase, 60-Hz, unless otherwise noted.
 - 2) Connections: Manufacturer's standard, unless otherwise noted.
 - d. On-line Efficiency: 89 to 92 percent minimum, unless otherwise noted.
 - e. Backup Runtime:
 - 1) Full Load: 9 minutes minimum, unless otherwise noted.
 - 2) Half Load: 20 minutes minimum, unless otherwise noted.
 - f. Continuous no-break power with no measurable transfer time.

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- g. True Sine-Wave Output Voltage Total Harmonic Distortion (THD): Plus or minus 6 percent or less.
 - h. Input Voltage Range: 80 to 144 volts without using batteries.
 - i. Output Voltage Regulation: Plus or minus 3 percent nominal.
 - j. Operating Temperature: 0 degrees to 40 degrees C (32 degrees to 104 degrees F).
 - k. Operating Relative Humidity: 0 to 90 percent without condensation.
 - l. Lightning and Surge Protection: Pass lightning standard IEEE C62.41 Category B.
3. Features:
- a. External Bypass Switches: Make before break bypass switch required.
 - b. Relay Adapter Board: Normal open dry relay contacts to activate on a low battery condition.
4. Manufacturer and Product:
- a. Powerware; 9130 Rackmount Uninterruptible Power System.
 - b. Or equal.

I. Y50 Programmable Logic Controller System:

1. General:
- a. Provide a complete and fully functioning PLC system consisting of the PLC major component items listed in the table below and as shown in the PLC Equipment List. Furnish all required ancillary devices and cables necessary to provide a functional system meeting the needs of the Project.
 - b. PLC hardware shall be Modicon Quantum to match existing PLC systems at the plant; no substitutions permitted.

Major PLC Component List			
Item	Model	Number	Description
1	140 CPU 434 12 U	Modicon	PLC Processor Module
2	140 XBP 016 00	Modicon	16 Slot Backplane
3	140 CPS 114 20	Modicon	Power Supply, 120/240V AC, High Capacity, 130VA
4	140 NWM 100 00	Modicon	Ethernet Module
5	140 ACI 030 00	Modicon	8-Point Analog Input Module

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Major PLC Component List			
Item	Model	Number	Description
6	140 ACO 020 00	Modicon	4-Point Analog Output Module
7	140 DAI 540 00	Modicon	16-Point Discrete Input Module
8	140 DAO 842 10	Modicon	16-Point Discrete Output Modules

J. Y51 Local Operator Terminal, Industrial Computer:

1. General: Provide rugged graphical interface to monitor and control the process via the plant supervisory control system.
2. Operator-Interface Terminal (OIT) Device:
 - a. Display:
 - 1) Type: Color Active Matrix Thin Film Transistor (TFT).
 - 2) Size: 15 inch, minimum.
 - 3) Resolution: 1,024 pixels by 768 pixels.
 - 4) Resistive Touch-screen.
 - b. Logic Module:
 - 1) Processor: 850 MHz Pentium III, minimum.
 - 2) Memory: 256 Mbytes RAM, minimum.
 - 3) Hard Drive: 20 Gbytes, minimum.
 - 4) Accessory Drives: DVD/CD-RW drive.
 - 5) Expansion Slots:
 - a) One half-length PCI slot.
 - b) One compact flash slot.
 - 6) Communications Ports:
 - a) 10/100 M Ethernet RJ-45 Port.
 - b) Keyboard and mouse ports.
 - c) Two USB ports.
 - 7) Operating System: Windows 2000, or Windows XP.
3. Physical:
 - a. Operating Temperature: 32 to 122 degrees F.
 - b. Humidity Rating: 5 to 90 percent, noncondensing.
 - c. Vibration, Operating: 0.006 inch p-p, 10 to 57-Hz. 1.0g peak, 57 to 500-Hz.
 - d. Shock, Operating: 10 g.
 - e. Rating: NEMA 4X.
 - f. UL recognized.

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4. Electrical:
 - a. Power Requirement: 120V ac.
5. Panel Enclosure: Mount device in a stainless-steel, NEMA 4X enclosure. Enclosure dimensions shall be minimum of 24 inches by 24 inches by 20 inches (H by W by D). Enclosure shall be Hoffman, or equal.
6. Manufacturers and Products:
 - a. Allen-Bradley; VersaView 1500P.
 - b. Ann Arbor Technologies; INX8500.

K. Y56 Industrial Ethernet Switch:

1. General:
 - a. Function: Connect PIC to process control network.
 - b. Type: Unmanaged.
 - c. Parts: Switch with built-in copper Ethernet ports and optional fiber ports.
2. Service:
 - a. Temperature: Minus 4 to 158 degrees F.
 - b. Humidity: 10 to 95 percent, noncondensing.
 - c. Vibration/Seismic: 50 g, 5 to 200 Hz, Triaxial.
 - d. Shock: 200 g at 10 ms.
3. Performance:
 - a. IEEE Compliance: Full 802.3.
 - b. EMI Emissions and Safety: FCC Part 15A, UL 1604, Class I, Division 2, Groups A, B, C, D, T4A.
4. Features:
 - a. Number of Ports:
 - 1) 10/100Base TX copper: As required to connect equipment shown on drawings with a minimum of 2 spare ports.
 - 2) Multimode 100Base FX fiber optic: Provide if noted. Quantity one or two as required for fiber connections shown on drawings.
 - b. Protocols: All standard IEEE 802.3.
 - c. Port Type:
 - 1) RJ45 copper connection; 10/100 Mbps auto-sensing.
 - 2) Fiber connection; 100 Mbps. Type ST or SC as noted. For connections to existing patch panels, match to existing connector type unless otherwise noted.
 - d. Full-Duplex Operation: Automatically switches from half-duplex to full-duplex when full-duplex capable devices are sensed on ports.
 - e. MAC Addresses Supported: 4,000.

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- f. Mounting: DIN rail, panel or rack mountable. Provide DIN rail mounting unless otherwise noted.
- 5. Power: 10V to 30V dc.
- 6. Manufacturers and Products:
 - a. N-Tron; 500 Series.
 - b. Or equal.

END OF SUPPLEMENT 1

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Supplement 2 -- Instrument List			
Tag No.	Comp Code	Component Title	Drawing
13FIT1481, 13FE1481	F4	Flow Element And Transmitter, Electromagnetic	M-1
13FIT1482, 13FE1482	F4	Flow Element And Transmitter, Electromagnetic	M-1
12LSL201	L23	Level Element And Switch, Thermal	I-5
13HS201	M12	Hand Switch And Light, Oiltight, Round	I-2
13YA211	M30	Indoor/Outdoor Horn	I-2
13YA212	M30	Indoor/Outdoor Horn	I-2
10PI1201	P4	Pressure Gauge	I-4
10PI1202	P4	Pressure Gauge	I-4
10PI1203	P4	Pressure Gauge	I-4
13PI131 P4		Pressure Gauge	I-3

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Supplement 2 – Instrument List				
Tag No.	Comp Code	Component Title	Component Options	Drawing
13PI132 P4		Pressure Gauge	Scale Range: 0 to 100 psig	I-3
13PI970	P4	Pressure Gauge	Scale Range: 0 to 60 psig	I-2
13PI980	P4	Pressure Gauge	Scale Range: 0 to 60 psig	I-2
10PSH1201	P8	Pressure Switch, Fixed Deadband	Setpoint: 30 psig, rising	I-4
10PSH1202	P8	Pressure Switch, Fixed Deadband	Setpoint: 30 psig, rising	I-4
10PSH1203	P8	Pressure Switch, Fixed Deadband	Setpoint: 30 psig, rising	I-4
13PSH970	P8	Pressure Switch, Fixed Deadband	Setpoint: 30 psig, rising	I-2
13PSH980	P8	Pressure Switch, Fixed Deadband	Setpoint: 30 psig, rising	I-2
10PE1201	P15	Pressure Seal, Annular	Pipe Size: 4 inch Instrument Connection: 1/2 inch female NPT	I-4
10PE1202	P15	Pressure Seal, Annular	Pipe Size: 4 inch Instrument Connection: 1/2 inch female NPT	I-4
10PE1203	P15	Pressure Seal, Annular	Pipe Size: 4 inch Instrument Connection: 1/2 inch female NPT	I-4
13PE970	P15	Pressure Seal, Annular	Pipe Size: 4 inch Instrument Connection: 1/2 inch female NPT	I-2
13PE980	P15	Pressure Seal, Annular	Pipe Size: 4 inch Instrument Connection: 1/2 inch female NPT	I-2
UPS	Y40	Uninterruptible Power Supply	Location: Inside CP-07	I-6

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Supplement 2 -- Instrument List			
Tag No.	Comp Code	Component Title	Drawing
		Power Output: 1500VA	
PLC-07	Y50	Plc Hardware	I-6
PLC-08	Y50	Plc Hardware	I-6
OPERATOR	Y51 Local	Operator Terminal, Industrial Computer	I-6
E-SWITCH	Y56	Industrial Ethernet Switch	I-6
E-SWITCH	Y56	Industrial Ethernet Switch	I-6
		Location: Inside CP-07	
		Location: Inside CP-08	
		Location: CP-07	
		Mounting: Front of Panel	
		Location: Inside CP-07	
		Location: Inside CP-08	

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**SUPPLEMENT 3
LOOP SPECIFICATIONS****GENERAL**

Modify existing Wonderware Intouch v9.5 plant control system HMI. Update HMI tag database with equipment Input/Output as shown on PLC IO List. Update HMI tag database with standard process data and alarms provide by equipment manufacturer's package control system's digital communication interface. Update HMI Alarm database with alarm Inputs as shown on PLC IO List.

The operator interface terminals (OIT) not part of a package system are configured as a terminal services client. OITs do not require additional process control software program.

A. Standard Analog Instrument Functions:

1. Functions:
 - a. Monitor analog instrument value
 - b. Alarm on High and Low value
2. PLC Functions:
 - a. Receive and Scale analog instrument value.
 - b. Provide Operator adjustable High and Low alarm setpoints.
 - c. Provide 30 second time delay to prevent nuisance alarm notification.
 - d. Provide alarm disable.
3. HMI/OIT Functions:
 - a. Display analog instrument value.
 - b. Display alarm status and alarm setpoint value.
 - c. Provide operator control to adjust alarm setpoint value.
 - d. Provide trend display of analog instrument value.
 - e. Provide operator control for alarm disable.

B. Standard Equipment Functions:

1. Functions:
 - a. Monitor equipment status.
 - b. Provide manual operator control (for equipment with REMOTE mode).
2. PLC Functions:
 - a. Provide individual runtime duration timer and reset.
 - b. Provide equipment start counter and reset.

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- c. Provide operator start and stop control (for equipment with REMOTE mode).
 - d. Receive equipment status and alarms.
 - e. Provide 30 second time delay to prevent nuisance alarm notification.
 - f. Provide alarm disable.
 - 3. HMI/OIT Functions
 - a. Display and trend equipment runtime.
 - b. Display and trend equipment start counter.
 - c. Display equipment status and alarms.
 - d. Provide operator start and stop control (for equipment with REMOTE mode).
 - e. Provide operator reset for equipment runtime and start counter.
 - f. Provide operator control for alarm disable.
- C. Dissolved Air Flotation Thickener (DAFT):
 - 1. HMI Functions:
 - a. Provide monitoring and control of the DAFT unit number 2 and 3.
 - b. Provide digital communication interface between the DAFT control panels and the plant control system HMI.
 - c. Provide a process screen to display equipment status and alarms. Annunciate standard alarm conditions on the HMI alarm screens.
 - d. Provide monitoring and control of DAFT equipment as shown on drawings.
 - 2. OIT Functions: Provided by equipment manufacturer's OIT.
- D. Thickened Sludge Pumping:
 - 1. Provide standard equipment functions for TWAS pumps 1 and 2.
 - 2. Provide standard analog instrument functions for TWAS wet well level instrument.
 - 3. HMI/OIT Functions:
 - a. Provide a process screen to display equipment status and alarms. Annunciate standard alarm conditions on the HMI alarm screens.
 - 4. DAFT Polymer Feed System: Provide standard equipment functions for DAFT Polymer Feed System
 - a. HMI/OIT Functions: Provide a process screen to display equipment status and alarms. Annunciate standard alarm conditions on the HMI alarm screens.
- E. Hot Water Boiler No. 2: Provide standard equipment functions for Hot Water Boiler No. 2.

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1. HMI Functions:
 - a. Provide monitoring of Hot Water Boiler system.
 - b. Provide digital communication interface between the Hot Water Boiler control panel and the plant control system HMI.
 - c. Provide a process screen to display equipment status and alarms. Annunciate standard alarm conditions on the HMI alarm screens.
 2. OIT Functions: Provided by equipment manufacturer's OIT.
- F. Digester Mixing Pump: Provide standard equipment functions for Digester Mixing Pump.
1. HMI/OIT Functions: Provide a process screen to display equipment status and alarms. Annunciate standard alarm conditions on the HMI alarm screens.
- G. Common Alarm:
1. Functions:
 - a. Provide a common alarm and reset to annunciate plant alarms.
 - b. Operate outside alarm horn to notify operations staff of a plant alarm condition.
 2. PLC Functions:
 - a. Provide common alarm for alarm conditions.
 - b. Provide operator reset.
 - c. Provide operator alarm disable.
 3. HMI/OIT Functions:
 - a. Provide operator reset control of alarm status.
 - b. Provide operator alarm disable control.
- H. PLC status and monitoring:
1. Functions: Provide watchdog timer to monitor communication between PLC and HMI.
 - a. PLC Functions:
 - 1) Provide operator control of PLC clock.
 - 2) Provide watchdog timer value equal to the total number of seconds in the current day.
 - 3) Provide alarm status for Input Output Modules.
 - b. HMI/OIT Functions:
 - 1) Display PLC clock.
 - 2) Provide operator control to synchronize PLC clock with HMI clock.
 - 3) Display and trend PLC watchdog timer value.