

MEPNN Supplier Scouting Opportunity Synopsis

Section 1: General Information

Scouting Number	2025-070
Item to be Scouted	BABA - Vibration Monitoring System
Days to be scouted	21
Response Due By	04/02/2025
Description	26 09 14: Vibration Monitoring System Pages 01 - 36 40 90 10: Instrument Components Package Control System Pages 75 - 136 of attached document 40 90 11: Network Components Pages 137 - 168 of attached document 40 90 12: PLC Components Pages 169 - 188 40 90 13: Control and Network Panel Components Pages 189 - 40 90 21: Analyzer Control Panels Page 245 - 270 40 90 22: Network Panels Page 271 - 294 40 99 90: Package Control Systems Page 301 - 319
Notify Requester Immediately	
State item to be used in	New Mexico

Section 2: Technical Information

Type of supplier being sought	Manufacturer
Reason	BABA

<p>Describe the manufacturing processes (elaborate to provide as much detail as possible)</p>	<p>See attached Spec sheets.</p> <p>26 09 14: Vibration Monitoring System Pages 01 - 36</p> <p>40 90 10: Instrument Components Package Control System Pages 75 - 136 of attached document</p> <p>40 90 11: Network Components Pages 137 - 168 of attached document</p> <p>40 90 12: PLC Components Pages 169 - 188</p> <p>40 90 13: Control and Network Panel Components Pages 189 -</p> <p>40 90 21: Analyzer Control Panels Page 245 - 270</p> <p>40 90 22: Network Panels Page 271 - 294</p> <p>40 99 90: Package Control Systems Page 301 - 319</p>
<p>Provide dimensions / size / tolerances / performance specifications for the item</p>	<p>See attached Spec sheets.</p> <p>26 09 14: Vibration Monitoring System Pages 01 - 36</p> <p>40 90 10: Instrument Components Package Control System Pages 75 - 136 of attached document</p> <p>40 90 11: Network Components Pages 137 - 168 of attached document</p> <p>40 90 12: PLC Components Pages 169 - 188</p> <p>40 90 13: Control and Network Panel Components Pages 189 -</p> <p>40 90 21: Analyzer Control Panels Page 245 - 270</p> <p>40 90 22: Network Panels Page 271 - 294</p> <p>40 99 90: Package Control Systems Page 301 - 319</p>

List required materials needed to make the product, including materials of product components	<p>See attached Spec sheets.</p> <p>26 09 14: Vibration Monitoring System Pages 01 - 36</p> <p>40 90 10: Instrument Components Package Control System Pages 75 - 136 of attached document</p> <p>40 90 11: Network Components Pages 137 - 168 of attached document</p> <p>40 90 12: PLC Components Pages 169 - 188</p> <p>40 90 13: Control and Network Panel Components Pages 189 -</p> <p>40 90 21: Analyzer Control Panels Page 245 - 270</p> <p>40 90 22: Network Panels Page 271 - 294</p> <p>40 99 90: Package Control Systems Page 301 - 319</p>
Are there applicable certification requirements?	No
Are there applicable regulations?	Yes
Details	<p>See attached Spec sheets.</p> <p>26 09 14: Vibration Monitoring System Pages 01 - 36</p> <p>40 90 10: Instrument Components Package Control System Pages 75 - 136 of attached document</p> <p>40 90 11: Network Components Pages 137 - 168 of attached document</p> <p>40 90 12: PLC Components Pages 169 - 188</p> <p>40 90 13: Control and Network Panel Components Pages 189 -</p> <p>40 90 21: Analyzer Control Panels Page 245 - 270</p> <p>40 90 22: Network Panels Page 271 - 294</p> <p>40 99 90: Package Control Systems Page 301 - 319</p>
Are there any other standards, requirements, etc.?	Yes

Details	<p>See attached spec sheets.</p> <p>26 09 14: Vibration Monitoring System Pages 01 - 36</p> <p>40 90 10: Instrument Components Package Control System Pages 75 - 136 of attached document</p> <p>40 90 11: Network Components Pages 137 - 168 of attached document</p> <p>40 90 12: PLC Components Pages 169 - 188</p> <p>40 90 13: Control and Network Panel Components Pages 189 -</p> <p>40 90 21: Analyzer Control Panels Page 245 - 270</p> <p>40 90 22: Network Panels Page 271 - 294</p> <p>40 99 90: Package Control Systems Page 301 - 319</p>
NAICS 1	541330 Engineering Services
NAICS 2	
Additional Technical Comments	

Section 4: Business Information

Estimated potential business volume	Likely one-time order. This is entirely dependent on the item, and this request seeks info on many varying items. Quantity can be discussed in negotiation.
Estimated target price / unit cost information (if unavailable explain)	Various - multiple components. Total: about \$3.5M
When is it needed by?	Generally Summer/Fall of 2025
Describe packaging requirements	Best available. Delivered undamaged. Specifics discussed in negotiation.
Where will this item be shipped?	Clovis, NM

Additional Comments

Is there other information you would like to include?	<p>Funding Agency: Interior, U.S. Department of / Reclamation, Bureau of / Albuquerque Area Office</p> <p>For all BABA related questions:</p> <p>Ken Richard <Krichard@usbr.gov></p>
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SECTION 26 09 14
VIBRATION MONITORING SYSTEM

PART 1 GENERAL

1.01 SUMMARY

- A. This section provides the requirements for the Vibration Monitoring System. The Vibration Monitoring System control panels and Vibration Monitoring HMI shall be completely coordinated, submitted, installed, executed, and completed by the Pump Supplier per Section 44 42 56.03, Vertical Turbine Pumps.

1.02 RELATED SECTIONS

- A. Refer to Section 26 19 00, Medium-Voltage Induction Motors, for all related sections.
- B. Refer to Section 26 19 23, Medium Voltage Adjustable Frequency Drive System, for all related sections.
- C. Refer to Section 40 99 00, Package Control System, for all related sections.
- D. Refer to Section 44 42 56.04, Vertical Turbine Pumps, for all related sections.

1.03 WORK INCLUDED

- A. Major Work Items:
 - 1. Included, but not limited to engineering, furnishing, installing, calibrating, adjusting, testing, documenting, starting up and training for Vibration Monitoring System:
 - a. Plant-wide condition monitoring and diagnostic software platform.
 - b. Protection and condition monitoring system, hardware, configuration, and parametrization software, for machinery condition monitoring and protection.
 - c. Vibration Monitoring Panels:
 - 1) IP20-VIB-865-01.
 - 2) IP20-VIB-865-02.
 - 3) CP20-VIB-865-01.
 - 4) CP20-VIB-865-02.
 - d. Vibration Monitoring System, Junction Boxes:
 - 1) IP20-TJB-851-01 to IP20-TJB-851-05, Quantity of five.
 - 2) CP20-TJB-851-01 to CP20-TJB-851-05, Quantity of five.

- e. Vibration Monitoring System, Vibration Sensors:
 - 1) IP20-VE-051-01 to IP20-VE-051-05, Quantity of five, Pump motor casing Z – axis sensor.
 - 2) IP20-VE-052-01 to IP20-VE-052-05, Quantity of five, Upper Bearing pump motor X-axis sensor.
 - 3) IP20-VE-053-01 to IP20-VE-052-05, Quantity of five, Upper Bearing, Pump motor Y-axis sensor.
 - 4) IP20-VE-054-01 to IP20-VE-054-05, Quantity of five, Lower Bearing, Pump flange Z-axis sensor.
 - 5) IP20-VE-055-01 to IP20-VE-055-05, Quantity of five, Lower Bearing Pump flange X-axis sensor.
 - 6) IP20-VE-056-01 to IP20-VE-056-05, Quantity of five, Lower Bearing Pump flange Y-axis sensor.
 - 7) CP20-VE-051-01 to CP20-VE-051-05, Quantity of five, Pump motor casing Z – axis sensor.
 - 8) CP20-VE-052-01 to CP20-VE-052-05, Quantity of five, Upper Bearing Pump motor X-axis sensor.
 - 9) CP20-VE-053-01 to CP20-VE-052-05, Quantity of five, Upper Bearing Pump motor Y-axis sensor.
 - 10) CP20-VE-054-01 to CP20-VE-054-05, Quantity of five, Lower Bearing Pump flange Z-axis sensor.
 - 11) CP20-VE-055-01 to CP20-VE-055-05, Quantity of five, Lower Bearing Pump flange X-axis sensor.
 - 12) CP20-VE-056-01 to CP20-VE-056-05, Quantity of five, Lower Bearing Pump flange Y-axis sensor.
- f. Vibration Monitoring System Temperature Keyphasor Sensors:
 - 1) IP20-VE-057-01 to IP20-VE-057-05, Quantity of five.
 - 2) CP20-VE-057-01 to CP20-VE-057-05, Quantity of five.
- g. Vibration Monitoring System Temperature Sensors:
 - 1) IP20-TE-041-01 to IP20-TE-041-05, Quantity of five, Upper Bearing sensor.
 - 2) IP20-TE-048-01 to IP20-TE-048-05, Quantity of five, Lower Bearing sensor.
 - 3) CP20-TE-041-01 to CP20-TE-041-05, Quantity of five, Upper Bearing sensor.
 - 4) CP20-TE-048-01 to CP20-TE-048-05, Quantity of five, Lower Bearing sensor.
- h. Vibration monitoring system panels to receive pump speed signals via 4 mA to 20 mA reference signal monitoring.
- i. Vibration monitoring system panels shall provide pump shutdown signals, one per associated pump drive, via normally closed output contact rated 5A at 120V ac.
- j. Vibration monitoring system, hardwired pump vibration warning signals to PLC.

- B. Provide all tools, supplies, materials, equipment, and all labor necessary for furnishing, constructing, installing, terminating, and testing all vibration monitoring system.
- C. Fabricate all vibration monitoring panels and junction boxes as shown on the Drawings.

1.04 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. American National Standards Institute (ANSI).
 - 2. American Petroleum Institute (API): Standard 670.
 - 3. Hydraulic Institute Standards (HIS):
 - a. 9.6.4, Rotodynamic Pumps for Vibration Measurements and Allowable Values.
 - b. 14.6, Rotodynamic Pumps for Hydraulic Performance Acceptance Tests.
 - 4. International Electrotechnical Commission (IEC):
 - a. 60255-26, Measuring Relays and Protection Equipment—Part 26: Electromagnetic Compatibility Requirements.
 - b. 60870-5-104, Telecontrol Equipment and Systems—Part 5-104: Transmission Protocols—Network Access for IEC 60870-5-101 Using Standard Transport Profiles.
 - c. 61850, Communication Networks and Systems for Power Utility Automation.
 - 5. Institute for Electrical and Electronics Engineers, Inc. (IEEE):
 - a. C37.90, Standard for Relays and Relay Systems Associated with Electric Power Apparatus.
 - b. C37.90.1, Standard for Surge Withstand Capability (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus.
 - c. C57.13, Standard Requirements for Instrument Transformers.
 - 6. National Electrical Manufacturers Association (NEMA):
 - a. C12.1, Electric Meters Code for Electricity Metering.
 - b. 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).
 - 7. Telecommunications Industry Association (TIA):
 - a. 232-F, Interface between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange.
 - b. 485-A, Electrical Characteristics of Generators and Receivers for Use in Balanced Digital Multipoint Systems.

1.05 DEFINITIONS

- A. AOR: Allowable Operating Region.
- B. EMI: Electromagnetic Interference.
- C. g: Gravitational Acceleration.
- D. IEPE: Integrated Electronics Piezo Electric.
- E. LCD: Liquid Crystal Display.
- F. LED: Light Emitting Diode.
- G. MPR: Motor Protection Relay.
- H. P&ID: Process and Instrumentation Diagram.
- I. PLC: Programmable Logic Controller.
- J. POR: Preferred Operating Region.
- K. RMS: Root Mean Square.
- L. RTD: Resistance Temperature Detectors.
- M. SCADA: Supervisory Control and Data Acquisition.
- N. UNF: Unified Fine Thread.

1.06 SUBMITTALS

- A. Action Submittals:
 - 1. Sensors:
 - a. Instruction manuals for each type of device.
 - b. Special features, licensed programming software.
 - c. Potential and current schematic diagrams.
 - d. Control and metering schematic diagrams.
 - e. Interconnection wiring diagrams.
 - f. Installation and mounting requirements.
 - g. Complete descriptive literature and renewal parts data.
 - h. Instrument Data Sheet.
 - i. Installation detail.
 - j. Housing installation detail.

2. Vibration Monitoring Panel:
 - a. Bill of Materials.
 - b. Catalog Cuts: I&C components, electrical devices, and mechanical devices.
 - c. Control Panel Instrument List.
 - d. Component Data Sheets: Data sheets for I&C components.
 - e. Sizing and Selection Calculations:
 - 1) DC Power supplies.
 - 2) Control panel AC and DC power consumption.
 - 3) Heat dissipation and air conditioning, where needed.
 - f. Preliminary Panel Elevation Drawings: Provide prior to submitting Panel Construction Drawings.
 - g. Panel Construction Drawings:
 - 1) Control Panel General Arrangement Drawings:
 - a) Freestanding Enclosure Type Panel: Enclosure.
 - b) Frame Mount Type Panel: Panel and frame.
 - 2) Control Panel, Panel Layout drawing.
 - 3) 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.
 - h. Panel Wiring Diagrams:
 - 1) Wireway Sizing Calculations: In accordance with UL 508A.
 - 2) Detailed Panel Control Wiring and Power Wiring Diagrams: For discrete control and power circuits within the panel.
 - a) Show point-to-point and terminal-to-terminal wiring within, or on the face of, the panel.
 - b) Field wiring, terminations, cabling for PICS discrete and analog circuits shall be shown on Loop Diagrams. PIC SI shall coordinate between Detailed Panel Control Wiring Diagrams and Loop Diagrams.

- c) 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.
 - (1) Relay Coils:
 - (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.
 - (2) Relay Contacts: Coil tag number, function, and coil location (ladder rung number and sheet number).
- d) Show each circuit individually. No “typical” diagrams or “typical” wire lists will be permitted.
- e) Ground wires, surge protectors, and connections.
- f) Circuit Names: Show names corresponding to Circuit and Raceway Schedule for circuits entering and leaving a panel. Refer to Division 26, Electrical.
- 3) Spares, expendables, and test equipment.
- 4) Electronic Copies: Microsoft Excel.
 - i. Server, network, and workstation hardware.
 - j. Vibration monitoring system software preliminary configuration.
 - k. Vibration monitoring system software final configuration.
 - l. Submit anchorage and bracing design drawings, cut sheets, and their installation information for components, distribution systems, and equipment as required by Section 01 88 15, Anchorage and Bracing.

B. Informational Submittals:

- 1. Programming software used to configure devices, along with settings files necessary to reload or revise settings as left by the Contractor.
- 2. Operation and Maintenance Data as specified in Section 01 78 23, Operation and Maintenance Data.
- 3. Vibration Monitoring Panel and Terminal Junction Boxes:
 - a. Operation and Maintenance Data.
 - b. Instrument calibration procedure.
 - c. Testing Related Submittals:
 - 1) Factory Demonstration Test:
 - a) Test Procedures:
 - (1) Proposed test procedures, forms, and checklists.
 - (2) Capacity, Timing, and Simulation: Describe simulation and monitoring methods used to demonstrate compliance with capacity and timing requirements.

- b) Test Documentation: Copy of signed off test results.
 - 2) Component Test:
 - a) Test Procedures: Proposed test procedures, forms, and checklists.
 - b) Test Documentation: Copy of signed-off test results.
 - 3) Functional Test:
 - a) Test Procedures: Proposed test procedures, forms, and checklists.
 - b) Test Documentation: Copy of signed-off test results.
 - 4) Performance Test:
 - a) Final Test Procedures: Proposed test procedures, forms, and checklists.
 - b) Test Documentation: Copy of signed-off test results.
- d. Configuration and Setpoints Records:
 - 1) Hard copy.
 - 2) Electronic copy.
- e. Calculations in Microsoft Excel Format:
 - 1) One file per a panel.
 - 2) File Name Format: "Network_Panel_Tag_Calculations".
- f. Drawings in AutoCAD or MicroStation Format:
 - 1) One file per Drawing.
 - 2) File Name Format: Panel "Tag_Drawing_Number_Drawing Title."
- 4. Sensor:
 - a. Instrument Data Sheet.
 - b. Operation and Maintenance Data.
 - c. Installation detail.
 - d. Calibration certificate.
 - e. Calibration schedule.
- 5. Installation Report:
 - a. Vibration test report.
 - b. Vibration collection report based on pump filed or factory acceptance testing.
 - c. Field test reports.

1.07 QUALITY ASSURANCE

A. Qualifications:

- 1. Vibration Monitoring System Supplier: Minimum of 5 years' experience providing, integrating, installing, and starting up similar systems as required for this Project.
- 2. Vibration Monitoring System Site Representative: Minimum of 5 years' experience installing similar systems as required for this Project.

B. Coordination:

1. Vibration Monitoring System shall be in accordance with Mechanical, Electrical and P&ID Drawings.
2. Coordinate with electrical contractor for all conduit entry and wiring interfaces including power and signal, all panel locations, and all mounting.
3. Coordinate with the pump Supplier for sensor selection, and all mounting.
4. Coordinate all sensor field mounting with mechanical contractor and pump Supplier.
5. Coordinate Ethernet I/P network connection to the plant SCADA system with the Engineer in accordance with the Block Diagrams in the Drawings.
6. Coordinate all data monitored by the plant SCADA system with the SCADA system application programming provided by the Engineer.
7. Coordinate with the Contractor in accordance with Section 01 91 14, Equipment Testing and Facility Startup.
8. Coordinate with Engineer and Owner vibration sensor range selection, voting logic configuration, settings, and alarm levels.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. In accordance with Section 01 61 00, Common Product Requirements.
- B. In accordance with Section 40 90 00, Instrumentation and Controls for Process Systems.

1.09 EXTRA MATERIALS

A. Expendables:

1. For the following items provide manufacturers recommended 2-year supply, unless otherwise noted:
 - a. Corrosion-inhibiting vapor capsules.

B. Spare Parts and Quantity:

1. Sensors: Quantity of two per each model used, per each site.
2. Sensor Housing: Quantity of two per each model used, per each site.
3. Sensor Cable: Quantity of two per each model used, per each site.
4. Sensor Cable Conduit: Quantity of two per each model used, per each site.
5. Vibration Monitoring System Modules: Quantity of one per each model used, per each site.
6. Power Supplies: Quantity of one per each model used, per each site.

PART 2 PRODUCTS

2.01 GENERAL

- A. Vibration system, motor, VFD, and pump shall be provided under the Pump Manufacturer's scope of supply. Pump Supplier is responsible for the combined performance and coordination between the systems.
- B. Meet requirements specified herein and as specified in Section 44 42 56.04, Vertical Turbine Pumps. See Section 26 19 00, Medium-Voltage Induction Motors for other requirements.
- C. Provide temperature and vibration monitoring systems as shown on the Drawings, including mechanical, electrical, and Process and Instrumentation Diagram (P&ID).
- D. Provide all configuration, programming, testing, calibration, testing, and place into operation.
- E. Cables requiring special calibration for optimum performance shall be calibrated by the Vibration Monitoring System Supplier.
- F. Install sensor and sensor housings cable conduits and junction boxes, terminate cable at junction boxes.
- G. Vibration Monitoring System Supplier is responsible for final system component selection, sensor location and installation, to meet the project performance criteria and include site specific installation features.

2.02 INSTALLATION CONDITIONS

- A. System will be installed in an indoor conditioned space, with temperatures between 40 degrees F and 100 degrees F.
- B. System will be installed at elevation of approximately 3,800 feet above sea level for the Intake Pump Station, and 4,270 feet above sea level for the Caprock Pump Station.
- C. Conduit routing of other cables and voltages is shown in the Contract Documents and provide a system complying with this specification requirements based on the conditions shown in the Contract Documents. Coordinate any additional cable routing requirements with the Contractor.
- D. A Cellular based communication network operating at X MHz and with a power of X kW is located at XYZ.

2.03 VIBRATION MONITORING SYSTEM FEATURES

- A. Machine Protection and Condition Monitoring System:
 - 1. Meets Hydraulic Institute Standard on pump protection.
 - 2. Meets typical functionality for pump condition monitoring system.
- B. Microprocessor based system with programmable firmware options.
- C. Programmable operating range, alarm delays, voting relay logic.
- D. Double voting logic for shutdown signal.
- E. Alarm bypass function.
- F. Cyber security
- G. Password protected.
- H. Diagnostic and condition monitoring platform.
- I. Ethernet connection to plant control system.
- J. Network Switch for Internal Connections at Vibration Monitoring Panel:
 - 1. Used: For internal ethernet connection inside vibration monitoring panel.
 - 2. Type: Managed, Layer 2, 1 Gbps.
- K. Configure alarm contacts to be normally closed, open in alarm condition and open on loss of power.

2.04 MEASUREMENT UNITS

- A. General:
 - 1. Acceleration: g RMS.
 - 2. Velocity: Inches per second RMS.
 - 3. Displacement: Inches Peak to Peak.
 - 4. Temperature: Fahrenheit.
- B. Varies, user configurable for machine diagnostic condition monitoring features.

2.05 REQUIREMENTS FOR MACHINE PROTECTION VIBRATION SYSTEM FUNCTIONALITY

- A. General: Comply with ANSI/HI 9.6.4 Standard.
- B. Bearing Housing Vibration:
 - 1. For pump nominal rotating speed of operation above 600 rpm:
 - a. The sole measurement quantity to be used for measuring the vibration of stationary parts associated with bearings of rotodynamic pumps is velocity in inches per second RMS.
 - b. A velocity or acceleration transducer is used to measure vibration at various frequencies, and the measurements are integrated in an electronic circuit as agreed upon by the pump manufacturer and the user to determine the overall RMS vibration in the appropriate units.
 - c. Overall RMS vibration is a measure of the total RMS vibration magnitude obtained using instruments that integrate the vibration withing a fixed frequency range over a fixed period of time.
 - d. Measurement of vibration filtered to discrete frequencies is not applicable.
- C. Vibration Measurement Instrumentation and Transducers:
 - 1. For all speeds, a 6-decibel (dB) per octave filter shall be used to filter out frequencies outside the measurement range to reduce the electronic noise.
 - 2. For speeds above 600 rpm, the measurement instrumentation shall be capable of measuring the RMS vibration velocity for a minimum frequency range of 5 Hz to 1,000 Hz.
 - 3. For pumps with speeds of 600 rpm and below, the measurement instrumentation shall be cable of measuring RMS vibration velocity and peak-to-peak displacement, both overall, for a minimum frequency of 2 Hz to 1,000 Hz.
 - 4. The manufacturer and purchaser should agree on the type of data collector and the data collector setting for frequency range, frequency resolution, filter settings, the number of readings to average, and any other instrument settings that may affect the measured vibration values.
 - 5. The vibration measurement system shall be calibrated per the instrument manufacturer's recommendations.
 - 6. The vibration transducers should be mounted in such a way as to not adversely affect the accuracy of the measurements.
 - 7. For permanently mounted transducers, the machined mounting surface should be a minimum of 1.1 times diameter of the transducer. Mounting surfaces should be flat to within 0.025 mm with a surface roughness of less than 3.2 micrometers.

D. Bearing Housing Measurements:

1. The vibration transducers should be located approximately at the center of the radial bearing location on bearing housing or the motor mounting flanges of vertical pumps, perpendicular to the plane of measurement.
2. Transducers must not be located on the flexible panels, nameplates, or motor and covers.

E. Allowable Bearing Housing Vibration:

1. Acceptance Criteria Based on: ANSI/HI 9.6.4 Standard.
2. For operation outside the POR within the allowable operation region (AOR), increase the values by 30 percent.
3. Overall vibration amplitude near the upper motor bearing should be no more than 1.5 times the acceptance criterion of HI designated mounting locations .
4. Configured by Vibration system Supplier.

F. Vibration Alarms:

1. An operator adjustable vibration velocity RMS alarms setpoints for each sensor, that are based on the magnitude of each frequency range (for example, 0 to 0.8 times operating speed, 0.8 to 1.2 times operating speed, 1.2-1.8X, 1.8X and above).
2. Automatically adjustable based on pump rotation speed and pump operation region.
3. Alarm Condition Triggers On Delay Timer: When an Operator adjustable time elapses and alarm conditions remains vibration alarm is raised. Alarm is automatically reset when conditions return to acceptance criteria.
4. Specific for each measurement point.
5. Logged and displayed locally and remotely with data time stamp at machine protection system.
6. Configured by Vibration system Supplier.

G. Vibration or Temperature Warnings:

1. Specific for each measurement point.
2. An Operator adjustable percentage of alarm.

H. Allowable Bearing Housing Temperature:

1. Acceptance criteria based on:
 - a. Pump manufacturer recommendation.
 - b. Motor manufacturer recommendation.
2. Configured by Vibration System Supplier.

I. Bearing Temperature Alarms:

1. An operator adjustable high temperature alarms setpoints.
2. Alarm condition triggers On Delay Timer. When an operator adjustable time elapses and alarm conditions remains vibration alarm is raised. Alarm is automatically reset when conditions return to acceptance criteria.
3. Specific for each measurement point.
4. Logged and displayed locally and remotely with data time stamp at machine protection system.
5. Configured by Vibration System Supplier.

J. Machine Shutdown:

1. Based on Dual Voting Logic:
 - a. Lower Bearing:
 - 1) Two of three lower bearing vibration sensors (X-axis, Y-axis, Z-axis) are alarming.
 - 2) One of three lower bearing vibration sensors (X-axis, Y-axis, Z-axis) is alarming and bearing high temperature alarm.
 - b. Upper Bearing (Motor Top):
 - 1) Two of Two upper bearing vibration sensors (X-axis, Y-axis, Z-axis) are alarming.
 - 2) One of Two upper bearing vibration sensors (X-axis, Y-axis, Z-axis) are alarming AND bearing high temperature alarm.
2. Voting logic triggers an Operator adjustable timer to count down to shut down.
3. Shut down can be Bypassed by an Operator:
 - a. Remotely at SCADA.
 - b. Locally at machine protection system display.
4. Shutdown action shall be:
 - a. Recorded and alarmed at machine protection system.
 - b. Identified by time date stamp.
 - c. Identified by voting logic identifier.

2.06 FUNCTIONAL REQUIREMENTS FOR VIBRATION MONITORING SYSTEM

A. General:

1. Comply with best practices on vertical pump vibration monitoring and vibration analysis.
2. Provide information on machine health.
3. Collect historical data on machine condition change.
4. Used for periodical machine condition check.

5. Used for preventive maintenance.
6. Used for machine fail root case analysis.

B. Minimal System Functionality:

1. Review of periodic Route-based Vibration Collected at Consistent Operating Conditions.
2. Time Waveform Analysis.
3. Frequency Spectral Analysis.
4. Trending Over Time While Measuring Other Parameters.
5. Phase Analysis and Operating Deflection Shape.
6. Orbit Analysis.

2.07 INTERFACE WITH SCADA

A. General:

1. Describes minimal requirements.
2. Interface shall be coordinated and detailed during workshop.

B. Digital Interface with SCADA:

1. Type: Monitoring, machine shutdown bypass command.
2. Physical: Ethernet, Category 6 cable.
3. Communication Protocol:
 - a. Modbus TCP/IP.
 - b. EtherNet/IP.
4. Signals to SCADA:
 - a. Discrete:
 - 1) Critical Alarms:
 - a) AC Power Fail.
 - b) DC Power Fail.
 - c) Equipment Fail.
 - 2) Major Equipment Status:
 - a) REMOTE/AUTO/MANUAL.
 - b) Running.
 - c) Stopped.
 - d) Fail.
 - 3) Alarms and Warnings:
 - a) Vibration.
 - b) Temperature.
 - b. Analog:
 - 1) Setpoints.
 - 2) Temperatures.
 - 3) Vibration velocity.

5. Signals from SCADA:
 - a. Discrete: Shutdown bypass command.
6. Type: Copper CAT6 cable.

C. Hardwire Interface with SCADA:

1. Type: Dry contact, 120V ac, 5 amps.
2. Signal: General High Vibration Warning.
3. Quantity: One for each pump.
4. Source: Vibration monitoring panel.
5. Normal Position: Normally Open.

2.08 INTERFACE WITH OTHER SYSTEMS

A. Interface:

1. Physical: Ethernet, Category 6 cable.
2. Communication Protocol: As required.
3. Connections to:
 - a. Engineering Workstation for vibration system configuration.
 - b. Diagnostic and condition monitoring software platform.
 - c. Network Time Server.

2.09 REMOTE SITE COMMUNICATIONS

- A. Provide functionality and hardware for complete remote access for system monitoring, control, and programming through VPN tunnel provided and configured by Engineer or Owner.

2.10 SWITCH

- A. General: Provide network switch for vibration monitoring panel internal connections.

B. Type:

1. DIN rail mount.
2. Industrial.
3. Managed, Layer 2, 1 Gbs.

- C. Model: Refer to Section 40 99 90, Package Control System.

2.11 INTERFACE WITH PUMP VFD

A. Hardwire Interface with pump VFD:

1. Type: Dry contact, 120V ac, 5 amps.
2. Signal: Pump shutdown.
3. Quantity: One for each pump.

4. Source: Vibration monitoring panel.
5. Normal Position: Normally Closed.

2.12 FIELD CABLE

A. General:

1. This point is informative.
2. Field cables are provided by electrical contractor, see Section 26 05 05, Conductors.
3. Information shall be used as reference for vibration sensor selection and vibration monitoring system configuration.
4. Cable type listed herein based on Section 26 05 05, Conductors.

B. Cable Type:

1. Accelerometers:
 - a. Cable Type: Type 11.
 - b. Description: Low-Capacitance Twisted Shielded Pair Cable.
2. Velometer:
 - a. Cable Type: Type 11.
 - b. Description: Low-Capacitance Twisted Shielded Pair Cable.
3. Keyphasor:
 - a. Cable Type: Type 12.
 - b. Description: Low-Capacitance Twisted Shielded Triad Cable.
4. Temperature: Three-wire cable.
 - a. Cable Type: Type 4.
 - b. Description:
 - 1) Twisted, Shielded Triad Instrumentation Cable: Single triad.

C. Maximum Estimated Cable Length:

1. Intake Pump Station: 190 feet.
2. Caprock Pump Station: 110 feet.
3. Supplier shall verify actual maximum cable lengths.

2.13 VIBRATION AND TEMPERATURE SENSORS

A. General:

1. Final selection of sensor type and model shall be determined by Vibration Monitoring System Vendor based on the required system performance and site-specific installation features and submitted to Engineer for approval.
2. Sensor selection shall consider ability of machine protection and condition monitoring in terms of frequency band, cable type, field

cabling length and field cable capacitance, set current at signal conditioner at Vibration Monitoring Panel.

B. Vibration Monitoring Sensors:

1. Permanently installed accelerometers and velometers shall be installed by the pump manufacturer.
2. Located at top flange of discharge head and on exterior of the motor in a manner to be as connected and stiff as possible to the thrust bearing.
3. At the top of the motor (Upper Bearing) and at the discharge head top flange (Lower Bearing), two radial elements shall be provided with one measuring discharge nozzle direction and one at 90 degrees to discharge nozzle direction, and one vertical element shall be provided to measure the Z axis.
4. Minimum Rated Operating Frequency: 7 Hz or lower, with less than 0.03 inch/second RMS combined measurement error through the total vibration system.
5. Maximum Rated Operating Frequency: 6 kHz or higher.
6. Sensor tags, quantity, and location as per Pump P&ID Drawings.
7. Sensors:
 - a. Accelerometers:
 - 1) Features:
 - a) Rugged design.
 - b) Corrosion resistant.
 - c) Hermetic seal.
 - 2) Type: IEPE.
 - 3) Parameter Specification Conditions:
 - a) Temperature: 20 degrees C to 30 degrees C.
 - b) Frequency: 100 Hz.
 - 4) Sensitivity: 100 mV/g plus or minus 5 percent at 25 degrees C.
 - 5) Acceleration Range: 80g peak.
 - 6) Amplitude Non-linearity: 1 percent.
 - 7) Frequency Response:
 - a) Plus or minus 5 percent: 3 Hz to 5,000 Hz.
 - b) Plus or minus 10 percent: 1 Hz to 9,000 Hz.
 - c) Plus or minus 3 dB: 0.5 Hz to 14,000 Hz.
 - 8) Resonance Frequency: 30,000 Hz.
 - 9) Transverse Sensitivity Maximum:
 - a) Minus 20 percent at minus 55 degrees C.
 - b) Plus 10 percent at plus 120 degrees C.
 - 10) Electrical:
 - a) Excitation Voltage: 18V dc to 30V dc.
 - b) Regulated Current: 2 mA to 10 mA.
 - c) Output Bias Voltage: 12V dc plus or minus 10 percent.

- d) Maximum Output Impedance: 100 ohm.
- e) Grounding: Case isolated.
- f) Cabling: Shield twisted pair.
- g) Connector: Two-pin.
- 11) Environmental:
 - a) Temperature Range: Minus 55 degrees C to 120 degrees C.
 - b) Vibration Limit: 500 g peak.
 - c) Shock Limit: 5,000 g peak.
 - d) Electromagnetic Sensitivity, Maximum: 70 micro g/ gauss.
- 12) Sealing: Hermetic.
- 13) Case Material: Type 316 steel stainless.
- 14) Mounting: 1/4-28 UNF tapped hole.
- b. Velometers:
 - 1) Features:
 - a) Rugged design.
 - b) Corrosion resistant.
 - c) Hermetic seal.
 - 2) Type: IEPE.
 - 3) Parameter Specification Conditions:
 - a) Temperature: 20 degrees C to 30 degrees C.
 - b) Frequency: 100 Hz.
 - 4) Sensitivity: 3.94 mV/mm plus or minus 5 percent.
 - 5) Frequency Response:
 - a) Plus or Minus 3 dB: 4.5 Hz to 5,000 Hz.
 - b) Plus or Minus 0.9 dB: 6 Hz to 2,500 Hz.
 - 6) Velocity Range: 1270 mm/sec peak.
 - 7) Amplitude Linearity: Plus or minus 2 percent to 152 mm/sec peak.
 - 8) Resonance Frequency: Greater than 12,000 Hz.
 - 9) Transverse Sensitivity: Less than 5 percent of sensitivity.
 - 10) Electrical:
 - a) Output Bias Voltage: Minus 12 plus or minus 3V dc.
 - b) Maximum Output Impedance: Less than 2,400 ohm.
 - c) Grounding: Case isolated.
 - d) Cabling: Shield twisted pair.
 - e) Connector: Two-pin.
 - 11) Environmental:
 - a) Temperature Range: Minus 55 degrees C to 121 degrees C.
 - b) Vibration Limit: 500 g peak.
 - c) Shock Limit: 5000 g peak.
 - d) Electromagnetic Sensitivity: Less than 50 gauss, 50 Hz to 60 Hz.
 - 12) Sealing: Hermetic.

- 13) Case Material: Type 316 steel stainless.
- 14) Mounting: 1/4.28 UNF tapped hole.
- 8. Accessories:
 - a. If required to isolate actual radio frequency or electrical noise in the final installed conditions, Dielectric ceramic mounting isolation puck, to rigidly attach the sensor to the pump/motor without dampening, but provide dielectric isolation so stray current and voltages cannot be transferred to the sensor:
 - 1) As Required, to accommodate the quantity of sensors and systems as shown on the Drawings and as specified herein. Final recommendation shall be submitted for Engineer approval by Vibration Monitoring System Vendor with consideration frequency response and equipment grounding system, EMI noise and the sensor case grounding type.
 - b. Sensor housing.
 - c. Interconnect Cable:
 - 1) Option:
 - a) Cable shield connected to the case of the sensor.
 - b) Cable shield not connected to the case of the sensor.
 - 2) Final selection of cable option by vibration monitoring system vendor, upon coordination with Pump and Motor vendor and verification pump and motor grounding system at sensor installation place. Final selections shall be submitted to Engineer for approval.

C. Keyphasor Sensors:

- 1. General:
 - a. Permanently installed by pump manufacturer.
 - b. Monitor pump shaft rotation.
- 2. Element:
 - a. Probe: Proximity probe or Proximitor.
 - b. Transducer: Located at junction box, if required.
 - c. Electrical:
 - 1) Cabling: shield twisted triad.
 - 2) Connector: Three-pin.
- 3. Accessories:
 - a. Sensor housing.
 - b. Cable:
 - 1) Option:
 - a) Cable shield connected to the case of the sensor.
 - b) Cable shield not connected to the case of the sensor.
 - 2) Final selection of cable option shall be determined by vibration monitoring system vendor, upon coordination with pump and motor vendor and verification pump and motor

grounding system at sensor installation place and submitted for Engineer approval.

D. External Housing for Vibration and Keyphasor Sensors:

1. Permanently installed by pump manufacturer.
2. Protect each sensor.
3. Installed in way to allow maintenance and sensor calibration.
4. Installed to prevent contact between accelerometer, to prevent affecting the accelerometer's frequency response.
5. Housing cover must allow room for the proper cable connections and cable bend radius.
6. Permit proper sealing of the base and to prevent water intrusion.
7. Shall be metallic and grounded to protect electrical shock and/or electromagnetic interference or noise.
8. Material shall be selected to avoid corrosion.

E. Bearing Temperature Elements:

1. Pt100 three-wire sensor.
2. Permanently installed by motor manufacturer.
3. Sensor shall be as specified in Section 26 19 00, Medium-Voltage Induction Motors.
4. Sensor cable shall be terminated at junction box located at motor.

F. Installation and Protection of Cables:

1. Mechanically protected by steel flexible conduit or cable armor.
2. Cable protection shall allow sensor maintenance.
3. Use high quality, well shielded cables.
4. Shall be properly routed and securely clamped.
 - a. Cable shall be routed to avoid excessive temperatures.
 - b. When routing cables, AC power lines shall be crossed only at right angles. Approach AC motors from a right angle to the motor shaft and do not route alongside a motor.
5. Use protective boot to seal the connector entry to the sensor.
6. Conduit or junction box shall be sealed at the cable entry point. Rubber grommets or removable, non-adhesive sealants shall be used.
7. Each sensor cable shall be protected from sensor to junction box. Use solid conduits, and where necessary, flexible interlocked steel conduits.
8. No wires or cables other than sensor wire or cables shall be run in the same conduit.
9. Cable conduit or cable armor shall be grounded.

G. Vibration and temperature sensors and vibration sensor housing assemblies shall be installed in accordance with guidelines provided by API 670.

1. Where applicable, use flush mount accelerometer detail with flex conduit, or armored cable.

2.14 VIBRATION SENSOR JUNCTION BOX

A. General:

1. Vibration Monitoring System Vendor to provide, install and furnish Vibration Sensor Junction Box.
2. Vibration Monitoring System Vendor is responsible for sensor cable termination at Junction Box.
3. Vibration Monitoring System Vendor is responsible for all required accessories and additional devices like transducers.

B. Features:

1. Type: Wall, Unistrut mount.
2. Field Cable Entry: Side, see electrical drawings and model.
3. Reserved space:
 - a. Size :
 - 1) Height: 1 foot.
 - 2) Width: 1 foot.
 - 3) Depth: 0.5 feet.
 - b. NOTE: Bigger sizes than listed herein may be accepted by Engineer upon earlier site coordination.
4. Location: Field, located near each pump. See mechanical and electrical Drawings.
5. NEMA Type: 4X.
6. Grounding: Protective ground.
7. Quantity: One per each pump.

2.15 VIBRATION MONITORING PANELS

A. General

1. Vibration Monitoring System Vendor to provide and furnish Vibration Monitoring System Panels.
2. Houses Vibration Monitoring System Hardware and Auxiliary Equipment.
3. Used for cable termination.
4. Provides power for vibration system.
5. All panel enclosures shall be UL recognized or listed.

B. Features:

1. Type: Freestanding, front and rear access.
2. Field Cable Entry: Top.
3. Reserved Space:
 - a. Size:
 - 1) Height: 2 feet 8 inches.
 - 2) Width: 2 feet 8 inches.
 - 3) Depth: 6 feet 8 inches.
 - b. NOTE: Bigger sizes than listed herein may be accepted by Engineer upon earlier site coordination.
4. Location: Electrical Room.
5. Cooling: Fan, If Required. Develop, and submit, heat load calculations to determine if required.
6. NEMA Type: 12.
7. AC Power Supply:
 - a. UPS Power: 120V ac.
8. DC Power Supply:
 - a. Redundant.
 - b. Shall be included as part of the panel.
9. Grounding:
 - a. Protective ground.
 - b. Instrument Ground:
 - 1) Note:
 - a) Instrument ground to be isolated from the panel.
 - b) Used for cable shield grounding and signal reference ground.
10. Quantity: Two per each site.

2.16 SENSOR AND PANEL INSTALLATION

A. General:

1. This point is informative and provide general information on sensor installation options and vibration system grounding referenced herein.
2. Final vibration monitoring system by Vibration Monitoring System Supplier.
3. Vibration system Supplier shall consider each site-specific installation condition for vibration system components selection and installation.

B. Installation and Grounding Detail:

1. Drawing:
 - a. Intake Pump Station: IP09-N-5061.
 - b. Caprock Pump Station: CP09-N-5061.
2. Title: Vibration sensor installation and grounding detail.

C. Site 3D Model:

1. Process mechanical model for Pump model and piping.
2. Electrical model for panel and cable tray model.

D. Contract Drawings:

1. Process mechanical for pump room plans and sections.
2. Electrical for plans and section, cable tray, junction box and panels, grounding system, motor control diagrams.
3. I&C for P&ID and Network Diagrams.

2.17 PLANT-WIDE CONDITION MONITORING AND DIAGNOSTIC SOFTWARE

A. General:

1. Condition monitoring and diagnostic software.
2. Proactive maintenance and management programs for maximum productivity.
3. Combining connectivity, analytics, and visualization capabilities.
4. Edge historian and condition monitoring platform.
5. Decision support.
6. Distributed Client/Server Deployment.
7. Data replication.
8. User security roles.

B. Software:

1. Software Configuration and Vibration System HMI Programming:
 - a. Software shall be provided ready for use.
 - b. All HMI, trends, alarm logs, and Reports shall reflect customized Vibration Monitoring System configuration required for this project.
2. License:
 - a. Package Type: Device-Based.
 - b. Server:
 - 1) Quantity: One.
 - 2) Location: Eastern New Mexico SCADA monitoring center.
 - 3) Remote access: Required for Vibration Monitoring System Vendor Support.
 - c. Client:
 - 1) Quantity: One.
 - 2) Location: Eastern New Mexico SCADA monitoring center.
3. Future System Expansion: 30 percent.
4. Features:
 - a. Includes the project specific requirements: Pumping stations and future Water Treatment Plant.

- b. OPC UA server Export:
 - 1) Waveforms.
 - 2) Static data.
 - 3) Alarm events.
- 5. Manufacturers:
 - a. Bently Nevada, System.
 - b. Rockwell.

C. Hardware:

- 1. Server: Provided by Supplier.
 - a. Rack mounted.
 - b. All software licenses for the workstation including both vibrations system software, and all other applications, necessary for viewing, reporting, data storage, and data analysis shall be provided.
 - c. System equipment to be supplied as necessary to provide complete system analysis, and storage, for up to 7 years of facility-wide data.
- 2. Client Workstation: Provided by Supplier.
 - a. Desk console mounted (desk top monitor with workstation inside desk console).
 - b. System equipment to be supplied as necessary to provide all real-time vibrations system data.
 - c. All software licenses for the workstation including both vibrations system software, and all other applications, necessary for viewing, reporting, data storage, and data analysis shall be provided.

2.18 PROTECTION AND CONDITON MONITORING SYSTEM HARDWARE CONFIGURATION AND PARAMETRIZATION SOFTWARE

A. General:

- 1. Configures the vibration system chassis, modules, channels, measurements, setpoints, relays.
- 2. Used to verify sensors and systems being monitored by the vibration system.
- 3. Connect multiple systems from a single Vibration System Studio client session.
- 4. Enabling security through user-based permissions.
- 5. Graphical system and relay configuration.
- 6. Current Values and loop check.
- 7. Validation of configuration settings.

B. Software:

1. Software Configuration and System Programming:
 - a. The system shall be provided ready for use.
 - b. All alarms, voting logic, and other functions shall be submitted and approved between vibration system vendor and the with the Engineer, prior to final system configuration.
2. License:
 - a. Quantity: One.
 - b. Location: Eastern New Mexico SCADA monitoring center.
3. Future System Expansion: 30 percent.
4. Manufacturer and Product:
 - a. Bently Nevada, Orbit Studio Configuration Software.
 - b. Rockwell Automation.

C. Hardware:

1. Workstation: Provided by Owner.

2.19 PROTECTION AND CONDITION MONITORING SYSTEM HARDWARE

A. General:

1. Scope:
2. Features:
 - a. Machinery monitoring and protection system.
 - b. Cyber Security:
 - 1) Comply with IEC 62443-4-2, up to security Level 4.
 - 2) Segregation of protection and condition monitoring networks.
 - c. Plant-wide and Flexible Deployments:
 - 1) Modular platform configuration.
 - 2) Protection and/or condition monitoring configuration
 - 3) Journal and rolling element bearing applications form high speed critical turbomachinery to plant-wide assets such as pump, motor and fan applications.
 - d. Process Data Integration:
 - 1) Communication Gateway.
 - 2) High-speed process data from DCS retrieval.
 - e. Distributed Architecture and Remote I/O: Bridge multiple bases together to develop a system that can be distributed in a daisy chain or star configuration.
 - f. Hot Swap Capability: All modules shall be capable of removal and insertion while the system is under power.
 - g. Remote Access.
 - h. Display: Integral dedicated display.

B. Chassis:

1. Features:
 - a. 3U Chassis: 19 general purpose slots.
 - b. Bulkhead, rack or panel mount.
2. Front Panel:
 - a. Status of power supplies and presence and operation on SIM module.
 - b. Key switch.
 - c. Reset button.
 - d. Ethernet jack for connection to the SIM module or configuration tasks.
 - e. Local display.
3. Quantity: As required to accommodate the quantity, and type, of sensors and systems as shown on the Drawings and as specified herein.
4. Accessories: As required, and as necessary, for a fully configured and functional system.
5. Manufacturer and Product:
 - a. Bently Nevada, ORBIT 60.
 - b. Rockwell Automation.

C. Power Input Module:

1. Features:
 - a. Connect and external power source to the system.
 - b. Supports two stacked redundant power input modules.
 - c. Protection for miswiring, overvoltage and overcurrent
2. Electrical:
 - a. Voltage Input plus 21V dc to plus 32V dc.
 - b. Current Draw:
 - 1) 3U 19-Inch Full Load: 7.1 amps at 24V dc.
3. Quantity: As required to accommodate the quantity, and type, of sensors and systems as shown on the Drawings and as specified herein.
4. Accessories: As required, and as necessary, for a fully configured and functional system.
5. Environmental:
 - a. Operating Temperature: Minus 30 degrees C to plus 70 degrees C.
 - b. Operating Humidity: 0 percent to 95 percent noncondensing.
6. Manufacturer and Product:
 - a. Bently Nevada, ORBIT 60, PIM module.
 - b. Rockwell Automation.

D. Protection Processor Module:

1. Features:
 - a. Serves as computational engine for the Vibration monitoring system.
 - b. Extract all machinery measurements for the protection system and performs alarm determinations.
 - c. Analyzes signals from transducers, generates measurements, statuses, and publishes them to other modules for data collection and external communication.
2. Measurements and Signal Processing:
 - a. 1x/2x/nX Amplitude and Phase.
 - b. Bias.
 - c. Case expansion.
 - d. Process variable.
 - e. Rotor Acceleration.
 - f. Speed.
3. Alarming:
 - a. Alarm Time Delays.
 - b. Setpoints.
 - c. Protection States.
4. Quantity: As required to accommodate the quantity of sensors and systems as shown on the Drawings and as specified herein.
5. Accessories: As required, and as necessary, for a fully configured and functional system.
6. Environmental:
 - a. Operating Temperature: Minus 30 degrees C to plus 70 degrees C.
 - b. Operating Humidity: 0 percent to 95 percent noncondensing.
7. Manufacturers and Product:
 - a. Bently Nevada, ORBIT 60, PPM module.
 - b. Rockwell Automation.

E. Comm Gateway Module:

1. Features:
 - a. Provides two independent ethernet or serial ports for bi-directional Modbus or EGD communications with process control, historian, and other automation platforms.
 - b. Provides information to external hosts including measurements alarms, statuses and system controls using standard industrial protocols.
 - c. Supporting Modbus and EGD protocols.
 - d. Modbus TCP/IP shall be available for connection to HMI, unit control systems, or other plant automation equipment. The module can only be configured as a server and supports configurable Modbus addresses within the 400,000 addressable ranges.

2. Communications:
 - a. Ethernet Port Quantity: Two.
 - b. Connector: RJ-45.
 3. Quantity: As required to accommodate the quantity of sensors and systems as shown on the Drawings and as specified herein.
 4. Accessories: As required, and as necessary, for a fully configured and functional system.
 5. Environmental:
 - a. Operating Temperature: minus 30 degree C to plus 70 degrees C.
 - b. Operating Humidity: 0 percent to 95 percent noncondensing.
 6. Manufacturers and Products:
 - a. Bently Nevada, ORBIT 60, CGW module.
 - b. Rockwell Automation.
- F. System Interface Module:
1. Features:
 - a. Provides user access to manage protection configuration, local display, system-level diagnostic, System LEDs, system contacts, and system protection fault relay.
 - b. Communicates to the Vibration System configuration software and transmits the configuration to other modules in the system.
 - c. Provides a physical access security feature through key-lock switch on the public side and contact on the utility side of the SIM.
 - d. Shall have three independently configurable Ethernet ports. Each port can be used for system configuration, system time synchronization, temporary troubleshooting, or an external display.
 2. Functions:
 - a. Alarm list.
 - b. System Event List.
 - c. System Level Diagnostics.
 - d. Firmware Updates.
 - e. System Level Controls:
 - 1) RUN/PROG mode.
 - 2) Trip Multiply.
 - 3) System Alarm Inhibit.
 - 4) System Reset.
 - 5) Protection Fault Relay.
 3. Cyber Security:
 - a. Aligned to the IEC 62443-4-2 standard.
 - b. Encrypted communications using latest TLS standard.
 - c. PKI implemented signed firmware images to facilitate secure boot and trusted firmware updates.

- d. Device identity management uses certificates for trusted connections.
 - e. Configure user, roles and right account management.
 - f. Uses physical Run/Program control.
4. System Contacts:
- a. Quantity: Four.
 - b. Functions:
 - 1) Trip Multiply.
 - 2) Alarm Inhibit.
 - 3) System Reset.
 - 4) Configuration Lock.
5. Communications:
- a. Ethernet Port Quantity: Three.
 - b. Connector: RJ-45.
 - c. Connections:
 - 1) NTP time sources.
 - 2) Orbit Config: System configuration.
 - 3) Orbit Display: Local System Display.
6. Quantity: As required to accommodate the quantity of sensors and systems as shown on the Drawings and as specified herein.
7. Accessories: As required, and as necessary, for a fully configured and functional system.
8. Environmental:
- a. Operating Temperature: Minus 30 degrees C to plus 70 degrees C.
 - b. Operating Humidity: 0 percent to 95 percent noncondensing.
9. Manufacturer and Product:
- a. Bently Nevada, ORBIT 60, SIM module.
 - b. Rockwell Automation.

G. Condition Monitoring Module:

1. Features:
- a. Listens to all information within the system, including all measurements, waveforms, digital transducer signals, system controls, status information, system configuration information, process data from external systems, and alarm and events logs.
 - b. It only listens, with no capability to write, allowing interface to System 1 over the business networks, with no risk to the protection system.
 - c. Data is transferred to System 1 continuously, but in the event of connection lost, non-volatile storage buffers historical data until the information is off-loaded to the host software.
 - d. Without System 1, the customer can use the CMM module to collect data to diagnose machinery issues when an alarm event occurs in the hardware.

2. Communications:
 - a. Ethernet Port Quantity: Two.
 - b. Connector: RJ-45.
3. Quantity: As required to accommodate the quantity of sensors and systems as shown on the Drawings and as specified herein.
4. Accessories: As Required, and as necessary, for a fully configured and functional system.
5. Environmental:
 - a. Operating Temperature: Minus 30 degrees C to plus 70 degrees C.
 - b. Operating Humidity: 0 percent to 95 percent noncondensing.
6. Manufacturers and Products:
 - a. Bently Nevada, ORBIT 60, CMM module.
 - b. Rockwell Automation.

H. Relay Module:

1. Features:
 - a. Programed to actuate base on alarm conditions defined in other modules.
 - b. Use standard logic elements (True AND, Normal AND, OR and NOT) to combine various alarms and statuses (Bypass, Protection State, Inhibit, Attention, Protection Fault) into relay activation conditions.
 - c. Statuses: Bypass, Protection State, Inhibit, Attention, Protection Fault.
2. Electromagnetic Relay:
 - a. Number of Outputs: Eight.
 - b. Operation: Configurable.
 - c. Type: Electromechanical Single-Pole, Double-Throw.
 - d. Arc Suppressor: 250 Vrms, installed standard.
 - e. Contact Rating:
 - 1) Minimum Switched Current: 100 mA.
 - 2) DC Maximum Switched Current: 4A at 30V dc.
 - 3) DC Minimum Switched Voltage: 5V dc.
 - 4) DC Maximum Switched Voltage: 30V dc.
 - 5) AC Maximum Switched Voltage: 250V rms.
 - 6) AC Maximum Switched Current: 4A.
3. Solid State Relay:
 - a. Number of Outputs: Eight.
 - b. Operation: Configurable.
 - c. Type: Electromechanical Single Pole, Double-Throw.
 - d. Arc Suppressor: 150V rms, installed standard.
 - e. Contact Rating:
 - 1) Current Range: 0.01 mA to 125 mA.
 - 2) DC Maximum Switched Current: 125 mA at 125V dc.
 - 3) Voltage Range: 1V dc to 125V dc.

4. Quantity: As required to accommodate the quantity of sensors and systems as shown on the Drawings and as specified herein.
5. Accessories: As required, and as necessary, for a fully configured and functional system.
6. Environmental:
 - a. Operating Temperature: Minus 30 degrees C to plus 70 degrees C.
 - b. Operating Humidity: 0 percent to 95 percent noncondensing.
7. Manufacturers and Product:
 - a. Bently Nevada, ORBIT 60, Relay module.
 - b. Rockwell Automation.

I. Keyphasor Input Module:

1. Features:
 - a. Provides a precision timing measurement.
 - b. Senses the keyphasor signal when the sensor reads a notch or protrusion in the target, then digitizes and processes the signal to provide machine rotative speed and phase reference for vector parameters such as 1x amplitude and phase.
 - c. Gives reference information for vibration measurements, providing key relationships for diagnostic analysis.
 - d. Provide speed/phase reference for the synchronously sampled waveforms captured by the Condition Monitoring Module.
2. Channels:
 - a. Quantity: Four.
3. Inputs:
 - a. Proximitors three-wire.
 - b. Accelerometers three-wire.
 - c. Proximitors Keyphasors three-wire.
 - d. Magnetic speed pickups.
4. Quantity: As required to accommodate the quantity of sensors and systems as shown on the Drawings and as specified herein.
5. Accessories: As required, and as necessary, for a fully configured and functional system.
6. Environmental:
 - a. Operating Temperature: Minus 30 degrees C to plus 70 degrees C.
 - b. Operating Humidity: 0 percent to 95 percent noncondensing.
7. Manufacturer and Product:
 - a. Bently Nevada, ORBIT 60, Keyphasor Input Module.
 - b. Will require vetting with Rockwell.

J. Temperature Module:

1. Features:
 - a. Temperature monitoring.
 - b. Temperature measurement used as reference for Condition Monitoring Analyzes.
2. Channels:
 - a. Quantity: Six.
3. Inputs:
 - a. RTD Sensors:
 - 1) Type: Pt100(385), Pt100(392), Ni120, Cu10.
 - 2) Maximum Error: Plus minus 1 degree C, except Cu10 plus minus 3 degrees C.
 - b. Thermocouple Sensors:
 - 1) Type: J, K, E, T.
 - 2) Maximum Error: Plus minus 3 degrees C.
4. Quantity: As required to accommodate the quantity of sensors and systems as shown on the Drawings and as specified herein.
5. Accessories: As required, and as necessary, for a fully configured and functional system.
6. Environmental:
 - a. Operating Temperature: Minus 30 degrees C to plus 70 degrees C.
 - b. Operating Humidity: 0 percent to 95 percent noncondensing.
7. Manufacturers and Products:
 - a. Bently Nevada, ORBIT 60, Temperature Module.
 - b. Rockwell Automation.

K. Dynamic Input Module:

1. Features:
 - a. Digitize the sensor signal at a rate that completely encompasses the signal content and provides transducer power for various sensors.
 - b. Optimized for signal processing required on complex machinery, roller element bearing machines.
2. Sampling Rate: 102.4 kHz.
3. Dynamic Input Modules:
 - a. PAV Negative Dynamic Sampler (Prox, Accel, Velom).
 - b. PAS Negative Dynamic Sampler (Prox, Accel, Velom).
 - c. PAA Negative Dynamic Sampler (Prox, Accel, Velom).
 - d. PAD Negative Dynamic Sampler (Prox, Accel, Velom).
 - e. PAT Positive Dynamic Sampler (Prox, Accel, Velom).
4. Module Type and Model: As required, to accommodate the quantity of sensors and systems as shown on the Drawings and as specified herein.
5. Quantity: As required to accommodate the quantity of sensors and systems as shown on the Drawings and as specified herein.

6. Accessories: As required, and as necessary, for a fully configured and functional system.
 7. Environmental:
 - a. Operating Temperature: Minus 30 degrees C to plus 70 degrees C.
 - b. Operating Humidity: 0 percent to 95 percent noncondensing.
 8. Manufacturers and Products:
 - a. Bently Nevada, ORBIT 60, Temperature Module.
 - b. Rockwell Automation.
- L. Isolated Process Variable/ Discrete Input Module:
1. Features:
 - a. Process machine-critical parameters, such as pressure, flow, temperature, and levels that merit continuous monitoring.
 - b. Conditions and digitized the signals so the result can be compared with user-programable alarm setpoints.
 - c. Programed using the Orbit Configuration software.
 2. Inputs:
 - a. Current: 4 mA to 20 mA.
 - b. Voltage: Minus 10V dc to plus 10V dc.
 - c. Contacts:
 - 1) Dry.
 - 2) Wet.
 3. Quantity: As required to accommodate the quantity of sensors and systems as shown on the Drawings and as specified herein.
 4. Accessories: As required, and as necessary, for a fully configured and functional system.
 5. Environmental:
 - a. Operating Temperature: Minus 30 degrees C to plus 70 degrees C.
 - b. Operating Humidity: 0 percent to 95 percent noncondensing.
 6. Manufacturers and Products:
 - a. Bently Nevada, ORBIT 60, PVD module.
 - b. Rockwell Automation.

2.20 SOURCE QUALITY CONTROL

- A. As specified in Section 44 42 56.03, Vertical Turbine Pumps.

PART 3 EXECUTION

3.01 INSTALLATION

- A. In accordance with manufacturer's written instructions.
- B. Vibration and Temperature Transducers: Install vibration sensors in accordance with vibration monitoring system best practices. Install lower x, y, and z velocity sensors in accordance with HI locations, and upper x, y, and z

acceleration sensors externally to the motor in a manner to best detect motor thrust bearing vibration. Install on tapped locations on pump or motor, epoxy is not accepted.

3.02 COMMISSIONING AND FACILITY STARTUP

- A. Commissioning and Facility Startup shall be in accordance with the requirements of Section 01 91 14, Equipment Testing and Facility Startup.
- B. Facility startup specifies the order of and prerequisites for the following tests of the equipment:
 - 1. Component Testing.
 - 2. Functional Testing.
 - 3. Software Operational Testing.
 - 4. Performance Testing.
 - 5. Demonstration Testing.
- C. Commissioning and Facility Startup shall be performed using a qualified representative provided by the Manufacturer as specified in Section 01 91 14, Equipment Testing and Facility Startup, Section 01 43 33, Manufacturers' Field Services, and as elaborated upon in this section.

3.03 FIELD QUALITY CONTROL

- A. Vibration system shall be tested and commissioned as part of the Vertical Turbine Pump systems specified in Section 44 42 56.03, Vertical Turbine Pumps and as specified herein.
- B. Perform partial system tests that check sensor installation and hardware configuration:
 - 1. At junction boxes for each pump. Use portable vibration monitors. Check sensor signal and pump vibration spectrum. Record data.
 - 2. At Vibration Monitoring Panel. Simulate input, check alarm levels. Record data.
- C. Perform EMI System Resistance Test:
 - 1. Procedure:
 - a. Use 5W Walkie-Talkie Radio to simulate EMI noise.
 - b. Perform test at 2-meter distance from sensors.
 - c. Perform test at 1-meter distance from junction box.
 - d. Perform test at 1-meter distance from vibration monitoring panel.
 - 2. Test Duration: 1 minute.

3. Acceptance Criteria:
 - a. No signal distortion.
 - b. No pump shut down signal.

D. Vibration Acceptance Test:

1. General:
 - a. Vibration acceptance tests are performed at field.
 - b. The maximum vibration magnitude observed at designated measurement locations shall be compared to the maximum allowable vibration values for a pump type.
2. Scope, procedure, and acceptance values per on ANSI/HI 9.6.4 Rotodynamic Pump for Vibration Measurements and allowable values, including 150 percent acceptance values for upper vibration sensors near top of motor.

3.04 MANUFACTURER'S SERVICES

A. Manufacturer's Representative:

1. Present at distribution equipment factory, Site, and classroom designated by Owner, as needed to perform the following:
 - a. At each site, to enter, confirm, and assist in testing protective relay settings and communications configuration at the distribution equipment. Device settings to be based on values generated in the device coordination study.
 - b. At each site, for initial energization and start-up of distribution system equipment.
 - c. At each site, for post-startup training of Owner's personnel. Training shall not commence until an accepted detailed lesson plan for each training activity has been reviewed by the Engineer.

B. See Section 01 43 33, Manufacturers' Field Services, and Section 01 91 14, Equipment Testing and Facility Startup.

C. Provide manufacturer's services necessary to provide Manufacturer's Certificate of Proper Installation per Section 01 43 33, Manufacturers' Field Services.

D. Software Maintenance and Support Services:

1. Software Maintenance and Support:
 - a. 24/7 technical support during entirety of testing and commissioning phases.

- b. Access to the latest software releases thru entirety of testing and commissioning phases.
 - 1) Operating system updates.
 - 2) Cyber security patches.
 - 3) User-driven feature additions.
- 2. Asset Monitoring Support by Vibration Monitoring System Vendor:
 - a. Frequency:
 - 1) Scheduled Review:
 - a) One per pump during pump, motor, and vibration system performance testing.
 - b) One per facility at completion of performance testing.
 - c) Include price quotation for annual 5 years after site startup.
 - d) In case of any pump, motor, or vibration system failure.

END OF SECTION

SECTION 40 90 00
INSTRUMENTATION AND CONTROL FOR PROCESS SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

- A. This section gives general requirements for Process Instrumentation and Control (PIC) and Process Instrumentation and Control Systems (PICS).

1.02 REFERENCES

- A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM):
 - a. A182, Standard Specification for Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service.
 - b. A276, Standard Specification for Stainless and Heat-Resisting Steel Bars and Shapes.
 - c. A312, Standard Specification for Seamless and Welded Austenitic Stainless Steel Pipes.
 - d. B32, Standard Specification for Solder Metal.
 - e. B88, Standard Specification for Seamless Copper Water Tube.
2. International Society of Automation (ISA):
 - a. S5.1, Instrumentation Symbols and Identification (NRC ADOPTED).
 - b. PR12.6, Installation of Intrinsically Safe Systems for Hazardous (Classified) Locations.
 - c. S5.4, Instrument Loop Diagrams.
 - d. S20, Specification Forms for Process Measurement and Control Instruments, Primary Elements and Control Valves.
 - e. S50.1, Compatibility of Analog Signals for Electronic Industrial Process Instruments.
 - f. TR20.00.01, Specification Forms for Process Measurement and Control Instruments, Part 1: General Considerations.
3. National Electrical Code (NEC).
4. National Electrical Manufacturers Association (NEMA):
 - a. 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).
 - b. ICS 1, General Standards for Industrial Control and Systems.
5. National Institute of Standards and Technology (NIST).

6. NSF International (NSF):
 - a. NSF/ANSI 61, Drinking Water System Components - Health Effects.
 - b. NSF/ANSI 372, Drinking Water System Components - Lead Content.
7. Telecommunications Industry Association (TIA): 568-B.2-1 Category 6.
8. UL: 508A, Standard for Safety, Industrial Control Panels.
9. UL 698A, Industrial Control Panels Relating to Hazardous (Classified) Locations.

1.03 DEFINITIONS

A. Abbreviations:

1. ACP: Analyzer Control Panel.
2. CAT: Component Acceptance Test.
3. CSFT: Communication Systems Functional Test.
4. DAT: Demonstration Acceptance Testing.
5. FAT: Functional Acceptance Test.
6. FDT: Factory Demonstration Test.
7. FSAT: Factory Software Acceptance Test.
8. LCP: Local Control Panel.
9. MCC: Motor Control Center.
10. NP: Network Panel.
11. OIT: Operator Interface Terminal.
12. PAT: Performance Acceptance Test.
- 13.
14. PIC: Process Instrumentation and Control.
15. PICS: Process Instrumentation and Control Systems.
16. PIC SI: Process Instrumentation and Control Systems Integrator.
17. PLC: Programmable Logic Controller.
18. SCADA: Supervisory Control and Data Acquisition.
19. SOAT: System Operational Acceptance Test.

B. Rising/Falling: Terms used to define actions of discrete devices about their setpoints.

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 dc to 20 mA dc signals conforming to ISA S50.1.
 - b. Unless otherwise indicated for specific PICS 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: 1V dc to 5V 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.
6. Network Signals, Ethernet/IP: Ethernet/IP is the protocol is a multi-discipline, control, and information platform for industrial environments and time-critical applications. Ethernet/IP uses standard Ethernet and TCP/IP technologies, and an open, application-layer protocol called the Common Industrial Protocol (CIP).

1.04 RELATED SECTIONS

A. The following are some of the major sections with significant interfaces and coordination with the requirements of this section:

1. Section 01 31 13, Project Coordination.
2. Section 01 33 00, Submittal Procedures.
3. Section 01 91 14, Equipment Testing and Facility Startup.
4. Section 23 09 23, Direct-Digital Control System for HVAC.
5. Section 26 05 05, Conductors.
6. Section 26 05 10, Network Communication System.
7. Section 26 05 30, Electrical Testing and Startup.
8. Section 26 09 14, Vibration Monitoring System.
9. Section 26 19 23, Medium-Voltage Adjustable Speed Drive System.
10. Section 26 24 19, Low-Voltage Motor Control.
11. Section 26 29 23, Low-Voltage Variable Frequency Drive System.
12. Section 26 32 13.13, Diesel Engine Generator Set.
13. Section 33 12 17.01, Surge Control System Engineer Designed.

14. Section 40 27 02, Process Valves and Operators.
 15. Section 40 99 90, Package Control Systems.
 16. Section 44 11 25, Powder Activated Carbon Feed System.
 17. Section 44 42 56.03, Vertical Turbine Pumps.
 18. Section 44 44 13.01, Chemical Metering Pumps.
 19. Section 44 44 13.02, Carbon Dioxide Package System.
- B. This section provides overall requirements for the entire PICS. The PICS in its entirety shall be completely provided and executed as specified herein, excluding Engineer provided Applications Software by a single contractual entity directly subcontracted to the Contractor. The entirety of the PICS shall be the responsibility of a single PIC System Integrator (PIC SI). The following sections are detailed PICS subsections that shall be considered as part of this section. All of the PICS subsections shall be supplied in their entirety by the PIC SI in accordance with the requirements of this section, and all of the respective PICS subsections:
1. Section 40 90 10, Instrument Components.
 2. Section 40 90 11, Network Components.
 3. Section 40 90 12, PLC Components.
 4. Section 40 90 13, Control and Network Panel Components.
 5. Section 40 90 20, Control Panels.
 6. Section 40 90 21, Analyzer Control Panels.
 7. Section 40 90 22, Network Panels.
 8. Section 40 90 30, Instrumentation and Control Testing and Startup.
- C. Detailed Design: PICS as shown, and specified, includes functional and performance requirements and component specifications. PIC SI shall finalize and complete a detailed PICS design.

1.05 WORK OVERVIEW AND SUMMARY

- A. PLC I/O List:
1. Managed by Engineer:
 - a. During construction Engineer will maintain PLC I/O List in electronic Microsoft Excel format.
 - b. Engineer will assign PLC I/O points to specific chassis, slot, and point addresses.
 2. PLC I/O List Changes managed by Engineer: Changes to PLC I/O List reflecting actual equipment and instrumentation provided and all field modifications.
 - a. Keep electronic file of latest PLC I/O List up to date.
 - b. Revision numbers.
 - c. Description of each change or modification.

B. Applications Software and Network Configuration:

1. Provided by Engineer for PLCs, networks, and the SCADA system, Excluding vendor package control systems. Work related to supporting this activity includes:
 - a. Early delivery of programming and network equipment to Engineer's office.
 - 1) Early submittal for all programming hardware.
 - 2) Deliver the equipment within 6 months of project notice to proceed.
 - 3) Setup and demonstration testing of programming equipment at Engineer's office by Engineer.
 - 4) PIC SI shall provide shipping and insurance for all equipment shipping to, and from, Engineers office.
 - 5) List of Equipment to be shipped:
 - a) Refer to Section 40 90 11, Network Components, and Section 40 90 12, PLC Components, for all components to be shipped as part of the early delivery of PLC and Network Components/Equipment.
 - b) At a minimum, shall include:
 - (1) Every PLC processor on the project.
 - (2) One complete PLC rack including rack power supply, rack.
 - (3) Every Ethernet module on the project.
 - (4) Any PLC module, HMI, or network devices, requiring IP configuration.
 - 6) Allow for a minimum of 9 months duration after early equipment delivery submittal approval and prior to panel factory demonstration tests for the Engineer to configure the equipment.
 - b. For additional related requirements refer to:
 - 1) Article Sequencing and Scheduling in this section.
 - 2) Section 01 91 14, Equipment Testing and Facility Startup.
 - 3) Section 40 90 30, Instrumentation and Control Testing and Startup.
 - 4) Section 01 31 13, Project Coordination, for definition of Milestones.
 - 5) Items elsewhere within the PICS that covers the equipment for which Engineer will provide applications software.

C. Major Work Items:

1. Work includes, but not limited to, engineering, furnishing, installing, calibrating, adjusting, testing, documenting, starting up, and Owner training for complete plant PICS. Major PICS system elements include:
 - a. Instrument Components including primary elements, transmitters, and control devices.
 - b. Control panels.
 - c. Network panels.
 - d. Network components.
 - e. Analyzer panels.
 - f. Programmable controllers (PLCs) components, communication modules, input/output (I/O) modules, I/O racks, I/O power supplies, and associated cabling and termination hardware.
 - g. Application Software:
 - 1) Software Coordination:
 - a) PIC SI shall provide support and assistance with onsite checkout of applications software, PLC Components, Network Components in accordance with these sections:
 - (1) Section 01 91 14, Equipment Testing and Facility Startup.
 - (2) Section 26 05 30, Electrical Testing and Startup.
 - (3) Section 40 90 30, Instrumentation and Control Testing and Startup.
 - (4) Section 40 99 90, Package Control Systems.
 - 2) Software field testing, startup, and commissioning.
 - h. Interfaces with existing control systems.
 - i. Extensive interface with other systems including, but not limited to, adjustable speed drives, actuated valves, security system, and vendor systems.
 - j. Extensive testing of entire PICS including, but not limited to, control panel factory testing, and complete field testing of each, and every, interface to, and from, PICS.
 - k. Installation of new PLC and SCADA Ethernet network including new network panels, network switches, PLCs, and OITs. Coordinate with Division 26, Electrical, for cabling to network devices. Refer to network block diagrams and electrical plans on the Drawings.

D. The PICS as shown, and specified, includes general functional requirements, performance requirements, and component specifications including:

1. Functional requirements, performance requirements, and component specifications.
2. P&IDs, block diagrams, and network diagrams.

3. Drawings for control/network/analyzer panel layout concepts, control/network/analyzer panel schedules, PLC I/O module wiring, panel power, and control diagrams. Coordinate all instrument installations in accordance with actual instrument manufacturer requirements.
- E. The PIC SI shall detail and complete a final PICS. Complete detailed PICS components, including detailed instrument component data sheets, detailed control panel layouts, detailed control panel wiring diagrams, loop diagrams, network panels, detailed network block diagrams, PLC I/O module wiring, control panel power wiring, field instrumentation wiring diagrams. The PICS final design requirements include:
1. For PICS Equipment and Ancillaries:
 - a. Completing detail design.
 - b. Submittals.
 - c. Equipment, enclosures, and ancillaries.
 - d. Instructions, details, and recommendations to, and coordination with Contractor for Certificate of Proper Installation.
 - e. Verify readiness for operation.
 - f. Verify correctness of final power and signal connections (lugging and connecting).
 - g. Adjusting and calibrating.
 - h. Starting up.
 - i. Testing and coordination of testing.
 - j. Training.
 - k. Participate with Contractor, other subcontractors, and equipment suppliers to execute functional testing in accordance with, and as defined in Section 40 90 30, Instrumentation and Control Testing and Startup.
 - l. Coordinate and participate with Contractor and Subcontractors to lead performance testing, and systems acceptance testing in accordance with, and as defined in Section 40 90 30, Instrumentation and Control Testing and Startup. With Contractor, lead activities associated with PICS Performance Testing. Lead PICS Systems Acceptance Test.
 2. Verify following Work not by PIC SI is provided to all devices that have a PICS interface:
 - a. Participate with Contractor and other Subcontractors to inspect PICS installation, witness functional testing continuity testing, witness the Communication Systems Functional Test and other testing as specified herein.
 - b. Correct type, size, and number of signal wires with their raceways.
 - c. Correct electrical power circuits and raceways.

- d. Correct size, type, and number of PICS-related pipes, valves, fittings, and tubes.
 - e. Correct size, type, materials, and connections of process mechanical piping for in-line primary elements.
 - f. Loop diagrams are the basis of the items included in the verification.
 - 1) Examples of items in this category include, but are not limited to, the following:
 - a) Power circuits to instruments.
 - b) Cabling and terminations for all devices wired to the PICS.
 - c) Network cables and connections to the PICS.
 - d) Power to devices such as actuators and other devices that are included on the loop diagrams.
 - e) Control stations that are wired to the MCC and/or the PICS.
3. Non-PICS Equipment Directly Connected to PICS Equipment:
- a. Obtain from Contractor, manufacturers' information on installation, interface, function, and adjustment.
 - b. Coordinate with Contractor to allow required interface and operation with PICS.
 - c. For operation and control, verify installations, interfacing signal terminations, and adjustments have been completed in accordance with manufacturer's recommendations.
 - d. Test to demonstrate required interface and operation with PICS.
 - e. Examples of items in this category, but not limited to the following:
 - 1) Valve and gate operators, position switches, and controls.
 - 2) Chemical feed pump and feeder speed/stroke controls.
 - 3) Motor control centers.
 - 4) Adjustable speed and adjustable frequency drive systems.
 - 5) Division 26, Electrical, Division 28, Electronic Safety and Security, Division 35, Waterway and Marine Construction, Division 40, Process Interconnections, Division 43, Process Gas and Liquid Handling, Purification, and Storage Equipment, and Division 44, Pollution and Waste Control Equipment, with interfaces to the PICS.
4. Drawings:
- a. This shall include all other Drawings and diagrams specified hereinafter. At a minimum shall include:
 - 1) Drawings: Final Instrument Installation Construction Drawings.
 - 2) Sizing and selection calculations.
 - 3) Panel Construction Drawings (analyzer, control, network, and existing panel modifications).
 - 4) Panel Power Wiring Diagrams (analyzer, control, network).

- 5) Detailed Panel Wiring Diagrams.
 - 6) Loop Wiring Diagrams:
 - a) Preliminary format and content for review and approval.
 - b) Final diagrams which shall be based on the approved format.
 - 7) Communications and Digital Networks Diagrams.
5. Coordination with Contractor:
 - a. Component, Functional, Software Operational, and Performance testing shall be executed in conjunction with Contractor in accordance with:
 - 1) Section 01 91 14, Equipment Testing and Facility Startup.
 - 2) Section 01 31 13, Project Coordination, for quantity and definition of Milestones. There are multiple milestones requiring different delivery of PICS equipment and testing.
 - b. Coordinate testing and delivery of control panels and all other PICS equipment with Contractor and milestones as identified in Section 01 31 13, Project Coordination.
 6. Coordination with Division 33, Utilities, Division 43, Process Gas and Liquid Handling, Purification, and Storage Equipment and Division 44, Pollution and Waste Control Equipment. Refer to specific sections in Division 33, Utilities, Division 43, Process Gas and Liquid Handling, Purification, and Storage Equipment, and Division 44, Pollution and Waste Control Equipment, for information on equipment and the details of that equipment available for PICS review, coordination, and use. These systems shall be tested and started up as part of this Contract by Contractor, with assistance from the associated package supplier and PIC SI. The PIC SI scope of services during construction required for each package system, may include, but is not limited to, installation coordination, installation testing, functional testing, performance testing, and system acceptance testing. These systems include, but are not limited to:
 - a. Chemical systems equipment and accessories.
 - b. Air compressor systems.
 - c. Fiberglass reinforced tank.
 - d. Pumps, (numerous types).
 - e. Surge control system.
 - f. HVAC system (add reference above)

7. Coordination with Division 40, Process Interconnections, for valve control interfaces. Refer to specific sections in Division 40, Process Interconnections, for information on equipment and details of valve control for PICS review, coordination, and use. These systems will be tested and started up as part of this Contract by Contractor, with assistance from the associated package supplier and PIC SI. The PIC SI scope of services during construction required for valve actuator systems includes, but is not limited to, installation coordination, installation testing, functional testing, performance testing, and system acceptance testing.
8. Coordination with Division 26, Electrical, for conduit and cable information to be included on PICS supplied loop wiring diagrams.
9. Coordination with Division 26, Electrical, Section 26 08 00, Commissioning of Electrical Systems, for testing requirements.
10. Coordination with Division 26, Electrical, for adjustable frequency drives, vibration systems, and motor control centers interfaces. Refer to specific Sections in Division 26, Electrical, for information on equipment and details of these devices available for PICS review, coordination, and use. These systems will be tested and started up as part of this Contract by Contractor, with assistance from the associated package supplier and PIC SI. The scope of services during construction required for electrical systems, may include, but is not limited to, installation coordination, installation testing, functional testing, performance testing, and system acceptance testing. These systems include, but are not limited to:
 - a. Adjustable frequency drives.
 - b. Motor control center.
 - c. Engine generator.
 - d. Vibration monitoring systems.
 - e. Fiber optic and network communication system.
11. Coordination with Division 28, Electronic Safety and Security, for system interfaces including connection of security system cameras to the network panels and signals from the fire alarm system.
12. Coordination with Division 01, General Requirements, Section 01 31 13 Project Coordination. Coordination with Contractor on the Milestones, and construction of the new systems. Coordination with Owner and Engineer on the Milestones, Milestone Sequences. The ENM Rural Water System consists of several milestones that result in phased delivery of the PICS. Coordinate implementation of the phased construction of the new systems with the Owners existing systems and Engineer provided Application Software.
13. Coordination of onsite system integration including participation, assistance, and coordination between electrical/process and systems furnished by others with interfaces to the PICS. Assure compliance with Section 01 91 14, Equipment Testing and Facility Startup. Refer to

Functional and Performance Testing for all other sections with interfaces to, and from, PICS.

14. Testing:
 - a. PLC I/O Testing: Complete and thorough testing of all control loop circuits including testing of I/O wiring to the control panels, package system panel interfaces, interface to devices supplied by others including but not limited to motor control centers, variable frequency drives, valves, gates, instruments, security cameras, and other similar devices.
 - b. Network Testing: Complete and thorough testing of all network components including testing of network devices and cabling to the network panels, control panels, package system panel interfaces, actuated valves networks, variable frequency drives, and network interfaces to devices supplied by others.
 - c. Software Testing: Complete and thorough testing of all PLC and SCADA functions.
15. Interface with Owner existing PLC and SCADA systems. The existing PLC and SCADA systems shall remain completely operational throughout the entire construction period.

1.06 OWNER-FURNISHED EQUIPMENT

- A. The PIC SI shall be responsible for receipt and installation of the Owner-furnished network equipment as specified herein and as shown on the Drawings.
 1. Many items of the items identified as Owner-furnished are based upon the current manufacturer and model numbers at the time of design, as specified herein, and as shown on the Drawings.
 2. The product information specified herein has been provided to the PIC SI for panel layout, power requirements, and cabling requirements as specified herein or shown on the Drawings.
 3. These items model numbers and catalog information may change due to the actual timing of the Owner-furnished procurement dates.
 4. This information will be communicated to the PIC SI and the Contractor by the Owner during the Project, prior to the network panel drawing submittals.
- B. The PIC SI shall be responsible to provide all labor, materials, and equipment to coordinate shipment and delivery, receiving, installing, startup, testing and commissioning of the network equipment as specified herein.
- C. Network Equipment: The network equipment shall be included by the PICS System Integrator on all of the control panel drawings, network panel drawings, including but not limited to, panel layout, panel construction, panel power diagrams, panel wiring diagrams, and all other drawings required

herein. PIC SI services to be provided for the Owner-furnished equipment are included herein.

- D. The PIC SI shall receive all products from the Owner, or entities as directed by the County.
- E. PIC SI shall store equipment indoors from receipt until installation.
- F. Transfer of Products:
 - 1. Unless indicated otherwise, items will be furnished f.o.b. the PIC SI shop for inclusion in the panels.
 - 2. Upon delivery, conduct an inspection for the purpose of identifying product, general verification of quantities, and observation of apparent condition. Such inspection will not be construed as final or as receipt of any product that, as a result of subsequent inspections and tests, are determined to be nonconforming.
 - 3. Damaged or incomplete products to be returned for replacement will not be unloaded, except as necessary to expedite return shipment. Owner will submit claims for transportation damage and expedite replacement of damaged, defective, or deficient items.
 - 4. Indicate signed acceptance of delivery on a copy of the invoice.
 - 5. The PIC SI shall coordinate with the Contractor for the delivery date of the Owner-furnished products to the project site. Contractor shall be prepared to accept delivery of the Owner-furnished products. The PIC SI shall bear all costs incurred for storage of the equipment if the Contractor is not ready for installation of the equipment when it arrives.
- G. Unloading, Storage, Maintenance, and Insurance:
 - 1. Subsequent to transfer, PIC SI shall have complete responsibility for unloading Owner-furnished products. Unload product in accordance with manufacturers' instructions, or as specified.
 - 2. Store, protect, and maintain product to prevent damage until final acceptance of completed work. Damage to or loss of products after date of transfer to PIC SI shall be repaired to original condition, or replaced with new identical products, at the discretion of Engineer and Owner. PIC SI shall store received equipment indoors from receipt until installation.
 - 3. Maintain complete inventory of all Owner-furnished products after their transfer to PIC SI.
 - 4. Upon transfer, receipt, and control of the equipment, PIC SI shall include the items within their insurance coverage until acceptance of the fully functioning equipment as a part of the facilities has occurred as if the PIC SI had purchased the equipment. Evidence of Insurance

coverage shall be provided to Owner. The value of the Owner-furnished equipment shall be assumed up to \$150,000.00.

1.07 SUBMITTALS

A. General:

1. First PICS Submittal:
 - a. Submit proposed PICS SI Schedule with a breakdown consisting of sequencing and packaging of information in accordance with Contractors Project Schedule. Coordinate PICS Schedule submittal with Contractor, Section 01 32 00, Construction Progress Documentation. Coordinate PICS Schedule with Section 01 11 14, Work Sequences and Continuity of Operations, and with Section 01 91 14, Equipment Testing and Facility Startup. PICS schedule shall illustrate each PICS item of supply, each PICS SI activity, all PICS submittals, all PICS testing, and startup for each of the multiple Milestones defined in Section 01 31 13, Project Coordination.
 - b. No additional PICS submittals will be reviewed by the Engineer until the PICS schedule has been reviewed and approved by Engineer.
 - c. PICS SI shall submit PICS SI schedule monthly after original PICS SI schedule submittal is approved.
2. Partial Submittals not in accordance with the approved Project Schedule, or approved PICS Schedule, will not be accepted.
3. Submittal Format:
 - a. Hard Copy: Required for all submittals. All hard copy submittals shall all be in bound volumes.
 - b. Electronic Copies: Required, unless otherwise noted for all submittals.
 - 1) Manufacturers' Standard Documents: Adobe Acrobat PDF.
 - 2) Documents Created Specifically for Project:
 - a) Text: Microsoft Word.
 - b) Lists and Data Sheets: Microsoft Excel, unless otherwise noted for specific items.
 - c) Drawings: AutoCAD.
4. Identify proposed items, options, installed spares, and other provisions for future work (for example, reserved panel space; unused components, wiring, and terminals).
5. Legends and Abbreviation Lists: Definition of symbols and abbreviations used on all diagrams and drawings.

B. Action Submittals:

1. General:

a. Shop Drawings, full-scaled details, wiring diagrams, catalog cuts, and descriptive literature. The following list of submittals is for preliminary reference only to establish definition of the term Shop Drawings. Other required submittals are as defined elsewhere in PICS.

- 1) Bill of Materials.
- 2) Catalog Cuts.
- 3) I/O List, by Engineer.
- 4) Instrument List.
- 5) Component Data Sheets.
- 6) Sizing and Selection Calculations.
 - a) UPS.
 - b) Control panel DC power supply.
 - c) Control Panel power consumption.
 - d) Control Panel, Analyzer Panel (if enclosed), and Network Panel Heat Dissipation and Air Conditioning calculations.
- 7) Panel Construction Drawings (analyzer, control, network).
- 8) Panel Power Wiring Diagrams (analyzer, control, network).
- 9) Panel Instrument List (analyzer, control, network).
- 10) Detailed Panel Wiring Diagrams (analyzer, control, network).
- 11) Loop Wiring Diagrams.
- 12) Communications and Digital Networks Diagrams.
- 13) As-Built Documentation.

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 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:
 - a. I&C Components, Electrical Devices, and Mechanical Devices:
 - 1) Catalog information, mark to identify proposed items and options.
 - 2) Descriptive literature.
 - 3) External power and signal connections.
 - 4) Scaled drawings showing exterior dimensions and locations of electrical and mechanical interfaces.
4. Software:
 - a. For plant PLC/HMI, only, excluding Package Systems, I/O List or Database:
 - 1) Managed, and supplied by, Engineer:
 - a) During construction Engineer will maintain PLC I/O List in electronic Microsoft Excel format.
 - b) Engineer will assign PLC I/O points to specific chassis, slot, and point addresses.
 - 2) PLC I/O List Changes managed by Engineer: Changes to PLC I/O List reflecting actual equipment and instrumentation provided and all field modifications.
 - a) Keep electronic file of latest PLC I/O List up to date.
 - b) Revision numbers.
 - c) Description of each change or modification.
 - b. Applications Software: Managed, and supplied by, Engineer.
5. Instrument List:
 - a. Instrument List included in Section 40 90 10, Instrument Components, can be provided for PIC SI to use as an initial Instrument List in Microsoft Excel. Data from this may be used as starting point for creating final Instrument List and some of the information to be included on Component Data Sheets.
 - b. Applicable fields to be completed include, but are not limited to:

Instrument List Characteristics	
Item	Initially Completed by
Tag Number	Engineer
Loop Number	Engineer
Description	Engineer
Manufacturer, options, and complete model number including identification of all options	PIC SI
Size and scale range	Engineer
Setpoints	Engineer

Instrument List Characteristics	
Item	Initially Completed by
Reference P&IDs, Electrical, Mechanical, Interconnection Drawings and Installation Details Drawings	Engineer
Instrument installation detail number	Engineer

- c. Submit updated version of Instrument List.
- d. Electronic Copies: Microsoft Excel.
6. Component Data Sheets: Data sheets for entirety of PICS including instruments, network hardware, and other PICS components and devices.
 - a. Format and Level of Detail: Microsoft Excel, in accordance with ISA-TR20.00.01.
 - b. Only one instrument per data sheet.
 - c. Include component type identification code and tag number on data sheet.
 - d. Specific features and configuration data for each instrument, device, or component:
 - 1) Tag number.
 - 2) Component type identification code.
 - 3) Description.
 - 4) Location or service.
 - 5) Service conditions.
 - 6) Manufacturer and complete model number.
 - 7) Size and scale range.
 - 8) Setpoints.
 - 9) Materials of construction.
 - 10) Options included.
 - 11) All other customized accessories required for installation or the application.
 - 12) Name, address, and telephone number of manufacturer's local office, representative, distributor, or service facility.
7. Sizing and selection calculations for the following equipment:
 - a. Uninterruptible power supply.
 - b. DC power supplies.
 - c. All panel heat and air conditioning.
 - d. Panel wire way sizing and wire way fill.
8. Panel Construction Drawings:
 - a. In accordance with specified requirements for all PICS panels including, control panels, analyzer panels, and network panels.

9. Detailed Panel Control Wiring and Power Wiring Diagrams: For discrete control and power circuits within the panel.
 - a. In accordance with specified requirements for all PICS panels including, control panels, analyzer panels, and network panels.
 - b. Circuit Names: Show names corresponding to Circuit and Raceway Schedule for circuits entering and leaving a panel. Refer to Division 26, Electrical. Refer to Project wire tag/label standards herein.
10. Communications and Digital Networks Diagrams and Schedules:
 - a. Scope: Includes site network schematic diagrams and detailed point to point interconnection schedules for plant wide Ethernet networks and I/O networks including adjustable frequency drives and digital power monitors.
 - b. Detailed diagrams shall be based on the Drawings and site layout drawings provided by Section 26 05 10, Network Communication System. Coordinate data on network diagrams and site layout drawings.
 - c. Show on the Network Diagrams:
 - 1) Interconnected devices, both passive and active.
 - 2) Device names and numbers.
 - 3) Communication Media: Type of cable.
 - 4) Node and device address numbers.
 - 5) Wire and cable numbers and colors.
 - 6) Duct banks, vaults, and access holes.
 - d. Show on the Schedules:
 - 1) Device names and numbers.
 - 2) Terminal, and or, port numbers.
 - 3) Communication Media: Type of cable and cable label.
 - 4) Connection Type: Type of connector.
 - 5) Node and device address numbers.
 - 6) Wire, or fiber, and cable numbers and colors.
11. Loop Wiring Diagrams: Individual, end-to-end wiring diagram for each analog and discrete or equipment loop. Refer to Drawings for sample drawings. These sample drawings are for general representative of the loop drawing format and content only. The PIC SI shall develop, and submit, final templates and, or prototypes using these sample drawings with Engineer input as the basis for all final templates. At a minimum include every cable and signal associated with each loop. Include all devices, all conductors, all cables, all terminations, all power and any other information for all instruments. At a minimum, include similar information for other systems that require interface to, and from, the PICS including but not limited to valves, MCC, power panel, package systems, and any other system. After the Engineer has reviewed and approved the final format and content, the PIC SI shall complete all of

the loop wiring diagrams for the project using the final approved diagram format and content.

- a. Applies to control panels.
- b. Field wiring, terminations, cabling for PICS discrete and analog circuits shall be shown on Loop Diagrams. All field wiring and termination information shall be shown on the loop diagrams.
- c. PIC SI shall coordinate with the Contractor and Division 26, Electrical, for the conduit and cable schedule for cable information to be included on the loop diagrams.
- d. All loop diagrams must be complete with field terminations, electrical cable information, field wire labels, and approved as final prior to commencing field installation and field testing. Minimum format and information shall include:
 - 1) One loop only per diagram, or sheet.
 - 2) One loop is defined as the I/O associated with each unique instrument, or equipment.
 - 3) Detailed wiring information including, but not limited to:
 - a) Instrument information.
 - b) Power and power supply.
 - c) All field and panel terminal numbers.
 - d) Fuses and fuse sizes.
 - e) Cable numbers from Division 26, Electrical.
 - f) Field wire labels, tags, numbers assigned by PIC SI, in accordance with the project labelling standard herein.
 - g) Field cable labels and tags assigned by Division 26, Electrical.
 - h) Wire colors.
 - i) PLC I/O address for each I/O point.
- e. PIC SI shall coordinate with the Contractor to include all field cables, field wiring, field termination, and wire labels information gathered from approved submittals for all field equipment that has an interface to the PICS. This includes, but is not limited to:
 - 1) Valves.
 - 2) Pumps.
 - 3) Compressors.
 - 4) Chemical pumping systems.
 - 5) Surge control system.
 - 6) Vendor package systems.
 - 7) Instruments.
 - 8) Motor control centers.
 - 9) Adjustable speed drive systems.
 - 10) Vibration monitoring system.
 - 11) Vendor package systems.
 - 12) UPS.
 - 13) Generator.
 - 14) All other equipment with an interface to the PICS.

- f. Title Block:
 - 1) Include a unique title for each Drawing which includes:
 - a) Process designation.
 - b) Equipment, and/or process variable loop description.
 - c) Loop number (organize each panel by sequential loop number).
 - d) Organize drawings by PLC.
- g. Conform to the minimum requirements of ISA S5.4.
- h. Under Paragraph 5.3 of ISA S5.4, include the information listed under Subparagraph 2 and Subparagraph 6.
- i. Show all loop components located either in the field, other systems, other devices, other panels, or within a PICS panel and identify each component, component terminals, and panel terminals.
- j. 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).
- k. If a loop connects to panels or devices not provided under this section and its subsections, such as control valves, motor control centers, package system panels, variable speed drives, include the following information:
 - 1) Show the first component connected to within the panel or device that is not provided under this section and its subsections.
 - 2) Identify the component by tag and description.
 - 3) Identify the other system panel numbers, component tag number, and all device terminal numbers.
 - 4) Identify power distribution panel and circuit number where non-UPS power is supplied to PICS equipment.
 - 5) Identify UPS panel and power distribution panel and circuit number where UPS power is supplied to PICS equipment.
- l. Drawing Size: Individual 11-inch by 17-inch sheet for each loop.
- m. Divide each loop diagram into areas for panel face, back-of-panel, field, and PLC.

- n. One Drawing Per Loop: Show each loop individually.
 - 1) No “typical” loop diagrams will be allowed.
 - 2) No combined loops will be allowed.
 - 3) Include loop drawings for both analog and discrete I/O.
 - 4) Combine all I/O associated with a loop on the same drawing unless a second sheet is required for some loops with multiple I/O requires an additional sheet.
 - o. Show:
 - 1) Terminal numbers, location of ac, or 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 analog loop 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.
 - 12. List of spares, expendables, test equipment and tools.
 - 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.
- C. Informational Submittals: For PICS equipment, provide Manufacturer’s Certificate of Proper Installation and readiness for operation.
- 1. PICS project schedule.
 - a. PICS SI shall develop project schedule which shall be updated, and submitted, monthly throughout the entirety of the project duration.
 - 2. Owner Training Plan. Reference Section 01 43 33, Manufacturers’ Field Services.
 - 3. 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 PICS 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 PICS 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) Communications and Digital Networks Diagrams: One reproducible copy.
 - j) Application Software Documentation.
 - k) Submit electronic copies of Drawings, data sheets, and diagrams in final O&M. One file per drawing in AutoCAD.
 - 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.
 - 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.
4. Factory Demonstration Test (FDT) Procedures and Forms Submittals:
 - a. Test Procedures: Outlines of all proposed tests, forms, drawings, and checklists.
5. Functional Acceptance Test (FAT) Forms 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. Use the Test Forms in Section 40 90 30, Instrumentation and Control Testing and Startup, as an example

test form. Update the test form to include all phases and additional information of the testing.

6. Performance Acceptance Test Forms (PAT) Submittals:
 - a. Preliminary Test Procedures: Outlines of proposed tests, forms, and checklists.
 - b. Final Test Procedures: Proposed test procedures, forms, and checklists. Add the following information to the Test Forms. Incorporate Detailed Software Loop Descriptions functions associated with PLC I/O and instruments including all instrument checkout and testing, PLC I/O points, interlocks, and all other operations associated with each loop.
 - c. Test Documentation: Copy of signed off test procedures when tests are completed.
7. Software Operational Acceptance Test Forms (SOAT) Submittals:
 - a. Preliminary Test Procedures: Outlines of proposed tests, forms, and checklists.
 - b. Final Test Procedures: Proposed test procedures, forms, and checklists.
 - c. Add the following information to the Test Forms:
 - 1) Incorporate Detailed Software Loop Descriptions that includes all operations HMI functions not tested in prior test phases.
 - d. Test Documentation: Copy of signed off test procedures when tests are completed.

D. Factory Software Acceptance Test (FSAT):

1. As specified in Source Quality Control, hereinafter.
2. All PLC, SCADA, and network functions will be tested at Engineer office.

1.08 QUALITY ASSURANCE

- A. Calibration Instruments: Each instrument used for calibrating PICS 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: Owner's office.
 3. Attended By: Engineer, Owner, PICS Supplier, and Contractor.
 4. Minimum of four are required. Specific dates will be established in Progress Schedule.
 5. First Meeting: Within 90 days after Notice to Proceed, prior to PIC SI schedule submittal.

1.09 DELIVERY, STORAGE, AND HANDLING

- A. Provide Site and warehouse storage facilities for PICS 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.

1.10 ENVIRONMENTAL REQUIREMENTS

- A. Standard Environmental Requirements:
 - 1. Unless otherwise noted, design equipment for continuous operation in these environments:
 - a. Freestanding Panel and Consoles:
 - 1) Inside: NEMA 12.
 - b. Smaller Panels and Assemblies (that are not Freestanding):
 - 1) Inside, Air Conditioned: NEMA 12.
 - 2) All Other Locations: NEMA 4X Type 316 stainless steel.
 - 3) Field Elements: Outside.
- B. Environmental Design Requirements: Following defines the types of environments referred to in the above.
 - 1. Inside, Air Conditioned:
 - a. Temperature:
 - 1) Normal: 60 degrees F to 80 degrees F.
 - 2) With Up to 4-Hour HVAC System Interruptions: 40 degrees F to 105 degrees F.
 - b. Relative Humidity:
 - 1) Normal: 10 percent (winter) to 70 percent (summer).
 - 2) With Up to 4-Hour HVAC System Interruption: 10 percent to 100 percent.
 - c. NEC Classification: Nonhazardous.
 - 2. Inside:
 - a. Temperature: 20 degrees F to 104 degrees F.
 - b. Relative Humidity: 10 percent to 100 percent.
 - c. NEC Classification: Nonhazardous.
 - 3. Inside, Corrosive:
 - a. Temperature: Minus 20 degrees F to 104 degrees F.
 - b. Relative Humidity: 10 percent to 100 percent.

- c. Corrosive Environment: As noted on the Drawings.
- d. NEC Classification: Nonhazardous.
- 4. Outside:
 - a. Temperature: Minus 20 degrees F to 104 degrees F.
 - b. Relative Humidity: 10 percent to 95 percent noncondensing, rain, snow, freezing rain.
 - c. NEC Classification: Nonhazardous.
- 5. Outside, Corrosive:
 - a. Temperature: Minus 20 degrees F to 104 degrees F.
 - b. Relative Humidity: 10 percent to 95 percent noncondensing, rain, snow, freezing rain.
 - c. Corrosive Environment: As noted on the Drawings.
 - d. NEC Classification: Nonhazardous.

1.11 SEQUENCING AND SCHEDULING

A. Activity Completion:

- 1. The following is a list of key activities and their completion criteria:
 - a. PICS SI Schedule:
 - 1) Shall be submitted illustrating the entire PICS project supply, all activities, all task durations.
 - 2) Shall be approved by Engineer, prior to any other submittals.
 - b. Shop Drawings: Reviewed and approved.
 - c. Quality Control Submittals: Reviewed and accepted.
 - d. Hardware Delivery: Hardware delivered to Site and inventoried by Owner.
 - e. PAT: Completed and required test documentation accepted.

B. PICS Substantial Completion: When Engineer issues Certificate of Substantial Completion by facility.

- 1. Prerequisites:
 - a. All PICS Submittals have been completed.
 - b. PICS has successfully completed PAT for a given facility.
 - c. Owner training plan is on schedule.
 - d. All spares, expendables, and test equipment have been delivered to Owner.

C. PICS Acceptance: When Engineer issues a written notice of Final Payment and Acceptance.

- 1. Prerequisites:
 - a. Certificate of Substantial Completion issued for PICS.
 - b. Punch-list items completed.

- c. Final revisions to O&M manuals accepted.
- d. Maintenance service agreements for PICS accepted by Owner.

D. Prerequisite Activities and Lead Times:

- 1. 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.
Receive Owner-furnished network hardware	Prior to panel fabrication
Hardware purchasing, fabrication, and assembly	Associated shop drawing Submittals completed.
FDT	Completion of PICS Shop Drawing Submittals for Control Panels, Network Panels, and Analyzer Panels.
Shipment	Completion of PICS Shop Drawing Submittals, with any FDT panel modifications incorporated, and preliminary O&M manuals.
Owner Training	Owner training plan completed by facility.
CAT	All CAT procedures and test forms completed, all PICS submittals completed and approved. All continuity tests in accordance with Section 26 05 30, Electrical Testing and Startup are completed.
FAT	Communication Systems Functional Test (CSFT) in accordance with Section 26 05 10, Network Communication System, is completed. All CAT is completed. All FAT procedures and test forms completed, all PICS submittals completed and approved.
SOAT	Owner training, and SOAT procedures and test forms completed; notice 4 weeks prior to start.

PART 2 PRODUCTS

2.01 GENERAL

- A. Reference, and in accordance with, all PICS subsections.
- B. PICS functions as shown on the Drawings and as required for each loop. Furnish equipment items as required. Furnish all materials, equipment, and software, necessary to effect required system and loop performance.
- C. First Named Manufacturer: PICS 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 Owner for such changes in accordance with Article Submittals.
 - 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.
- D. 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.
- E. Components and Materials in Contact with Water for Human Consumption: Comply with the requirements of the Safe Drinking Water Act and other applicable federal, state, and local requirements. Provide certification by manufacturer or an accredited certification organization recognized by the Authority Having Jurisdiction that components and materials comply with the maximum lead content standard in accordance with NSF/ANSI 61 and NSF/ANSI 372. Use or reuse of components and materials without a traceable certification is prohibited.

2.02 INSTRUMENT COMPONENTS

- A. All PIC components and systems shall be supplied in their entirety by the PIC SI in accordance with the requirements of this section, and the respective PICS subsections.
- B. Components for Each Loop: Major components for each loop are listed in Instrument List referenced in Section 40 90 10, Instrument Components.

Furnish all equipment, and appurtenances, that are necessary to achieve required instrument installation, instrument function, and loop performance.

- C. Component Specifications: Generalized specifications for each type of component are located in Section 40 90 10, Instrument Components. The Drawings, Details, and coordination are based upon the first listed instrument and model in the component specifications. The PIC SI shall ensure that all installation requirements, instrument specification requirements, and options are for other manufacturers are included at the time of submittal.
- D. Reference all PICS subsections as there may be instrument requirements, or elements, contained in other PICS subsections.

2.03 PROGRAMMABLE LOGIC CONTROLLERS

- A. All PICS components and systems shall be supplied in their entirety by the PIC SI in accordance with the requirements of this section, and the respective PICS subsections.
- B. Reference PLC Equipment List in Section 40 90 10, Instrument Components.
- C. Reference block diagrams on the Drawings.
- D. Reference all PICS subsections as there may be PLC requirements, or elements, contained in other PICS subsections.

2.04 CONTROL PANELS

- A. All PICS control panels, components, and systems shall be supplied in their entirety by the PIC SI in accordance with the requirements of this section, and all of the PICS subsections.
- B. Function: Provides PLC and control system equipment mounting and field wiring termination.
- C. Reference Control Panel Schedule, Network Component List, PLC Equipment List, and PLC I/O lists in PICS subsystems. Including, but not limited to, Section 40 90 20, Control Panels.
- D. Reference P&IDs and block diagrams on the Drawings.
- E. Reference all PICS subsections as there may be panel requirements, or elements, contained in other PICS subsections.

2.05 ANALYZER PANELS

- A. All PICS analyzer panels, components, and systems shall be supplied in their entirety by the PIC SI in accordance with the requirements of this section, and all of the PICS subsections.
- B. Function: Provides analyzer instrument, piping, plumbing, and electrical equipment mounting and field wiring termination.
- C. Reference Analyzer Panel Schedule..
- D. Including, but not limited to, Section 40 90 10, Instrument Components, and Section 40 90 21, Analyzer Control Panels.
- E. Reference P&IDs and analyzer panels on the Drawings.
- F. Reference all PICS subsections as there may be panel requirements, or elements, contained in other PICS subsections.

2.06 NETWORK PANELS

- A. All PICS network panels, components, and systems shall be supplied in their entirety by the PIC SI in accordance with the requirements of this section, and all of the PICS subsections.
- B. Function: Provides secure place to terminate fiber optic cables, CAT6 cables, mount rack mounted network equipment, fiber patch panels, copper patch panels, network components, and other accessories.
- C. Reference Network Component List in Section 40 90 11, Network Components.
- D. Reference block diagrams on the Drawings.
- E. Reference all PICS subsections as there may be panel requirements, or elements, contained in other PICS subsections.

2.07 NETWORK COMPONENTS

- A. All PICS network components and systems shall be supplied in their entirety by the PIC SI in accordance with the requirements of this section, and all of the PICS subsections.

- B. Reference Section 40 90 11, Network Components.
- C. Reference Section 26 05 10, Network Communication System, for network component specifications as applicable:
 - 1. Ethernet fiber optic repeaters.
 - 2. Ethernet fiber-to-copper transceivers.
 - 3. Fiber distribution frame.
 - 4. Fiber centers (patch panels).
 - 5. Housings.
 - 6. Panels (mounting plates).
 - 7. Splice tray.
 - 8. Connectors.
 - 9. Patchcords.
 - 10. Accessories.
 - 11. Cable identification tape.
- D. Reference all PICS subsections as there may be network component requirements, or elements, contained in other PICS subsections.

2.08 NAMEPLATES AND TAGS

- A. Reference all PICS subsections for specific nameplate and tagging requirements for all PICS items. Every PICS element shall be tagged and labeled, including but not limited to:
 - 1. Panel Nameplates: Enclosure identification located on the enclosure face.
 - 2. Panel Component Nameplates—Panel Face: Component identification.
 - 3. Panel Component Nameplates—Back of Panel.
- B. 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-gauge or 18-gauge stainless steel wire or stainless steel screws.

2.09 EXTERNAL CABLE AND WIRE LABELS

- A. Cables
 - 1. External control and communication cable labels/tags shall be in accordance with Division 26, Electrical.
 - 2. Internal cables labels/tags shall be developed by vendor package system supplier and shown on applicable panel submittal diagrams.

- B. External Control Wires: For any and all circuits, wires, and any devices connected to PIC SI supplied panels, these wire label/tags shall be created by the PIC SI and shown on loop wiring diagrams.
- C. Samples:
1. Communication Cable:
 - a. Source and target terminations point are coded by:
 - 1) Simplified Panel Tag: Equipment Code. Equipment specific Termination Point.
 - 2) Example:
 - a) Communication Cable Running:
 - (1) From: CP-801-01 Control panel at Facility 20 terminated in PLC CPU within this control panel.
 - (2) To: NP-831-01 Network Panel at Facility 20, terminated in CPP-01 copper patch panel within this network panel, in 9-port of this patch panel.
 - b. Label:
 - 1) Tag format as:
 - a) Row 1.
 - b) Row 2.
 - 2) Where tag appears as:
 - a) 20CP80101:PLC.CPU.
 - b) 20NP83101:CPP01.9.
 2. Patchcords:
 - a. Source and target terminations point are coded by:
 - 1) Equipment Tag: Equipment specific Termination Point.
 - 2) Example:
 - a) Patch Cable Running:
 - (1) From: SW-01 switch within a panel, terminated at 1 port of this switch.
 - (2) To: CPP-01 copper patch panel within a panel, terminated at 9-port of this patch panel.
 - b. Label:
 - 1) Tag format as:
 - a) Row 1.
 - b) Row 2.
 - 2) Where tag appears as:
 - a) SW01.P1.
 - b) CPP01.9S.
 3. Instrument Cables:
 - a. Source termination point is coded: Field equipment terminal Equipment Tag Signal tag.
 - b. Target Termination Point is Coded: Field equipment terminal Equipment Tag Signal tag.

- c. Example:
 - 1) Instrument Cable Running:
 - a) From: FIT-006-01 Flow meter at Facility 28, terminated at 26 flow meter terminal.
 - b) To: 401 Control Panel, terminated at TB309 terminal strip 00I terminal.
- d. Label:
 - 1) Tag format as:
 - a) Row 1.
 - b) Row 2.
 - 2) Where tag appears as:
 - a) 26 28FIT00601 FLOW.
 - b) 401 TB309 00I.

2.10 ELECTRICAL REQUIREMENTS

- A. In accordance with Division 26, Electrical.
- B. PICS Instruments and Electrical Components, Terminals, and Wires: UL Recognized or UL listed.
- C. All PICS electrical requirements shall be in accordance with the requirements of this section, and all of the PICS subsections.

2.11 SPARE PARTS

- A. All PICS spares shall be supplied in their entirety by the PIC SI in accordance with the requirements of this section, and all of the PICS subsections.

2.12 ELECTRICAL TRANSIENT PROTECTION

- A. General:
 - 1. Function: Protect elements of PICS against damage due to electrical transients induced in interconnecting lines by lightning and nearby electrical systems.
 - 2. Implementation:
 - a. Provide, install, coordinate, and inspect grounding of surge suppressors at:
 - 1) Connection of ac power to PICS equipment including panels, consoles assemblies, and field mounted analog transmitters and receivers.
 - 2) 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.
7. Manufacturer: Phoenix Contact.

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:
 - a. Power supplies for one four-wire transmitter or receiver: 5 amps minimum at 130V ac.
 - b. All Other Applications: 30 amps minimum at 130V ac.
5. Manufacturer: Phoenix Contact.

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 percent 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.
3. Manufacturer: Phoenix Contact.

D. Physical Characteristics:

1. Mounted in Enclosures: Encapsulated inflame retardant epoxy.
2. For Analog Signals Lines:
 - a. Plug: Phoenix Contact, PT 2X2-24DC-ST.
 - b. Base: Phoenix Contact, PT 2X2+F-BE.
3. For 120V ac Lines:
 - a. Plug: Phoenix Contact, PT 2-PE/S-120AC-ST.
 - b. Base: Phoenix Contact, PT-BE/FM.
4. Field Mounted at Two-Wire Instruments: Encapsulated in stainless steel pipe nipples. Emerson 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: Emerson; 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.

2.13 CORROSION PROTECTION

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

2.14 SOURCE QUALITY CONTROL

- A. All PICS source quality control shall be supplied in their entirety by the PIC SI in accordance with the requirements of this section, and all of the PICS subsections.
- B. Scope: Inspect and test entire PICS to ensure it is ready for shipment, installation, and operation.
- C. Location: Manufacturer's factory or Engineer approved staging Site.
- D. Test: Exercise and test all functions.
- E. Temporary PLC software configuring to allow PLC and PLC I/O testing.
- F. FDT General:
 1. Engineer may actively participate in many of the tests.
 2. Engineer reserves right to test or retest specified functions.
 3. Engineer's decision will be final regarding acceptability and completeness of testing.
 4. Procedures, Forms, and Checklists:
 - a. Except for Unwitnessed Factory Test, conduct tests in accordance with, and documented on, Engineer accepted procedures, forms, and checklists.
 - b. Describe each test item to be performed.
 - c. Have space after each test item description for sign off by appropriate party after satisfactory completion.

5. Required Test Documentation: Test procedures, forms, and checklists signed by Engineer and Contractor.
 6. Conducting Tests:
 - a. Provide special testing materials and equipment.
 - b. Wherever possible, perform tests using actual process variables, equipment, and data.
 - c. If not practical to test with real process variables, equipment, and data provide suitable means of simulation.
 - d. Define simulation techniques in test procedures.
 - e. Test Format: Cause and effect.
 - 1) Person conducting test initiates an input (cause).
 - 2) Specific test requirement is satisfied if correct result (effect), occurs.
- G. Unwitnessed FDT:
1. Scope: Inspect and test PICS control panels, network panels, and analyzer panels to ensure it is operational, ready for FDT.
 2. Location: PIC SI facility.
 3. Integrated Test:
 - a. Interconnect and test PICS, except for primary elements and smaller panels.
 - b. Exercise and test functions.
 - c. Provide stand-alone testing of smaller panels.
 - d. Simulate PLC inputs at panel terminations, and forced PLC outputs for primary elements, final control elements, and panels excluded from test.
- H. Factory Demonstration Tests (FDT):
1. Notify Engineer of test schedule 4 weeks prior to start of test.
 2. Scope:
 - a. Test entire PICS, with exception of primary elements, final control elements, and certain smaller panels, to demonstrate control panels, network panels, and analyzer panels are operational.
 - b. Coordinate testing of different panels with schedule.
 3. Location: PIC SI facility.
 4. Correctness of wiring from panel field terminals to PLC system input/output points and to panel components.
 - a. Simulate each discrete signal at terminal strip.
 - b. Simulate correctness of each analog signal using current source.
 - c. Force PLC outputs and test at terminal strip.
 5. Operation of communications between PLCs and I/O and between PLCs and network components.

6. Operation of communications between the PLC system, and networked components, including network tests of network cables internal to panels:
 - a. All network, cable, and connector tests shall be with TIA standard and qualified CAT6 network diagnostics and test equipment.
 - b. Tests shall be documented:
 - 1) Electrical performance as required for TIA-568-B including wiremap, cable length, insertion loss, near end crosstalk, power sum near end crosstalk, equal level far end crosstalk, power sum equal level far end crosstalk, return loss, propagation delay, and delay skew.
 - 2) Physical installation shall be certified by the installer including location of cabling with respect to electrical noise and environmental conditions, grounding of devices, cable bending radii, cable supports, and terminations. All network tests shall be to TIA standards using qualified CAT6 installer, network diagnostics, and test equipment.
 - 3) Ping testing shall not be considered as a test of CAT6 cables.
 - 4) All network cables shall be tested from meter source, through end connector, through the network cable, through the second end connector, and meter receive.
 - 5) Tests shall be verifiable and documented.
 - 6) Diagnosis and Correction:
 - a) Installed cabling links and channels shall be field tested and pass test requirements and analysis as described herein.
 - b) Link or channel that fails these requirements shall be diagnosed and corrected.
 - c) Document corrective action and follow with new test to prove corrected link or channel meets performance requirements.
 - d) Provide final and passing result of tests for links and channels.
 - 7) Acceptance: Acceptance of test results shall be given in writing after test has been completed in accordance with Contract Documents and satisfaction of Engineer.
7. Nonloop-specific Functions:
 - a. Capacity: Demonstrate that PICS have required spare capacity for expansion. Include tests for both storage capacity and processing capacity.
 - b. Timing: Include tests for timing requirements.
 - c. Diagnostics: Demonstrate online and offline diagnostic tests and procedures.
8. Correct deficiencies found and complete prior to shipment to Site.

9. Failed Tests:
 - a. Repeat and witnessed by Engineer.
 - b. With approval of Engineer, certain tests may be conducted by PIC SI and witnessed by Engineer as part of Functional Test.
10. Make following documentation available to Engineer at test site both before and during FDT:
 - a. Drawings, Specifications, Addenda, and Change Orders.
 - b. Master copy of FDT procedures.
 - c. List of equipment to be tested including make, model, and serial number.
 - d. Approved hardware Shop Drawings for equipment being tested.
 - e. Approved preliminary software documentation Submittal.
11. Daily Schedule for FDT:
 - a. Begin each day with meeting to review day's test schedule.
 - b. End each day with each meeting to review day's test results and to review or revise next day's test schedule.

PART 3 EXECUTION

3.01 EXAMINATION

- A. For equipment not provided by PICS, but that directly interfaces with the PICS, 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.
- C. Mechanical Systems:
 1. Drawings for PICS Mechanical Systems are diagrammatic and not intended to specifically define element locations or piping and tubing run lengths. Base materials and installations on field measurements.

2. Copper and Stainless Steel Tubing Support: Continuously supported by an aluminum tubing raceway system.
3. Install tubing conduit for plastic tubing and tubing raceways parallel with, or at right angles to, structural members of buildings. Make vertical runs straight and plumb.
4. Tubing and Conduit Bends:
 - a. Tool-formed without flattening, and all of same radius.
 - b. Bend Radius: Equal to or larger than conduit and tubing manufacturer's recommended minimum bend radius.
 - c. Slope instrument connection tubing in accordance with installation details.
 - d. Do not run liquid filled instrument tubing immediately over or within a 3-foot plan view clearance of electrical panels, motor starters, or mechanical mounting panel without additional protection. Where tubing must be located in these zones, shield electrical device to prevent water access to electrical equipment.
 - e. Straighten coiled tubing by unrolling on flat surface. Do not pull to straighten.
 - f. Cut tubing square with sharp tubing cutter. Deburr cuts and remove chips. Do not gouge or scratch surface of tubing.
 - g. Blow debris from inside of tubing.
 - h. Make up and install fittings in accordance with manufacturer's recommendations. Verify makeup of tube fittings with manufacturer's inspection gauge.
 - i. Use lubricating compound or TFE tape on stainless steel threads to prevent seizing or galling.
 - j. Run tubing to allow, for example, clear access to doors, controls, and control panels; and to allow for easy removal of equipment.
 - k. Provide separate support for components in tubing runs.
 - l. Supply expansion loops and use adapters at pipe, valve, or component connections for proper orientation of fitting.
 - m. Keep tubing and conduit runs at least 12 inches from hot pipes.
 - n. Locate and install tubing raceways in accordance with manufacturer's recommendations. Locate tubing to prevent spillage, overflow, or dirt from above.
 - o. Securely attach tubing raceways to building structural members.
5. 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.

END OF SECTION

SECTION 40 90 10
INSTRUMENT COMPONENTS

PART 1 GENERAL

1.01 SUMMARY

- A. This PICS section gives requirements for PICS instrumentation components. The PICS instrument components shall be completely executed by the overall PIC SI in accordance with Section 40 90 00, Instrumentation and Control for Process Systems. This subsection shall meet all requirements of, and be in accordance with, Section 40 90 00, Instrumentation and Control for Process Systems, including but not limited to:
1. Submittals.
 2. References.
 3. Definitions.
 4. Related Sections.
 5. Environmental Requirements.
 6. Delivery, Storage, and Handling.

1.02 RELATED SECTIONS

- A. Refer to Section 40 90 00, Instrumentation and Control for Process Systems for all related sections.
- B. Refer to Section 40 90 20, Control Panels.
- C. Refer to Section 40 90 21, Analyzer Control Panels.
- D. Refer to Section 40 90 22, Network Panels.

PART 2 PRODUCTS

2.01 INSTRUMENT COMPONENTS

- A. A00 Analyzer Transmitter
1. General:
 - a. Function:
 - 1) Measure, indicate, display and transmit process analytical data.
 - 2) Transmit data, device status, and alarm to SCADA.
 - 3) Store measured data and alarms in internal memory.

- b. Parts:
 - 1) Analyzer transmitter.
 - 2) Extension modules.
 - 3) Cables and accessories.
- 2. Features:
 - a. Display: 3.5-inch TFT color with capacitive touchpad.
 - b. Digital Communication to SCADA: EtherNet/IP.
 - c. Process data graph screen.
 - d. Configuration: Password protected.
- 3. Signal Interface:
 - a. Input:
 - 1) Quantity: Two channels.
 - 2) Type: Digital or analog.
 - b. Output:
 - 1) Relay: Two, dry contact.
 - 2) Analog: Optional, if noted.
 - 3) Communication: EtherNet/IP.
- 4. Enclosure:
 - a. Type: NEMA 4X.
 - b. Mounting: Wall.
- 5. Power Supply:
 - a. Voltage: 100V ac to 230V ac, 50-Hz to 60-Hz, auto-selecting.
 - b. Power: 100 VA with 28W sensor load.
- 6. Cabling: As required.
- 7. Accessories:
 - a. EtherNet/IP communication module.
 - b. Extension module, As required.
- 8. Operating Temperature: minus 4 degrees F to 140 degrees F.
- 9. Manufacturer Services: As noted.
- 10. Manufacturer and Product: HACH, SC4500.

B. A03 Conductivity Analyzer Element:

- 1. General:
 - a. Digital contacting conductivity sensor.
 - b. Compression fitting style.
- 2. Parts:
 - a. Element.
 - b. Integral digital gateway.
 - c. Cable.
- 3. Performance:
 - a. Range: 0 μ S/cm to 10,000 μ S/cm.
 - b. Cell Constant: 5.
 - c. Temperature Element: Pt 1000 RTD.

- d. Repeatability/Precision:
 - 1) 0 $\mu\text{S}/\text{cm}$ to 20 $\mu\text{S}/\text{cm}$: Plus or minus 0.1 $\mu\text{S}/\text{cm}$.
 - 2) 20 $\mu\text{S}/\text{cm}$ to 10,000 $\mu\text{S}/\text{cm}$: plus or minus 0.5 percent of reading.
- e. Accuracy: Plus or minus 2 percent of reading above 200 $\mu\text{S}/\text{cm}$.
- f. Pressure Range: 0 psi to 300 psi.
- g. Operating Temperature: Minus 4 degrees F to 140 degrees F.
- 4. Element:
 - a. Process Connection: Compression fitting.
 - b. Size:
 - 1) Diameter: 0.75 inch.
 - 2) Immersion Length: 6.1 inch.
 - c. Material:
 - 1) Electrode: Titanium.
 - 2) Body: 316L.
 - d. Thread: 3/4 NPT Kynar (PVDF).
 - e. Mounting/Process Connections: Insertion, install in accordance with manufacturer's instructions and applicable codes.
- 5. Process Fluid: As noted.
- 6. Accessories:
 - a. Tube Fitting, PVDF, 3/4-inch compression fitting for 3422 series sensors.
 - b. PVC flow chamber with 3 by 3/4 FNPT bores.
- 7. Expendables (for each unit provided):
 - a. Standard: KCl calibration solution set.
- 8. Manufacturer Services: As noted.
- 9. Manufacturer and Product: Hach, Model 3422, k=5.

C. A07 pH Analyzer Element:

- 1. General:
 - a. Features:
 - 1) pHD sc digital differential sensor.
 - 2) Three electrode.
 - 3) Replaceable salt bridge holds higher volumes of buffer which extend pH sensor life and protect the junction reference electrode.
 - b. Parts:
 - 1) Element.
 - 2) Internal digital gateway.
 - 3) Cable.
- 2. Performance:
 - a. Range: 2 pH to 14 pH.
 - b. Accuracy: Plus or minus 0.02 pH.
 - c. Repeatability: Plus or minus 0.5 pH.
 - d. Sensitivity: Plus or minus 0.1 pH.

- e. Stability: 0.03 pH per 24 hours, non-cumulative.
- f. Temperature:
 - 1) Element: NTC 300 ohm.
 - 2) Automatic compensation.
 - 3) Accuracy: Plus or minus 0.9 degrees F.
- g. Operating Temperature: 32 degrees F to 284 degrees F.
- h. Operating Pressure: 100 psig maximum.
- i. Operating Temperature: 23 degrees F to plus 158 degrees F.
- 3. Element:
 - a. Process Connection: Insertion type.
 - b. Fully submersible.
 - c. Size:
 - 1) Length: 10.3 inch
 - d. Body Material: PEEK.
 - e. Process Fluid: As noted.
 - f. Junction: Ceramic.
 - g. Reference System: Ag/AgCl, electrolyte.
 - h. Mounting/Process Connections: Insertion, install in accordance with manufacturer's instructions.
- 4. Expendables (for each unit provided):
 - a. Chemicals: 1 pint each, buffer solution for pH 4, pH 7, and pH 9.
 - b. Salt bridge.
- 5. Manufacturer and Product: Hach, pHD sc:Digital pH Sensor, DPD2P1.

A11 Dual O2/CO2 Gas Analyzer & Transmitter:

- 1. General:
 - a. Function: Dual O2/CO2 monitor for the continuous monitoring of inert gas storage areas, confined spaces and other location where low oxygen level may pose a hazard to personnel.
 - b. Features:
 - 1) Monitor does not drift or loose sensitivity weather or temperature changes.
 - 2) Long Life Zirconium Oxide O2 Sensor. 10 years of continuous operation.
 - 3) Non Dispersive Infrared CO2 Sensor with built-in auto calibration feature that adjusts the sensor to ambient every 180 hours.
- 2. Performance:
 - a. Oxygen sensor:
 - 1) Type: Long Life Zirconium Oxide Sensor Cell
 - 2) Range: 0 percent to 25 percent.
 - 3) Response Time: Within 1 second of any change in O2.
 - 4) Accuracy: Plus or minus 1 percent of full scale.

- 5) Fault Indicators:
 - a) Loss of VDC power (analog signal drops to 0mA),
 - b) Sensor cell failure: Fault relay activated
- 6) Operating Temperature: minus 40 degrees C to 55 degrees C.
- b. Carbon Dioxide sensor:
 - 1) Type: Long life NDIR sensor.
 - 2) Range: 0 ppm to 10,000 ppm.
 - 3) Response Time: Within 1 second of any change in CO2.
 - 4) Accuracy: Plus or minus 30 ppm, plus or minus 3 percent of measured value.
 - 5) Fault Indicators:
 - a) Loss of VDC power (analog signal drops to 0mA).
 - b) Sensor Cell Failure: Fault relay activated.
 - 6) Operating Temperature: 0 degree C to 55 degrees C
- c. Humidity: 0 percent to 95 percent RH.
- d. Environment:
 - 1) Max. Altitude 2000m.
 - 2) Pollution degree 3.
 - 3) For indoor use.
3. Transmitter:
 - a. Type: Microprocessor electronics with built-in 3-digit backlit LCD display, Joystick operated menus.
 - b. Local Display: Yes.
 - c. Audio: Built-in horn with local and external reset.
 - d. Password protected.
 - e. Analog Output:
 - 1) Type: 3-wire, 4 mA to 20 mA.
 - 2) Quantity: One.
 - 3) Settings: CO2.
 - f. Relay Outputs:
 - 1) Type: Dual level user selectable alarm relays one fault relay.
 - 2) Quantity: Three.
 - 3) Rated: 2Amps at 24V ac, or 24V dc.
 - 4) Delay: 5 seconds
 - 5) Hysteresis: 0 ppm, 0 percent.
 - 6) Latching: Non-Latching.
 - 7) Alarm relay State: Fail safe. Deenergize on alarm when alarm activates.
 - 8) Settings:
 - a) Relay O2 Alarm:
 - (1) Value: Less or equal than 19.5 percent.
 - b) Relay CO2 Alarm:
 - (1) Value: Higher or equal than 0.5 percent.

- c) Relay Fault:
 - (1) Fault conditions:
 - (a) Loss of VDC power.
 - (b) Sensor cell failure.
 - g. Electrical:
 - 1) Power: 24V dc.
 - 2) Type: External, regulated.
 - 3) Current Consumption: 250 mA.
- 4. Enclosure:
 - a. Type: General purpose; not intended for explosive atmospheres.
- 5. Manufacturer and Product: PureAire Monitoring Systems Inc., PureAire Dual O2/CO2 Monitor.

, A16 Turbidity Analyzer, Low Range:

- 6. General:
 - a. Function: Continuously measure, indicate, flow sensor, and transmit signal proportional to turbidity of a sample stream of process fluid.
 - b. Parts:
 - 1) Element.
 - 2) Automatic cleaning module.
 - 3) Flow sensor.
 - 4) Bubble trap.
 - 5) Flow control valve.
 - 6) Interconnecting cable, mounting hardware, and expendables.
- 7. Performance:
 - a. Complies with ISO Method 7027-1 and US FDA accession number 1420493-000 EPA version.
 - b. Range: EPA 0 NTU to 700 NTU.
 - c. Displayed Resolution: 0.0001 NTU.
 - d. Repeatability: Better than 1 percent of reading or plus minus 0.002 NTU, whichever is greater.
 - e. Initial Response Time: Within 45 seconds at 100 mL/minimum.
 - f. Required Flow: 100 ml to 1,000 ml per minute.
 - g. Sample Temperature: 35 degrees F to 140 degrees F.
 - h. Operating Temperature:
 - 1) System: Minus 40 degrees F to 140 degrees F.
 - i. Operating Humidity: 5 percent to 95 percent, noncondensing.
 - j. Accuracy:
 - 1) From 0 NTU to 40 NTU: Plus or minus 0.01 NTU.
 - 2) From 40 NTU to 1000 NTU: Plus or minus 10 percent of reading.

8. Element:
 - a. General: Flow-through body using Type: Class 2 laser product, with embedded 650 nm (EPA 0.43 mW) or Class 1 laser product, with embedded 850 nm (ISO), maximum 0.55 mW (complies with IEC/EN 60825-1 and to 21 CFR 1040.10 in accordance with Laser Notice No. 50).
 - b. Flow sensor.
 - c. Automatic cleaning module.
 - d. Body Materials: ASA Luran S 777K / RAL7000, TPE RESIN Elastocon® STK40, Thermoplastic Elastomer TPS-SEBS.
 - e. Fittings:
 - 1) Sample inlet.
 - 2) Drain.
 - 3) Valve.
 - 4) Tubing.
9. Cabling: As required.
10. Accessories and Expendables:
 - a. Calibration Kits:
 - 1) Stablcal Verification Standards:
 - a) One liter of 20 NTU calibration standard.
 - b) One liter of 1 NTU verification standard.
 - c) Quantity: One each for each turbidimeter.
 - d) Two stablcal calibration cylinders, minimum.
 - 2) Formazin Calibration Standard:
 - a) Kit including 0.5 liter of 4,000 NTU Formazin, pipet, and calibration cylinder.
 - b) Quantity: One for each turbidimeter.
 - 3) Order expendables just before startup.
 - b. Verification Module: 1 NTU, unless otherwise noted.
11. Manufacturer Services: As noted.
12. Manufacturer and Product: Hach Company, Hach TU5300 low range turbidimeter with Product Number LQV159.97.00002 automatic cleaning module, Product Number LQV160.99.00002 flow sensor, Calibration Kits, and Product Number LZY898 Stablcal Primary Standards Set without RFID (10 NTU, 20 NTU, 600 NTU).

D. F04 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.
2. Parts: Flow element, transmitter, interconnecting cables, and mounting hardware. Other parts as noted.
3. 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.
4. Operating Temperature:
 - a. Element:
 - 1) Ambient: 14 degrees F to 140 degrees F, typical, unless otherwise noted.
 - 2) Process: 14 degrees F to 140 degrees F, typical, unless otherwise noted.
 - b. Transmitter:
 - 1) Ambient: Minus 4 degrees F to 140 degrees F, typical, unless otherwise noted.
 - 2) Storage: 15 degrees F to 120 degrees F, typical, unless otherwise noted.
5. Performance:
 - a. Flow Range: As noted.
 - b. Accuracy:
 - 1) For installations not requiring zero up/zero down plus or minus 0.5 percent of rate for all flows resulting from pipe velocities of 2 feet to 30 feet per second.
 - 2) For installations requiring zero up/zero down plus or minus 0.8 percent of rate for all flow resulting from pipe velocities of 2 feet to 30 feet per section.
 - c. Turndown Ratio: Minimum of 10 to 1 when flow velocity at minimum flow is at least 1 foot per second.
6. Features:
 - a. Zero stability feature to eliminate the need to stop flow to check zero alignment.
 - b. No obstructions to flow.
 - c. NSF 61 certification.
 - d. Very low-pressure loss.
 - e. Measures bi-directional flow with a discrete signal for reverse flow.

7. Process Connection:
 - a. Meter Size (diameter inches): As noted.
 - b. Connection Type: Flanges compatible with adjacent piping and matching or exceeding adjacent piping pressure rating as specified in Section 33 05 01, Conveyance Piping—General, unless otherwise noted.
 - c. Flange Material: Carbon steel, unless otherwise noted.
8. Power (Transmitter): 120V ac, 60-Hz, unless otherwise noted.
9. Element:
 - a. Meter Tube Material: Type 304 stainless steel or Type 316 stainless steel, unless otherwise noted.
 - b. Liner Material: EPDM, unless otherwise noted.
 - 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. Self-cleaning.
 - e. Electrode Material: Type 316 stainless steel.
 - 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. Hazardous Area Certification: Unclassified.
10. Transmitter:
 - a. Mounting: Surface (wall), unless otherwise noted.
 - b. Display: Required, unless otherwise noted.
 - 1) Digital LCD display, indicating flow rate and total.
 - 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 nonintrusive means.
 - d. Enclosure: NEMA 4X, minimum, unless otherwise noted.
 - e. Empty Pipe Detection: Drives display and outputs to zero when empty pipe detected.
 - f. Clock display 45 degrees upwards from the horizontal to be easily viewable by Operator.
11. Signal Interface (at Transmitter):
 - a. Analog Output:
 - 1) Isolated 4 mA dc 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 Output: Discrete contact pulse output per 1,000 gpm, or similar, depending on the meter scale and meter maximum flow rate.
- 12. Cables:
 - a. Types: As recommended by manufacturer.
 - b. Lengths: As required to accommodate device locations.
- 13. 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.
- 14. Factory Calibration:
 - a. Calibrated in an ISO 9001 and NIST certified factory.
 - 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.
- 15. Accessories: Tagging stainless steel.
- 16. Manufacturers and Products:
 - a. Siemens Sitrans System:
 - 1) Installations not requiring zero up/zero down shall be 3100W with MAG5000 transmitter.
 - 2) Zero up/zero down installations shall be 5100W with MAG6000 transmitter.
 - b. Endress and Hauser:
 - 1) Installations not requiring zero up/zero down shall be Promag W400.
 - 2) Zero up/zero down installations shall be Promag W400 5W4C.

E. F16 Flow Element, Rotameter:

- 1. General:
 - a. Function: Indicate flow rate.
 - b. Type: Variable area; float and tapered tube.
- 2. Service Conditions:
 - a. Process Fluid: Water, unless otherwise noted.
 - b. Temperature Range:
 - 1) Process Fluid: 33 degrees F to 250 degrees F.
 - 2) Ambient: 32 degrees F to 125 degrees F.
 - c. Maximum Operating Pressure: As noted.

3. Performance:
 - a. Flowrate Range: As noted.
 - b. Accuracy: Plus or minus 2 percent full scale flow.
 - c. Repeatability: 0.5 percent of full scale.
 - d. Turn down: 10:1.
4. Features:
 - a. Scale: 10 inches, direct reading, detachable.
 - b. Float Material: Type 316 stainless steel.
 - c. Tube: Borosilicate glass.
 - d. Seal:
 - 1) Type: O-ring, unless otherwise noted.
 - 2) Material: Viton, unless otherwise noted.
 - e. Case and Covers: Type 304 stainless steel case, Polycarbonate operator protection shield.
 - f. Mounting: In line, unless otherwise noted.
 - g. Pressure Drop Design: Standard, unless otherwise noted.
5. Size and Process Connections:
 - a. Connection Material: Type 316 stainless steel.
 - b. Connection Type: Threaded FNPT, unless otherwise noted.
 - c. Connection Orientation: Vertical, unless otherwise noted.
6. Signal Interface: None, unless otherwise noted.
7. Alarm Interface: Yes, unless otherwise noted.
8. Accessories:
 - a. Tagging stainless steel.
 - b. Alarm: Latching reed switch.
9. Manufacturers and Products: King Instruments, 7480 Series.

F. F22 Flow Switch, Magnetic Piston:

1. General:
 - a. Function: Monitor process fluid flow and provide contact closure at setpoint.
 - b. Type: Magnetic piston which responds to the motion of fluids within the line. Movement of the piston actuates an external hermetically sealed reed switch.
2. Service:
 - a. Process Fluid: Water, unless otherwise noted.
 - b. Process Pressure: As noted.
 - c. Process Temperature: As noted.
3. Features:
 - a. Hermetically sealed.
 - b. Inline.
 - c. Low pressure drop.

4. Performance:
 - a. Calibration Range:
 - 1) Water: 0.1 to 7 GPM
 - b. Setpoint:
 - 1) Factory Calibration. As Noted,
 - c. Set Point Accuracy: 10 percent maximum.
 - d. Repeatability: 2 percent.
 - e. Hysteresis: 15 percent.
 5. Materials:
 - a. Body: 316 stainless steel.
 - b. Wetted Surfaces Materials: Type 316 stainless steel, unless otherwise noted.
 6. Process Connections:
 - a. Type: 3/8-inch FNPT, unless otherwise noted.
 7. Mounting: Any orientation.
 8. Signal Interface Contact:
 - a. Type: SPDT.
 - b. DC Resistive: 3W.
 - c. Switching Current: 0.25A.
 - d. Carrying Current: 0.5A.
 9. Manufacturer and Product: Malema, M-64.
- G. L08 Level Switch, Float:
1. General:
 - a. Function: Actuate contact at preset liquid level.
 - b. Type:
 - 1) Direct-acting float with enclosed switch and integral cable.
 - 2) Mercury-free.
 2. Service (Liquid): Water, unless otherwise noted.
 3. Performance:
 - a. Setpoint: As noted.
 - b. Accuracy:
 - 1) Setpoint Accuracy: 10 percent.
 - 2) Setpoint Differential: 15 percent.
 - c. Repeatability: 1 percent Maximum Deviation.
 - d. Temperature: 200 degrees F, Maximum.
 4. Signal Interface:
 - a. Switch Type: SPDT.
 - b. Switch Contacts:
 - 1) 125V ac, 1A maximum load.
 - 2) 30V dc, 0.1 maximum load.
 5. Features:
 - a. NSF 61 approval, if noted.
 - b. Cable Length: As noted.
 - c. Normal Position: Normally closed.

6. Accessory:
 - a. Cable clamp.
 - b. Wire nut.
 - c. Tagging stainless steel.
 - d. Intrinsically Safe Barrier:
 - 1) 12V dc to 24V dc powered.
 - 2) Switch Circuit (relay).
 - 3) Certificate: Class I, Division 1.
7. Manufacturer and Product: SJE, MilliampMaster WPS Control Switch.

H. L10 Level Transmitter, Pressure:

1. General:
 - a. Function: chemical tank level measurement based on gauge pressure.
 - b. Type:
 - 1) Electronic variable capacitance or silicon strain gauge.
 - 2) Two-wire transmitter; "smart electronics."
 - c. Parts: Transmitter and accessories.
2. Performance:
 - a. Range: As noted.
 - 1) Select transmitter's factory upper range limit (URL) such that upper boundary of noted range is as close as possible to 80 percent of factory URL but does not exceed it.
 - b. Accuracy: Plus or minus 0.15 percent of span, unless otherwise noted.
 - c. Ambient Operating Temperature: Minus 40 degrees F to plus 185 degrees F, with integral meter.
 - d. Process Operating Temperature: Minus 40 degrees F to plus 257 degrees F.
 - e. Humidity: 0 percent to 100 percent relative humidity.
 - f. Hazardous Location Certifications: Unclassified.
3. Features:
 - a. Type: Gauge pressure, unless otherwise noted.
 - b. Adjustable damping.
 - c. Display in engineering units, field configurable.
 - d. Wetted Metallic Parts: Type 316 stainless steel, unless otherwise noted. Includes, process flanges and adapters, and process isolating diaphragm.
 - e. Wetted O-rings: Glass filled TFE, graphite filled PTFE, or Viton, unless otherwise noted.
 - f. Bolts and Nuts (if required): Type 316 stainless steel, unless otherwise noted.
 - g. Fill Fluid: Silicone, unless otherwise noted.
 - h. Bluetooth.

- i. Heartbeat technology:
 - 1) Continuous self-monitoring of the device without interrupting the process.
 - 2) Diagnostic messages output.
 - 4. Local Display:
 - a. Segment Display:
 - 1) Measured value (up to 5 digits).
 - 2) Bar graph proportional to the current output.
 - 3) Unit of measured value.
 - b. Bluetooth wireless technology.
 - c. Functions:
 - 1) Display of measured values and fault and notice messages
 - 2) Background lighting, which switches from green to red in the event of an error.
 - 3) The device display can be removed for easier operation.
 - 5. Process Connections:
 - a. Line Size: 3 inch.
 - b. Connection Type: ANSI Flange.
 - c. Compact Diaphragm Seal.
 - 6. Signal Interface:
 - a. 4 mA dc to 20 mA dc output with digital signal based on HART protocol, unless otherwise noted below.
 - 1) Nominal Maximum Loop Resistance with External 24V dc Power Supply: 550 ohms.
 - 7. Enclosure:
 - a. Type: NEMA 4X/6P.
 - b. Dual compartment.
 - c. Materials: Coated aluminum, unless otherwise noted.
 - d. Electrical Connection: 1/2-inch NPT.
 - 8. Accessories: Tagging stainless steel.
 - 9. Approval: NSF drinking water approval.
 - 10. Manufacturer and Product: E+H, Cerabar S PMP71B.
- I. L29 Level Element and Transmitter, Radar:
- 1. General:
 - a. Function: Continuous liquids level measurement.
 - b. Type: Radar, noncontacting.
 - c. Loop powered.
 - d. Parts: Element/integral transmitter and accessories as noted.

2. Service:
 - a. Application: Water, polymer solution, as noted.
 - b. Operating Temperature Range:
 - 1) Ambient: Minus 40 degrees F to plus 176 degrees F.
 - 2) At Flange (Inside Vessel):
 - a) Dependent on antenna type and O-ring materials.
 - b) For PTFE rod with PVDF threaded connection, minus 40 degrees F to plus 176 degrees F.
 - c. Pressure Rating: Ambient.
3. Performance:
 - a. Process Range: As noted.
 - b. Zero Reference: As noted.
 - c. Frequency: 80-GHz.
 - d. Accuracy (Maximum Measurement Error):
 - 1) Up to 0.8 meter (2.62 feet), plus or minus 4 mm (0.16 inch).
 - 2) More than 0.8 meter (2.62 feet), plus or minus 1 mm (0.04 inch).
 - e. Resolution: 0.04 inch (1 mm.).
 - f. Medium Suitability:
 - 1) Suitable for most liquids with measuring range decreasing for liquids with smaller dielectric constants.
 - 2) For conductive liquids, (for example, water) maximum possible measuring range is 164 feet.
4. Element/Integral Transmitter:
 - a. Display: Integral, unless otherwise noted. Graphic display with touch control plus Bluetooth.
 - b. Antenna:
 - 1) Drip-off.
 - 2) Size: 2 inch.
 - 3) Material: PTFE.
 - 4) Beam Angle: 6 degrees.
 - c. Process Connection:
 - 1) Type: 6-inch ANSI flange, RF.
 - 2) Material: Type 316 stainless steel.
 - 3) Seal: EPDM, unless otherwise noted.
5. Signal and Electrical Interface:
 - a. Analog:
 - 1) 4 mA dc to 20 mA dc HART.
 - 2) Not furnished when digital interface is noted.
6. Features:
 - a. Bluetooth.
 - b. Heartbeat Technology.
7. Enclosure:
 - a. Transmitter: NEMA 4X/IP65 watertight.
 - b. Antenna: NEMA 6P/IP68.

- c. Dual compartment, aluminum coated.
 - d. Conduit Entry: 1/2-inch NPT, unless otherwise noted.
 - 8. Accessories:
 - a. Weather protection cover, if noted.
 - b. Tagging Stainless Steel
 - 9. Approvals: UL or other NRTL.
 - 10. Manufacturer and Product: Endress and Hauser, Micropilot FMR62B.
- J. L42 Level Transmitter, Submersible:
- 1. General:
 - a. Function: Continuous liquids level measurement.
 - b. Type: hydrostatic pressure.
 - c. Loop powered.
 - d. Parts: Element/integral transmitter and accessories as noted.
 - 2. Performance:
 - a. Scale Range: As noted.
 - b. Accuracy:
 - 1) Less or equal plus or minus 0.35 percent, for range greater or equal than 400 mbar.
 - 2) Less or equal plus or minus 0.50 percent, for range less than 400 mbar.
 - 3. Process Connections:
 - a. Type: Stilling well, submersible cable hanging transmitter.
 - 4. Features:
 - a. Approval: NSF 61.
 - b. Cable Length: As noted.
 - 5. Signal and Electrical Interface:
 - a. Analog: Two-wire, 4 mA dc to 20 mA dc.
 - b. Cable:
 - 1) Length: As noted.
 - 2) UV-resistant.
 - 3) TPE for use in water and drinking water.
 - 6. Power Supply:
 - a. Voltage: 8V dc to 28V dc.
 - b. Current Consumption:
 - 1) Minimum: 2 mA.
 - 2) Maximum: 22 mA.
 - c. Power Consumption: Less or equal 0.62 W at 28V dc.
 - 7. Enclosure:
 - a. Rating: IP68, permanently hermetically sealed at 10 bar (145 psi).
 - 8. Environmental:
 - a. Ambient Temperature:
 - 1) Instrument: 14 degrees F to 158 degrees F.
 - 2) Terminal Box: Minus 40 degrees F to 176 degrees F.
 - b. Medium Temperature: 32 degrees F to 158 degrees F.

9. Accessories:
 - a. Suspension Clamp: 52006241.
 - b. Terminal Box with Filter: 52006152.
 - c. Tagging stainless steel.
 10. Manufacturers and Products: Endress and Hauser, Waterpilot FMX11.
- K. L50 Level Switch, Tuning Fork:
1. General:
 - a. Function: Point level switch for liquids.
 - b. Type: Vibronic.
 2. Performance:
 - a. Measured Error: plus minus 1 mm (0.04 inch) at switch point.
 - b. Hysteresis: Typically: 2.5 mm (0.1 inch).
 - c. Non-Repeatability: 0.5 mm (0.02 inch).
 3. Process Connections:
 - a. Type: Male NPT tread.
 - b. Size: 1 inch.
 4. Probe:
 - a. Length: As noted.
 - b. Design: Compact.
 - c. Material: Type 316 stainless steel.
 5. Features:
 - a. Approval: NSF 61.
 - b. Bluetooth and Heart beat technology.
 6. Signal and Electrical Interface:
 - a. Discrete Output: Relay.
 - b. Insert Type: FEL64.
 7. Power Supply:
 - a. Voltage: 19V ac to 253V ac.
 - b. Power Consumption: S less 25 VA, P less 1.3W.
 8. Enclosure:
 - a. Rating: NEMA Type 4X/6P, 1.83 m H₂O for 24 hours.
 - b. Cable entry: NPT 1/2 inch.
 - c. Type: Single compartment, unless otherwise noted.
 - d. Material: Aluminum coated.
 9. Environmental:
 - a. Ambient Temperature: Minus 40 degrees F to 158 degrees F.
 - b. Medium Temperature: Minus 58 degrees F to 302 degrees F.
 10. Accessories:
 - a. Protective Cover:
 - 1) Type: For single compartment housing.
 - 2) Material: Plastic.
 - b. Tagging stainless steel.
 11. Manufacturers and Products: Endress and Hauser, Liquiphant FTL51B.

- L. P04 Pressure Gauge:
 - 1. General:
 - a. Function: Local pressure indication.
 - b. Type: Bourdon tube element.
 - 2. Performance:
 - a. Scale Range: As noted.
 - b. Accuracy: Less or equal plus or minus 0.50 percent of full scale.
 - 3. Features:
 - a. Dial: 4-1/2-inch diameter, unless otherwise noted.
 - b. Pointer Vibration Reduction:
 - 1) Required, unless otherwise noted. Use one of the following methods:
 - a) PLUS! Performance.
 - b) Liquid filled gauge front, unless otherwise noted.
 - (1) 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): 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.
 - c. Provide block and bleed valve.
 - 5. Weather Protection: NEMA 4X (IP66), unless otherwise noted.
 - 6. Accessories:
 - a. Throttling Device: Required, unless otherwise noted.
 - 1) Type suitable for the intended service.
 - 2) Install in gauge socket bore.
 - b. Two-valve (isolate and vent) instrument manifold:
 - 1) Material: Type 316 stainless steel.
 - 2) Connection:
 - a) Instrument:
 - (1) Size: 1/2 inch.
 - (2) Type: Female NPT.
 - b) Process:
 - (1) Size: 1/2 inch.
 - (2) Type: Female NPT.
 - c. Tagging stainless steel.
 - 7. Manufacturers and Products: Ashcroft, Duragauge Model 1259.

M. P08 Pressure Switch:

1. General:
 - a. Function: Monitor pressure.
 - b. Type: Diaphragm-type, Snap action switch.
2. Performance:
 - a. Setpoint:
 - 1) As Noted.
 - 2) Adjustable from 15 percent to 100 percent of range.
 - 3) Setpoint Repeatability: plus or minus 1 percent of full range.
 - 4) Setpoint Direction: As Noted.
 - b. Range: As Noted.
 - c. Overpressure Proof Pressure: At least 400 percent of rated maximum static pressure.
 - d. Operating Temperature Limit: 170 degrees F.
3. Features:
 - a. Diaphragm Material: Buna-N, unless otherwise noted.
 - b. Differential (deadband): Fixed.
 - c. Reset: Automatic, unless otherwise noted.
 - d. Mounting: Surface, unless otherwise noted.
 - e. SIL 3 Capable.
 - f. Internal setpoint locking screw.
4. Process Connection:
 - a. 1/2-inch NPT Male, 1/4-inch NPT Female (Combination connections), unless otherwise noted.
 - b. Materials: Stainless steel, unless otherwise noted.
5. Enclosure:
 - a. Type: NEMA 4X, unless otherwise noted.
 - b. Material: Epoxy coated aluminum.
6. Signal Interface:
 - a. Contact Type:
 - 1) General purpose, UL/CSA Listed SPDT, unless otherwise noted.
 - 2) Rated for 15 amps minimum at 125V ac, 6A at 30V dc.
 - b. Electrical Termination: 1/2-inch NPT.
7. Accessories: Tagging stainless steel.
8. Manufacturer and Product: Ashcroft, B-Series Pressure Switch.

N. P09 Pressure Transmitter:

1. General:
 - a. Function: chemical tank level measurement based on gauge pressure.
 - b. Type:
 - 1) Electronic variable capacitance or silicon strain gauge.
 - 2) Two-wire transmitter; “smart electronics.”
 - c. Parts: Transmitter and accessories.
2. Performance:
 - a. Range: As noted.
 - 1) Select transmitter’s factory upper range limit (URL) such that upper boundary of noted range is as close as possible to 80 percent of factory URL but does not exceed it.
 - b. Accuracy: Plus or minus 0.05 percent of span, unless otherwise noted.
 - c. Ambient Operating Temperature: Minus 40 degrees F to plus 185 degrees F, with integral meter.
 - d. Process Operating Temperature: Minus 40 degrees F to plus 257 degrees F.
 - e. Humidity: 0 percent to 100 percent relative humidity.
 - f. Hazardous Location Certifications: Unclassified.
3. Features:
 - a. Type: Gauge pressure, unless otherwise noted.
 - b. Adjustable damping.
 - c. Display in engineering units, field configurable.
 - d. Wetted Metallic Parts: Type 316 stainless steel, unless otherwise noted. Includes, process flanges and adapters, and process isolating diaphragm.
 - e. Wetted O-rings: Glass filled TFE, graphite filled PTFE, or Viton, unless otherwise noted.
 - f. Bolts and Nuts (if required): Type 316 stainless steel, unless otherwise noted.
 - g. Fill Fluid: Silicone, unless otherwise noted.
 - h. Bluetooth.
 - i. Heartbeat Technology:
 - 1) Continuous self-monitoring of the device without interrupting the process.
 - 2) Diagnostic messages output.
4. Local Display:
 - a. Segment Display:
 - 1) Measured value (up to 5 digits).
 - 2) Bar graph proportional to the current output.
 - 3) Unit of measured value.
 - b. Bluetooth wireless technology.

- c. Functions:
 - 1) Display of measured values and fault and notice messages
 - 2) Background lighting, which switches from green to red in the event of an error.
 - 3) The device display can be removed for easier operation.
 - 5. Process Connections:
 - a. Line Size: 1/2 inch.
 - b. Connection Type: Male NPT.
 - c. Internal diaphragm seal.
 - d. Provide block and bleed valve.
 - 6. Signal Interface:
 - a. 4 mA dc to 20 mA dc output with digital signal based on HART protocol, unless otherwise noted below:
 - 1) Nominal Maximum Loop Resistance with External 24V dc Power Supply: 550 ohms.
 - 7. Enclosure:
 - a. Type: NEMA 4X/6P.
 - b. Single compartment.
 - c. Materials: Coated aluminum, unless otherwise noted.
 - d. Electrical Connection: 1/2-inch NPT.
 - 8. Accessories:
 - a. Two-valve (isolate and vent) instrument manifold.
 - 1) Material: Type 316 stainless steel.
 - 2) Connection:
 - a) Instrument:
 - (1) Size: 1/2 inch.
 - (2) Type: Female NPT.
 - b) Process:
 - (1) Size: 1/2 inch.
 - (2) Type: Female NPT.
 - b. Tagging stainless steel.
 - 9. Approval: NSF drinking water approval.
 - 10. Manufacturer and Product: E+H, Cerabar S PMP71B.
- O. T21 Temperature Transmitter, Wall Mount:
- 1. General:
 - a. Function: Measure temperature of air and transmit analog signal proportional to temperature.
 - b. Type: RTD transmitter.
 - 2. Service:
 - a. Ambient indoor or outdoor air temperature.
 - b. Temperature Range: Minus 30 degrees F to 130 degrees F.

3. Element:
 - a. Type: Platinum 1,000-ohm RTD, 1/3 DIN.
 - b. Performance: Sensor Accuracy for 70 degrees F. Plus or minus 0.9 degree F.
 - c. Range: Selectable.
 - 1) Settings:
 - a) S0: Minus 30 degrees F plus 130 degrees F.
 - b) S6: Minus 20 degrees F plus 80 degrees F.
4. Transmitter:
 - a. Ambient Operation Conditions:
 - 1) Temperature: Minus 30 degrees F to 130 degrees F.
 - 2) Relative Humidity: 0 percent to 95 percent, noncondensing.
 - b. Type: Two-wire, powered by remote power supply.
 - c. Performance:
 - 1) Digital Accuracy: Greater of plus or minus 0.09 degrees F or plus or minus 0.1 percent of span.
 - 2) Response Time: 542 seconds.
 - d. Signal Interface: 4 mA dc to 20 mA dc.
 - e. Power: 24V dc loop powered.
5. Enclosure:
 - a. Mounting: Wall.
 - b. Degree of Protection: NEMA 4X.
6. Accessories:
 - a. Wall mounting plate.
 - b. Custom Panel mounting bracket, if noted.
 - c. Tagging stainless steel.
7. Manufacturer and Product: Belimo, 22UT-54.

2.02 ELECTRICAL TRANSIENT PROTECTION

- A. Refer to Section 40 90 00, Instrumentation and Control for Process Systems.

PART 3 EXECUTION

3.01 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.
- C. Refer to Instrument Component Manufacturer installation manual.

3.02 EXAMINATION

A. For equipment not provided verify the following conditions:

1. Proper installation.
2. Calibration and adjustment.
3. Correct control action.
4. Switch settings and dead bands.
5. Opening and closing speeds and travel stops.
6. Input and output signals.

3.03 INSTRUMENTATION TESTING AND STARTUP

A. This subsection shall meet the requirements of, and be in accordance with, Section 40 90 00, Instrumentation and Control for Process Systems, and Section 40 90 30, Instrumentation and Control Testing and Startup.

3.04 QUALITY CONTROL

A. Provide Instrument Component Calibration Certificate.

B. For analyzers provide:

1. Installation validation protocol.
2. Functional validation protocol.
3. Calibration Certificate.

3.05 MANUFACTURER'S SERVICES

A. Specialty Equipment: For following equipment, provide the services of a qualified manufacturer's representative during installation, startup, and demonstration testing and Owner training. Provide original equipment manufacturer's services as noted in Project Specific Requirements Table.

1. Manufacturers services shall be utilized for analyzer instruments.
2. 1 day, not including travel time to, or from, the Project Site, for each of the instrument component specification types listed in the Project Specific Requirements Table.
3. Services shall be manufacturer employee specifically qualified and trained in the installation, testing, and operation of the specific manufacturer instrument.
4. Services shall include on-site instrument installation setup, testing, configuration and operations.
5. To be coordinated and executed during Component or Functional testing.
6. All services to be executed prior to the completion of the Functional testing.

3.06 SUPPLEMENTS

A. The supplements listed below, following “End of Section,” are a part of this specification:

1. Instrument List:
 - a. Caprock Pump Station (CPS).
 - b. Caprock Tank (CT).
 - c. Intake Pump Station (IPS).
2. Options Sheet List:
 - a. Caprock Pump Station (CPS).
 - b. Caprock Tank (CT).
 - c. Intake Pump Station (IPS).

END OF SECTION

CAPROCK PUMP STATION
INSTRUMENT LIST

ITEM	P+I ID NO	LOOP NO	TAG NO	LOOP TITLE	COMP CODE	INSTRUMENT NAME	DESIGN DETAIL
1	CP09-N-101_D3299318	CP1100801	CP11-LSH-008-01	CAPROCK PS FOREBAY INLET VALVE VAULT FLOODING	L50	Level Switch, Tuning Fork	4091-242
2	CP09-N-1801_D3299318	CP1800101	CP18-LIT-001-01	CAPROCK PS FOREBAY TANK COMPARTMENT 1 LEVEL A	L29	Level Element & Transmitter, Radar	4091-253
3	CP09-N-1801_D3299318	CP1800102	CP18-LIT-001-02	CAPROCK PS FOREBAY TANK COMPARTMENT 2 LEVEL A	L29	Level Element & Transmitter, Radar	4091-253
4	CP09-N-1801_D3299318	CP1800201	CP18-LSHH-002-01	CAPROCK PS FOREBAY TANK COMPARTMENT 1 OVERFLOW	L50	Level Switch, Tuning Fork	4091-267
5	CP09-N-1801_D3299318	CP1800202	CP18-LSHH-002-02	CAPROCK PS FOREBAY TANK COMPARTMENT 2 OVERFLOW	L50	Level Switch, Tuning Fork	4091-267
6	CP09-N-1801_D3299318	CP1800301	CP18-LT-003-01	CAPROCK PS FOREBAY TANK COMPARTMENT 1 LEVEL B	L42	Level Transmitter, Submersible	4091-254
7	CP09-N-1801_D3299318	CP1800302	CP18-LT-003-02	CAPROCK PS FOREBAY TANK COMPARTMENT 2 LEVEL B	L42	Level Transmitter, Submersible	4091-254
8	CP09-N-1901_D3299318	CP1900801	CP19-LSH-008-01	CAPROCK PS FOREBAY OUTLET VALVE VAULT FLOODING	L50	Level Switch, Tuning Fork	4091-242
9	CP09-N-2001_D3299318	CP2000201	CP20-LSH-002-01	CAPROCK PS INTAKE VALVE VAULT FLOODING	L50	Level Switch, Tuning Fork	4091-242
10	CP09-N-2001_D3299318	CP2000301	CP20-PI-003-01	CAPROCK PS RAW WATER DISCHARGE HEADER PRESSURE	P04	Pressure Gauge	4091-306B
11	CP09-N-2001_D3299318	CP2000501	CP20-PSH-005-01	CAPROCK PS RAW WATER DISCHARGE HEADER PRESSURE HIGH	P08	Pressure Switch	4091-306B
12	CP09-N-2001_D3299318	CP2000601	CP20-PIT-006-01	CAPROCK PS RAW WATER DISCHARGE HEADER PRESSURE	P09	Pressure Transmitter	4091-306B
13	CP09-N-2001_D3299318	CP2000801	CP20-PI-008-01	CAPROCK PS RAW WATER LOW PRESSURE DISCHARGE HEADER PRESSURE	P04	Pressure Gauge	4091-301A
14	CP09-N-2001_D3299318	CP20001201	CP20-PI-012-01	CAPROCK PS SERVICE WATER TO NON-POTABLE WATER PRESSURE	P04	Pressure Gauge	4091-301A
15	CP09-N-2001_D3299318	CP20001202	CP20-PI-012-02	CAPROCK PS SERVICE WATER TO HOSE BIB SYSTEM PRESSURE	P04	Pressure Gauge	4091-301A
16	CP09-N-2001_D3299318	CP20001401	CP20-PI-014-01	CAPROCK PS SERVICE WATER TO NON-POTABLE WATER PRESSURE	P04	Pressure Gauge	4091-301A
17	CP09-N-2001_D3299318	CP20001402	CP20-PI-014-02	CAPROCK PS SERVICE WATER TO HOSE BIB SYSTEM PRESSURE	P04	Pressure Gauge	4091-301A
18	CP09-N-2001_D3299318	CP20001701	CP20-PI-017-01	CAPROCK PS NON-POTABLE WATER PRESSURE	P04	Pressure Gauge	4091-301A
19	CP09-N-2002_D3299318	CP2002701	CP20-PIT-027-01	CAPROCK PS RAW WATER CAPROCK PUMP 1 DISCHARGE HEADER PRESSURE	P09	Pressure Transmitter	4091-306B
20	CP09-N-2002_D3299318	CP2002801	CP20-PSH-028-01	CAPROCK PS RAW WATER CAPROCK PUMP 1 DISCHARGE HEADER PRESSURE HIGH	P08	Pressure Switch	4091-306B
21	CP09-N-2002_D3299318	CP2003101	CP20-FEIT-031-01	CAPROCK PS RAW WATER CAPROCK PUMP 1 DISCHARGE HEADER FLOW	F04	Flow Element & Transmitter, Electromagnetic	4091-220A
22	CP09-N-2002_D3299318	CP2003401	CP20-PI-034-01	CAPROCK PS RAW WATER CAPROCK PUMP 1 DISCHARGE HEADER PRESSURE	P04	Pressure Gauge	4091-306B
23	CP09-N-2002_D3299318	CP2002702	CP20-PIT-027-02	CAPROCK PS RAW WATER CAPROCK PUMP 2 DISCHARGE HEADER PRESSURE	P09	Pressure Transmitter	4091-306B
24	CP09-N-2003_D3299318	CP2002802	CP20-PSH-028-02	CAPROCK PS RAW WATER CAPROCK PUMP 2 DISCHARGE HEADER PRESSURE HIGH	P08	Pressure Switch	4091-306B
25	CP09-N-2003_D3299318	CP2003102	CP20-FEIT-031-02	CAPROCK PS RAW WATER CAPROCK PUMP 2 DISCHARGE HEADER FLOW	F04	Flow Element & Transmitter, Electromagnetic	4091-220A
26	CP09-N-2003_D3299318	CP2003402	CP20-PI-034-02	CAPROCK PS RAW WATER CAPROCK PUMP 2 DISCHARGE HEADER PRESSURE	P04	Pressure Gauge	4091-306B
27	CP09-N-2004_D3299318	CP2002703	CP20-PIT-027-03	CAPROCK PS RAW WATER CAPROCK PUMP 3 DISCHARGE HEADER PRESSURE	P09	Pressure Transmitter	4091-306B
28	CP09-N-2004_D3299318	CP2002803	CP20-PSH-028-03	CAPROCK PS RAW WATER CAPROCK PUMP 3 DISCHARGE HEADER PRESSURE HIGH	P08	Pressure Switch	4091-306B
29	CP09-N-2004_D3299318	CP2003103	CP20-FEIT-031-03	CAPROCK PS RAW WATER CAPROCK PUMP 3 DISCHARGE HEADER FLOW	F04	Flow Element & Transmitter, Electromagnetic	4091-220A
30	CP09-N-2004_D3299318	CP2003403	CP20-PI-034-03	CAPROCK PS RAW WATER CAPROCK PUMP 3 DISCHARGE HEADER PRESSURE	P04	Pressure Gauge	4091-306B
31	CP09-N-2005_D3299318	CP2002704	CP20-PIT-027-04	CAPROCK PS RAW WATER CAPROCK PUMP 4 DISCHARGE HEADER PRESSURE	P09	Pressure Transmitter	4091-306B
32	CP09-N-2005_D3299318	CP2002804	CP20-PSH-028-04	CAPROCK PS RAW WATER CAPROCK PUMP 4 DISCHARGE HEADER PRESSURE HIGH	P08	Pressure Switch	4091-306B
33	CP09-N-2005_D3299318	CP2003104	CP20-FEIT-031-04	CAPROCK PS RAW WATER CAPROCK PUMP 4 DISCHARGE HEADER FLOW	F04	Flow Element & Transmitter, Electromagnetic	4091-220A
34	CP09-N-2005_D3299318	CP2003404	CP20-PI-034-04	CAPROCK PS RAW WATER CAPROCK PUMP 4 DISCHARGE HEADER PRESSURE	P04	Pressure Gauge	4091-306B
35	CP09-N-2006_D3299318	CP2002705	CP20-PIT-027-05	CAPROCK PS RAW WATER CAPROCK PUMP 5 DISCHARGE HEADER PRESSURE	P09	Pressure Transmitter	4091-306B
36	CP09-N-2006_D3299318	CP2002805	CP20-PSH-028-05	CAPROCK PS RAW WATER CAPROCK PUMP 5 DISCHARGE HEADER PRESSURE HIGH	P08	Pressure Switch	4091-306B
37	CP09-N-2006_D3299318	CP2003105	CP20-FEIT-031-05	CAPROCK PS RAW WATER CAPROCK PUMP 5 DISCHARGE HEADER FLOW	F04	Flow Element & Transmitter, Electromagnetic	4091-220A
38	CP09-N-2006_D3299318	CP2003405	CP20-PI-034-05	CAPROCK PS RAW WATER CAPROCK PUMP 5 DISCHARGE HEADER PRESSURE	P04	Pressure Gauge	4091-306B
39	CP09-N-2007_D3299318	CP2010501	CP20-PI-105-01	CAPROCK PS AIR RECEIVING TANK HIGH PRESSURE AIR PRESSURE A	P04	Pressure Gauge	4091-301A
40	CP09-N-2007_D3299318	CP2012801	CP20-PIT-128-01	CAPROCK PS AIR RECEIVING TANK HIGH PRESSURE AIR PRESSURE B	P09	Pressure Transmitter	4091-301A
41	CP09-N-2202_D3299318	CP2204301	CP22-LSH-043-01	CAPROCK PS ISOLATION VALVE VAULT FLOODING	L50	Level Switch, Tuning Fork	4091-242
42	CP09-N-2401_D3299318	CP2414401	CP24-LSH-144-01	CAPROCK PS ISOLATION VALVE VAULT FLOODING	L50	Level Switch, Tuning Fork	4091-242
43	CP09-N-4902_D3299318	GP0751001	CP07-LSH-510-01	CAPROCK PS WASTE HOLDING TANK LEVEL	L08	Level Switch, Float	4091-247A
44	CP09-N-4902_D3299318	CP2050101	CP20-TT-501-01	CAPROCK PS ELECTRICAL ROOM TEMPERATURE A	T21	Temperature Transmitter, Wall Mount	4091-160
45	CP09-N-4902_D3299318	CP2050102	CP20-TT-501-02	CAPROCK PS ELECTRICAL ROOM TEMPERATURE B	T21	Temperature Transmitter, Wall Mount	4091-160

CAPROCK PUMP STATION
INSTRUMENT LIST

ITEM	P-I-D NO	LOOP NO	TAG NO	LOOP TITLE	COMP CODE	INSTRUMENT NAME	DESIGN DETAIL
46	CP09-N-4902_D3299318	CP2080201	CP20-TT-502-01	CAPROCK PS PLC ROOM AMBIENT TEMPERATURE	T21	Temperature Transmitter, Wall Mount	4091-160
47	CP09-N-4902_D3299318	CP2050401	CP20-TT-504-01	CAPROCK PS PUMP ROOM AMBIENT TEMPERATURE A	T21	Temperature Transmitter, Wall Mount	4091-160
48	CP09-N-4902_D3299318	CP2050402	CP20-TT-504-02	CAPROCK PS PUMP ROOM AMBIENT TEMPERATURE B	T21	Temperature Transmitter, Wall Mount	4091-160
49	CP09-N-4902_D3299318	CP2080501	CP20-TT-505-01	CAPROCK PS OUTDOOR TEMPERATURE	T21	Temperature Transmitter, Wall Mount	4091-160
50	CP09-N-4902_D3299318	CP2080101T	CP20-TT-801-01T	CAPROCK PS MAIN CONTROL PANEL	T21	Temperature Transmitter, Wall Mount	SEE CP09-N-7002
51	CP09-N-4902_D3299318	CP2083101T	CP20-TT-831-01T	CAPROCK PS NETWORK PANEL	T21	Temperature Transmitter, Wall Mount	SEE CP09-N-7012

CAPROCK TANK
INSTRUMENT LIST

ITEM	P+ID NO	LOOP NO	TAG NO	LOOP TITLE	COMP CODE	INSTRUMENT NAME	DESIGN DETAIL
1	CT09-N-1101_D3299318	CT1100601	CT11-LSH-006-01	CAPROCK TANK INLET VALVE VAULT FLOODING	L50	Level Switch, Tuning Fork	4091-242
2	CT09-N-2501_D3299318	CT2500101	CT25-LIT-001-01	CAPROCK TANK COMPARTMENT 1 LEVEL A	L29	Level Element & Transmitter, Radar	4091-253
3	CT09-N-2501_D3299318	CT2500102	CT25-LIT-001-02	CAPROCK TANK COMPARTMENT 2 LEVEL A	L29	Level Element & Transmitter, Radar	4091-253
4	CT09-N-2501_D3299318	CT2500201	CT25-LSHH-002-01	CAPROCK TANK COMPARTMENT 1 OVERFLOW	L50	Level Switch, Tuning Fork	4091-267
5	CT09-N-2501_D3299318	CT2500202	CT25-LSHH-002-02	CAPROCK TANK COMPARTMENT 2 OVERFLOW	L50	Level Switch, Tuning Fork	4091-267
6	CT09-N-2501_D3299318	CT2500301	CT25-LT-003-01	CAPROCK TANK COMPARTMENT 1 LEVEL B	L42	Level Transmitter, Submersible	4091-254
7	CT09-N-2501_D3299318	CT2500302	CT25-LT-003-02	CAPROCK TANK COMPARTMENT 2 LEVEL B	L42	Level Transmitter, Submersible	4091-254
8	CT09-N-3201_D3299318	CT3200601	CT32-LSH-006-01	CAPROCK TANK OUTLET VALVE AND CHEMICAL INJECTION VAULT FLOODING	L50	Level Switch, Tuning Fork	4091-242
9	CT09-N-4901_D3299318	CT2750201	CT27-TT-502-01	CAPROCK TANK ELECTRICAL BUILDING TEMPERATURE	T21	Temperature Transmitter, Wall Mount	4091-160
10	CT09-N-4901_D3299318	CT2750202	CT27-TT-502-02	CAPROCK TANK COMPRESSOR ROOM TEMPERATURE	T21	Temperature Transmitter, Wall Mount	4091-160
11	CT09-N-4901_D3299318	CT2750501	CT27-TT-505-01	CAPROCK TANK OUTDOOR TEMPERATURE	T21	Temperature Transmitter, Wall Mount	4091-160
12	CT09-N-4901_D3299318	CT2780101T	CT27-TT-801-01T	CAPROCK TANK MAIN CONTROL PANEL	T21	Temperature Transmitter, Wall Mount	SEE CT09-N-7002
13	CT09-N-4901_D3299318	CT2783101T	CT27-TT-831-01T	CAPROCK TANK MAIN NETWORK PANEL	T21	Temperature Transmitter, Wall Mount	SEE CT09-N-7012

INTAKE PUMP STATION
INSTRUMENT LIST

ITEM	LOOP NO	TAG NO	LOOP TITLE	COMP CODE	INSTRUMENT NAME	P + ID NO	DESIGN DETAIL
1	IP1500201	IP15-LIT-002-01	INTAKE PS COPPER SULFATE STORAGE TANK LEVEL	L10	Level Transmitter, Pressure	IP09-N-1501_D3299318	4091-255
2	IP1500701	IP15-LSH-007-01	INTAKE PS CONTAINMENT SUMP OVERFLOW	L50	Level Switch, Tuning Fork	IP09-N-1501_D3299318	4091-242
3	IP1503101	IP15-FI-031-01	INTAKE PS CHEMICAL FACILITY SERVICE WATER FLOW METER	F16	Flow Element, Rotameter	IP09-N-1502_D3299318	4091-216
4	IP1503701	IP15-PI-037-01	INTAKE PS CHEMICAL FACILITY SERVICE WATER PRESSURE	P04	Pressure Gauge	IP09-N-1502_D3299318	4091-301A
5	IP1515101	IP15-AIT-151-01	INTAKE PS CHEMICAL FACILITY CO2 INJECTION SKID ROOM CO2/O2 CONCENTRATION	A11	Dual O2/CO2 Gas Analyzer & Transmitter	IP09-N-1504_D3299318	4091-161
6	IP1515401	IP15-PIT-154-01	INTAKE PS CHEMICAL FACILITY CO2 INJECTION SKID W3 WATER INLET PRESSURE	P09	Pressure Transmitter	IP09-N-1504_D3299318	4091-301A
7	IP2000101	IP20-LIT-001-01	INTAKE PS RAW WATER INTAKE WELL LEVEL	L29	Level Element & Transmitter, Radar	IP09-N-2001_D3299318	4091-252
8	IP2000201	IP20-PI-002-01	INTAKE PS RAW WATER DISCHARGE HEADER PRESSURE	P04	Pressure Gauge	IP09-N-2001_D3299318	4091-306B
9	IP2000301	IP20-PG-003-01	INTAKE PS RAW WATER QUALITY ANALYZER SAMPLE INLET PRESSURE	P04	Pressure Gauge	IP09-N-2001_D3299318	SEE IP09-N-8002
10	IP2000501	IP20-AE-005-01	INTAKE PS RAW WATER TURBIDITY	A16	Turbidity Analyzer & Transmitter, Low Range	IP09-N-2001_D3299318	SEE IP09-N-8002
11	IP2000701	IP20-FSL-007-01	INTAKE PS RAW WATER QUALITY ANALYZER PANEL FLOW	F22	Flow Switch, Magnetic Piston	IP09-N-2001_D3299318	SEE IP09-N-8002
12	IP2000801	IP20-AE-008-01	INTAKE PS RAW WATER PH/TEMP	A07	pH Analyzer & Transmitter	IP09-N-2001_D3299318	SEE IP09-N-8002
13	IP2000901	IP20-AE-009-01	INTAKE PS RAW WATER CONDUCTIVITY	A03	Conductivity Element & Transmitter	IP09-N-2001_D3299318	SEE IP09-N-8002
14	IP2001001	IP20-AIT-010-01	INTAKE PS RAW WATER QUALITY ANALYZER TURBIDITY AND FLOW TRANSMITTER	A00	Universal Digital Transmitter	IP09-N-2001_D3299318	SEE IP09-N-8002
15	IP2001101	IP20-AIT-011-01	INTAKE PS RAW WATER QUALITY ANALYZER PH/TEMP AND CONDUCTIVITY TRANSMIT	A00	Universal Digital Transmitter	IP09-N-2001_D3299318	SEE IP09-N-8002
16	IP2001601	IP20-PI-016-01	INTAKE PS RAW WATER DISCHARGE HEADER REGULATED PRESSURE A	P04	Pressure Gauge	IP09-N-2001_D3299318	4091-301A
17	IP2001602	IP20-PI-016-02	INTAKE PS RAW WATER DISCHARGE HEADER REGULATED PRESSURE B	P04	Pressure Gauge	IP09-N-2001_D3299318	4091-301A
18	IP2001603	IP20-PI-016-03	INTAKE PS RAW WATER DISCHARGE HEADER REGULATED PRESSURE C	P04	Pressure Gauge	IP09-N-2001_D3299318	4091-301A
19	IP2001604	IP20-PI-016-04	INTAKE PS RAW WATER DISCHARGE HEADER REGULATED PRESSURE D	P04	Pressure Gauge	IP09-N-2001_D3299318	4091-301A
20	IP2001801	IP20-PIT-018-01	INTAKE PS RAW WATER DISCHARGE HEADER PRESSURE	P09	Pressure Transmitter	IP09-N-2001_D3299318	4091-306B
21	IP2002301	IP20-PSH-023-01	INTAKE PS RAW WATER DISCHARGE HEADER PRESSURE HIGH	P08	Pressure Switch	IP09-N-2001_D3299318	4091-306B
22	IP2002301	IP20-PSH-203-01	INTAKE PS WET WELL RECIRCULATION PUMP 2 PRESSURE HIGH	P08	Pressure Switch	IP09-N-2001_D3299318	4091-301A
23	IP2002302	IP20-PSH-203-02	INTAKE PS WET WELL RECIRCULATION PUMP 2 PRESSURE HIGH	P08	Pressure Switch	IP09-N-2001_D3299318	4091-301A
24	IP2002401	IP20-PI-204-01	INTAKE PS WET WELL RECIRCULATION PUMP 2 PRESSURE	P04	Pressure Gauge	IP09-N-2001_D3299318	4091-301A
25	IP2002402	IP20-PI-204-02	INTAKE PS WET WELL RECIRCULATION PUMP 2 PRESSURE	P04	Pressure Gauge	IP09-N-2001_D3299318	4091-301A
26	IP2002701	IP20-PIT-027-01	INTAKE PS RAW WATER INTAKE PUMP 1 DISCHARGE HEADER PRESSURE	P09	Pressure Transmitter	IP09-N-2002_D3299318	4091-306B
27	IP2002801	IP20-PSH-028-01	INTAKE PS RAW WATER INTAKE PUMP 1 DISCHARGE HEADER PRESSURE HIGH	P08	Pressure Switch	IP09-N-2002_D3299318	4091-306B
28	IP2003101	IP20-FEIT-031-01	INTAKE PS RAW WATER INTAKE PUMP 1 DISCHARGE HEADER FLOW	F04	Flow Element & Transmitter, Electromagnetic	IP09-N-2002_D3299318	4091-220A
29	IP2003401	IP20-PI-034-01	INTAKE PS RAW WATER INTAKE PUMP 1 DISCHARGE HEADER PRESSURE	P04	Pressure Gauge	IP09-N-2002_D3299318	4091-306B
30	IP2002702	IP20-PIT-027-02	INTAKE PS RAW WATER INTAKE PUMP 2 DISCHARGE HEADER PRESSURE	P09	Pressure Transmitter	IP09-N-2003_D3299318	4091-306B
31	IP2003102	IP20-FEIT-031-02	INTAKE PS RAW WATER INTAKE PUMP 2 DISCHARGE HEADER FLOW	F04	Flow Element & Transmitter, Electromagnetic	IP09-N-2003_D3299318	4091-220A
32	IP2003402	IP20-PI-034-02	INTAKE PS RAW WATER INTAKE PUMP 2 DISCHARGE HEADER PRESSURE	P04	Pressure Gauge	IP09-N-2003_D3299318	4091-306B
33	IP2002703	IP20-PIT-027-03	INTAKE PS RAW WATER INTAKE PUMP 3 DISCHARGE HEADER PRESSURE	P09	Pressure Transmitter	IP09-N-2004_D3299318	4091-306B
34	IP2002803	IP20-PSH-028-03	INTAKE PS RAW WATER INTAKE PUMP 3 DISCHARGE HEADER PRESSURE HIGH	P08	Pressure Switch	IP09-N-2004_D3299318	4091-306B
35	IP2003103	IP20-FEIT-031-03	INTAKE PS RAW WATER INTAKE PUMP 3 DISCHARGE HEADER FLOW	F04	Flow Element & Transmitter, Electromagnetic	IP09-N-2004_D3299318	4091-220A
36	IP2003403	IP20-PI-034-03	INTAKE PS RAW WATER INTAKE PUMP 3 DISCHARGE HEADER PRESSURE	P04	Pressure Gauge	IP09-N-2004_D3299318	4091-306B
37	IP2002704	IP20-PIT-027-04	INTAKE PS RAW WATER INTAKE PUMP 4 DISCHARGE HEADER PRESSURE	P09	Pressure Transmitter	IP09-N-2005_D3299318	4091-306B
38	IP2002804	IP20-PSH-028-04	INTAKE PS RAW WATER INTAKE PUMP 4 DISCHARGE HEADER PRESSURE HIGH	P08	Pressure Switch	IP09-N-2005_D3299318	4091-306B
39	IP2003104	IP20-FEIT-031-04	INTAKE PS RAW WATER INTAKE PUMP 4 DISCHARGE HEADER FLOW	F04	Flow Element & Transmitter, Electromagnetic	IP09-N-2005_D3299318	4091-220A
40	IP2003404	IP20-PI-034-04	INTAKE PS RAW WATER INTAKE PUMP 4 DISCHARGE HEADER PRESSURE	P04	Pressure Gauge	IP09-N-2005_D3299318	4091-306B
41	IP2002705	IP20-PIT-027-05	INTAKE PS RAW WATER INTAKE PUMP 5 DISCHARGE HEADER PRESSURE	P09	Pressure Transmitter	IP09-N-2006_D3299318	4091-306B
42	IP2002805	IP20-PSH-028-05	INTAKE PS RAW WATER INTAKE PUMP 5 DISCHARGE HEADER PRESSURE HIGH	P08	Pressure Switch	IP09-N-2006_D3299318	4091-306B

INTAKE PUMP STATION
INSTRUMENT LIST

ITEM	LOOP NO	TAG NO	LOOP TITLE	COMP CODE	INSTRUMENT NAME	P + ID NO	DESIGN DETAIL
43	IP2003105	IP20-FEIT-031-05	INTAKE PS RAW WATER INTAKE PUMP 5 DISCHARGE HEADER FLOW	F04	Flow Element & Transmitter, Electromagnetic	IP09-N-2006_D3299318	4091-220A
44	IP2003405	IP20-PI-034-05	INTAKE PS RAW WATER INTAKE PUMP 5 DISCHARGE HEADER PRESSURE	P04	Pressure Gauge	IP09-N-2006_D3299318	4091-306B
45	IP2010501	IP20-PI-105-01	INTAKE PS AIR RECEIVING TANK HIGH PRESSURE AIR PRESSURE A	P04	Pressure Gauge	IP09-N-2007_D3299318	4091-301A
46	IP2012801	IP20-PIT-128-01	INTAKE PS AIR RECEIVING TANK HIGH PRESSURE AIR PRESSURE B	P09	Pressure Transmitter	IP09-N-2007_D3299318	4091-301A
47	IP2414501	IP24-PI-145-01	INTAKE PS ISOLATION VALVE VAULT RAW WATER PRESSURE A	P04	Pressure Gauge	IP09-N-2401_D3299318	4091-306A
48	IP2414601	IP24-PI-146-01	INTAKE PS ISOLATION VALVE VAULT RAW WATER PRESSURE B	P04	Pressure Gauge	IP09-N-2401_D3299318	4091-306A
49	IP2414801	IP24-LSH-148-01	INTAKE PS ISOLATION VALVE VAULT FLOODING	L50	Level Switch, Tuning Fork	IP09-N-2401_D3299318	4091-242
50	IP0751001	IP07-LSH-510-01	INTAKE PS WASTE HOLDING TANK LEVEL	L08	Level Switch, Float	IP09-N-4902_D3299318	4091-247A
51	IP1550101	IP15-TT-501-01	INTAKE PS CHEMICAL FACILITY AMBIENT TEMPERATURE	T21	Temperature Transmitter, Wall Mount	IP09-N-4902_D3299318	4091-160
52	IP1550102	IP15-TT-501-02	INTAKE PS CHEMICAL FACILITY CO2 INJECTION SKID ROOM TEMPERATURE	T21	Temperature Transmitter, Wall Mount	IP09-N-4902_D3299318	4091-160
53	IP2000101	IP20-TT-001-01	INTAKE PS RAW WATER INTAKE WELL LEVEL	T21	Temperature Transmitter, Wall Mount	IP09-N-4902_D3299318	4091-160
54	IP2050101	IP20-TT-501-01	INTAKE PS ELECTRICAL ROOM TEMPERATURE A	T21	Temperature Transmitter, Wall Mount	IP09-N-4902_D3299318	4091-160
55	IP2050102	IP20-TT-501-02	INTAKE PS ELECTRICAL ROOM TEMPERATURE B	T21	Temperature Transmitter, Wall Mount	IP09-N-4902_D3299318	4091-160
56	IP2050201	IP20-TT-502-01	INTAKE PS PLC ROOM AMBIENT TEMPERATURE	T21	Temperature Transmitter, Wall Mount	IP09-N-4902_D3299318	4091-160
57	IP2050401	IP20-TT-504-01	INTAKE PS PUMP ROOM AMBIENT TEMPERATURE A	T21	Temperature Transmitter, Wall Mount	IP09-N-4902_D3299318	4091-160
58	IP2050402	IP20-TT-504-02	INTAKE PS PUMP ROOM AMBIENT TEMPERATURE B	T21	Temperature Transmitter, Wall Mount	IP09-N-4902_D3299318	4091-160
59	IP2050501	IP20-TT-505-01	INTAKE PS OUTDOOR TEMPERATURE	T21	Temperature Transmitter, Wall Mount	IP09-N-4902_D3299318	4091-160
60	IP2080101T	IP20-TT-801-01T	INTAKE PS MAIN CONTROL PANEL	T21	Temperature Transmitter, Wall Mount	IP09-N-4902_D3299318	SEE IP09-N-7002
61	IP2083101T	IP20-TT-831-01T	INTAKE PS MAIN NETWORK PANEL	T21	Temperature Transmitter, Wall Mount	IP09-N-4902_D3299318	SEE IP09-N-7002
62	IP3250401	IP32-TT-504-01	INTAKE PS COMPRESSOR BUILDING TEMPERATURE	T21	Temperature Transmitter, Wall Mount	IP09-N-4902_D3299318	4091-160

CAPROCK PUMP STATION
FO4 FLOW ELEMENT AND TRANSMITTER, ELECTROMAGNETIC - OPTIONS SHEET

ITEM	LOOP NO.	TAG NO.	LOOP TITLE	P-I.D. NO.	DESIGN DETAIL	SERVICE	PROCESS RANGE	CALIBRATED RANGE	OUTPUT	ELEMENT SIZE	PROCESS CONN.	LINER	ELECTRODE	REMARKS
1	CP2003101	CP20-FEIT-031-01	CAPROCK PS RAW WATER CAPROCK PUMP 1 DISCHARGE HEADER FLOW	CP09-N-2002_D3299318	4091-220A	RW2	500 to 7000 gpm	0 to 10000 gpm	4...20mA, Pulse	16 inch	ANSI Flange	EPDM	Stainless Steel	ODn up ODn down
2	CP2003102	CP20-FEIT-031-02	CAPROCK PS RAW WATER CAPROCK PUMP 2 DISCHARGE HEADER FLOW	CP09-N-2003_D3299318	4091-220A	RW2	500 to 7000 gpm	0 to 10000 gpm	4...20mA, Pulse	16 inch	ANSI Flange	EPDM	Stainless Steel	ODn up ODn down
3	CP2003103	CP20-FEIT-031-03	CAPROCK PS RAW WATER CAPROCK PUMP 3 DISCHARGE HEADER FLOW	CP09-N-2004_D3299318	4091-220A	RW2	500 to 7000 gpm	0 to 10000 gpm	4...20mA, Pulse	16 inch	ANSI Flange	EPDM	Stainless Steel	ODn up ODn down
4	CP2003104	CP20-FEIT-031-04	CAPROCK PS RAW WATER CAPROCK PUMP 4 DISCHARGE HEADER FLOW	CP09-N-2005_D3299318	4091-220A	RW2	500 to 7000 gpm	0 to 10000 gpm	4...20mA, Pulse	16 inch	ANSI Flange	EPDM	Stainless Steel	ODn up ODn down
5	CP2003105	CP20-FEIT-031-05	CAPROCK PS RAW WATER CAPROCK PUMP 5 DISCHARGE HEADER FLOW	CP09-N-2006_D3299318	4091-220A	RW2	500 to 7000 gpm	0 to 10000 gpm	4...20mA, Pulse	16 inch	ANSI Flange	EPDM	Stainless Steel	ODn up ODn down

CAPROCK PUMP STATION
L08 LEVEL SWITCH, FLOAT - OPTIONS SHEET

ITEM	LOOP NO.	TAG NO.	LOOP TITLE	P-I-D NO.	DESIGN DETAIL	SERVICE	ZERO ELEVATION	SETPOINT	OUTPUT	CABLE	REMARKS
1	CP075T001	CP07-LSH-510-01	CAPROCK PS WASTE HOLDING TANK LEVEL	CP09-N-4902_D3299318	4091-247A	W3/SAM	Tank Bottom	Adjustable	NO. Contact	33ft	I-S circuit

CAPROCK PUMP STATION
L29 LEVEL ELEMENT AND TRANSMITTER, RADAR - OPTIONS SHEET

ITEM	LOOP NO.	TAG NO.	LOOP TITLE	P+ID NO.	DESIGN DETAIL	SERVICE	PROCESS CONN.	ELEMENT TYPE	SENSOR ELEVATION	ZERO REFERENCE	CALIBRATED RANGE	OUTPUT	REMARKS
1	CP1800101	CP18-LIT-001-01	CAPROCK PS FOREBAY TANK COMPARTMENT 1 LEVEL A	CP09-NI-1801_D3299318	4091-253	RWLP	6" FLANGE	6deg BEAM	EL 4294ft	EL 4265ft	0 to 24 ft	4 to 20mA HART	Weather protection
2	CP1800102	CP18-LIT-001-02	CAPROCK PS FOREBAY TANK COMPARTMENT 2 LEVEL A	CP09-NI-1801_D3299318	4091-253	RWLP	6" FLANGE	6deg BEAM	EL 4294ft	EL 4265ft	0 to 24 ft	4 to 20mA HART	Weather protection

CAPROCK PUMP STATION
L42 LEVEL TRANSMITTER, SUBMERSIBLE - OPTIONS SHEET

ITEM	LOOP NO.	TAG NO.	ACCESSORY	LOOP TITLE	P-I-D NO.	DESIGN DETAIL	SERVICE	ZERO REFERENCE	CALIBRATED RANGE	OUTPUT	CABLE	REMARKS
1	CP1800301	CP18-LT-003-01	CP18-TJB-003-01	CAPROCK PS FOREBAY TANK COMPARTMENT 1 LEVEL B	CP09-N-1801_D3299318	4091-254	RWLP	2.5ft	2.5 to 24ft	4 to 20mA	50ft	2.5ft zero level offset in MIN/MAX calibration
2	CP1800302	CP18-LT-003-02	CP18-TJB-003-02	CAPROCK PS FOREBAY TANK COMPARTMENT 2 LEVEL B	CP09-N-1801_D3299318	4091-254	RWIP	2.5ft	2.5 to 24ft	4 to 20mA	50ft	2.5ft zero level offset in MIN/MAX calibration

CAPROCK PUMP STATION
LSO LEVEL SWITCH, TUNING FORK - OPTIONS SHEET

ITEM	LOOP NO	TAG NO	LOOP TITLE	P+I D NO	DESIGN DETAIL	SERVICE	INSERTION LENGTH	WETTED MATERIALS	SETPPOINT	SP DIRECTION	REMARKS
1	CP1100801	CP11-LSH-008-01	CAPROCK PS FOREBAY INLET VALVE VAULT FLOODING	CP09-N-1101_D329931B	4091-242	RWLP	15"	Stainless Steel	2"	MAX	
2	CP1800201	CP18-LSH-002-01	CAPROCK PS FOREBAY TANK COMPARTMENT 1 OVERFLOW	CP09-N-1801_D329931B	4091-267	RWLP	TBD	Stainless Steel	EL4284.50	MAX	Coordinated on nozzle location on tank drawings
3	CP1800202	CP18-LSH-002-02	CAPROCK PS FOREBAY TANK COMPARTMENT 2 OVERFLOW	CP09-N-1801_D329931B	4091-267	RWLP	TBD	Stainless Steel	EL4284.50	MAX	Coordinated on nozzle location on tank drawings
4	CP1900801	CP19-LSH-008-01	CAPROCK PS FOREBAY OUTLET VALVE VAULT FLOODING	CP09-N-1901_D329931B	4091-242	RWLP	15"	Stainless Steel	2"	MAX	
5	CP2000201	CP20-LSH-002-01	CAPROCK PS INTAKE VALVE VAULT FLOODING	CP09-N-2001_D329931B	4091-242	RWLP	15"	Stainless Steel	2"	MAX	
6	CP2204301	CP22-LSH-043-01	CAPROCK PS SURGE TANKS VALVE VAULT FLOODING	CP09-N-2202_D329931B	4091-242	RWLP	15"	Stainless Steel	2"	MAX	
7	CP2414401	CP24-LSH-144-01	CAPROCK PS ISOLATION VALVE VAULT FLOODING	CP09-N-2401_D329931B	4091-242	RW2	15"	Stainless Steel	2"	MAX	

CAPROCK PUMP STATION
P04 PRESSURE GAUGE - OPTIONS SHEET

ITEM	LOOP NO.	TAG NO.	LOOP TITLE	P+ID NO.	DESIGN DETAIL	SERVICE	PROCESS RANGE	PROCESS CONN.	WETTED PARTS	BODY MATERIAL	DIAL	RANGE	REMARKS
1	CP2000301	CP20-PI-003-01	CAPROCK PS RAW WATER DISCHARGE HEADER PRESSURE	CP09-N-2001_D3299318_4091-306B		RW2	0 to 400 psi	1/2 inch, Lower	Stainless Steel	Phenolic	4.5 inch	0 to 600 ps	
2	CP2000801	CP20-PI-008-01	CAPROCK PS RAW WATER LOW PRESSURE DISCHARGE HEADER PRESSURE	CP09-N-2001_D3299318_4091-301A		RWLP	0 to 30 psi	1/2 inch, Lower	Stainless Steel	Phenolic	4.5 inch	0 to 60 psi	
3	CP2001201	CP20-PI-012-01	CAPROCK PS SERVICE WATER TO NON-POTABLE WATER PRESSURE	CP09-N-2001_D3299318_4091-301A		RW2	0 to 150 psi	1/2 inch, Lower	Stainless Steel	Phenolic	4.5 inch	0 to 300 psi	
4	CP2001202	CP20-PI-012-02	CAPROCK PS SERVICE WATER TO HOSE BIB SYSTEM PRESSURE	CP09-N-2001_D3299318_4091-301A		RW2	0 to 150 psi	1/2 inch, Lower	Stainless Steel	Phenolic	4.5 inch	0 to 300 psi	
5	CP2001401	CP20-PI-014-01	CAPROCK PS SERVICE WATER TO NON-POTABLE WATER PRESSURE	CP09-N-2001_D3299318_4091-301A		W3	0 to 150 psi	1/2 inch, Lower	Stainless Steel	Phenolic	4.5 inch	0 to 300 psi	
6	CP2001402	CP20-PI-014-02	CAPROCK PS SERVICE WATER TO HOSE BIB SYSTEM PRESSURE	CP09-N-2001_D3299318_4091-301A		W3	0 to 150 psi	1/2 inch, Lower	Stainless Steel	Phenolic	4.5 inch	0 to 300 psi	
7	CP2001701	CP20-PI-017-01	CAPROCK PS NON-POTABLE WATER PRESSURE	CP09-N-2001_D3299318_4091-301A		W3	0 to 150 psi	1/2 inch, Lower	Stainless Steel	Phenolic	4.5 inch	0 to 300 psi	
8	CP2003401	CP20-PI-034-01	CAPROCK PS RAW WATER CAPROCK PUMP 1 DISCHARGE HEADER PRESSURE	CP09-N-2002_D3299318_4091-306B		RW2	0 to 400 psi	1/2 inch, Lower	Stainless Steel	Phenolic	4.5 inch	0 to 600 psi	
9	CP2003402	CP20-PI-034-02	CAPROCK PS RAW WATER CAPROCK PUMP 2 DISCHARGE HEADER PRESSURE	CP09-N-2003_D3299318_4091-306B		RW2	0 to 400 psi	1/2 inch, Lower	Stainless Steel	Phenolic	4.5 inch	0 to 600 ps	
10	CP2003403	CP20-PI-034-03	CAPROCK PS RAW WATER CAPROCK PUMP 3 DISCHARGE HEADER PRESSURE	CP09-N-2004_D3299318_4091-306B		RW2	0 to 400 psi	1/2 inch, Lower	Stainless Steel	Phenolic	4.5 inch	0 to 600 ps	
11	CP2003404	CP20-PI-034-04	CAPROCK PS RAW WATER CAPROCK PUMP 4 DISCHARGE HEADER PRESSURE	CP09-N-2005_D3299318_4091-306B		RW2	0 to 400 psi	1/2 inch, Lower	Stainless Steel	Phenolic	4.5 inch	0 to 600 ps	
12	CP2003405	CP20-PI-034-05	CAPROCK PS RAW WATER CAPROCK PUMP 5 DISCHARGE HEADER PRESSURE	CP09-N-2006_D3299318_4091-306B		RW2	0 to 400 psi	1/2 inch, Lower	Stainless Steel	Phenolic	4.5 inch	0 to 600 ps	
13	CP2010501	CP20-PI-105-01	CAPROCK PS AIR RECEIVING TANK HIGH PRESSURE AIR PRESSURE A	CP09-N-2007_D3299318_4091-301A		AHP	0 to 450 psi	1/2 inch, Lower	Stainless Steel	Phenolic	4.5 inch	0 to 800 psi	

CAPROCK PUMP STATION
P08 PRESSURE SWITCH - OPTIONS SHEET

ITEM	LOOP NO	TAG NO	LOOP TITLE	P+ID NO	DESIGN DETAIL	SERVICE	PROCESS RANGE	INSTRUMENT RANGE	SEAL TYPE	DEADBAND	SETPPOINT	OUTPUT	SP DIRECTION	REMARKS
1	CP2000601	CP20-PSH-005-01	CAPROCK P8 RAW WATER DISCHARGE HEADER PRESSURE HIGH	CP09-N-2001_D3299318	4091-306B	RW2	0 to 32.5 psi	0 to 600 psi	Buna-N	9-30psl	340 psi	Dry Contact	Increasing	
2	CP2002801	CP20-PSH-028-01	CAPROCK P8 RAW WATER CAPROCK PUMP 1 DISCHARGE HEADER PRESSURE HIGH	CP09-N-2002_D3299318	4091-306B	RW2	0 to 32.5 psi	0 to 600 psi	Buna-N	9-30psl	340 psi	Dry Contact	Increasing	
3	CP2002802	CP20-PSH-028-02	CAPROCK P8 RAW WATER CAPROCK PUMP 2 DISCHARGE HEADER PRESSURE HIGH	CP09-N-2003_D3299318	4091-306B	RW2	0 to 32.5 psi	0 to 600 psi	Buna-N	9-30psl	340 psi	Dry Contact	Increasing	
4	CP2002803	CP20-PSH-028-03	CAPROCK P8 RAW WATER CAPROCK PUMP 3 DISCHARGE HEADER PRESSURE HIGH	CP09-N-2004_D3299318	4091-306B	RW2	0 to 32.5 psi	0 to 600 psi	Buna-N	9-30psl	340 psi	Dry Contact	Increasing	
5	CP2002804	CP20-PSH-028-04	CAPROCK P8 RAW WATER CAPROCK PUMP 4 DISCHARGE HEADER PRESSURE HIGH	CP09-N-2005_D3299318	4091-306B	RW2	0 to 32.5 psi	0 to 600 psi	Buna-N	9-30psl	340 psi	Dry Contact	Increasing	
6	CP2002805	CP20-PSH-028-05	CAPROCK P8 RAW WATER CAPROCK PUMP 5 DISCHARGE HEADER PRESSURE HIGH	CP09-N-2006_D3299318	4091-306B	RW2	0 to 32.5 psi	0 to 600 psi	Buna-N	9-30psl	340 psi	Dry Contact	Increasing	

CAPROCK PUMP STATION
P09 PRESSURE TRANSMITTER - OPTIONS SHEET

ITEM	LOOP NO	TAG NO	LOOP TITLE	P-I.D. NO	DESIGN DETAIL	SERVICE	PROCESS RANGE	SEAL TYPE	SEAL MATERIAL	BODY MATERIAL	CALIBRATED RANGE	OUTPUT	REMARKS
1	CP2000601	CP20-PIT-006-01	CAPROCK PS RAW WATER DISCHARGE HEADER PRESSURE	CP09-N-2001_D3299318-4091-306B		RW2	0 to 400 psi	Internal	Stainless Steel	Alu coated	0 to 550 psi	4 to 20mA	
2	CP2002701	CP20-PIT-027-01	CAPROCK PS RAW WATER CAPROCK PUMP 1 DISCHARGE HEADER PRESSURE	CP09-N-2002_D3299318-4091-306B		RW2	0 to 400 psi	Internal	Stainless Steel	Alu coated	0 to 550 psi	4 to 20mA	
3	CP2002702	CP20-PIT-027-02	CAPROCK PS RAW WATER CAPROCK PUMP 2 DISCHARGE HEADER PRESSURE	CP09-N-2003_D3299318-4091-306B		RW2	0 to 400 psi	Internal	Stainless Steel	Alu coated	0 to 550 psi	4 to 20mA	
4	CP2002703	CP20-PIT-027-03	CAPROCK PS RAW WATER CAPROCK PUMP 3 DISCHARGE HEADER PRESSURE	CP09-N-2004_D3299318-4091-306B		RW2	0 to 400 psi	Internal	Stainless Steel	Alu coated	0 to 550 psi	4 to 20mA	
5	CP2002704	CP20-PIT-027-04	CAPROCK PS RAW WATER CAPROCK PUMP 4 DISCHARGE HEADER PRESSURE	CP09-N-2005_D3299318-4091-306B		RW2	0 to 400 psi	Internal	Stainless Steel	Alu coated	0 to 550 psi	4 to 20mA	
6	CP2002705	CP20-PIT-027-05	CAPROCK PS RAW WATER CAPROCK PUMP 5 DISCHARGE HEADER PRESSURE	CP09-N-2006_D3299318-4091-306B		RW2	0 to 400 psi	Internal	Stainless Steel	Alu coated	0 to 550 psi	4 to 20mA	
7	CP2012801	CP20-PIT-128-01	CAPROCK PS AIR RECEIVING TANK HIGH PRESSURE AIR PRESSURE B	CP09-N-2007_D3299318-4091-307A		AHP	0 to 500 psi	Internal	Stainless Steel	Alu coated	0 to 650 psi	4 to 20mA	

CAPROCK PUMP STATION
T21 AMBIENT TEMPERATURE TRANSMITTER - OPTIONS SHEET

ITEM	LOOP NO.	TAG NO.	LOOP TITLE	P+ID NO.	DESIGN DETAIL	PROCESS RANGE	INSTRUMENT RANGE	OUTPUT	REMARKS
1	CP2050101	CP20-TT-501-01	CAPROCK PS ELECTRICAL ROOM TEMPERATURE A	CP09-N-4902_D3299318	4091-160	Ambient	0 to 100 F	4 to 20 mA	
2	CP2050102	CP20-TT-501-02	CAPROCK PS ELECTRICAL ROOM TEMPERATURE B	CP09-N-4902_D3299318	4091-160	Ambient	0 to 100 F	4 to 20 mA	
3	CP2050201	CP20-TT-502-01	CAPROCK PS PLC ROOM AMBIENT TEMPERATURE	CP09-N-4902_D3299318	4091-160	Ambient	0 to 100 F	4 to 20 mA	
4	CP2050401	CP20-TT-504-01	CAPROCK PS PUMP ROOM AMBIENT TEMPERATURE A	CP09-N-4902_D3299318	4091-160	Ambient	0 to 100 F	4 to 20 mA	
5	CP2050402	CP20-TT-504-02	CAPROCK PS PUMP ROOM AMBIENT TEMPERATURE B	CP09-N-4902_D3299318	4091-160	Ambient	0 to 100 F	4 to 20 mA	
6	CP2050501	CP20-TT-505-01	CAPROCK PS OUTDOOR TEMPERATURE	CP09-N-4902_D3299318	4091-160	Ambient	-30 to 130 F	4 to 20 mA	Custom panel mounting bracket
7	CP2080101T	CP20-TT-801-01T	CAPROCK PS MAIN CONTROL PANEL	CP09-N-4902_D3299318	SEE CP09-N-7002	Ambient	0 to 150 F	4 to 20 mA	Custom panel mounting bracket
8	CP2083101T	CP20-TT-831-01T	CAPROCK PS NETWORK PANEL	CP09-N-4902_D3299318	SEE CP09-N-7012	Ambient	0 to 150 F	4 to 20 mA	Custom panel mounting bracket

CAPROCK TANK
L29 LEVEL ELEMENT AND TRANSMITTER, RADAR - OPTIONS SHEET

LOOP NO	TAG NO	LOOP TITLE	P+I ID NO	DESIGN DETAIL	SERVICE	PROCESS CONN	ELEMENT TYPE	SENSOR ELEVATION	ZERO REFERENCE	CALIBRATED RANGE	OUTPUT	REMARKS
CT2500101	CT25-LIT-001-01	CAPROCK TANK COMPARTMENT 1 LEVEL A	CT09-N-2501_D3299318	4091-253	RWLP	6" FLANGE	6dkg BEAM	EL. 4938ft	EL. 4895ft	0 to 37 ft	4 to 20mA HART	Weather protection
CT2500102	CT25-LIT-001-02	CAPROCK TANK COMPARTMENT 2 LEVEL A	CT09-N-2501_D3299318	4091-253	RWLP	6" FLANGE	6dkg BEAM	EL. 4938ft	EL. 4895ft	0 to 37 ft	4 to 20mA HART	Weather protection

CAPROCK TANK
L42 LEVEL TRANSMITTER, SUBMERSIBLE - OPTIONS SHEET

ITEM	LOOP NO	TAG NO	ACCESSORY	LOOP TITLE	P-I-D NO	DESIGN DETAIL	SERVICE	ZERO REFERENCE	CALIBRATED RANGE	OUTPUT	CABLE	REMARKS
1	CT2500301	CT25-LT-003-01	CT25-TJB-003-01	CAPROCK TANK COMPARTMENT 1 LEVEL B	CT09-N-2501_D3299318	4091-254	RWLP	2.5ft	2.5 to 37ft	4 to 20mA	50ft	2.5ft zero level offset in MIN/MAX calibration
2	CT2500302	CT25-LT-003-02	CT25-TJB-003-02	CAPROCK TANK COMPARTMENT 2 LEVEL B	CT09-N-2501_D3299318	4091-254	RWLP	2.5ft	2.5 to 37ft	4 to 20mA	50ft	2.5ft zero level offset in MIN/MAX calibration

CAPROCK TANK
L50 LEVEL SWITCH, TUNING FORK - OPTIONS SHEET

ITEM	LOOP NO	TAG NO	LOOP TITLE	P+ID NO	DESIGN DETAIL	SERVICE	INSERTION LENGTH	WETTED MATERIALS	SETPoint	SP DIRECTION	REMARKS
1	CT1100601	CT11-LSH-006-01	CAPROCK TANK INLET VALVE VAULT FLOODING	CT09-N-1101_D3299318	4091-242	RWLP	15"	Stainless Steel	2"	MAX	
2	CT2500201	CT25-LSHH-002-01	CAPROCK TANK COMPARTMENT 1 OVERFLOW	CT09-N-2501_D3299318	4091-267	RWLP	TBD	Stainless Steel	EL. 4928.50	MAX	Coordinated on nozzle location on tank drawings
3	CT2500202	CT25-LSHH-002-02	CAPROCK TANK COMPARTMENT 2 OVERFLOW	CT09-N-2501_D3299318	4091-267	RWLP	TBD	Stainless Steel	EL. 4928.50	MAX	Coordinated on nozzle location on tank drawings
4	CT3200601	CT32-LSH-006-01	CAPROCK TANK OUTLET VALVE AND CHEMICAL INJECTION VAULT FLOODING	CT09-N-3201_D3299318	4091-242	RWLP	15"	Stainless Steel	2"	MAX	

CAPROCK TANK
T21 AMBIENT TEMPERATURE TRANSMITTER - OPTIONS SHEET

ITEM	LOOP NO.	TAG NO.	LOOP TITLE	P+ID NO.	DESIGN DETAIL	PROCESS RANGE	INSTRUMENT RANGE	OUTPUT	REMARKS
1	CT2750201	CT27-TT-502-01	CAPROCK TANK ELECTRICAL BUILDING TEMPERATURE	CT09-NI-4901_D3299318	4091-160	Ambient	0 to 100 F	4 to 20 mA	
2	CT2750202	CT27-TT-502-02	CAPROCK TANK COMPRESSOR ROOM TEMPERATURE	CT09-NI-4901_D3299318	4091-160	Ambient	0 to 100 F	4 to 20 mA	
3	CT2750501	CT27-TT-505-01	CAPROCK TANK OUTDOOR TEMPERATURE	CT09-NI-4901_D3299318	4091-160	Ambient	-30 to 130 F	4 to 20 mA	
4	CT2780101T	CT27-TT-801-01T	CAPROCK TANK MAIN CONTROL PANEL	CT09-NI-4901_D3299318	SEE CT09-NI-7002	Ambient	0 to 150 F	4 to 20 mA	Custom panel mounting bracket
5	CT2783101T	CT27-TT-831-01T	CAPROCK TANK MAIN NETWORK PANEL	CT09-NI-4901_D3299318	SEE CT09-NI-7012	Ambient	0 to 150 F	4 to 20 mA	Custom panel mounting bracket

INTAKE PUMP STATION
A00 ANALYZER TRANSMITTER - OPTIONS SHEET

ITEM	LOOP NO	TAG NO	LOOP TITLE	P+ID NO	DESIGN DETAIL	INPUT 1	INPUT 2	ANALOG OUTPUT	DISC OUTPUT	COMM	PANEL NO	REMARKS
1	IP2001001	IP20-AIT-010-01	INTAKE PS RAW WATER QUALITY ANALYZER TURBIDITY AND FLOW TRANSMITTER	IP09-N-2001_D329931	SEE IP09-N-8002	IP20-AE-005-01	N/A	N/A	N/A	EtherNet/IP	IP20-ACP-822-01	
2	IP2001101	IP20-AIT-011-01	INTAKE PS RAW WATER QUALITY ANALYZER PH/TEMP AND CONDUCTIVITY TRANSMITTER	IP09-N-2001_D329931	SEE IP09-N-8002	IP20-AE-008-01	IP20-AE-009-01	N/A	N/A	EtherNet/IP	IP20-ACP-822-01	

INTAKE PUMP STATION
A03 CONDUCTIVITY ELEMENT - OPTIONS SHEET

ITEM	LOOP NO	TAG NO	LOOP TITLE	P+ID NO	DESIGN DETAIL	SERVICE	ELEMENT TYPE	PROCESS RANGE	CALIBRATED RANGE	XMITTER TAG	XMITTER OUTPUT	REMARKS
1	IP200901	IP20-AE-009-01	INTAKE PS RAW WATER CONDUCTIVITY	IP09-N-2001_D329931	SEE IP09-N-8002	RW1	digital, K=5	500-2500 uS/cm	10-10000 uS/cm	IP20-AIT-011-01	EtherNet/IP	

INTAKE PUMP STATION
A07 PH/TEMP ELEMENT - OPTIONS SHEET

ITEM	LOOP NO	TAG NO	LOOP TITLE	P-ID NO	DESIGN DETAIL	SERVICE	ELEMENT TYPE	PROCESS RANGE	CALIBRATED RANGE	XMITTER TAG	XMITTER OUTPUT	PANEL NO	REMARKS
1	IP2000801	IP20-AE-008-01	INTAKE PS RAW WATER PH/TEMP	IP09-N-2001_D329931	SEE IP09-N-8002	RWT	Digital	6-10pH, 5 -35deg C	3-12pH, 0-50degC	IP20-AIT-011-01	EtherNet/IP	IP20-ACP-822-01	

INTAKE PUMP STATION
A11 DUAL O2/CO2 GAS ANALYZER TRANSMITTER - OPTIONS SHEET

ITEM	LOOP NO	TAG NO	LOOP TITLE	P+I D NO	DESIGN DETAIL	SERVICE	ELEMENT TYPE
1	IP1515101	IP15-AIT-151-01	INTAKE PS RAW WATER CONDUCTIVITY	IP09-N-1504_D3299318	4091-161	AIR	Oxygen sensor: Zirconium Oxide Carbon Dioxide sensor: Non Dispersive Infrared

INTAKE PUMP STATION
A11 DUAL O2/CO2 GAS ANALYZER TRANSMITTER - OPTIONS SHEET

PROCESS RANGE	INSTRUMENT RANGE	ALARM	OUTPUT	REMARKS
Ambient air CO2 leak detection Limits acc. To OSHA Standard	O2: 0 to 25% CO2: 0 to 10000 ppm	Oxygen concentration below 19.5% Carbon Dioxide concentration above 0.5% (5000 ppm) Sensor fault	4 to 20mA, 3 Dry Relays	

INTAKE PUMP STATION
A16 TURBIDITY ANALYZER AND TRANSMITTER - OPTIONS SHEET

ITEM	LOOP NO.	TAG NO.	FUNCTION	ACCESSORY	LOOP TITLE	P-ID NO.	DESIGN DETAIL	SERVICE	PROCESS RANGE	CALIBRATED RANGE	OUTPUT	XMITTER TAG	PANEL NO.	REMARKS
1	IP2000501	IP20-AE-005-01	TURB	IP20-FE-006-01	INTAKE PS RAW WATER TURBIDITY	IP09-N-2001_D329931	SEE IP09-N-8002	RWT	0.5-100 NTU	0-500NTU	EtherNet/IP	IP20-AIT-010-01	IP20-ACP-B22-01	Flow sensor, 0-1250ml/min

INTAKE PUMP STATION
F04 FLOW ELEMENT AND TRANSMITTER, ELECTROMAGNETIC - OPTIONS SHEET

ITEM	LOOP NO	TAG NO	LOOP TITLE	P-ID NO	DESIGN DETAIL	SERVICE	PROCESS RANGE	CALIBRATED RANGE	OUTPUT	ELEMENT SIZE	PROCESS CONN	LINER	ELECTRODE	REMARKS
1	IP2003101	IP20-FEIT-031-01	INTAKE PS RAW WATER INTAKE PUMP 1 DISCHARGE HEADER FLOW	IP09-N-2002_D3299318	4091-220A	RW1	500 to 7000 gpm	0 to 10000 gpm	4...20mA, Pulse	16 inch	ANSI Flange	EPDM	Stainless Steel	0Dn up 0Dn down
2	IP2003102	IP20-FEIT-031-02	INTAKE PS RAW WATER INTAKE PUMP 2 DISCHARGE HEADER FLOW	IP09-N-2003_D3299318	4091-220A	RW1	500 to 7000 gpm	0 to 10000 gpm	4...20mA, Pulse	16 inch	ANSI Flange	EPDM	Stainless Steel	0Dn up 0Dn down
3	IP2003103	IP20-FEIT-031-03	INTAKE PS RAW WATER INTAKE PUMP 3 DISCHARGE HEADER FLOW	IP09-N-2004_D3299318	4091-220A	RW1	500 to 7000 gpm	0 to 10000 gpm	4...20mA, Pulse	16 inch	ANSI Flange	EPDM	Stainless Steel	0Dn up 0Dn down
4	IP2003104	IP20-FEIT-031-04	INTAKE PS RAW WATER INTAKE PUMP 4 DISCHARGE HEADER FLOW	IP09-N-2005_D3299318	4091-220A	RW1	500 to 7000 gpm	0 to 10000 gpm	4...20mA, Pulse	16 inch	ANSI Flange	EPDM	Stainless Steel	0Dn up 0Dn down
5	IP2003105	IP20-FEIT-031-05	INTAKE PS RAW WATER INTAKE PUMP 5 DISCHARGE HEADER FLOW	IP09-N-2006_D3299318	4091-220A	RW1	500 to 7000 gpm	0 to 10000 gpm	4...20mA, Pulse	16 inch	ANSI Flange	EPDM	Stainless Steel	0Dn up 0Dn down

INTAKE PUMP STATION
F16 ROTAMETER - OPTIONS SHEET

ITEM	LOOP NO	TAG NO	LOOP TITLE	DESCRIPTION	P-ID NO	DESIGN DETAIL	SERVICE	MIN FLOW	MAX FLOW	PROCESS CONN	TUBE SIZE	INLET ORIENT	OUTLET ORIENT	RANGE	REMARKS
1	IP1503T01	IP15-FI-031-01	INTAKE PS CHEMICAL FACILITY SERVICE WATER FLOW METER	Flow Element, Rotameter	IP09-N-1502_D3299314	091-216	W3	0 GPM	5 GPM	1" FNPT	1"	VERTICAL	VERTICAL	0 to 5 GPM	Alarm contact SP=0.5GPM

INTAKE PUMP STATION
F22 FLOW SWITCH, MAGNETIC PISTON - OPTIONS SHEET

ITEM	LOOP NO.	TAG NO.	LOOP TITLE	P+I ID NO.	DESIGN DETAIL	SERVICE	PROCESS RANGE	PROCESS CONN	SETPPOINT	OUTPUT	PANEL NO.	REMARKS
1	IP2000701	IP20-FSL-007-01	INTAKE PS RAW WATER QUALITY ANALYZER PANEL FLOW	IP09-N-200T_D3299318	SEE IP09-N-8002	RW1	6 to 30 GPH	3/8"		15 GPH	Dry contact	IP20-ACP-822-01

INTAKE PUMP STATION
L08 LEVEL SWITCH, FLOAT - OPTIONS SHEET

ITEM	LOOP NO.	TAG NO.	LOOP TITLE	P-I-D NO.	DESIGN DETAIL	SERVICE	ZERO ELEVATION	SETPOINT	OUTPUT	CABLE	REMARKS
1	IP075T001	IP07-LSH-510-01	INTAKE PS WASTE HOLDING TANK LEVEL	IP09-N-4902-D3299318	4091-247A	W3/SAM	Tank Bottom	Adjustable	NO. Contact	33ft	I-S circuit

INTAKE PUMP STATION
L10 LEVEL TRANSMITTER, PRESSURE - OPTIONS SHEET

ITEM	LOOP NO.	TAG NO.	LOOP TITLE	DESIGN DETAIL	SERVICE	FLUID DENSITY	CONNECTION	WETTED MATERIAL	ZERO OFFSET	TANK MAX LEVEL	CALIBRATED RANGE	OUTPUT	REMARKS
1	IPT500201	IP15-LIT-002-01	INTAKE PS COPPER SULFATE STORAGE TANK LEVEL	4091-255	CUS	1.19	3" FLANGE	SS	8"	13'6"	0 to 15 feet	4 to 20mA	

INTAKE PUMP STATION
L29 LEVEL ELEMENT AND TRANSMITTER, RADAR - OPTIONS SHEET

ITEM	LOOP NO.	TAG NO.	LOOP TITLE	P+ID NO.	DESIGN DETAIL	SERVICE	PROCESS CONN.	ELEMENT TYPE	SENSOR ELEVATION	ZERO REFERENCE	CALIBRATED RANGE	OUTPUT	REMARKS
1	IP2000101	IP20-LIT-001-01	INTAKE PS RAW WATER INTAKE WELL LEVEL	IP09-N-200T_D3299318	4091.252	RW1	6" FLANGE	6deg BEAM	EL 3815.75ft	EL 3728.00ft	0 to 86 ft	4 to 20mA HART	

INTAKE PUMP STATION
L50 LEVEL SWITCH, TUNING FORK - OPTIONS SHEET

ITEM	LOOP NO	TAG NO	LOOP TITLE	P-I D NO	DESIGN DETAIL	SERVICE	INSERTION LENGTH	WETTED MATERIALS	SETPOINT	SP DIRECTION	REMARKS
1	IP1500701	IP15-LSH-007-01	INTAKE PS CONTAINMENT SUMP OVERFLOW	IP09-N-1501_D3299318	4091-242	SPD/FPD	15"	Stainless Steel	2"	MAX	
2	IP2414801	IP24-LSH-148-01	INTAKE PS ISOLATION VALVE VAULT FLOODING	IP09-N-2401_D3299318	4091-242	SPD	15"	Stainless Steel	2"	MAX	

INTAKE PUMP STATION
P04 PRESSURE GAUGE - OPTIONS SHEET

ITEM	LOOP NO	TAG NO	LOOP TITLE	P-I.D. NO	DESIGN DETAIL	SERVICE	PROCESS RANGE	PROCESS CONN	WETTED PARTS	BODY MATERIAL	DIAL	RANGE	REMARKS
1	IP1503701	IP15-PI-037-01	INTAKE PS CHEMICAL FACILITY SERVICE WATER PRESSURE	IP09-N-1502_D3299318-4091-301A	WW	WW	0 to 150 psi	1/2 inch, Lower	Stainless Steel	Phenolic	4.5 inch	0 to 300 psi	
2	IP2000301	IP20-PG-003-01	INTAKE PS RAW WATER QUALITY ANALYZER SAMPLE INLET PRESSURE	IP09-N-2001_D3299318-4091-301A	RW1	RW1	0 to 58 psi	1/4 inch, Lower	Stainless Steel	Phenolic	2.5 inch	0 to 100 psi	
3	IP2000201	IP20-PI-002-01	INTAKE PS RAW WATER DISCHARGE HEADER PRESSURE	IP09-N-2001_D3299318-4091-306B	RW1	RW1	0 to 450 psi	1/2 inch, Lower	Stainless Steel	Phenolic	4.5 inch	0 to 600 ps	
4	IP2001601	IP20-PI-016-01	INTAKE PS RAW WATER DISCHARGE HEADER REGULATED PRESSURE A	IP09-N-2001_D3299318-4091-301A	W3	W3	0 to 150 psi	1/2 inch, Lower	Stainless Steel	Phenolic	4.5 inch	0 to 300 psi	
5	IP2001602	IP20-PI-016-02	INTAKE PS RAW WATER DISCHARGE HEADER REGULATED PRESSURE B	IP09-N-2001_D3299318-4091-301A	W3	W3	0 to 150 psi	1/2 inch, Lower	Stainless Steel	Phenolic	4.5 inch	0 to 300 psi	
6	IP2001603	IP20-PI-016-03	INTAKE PS RAW WATER DISCHARGE HEADER REGULATED PRESSURE C	IP09-N-2001_D3299318-4091-301A	W3	W3	0 to 250 psi	1/2 inch, Lower	Stainless Steel	Phenolic	4.5 inch	0 to 400 psi	
7	IP2001604	IP20-PI-016-04	INTAKE PS RAW WATER DISCHARGE HEADER REGULATED PRESSURE D	IP09-N-2001_D3299318-4091-301A	W3	W3	0 to 250 psi	1/2 inch, Lower	Stainless Steel	Phenolic	4.5 inch	0 to 400 psi	
8	IP2003401	IP20-PI-034-01	INTAKE PS RAW WATER INTAKE PUMP 1 DISCHARGE HEADER PRESSURE	IP09-N-2002_D3299318-4091-306B	RW1	RW1	0 to 450 psi	1/2 inch, Lower	Stainless Steel	Phenolic	4.5 inch	0 to 600 ps	
9	IP2003402	IP20-PI-034-02	INTAKE PS RAW WATER INTAKE PUMP 2 DISCHARGE HEADER PRESSURE	IP09-N-2003_D3299318-4091-306B	RW1	RW1	0 to 450 psi	1/2 inch, Lower	Stainless Steel	Phenolic	4.5 inch	0 to 600 ps	
10	IP2003403	IP20-PI-034-03	INTAKE PS RAW WATER INTAKE PUMP 3 DISCHARGE HEADER PRESSURE	IP09-N-2004_D3299318-4091-306B	RW1	RW1	0 to 450 psi	1/2 inch, Lower	Stainless Steel	Phenolic	4.5 inch	0 to 600 ps	
11	IP2003404	IP20-PI-034-04	INTAKE PS RAW WATER INTAKE PUMP 4 DISCHARGE HEADER PRESSURE	IP09-N-2005_D3299318-4091-306B	RW1	RW1	0 to 450 psi	1/2 inch, Lower	Stainless Steel	Phenolic	4.5 inch	0 to 600 ps	
12	IP2003405	IP20-PI-034-05	INTAKE PS RAW WATER INTAKE PUMP 5 DISCHARGE HEADER PRESSURE	IP09-N-2006_D3299318-4091-306B	RW1	RW1	0 to 450 psi	1/2 inch, Lower	Stainless Steel	Phenolic	4.5 inch	0 to 600 ps	
13	IP2020401	IP20-PI-105-01	INTAKE PS AIR RECEIVING TANK HIGH PRESSURE AIR PRESSURE A	IP09-N-2007_D3299318-4091-301A	AHP	AHP	0 to 450 psi	1/2 inch, Lower	Stainless Steel	Phenolic	4.5 inch	0 to 600 psi	
14	IP2020401	IP20-PI-204-01	INTAKE PS WET WELL RECIRCULATION PUMP 2 PRESSURE	IP09-N-2001_D3299318-4091-301A	CDS	CDS	45 to 115 psi	1/2 inch, Lower	Stainless Steel	Phenolic	4.5 inch	0 to 200 psi	
15	IP2020402	IP20-PI-204-02	INTAKE PS WET WELL RECIRCULATION PUMP 2 PRESSURE	IP09-N-2001_D3299318-4091-301A	CDS	CDS	45 to 115 psi	1/2 inch, Lower	Stainless Steel	Phenolic	4.5 inch	0 to 200 psi	
16	IP2414501	IP24-PI-145-01	INTAKE PS ISOLATION VALVE VAULT RAW WATER PRESSURE A	IP09-N-2401_D3299318-4091-306A	RW1	RW1	0 to 400 psi	1/2 inch, Lower	Stainless Steel	Phenolic	4.5 inch	0 to 600 ps	
17	IP2414601	IP24-PI-146-01	INTAKE PS ISOLATION VALVE VAULT RAW WATER PRESSURE B	IP09-N-2401_D3299318-4091-306A	RW1	RW1	0 to 400 psi	1/2 inch, Lower	Stainless Steel	Phenolic	4.5 inch	0 to 600 ps	

INTAKE PUMP STATION
PO8 PRESSURE SWITCH - OPTIONS SHEET

ITEM	LOOP NO.	TAG NO.	LOOP TITLE	P+I ID NO.	DESIGN DETAIL	SERVICE	PROCESS RANGE	INSTRUMENT RANGE	SEAL TYPE	DEADBAND	SETPPOINT	OUTPUT	SP DIRECTION	REMARKS
1	IP2002301	IP20-FSH-023-01	INTAKE PS RAW WATER DISCHARGE HEADER PRESSURE HIGH	IP09-N-2001_D3299318	4091-306B	RW1	0 to 450 psi	0 to 600 psi	Buna-N	9-30psi	408 psi	Dry Contact	Increasing	
2	IP2002801	IP20-FSH-028-01	INTAKE PS RAW WATER INTAKE PUMP 1 DISCHARGE HEADER PRESSURE HIGH	IP09-N-2002_D3299318	4091-306B	RW1	0 to 450 psi	0 to 600 psi	Buna-N	9-30psi	408 psi	Dry Contact	Increasing	
3	IP2002803	IP20-FSH-028-03	INTAKE PS RAW WATER INTAKE PUMP 3 DISCHARGE HEADER PRESSURE HIGH	IP09-N-2004_D3299318	4091-306B	RW1	0 to 450 psi	0 to 600 psi	Buna-N	9-30psi	408 psi	Dry Contact	Increasing	
4	IP2002804	IP20-FSH-028-04	INTAKE PS RAW WATER INTAKE PUMP 4 DISCHARGE HEADER PRESSURE HIGH	IP09-N-2005_D3299318	4091-306B	RW1	0 to 450 psi	0 to 600 psi	Buna-N	9-30psi	408 psi	Dry Contact	Increasing	
5	IP2002805	IP20-FSH-028-05	INTAKE PS RAW WATER INTAKE PUMP 5 DISCHARGE HEADER PRESSURE HIGH	IP09-N-2006_D3299318	4091-306B	RW1	0 to 450 psi	0 to 600 psi	Buna-N	9-30psi	408 psi	Dry Contact	Increasing	
6	IP2020301	IP20-FSH-203-01	INTAKE PS WET WELL RECIRCULATION PUMP 2 PRESSURE HIGH	IP09-N-2001_D3299318	4091-301A	CDS	45 to 115 psi	0 to 200 psi	Buna-N	3-30psi	145 psi	Dry Contact	Increasing	NEMA 6
7	IP2020302	IP20-FSH-203-02	INTAKE PS WET WELL RECIRCULATION PUMP 2 PRESSURE HIGH	IP09-N-2001_D3299318	4091-301A	CDS	45 to 115 psi	0 to 200 psi	Buna-N	3-30psi	145 psi	Dry Contact	Increasing	NEMA 6

INTAKE PUMP STATION
P09 PRESSURE TRANSMITTER - OPTIONS SHEET

ITEM	LOOP NO	TAG NO	LOOP TITLE	P-ID NO	DESIGN DETAIL	SERVICE	PROCESS RANGE	SEAL TYPE	SEAL MATERIAL	BODY MATERIAL	CALIBRATED RANGE	OUTPUT	REMARKS
1	IP1515401	IP15-PIT-154-01	INTAKE PS CHEMICAL FACILITY CO2 INJECTION SKID W3 WATER INLET PRESSURE	IP09-N-1504_D3299318	4091-301A	GDS	45 to 115 psi	Internal	Stainless Steel	Alu coated	0 to 200 psi	4 to 20mA	
2	IP2001801	IP20-PIT-018-01	INTAKE PS RAW WATER DISCHARGE HEADER PRESSURE	IP09-N-2001_D3299318	4091-306B	RW1	0 to 450 psi	Internal	Stainless Steel	Alu coated	0 to 550 psi	4 to 20mA	
3	IP2002701	IP20-PIT-027-01	INTAKE PS RAW WATER INTAKE PUMP 1 DISCHARGE HEADER PRESSURE	IP09-N-2002_D3299318	4091-306B	RW1	0 to 450 psi	Internal	Stainless Steel	Alu coated	0 to 550 psi	4 to 20mA	
4	IP2002702	IP20-PIT-027-02	INTAKE PS RAW WATER INTAKE PUMP 2 DISCHARGE HEADER PRESSURE	IP09-N-2003_D3299318	4091-306B	RW1	0 to 450 psi	Internal	Stainless Steel	Alu coated	0 to 550 psi	4 to 20mA	
5	IP2002703	IP20-PIT-027-03	INTAKE PS RAW WATER INTAKE PUMP 3 DISCHARGE HEADER PRESSURE	IP09-N-2004_D3299318	4091-306B	RW1	0 to 450 psi	Internal	Stainless Steel	Alu coated	0 to 550 psi	4 to 20mA	
6	IP2002704	IP20-PIT-027-04	INTAKE PS RAW WATER INTAKE PUMP 4 DISCHARGE HEADER PRESSURE	IP09-N-2005_D3299318	4091-306B	RW1	0 to 450 psi	Internal	Stainless Steel	Alu coated	0 to 550 psi	4 to 20mA	
7	IP2002705	IP20-PIT-027-05	INTAKE PS RAW WATER INTAKE PUMP 5 DISCHARGE HEADER PRESSURE	IP09-N-2006_D3299318	4091-306B	RW1	0 to 450 psi	Internal	Stainless Steel	Alu coated	0 to 550 psi	4 to 20mA	
8	IP2012801	IP20-PIT-128-01	INTAKE PS AIR RECEIVING TANK HIGH PRESSURE AIR PRESSURE B	IP09-N-2007_D3299318	4091-301A	AHP	0 to 500 psi	Internal	Stainless Steel	Alu coated	0 to 650 psi	4 to 20mA	

INTAKE PUMP STATION
T21 AMBIENT TEMPERATURE TRANSMITTER - OPTIONS SHEET

ITEM	LOOP NO	TAG NO	LOOP TITLE	P+ID NO	DESIGN DETAIL	PROCESS RANGE	INSTRUMENT RANGE	OUTPUT	REMARKS
1	IP1550101	IP15-TT-501-01	INTAKE PS CHEMICAL FACILITY AMBIENT TEMPERATURE	IP09-N-4902_D3299318	4091 -160	Ambient	0 to 100 F	4 to 20 mA	
2	IP1550102	IP15-TT-501-02	INTAKE PS CHEMICAL FACILITY CO2 INJECTION SKID ROOM TEMPERATURE	IP09-N-4902_D3299318	4091 -160	Ambient	0 to 100 F	4 to 20 mA	
3	IP2000101	IP20-TT-001-01	INTAKE PS RAW WATER INTAKE WELL LEVEL	IP09-N-4902_D3299318	4091 -160	Ambient	0 to 100 F	4 to 20 mA	
4	IP2050101	IP20-TT-501-01	INTAKE PS ELECTRICAL ROOM TEMPERATURE A	IP09-N-4902_D3299318	4091 -160	Ambient	0 to 100 F	4 to 20 mA	
5	IP2050102	IP20-TT-501-02	INTAKE PS ELECTRICAL ROOM TEMPERATURE B	IP09-N-4902_D3299318	4091 -160	Ambient	0 to 100 F	4 to 20 mA	
6	IP2050201	IP20-TT-502-01	INTAKE PS PLC ROOM AMBIENT TEMPERATURE	IP09-N-4902_D3299318	4091 -160	Ambient	0 to 100 F	4 to 20 mA	
7	IP2050401	IP20-TT-504-01	INTAKE PS PUMP ROOM AMBIENT TEMPERATURE A	IP09-N-4902_D3299318	4091 -160	Ambient	0 to 100 F	4 to 20 mA	
8	IP2050402	IP20-TT-504-02	INTAKE PS PUMP ROOM AMBIENT TEMPERATURE B	IP09-N-4902_D3299318	4091 -160	Ambient	0 to 100 F	4 to 20 mA	
9	IP2050501	IP20-TT-505-01	INTAKE PS OUTDOOR TEMPERATURE	IP09-N-4902_D3299318	4091 -160	Ambient	-30 to 130 F	4 to 20 mA	
10	IP2080101T	IP20-TT-801-01T	INTAKE PS MAIN CONTROL PANEL	IP09-N-4902_D3299318	SEE IP09-N-7002	Ambient	0 to 150 F	4 to 20 mA	Custom panel mounting bracket
11	IP2083101T	IP20-TT-831-01T	INTAKE PS MAIN NETWORK PANEL	IP09-N-4902_D3299318	SEE IP09-N-7002	Ambient	0 to 150 F	4 to 20 mA	Custom panel mounting bracket
12	IP3250401	IP32-TT-504-01	INTAKE PS COMPRESSOR BUILDING TEMPERATURE	IP09-N-4902_D3299318	4091 -160	Ambient	0 to 100 F	4 to 20 mA	

SECTION 40 90 11
NETWORK COMPONENTS

PART 1 GENERAL

1.01 SUMMARY

- A. This PICS section gives requirements for PICS network components. The PICS network components shall be completely coordinated, submitted, installed, executed, and completed by the overall PIC SI in accordance with Section 40 90 00, Instrumentation and Control for Process Systems. This section shall meet all requirements of, and be in accordance with, Section 40 90 00, Instrumentation and Control for Process Systems, including but not limited to:
1. Submittals.
 2. References.
 3. Definitions.
 4. Related Sections.
 5. Environmental Requirements.
 6. Delivery, Storage, and Handling.

1.02 RELATED SECTIONS

- A. Refer to Section 40 90 00, Instrumentation and Control for Process Systems for all related sections.

PART 2 PRODUCTS

2.01 NETWORK COMPONENTS

- A. N-FW-01 Firewall:
1. General:
 - a. Owner furnished.
 - b. Function: FGR-70F-3G4G, Rugged next-generation firewall, DIN rail mount, 3G cellular.
 2. Features:
 - a. Next generation firewall.
 - b. IPS: 9750 Mbps.
 - c. NGFW: 950 Mbps.
 - d. Threat Protection: 580 Mbps.
 - e. Fanless.
 3. Interfaces:
 - a. 6 GE, RJ45.
 - b. 2 SFP slots.

- c. 3G4G Modem and GPS (Dual SIM Active/Passive).
 - d. Antenna Connection.
 - e. Digital I/O.
 - f. USB.
4. Power Supply:
 - a. Redundant Dual Inputs:
 - 1) Input Voltage: 12V dc to 125V dc.
 - 2) Input Current: 1.67 amps at 12V dc.
 - b. Power Consumption: 18.3W.
 5. Environmental:
 - a. Operating Temperature: minus 40 degrees C to plus 75 degrees C.
 - b. Operating Humidity: 5 percent to 95 percent noncondensing.
 6. Enclosure: DIN rail mount.
 7. Manufacturer and Product: FortiGate Rugged, FGR-70F-3G4G.
- B. N-DS-01 Distribution Switch:
1. General:
 - a. Owner furnished.
 - b. Function: Site distribution, fiber optic ring connection.
 - c. Features:
 - 1) Robust Industry Design.
 - 2) Removable SD storage.
 - 3) Console port.
 - 4) Alarm: Four dry-contact alarm inputs.
 2. Interface:
 - a. Uplink:
 - 1) SFP/SFP+: 4 ports 1/10G.
 - b. Downlink:
 - 1) 22 ports 100/1000M SFP.
 - 2) Two ports Dual-media.
 3. Power Supply:
 - a. Redundant.
 - b. Voltage: 85V dc to 264V ac.
 - c. Wattage: 150W.
 4. Environmental:
 - a. Operating Temperature: Minus 40 degrees C to plus 75 degrees C.
 - b. Operating Humidity: 5 percent to 95 percent noncondensing.
 5. Enclosure: 19-inch rack mount.
 6. Accessories: Stacking cable.
 7. Manufacturer and Product: CISCO, IE-9320-22S2C4X-A.

C. N-AS-01 Access Switch:

1. General:
 - a. Function: Fiber Optic connection, PRP protocol, SCADA equipment connection.
 - b. Features:
 - 1) Robust industry design.
 - 2) Removable SD storage.
 - 3) Console Port.
 - 4) Alarm: Four dry-contact alarm inputs.
2. Interface:
 - a. Uplink: Four ports 1G.
 - b. Downlink: 24 ports 100/1000M PoE+.
3. Power Supply:
 - a. Redundant.
 - b. Voltage: 85V dc to 264V ac.
 - c. Wattage: 150W.
4. Environmental:
 - a. Operating Temperature: Minus 40 degrees C to plus 75 degrees C.
 - b. Operating Humidity: 5 percent to 95 percent noncondensing.
5. Enclosure: 19-inch rack mount.
6. Accessories: Stacking cable.
7. Manufacturer and Product: CISCO, IE-9320-24P4S-A.

D. N-AS-02 Access Switch:

1. General:
 - a. Owner furnished.
 - b. Function: Fiber Optic connection, Business and Security equipment connection.
 - c. Features:
 - 1) Console port.
 - 2) Redundant fans.
2. Interface:
 - a. Uplink: Four ports 1/10G fixed.
 - b. Downlink: 24 ports full PoE+.
3. Power Supply:
 - a. Redundant.
 - b. Voltage: 85V dc to 264V ac.
 - c. Wattage: 600W.
4. Environmental:
 - a. Operating Temperature: Minus 40 degrees C to plus 75 degrees C.
 - b. Operating Humidity: 5 percent to 95 percent noncondensing.
5. Enclosure: 19-inch rack mount.
6. Manufacturer and Product: CISCO, C9200L-24P-4X-E.

E. N-ES-01 Edge Switch

1. General:
 - a. Owner furnished.
 - b. Function: Edge equipment connection, 1GE copper, SFP/SFP+.
 - c. Features:
 - 1) Robust Industry Design:
 - a) Fanless, convection-cooled with no moving parts.
 - b) Hardened for vibration, shock and surge and electrical noise immunity.
 - c) Complies with multi-industry specifications for automation.
 - d) Improves uptime, performance and safety of industrial system and equipment.
 - e) Cover wide range of Power over Ethernet.
 - f) Alarm I/O for monitoring and signaling to external equipment.
 - 2) Managed:
 - a) Graphical user interface.
 - b) Web user interface.
 - c) USB, CD card.
 - d) Console.
 - 3) Supports:
 - a) Multiple rings, redundant ring topologies.
 - b) IPv6 ready.
 - c) Full Flexible NetFlow (FNF).
 - d) SwapDrive for zero-configuration replacement.
 - e) ODVA Industrial Ethernet/IP protocol.
2. Interface:
 - a. Uplink:
 - 1) Ports Quantity and Type: Two, SFP+.
 - 2) Bandwidth: 10 Gbps.
 - b. Downlink:
 - 1) Ports: Eight, copper, RJ45.
 - 2) Bandwidth: 1 Gbps.
 - c. Downlink Expandable: Up to 26 ports.
3. Removable Storage:
 - a. SD card.
 - b. Configuration backup.
4. Power Supply:
 - a. Dual dc power inputs.
 - b. Voltage: 9.6V dc to 60V dc
 - c. Maximum Input Current: 3.8A at 9V.
 - d. Power Consumption: 23W.

5. Environmental:
 - a. Operating Temperature: Minus 40 degrees C to plus 75 degrees C (200LFM fan or blower-equipped enclosure).
 - b. Operating Humidity: 5 percent to 95 percent noncondensing.
 6. Enclosure:
 - a. Rating: IP 30/NEMA 1.
 - b. DIN rail mount.
 7. Accessories:
 - a. SFP Module:
 - 1) IEM-3300-8S, If Noted:
 - a) Port Quantity: Eight.
 - b) Port Type: SFP.
 - 2) IEM-3300-6T2S, If Noted:
 - a) Port: Six copper, 2 SFP.
 - b) Port Type: 100/1,000 Mbps/ SFP.
 - b. Copper Module:
 - 1) IEM-3300-8T, If Noted:
 - a) Port Quantity: Eight.
 - b) Port Type: 100/1,000 Mbps.
 - 2) IEM-3300-16T, If Noted:
 - a) Port Quantity: 16.
 - b) Port Type: 100/1,000 Mbps.
 8. Manufacturer and Product: CISCO, IE3300, IE-3300-8T2X-E.
- F. N-ES-02 Edge Switch with PoE/PoE+:
1. General:
 - a. Owner furnished.
 - b. Function: Edge equipment connection, 1GE copper, SFP/SFP+.
 - c. Features:
 - 1) Robust Industry Design:
 - a) Fanless, convection-cooled with no moving parts.
 - b) Hardened for vibration, shock and surge and electrical noise immunity.
 - c) Complies with multi-industry specifications for automation.
 - d) Improves uptime, performance and safety of industrial system and equipment.
 - e) Cover wide range of Power over Ethernet.
 - f) Alarm I/O for monitoring and signaling to external equipment.
 - g) PoE, PoE+.
 - 2) Managed:
 - a) Graphical user interface.
 - b) Web user interface.

- c) USB, CD card.
 - d) Console.
 - 3) Supports:
 - a) Multiple rings, redundant ring topologies.
 - b) IPv6 ready.
 - c) Full Flexible NetFlow (FNF).
 - d) SwapDrive for zero-configuration replacement.
 - e) ODVA Industrial Ethernet/IP protocol.
- 2. Interface:
 - a. Uplink:
 - 1) Ports Quantity and Type: Two, SFP+.
 - 2) Bandwidth: 10 Gbps.
 - b. Downlink:
 - 1) Ports: Eight, copper, RJ45.
 - 2) Bandwidth: 1 Gbps.
 - 3) PoE+.
 - c. Downlink Expandable: Up to 26 ports.
- 3. Removable Storage:
 - a. SD card.
 - b. Configuration backup.
- 4. PoE Power Budget: 480W (including expansion module).
- 5. Power Supply:
 - a. Dual dc power inputs.
 - b. Voltage: 9.6V dc to 60V dc, 48V dc is required for PoE and 54V dc is required for PoE+.
 - c. Maximum Input Current: 10.5A.
 - d. Power Consumption: 42W.
- 6. Environmental:
 - a. Operating Temperature: Minus 40 degrees C to plus 75 degrees C (200LFM fan or blower-equipped enclosure).
 - b. Operating Humidity: 5 percent to 95 percent noncondensing.
- 7. Enclosure:
 - a. Rating: IP 30/NEMA 1.
 - b. DIN rail mount.
- 8. Accessories:
 - a. SFP Module:
 - 1) IEM-3300-8S, If Noted:
 - a) Port Quantity: Eight.
 - b) Port Type: SFP.
 - 2) IEM-3300-6T2S, If Noted:
 - a) Port: Six copper, 2 SFP.
 - b) Port Type: 100/1,000 Mbps/ SFP.
 - b. Copper Module:
 - 1) IEM-3300-8T, If Noted:
 - a) Port Quantity: Eight.
 - b) Port Type: 100/1,000 Mbps.

- 2) IEM-3300-16T, If Noted:
 - a) Port Quantity: 16.
 - b) Port Type: 100/1,000 Mbps.
 - c. PoE/PoE+ Module:
 - 1) IEM-3300-8T, If Noted:
 - a) Port Quantity: Eight.
 - b) Port Type: 100/1,000 Mbps PoE.
 - 2) IEM-3300-16P, If Noted:
 - a) Port Quantity: 16.
 - b) Port Type: 100/1,000 Mbps PoE.
 - 9. Manufacturer and Product: CISCO, IE3300, IE-3300-8U2X-E.
- G. N-SFP-01 SFP+ Module, Single-Mode 10 Gbps:
- 1. General:
 - a. Owner furnished.
 - b. Function: Multirate 10GBASE-ZR, 10GBASE-ZW, and OTU2/OTU2e module for industrial operating temperature range.
 - c. Features:
 - 1) Supports link lengths of up to 70 kilometers on standard Single-Mode Fiber (SMF, G.652), assuming a fiber chromatic dispersion of 20 ps/(nm*km).
 - 2) 10 Gigabit.
 - 3) Cold start at minus 40 degrees C.
 - 4) Fully operational from minus 28 degrees C to 85 degrees C.
 - d. Performance:
 - 1) Wavelength: 1550nm (1530nm to 1565nm).
 - 2) Cable Type: SMF.
 - 3) Core Size: G.652.
 - 4) Cable Distance: 70 kilometers.
 - e. Optical Transmit and Receive:
 - 1) Transmit Power:
 - a) Maximum: 4.0 dBm.
 - b) Minimum: 0 dBm.
 - 2) Receive Power:
 - a) Maximum: Minus 7.0 dBm.
 - b) Minimum: Minus 24 dBm.
 - 3) Optical Parameters:
 - a) Transmitter:
 - (1) Wavelength:
 - (a) Minium: 1530 nm.
 - (b) Maximum: 1565 nm.
 - (2) Single-Mode Suppression Ratio: 30 dB.
 - (3) Extinction Ratio: 9 dB.

- (4) Output Power:
 - (a) Minimum: 0 dB.
 - (b) Maximum: 4 dB.
- b) Receiver:
 - (1) Wavelength:
 - (a) Minimum: 1260 nm.
 - (b) Maximum: 1565 nm.
 - (2) Damage Threshold: 5 dBm.
 - (3) Overload: Minus 7 dBm.
 - (4) Sensitivity: Minus 24 dBm.
 - (5) Chromatic dispersion penalty at 1,400 ps/nm: 3 dB.
- 4) Bail Latch Color: Green.
- 5) Power Consumption: 2W.
- 6) Connector: Dual LC/PC.
- 7) Accessories:
 - a) Optical Attenuator.
 - (1) dB Loss: As required.
- 8) Environmental:
 - a) Temperature: Minus 40 degrees C to 85 degrees°C (minus 40 degrees F to 185 degrees F).
- 9) Manufacturer and Product: CISCO, SFP-10G-ZR-I.

H. N-SFP-02 SFP Module, Multi-Mode 1 Gbps:

- 1. General:
 - a. Function: Cisco Compatible SFP 100BASE-SX 850nm.
 - b. Features:
 - 1) Form Factor: SFP.
 - 2) Connector: Duplex LC.
 - 3) DDM/DOM: Supported.
 - 4) Connectivity: 1 Gbps.
 - c. Performance:
 - 1) Wavelength: 850 nm.
 - 2) Media: MMF.
 - 3) Maximal Cable Distance:
 - a) 550m at 50/125 um OM2 MMF.
 - b) 275m at 62.5/125 um OM1 MMF.
 - c) 220m at 62.5/125 um FDDI MMF.
- 2. Optical Transmit and Receive:
 - a. Transmitter Power: Minus 9.5, minus 3 dBm.
 - b. Receiver Sensitivity: Less than minus 17 dBm.
 - c. Receiver Overload: Minus 3 dBm.
 - d. Extinction Ratio: More than 9 dB.

3. Environmental:
 - a. Temperature: Minus 0 degrees C to 70 degrees°C.
 4. Manufacturer and Product: FS, SFP1G-SX-85.
- I. N-GW-01 Modbus RTU Gateway:
1. General:
 - a. Function: Protocol conversion between Modbus and Ethernet/IP.
 - b. Industrial Ethernet gateway for Modbus RTU/ASCII/TCP and Ethernet/IP network communications with IIoT applications, based on MQTT or third-party cloud services.
 - c. Modbus master or slave collect data and exchange with EtherNet/IP devices. converts stored Modbus data into EtherNet/IP packets so the EtherNet/IP scanner can control or monitor Modbus devices.
 - d. MicroSD card can be used to back up system configuration.
 2. Ethernet Software Features:
 - a. Industrial Protocols: EtherNet/IP Scanner, EtherNet/IP Adapter, Modbus TCP Client, Modbus TCP Server.
 - b. Configuration Options: WebConsole.
 - c. Management: NTP Client, ARP, DHCP, DNS, SMTP, SNMP, TCP/IP, Telnet, SSH, UDP.
 - d. Security Protocols: SNMP, HTTPS, AES-256, SHA-256.
 3. Interface:
 - a. Ethernet:
 - 1) Ports: Two, 10/100BaseT, RJ45.
 - b. Serial:
 - 1) Console port.
 - 2) Ports: One, DB9 male.
 - 3) Standard: RS-232/422/485.
 - 4) Data Bits: 7, 8.
 - 5) Parity: None, even, odd, space, mark.
 - 6) Stop Bits: 1, 2.
 - 7) Flow Control: RTS, RTS/CTS.
 - 8) RS-485 Data Direction: ADDC.
 - 9) RS-485 Pull HIGH/LOW Resistor 1 kilo-ohm, 150 kilo-ohms.
 - 10) RS-485 Terminator: 120 ohms.
 4. Serial Signals:
 - a. RS-232: TxD, RxD, RTS, CTS, DTR, DSR, DCD, GND.
 - b. RS-422: Tx+, Tx-, Rx+, Rx-, GND.
 - c. RS-485-2W: Data +, Data -, GND.
 - d. RS-485: Tx+, Tx-, Rx+, Rx-, GND.

5. Serial Software Features:
 - a. Configuration: Serial console.
 - b. Protocols: Modbus RTU/ASCII Master, Modbus RTU/ASCII Slave.
6. Modbus RTU/ASCII:
 - a. Mode: Master, slave.
 - b. Functions: 1, 2, 3, 4, 5, 6, 15, 16, 23.
 - c. Maximum Number of Commands: 100.
 - d. Input Data Size: 2,048 bytes.
 - e. Output Data Size: 2,024 bytes.
7. Modbus TCP:
 - a. Mode: Client (Master), Server (Slave).
 - b. Functions: 1, 2, 3, 4, 5, 6, 15, 16, 23.
 - c. Maximum Number of Client Connections: 16.
 - d. Maximum Number of Server Connections: 32.
 - e. Maximum Number of Commands: 100.
 - f. Input Data Size: 2,048 bytes.
 - g. Output Data Size: 2,024 bytes.
8. EtherNet/IP:
 - a. Mode: Scanner, Adapter.
 - b. CIP Objects: Identity, message router, assembly, connection manager, TCP/IP interface, Ethernet link port.
 - c. Maximum Number of Scanner Connections: 16 (for read-only), one (for read/write).
 - d. Maximum Number of Adapter Connections: 100.
 - e. Input Data Size: 496 bytes.
 - f. Output Data Size: 496 bytes.
9. MQTT:
 - a. Mode: Publisher/Subscriber of MQTT, Azure IoT Hub Device, Alibaba IoT Platform Device.
 - b. Maximum Number of Data Tag: 300 data tags.
 - c. Maximum Number of Message: 20 messages.
 - d. MQTT General Features: Keep alive, retain message, last will message, clean session.
10. Removable Storage:
 - a. MicroSD card, up to 32 GB.
 - b. Configuration backup.
11. Power Supply:
 - a. Dual dc power inputs.
 - b. Voltage: 12V dc to 48V dc.
 - c. Input Current: 0.455A at 12V dc.
12. Environmental:
 - a. Operating Temperature: Minus 40 degrees C to plus 85 degrees C.
 - b. Operating Humidity: 5 percent to 95 percent noncondensing.

13. Enclosure:
 - a. Rating: IP 30/NEMA 1.
 14. Package Contents:
 - a. Device.
 - b. Cable: RJ45-to-DB9 console cable.
 - c. Installation Kit: DIN-rail kit.
 - d. Documentation.
 15. Accessories:
 - a. DB9 female to DB9 male serial cable, 20 cm.
 - b. DB9 female DIN-rail wiring terminal.
 16. Manufacturer and Product: MOXA, Mgate 5105-MB-EIP-T.
- J. N-MC-01 Media Converter, SFP+:
1. General: Function: Industrial 1x 100M/1G/2.5G/5G/10G Base-T RJ45 to 1x 10G Base-X SFP+ Slot, Ethernet Media Converter.
 2. Features:
 - a. Type: Industrial converter.
 3. Interfaces:
 - a. Copper:
 - 1) Port: RJ45.
 - 2) Quantity: One.
 - 3) Category: 3/4/5/5e/6.
 - 4) Standard: 100M/1G/2.5G/5G/10G Base-T Ethernet.
 - b. Fiber:
 - 1) Port: SFP+.
 - 2) Quantity: One.
 - 3) Type:
 - a) Multi-Mode: 50/125um or 62.5/125um.
 - b) Single-Mode: 9/125um.
 - 4) Standard: 10G Base-X.
 4. Power Supply:
 - a. Dual dc power inputs.
 - b. Voltage: 12V dc to 56V dc.
 5. Environmental:
 - a. Operating Temperature: Minus 40 degrees C to plus 75 degrees C.
 - b. Operating Humidity: 5 percent to 95 percent noncondensing.
 6. Enclosure:
 - a. Rating: IP 30/NEMA 1.
 - b. Material: Metal.
 - c. Mount: DIN-Rail.
 7. Accessories: SFP module, as required.
 8. Manufacturer and Product: FS, IMC-1S1XMG, 170200.

K. N-MC-02 Media Converter, SFP, PoE+:

1. General:
 - a. Function: Industrial 1x 10/100/1000Base-T RJ45 to 1x 100/1000Base-X SFP Slot, Ethernet Media Converter, PoE+.
2. Features:
 - a. Type: PoE++ Industrial converter.
 - b. PoE Power Budget: 30 watts.
3. Interfaces:
 - a. Copper:
 - 1) Port: RJ45.
 - 2) Quantity: One.
 - 3) Category: 3/4/5/5e/6.
 - 4) Standard: 10/100/1000Base-T Ethernet.
 - 5) PoE.
 - b. Fiber:
 - 1) Port: SFP.
 - 2) Quantity: One.
 - 3) Type:
 - a) Multi-Mode: 50/125um or 62.5/125um.
 - b) Single-Mode: 9/125um.
 - 4) Standard: 100/1000Base-X.
4. Power Supply:
 - a. Dual dc power inputs.
 - b. Voltage: 12V dc to 56V dc.
5. Environmental:
 - a. Operating Temperature: Minus 40 degrees C to plus 75 degrees C.
 - b. Operating Humidity: 5 percent to 95 percent noncondensing.
6. Enclosure:
 - a. Rating: IP 30/NEMA 1.
 - b. Material: Metal
 - c. Mount: DIN-Rail.
7. Accessories: SFP module, as required.
8. Manufacturer and Product: FS, IMC-1F1T, 101483.

L. N-AP-01 Wi-Fi Access Point:

1. General:
 - a. Function: Device that creates a wireless local area network. Connects to a wired router, switch via an Ethernet cable and project a Wi-Fi signal to a designated area.
 - b. Features:
 - 1) Wi-Fi 6 (802.11ax).
 - 2) The Cisco RF Application-Specific Integrated Circuit (ASIC) is a fully integrated Software-Defined Radio (SDR) that can perform advanced RF spectrum analysis and

- delivers features such as Cisco CleanAir, Wireless Intrusion Prevention System (WIPS), FastLocate, and Dynamic Frequency Selection (DFS) detection.
- 3) Orthogonal Frequency-Division Multiple Access (OFDMA)-based scheduling splits the bandwidth into smaller frequency allocations called Resource Units (RUs), which can be assigned to individual clients in both the downlink and uplink directions to reduce overhead and latency.
 - 4) Supporting eight spatial streams, Multiuser Multiple Input, Multiple Output (MU-MIMO) enables access points to split spatial streams between client devices to maximize throughput.
 - 5) Integrated Bluetooth Low Energy (BLE) five radio enables location-based use cases such as asset tracking, wayfinding, and analytics.
 - 6) A new power-saving mode called Target Wake Time (TWT) allows the client to stay asleep and to wake up only at prescheduled (target) times to exchange data with the access point. This offers significant energy savings for battery operated devices, up to three to four times the savings achieved by 802.11n and 802.11ac.
 - 7) DNA analytics and assurance.
- c. Power:
- 1) Input Power Requirements:
 - a) 802.3at Power over Ethernet Plus (PoE+).
 - b) 802.3bt Cisco Universal PoE (Cisco UPOE).
 - 2) Max PoW Power Consumption:
 - a) 4x4 2.4 GHz, 8x8 5 GHz, 5G Link: 25.5W.
 - b) 4x4 2.4 GHz, 8x8 5 GHz, 5G Link, USB: 30.5W.
 - c) 1x1 2.4 GHz, 1x1 5 GHz, 1G Link: 13.4W.
2. Integrated Antenna:
- a. 2.4 GHz: Peak gain 4 dBi, internal antenna, omnidirectional in Azimuth.
 - b. 5 GHz: Peak gain 6 dBi, internal antenna, omnidirectional in Azimuth.
3. Available Transmit Power Settings:
- a. 2.4 GHz:
 - 1) 23 dBm (200 mW).
 - 2) Minus 4 dBm (0.39 mW).
 - b. 5 GHz:
 - 1) 26 dBm (400 mW).
 - 2) Minus 1 dBm (0.79 mW).

4. Interfaces:
 - a. 1x 100, 1000, 2500, 5000 Multigigabit Ethernet (RJ-45).
 - b. Management console port (RJ-45).
 - c. USB 2.0 at 4.5W.
 5. Environmental:
 - a. Operating Temperature: Minus 22 degrees C to plus 70 degrees C.
 - b. Operating Humidity: 10 percent to 90 percent noncondensing.
 6. Enclosure:
 - a. Rating: IP 30/NEMA 1.
 7. Accessories:
 - a. Mounting Bracket, As Noted:
 - 1) For Wall or Electrical Box Installation:
AIR-AP-BRACKET-2.
 - 2) For Ceiling Mounting: AIR-AP-BRACKET-1.
 8. Manufacturer and Product: Cisco, Catalyst 9130AXE.
- M. N-FOE-01 Fiber Optic Panel Enclosure:
1. General:
 - a. Function: Rack mount fiber enclosure, ensures network reliability by housing, organizing, managing and protecting fiber optic cable, terminations, splices, connectors and patch cords.
 - b. Features:
 - 1) RU1, up to 96 fibers.
 - 2) Fibers are easily accessible through a slide-out, tilt-down drawn.
 2. Material: Steel.
 3. RU Height: One.
 4. FAP Quantity: Four.
 5. Splice Tray Quantity: Four.
 6. Color: Black.
 7. Accessories:
 - a. Fiber splice module holder 1RU, unless otherwise noted.
 - 1) Part Number: FOSMH1U.
 - 2) Quantity: Two.
 - b. Slack Spools: As noted.
 8. Manufacturer and Product: Panduit, FCE1U.
- N. N-FAP-01 Fiber Optic Adapter Panel, SMF:
1. General:
 - a. Function: Fiber optic connection panel for 19-inch FO enclosure.
 2. Split Sleeve: Zirconia ceramic.
 3. Fiber Type: APC OS1/OS2.

4. Adapter Type:
 - a. Duplex.
 - b. Connector Type: LC.
 - c. Quantity: Six.
 - d. Color: APC Green.
 5. Accessories:
 - a. LC Connector: Plug, for unused ports.
 6. Manufacturer and Product: Panduit, FAP6WGDLCZ.
- O. N-FAP-02 Fiber Optic Adapter Panel, MMF:
1. General:
 - a. Function: Fiber optic connection panel for 19-inch FO enclosure.
 2. Split Sleeve: Zirconia ceramic.
 3. Fiber Type: OM3/OM4.
 4. Adapter Type:
 - a. Duplex.
 - b. Connector Type: LC.
 - c. Quantity: Six.
 - d. Color: Aqua.
 5. Accessories:
 - a. LC Connector: Plug, for unused ports.
 6. Manufacturer and Product: Panduit, FAP6WAQDLCZ.
- P. N-FST-01 Fiber Optic Splice Tray:
1. General:
 - a. Function: Tray for fiber splicing, splice holder. The fiber optic splice module (FOSM) shall house and protect fiber optic splices, guarantee proper fiber cable management and bend radius control, and allow for clear labeling and logical organization of the fiber optic splices. The FOSM shall support 24 fusion splices or 12 mechanical splices in one module and shall be compatible with all Panduit rack mounted fiber enclosures. Slacking and spooling shall be self-contained within the FOSM. The FOSM shall be self-stacking with a hinged clear cover.
 - b. Features:
 - 1) Fiber splice module holds and protects up to 24 fusion and 144 ribbon splices within Panduit Opticom Rack Mount Fiber Enclosures.
 - 2) Compatible with OS2, OM1, OM2, OM3/OM4 fiber and factory-terminated pigtails.
 - 3) Integral bend radius control.
 - 4) Self-stacking trays with interlocking hinge.
 - 5) Clear hinged cover.

2. Accessories:
 - a. Fusion Splice Chips, Unless Otherwise Noted:
 - 1) Part Number: FOSMF.
 - 2) Quantity: Four chips for 24 splices.
 - b. Mechanical Splice Chips, as Noted:
 - 1) Part Number: FOSMM.
 - 2) Quantity: Two chips for 12 splices.
3. Manufacturer and Product: Panduit, FOSMF.

Q. N-PTS-01 Fiber Optic Pigtail Set, SMF:

1. General:
 - a. Function: Opti-Core 900 micron Buffered Fiber Optic Pigtail Set, OS2, LC/APC.
2. Features:
 - a. Quantity per One Set: 12.
 - b. Length: 1 meter.
 - c. Buffer Color: EIA/TIA 598-C.
 - d. Count: Simplex (1-fiber), tight buffered.
 - e. Jacket: No jacket 900 um Buffered fiber.
3. Fiber:
 - a. Type: Single-mode OS2.
4. Connector Type:
 - a. Connector A: LC/APC.
 - b. Connector B: None; pigtail.
5. Optical Properties:
 - a. Connector Insertion Loss: 0.30 dB maximum (LC APC OS2).
 - b. Connection Return Loss: 65 dB minimum (OS2 LC APC).
6. Environmental:
 - a. Operating Temperature: Minus 20 degrees C to plus 70 degrees C.
7. Manufacturer and Product: Panduit, F9TBNBNNNSZM1.

R. N-PTS-02 Fiber Optic Pigtail Set, MMF:

1. General:
 - a. Function: Opti-Core 900 micron Buffered Fiber Optic Pigtail Set, OM4, LC.
2. Features:
 - a. Quantity per One Set: 12.
 - b. Length: 1 meter.
 - c. Buffer Color: EIA/TIA 598-C.
 - d. Count: Simplex (1-fiber), tight buffered.
 - e. Jacket: No jacket 900 um Buffered fiber.
3. Fiber:
 - a. Type: Single-mode OM4.

4. Connector Type:
 - a. Connector A: LC.
 - b. Connector B: None; pigtail.
5. Optical Properties:
 - a. Connector Insertion Loss: 0.25 dB maximum (MMF).
 - b. Connection Return Loss: 26 dB minimum (OM3, OM4, OM5).
6. Environmental:
 - a. Operating Temperature: Minus 20 degrees C to plus 70 degrees C.
7. Manufacturer and Product: Panduit, FZTBN1NNSZM1.

S. N-FOPP-11 Single-Mode Fiber Optic Patch Panel, LC:

1. General:
 - a. Function: DIN Mount, Single-Mode Fiber Optic Patch Panel.
2. Features:
 - a. Compact size for limited space enclosures.
 - b. UL listed.
 - c. Versatile surface or DIN-Rail mount.
 - d. Slide-Hinged faceplate aids field termination.
 - e. Patch or Fusion splice field termination.
 - f. Rugged metal construction.
3. Fiber:
 - a. Type: OS1/OS2.
 - b. Quantity: 24.
4. Adapter Type:
 - a. Duplex.
 - b. Connector Type: LC.
 - c. Quantity: 12.
5. Accessories:
 - a. LC Connector: Plug, for unused ports.
6. Manufacturer and Product: DINSpace, SNAP-24LC-SM.

T. N-FOPP-12 Multi-Mode Fiber Optic Patch Panel, LC:

1. General:
 - a. Function: DIN Mount, Single-Mode Fiber Optic Patch Panel.
2. Features:
 - a. Compact size for limited space enclosures.
 - b. UL listed.
 - c. Versatile surface or DIN-Rail mount.
 - d. Slide-hinged faceplate aids field termination.
 - e. Patch or fusion splice field termination.
 - f. Rugged metal construction.

3. Fiber:
 - a. Type: OM1, OM2, OM3, OM4.
 - b. Quantity: 12.
4. Adapter Type:
 - a. Duplex.
 - b. Connector Type: LC.
 - c. Quantity: Six.
5. Accessories:
 - a. LC Connector: Plug, for unused ports.
6. Manufacturer and Product: DINSpace, SNAP-24LC-MM.

U. N-CPP-01 Copper Patch Panel:

1. General:
 - a. Function: 19-Rack, Mini-com Jack Shielded, Modular.
2. Features:
 - a. Rack unit.
 - b. Color: Black.
 - c. Identification Type: Adhesive label.
 - d. Style: Flat.
 - e. Grounding stud.
 - f. Built-in strain relief bar.
3. Ports:
 - a. Type: Modular, mini-com jack shielded modules.
 - b. Quantity: 24.
4. Manufacturer and Product: Panduit, CP24WSBLY.

V. N-CPP-02 Copper Patch Panel:

1. General:
 - a. Function: 19-Rack, Punch down. Category 6.
2. Features:
 - a. Rack Unit: One.
 - b. Color: Black.
 - c. Identification Type: Adhesive label.
 - d. Style: Flat.
 - e. Wiring Scheme: T568A/T568B.
 - f. PoE compliance.
3. Ports:
 - a. Type: Punch down Category 6 shielded.
 - b. Quantity: 24.
4. Manufacturer and Product: Panduit, DP246X88TGY.

W. N-CPP-11 Copper Patch Panel:

1. General:
 - a. Function: DIN rail mount, copper patch panel.
2. Features:
 - a. Compact size for limited space enclosures.
 - b. UL listed.
 - c. Versatile surface or DIN-Rail mount.
 - d. Slide-hinged faceplate aids field termination.
 - e. Rugged metal construction.
3. Ports:
 - a. Type: Keystone jacks, punch down Category 6 shielded.
 - b. Quantity: 12.
4. Accessories:
 - a. Keystone jack Category 6, shielded
 - 1) Quantity: 12.
 - b. DIN-Rail mount adapter.
 - c. Punch down tool.
5. Manufacturer and Product: DINSpace, SNAP-CU-12.

X. N-JMS-01 Spring Shuttered Shielded Jack Module, Category 6:

1. General:
 - a. Function: Mini-Com TX6 Plus Shielded Jack Modules.
2. Features:
 - a. Shielded.
 - b. Category: 6.
 - c. Spring shuttered.
 - d. Color:
 - 1) SCADA Network: Blue (BU).
 - 2) Business and Security: Green (GR).
 - 3) Telephony: White (WH).
3. Accessories:
 - a. Jack Module Termination Tool: EGJT-1 or TGJT, one per construction site.
4. Manufacturer and Product: Panduit, CJSH688TG**Y.

Y. N-PH-01 IP Phone:

1. General:
 - a. Function: IP Phone with Multiplatform Phone Firmware for voice.
2. Features:
 - a. Category: 6.
 - b. PoE+.

- c. 2 SIP registrations.
- d. Desktop.
- 3. Manufacturer and Product: Cisco, IP Phone 6821.

PART 3 EXECUTION

3.01 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.
- C. Network, and Fiber Optic, Cabling: As specified in Section 26 05 10, Network Communication System.
- D. Refer to Network Component Manufacturer installation manual.

3.02 SUPPLEMENTS

- A. The supplements listed below, following "End of Section," are a part of this specification:
 - 1. Network Components List.
 - a. Caprock Pump Station (CPS).
 - b. Caprock Tank (CT).
 - c. Intake Pump Station (IPS).
 - 2. Owner-Furnished Network Components List.
 - a. Caprock Pump Station (CPS).
 - b. Caprock Tank (CT).
 - c. Intake Pump Station (IPS).

END OF SECTION

CAPROCK PUMP STATION
NETWORK COMPONENTS LIST

ITEM	LOCATION	P/NL TAG	TAG	TYPE	DESCRIPTION	QTY	COMP. CODE	MANUFACTURER	MODEL
CAPROCK PUMP STATION, MAIN NETWORK PANEL									
1	PLC ROOM	CP20-NP-831-01	CP20-FOE-831-01, 02 CP20-FOE-831-03, 04 CP20-FOE-831-31	FOE	Fiber Optic Panel Enclosure	5	N-FOP-01	Panduit	FCE1U
2	PLC ROOM	CP20-NP-831-01	CP20-FAP-831-01A, 01B CP20-FAP-831-02A, 02B CP20-FAP-831-03A, 03B CP20-FAP-831-04A, 04B	FAP	Fiber Optic Panel Adapter, OS2, 6 LC, Duplex, APC Green, SMF	8	N-FAP-01	Panduit	FAP6WGDLCZ
3	PLC ROOM	CP20-NP-831-01	CP20-FAP-831-31A, 31B	FAP	Fiber Optic Panel Adapter, OM4, 6 LC, Duplex, MMF	2	N-FAP-02	Panduit	FAP6WAQDLCZ
4	PLC ROOM	CP20-NP-831-01	CP20-FST-831-01A, 01B CP20-FST-831-02A, 02B CP20-FST-831-03A, 03B CP20-FST-831-04A, 04B CP20-FST-831-31A, 31B	TRAY	Fiber Optic Splice Tray	10	N-FST-01	Panduit	FOSMF
5	PLC ROOM	CP20-NP-831-01	N/A	PIGTAIL	Fiber Optic Pigtail Set, Opti-Core 900 micron Buffered Fiber Optic Pigtail Set, OS2, LC/APC	8	N-PTS-01	Panduit	F9TBNBNNSZM1
6	PLC ROOM	CP20-NP-831-01	N/A	PIGTAIL	Fiber Optic Pigtail, Opti-Core 900 micron Buffered Fiber Optic Pigtail Set, OM4, LC.	2	N-PTS-012	Panduit	FZTBN1NNSZM1
7	PLC ROOM	CP20-NP-831-01	CP20-CPP-831-12A, 12B CP20-CPP-831-21	CPP	Copper Patch Panel, 24 ports, 19-Rack, Mini-com Jack Shielded, Modular	3	N-CPP-01	Panduit	CP24WSBLY
8	PLC ROOM	CP20-NP-831-01	N/A	JACK	Shielded RJ45 Cat 6A TG Jack Module, Colors As Req.	As req.	N-JMS-01	Panduit	CJSH688TG**Y
CAPROCK PUMP STATION, FIELD									
9	PUMPING ROOM	N/A	CP20-AP-891-03	AP	WiFi Access Point, Wi-Fi 6, 2.4 GHz, 5 GHz, PoE, Mu-MIMO	1	N-AP-01	CISCO	Catalyst 9130AXE
10	ELECTRICAL ROOM	N/A	CP20-AP-891-02	AP	WiFi Access Point, Wi-Fi 6, 2.4 GHz, 5 GHz, PoE, Mu-MIMO	1	N-AP-01	CISCO	Catalyst 9130AXE
11	SCADA ROOM	N/A	CP20-AP-891-01	AP	WiFi Access Point, Wi-Fi 6, 2.4 GHz, 5 GHz, PoE, Mu-MIMO	1	N-AP-01	CISCO	Catalyst 9130AXE
12	SCADA ROOM	N/A	CP20-VOIP-892-01	VT	VoIP telephone	1	N-PH-01	CISCO	IP Phone 6821

CAPROCK TANK
NETWORK COMPONENTS LIST

ITEM	LOCATION	PNL TAG	TAG	TYPE	DESCRIPTION	QTY	COMP. CODE	MANUFACTURER	MODEL
CAPROCK TANK, MAIN NETWORK PANEL									
1	ELECTRICAL ROOM	CT127-NP-831-01	CT127-FOE-831-01, CT127-FOE-831-02, CT127-FOE-831-31	FOE	Fiber Optic Panel Enclosure	3	N-FOP-01	Panduit	FCEIU
2	ELECTRICAL ROOM	CT127-NP-831-01	CT127-FAP-831-01A, 01B CT127-FAP-831-02A, 02B	FAP	Fiber Optic Panel Adapter, OS2, 6 LC, Duplex, APC Green, SMF	4	N-FAP-01	Panduit	FAP6WGDLCZ
3	ELECTRICAL ROOM	CT127-NP-831-01	CT127-FAP-831-31A, 31B	FAP	Fiber Optic Panel Adapter, OM4, 6 LC, Duplex, MMF	2	N-FAP-02	Panduit	FAP6WAODLCZ
4	ELECTRICAL ROOM	CT127-NP-831-01	CT127-FST-831-01A, 01B CT127-FST-831-02A, 02B CT127-FST-831-31A, 31B	TRAY	Fiber Optic Splice Tray	8	N-FST-01	Panduit	FOSMF
5	ELECTRICAL ROOM	CT127-NP-831-01	N/A	PIGTAIL	Fiber Optic Pigtail Set, Opti-Core 900 micron Buffered Fiber Optic Pigtail Set, OS2, LC/APC	4	N-PTS-01	Panduit	F9TBNBNNNSZM1
6	ELECTRICAL ROOM	CT127-NP-831-01	N/A	PIGTAIL	Fiber Optic Pigtail, Opti-Core 900 micron Buffered Fiber Optic Pigtail Set, OM4, LC	2	N-PTS-012	Panduit	FZTBN1NNSZM1
7	ELECTRICAL ROOM	CT127-NP-831-01	CT127-OPP-831-12A, 12B CT127-OPP-831-21	CPP	Copper Patch Panel, 24 ports, 19-Rack, Mini-com Jack Shielded, Modular	3	N-OPP-01	Panduit	CP24WSBLY
8	ELECTRICAL ROOM	CT127-NP-831-01	N/A	JACK	Shielded RJ45 Cat 6A TG Jack Module, Colors As Req.	As req.	N-JMS-01	Panduit	CJSH688TG**Y
CAPROCK TANK, FIELD									
9	ELECTRICAL ROOM	N/A	CT127-AP-891-01	AP	WiFi Access Point, Wi-Fi 6, 2.4 GHz, 5 GHz, PoE, MU-MIMO	1	N-AP-01	CISCO	Catalyst 9130AXE
10	ELECTRICAL ROOM	N/A	CP20-VOIP-892-01	VT	VoIP telephone	1	N-PH-01	CISCO	IP Phone 6821

INTAKE PUMP STATION
NETWORK COMPONENTS LIST

ITEM	LOCATION	PNL TAG	TAG	TYPE	DESCRIPTION	QTY	COMP. CODE	MANUFACTURER	MODEL
INTAKE PUMP STATION, MAIN NETWORK PANEL									
1	PLC ROOM	IP20-NP-831-01	IP20-FOE-831-01, IP20-FOE-831-02, IP20-FOE-831-31	FOE	Fiber Optic Panel Enclosure	3	N-FOP-01	Panduit	FCE1U
2	PLC ROOM	IP20-NP-831-01	IP20-FAP-831-01A, 01B IP20-FAP-831-02A, 02B	FAP	Fiber Optic Panel Adapter, OS2, 6 LC, Duplex, APC Green, SMF	4	N-FAP-01	Panduit	FAP6WGDLCZ
3	PLC ROOM	IP20-NP-831-01	IP20-FAP-831-31A, 31B	FAP	Fiber Optic Panel Adapter, OM4, 6 LC, Duplex, MMF	2	N-FAP-02	Panduit	FAP6WAODLCZ
4	PLC ROOM	IP20-NP-831-01	IP20-FST-831-01A, 01B IP20-FST-831-02A, 02B IP20-FST-831-31A, 31B	TRAY	Fiber Optic Splice Tray	6	N-FST-01	Panduit	FOSMF
5	PLC ROOM	IP20-NP-831-01	N/A	PIGTAIL	Fiber Optic Pigtail Set, Opti-Core 900 micron Buffered Fiber Optic Pigtail Set, OS2, LC/APC	4	N-PTS-01	Panduit	F9TBNBNNSZM1
6	PLC ROOM	IP20-NP-831-01	N/A	PIGTAIL	Fiber Optic Pigtail, Opti-Core 900 micron Buffered Fiber Optic Pigtail Set, OM4, LC	2	N-PTS-012	Panduit	FZTBN1NNSZM1
7	PLC ROOM	IP20-NP-831-01	IP20-CPP-831-12A, 12B IP20-CPP-831-21	CPP	Copper Patch Panel, 24 ports, 19-Rack, Mini-com Jack Shielded, Modular	3	N-CPP-01	Panduit	CP24WSBLY
8	PLC ROOM	IP20-NP-831-01	N/A	JACK	Shielded RJ45 Cat 6A TG Jack Module, Colors As Req	As req.	N-JMS-01	Panduit	CJSH688TG**Y

INTAKE PUMP STATION, AUX. NETWORK PANEL

9	CHEMICAL FACILITY	IP15-NP-831-01	IP15-MC-831-01	MC	Media Converter, Multi-Mode Fiber Optic to Ethernet Cat. 6, 850nm, 1 x SFP, 1 x RJ45, PoE+	1	N-DAS-02	FS	IMC-1FT, 101483
10	CHEMICAL FACILITY	IP15-NP-831-01	N/A	SFP	SFP Module, 1Gb, 550m, Multi Mode Fiber, 850 nm	1	N-SFP-02	FS	SFP1G-SX-85
11	CHEMICAL FACILITY	IP15-NP-831-01	IP15-FOE-831-01	FOE	Fiber Optic Panel Enclosure	1	N-FOP-01	Panduit	FCE1U
12	CHEMICAL FACILITY	IP15-NP-831-01	IP15-FAP-831-01A	FAP	Fiber Optic Panel Adapter, OM4, 6 LC, Duplex, MMF	1	N-FAP-02	Panduit	FAP6WAODLCZ
13	CHEMICAL FACILITY	IP15-NP-831-01	N/A	PIGTAIL	Fiber Optic Pigtail, Opti-Core 900 micron Buffered Fiber Optic Pigtail Set, OM4, LC	1	N-PTS-012	Panduit	FZTBN1NNSZM1
14	CHEMICAL FACILITY	IP15-NP-831-01	IP15-CPP-831-01	CPP	Copper Patch Panel, 24 ports, 19-Rack, Mini-com Jack Shielded, Modular	1	N-CPP-01	Panduit	CP24WSBLY
15	CHEMICAL FACILITY	IP15-NP-831-01	N/A	JACK	Shielded RJ45 Cat 6A TG Jack Module	As req.	N-JMS-01	Panduit	CJSH688TG**Y

INTAKE PUMP STATION, AUX. NETWORK PANEL

16	COMPRESSOR BUILDING	IP32-NP-831-01	IP32-MC-831-01	MC	Media Converter, Multi-Mode Fiber Optic to Ethernet Cat. 6, 850nm, 1 x SFP, 1 x RJ45, PoE+	1	N-DAS-02	FS	IMC-1FT, 101483
17	COMPRESSOR BUILDING	IP32-NP-831-01	N/A	SFP	SFP Module, 1Gb, 550m, Multi Mode Fiber, 850 nm	1	N-SFP-02	FS	SFP1G-SX-85
18	COMPRESSOR BUILDING	IP32-NP-831-01	IP32-FOE-831-01	FOE	Fiber Optic Panel Enclosure	1	N-FOP-01	Panduit	FCE1U
19	COMPRESSOR BUILDING	IP32-NP-831-01	IP32-FAP-831-01A	FAP	Fiber Optic Panel Adapter, OM4, 6 LC, Duplex, MMF	1	N-FAP-02	Panduit	FAP6WAODLCZ
20	COMPRESSOR BUILDING	IP32-NP-831-01	N/A	PIGTAIL	Fiber Optic Pigtail, Opti-Core 900 micron Buffered Fiber Optic Pigtail Set, OM4, LC	1	N-PTS-012	Panduit	FZTBN1NNSZM1
21	COMPRESSOR BUILDING	IP32-NP-831-01	IP32-CPP-831-01	CPP	Copper Patch Panel, 24 ports, 19-Rack, Mini-com Jack Shielded, Modular	1	N-CPP-01	Panduit	CP24WSBLY
22	COMPRESSOR BUILDING	IP32-NP-831-01	N/A	JACK	Shielded RJ45 Cat 6A TG Jack Module	As req.	N-JMS-01	Panduit	CJSH688TG**Y

INTAKE PUMP STATION
NETWORK COMPONENTS LIST

ITEM	LOCATION	P/NL TAG	TAG	TYPE	DESCRIPTION	QTY	COMP. CODE	MANUFACTURER	MODEL
INTAKE PUMP STATION, FIELD									
23	COMPRESSOR BUILDING	N/A	IP32-AP-891-01	AP	WiFi Access Point, Wi-Fi 6, 2.4 GHz, 5 GHz, PoE, Mu-MIMO	1	N-AP-01	CISCO	Catalyst 9130AXE
24	PUMPING ROOM	N/A	IP20-AP-891-03	AP	WiFi Access Point, Wi-Fi 6, 2.4 GHz, 5 GHz, PoE, Mu-MIMO	1	N-AP-01	CISCO	Catalyst 9130AXE
25	ELECTRICAL ROOM	N/A	IP20-AP-891-02	AP	WiFi Access Point, Wi-Fi 6, 2.4 GHz, 5 GHz, PoE, Mu-MIMO	1	N-AP-01	CISCO	Catalyst 9130AXE
26	SCADA ROOM	N/A	IP20-AP-891-01	AP	WiFi Access Point, Wi-Fi 6, 2.4 GHz, 5 GHz, PoE, Mu-MIMO	1	N-AP-01	CISCO	Catalyst 9130AXE
27	CHEMICAL FACILITY	N/A	IP15-AP-891-01	AP	WiFi Access Point, Wi-Fi 6, 2.4 GHz, 5 GHz, PoE, Mu-MIMO	1	N-AP-01	CISCO	Catalyst 9130AXE
28	SCADA ROOM	N/A	IP20-VOIP-892-01	VT	VoIP telephone	1	N-PH-01	CISCO	IP Phone 6821

CAPROCK PUMP STATION
OWNER-FURNISHED NETWORK COMPONENTS LIST

ITEM	LOCATION	PNL TAG	TAG	TYPE	DESCRIPTION	QTY	COMP. CODE	MANUFACTURER	MODEL
CAPROCK PUMP STATION, MAIN NETWORK PANEL									
1	PLC ROOM	CP20-NP-831-01	CP20-FW-831-01A, 01B	FW	Firewall	2	N-FW-01	FortiNet	FORTIGATE FGR-70F-3C4G
2	PLC ROOM	CP20-NP-831-01	CP20-SW-831-11A, 11B	SW	IE-9320 Distribution switch	2	N-DS-01	CISCO	IE-9320-22S2C4X-A
3	PLC ROOM	CP20-NP-831-01	CP20-SW-831-12A, 12B	SW	IE-9320 Access switch	2	N-AS-01	CISCO	IE-9320-24P4S-A
4	PLC ROOM	CP20-NP-831-01	CP20-SW-831-21	SW	IE-9320 Access switch, PoE	1	N-AS-02	CISCO	C9200L-24P-4X-E
5	PLC ROOM	CP20-NP-831-01	N/A	SFP+	SFP+ Module, 10Gb, 70km, Industrial, Single-Mode Fiber, 1550 nm	6	N-SFP-01	CISCO	SFP-10G-ZR-I
6	PLC ROOM	CP20-NP-831-01	N/A	SFP	SFP Module, 1Gb, 550m, Multi-Mode Fiber, 850 nm	20	N-SFP-02	FS	SFP1G-SX-85
7	PLC ROOM	CP20-NP-831-01	N/A	OA	Optical Attenuator, dB loss as required	As req.			

CAPROCK TANK
OWNER-FURNISHED NETWORK COMPONENTS LIST

ITEM	LOCATION	PNL TAG	TAG	TYPE	DESCRIPTION	QTY	COMP. CODE	MANUFACTURER	MODEL
CAPROCK TANK, MAIN NETWORK PANEL									
1	ELECTRICAL ROOM	CT27-NP-831-01	CT27-FW-831-01A, 01B	FW	Firewall	2	N-FW-01	FortiNet	FORTIGATE FGR-70F-3G4G
2	ELECTRICAL ROOM	CT27-NP-831-01	CT27-SW-831-11A, 11B	SW	IE-9320 Distribution switch	2	N-DS-01	CISCO	IE-9320-22S2C4X-A
3	ELECTRICAL ROOM	CT27-NP-831-01	CT27-SW-831-12A, 12B	SW	IE-9320 Access switch	2	N-AS-01	CISCO	IE-9320-24P4S-A
4	ELECTRICAL ROOM	CT27-NP-831-01	CT27-SW-831-21	SW	IE-9320 Access switch, PoE	1	N-AS-02	CISCO	C9200L-24P-4X-E
5	ELECTRICAL ROOM	CT27-NP-831-01	N/A	SFP+	SFP+Module, 10Gb, 70km, Industrial, Single-Mode Fiber, 1550 nm	4	N-SFP-01	CISCO	SFP-10G-ZR-I
6	ELECTRICAL ROOM	CT27-NP-831-01	N/A	SFP	SFP Module, 1Gb, 550m, Multi-Mode Fiber, 850 nm	18	N-SFP-02	FS	SFP1G-SX-85
7	ELECTRICAL ROOM	CT27-NP-831-01	N/A	OA	Optical Attenuator, dB loss as required	As req.			

INTAKE PUMP STATION
OWNER-FURNISHED NETWORK COMPONENTS LIST

ITEM	LOCATION	PNL TAG	TAG	TYPE	DESCRIPTION	QTY	COMP. CODE	MANUFACTURER	MODEL
INTAKE PUMP STATION, MAIN NETWORK PANEL									
1	PLC ROOM	IP20-NP-831-01	IP20-FW-831-01A, 01B	FW	Firewall	2	N-FW-01	FortiNet	FORTIGATE FGR-70F-3G4G
2	PLC ROOM	IP20-NP-831-01	IP20-FW-831-11A, 11B	SW	IE-9320 Distribution switch	2	N-DS-01	CISCO	IE-9320-22S2C4X-A
3	PLC ROOM	IP20-NP-831-01	IP20-FW-831-12A, 12B	SW	IE-9320 Access switch	2	N-AS-01	CISCO	IE-9320-24P4S-A
4	PLC ROOM	IP20-NP-831-01	IP20-FW-831-21	SW	IE-9320 Access switch, PoE	1	N-AS-02	CISCO	C9200L-24P-4X-E
5	PLC ROOM	IP20-NP-831-01	N/A	SFP+	SFP+ Module, 10Gb, 70km, Industrial, Single-Mode Fiber, 1550 nm	4	N-SFP-01	CISCO	SFP-10G-ZR-I
6	PLC ROOM	IP20-NP-831-01	N/A	SFP	SFP Module, 1Gb, 550m, Multi-Mode Fiber, 850 nm	21	N-SFP-02	FS	SFP1G-SX-85
7	PLC ROOM	IP20-NP-831-01	N/A	OA	Optical Attenuator, dB loss as required	As req.			

SECTION 40 90 12 PLC COMPONENTS

PART 1 GENERAL

1.01 SUMMARY

- A. This PICS section gives requirements for PLC Components. The PICS PLC components shall be completely coordinated, submitted, installed, executed, and completed by the overall PIC SI in accordance with Section 40 90 00, Instrumentation and Control for Process Systems. This section shall meet all requirements of, and be in accordance with, Section 40 90 00, Instrumentation and Control for Process Systems, including but not limited to:
1. Submittals.
 2. References.
 3. Definitions.
 4. Related Sections.
 5. Environmental Requirements.
 6. Delivery, Storage, and Handling.

1.02 RELATED SECTIONS

- A. Refer to Section 40 90 00, Instrumentation and Control for Process Systems for all related sections.

PART 2 PRODUCTS

2.01 PLC COMPONENTS

- A. C-CPU-01 Controller, 5580 3 MB:
1. General:
 - a. CPU Module.
 - b. ControlLogix 5580 Controller.
 2. Features:
 - a. Controller Tasks:
 - 1) 32 task including combination of continuous, periodic and event tasks.
 - 2) 1,000 programs/task.
 - b. Programming Languages:
 - 1) Relay ladder logic.
 - 2) Structured text.
 - 3) Function Block Diagram.
 - 4) Sequential Function Chart.
 - c. Energy Storage Module: Embedded in controller, nonremovable.

- d. Module Location: Chassis-based, any slot.
- e. Communication Options:
 - 1) EtherNet/IP.
 - 2) Remote I/O.
- 3. Interfaces:
 - a. USB Port:
 - 1) Quantity: One.
 - 2) Type: USB 2.0, Full speed (12 Mbps).
 - b. Ethernet:
 - 1) Quantity: One.
 - 2) Type: 10/100/1,000 Mps.
- 4. Performance:
 - a. User Memory: 10 MB.
 - b. Digital I/O Maximum: 128000.
 - c. Analog IO Maximum: 4000.
 - d. Total I/O Maximum: 128000.
 - e. EtherNet/IP Nodes Supported: 250 nodes, Studio 5000Logix Version 30.00.00 or later.
 - f. Network Connections, per Network Module Located in the Local Chassis:
 - 1) 528 EtherNet/IP, 512 TCP (1756-EN4TR).
 - 2) 256 EtherNet/IP, 128 TCP (1756-EN2X).
 - 3) 128 EtherNet/IP, 64 TCP (1756-ENBT).
 - 4) 100 ControlNet (1756-CN2/A).
 - 5) 40 ControlNet (1756-CN2/D, 1756-CNB/e).
 - 6) 128 ControlNet (1756-CN2/B).
- 5. Environmental:
 - a. Operating Temperature:
 - 1) Standard Chassis, Series C: 0 degrees C to plus 60 degrees C.
 - 2) Standard Chassis, Series B: 0 degrees C to plus 50 degrees C.
 - b. Operating Humidity: 5 percent to 95 percent noncondensing.
- 6. Accessories:
 - a. Memory Card:
 - 1) Memory: 2 GB.
 - 2) Type: Secure Digital.
 - b. Ethernet and USB Port Protection Plugs.
- 7. Manufacturer and Product: Rockwell 1756-L81E.

B. C-CPU-02 Controller, 5580 10 MB:

- 1. General:
 - a. CPU Module.
 - b. ControlLogix 5580 Controller.

2. Features:
 - a. Controller Tasks:
 - 1) 32 task including combination of continuous, periodic and event tasks.
 - 2) 1,000 programs/task.
 - b. Programming Languages:
 - 1) Relay ladder logic.
 - 2) Structured text.
 - 3) Function Block Diagram.
 - 4) Sequential Function Chart.
 - c. Energy Storage Module: Embedded in controller, nonremovable.
 - d. Module Location: Chassis-based, any slot.
 - e. Communication Options:
 - 1) EtherNet/IP.
 - 2) Remote I/O.
3. Interfaces:
 - a. USB Port:
 - 1) Quantity: One.
 - 2) Type: USB 2.0, Full speed (12 Mbps).
 - b. Ethernet:
 - 1) Quantity: One.
 - 2) Type: 10/100/1,000 Mps.
4. Performance:
 - a. User Memory: 10 MB.
 - b. Digital I/O Maximum: 128000.
 - c. Analog IO Maximum: 4000.
 - d. Total I/O Maximum: 128000.
 - e. EtherNet/IP Nodes Supported: 100 nodes, Studio 5000Logix Version 30.00.00 or later.
 - f. Network Connections, per Network Module Located in the Local Chassis:
 - 1) 528 EtherNet/IP, 512 TCP (1756-EN4TR).
 - 2) 256 EtherNet/IP, 128 TCP (1756-EN2X).
 - 3) 128 EtherNet/IP, 64 TCP (1756-ENBT).
 - 4) 100 ControlNet (1756-CN2/A).
 - 5) 40 ControlNet (1756-CN2/D, 1756-CNB/e).
 - 6) 128 ControlNet (1756-CN2/B).
5. Environmental:
 - a. Operating Temperature:
 - 1) Standard Chassis, Series C: 0 degree C to plus 60 degrees C.
 - 2) Standard Chassis, Series B: 0 degree C to plus 50 degrees C.
 - b. Operating Humidity: 5 percent to 95 percent noncondensing.

6. Accessories:
 - a. Memory Card:
 - 1) Memory: 2 GB.
 - 2) Type: Secure digital.
 - b. Ethernet and USB Port Protection Plugs.
 7. Manufacturer and Product: Rockwell 1756-L83E.
- C. C-DO-01 Relay Discrete Output, 16 Isolated:
1. General:
 - a. 1756 ControlLogix PLC Module.
 - b. 16 Point Contact Discrete Output.
 2. Features:
 - a. Outputs: 16 Normally Opened Individually isolated.
 - b. Output Voltage Range (load dependent):
 - 1) 1A at 5V dc to 30V dc.
 - 2) 0.5A at 48V dc.
 - 3) 0.22A at 125V dc.
 - 4) 1.5A at 120V ac 50/60 Hz.
 - 5) 0.75A at 240V ac 50/60 Hz.
 3. Performance:
 - a. Switching Frequency Maximum: One operation/3 s (0.3 Hz at rated load).
 - b. Bounce Time Mean: 1.2 ms.
 - c. Expected Contact Life:
 - 1) 300000 cycles resistive.
 - 2) 100000 cycles inductive.
 - d. Operating Voltage Range:
 - 1) 5V dc to 125V dc.
 - 2) 10V ac to 240V ac.
 - e. Output Voltage Range (load dependent).
 - 1) 1A at 5V dc to 30V dc.
 - 2) 0.5A at 48V dc.
 - 3) 0.22A at 125V dc.
 - 4) 1.5A at 120V ac 50/60 Hz.
 - 5) 0.75A at 240V ac 50/60 Hz.
 - f. Output Delay Time: 10 ms maximum.
 4. Environmental:
 - a. Operating Temperature: 0 degrees C to plus 60 degrees C.
 - b. Operating Humidity: 5 percent to 95 percent noncondensing.
 5. Accessories:
 - a. Removable terminal block.
 - b. Jumper bar.
 6. Manufacturer and Product: Rockwell, ControlLogix 1756-OW16I.

D. C-DI-01 DC Discrete Input, 16 Isolated:

1. General:
 - a. 1756 ControlLogix PLC Module.
 - b. 16Pt Isolated DC Discrete Input Module.
2. Features:
 - a. Inputs: 16 individually isolated.
 - b. Voltage: 12/24V dc sink/source.
 - c. Operating Voltage Range: 10V dc to 30V dc.
3. Performance:
 - a. Delay Time:
 - 1) OFF to ON:
 - a) Hardware Delay: 1 ms maximum plus filter time.
 - b) User-selectable Filter Time: 0 ms, 1 ms, or 2 ms.
 - 2) ON to OFF:
 - a) Hardware Delay: 4 ms maximum plus filter time.
 - b) User-selectable Filter Time: 0 ms, 1 ms, 2 ms, 9 ms, or 18 ms.
 - b. Off-state:
 - 1) Voltage Maximum: 5V.
 - 2) Current Maximum: 1.5 mA.
 - c. On-state:
 - 1) Current Minimum: 2 mA at 10V dc.
 - 2) Current Maximum: 10 mA at 30V dc.
4. Environmental:
 - a. Operating Temperature: 0 degree C to plus 60 degrees C.
 - b. Operating Humidity: 5 percent to 95 percent noncondensing.
5. Accessories:
 - a. Removable terminal block.
 - b. Jumper bar.
6. Manufacturer and Product: Rockwell, ControlLogix 1756-IB16I.

E. C-DI-02 AC Discrete Input, 16 Isolated:

1. General:
 - a. 1756 ControlLogix PLC Module.
 - b. 16Pt Isolated 120V ac Discrete Input Module.
2. Features:
 - a. Inputs: 16 individually isolated.
 - b. Voltage: 120V ac 50/60 Hz.
 - c. Operating Voltage Range: 79V ac to 123V ac, 47 Hz to 63 Hz.
3. Performance:
 - a. Delay Time:
 - 1) OFF to ON:
 - a) Hardware Delay: 10 ms maximum plus filter time.
 - b) User-selectable Filter Time: 0 ms, 1 ms, or 2 ms.

- 2) ON to OFF:
 - a) Hardware Delay: 8 ms maximum plus filter time.
 - b) User-selectable Filter Time: 9 ms or 18 ms.
- b. Off-state:
 - 1) Voltage Maximum: 20V.
 - 2) Current Maximum: 2.5 mA.
- c. On-state:
 - 1) Current Minimum: 5 mA at 79V ac.
 - 2) Current Maximum: 15 mA at 132V ac.
- 4. Environmental:
 - a. Operating Temperature: 0 degree C to plus 60 degrees C.
 - b. Operating Humidity: 5 percent to 95 percent noncondensing.
- 5. Accessories:
 - a. Removable terminal block.
 - b. Jumper bar.
- 6. Manufacturer and Product: Rockwell, ControlLogix 1756-AI16I.

F. C-AO-01 Voltage/Current Analog Output, 8 Isolated:

- 1. General:
 - a. 1756 ControlLogix PLC Module.
 - b. 8Pt Isolated Voltage/Current Analog Output.
- 2. Features:
 - a. Outputs: Eight isolated channels, any combination of voltage or current mode.
 - b. Output Range:
 - 1) Minus 10V to 10V.
 - 2) 0V to 10V.
 - 3) 0V to 5V.
 - 4) 0 mA to 20 mA.
- 3. Performance:
 - a. Resolution: 16 bit.
 - b. Open Circuit Detection: Yes.
 - c. Short Circuit Detection: Yes.
 - d. Overvoltage Protection: Plus, or minus, 30V dc.
 - e. Isolation Voltage: 250V.
- 4. Environmental:
 - a. Operating Temperature: 0 degree C to plus 60 degrees C.
 - b. Operating Humidity: 5 percent to 95 percent noncondensing.
- 5. Accessories: Removable terminal block.
- 6. Manufacturer and Product: Rockwell, ControlLogix 1756-OF8I.

G. C-AI-01 Voltage/Current Analog Input, 8 Isolated:

- 1. General:
 - a. 1756 ControlLogix PLC Module.
 - b. 8Pt Isolated Voltage/Current Analog Input.

2. Features:
 - a. Inputs: Eight isolated channels, any combination of voltage or current mode.
 - b. Input Range:
 - 1) Minus 10V to 10V.
 - 2) 0V to 10V.
 - 3) 0 mA to 5V.
 - 4) 0 mA to 20 mA.
3. Performance:
 - a. Resolution: 24 bit.
 - b. Calibrated Accuracy: 0.05 percent.
 - c. Open Circuit Detection: Yes.
 - d. Short Circuit Detection Time: 5s.
 - e. Overvoltage Protection: Plus, or minus, 30V dc.
 - f. Isolation Voltage: 250V.
4. Environmental:
 - a. Operating Temperature: 0 degrees C to plus 60 degrees C.
 - b. Operating Humidity: 5 percent to 95 percent noncondensing.
5. Accessories: Removable terminal block.
6. Manufacturer and Product: Rockwell, ControlLogix 1756-IF8I.

H. C-COM-01 EtherNet/IP, PRP, DLR:

1. General:
 - a. 1756 ControlLogix PLC Module.
 - b. Ethernet Industrial (EtherNet/IP) network protocol.
2. Features:
 - a. Supports:
 - 1) Parallel Redundancy Protocol (PRP).
 - 2) Device Level Ring (DLR) and linear topologies.
 - b. Control I/O modules and drives.
 - c. Act as an adapter for I/O and remote EtherNet/IP link.
 - d. Communicate with other EtherNet/IP devices (messages and HMI).
 - e. Bridge EtherNet/IP links to route messages to devices on other networks.
 - f. Redundant adapters.
 - g. Ethernet Port:
 - 1) 2 Ethernet RJ45.
 - 2) Category 5E.
 - h. USB Port: USB full speed (12 Mbps).
3. Performance:
 - a. Connections:
 - 1) TCP: 128.
 - 2) CIP: 1000 I/O.

- 3) CIP Unconnected Messages (backplane + Ethernet):
256+256.
- b. Produced/Consumed Tags: 32.
- c. Pocket Rate Capacity:
 - 1) I/O: 50000 without CIP Security.
 - 2) HMI/MSG: 3700 without CIP Security.
- 4. Environmental:
 - a. Operating Temperature: 0 degree C to plus 60 degrees C.
 - b. Operating Humidity: 5 percent to 95 percent noncondensing.
- 5. Manufacturer and Product: Rockwell, ControlLogix 1756-EN4TR.

I. C-COM-11 ProfiBus DP:

- 1. General:
 - a. 1756 ControlLogix PLC Module.
 - b. ProfiBus DP network protocol.
- 2. Features:
 - a. Supports: ProfiBus DPV1 Master/Multi Slave.
 - b. Control I/O modules and drives.
 - c. Interface: RS-485, Maximum 12 Mbps, Potential free.
- 3. Performance:
 - a. Master:
 - 1) Slaves: Maximum 125.
 - 2) Input/Output: Maximum 244 Bytes per slave.
 - 3) Output Data: Maximum 5,000 Bytes.
 - 4) DPV1 Services:
 - a) Class 1 Read/Write.
 - b) Class 1 Alarm.
 - c) Class 2 Initiate/Read/Write/Abort.
 - 5) Baud Rate: From 9.6 kBaud to 12 MBaud.
 - b. Slave:
 - 1) Slaves: Emulate up to 10 slaves.
 - 2) Input/Output: Maximum 244 Bytes per slave.
 - 3) Output Data: Maximum 2440 Bytes.
 - 4) DPV1 Services:
 - a) Class 1 Read/Write.
 - b) Class 1 Alarm.
 - 5) Baud Rate: From 9.6 kBaud to 12 MBaud,
- 4. Environmental:
 - a. Operating Temperature: 0 degree C to plus 60 degrees C.
 - b. Operating Humidity: 5 percent to 95 percent noncondensing.
- 5. Manufacturer and Product: ProSoft, ILX56-PBM.

J. C-CH-01 Chassis 7 Slot, Slim:

1. General:
 - a. 1756 ControlLogix Chassis.
 - b. Series B.
2. Features:
 - a. Slots Quantity: Seven.
 - b. Redundant power supply.
 - c. Size (HxWxD): 14.47 inch by 11.46 inch by 5.71 inch.
3. Environmental:
 - a. Operating Temperature: Minus 25 degrees C to plus 60 degrees C.
 - b. Operating Humidity: 5 percent to 95 percent noncondensing.
4. Accessories:
 - a. Slot Filler Module for Empty Slots: As required.
 - b. Slim Power Supplier: As noted.
5. Manufacturer and Product: Rockwell, ControlLogix 1756-A7/B.

K. C-CH-11 Chassis 4 Slot, Redundant PS:

1. General:
 - a. 1756 ControlLogix Chassis.
 - b. Series B.
 - c. Chassis adapter module.
2. Features:
 - a. Slots Quantity: Four.
 - b. Redundant power supply.
 - c. Size (HxWxD): 6.65 inch by 7.32 inch by 5.71 inch.
3. Environmental:
 - a. Operating Temperature: Minus 25 degrees C to plus 60 degrees C.
 - b. Operating Humidity: 5 percent to 95 percent noncondensing.
4. Accessories:
 - a. Slot Filler Module for Empty Slots: As required.
 - b. Redundant power supply adapter.
5. Manufacturer and Product: Rockwell, ControlLogix 1756-A4/B.

L. C-CH-12 Chassis 7 Slot, Redundant PS:

1. General:
 - a. 1756 ControlLogix Chassis.
 - b. Series B.
 - c. Chassis adapter module.
2. Features:
 - a. Slots Quantity: Seven.
 - b. Redundant power supply.
 - c. Size (HxWxD): 6.65 inch by 11.46 inch by 5.71 inch.

3. Environmental:
 - a. Operating Temperature: Minus 25 degrees C to plus 60 degrees C.
 - b. Operating Humidity: 5 percent to 95 percent noncondensing.
 4. Accessories:
 - a. Slot Filler Module for Empty Slots: As required.
 - b. Redundant power supply adapter.
 5. Manufacturer and Product: Rockwell, ControlLogix 1756-A7/B.
- M. C-CH-13 Chassis 10 Slot, Redundant PS:
1. General:
 - a. 1756 ControlLogix Chassis.
 - b. Series B.
 - c. Chassis adapter module.
 2. Features:
 - a. Slots Quantity: 10.
 - b. Redundant power supply.
 - c. Size (HxWxD): 6.65 inch by 15.98 inch by 5.71 inch.
 3. Environmental:
 - a. Operating Temperature: Minus 25 degrees C to plus 60 degrees C.
 - b. Operating Humidity: 5 percent to 95 percent noncondensing.
 4. Accessories:
 - a. Slot Filler Module for Empty Slots: As required.
 - b. Redundant power supply adapter.
 5. Manufacturer and Product: Rockwell, ControlLogix 1756-A10/B.
- N. C-CH-14 Chassis 13 Slot, Redundant PS:
1. General:
 - a. 1756 ControlLogix Chassis.
 - b. Series B.
 - c. Chassis adapter module.
 2. Features:
 - a. Slots Quantity: 13.
 - b. Redundant power supply.
 - c. Size (HxWxD): 6.65 inch by 20.12 inch by 5.71 inch.
 3. Environmental:
 - a. Operating Temperature: Minus 25 degrees C to plus 60 degrees C.
 - b. Operating Humidity: 5 percent to 95 percent noncondensing.
 4. Accessories:
 - a. Slot Filler Module for Empty Slots: As required.
 - b. Redundant power supply adapter.
 5. Manufacturer and Product: Rockwell, ControlLogix 1756-A13/B.

O. C-PS-01 Standard AC Power Supplier, 50W:

1. General:
 - a. 1756 ControlLogix, Slim, 50W.
 - b. Standard temperature range.
 - c. AC input.
2. Features:
 - a. Input:
 - 1) Voltage: 120V/240V ac, 50/60 Hz.
 - 2) Inrush Current Maximum: 20A.
 - b. Output Power: 50W.
3. Environmental:
 - a. Operating Temperature: Minus 25 degrees C to plus 60 degrees C.
 - b. Operating Humidity: 5 percent to 95 percent noncondensing.
4. Accessories:
 - a. Slot Filler Module for Empty Slots: As required.
5. Manufacturer and Product: Rockwell, ControlLogix 1756-PA50.

P. C-PS-11 Redundant Power Supplier, 75W:

1. General:
 - a. 1756 ControlLogix, Chassis, Redundant, 75W.
 - b. Standard temperature range.
 - c. AC input.
2. Features:
 - a. Input:
 - 1) Voltage: 120V/240V ac, 50/60 Hz.
 - 2) Inrush Current Maximum: 20A.
 - b. Output Power: 75W.
3. Environmental:
 - a. Operating Temperature: Minus 25 degrees C to plus 60 degrees C.
 - b. Operating Humidity: 5 percent to 95 percent noncondensing.
4. Accessories:
 - a. Slot Filler Module for Empty Slots: As required.
5. Manufacturer and Product: Rockwell, ControlLogix 1756-PA75R.

Q. C-CBL-01 Redundant PS Cable, Straight:

1. General:
 - a. 1756 ControlLogix Chassis.
 - b. Style: Straight.
2. Features:
 - a. Cable Bend Radius: 5 inches.
 - b. Length: 3 feet.

- c. Connector:
 - 1) Power Supply: Straight.
 - 2) Chassis Adapter: Straight.
 - 3. Manufacturer and Product: Rockwell, ControlLogix 1756-CPR2.

- R. C-CBL-02 Redundant PS Cable, Up:
 - 1. General:
 - a. 1756 ControlLogix Chassis.
 - b. Style: Up.
 - 2. Features:
 - a. Clearance Next to Chassis Adapter: 4 inches.
 - b. Length: 3 feet.
 - c. Connector:
 - 1) Power Supply: Straight.
 - 2) Chassis Adapter: Up.
 - 3. Manufacturer and Product: Rockwell, ControlLogix 1756-CPR2U.

- S. C-CBL-03 Redundant PS Cable, Down:
 - 1. General:
 - a. 1756 ControlLogix Chassis.
 - b. Style: Down.
 - 2. Features:
 - a. Clearance Next to Chassis Adapter: 4 inches.
 - b. Length: 3 feet.
 - c. Connector:
 - 1) Power Supply: Straight.
 - 2) Chassis Adapter: Down.
 - 3. Manufacturer and Product: Rockwell, ControlLogix 1756-CPR2D.

- T. C-RTB-01 Removable Terminal Blocks, 36-Pin:
 - 1. General:
 - a. 1756 Removable Terminal Block.
 - b. 36-pin removable terminal block with standard housing.
 - 2. Feature:
 - a. Screw.
 - b. Standard housing.
 - 3. Performance:
 - a. Wire Size:
 - 1) Single Wire Connection: 0.33 mm² to 2.1 mm².
 - 2) Double Wire Connection: 0.33 mm² to 1.3 mm².
 - 4. Manufacturer and Product: Rockwell, ControlLogix 1756-TBCH.

- U. C-MD-01 Memory Card, 2GB:
 - 1. General: 1756 Memory card.
 - 2. Feature:
 - a. Memory: 2 GB.
 - b. Type: Secure digital.
 - c. ControlLogix 5580 Controller Compatible.
 - 3. Environmental:
 - a. Operating Temperature: Minus 25 degrees C to plus 70 degrees C.
 - b. Operating Humidity: 5 percent to 95 percent noncondensing.
 - 4. Manufacturer and Product: Rockwell, ControlLogix 1784-SD2.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Material and Equipment Installation:
 - 1. Retain a copy of manufacturer's instructions at Site.
 - 2. Available for review at all times.
- B. Electrical Wiring: As specified in Division 26, Electrical.
- C. Refer to PLC Component Manufacturer Installation Manual.

3.02 SUPPLEMENT

- A. The supplement listed below, following "End of Section," is a part of this specification:
 - 1. PLC Components List.
 - a. Caprock Pump Station (CPS).
 - b. Caprock Tank (CT).
 - c. Intake Pump Station (IPS).

END OF SECTION

CAPROCK PUMP STATION
PLC COMPONENTS LIST

ITEM	SITE	LOCATION	P/NL TAG	TYPE	DESCRIPTION	QTY	COMP. CODE	MANUFACTURER	MODEL	REMARKS
CAPROCK PUMP STATION, MAIN CONTROL PANEL										
1	CPS	PLC ROOM	CP20-CP-801-01	CPU	ControlLogix 5580 Controller with 10 MB User Memory, USB Port, 1 gigabit (Gb) Ethernet Port	1	C-CPU-02	Allen-Bradley	1756-L83E	
2	CPS	PLC ROOM	CP20-CP-801-01	COMM	EtherNet/IP 10/100/1G High Performance Bridge w/CIP Security	3	C-COM-01	Allen-Bradley	1756-EN4TR	
3	CPS	PLC ROOM	CP20-CP-801-01	DO	120V ac and/or Contact Digital Outputs: Normally Opened, Isolated Relay Output 16 Points	1	C-DO-01	Allen-Bradley	1756-OW16I	
4	CPS	PLC ROOM	CP20-CP-801-01	DI	120V AC Digital Inputs: 120V ac, Isolated Input, 16 Points	5	C-DI-02	Allen-Bradley	1756-IA16I	
5	CPS	PLC ROOM	CP20-CP-801-01	DI	24V dc Digital Inputs and/or Pulse Signal: 10-30VDC, Isolated Input, 16 points, 12/24V dc Sink/Source	2	C-DI-01	Allen-Bradley	1756-IB16I	
6	CPS	PLC ROOM	CP20-CP-801-01	AO	Analog Outputs: 1756-OF8I (Isolated 8 points, Current and Voltage)	1	C-AO-01	Allen-Bradley	1756-OF8I	
7	CPS	PLC ROOM	CP20-CP-801-01	AI	Analog Inputs Voltage/Current: 1756-IF8I (Isolated, Voltage/Current, 8 Points)	5	C-AI-01	Allen-Bradley	1756-IF8I	
8	CPS	PLC ROOM	CP20-CP-801-01	RACK	Chassis 7 Slot	1	C-CH-11	Allen-Bradley	1756-A7	
9	CPS	PLC ROOM	CP20-CP-801-01	RACK	Chassis 13 Slot	2	C-CH-14	Allen-Bradley	1756-A13	
10	CPS	PLC ROOM	CP20-CP-801-01	PS	Redundant Power Suppliers	6	C-PS-11	Allen-Bradley	1756-PA75R	
11	CPS	PLC ROOM	CP20-CP-801-01	CABLE	PS Cable, Angle Down/Straight Connector	6	C-CBL-03	Allen-Bradley	1756-CPR2D	
12	CPS	PLC ROOM	CP20-CP-801-01	SD CARD	2GB SD Memory card	1	C-MD-01	Allen-Bradley	1784-SD2	
13	CPS	PLC ROOM	CP20-CP-801-01	FILLER	Empty Slot Filler	As Req.	N/A	Allen-Bradley	1756-N2	

CAPROCK TANK
PLC COMPONENTS LIST

ITEM	SITE	LOCATION	P/NL TAG	TYPE	DESCRIPTION	QTY	COMP. CODE	MANUFACTURER	MODEL	REMARKS
CAPROCK TANK, MAIN CONTROL PANEL										
1	CT	ELECTRICAL ROOM	CT27-CP-801-01	CPU	ControlLogix 5680 Controller with 3 MB User Memory, USB Port, 1 gigabit (Gb) Ethernet port	1	C-CPU-01	Allen-Bradley	1756-L81E	
2	CT	ELECTRICAL ROOM	CT27-CP-801-01	COMM	EtherNet/IP 10/100/1G High Performance Bridge w/cIP Security	1	C-COM-01	Allen-Bradley	1756-EN4TR	
3	CT	ELECTRICAL ROOM	CT27-CP-801-01	DO	120V ac and/or Contact Digital Outputs: Normally Opened, Isolated Relay Output 16 Points	1	C-DO-01	Allen-Bradley	1756-OW16I	
4	CT	ELECTRICAL ROOM	CT27-CP-801-01	DI	120V ac Digital Inputs: 120V ac, Isolated Input, 16 Points	1	C-DI-02	Allen-Bradley	1756-IA16I	
5	CT	ELECTRICAL ROOM	CT27-CP-801-01	DI	24V dc Digital Inputs and/or Pulse Signal: 10-30V dc, Isolated Input, 16 Points, 12/24V dc Sink/Source	1	C-DI-01	Allen-Bradley	1756-IB16I	
6	CT	ELECTRICAL ROOM	CT27-CP-801-01	AO	Analog Outputs: 1756-OF8I (Isolated 8 Points, Current and Voltage)	1	C-AO-01	Allen-Bradley	1756-OF8I	
7	CT	ELECTRICAL ROOM	CT27-CP-801-01	AI	Analog Inputs Voltage/Current: 1756-IF8I (Isolated, Voltage/Current, 8 Points)	1	C-AI-01	Allen-Bradley	1756-IF8I	
8	CT	ELECTRICAL ROOM	CT27-CP-801-01	RACK	Chassis 13 Slot	1	C-CH-14	Allen-Bradley	1756-A13	
9	CT	ELECTRICAL ROOM	CT27-CP-801-01	PS	Redundant Power Suppliers	2	C-PS-11	Allen-Bradley	1756-PA75R	
10	CT	ELECTRICAL ROOM	CT27-CP-801-01	CABLE	PS Cable, Angle Down/Straight Connector	2	C-CBL-03	Allen-Bradley	1756-CPR2D	
11	CT	ELECTRICAL ROOM	CT27-CP-801-01	SD CARD	2GB SD Memory Card	1	C-MD-01	Allen-Bradley	1784 SD2	
12	CT	ELECTRICAL ROOM	CT27-CP-801-01	FILLER	Empty Slot Filler	As Req	n/a	Allen-Bradley	1756-N2	

INTAKE PUMP STATION
PLC COMPONENTS LIST

ITEM	SITE	LOCATION	P/NL TAG	TYPE	DESCRIPTION	QTY	COMP. CODE	MANUFACTURER	MODEL	REMARKS
INTAKE PUMP STATION, MAIN CONTROL PANEL										
1	IPS	PLC ROOM	IP20-CP-801-01	CPU	ControlLogix 55680 Controller with 10 MB User Memory, USB Port, 1 gigabit (Gb) Ethernet port	1	C-CPU-02	Allen-Bradley	1756-L83E	
2	IPS	PLC ROOM	IP20-CP-801-01	COMM	EtherNet/IP 10/100/1G High Performance Bridge w/CP Security	3	C-COM-01	Allen-Bradley	1756-EN4TR	
3	IPS	PLC ROOM	IP20-CP-801-01	DO	120V ac and/or Contact Digital Outputs: Normally Opened, Isolated Relay Output 16 Points	1	C-DO-01	Allen-Bradley	1756-OW16I	
4	IPS	PLC ROOM	IP20-CP-801-01	DI	120V ac Digital Inputs: 120V ac, Isolated Input, 16 Points	5	C-DI-02	Allen-Bradley	1756-IA16I	
5	IPS	PLC ROOM	IP20-CP-801-01	DI	24V dc Digital Inputs and/or Pulse Signal: 10-30Vdc, Isolated Input, 16 Points, 12/24V dc Sink/Source	2	C-DI-01	Allen-Bradley	1756-IB16I	
6	IPS	PLC ROOM	IP20-CP-801-01	AO	Analog Outputs: 1756-OF8I (Isolated 8 Points, Current and Voltage)	1	C-AO-01	Allen-Bradley	1756-OF8I	
7	IPS	PLC ROOM	IP20-CP-801-01	AI	Analog Inputs Voltage/Current: 1756-IF8I (Isolated, Voltage/Current, 8 Points)	5	C-AI-01	Allen-Bradley	1756-IF8I	
8	IPS	PLC ROOM	IP20-CP-801-01	RACK	Chassis 4 Slot, Redundant PS	1	C-CH-11	Allen-Bradley	1756-A4	
9	IPS	PLC ROOM	IP20-CP-801-01	RACK	Chassis 13 Slot, Redundant PS	2	C-CH-14	Allen-Bradley	1756-A13	
10	IPS	PLC ROOM	IP20-CP-801-01	PS	Redundant Power Suppliers	6	C-PS-11	Allen-Bradley	1756-PA75R	
11	IPS	PLC ROOM	IP20-CP-801-01	CABLE	PS Cable, Angle Down/Straight Connector	6	C-CBL-03	Allen-Bradley	1756-CPR2D	
12	IPS	PLC ROOM	IP20-CP-801-01	SD CARD	2GB SD Memory Card	1	C-MD-01	Allen-Bradley	1784 SD2	
13	IPS	PLC ROOM	IP20-CP-801-01	FILLER	Empty Slot Filler	As Req.	N/A	Allen-Bradley	1756-N2	

SECTION 40 90 13
CONTROL AND NETWORK PANEL COMPONENTS

PART 1 GENERAL

1.01 SUMMARY

- A. This PICS section gives requirements for Control and Network Panel Components. The PICS control and network panel components shall be completely coordinated, submitted, installed, executed, and completed by the overall PIC SI in accordance with Section 40 90 00, Instrumentation and Control for Process Systems. This section shall meet all requirements of, and be in accordance with, Section 40 90 00, Instrumentation and Control for Process Systems, including but not limited to:
1. Submittals.
 2. References.
 3. Definitions.
 4. Related Sections.
 5. Environmental Requirements.
 6. Delivery, Storage, and Handling.
- B. All panel components shall be UL recognized or listed excluding nameplates and tags.

1.02 RELATED SECTIONS

- A. Refer to Section 40 90 00, Instrumentation and Control for Process Systems for all related sections.

PART 2 PRODUCTS

2.01 ENCLOSURE

- A. Manufacturers:
1. Saginaw Control and Engineering.
 2. Eaton B-Line.
 3. Hoffman Engineering Co.
 4. Rittal.

2.02 NAMEPLATES AND TAGS

- A. Panel Component Nameplates—Panel Face: Component identification.
1. Location and Inscription:
 - a. Located on panel face under or near component.
 - b. Materials: Laminated Component tag number.
 - c. Inscription: Component tag number and loop title description per Instrument List.
 - d. Refer to:
 - 1) Table under Paragraph Standard Pushbutton Colors and Inscriptions.
 - 2) Table under Paragraph Standard Light Colors and Inscriptions.
 2. Materials: Laminated plastic attached to panel with stainless steel screws.
 3. Letters: 3/16-inch white on black background, unless otherwise noted.
- B. Panel Component Nameplates—Back of Panel:
1. Location and Inscription:
 - a. Located on back panel under or near component.
 - b. Materials: Laminated Component tag number.
 - c. Inscription: Component tag number and loop title description per Instrument List, if applicable or as labelled on Panel Wiring Diagrams.
 - d. Refer to:
 - 1) Table under Paragraph Standard Pushbutton Colors and Inscriptions.
 - 2) Table under Paragraph Standard Light Colors and Inscriptions.
 2. Materials: Laminated plastic attached to panel with stainless steel screws.
 3. Letters: 3/16-inch white on black background, unless otherwise noted.

2.03 PLCS

- A. In accordance with Section 40 90 12, PLC Components.

2.04 WIRES WITHIN ENCLOSURES

- A. AC Circuits:
1. Type: 300-volt, Type MTW stranded copper.
 2. Size: For current to be carried, but not less than 18 AWG.

- B. Analog Signal Circuits:
 - 1. Type: 300-volt stranded copper, twisted shielded pairs.
 - 2. Size: 18 AWG, minimum.
- C. Other dc Circuits.
 - 1. Type: 300-volt, Type MTW stranded copper.
 - 2. Size: For current carried, but not less than 18 AWG.
- D. Special Signal Circuits: Use manufacturer's standard cables.
- E. Wire Identification: Numbered and tagged at each termination.
 - 1. Wire Tags:
 - a. Machine printed, heat shrink.
 - b. In accordance with project tagging and labeling requirements.
 - 2. Manufacturers:
 - a. Brady PermaSleeve.
 - b. Tyco Electronics.

2.05 TERMINAL BLOCKS AND GROUNDING BUS

- A. Quantity:
 - 1. Accommodate present and spare indicated needs.
 - 2. Wire spare PLC I/O points to terminal blocks.
 - 3. One wire per terminal for field wires entering enclosures.
 - 4. Maximum of two wires per terminal for 18-WG wire for internal enclosure wiring.
 - 5. Spare Terminals: 20 percent of all connected terminals, but not less than five per terminal block.
- B. General:
 - 1. Connection Type: Screw compression clamp.
 - 2. Compression Clamp:
 - a. Complies with DIN-VDE 0611.
 - b. Hardened steel clamp with transversal groves that penetrate wire strands providing a vibration-proof connection.
 - c. Guides strands of wire into terminal.
 - 3. Screws: Hardened steel, captive and self-locking.
 - 4. Current Bar: Copper or treated brass.
 - 5. Insulation:
 - a. Thermoplastic rated for minus 55 degrees C to plus 110 degrees C.
 - b. Two funneled shaped inputs to facilitate wire entry.

6. Mounting:
 - a. Standard DIN rail.
 - b. Terminal block can be extracted from an assembly without displacing adjacent blocks.
 - c. End Stops: Minimum of one at each end of rail.
7. Wire Preparation: Stripping only permitted.
8. Jumpers: Allow jumper installation without loss of space on terminal or rail.
9. Marking System:
 - a. Terminal number shown on both sides of terminal block.
 - b. Allow use of preprinted and field marked tags.
 - c. Terminal strip numbers shown on end stops.
 - d. Mark terminal block and terminal strip numbers as shown on Panel Control Diagrams and Loop Diagrams.
 - e. Fuse Marking for Fused Terminal Blocks: Fuse voltage and amperage rating shown on top of terminal block.

C. Terminal Block, General-Purpose:

1. Rated Voltage: 600V ac.
2. Rated Current: 30-amp.
3. Wire Size: 22 AWG to 10 AWG.
4. Rated Wire Size: 10 AWG.
5. Color: Grey body.
6. Spacing: 0.25 inch, maximum.
7. Test Sockets: One screw test socket 0.079-inch diameter.
8. Manufacturer and Product: Phoenix Contact, or Entrelec, Type M4/6.T.

D. Terminal Block, Ground:

1. Wire Size: 22 AWG to 12 AWG.
2. Rated Wire Size: 12 AWG.
3. Color: Green and yellow body.
4. Spacing: 0.25 inch, maximum.
5. Grounding: Ground terminal blocks electrically grounded to the mounting rail.
6. Manufacturer and Product: Phoenix Contact, or Entrelec, Type M4/6.P.

E. Terminal Block, Blade Disconnect Switch:

1. Rated Voltage: 600V ac.
2. Rated Current: 10-amp.
3. Wire Size: 22 AWG to 12 AWG.
4. Rated Wire Size: 12 AWG.
5. Color: Grey body, orange switch.

6. Spacing: 0.25 inch, maximum.
 7. Manufacturer and Product: Phoenix Contact, or Entrelec, Type M4/6.SN.T.
- F. Terminal Block, Fused, 24V dc:
1. Rated Voltage: 600V dc.
 2. Rated Current: 16-amp.
 3. Wire Size: 22 AWG to 10 AWG.
 4. Rated Wire Size: 10 AWG.
 5. Color: Grey body.
 6. Fuse: 0.25 inch by 1.25 inches.
 7. Indication: LED diode 24V dc.
 8. Spacing: 0.512 inch, maximum.
 9. Manufacturer and Product: Phoenix Contact, or Entrelec, Type M10/13T.SFL.
- G. Terminal Block, Fused, 120V ac:
1. Rated Voltage: 600V ac.
 2. Rated Current: 16-amp.
 3. Wire Size: 22 AWG to 10 AWG.
 4. Rated Wire Size: 10 AWG.
 5. Color: Grey body.
 6. Fuse: 0.25 inch by 1.25 inches.
 7. Indication: Neon Lamp 110V ac.
 8. Leakage Current: 1.8 mA, maximum.
 9. Spacing: 0.512 inch, maximum
 10. Manufacturer and Product: Phoenix Contact, or Entrelec; Type M10/13T.SFL.
- H. Terminal Block, Fused, 120V ac, High Current:
1. Rated Voltage: 600V ac.
 2. Rated Current: 35 amps.
 3. Wire Size: 18 AWG to 8 AWG.
 4. Rated Wire Size: 8 AWG.
 5. Color: Grey.
 6. Fuse: 13/32 inch by 1.5 inches.
 7. Spacing: 0.95 inch, maximum.
 8. Manufacturer and Product: Phoenix Contact, or Entrelec; Type MB10/24.SF.

I. Grounding Bus:

1. General:

- a. Equipotential plane between service grounds and equipment during fault and transient conditions.
- b. Provides a convenient, single-point grounding and bounding location.
- c. UL Certificate.

2.06 BREAKERS

A. Power Distribution within Panels:

1. 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.
 - 1) Branch Circuit Breaker: 15 amps at 250V ac.
 - c. Breaker Manufacturers and Products:
 - 1) Allen Bradley 1489-M.
 - 2) Altech L Series.

2.07 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 amps to 5 amps at 28V dc or 120V ac.
- d. Contact Material: Gold or silver.
- e. Coil Voltage: As noted or shown.
- f. Operating Temperature: Minus 10 degrees C to 70 degrees C.
- g. Coil Power: 0.9 watts (dc), 1.2VA (ac).
- h. Expected Mechanical Life: 10,000,000 operations.
- i. Expected Electrical Life at Rated Load: 100,000 operations.
- j. Indication Type: Neon or LED indicator lamp.
- k. Seal Type: Hermetically sealed case.
- l. 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: (2 or 3 or 4) Form C contacts. Based on Isolation requirements.
 - 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. Operating Temperature: Minus 10 degrees C to 70 degrees C.
 - g. Coil Power: 1.8 watts (dc), 2.7VA (ac).
 - h. Expected Mechanical Life: 10,000,000 operations.
 - i. Expected Electrical Life at Rated Load: 100,000 operations.
 - j. Indication Type: Neon or LED indicator lamp.
 - k. Push to test button.
 - l. 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 minimum.
 - 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. Operating Temperature: Minus 10 degrees C to 70 degrees C.
 - g. Coil Power: 2.7 watts (dc), 5.3VA (ac).
 - h. Expected Mechanical Life: 500,000 operations.
 - i. Expected Electrical Life at Rated Load: 50,000 operations.
 - j. 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 minimum.
 - 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 degrees C to 70 degrees C.
 - f. Repeatability: Plus or minus 2 percent.
 - g. Delay Time Range: Select range such that time delay setpoint fall between 20 percent 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:
 - 1) Potter and Brumfield:
 - a) Series CB for 0.1 second to 100-minute delay time ranges.
 - b) Series CK for 0.1 second to 120-second delay time ranges.

6. Coupling Relay:
 - a. Type:
 - 1) Force-guided contacts.
 - 2) Safe coupling relay.
 - b. Contact Arrangement:
 - 1) Four Normally Opened contacts.
 - 2) Two Normally Closed contacts.
 - c. Contact Rating:
 - 1) 5A at 250V ac.
 - 2) 5A at 24V dc.
 - 3) Contact Material: Silver stannum oxide alloy.
 - d. Coil Voltage: 24 Vac/dc, unless otherwise noted.
 - e. Operating Temperature: Minus 20 degrees C to 55 degrees C.
 - f. Connection: fixed screw terminal block
 - g. Manufacturer and Products:
 - 1) Phoenix Contact, PSR-. -24UC/URM/4X1/2X2.

2.08 24V DC POWER SUPPLIES

- A. Furnish to power instruments requiring external dc power, including two-wire transmitters and dc relays.
- B. 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.
- C. Provide 24V dc power supply redundancy for all 24V dc power supplies.
- D. Provide output over voltage and over current protective devices to:
 1. Protect instruments from damage due to power supply failure.
 2. Protect power supply from damage due to external failure.
- E. Provide backup battery and uninterruptible DC power supply module. Size the unit for 20 minutes backup power. If shown on the Drawings.
- F. Enclosures: NEMA 1 in accordance with NEMA 250.
- G. Mount such that dissipated heat does not adversely affect other components.
- H. Fuses: For each dc supply line to each individual two-wire transmitter.
 1. Type: Indicating.
 2. Mount so fuses can be easily seen and replaced.
- I. Operating Temperature: Minus 10 degrees C to 70 degrees C.

J. Sizing and Calculations:

1. Size the unit for minimum 20 spare capacity.
2. Provide power sizing calculation with panel submittals.

2.09 48V DC POWER SUPPLIES

A. Furnish to power instruments requiring external dc power ethernet switches,

B. 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.

C. Provide 48V dc power supply redundancy for all 48V dc power supplies.

D. Provide output over voltage and over current protective devices to:

1. Protect network equipment.
2. Protect power supply from damage due to external failure.

E. Enclosures: NEMA 1 in accordance with NEMA 250.

F. 48V dc power supplier provides:

1. Adjustable output voltage.
2. Protective Circuit:
 - a. Transient surge protection.
 - b. Varistor, gas-filled surge arrester.
 - c. Connection in Parallel: Yes, for redundancy and increased capacity.
 - d. Output fuse mode.

G. Mount such that dissipated heat does not adversely affect other components.

H. Fuses: For each dc supply line to each individual two-wire transmitter.

1. Type: Indicating.
2. Mount so fuses can be easily seen and replaced.

I. Operating Temperature: Minus 10 degrees C to 70 degrees C.

J. Sizing and Calculations:

1. Size the unit for minimum 20 spare capacity.
2. Provide power sizing calculation with panel submittals.

K. Manufacturer and Products: Phoenix Contact, QUINT4-PS.

2.10 INTERNAL PANEL LIGHTS AND SERVICE RECEPTACLES

A. Internal Panel Lights for Freestanding Panels:

1. Type: Switched 120V, 400 Lumen LED panel light.
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 shield for lights.

B. 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.

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

1. Internal Panel Light: Switched 120V, 400 Lumen LED panel light.
2. Service Outlet: Breaker protected 120-volt, 15-amp, GFCI duplex receptacle.
3. Required for following panels:
 - a. Where noted on the Drawings, Specifications, or panel schedule.

2.11 ANALOG SIGNAL ISOLATORS

A. General:

1. Function: Isolate an analog current signal.
2. Type:
 - a. Solid state with external power supply.
 - b. Three-way isolation of the input signal, output signal, and external power supply.

B. Performance:

1. Isolation:
 - a. Three-way isolation between input, output, and power circuits for common mode voltages up to 250V ac, or 354V dc of ground, on a continuous basis.
 - b. Able to withstand 1,500V ac dielectric strength test for 60 seconds without breakdown.
2. Output Ripple: Less than plus or minus 0.1 percent of maximum output span.
3. Accuracy: Plus or minus 0.1 percent of output span.

4. RFI Resistance: Less than plus or minus 0.5 percent of output span with RFI field strengths of up to 10V/meter at frequencies of 27, 151, and 467 MHz.
 5. EMI Resistance: Less than plus or minus 0.25 percent of output span effect with switching solenoids or commutator motors.
 6. Ambient Temperature, Operating: Minus 13 degrees F to plus 185 degrees F.
- C. Features:
1. Zero and span trim adjustments using 15-turn potentiometers.
 2. Calibration independent of load.
- D. Signal Interface:
1. Input:
 - a. 4 mA dc to 20 mA dc.
 - b. Impedance: 75 ohms.
 2. Output:
 - a. 4 mA dc to 20 mA dc.
 - b. Drives output load impedance up to 1,050 ohms independent of supply voltage to isolator.
- E. Enclosure:
1. NEMA 1, unless otherwise noted.
 2. Mounting: DIN Rail, unless otherwise noted.
- F. Power: 115V ac, unless otherwise noted.
- G. Accessories: 3-inch Type T DIN rail strip.
- H. Manufacturer:
1. Phoenix Contact.
 2. Acromag Model Flat Pack 330I/430I Isolators.

2.12 INTRINSIC SAFETY BARRIERS

- A. Intrinsically Safe Relays: Monitor discrete signals that originate in hazardous area and are used in a safe area.
1. Manufacturer and Product: GEMS; SafePak Series.
- B. Intrinsically Safe Barriers: Interface analog signals as they pass from hazardous area to safe area.
1. Galvanic signal isolation.
 2. HART compatible.

3. Mount: DIN rail.
4. Input: Two 4 mA to 20 mA.
5. Output: Two 4 mA to 20 mA.
6. Approval: Factory Mutual Class 1, Division 1.
7. Manufacturer and Product: Phoenix Contact MACX series.

2.13 ELECTRICAL TRANSIENT PROTECTION

A. General:

1. Function: Protect elements of PICS against damage due to electrical transients induced in interconnecting lines by lightning and nearby electrical systems.
2. Implementation:
 - a. Provide, install, coordinate, and inspect grounding of surge suppressors at:
 - 1) Connection of ac power to PICS equipment including panels, consoles assemblies, and field mounted analog transmitters and receivers.
 - 2) 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.
7. Manufacturer: Phoenix Contact.

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:
 - a. Power Supplies for One Four-wire Transmitter or Receiver: 5 amps minimum at 130V ac.
 - b. All Other Applications: 30 amps minimum at 130V ac.
5. Manufacturer: Phoenix Contact.

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 percent 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.
 3. Manufacturer: Phoenix Contact.
- D. Suppressors on Cellular Antenna Signal Line Field Mount:
1. Function: External Cellular/GPS antenna surge protection device.
 2. Features:
 - a. Type: Weatherized, Flange or Bulkhead Mount.
 - b. Connection Method: N connector 50 ohms.
 - c. Power: 300W RMS.
 - d. Hybrid.
 3. Protection Circuit:
 - a. Frequency Range: 800 Hz to 2,500 Hz.
 - b. VSWR: Less than 1.1:1 Over Frequency Range.
 - c. Insertion Loss: Less than 0.1 dB.
 - d. Turn On: Plus 6.5V dc.
 - e. Turn On Time: 4 nano seconds for 2 kV.
 - f. Max Surge: 20 kA.
 4. Manufacturer and Product: PolyPhaser-6NFNF-F (SPP-GPS).
- E. Suppressors on Cellular Antenna Signal Line Network Panel Mount:
1. Function: Cellular/GPS antenna signal line surge protection device.
 2. Features:
 - a. Type: Attachment plug.
 - b. Overvoltage Category: III.
 - c. Connection Method: N connector 50 ohms.
 3. Protection Circuit:
 - a. Direction of Action: Line-shield/earth ground.
 - b. Maximum Continuous Voltage: 280V dc.
 - c. Operating Effective Current: Less than 1 micro amper.
 - d. Nominal Discharge Current (8/20): 20 kA.
 - e. Total Surge Current (10/350): 2.5 kA.
 - f. Voltage Protection Level: Less than 900V.
 - g. Response Time: Less than 100 nano seconds.
 - h. Frequency Range: 0 Hz to 3 GHz.
 4. Manufacturer and Product: Phoenix Contact, CN-UB-280DC-3-SB.

F. Surge Suppressor:

1. Mounted in Enclosures: Encapsulated inflame retardant epoxy.
2. For Analog Signals Lines:
 - a. Plug: Phoenix Contact, PT 2X2-24DC-ST.
 - b. Base: Phoenix Contact, PT 2X2+F-BE.
3. For 120V ac Lines:
 - a. Plug: Phoenix Contact, PT 2-PE/S-120AC-ST.
 - b. Base: Phoenix Contact, PT-BE/FM.
4. Field Mounted at Two-Wire Instruments: Encapsulated in stainless steel pipe nipples.
 - a. Manufacturer and Product: 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: Emerson; SLAC Series.

G. 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.

2.14 FRONT OF PANEL DEVICES

A. Front-of-Panel Devices in Conjunction with NEMA 250, Type 1 and Type 12 Panels:

1. 120V ac front of panel devices shall have covers to protect maintenance personnel from electrical shock.
2. Potentiometer Units:
 - a. Three-terminal, oiltight construction, resolution of 1 percent and linearity of plus or minus 5 percent.
 - b. Single-hole, panel mounting accommodating panel thicknesses between 1/8 inch and 1/4 inch.
 - c. Include legend plates with service markings.
 - d. Manufacturers and Products:
 - 1) General Electric Co.; Type CR104P.
 - 2) Square D Co.; Type T.
 - 3) Eaton/Cutler-Hammer; Model 10250T.
3. Indicating Lights:
 - a. Heavy-duty, push-to-test type, oiltight, industrial type with integral transformer for 120V ac applications.
 - b. Screwed on prismatic glass lenses in colors noted and factory engraved legend plates for service legend.

- c. Manufacturers and Products:
 - 1) General Electric Co.; Type CR104P.
 - 2) Square D Co.; Type T.
 - 3) Eaton/Cutler-Hammer; Model 10250T.
 - 4. Pushbutton, Momentary:
 - a. Heavy-duty, oiltight, industrial type with full guard and momentary contacts rated for 10 amperes continuous at 120V ac.
 - b. Standard size legend plates with black field and white markings for service legend.
 - c. Manufacturers and Products:
 - 1) General Electric Co.; Type CR104P.
 - 2) Square D Co.; Type T.
 - 3) Eaton/Cutler-Hammer; Model 10250T.
 - 5. Selector Switch:
 - a. Heavy-duty, oiltight, industrial type with contacts rated for 120V ac service at 10 amperes continuous.
 - b. Standard size, black field, legend plates with white markings, for service legend.
 - c. Operators: Black knob type.
 - d. Single-hole mounting, accommodating panel thicknesses from 1/16 inch to 1/4 inch.
 - e. Manufacturers and Products for Units with up to Four Selection Positions:
 - 1) General Electric Co.; Type CR104P.
 - 2) Square D Co.; Type T.
 - 3) Eaton/Cutler-Hammer; Model 10250T.
- B. Front-of-Panel Devices Used in Conjunction with NEMA 250, Type 4X Panels:
 - 1. Potentiometer, Watertight:
 - a. Three-terminal, heavy-duty NEMA 250, Type 4X watertight construction, resolution of 1 percent and linearity of plus or minus 5 percent.
 - b. Single-hole, panel mounting accommodating panel thicknesses between 1/8 inch and 1/4 inch.
 - c. Include engraved legend plates with service markings.
 - d. Manufacturers and Products:
 - 1) General Electric Co.; Type CR104P.
 - 2) Square D Co.; Type T.
 - 3) Eaton/Cutler-Hammer; Model 10250T.
 - 2. Indicating Lights, Watertight:
 - a. Heavy-duty, push-to-test type, NEMA 250, Type 4X watertight, industrial type with integral transformer for 120V ac applications and corrosion-resistant service.

- b. Screwed on prismatic lenses and factory engraved legend plates for service legend.
 - c. Manufacturers and Products:
 - 1) Square D; Type SK.
 - 2) General Electric Co.; Type CR 104P.
 - 3) Eaton/Cutler-Hammer; Type E34.
 - 4) Crouse-Hinds; Type NCS.
3. Pushbutton, Momentary, Watertight:
- a. Heavy-duty, NEMA 250, Type 4X watertight, industrial type with momentary contacts rated for 120V ac service at 10 amperes continuous and corrosion-resistant service.
 - b. Standard size, black field, legend plates with white markings for service legend.
 - c. Manufacturers and Products:
 - 1) Square D; Type SK.
 - 2) General Electric Co.; Type CR 104P.
 - 3) Eaton/Cutler-Hammer; Type E34.
 - 4) Crouse-Hinds; Type NCS.
4. Selector Switch, Watertight:
- a. Heavy-duty, NEMA 250, Type 4X watertight, industrial type with contacts rated for 120V ac service at 10 amperes continuous and corrosion-resistant service.
 - b. Standard size, black field, legend plates with white markings, for service legend.
 - c. Operators: Black knob type.
 - d. Single-hole mounting, accommodating panel thicknesses from 1/16 inch to 1/4 inch.
 - e. Manufacturer and Products:
 - 1) Square D; Type SK.
 - 2) General Electric Co.; Type CR 104P.
 - 3) Eaton/Cutler-Hammer; Type E34.
 - 4) Crouse-Hinds; Type NCS.

C. Standard Pushbutton Colors and Incriptions:

1. Use following color code and inscriptions for pushbuttons, unless otherwise noted in Article Supplements:

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

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

D. Standard Light Colors and Incriptions:

1. 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	CLOSED	Red
LOW	LOW	Green
FAIL	FAIL	Amber
HIGH	HIGH	Red
AUTO	AUTO	White
MANUAL	MANUAL	Yellow
LOCAL	LOCAL	White
REMOTE	REMOTE	Yellow

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

2.15 CORROSION PROTECTION

- A. Provide for all control panels, network panels, and analyzer panels.
- B. Protect enclosures, and other equipment, containing electrical, instrumentation and control devices, including spare parts, from corrosion through the use of corrosion-inhibiting vapor modules.
- C. Periodically replace capsules in accordance with capsules manufacturer's recommendations. Replace capsules just prior to Final Payment and Acceptance.
 1. Corrosion-Inhibiting Vapor Capsule Manufacturers:
 - a. Northern Instruments; Model Zerust VC.
 - b. Hoffmann Engineering Co.; Model A-HCI.

2.16 PANEL MOUNTED UPS

- A. For control panels that are not powered from an external Uninterruptible Power Supply (UPS), provide an internal panel mounted UPS and

maintenance bypass switch to provide power to all instruments, PLC, and network equipment in control panel. Size the unit for 20 minutes backup power.

1. Certification: UL 508.
2. Capacity: Provide backup power sizing calculation with panel submittals.
3. Input Power:
 - a. 240/120V ac single-phase, three-wire plus ground, 60-Hz, unless otherwise noted.
 - b. Connections: Hardwired or via receptacle.
4. Output Power:
 - a. 120V ac single-phase, three-wire plus ground, 60-Hz, unless otherwise noted.
 - b. PFC Sinewave.
 - c. Connections: Receptacle/plug.
5. Bypass Switch: Externally mounted, make-before-break type, manufacturer's standard product.
 - a. Where required, provide dedicated, separately mounted, fully rated circuit breaker in the external maintenance bypass circuit. Size per manufacturer's instructions.
 - b. Mounting:
6. Manufacturer.

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 40 90 20 CONTROL PANELS

PART 1 GENERAL

1.01 SUMMARY

- A. This PICS section gives requirements for control panels. The PICS control panels shall be completely coordinated, submitted, installed, executed, and completed by the overall PIC SI in accordance with Section 40 90 00, Instrumentation and Control for Process Systems. For the following items, this subsection shall meet the requirements of, and be in accordance with, Section 40 90 00, Instrumentation and Control for Process Systems:
 - 1. Submittals.
 - 2. References.
 - 3. Definitions.
 - 4. Related Sections.
 - 5. Environmental Requirements.
 - 6. Delivery, Storage, and Handling.
- B. All panel enclosures shall be UL recognized or listed.

1.02 RELATED SECTIONS

- A. Refer to Section 40 90 00, Instrumentation and Control for Process Systems, for all related sections.

1.03 WORK INCLUDED

- A. Major Work Items: Included, but not limited to engineering, furnishing, installing, calibrating, adjusting, testing, documenting, starting up and training for all PICS control panels.
- B. Provide all tools, supplies, materials, equipment, and all labor necessary for furnishing, constructing, installing, terminating, and testing all PICS Control Panel.
- C. Fabricate all control panels as shown on the Drawings and Schedules.

1.04 SUBMITTALS

- A. Action Submittals:
 - 1. Bill of Materials: List of required equipment.
 - 2. Catalog Cuts: I&C components, electrical devices, and mechanical devices.

3. Control Panel Instrument List.
4. Component Data Sheets: Data sheets for I&C components.
5. Sizing and Selection Calculations:
 - a. UPS, if shown on the Drawings.
 - b. DC Power supplies.
 - c. Control panel AC and DC power consumption.
 - d. Heat dissipation and air conditioning, where needed.
6. Preliminary Panel Elevation Drawings: Provide prior to submitting Panel Construction Drawings.
7. Panel Construction Drawings:
 - a. Control Panel General Arrangement drawings:
 - 1) Free standing enclosure type panel: Enclosure.
 - 2) Frame mount type panel: Panel and frame.
 - b. Control Panel, Panel Layout drawing.
 - c. Panel Construction Drawings:
 - 1) Scale Drawings: Show dimensions and location of panel mounted devices, doors, louvers, and subpanels, internal and external.
 - 2) Panel Legend: List front of panel devices by tag numbers, nameplate inscriptions, service legends, and annunciator inscriptions.
 - 3) Bill of Materials: List devices mounted within panel that are not listed in panel legend. Include tag number, description, manufacturer, and model number.
 - 4) 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.
 - 5) Construction Notes: Finishes, wire color schemes, wire ratings, wire and terminal block, numbering, and labeling scheme.
8. Panel Wiring Diagrams:
 - a. Wireway sizing calculations: In accordance with UL 508A.
 - b. Detailed Panel Control Wiring and Power Wiring Diagrams: For discrete control and power circuits within the panel.
 - 1) Show point-to-point and terminal-to-terminal wiring within, or on the face of, the panel.
 - 2) Field wiring, terminations, cabling for PICS discrete and analog circuits shall be shown on Loop Diagrams. PIC SI shall coordinate between Detailed Panel Control Wiring Diagrams and Loop Diagrams.
 - 3) 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.

- a) Relay Coils:
 - (1) Tag number and its function.
 - (2) On right side of run where coil is located, list contact location by ladder number and sheet number. Underline normally closed contacts.
- b) Relay Contacts: Coil tag number, function, and coil location (ladder rung number and sheet number).
- 4) Show each circuit individually. No “typical” diagrams or “typical” wire lists will be permitted.
- 5) Ground wires, surge protectors, and connections.
- 6) Circuit Names: Show names corresponding to Circuit and Raceway Schedule for circuits entering and leaving a panel. Refer to Division 26, Electrical.
- c. Spares, expendables, and test equipment.
- d. Electronic Copies: Microsoft Excel.
- e. Submit anchorage and bracing design drawings, cut sheets, and their installation information for components, distribution systems, and equipment as required by Section 01 88 15, Anchorage and Bracing.

B. Informational Submittals:

- 1. Operation and Maintenance Data.
- 2. Instrument calibration procedure.
- 3. Testing Related Submittals:
 - a. Factory Demonstration Test:
 - 1) Preliminary Test Procedures: Outline of proposed tests, forms, and checklists.
 - 2) Final Test Procedures:
 - a) Proposed test procedures, forms, and checklists.
 - b) Capacity, Timing, and Simulation: Describe simulation and monitoring methods used to demonstrate compliance with capacity and timing requirements.
 - 3) Test Documentation: Copy of signed off test results.
 - b. Site Performance Test:
 - 1) Preliminary Test Procedures: Outline of proposed tests, forms, and checklists.
 - 2) Final Test Procedures: Proposed test procedures, forms, and checklists.
 - 3) Test Documentation: Copy of signed-off test results.
- 4. Configuration and Setpoints Records:
 - a. Hard copy.
 - b. Electronic copy.

1.05 QUALITY ASSURANCE

A. Qualifications:

1. Control Panel Supplier: Minimum of 5 years' experience providing, integrating, installing, and starting up similar systems as required for this Project.
2. Control Panel Supplier Site Representative: Minimum of 5 years' experience installing similar systems as required for this Project.

B. Coordination:

1. Control panels shall be in accordance with control panel and P&ID Drawings.
2. Coordinate with electrical contractor for all conduit entry and wiring interfaces including power and signal, all panel locations, and all mounting.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. In accordance with Section 01 61 00, Common Product Requirements.
- B. In accordance with Section 40 90 00, Instrumentation and Controls for Process Systems.

1.07 EXTRA MATERIALS

A. Expendables:

1. For following items provide manufacturer's recommended 2-year supply, unless otherwise noted:
 - a. Calibration kits.
 - b. Corrosion-inhibiting vapor capsules.

PART 2 PRODUCTS

2.01 CONTROL PANELS

- A. Function: Provides PLC and control system equipment mounting and field wiring termination.
- B. Reference Control Panel Schedule, Network Component List, PLC Equipment List, and PLC I/O lists in Article Supplements.
- C. Reference P&IDs and block diagrams on the Drawings.
- D. Reference all PICS subsections as there may be panel requirements, or elements, contained in other PICS subsections.

E. Freestanding Panel:

1. Materials: Sheet steel, unless otherwise shown on the 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 the 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.
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 the 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 the Drawings.
7. Internal Panel Lights:
 - a. Quantity: One light for every 4 feet of panel width.
 - b. Mounting: Inside and in the top of back-of-panel area.
 - c. Protective shield for lights.
8. Service Outlets:
 - a. Type: Three-wire, 120-volt, 15-ampere, GFCI duplex receptacle.
 - b. Quantity:
 - 1) For Panels 6 Feet Wide and Smaller: One.
 - 2) For Panels Wider than 6 Feet: One for every 6 feet of panel width, two minimum per panel.
 - c. Mounting: Evenly spaced along back-of-panel area.
9. Enclosure Manufacturer: In accordance with Section 40 90 13, Control and Network Panel Components.

F. Non-freestanding Panel:

1. Based on environmental design requirements required and referenced in accordance with Section 40 90 00, Instrumentation and Control for

Process Systems; Article Environmental Requirements, provide the following:

- a. For panels listed as inside, air conditioned:
 - 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. Internal Panel Lights and Service Outlets:
 - a. Internal Panel Light: Switched 120V, 400 Lumen LED panel light.
 - b. Service Outlet: Breaker protected 120-volt, 15-amp, GFCI duplex receptacle:
 - c. Required for all PICS supplied panels.

2.02 NAMEPLATES AND TAGS

- A. In accordance with Section 40 90 13, Control and Network Panel Components.

2.03 PLCS

- A. In accordance with Section 40 90 12, PLC Components.

2.04 WIRES WITHIN ENCLOSURES

- A. In accordance with Section 40 90 13, Control and Network Panel Components.

2.05 TERMINAL BLOCKS AND GROUNDING BUS

- A. In accordance with Section 40 90 13, Control and Network Panel Components.

2.06 BREAKERS

- A. In accordance with Section 40 90 13, Control and Network Panel Components.

2.07 RELAYS

- A. In accordance with Section 40 90 13, Control and Network Panel Components.

2.08 DC POWER SUPPLIES

A. In accordance with Section 40 90 13, Control and Network Panel Components.

2.09 INTERNAL PANEL LIGHTS AND SERVICE RECEPTACLES

A. In accordance with Section 40 90 13, Control and Network Panel Components.

2.10 ANALOG SIGNAL ISOLATORS

A. In accordance with Section 40 90 13, Control and Network Panel Components.

2.11 INTRINSIC SAFETY BARRIERS

A. In accordance with Section 40 90 13, Control and Network Panel Components.

2.12 ELECTRICAL TRANSIENT PROTECTIONFRONT OF PANEL DEVICES

A. In accordance with Section 40 90 13, Control and Network Panel Components.

2.13 CORROSION PROTECTION

A. In accordance with Section 40 90 13, Control and Network Panel Components.

2.14 SPARE PARTS

Description	Percent of Each Type and Size Used	No Less Than
Fuses	20	5
Relays	20	3
Terminal Blocks	10	10

PART 3 EXECUTION

3.01 FABRICATION

A. General:

1. Panels with external dimensions and instruments arrangement as shown on the Drawings.

2. Panel Construction and Interior Wiring: In accordance with the National Electrical Code, UL 508, state, and local codes, NEMA, ANSI, UL, and ICECA.
- B. Factory Assembly: Fabricate panels, install instruments, wire, and plumb, 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. All UL 508A labelling of the panels shall be placed and applied prior to delivery to Site.
- D. UL Listing Mark for Hazardous Control Enclosures: "Listed Enclosed Industrial Control Panel" per UL 698A.
- E. Control panels with PLCs shall be fed with two external 120V ac power sources.
1. External UPS Power: Power critical loads including PLC, OIT, network components, power supplies, and field instruments.
 2. External Utility Power: Power noncritical loads including lights, convenience receptacles, fans, heaters, and air conditioners.
- F. Wiring Within PICS Panels:
1. Wire Identification: Numbered and tagged at each termination.
 2. Restrain by plastic ties or ducts or metal raceways.
 3. Hinge Wiring: Secure at each end so that bending or twisting will be around longitudinal axis of wire. Protect bend area with sleeve.
 4. Arrange wiring neatly, cut to proper length, and remove surplus wire.
 5. Abrasion protection for wire bundles which pass through holes or across edges of sheet metal.
 6. 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.
 7. 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.

8. Splicing and tapping of wires, allowed only at device terminals or terminal blocks.
9. Terminate 24V dc and analog signal circuits on separate terminal block from ac circuit terminal blocks.
10. 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.
11. Arrange wiring to allow access for testing, removal, and maintenance of circuits and components.
12. Plastic Wire Ducts Fill:
 - a. Do not exceed manufacturer's recommendation.
 - b. Provide sizing calculations with all control panel submittals that have wire ducts.

G. Circuit Identification:

1. Identify power, instrumentation, and control conductors at each termination. Reference project wire label/tag project standard herein.
 - a. Add wire labels for all panel internal wiring, using the PLC rack, slot, point in the internal wiring label.
 - b. Add wire labels for all field wiring as specified hereinafter.
 - 1) All wiring labels shall be included on Supplier loop diagrams and field wiring diagrams.
 - c. Use the following internal panel wire color standards: UL 508A.
2. Method:
 - a. Conductors 3 AWG and Smaller: Identify with sleeves or heat bond markers.
 - b. Cables and Conductors 2 AWG and Larger:
 - 1) Identify with marker plates or tie-on cable marker tags.
 - 2) Attach with nylon tie cord.
 - c. Taped-on markers or tags relying on adhesives not permitted.

H. Analog Signal Distribution:

1. Within Panels: 4 mA dc to 20 mA dc signals may be distributed as 1V dc to 5V dc.
2. Outside Panels: Isolated 4 mA dc to 20 mA dc only.
3. All signal wiring twisted in shielded pairs.
4. 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.

- I. Analog 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 dc to 20 mA dc Signals: 0.2 mA, maximum.
 - b. 1V dc to 5V dc Signals: 0.05V, maximum.

- J. Discrete Signal Switching:
 - 1. Where interlocks are indicated on the Drawings.
 - 2. Interposing relays if, or where, indicated on the Drawings.

- K. Cables entering or leaving enclosures, terminate and identify as follows:
 - 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.
 - 4. Cable Type: As specified in Section 26 05 05, Conductors.

- L. Power Distribution within Panels:
 - 1. Feeder Circuits:
 - a. One or more 120V ac, 60-Hz feeder circuits as shown on the Drawings.
 - b. Make provisions for feeder circuit conduit entry.
 - c. Furnish terminal board for termination of wires.
 - 2. Power: 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.
 - 1) Branch Circuit Breaker: 15 amps at 250V ac.
 - 3. Circuit Wiring:
 - a. P&IDs and Control Diagrams on the Drawings show function only. Use following rules for actual circuit wiring:
 - 1) Devices on Single Circuit: 20, maximum.
 - 2) 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.
 - 3) Branch Circuit Loading: 12 amperes continuous, maximum.
 - 4) Panel Lighting and Service Outlets: Put on separate 15-amp, 120V ac branch circuit.
 - 5) Provide 120V ac plugmold for panel components with line cords.

4. For control panels that are not supplied Uninterruptible Power Supply (UPS), provide an internal panel mounted UPS and maintenance bypass switch to provide power to all instruments, PLC, and network equipment in control panel.
 - a. Unit shall be PFC Sinewave UPS Series with MBP20A6 maintenance bypass switch.
 - b. Size the unit for 20 minutes backup power.
 - c. Provide backup power sizing calculation with panel submittals.

M. 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 24V dc power supply redundancy for all 24V dc power supplies.
4. 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.
5. Enclosures: NEMA Type I in accordance with NEMA 250 standard.
6. Mount such that dissipated heat does not adversely affect other components.
7. 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.

N. Electrical Transient Protection: In accordance with Section 40 90 00, Instrumentation and Controls for Process Systems.

O. 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 the following locations: Control cabinet.
4. Ground terminal block rails to ground bus.

P. Temperature Control:

1. PICS Enclosure Temperature Control Calculations: Provide heat calculations for all panels at time of panel submittals. If the heat calculations indicate required heating, and/or cooling, provide adequate heating and/or cooling.
2. 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) Pull inlet air into panel through filters on lower door, providing cooler air over components exhausted through fan at top of panel.
 - c) Fan Motor Power: 120V ac, 60-Hz, thermostatically controlled.
 - 6) Air Filters: Washable aluminum, Hoffman Series A-FLT.
3. Refrigerated System: Furnish where heat dissipation cannot be adequately accomplished with natural convection or forced ventilation. Smaller Panels (that are not freestanding): Size to adequately dissipate heat from equipment mounted inside panel or in panel face.
4. Space Heaters: Thermostatically controlled to maintain internal panel temperatures above dew point.

Q. 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.
 - 5) Dry Film Thickness: 3 mils, minimum.
 - 6) Color: Light 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.

3.02 INSTALLATION

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

3.03 FIELD FINISHING

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

3.04 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.

3.05 PROTECTION

- A. Corrosion: In accordance with Section 40 90 00, Instrumentation and Control for Process Systems.

3.06 SUPPLEMENTS

- A. The supplements listed below, following "End of Section," are a part of this specification:
 1. Control Panel Schedule:
 - a. Caprock Pump Station (CPS).
 - b. Caprock Tank (CT).
 - c. Intake Pump Station (IPS).

2. I/O List – Hardwired:
 - a. Caprock Pump Station (CPS).
 - b. Caprock Tank (CT).
 - c. Intake Pump Station (IPS).
3. PLC Input and Output List – Networked:
 - a. Caprock Pump Station (CPS).
 - b. Caprock Tank (CT).
 - c. Intake Pump Station (IPS).

END OF SECTION

CAPROCK PUMP STATION
CONTROL PANEL SCHEDULE

MAXIMUM PANEL SIZE
(INCHES)

ITEM	TAG	LOCATION	NAME	DESCRIPTION	MOUNTING	H	W	D	PANEL RATING	NOTES
1	CP20-CP-801-01	CAPROCK PUMP STATION PLC ROOM	MAIN CONTROL PANEL	TWO DOOR SINGLE ACCESS, THREE-POINT LATCHING ENCLOSURE. ONE BACK PANEL AND TWO SIDE PANELS WITH ACCESSORIES: LIGHTS, FAN, INTRUSION SWITCH, DOOR STOP KIT, KEYLOCK.	FREESTAND	90	72	24	NEMA 12	

CAIROCK TANK
CONTROL PANEL SCHEDULE

MAXIMUM PANEL SIZE
(INCHES)

ITEM	TAG	LOCATION	NAME	DESCRIPTION	MOUNTING	H	W	D	PANEL RATING	NOTES
1	GT27-CP-801-01	CAIROCK TANK ELECTRICAL ROOM	MAIN CONTROL PANEL	TWO DOOR SINGLE ACCESS, THREE-POINT LATCHING ENCLOSURE. ONE BACK PANEL AND TWO SIDE PANELS WITH ACCESSORIES: LIGHTS, FAN, INTRUSION SWITCH, DOOR STOP KIT, KEYLOCK.	FREESTAND	72	72	24	NEMA 12	

INTAKE PUMP STATION
CONTROL PANEL SCHEDULE

MAXIMUM PANEL SIZE
(INCHES)

ITEM	TAG	LOCATION	NAME	DESCRIPTION	MOUNTING	H	W	D	PANEL RATING	NOTES
1	IP20-CP-801-01	INTAKE PUMP STATION PLC ROOM	MAIN CONTROL PANEL	TWO DOOR SINGLE ACCESS, THREE-POINT LATCHING ENCLOSURE. ONE BACK PANEL AND TWO SIDE PANELS WITH ACCESSORIES: LIGHTS, FAN, INTRUSION SWITCH, DOOR STOP KIT, KEYLOCK.	FREESTAND	90	72	24	NEMA 12	
2	IP15-LCP-811-01	INTAKE PUMP STATION CHEMICAL FACILITY	TRUCK UNLOADING PANEL	ONE DOOR SINGLE ACCESS, THREE-POINT LATCHING ENCLOSURE. ONE BACK PANEL WITH ACCESSORIES: KEYLOCK.	WALL MOUNT	20	16	10	NEMA 4X	OUTDOOR
3	IP15-LCP-155-01	INTAKE PUMP STATION CHEMICAL FACILITY	CO2/O2 LIFE SAFETY PANEL	ONE DOOR SINGLE ACCESS, THREE-POINT LATCHING ENCLOSURE. ONE BACK PANEL WITH ACCESSORIES: KEYLOCK.	WALL MOUNT	30	24	16	NEMA 4X	
4	IP15-LCP-156-01	INTAKE PUMP STATION CHEMICAL FACILITY	CO2/O2 LIFE SAFETY PANEL	ONE DOOR SINGLE ACCESS, THREE-POINT LATCHING ENCLOSURE. ONE BACK PANEL WITH ACCESSORIES: KEYLOCK.	WALL MOUNT	20	16	10	NEMA 4X	OUTDOOR

CAPROCK PUMP STATION
I/O LIST HARDWIRED

ITEM	PANEL NO	PLC NO	LOOP NO	TAG NO	LOOP TITLE	ONE STATE	I/O TYPE	P+I D NO
1	CP20-CP-801-01	CP20-RIO-801-01A	CP1800101	CP18LT00101LVL	CAPROCK PS FOREBAY TANK COMPARTMENT 1 LEVEL A		AI	CP09-N-1801_D3299318
2	CP20-CP-801-01	CP20-RIO-801-01A	CP1800301	CP18LT00301LVL	CAPROCK PS FOREBAY TANK COMPARTMENT 1 LEVEL B		AI	CP09-N-1801_D3299318
3	CP20-CP-801-01	CP20-RIO-801-01A	CP2000601	CP20PT00601PRSS	CAPROCK PS RAW WATER DISCHARGE HEADER PRESSURE		AI	CP09-N-2001_D3299318
4	CP20-CP-801-01	CP20-RIO-801-01A	CP2002701	CP20PIT02701PRSS	CAPROCK PS RAW WATER CAPROCK PUMP 1 DISCHARGE HEADER PRESSURE		AI	CP09-N-2002_D3299318
5	CP20-CP-801-01	CP20-RIO-801-01A	CP2002703	CP20PIT02703PRSS	CAPROCK PS RAW WATER CAPROCK PUMP 3 DISCHARGE HEADER PRESSURE		AI	CP09-N-2004_D3299318
6	CP20-CP-801-01	CP20-RIO-801-01A	CP2002705	CP20PIT02705PRSS	CAPROCK PS RAW WATER CAPROCK PUMP 5 DISCHARGE HEADER PRESSURE		AI	CP09-N-2006_D3299318
7	CP20-CP-801-01	CP20-RIO-801-01A	CP2003101	CP20FEIT03101FLOW	CAPROCK PS RAW WATER CAPROCK PUMP 1 DISCHARGE HEADER FLOW		AI	CP09-N-2002_D3299318
8	CP20-CP-801-01	CP20-RIO-801-01A	CP2003103	CP20FEIT03103FLOW	CAPROCK PS RAW WATER CAPROCK PUMP 3 DISCHARGE HEADER FLOW		AI	CP09-N-2004_D3299318
9	CP20-CP-801-01	CP20-RIO-801-01A	CP2003105	CP20FEIT03105FLOW	CAPROCK PS RAW WATER CAPROCK PUMP 5 DISCHARGE HEADER FLOW		AI	CP09-N-2006_D3299318
10	CP20-CP-801-01	CP20-RIO-801-01A	CP2050101	CP20T50101TEMP	CAPROCK PS ELECTRICAL ROOM TEMPERATURE A		AI	CP09-N-4902_D3299318
11	CP20-CP-801-01	CP20-RIO-801-01A	CP2050102	CP20T50102TEMP	CAPROCK PS ELECTRICAL ROOM TEMPERATURE B		AI	CP09-N-4902_D3299318
12	CP20-CP-801-01	CP20-RIO-801-01A	CP2050401	CP20T50401TEMP	CAPROCK PS PUMP ROOM AMBIENT TEMPERATURE A		AI	CP09-N-4902_D3299318
13	CP20-CP-801-01	CP20-RIO-801-01A	CP2050402	CP20T50402TEMP	CAPROCK PS PUMP ROOM AMBIENT TEMPERATURE B		AI	CP09-N-4902_D3299318
14	CP20-CP-801-01	CP20-RIO-801-01A	CP2050501	CP20T50501TEMP	CAPROCK PS OUTDOOR TEMPERATURE		AI	CP09-N-4902_D3299318
15	CP20-CP-801-01	CP20-RIO-801-01A	CP2200601	CP22LIT00601LVL	CAPROCK PS SURGE TANK 1 LEVEL A		AI	CP09-N-2201_D3299318
16	CP20-CP-801-01	CP20-RIO-801-01B	CP1800102	CP18LT00102LVL	CAPROCK PS FOREBAY TANK COMPARTMENT 2 LEVEL A		AI	CP09-N-1801_D3299318
17	CP20-CP-801-01	CP20-RIO-801-01B	CP1800302	CP18LT00302LVL	CAPROCK PS FOREBAY TANK COMPARTMENT 2 LEVEL B		AI	CP09-N-1801_D3299318
18	CP20-CP-801-01	CP20-RIO-801-01B	CP2002702	CP20PIT02702PRSS	CAPROCK PS RAW WATER CAPROCK PUMP 2 DISCHARGE HEADER PRESSURE		AI	CP09-N-2003_D3299318
19	CP20-CP-801-01	CP20-RIO-801-01B	CP2002704	CP20PIT02704PRSS	CAPROCK PS RAW WATER CAPROCK PUMP 4 DISCHARGE HEADER PRESSURE		AI	CP09-N-2005_D3299318
20	CP20-CP-801-01	CP20-RIO-801-01B	CP2003102	CP20FEIT03102FLOW	CAPROCK PS RAW WATER CAPROCK PUMP 2 DISCHARGE HEADER FLOW		AI	CP09-N-2003_D3299318
21	CP20-CP-801-01	CP20-RIO-801-01B	CP2003104	CP20FEIT03104FLOW	CAPROCK PS RAW WATER CAPROCK PUMP 4 DISCHARGE HEADER FLOW		AI	CP09-N-2005_D3299318
22	CP20-CP-801-01	CP20-RIO-801-01B	CP2012801	CP20PIT12801PRSS	CAPROCK PS AIR RECEIVING TANK HIGH PRESSURE AIR PRESSURE B		AI	CP09-N-2007_D3299318
23	CP20-CP-801-01	CP20-RIO-801-01B	CP2050201	CP20T50201TEMP	CAPROCK PS PLC ROOM AMBIENT TEMPERATURE		AI	CP09-N-4902_D3299318
24	CP20-CP-801-01	CP20-RIO-801-01B	CP2080101	CP20T80101TEMP	CAPROCK PS MAIN CONTROL PANEL		AI	CP09-N-4902_D3299318
25	CP20-CP-801-01	CP20-RIO-801-01B	CP2083101	CP20T83101TEMP	CAPROCK PS MAIN NETWORK PANEL		AI	CP09-N-4902_D3299318
26	CP20-CP-801-01	CP20-RIO-801-01B	CP2200602	CP22LIT00602LVL	CAPROCK PS SURGE TANK 2 LEVEL A		AI	CP09-N-2201_D3299318
27	CP20-CP-801-01	CP20-RIO-801-01B	CP2080101	CP20PS8010124V-FAIL	CAPROCK PS MAIN CONTROL PANEL	24VDC	DI	CP09-N-4902_D3299318
28	CP20-CP-801-01	CP20-RIO-801-01B	CP2080101	CP20PS80101RACK-FAIL	CAPROCK PS MAIN CONTROL PANEL	24VDC	DI	CP09-N-4902_D3299318
29	CP20-CP-801-01	CP20-RIO-801-01B	CP2083101	CP20PS8310148V-FAIL	CAPROCK PS MAIN NETWORK PANEL	24VDC	DI	CP09-N-4902_D3299318
30	CP20-CP-801-01	CP20-RIO-801-01B	CP2083101	CP20XS83101DOOR	CAPROCK PS MAIN NETWORK PANEL	24VDC	DI	CP09-N-4902_D3299318
31	CP20-CP-801-01	CP20-RIO-801-01B	CP2097101	CP20UPS97101BATT	CAPROCK PS UNINTERRUPTIBLE POWER SUPPLY	24VDC	DI	CP09-N-4902_D3299318
32	CP20-CP-801-01	CP20-RIO-801-01B	CP2097101	CP20UPS97101FAIL	CAPROCK PS UNINTERRUPTIBLE POWER SUPPLY	24VDC	DI	CP09-N-4902_D3299318
33	CP20-CP-801-01	CP20-RIO-801-01B	CP2097101	CP20UPS97101UTIL	CAPROCK PS UNINTERRUPTIBLE POWER SUPPLY	24VDC	DI	CP09-N-4902_D3299318
34	CP20-CP-801-01	CP20-RIO-801-01A	CP2003101	CP20FEIT03101TOT	CAPROCK PS RAW WATER CAPROCK PUMP 1 DISCHARGE HEADER FLOW	24VDC Pulse	DI	CP09-N-2002_D3299318
35	CP20-CP-801-01	CP20-RIO-801-01A	CP2003103	CP20FEIT03103TOT	CAPROCK PS RAW WATER CAPROCK PUMP 3 DISCHARGE HEADER FLOW	24VDC Pulse	DI	CP09-N-2004_D3299318
36	CP20-CP-801-01	CP20-RIO-801-01A	CP2003105	CP20FEIT03105TOT	CAPROCK PS RAW WATER CAPROCK PUMP 5 DISCHARGE HEADER FLOW	24VDC Pulse	DI	CP09-N-2006_D3299318
37	CP20-CP-801-01	CP20-RIO-801-01B	CP2003102	CP20FEIT03102TOT	CAPROCK PS RAW WATER CAPROCK PUMP 2 DISCHARGE HEADER FLOW	24VDC Pulse	DI	CP09-N-2003_D3299318
38	CP20-CP-801-01	CP20-RIO-801-01B	CP2003104	CP20FEIT03104TOT	CAPROCK PS RAW WATER CAPROCK PUMP 4 DISCHARGE HEADER FLOW	24VDC Pulse	DI	CP09-N-2005_D3299318
39	CP20-CP-801-01	CP20-RIO-801-01A	CP0751001	CP07L5H51001HIGH	CAPROCK PS WASTE HOLDING TANK LEVEL	I.S. circuit	DI	CP09-N-4902_D3299318
						SUM: 13		
40	CP20-CP-801-01	CP20-RIO-801-01A	CP1100101	CP11BFV00101CLSD	CAPROCK PS FOREBAY INLET VALVE VAULT TANK COMPARTMENT 1 ISOLATION VALVE		DI	CP09-N-1101_D3299318
41	CP20-CP-801-01	CP20-RIO-801-01A	CP1100101	CP11BFV00101OPND	CAPROCK PS FOREBAY INLET VALVE VAULT TANK COMPARTMENT 1 ISOLATION VALVE		DI	CP09-N-1101_D3299318

CAPROCK PUMP STATION
I/O LIST HARDWIRED

ITEM	PANEL NO	PLC NO	LOOP NO	TAG NO	LOOP TITLE	ONE STATE	I/O TYPE	P-I D NO
42	CP20-CP-801-01	CP20-RIO-801-01A	CP1100102	CP11BFV00102CLSD	CAPROCK PS FOREBAY INLET VALVE VAULT TANK COMPARTMENT 2 ISOLATION VALVE	DI	DI	CP09-N-1101_D3299318
43	CP20-CP-801-01	CP20-RIO-801-01A	CP1100102	CP11BFV00102OPND	CAPROCK PS FOREBAY INLET VALVE VAULT TANK COMPARTMENT 2 ISOLATION VALVE	DI	DI	CP09-N-1101_D3299318
44	CP20-CP-801-01	CP20-RIO-801-01A	CP1100801	CP11LSH00801HIGH	CAPROCK PS FOREBAY INLET VALVE VAULT FLOODING	DI	DI	CP09-N-1101_D3299318
45	CP20-CP-801-01	CP20-RIO-801-01A	CP1800201	CP18LSHH00201HIGH	CAPROCK PS FOREBAY TANK COMPARTMENT 1 OVERFLOW	DI	DI	CP09-N-1801_D3299318
46	CP20-CP-801-01	CP20-RIO-801-01A	CP2000201	CP20LSHH00201HIGH	CAPROCK PS INTAKE VALVE VAULT FLOODING	DI	DI	CP09-N-1801_D3299318
47	CP20-CP-801-01	CP20-RIO-801-01A	CP2000501	CP20SH00501HIGH	CAPROCK PS RAW WATER DISCHARGE HEADER PRESSURE HIGH	DI	DI	CP09-N-2001_D3299318
48	CP20-CP-801-01	CP20-RIO-801-01A	CP2002101	CP20BFV02101CLSD	CAPROCK PS INLET VALVE VAULT FLOODING	DI	DI	CP09-N-2002_D3299318
49	CP20-CP-801-01	CP20-RIO-801-01A	CP2002101	CP20BFV02101OPND	CAPROCK PS INLET VALVE VAULT FLOODING	DI	DI	CP09-N-2002_D3299318
50	CP20-CP-801-01	CP20-RIO-801-01A	CP2002103	CP20BFV02103CLSD	CAPROCK PS RAW WATER LOW PRESSURE INTAKE VALVE VAULT ISOLATION VALVE	DI	DI	CP09-N-2004_D3299318
51	CP20-CP-801-01	CP20-RIO-801-01A	CP2002103	CP20BFV02103OPND	CAPROCK PS RAW WATER LOW PRESSURE INTAKE VALVE VAULT ISOLATION VALVE	DI	DI	CP09-N-2004_D3299318
52	CP20-CP-801-01	CP20-RIO-801-01A	CP2002105	CP20BFV02105CLSD	CAPROCK PS RAW WATER LOW PRESSURE INTAKE VALVE VAULT ISOLATION VALVE	DI	DI	CP09-N-2006_D3299318
53	CP20-CP-801-01	CP20-RIO-801-01A	CP2002105	CP20BFV02105OPND	CAPROCK PS RAW WATER LOW PRESSURE INTAKE VALVE VAULT ISOLATION VALVE	DI	DI	CP09-N-2006_D3299318
54	CP20-CP-801-01	CP20-RIO-801-01A	CP2003201	CP20BFV03201CLSD	CAPROCK PS RAW WATER CAPROCK PUMP 1 DISCHARGE HEADER ISOLATION VALVE	DI	DI	CP09-N-2002_D3299318
55	CP20-CP-801-01	CP20-RIO-801-01A	CP2003201	CP20BFV03201OPND	CAPROCK PS RAW WATER CAPROCK PUMP 1 DISCHARGE HEADER ISOLATION VALVE	DI	DI	CP09-N-2002_D3299318
56	CP20-CP-801-01	CP20-RIO-801-01A	CP2003203	CP20BFV03203CLSD	CAPROCK PS RAW WATER CAPROCK PUMP 3 DISCHARGE HEADER ISOLATION VALVE	DI	DI	CP09-N-2004_D3299318
57	CP20-CP-801-01	CP20-RIO-801-01A	CP2003203	CP20BFV03203OPND	CAPROCK PS RAW WATER CAPROCK PUMP 3 DISCHARGE HEADER ISOLATION VALVE	DI	DI	CP09-N-2004_D3299318
58	CP20-CP-801-01	CP20-RIO-801-01A	CP2003205	CP20BFV03205CLSD	CAPROCK PS RAW WATER CAPROCK PUMP 5 DISCHARGE HEADER ISOLATION VALVE	DI	DI	CP09-N-2006_D3299318
59	CP20-CP-801-01	CP20-RIO-801-01A	CP2003205	CP20BFV03205OPND	CAPROCK PS RAW WATER CAPROCK PUMP 5 DISCHARGE HEADER ISOLATION VALVE	DI	DI	CP09-N-2006_D3299318
60	CP20-CP-801-01	CP20-RIO-801-01A	CP2005001	CP20VIB05001WARN	CAPROCK PS RAW WATER CAPROCK PUMP 1 VIBRATION ALARM	DI	DI	CP09-N-2002_D3299318
61	CP20-CP-801-01	CP20-RIO-801-01A	CP2005003	CP20VIB05003WARN	CAPROCK PS RAW WATER CAPROCK PUMP 3 VIBRATION ALARM	DI	DI	CP09-N-2004_D3299318
62	CP20-CP-801-01	CP20-RIO-801-01A	CP2005005	CP20VIB05005WARN	CAPROCK PS RAW WATER CAPROCK PUMP 5 VIBRATION ALARM	DI	DI	CP09-N-2006_D3299318
63	CP20-CP-801-01	CP20-RIO-801-01A	CP2006201	CP20HCP06201SMOKE_ELECTR	CAPROCK PS SMOKE DETECTED IN ELECTRICAL ROOM	DI	DI	CP09-N-4902_D3299318
64	CP20-CP-801-01	CP20-RIO-801-01A	CP2065101	CP20LSH65101HIGH	CAPROCK PS PUMP ROOM WATER HEATER PAN LEVEL	DI	DI	CP09-N-4902_D3299318
65	CP20-CP-801-01	CP20-RIO-801-01A	CP20086101	CP20IPR6101POWER	CAPROCK PS INTERLOCK PANEL	DI	DI	CP09-N-2002_D3299318
66	CP20-CP-801-01	CP20-RIO-801-01A	CP2414101	CP24BFV14101CLSD	CAPROCK PS ISOLATION VALVE VAULT ISOLATION VALVE	DI	DI	CP09-N-2401_D3299318
67	CP20-CP-801-01	CP20-RIO-801-01A	CP2414101	CP24BFV14101OPND	CAPROCK PS ISOLATION VALVE VAULT ISOLATION VALVE	DI	DI	CP09-N-2401_D3299318
68	CP20-CP-801-01	CP20-RIO-801-01A	CP2414201	CP24BLV14201CLSD	CAPROCK PS ISOLATION VALVE VAULT MAIN BYPASS VALVE	DI	DI	CP09-N-2401_D3299318
69	CP20-CP-801-01	CP20-RIO-801-01A	CP2414201	CP24BLV14201OPND	CAPROCK PS ISOLATION VALVE VAULT MAIN BYPASS VALVE	DI	DI	CP09-N-2401_D3299318
70	CP20-CP-801-01	CP20-RIO-801-01A	CP2414401	CP24LSH14401HIGH	CAPROCK PS ISOLATION VALVE VAULT FLOODING	DI	DI	CP09-N-2401_D3299318
71	CP20-CP-801-01	CP20-RIO-801-01A	CP2414701	CP24BLV14701CLSD	CAPROCK PS ISOLATION VALVE VAULT BYPASS ISOLATION VALVE	DI	DI	CP09-N-2401_D3299318
72	CP20-CP-801-01	CP20-RIO-801-01A	CP2414701	CP24BLV14701OPND	CAPROCK PS ISOLATION VALVE VAULT BYPASS ISOLATION VALVE	DI	DI	CP09-N-2401_D3299318
73	CP20-CP-801-01	CP20-RIO-801-01A	CP2415001	CP24BLV15001CLSD	CAPROCK PS ISOLATION VALVE VAULT BYPASS DRAINAGE VALVE	DI	DI	CP09-N-2401_D3299318
74	CP20-CP-801-01	CP20-RIO-801-01A	CP2415001	CP24BLV15001OPND	CAPROCK PS ISOLATION VALVE VAULT BYPASS DRAINAGE VALVE	DI	DI	CP09-N-2401_D3299318
75	CP20-CP-801-01	CP20-RIO-801-01B	CP1800202	CP18LSHH00202HIGH	CAPROCK PS FOREBAY TANK COMPARTMENT 2 OVERFLOW	DI	DI	CP09-N-1801_D3299318
76	CP20-CP-801-01	CP20-RIO-801-01B	CP1900101	CP19BFV00101CLSD	CAPROCK PS FOREBAY OUTLET VALVE VAULT TANK COMPARTMENT 1 ISOLATION VALVE	DI	DI	CP09-N-1901_D3299318
77	CP20-CP-801-01	CP20-RIO-801-01B	CP1900101	CP19BFV00101OPND	CAPROCK PS FOREBAY OUTLET VALVE VAULT TANK COMPARTMENT 1 ISOLATION VALVE	DI	DI	CP09-N-1901_D3299318
78	CP20-CP-801-01	CP20-RIO-801-01B	CP1900102	CP19BFV00102CLSD	CAPROCK PS FOREBAY OUTLET VALVE VAULT TANK COMPARTMENT 2 ISOLATION VALVE	DI	DI	CP09-N-1901_D3299318
79	CP20-CP-801-01	CP20-RIO-801-01B	CP1900102	CP19BFV00102OPND	CAPROCK PS FOREBAY OUTLET VALVE VAULT TANK COMPARTMENT 2 ISOLATION VALVE	DI	DI	CP09-N-1901_D3299318
80	CP20-CP-801-01	CP20-RIO-801-01B	CP1900801	CP19LSHH00801HIGH	CAPROCK PS FOREBAY OUTLET VALVE VAULT FLOODING	DI	DI	CP09-N-1901_D3299318
81	CP20-CP-801-01	CP20-RIO-801-01B	CP2002102	CP20BFV02102CLSD	CAPROCK PS RAW WATER LOW PRESSURE INTAKE VALVE VAULT ISOLATION VALVE	DI	DI	CP09-N-2003_D3299318
82	CP20-CP-801-01	CP20-RIO-801-01B	CP2002102	CP20BFV02102OPND	CAPROCK PS RAW WATER LOW PRESSURE INTAKE VALVE VAULT ISOLATION VALVE	DI	DI	CP09-N-2003_D3299318
83	CP20-CP-801-01	CP20-RIO-801-01B	CP2002104	CP20BFV02104CLSD	CAPROCK PS RAW WATER LOW PRESSURE INTAKE VALVE VAULT ISOLATION VALVE	DI	DI	CP09-N-2005_D3299318
84	CP20-CP-801-01	CP20-RIO-801-01B	CP2002104	CP20BFV02104OPND	CAPROCK PS RAW WATER LOW PRESSURE INTAKE VALVE VAULT ISOLATION VALVE	DI	DI	CP09-N-2005_D3299318

CAPROCK PUMP STATION
I/O LIST HARDWIRED

ITEM	PANEL NO	PLC NO	LOOP NO	TAG NO	LOOP TITLE	ONE STATE	I/O TYPE	P-I D NO
85	CP20-CF-801-01	CP20-RIO-801-01B	CP2003202	CP20BFCV03202CLSD	CAPROCK PS RAW WATER CAPROCK PUMP 2 DISCHARGE HEADER ISOLATION VALVE		DI	CP09-N-2003_D3299318
86	CP20-CF-801-01	CP20-RIO-801-01B	CP2003202	CP20BFCV03202OPND	CAPROCK PS RAW WATER CAPROCK PUMP 2 DISCHARGE HEADER ISOLATION VALVE		DI	CP09-N-2003_D3299318
87	CP20-CF-801-01	CP20-RIO-801-01B	CP2003204	CP20BFCV03204CLSD	CAPROCK PS RAW WATER CAPROCK PUMP 4 DISCHARGE HEADER ISOLATION VALVE		DI	CP09-N-2005_D3299318
88	CP20-CF-801-01	CP20-RIO-801-01B	CP2003204	CP20BFCV03204OPND	CAPROCK PS RAW WATER CAPROCK PUMP 4 DISCHARGE HEADER ISOLATION VALVE		DI	CP09-N-2005_D3299318
89	CP20-CF-801-01	CP20-RIO-801-01B	CP2005002	CP20VIB05002WARN	CAPROCK PS RAW WATER CAPROCK PUMP 2 VIBRATION ALARM		DI	CP09-N-2003_D3299318
90	CP20-CF-801-01	CP20-RIO-801-01B	CP2005004	CP20VIB05004WARN	CAPROCK PS RAW WATER CAPROCK PUMP 4 VIBRATION ALARM		DI	CP09-N-2005_D3299318
91	CP20-CF-801-01	CP20-RIO-801-01B	CP2006010	CP20HCP60101SMOKE_PUMP	CAPROCK PS SMOKE DETECTED IN PUMP ROOM		DI	CP09-N-4902_D3299318
92	CP20-CF-801-01	CP20-RIO-801-01B	CP2008010	CP20SDR80101SPD-FAIL	CAPROCK PS MAIN CONTROL PANEL		DI	CP09-N-4902_D3299318
93	CP20-CF-801-01	CP20-RIO-801-01B	CP2008010	CP20XS80101DOOR	CAPROCK PS MAIN CONTROL PANEL		DI	CP09-N-4902_D3299318
94	CP20-CF-801-01	CP20-RIO-801-01B	CP2008310	CP20SPD83101SPD-FAIL	CAPROCK PS MAIN NETWORK PANEL		DI	CP09-N-4902_D3299318
95	CP20-CF-801-01	CP20-RIO-801-01B	CP2009450	CP20ATC94501FAIL	CAPROCK PS AUTOMATIC TRANSFER CONTROLLER		DI	CP09-N-4901_D3299318
96	CP20-CF-801-01	CP20-RIO-801-01B	CP2009450	CP20ATC94501GNV	CAPROCK PS AUTOMATIC TRANSFER CONTROLLER		DI	CP09-N-4901_D3299318
97	CP20-CF-801-01	CP20-RIO-801-01B	CP2009450	CP20ATC94501LOADBNK	CAPROCK PS AUTOMATIC TRANSFER CONTROLLER		DI	CP09-N-4901_D3299318
98	CP20-CF-801-01	CP20-RIO-801-01B	CP2009450	CP20ATC94501ONGN	CAPROCK PS AUTOMATIC TRANSFER CONTROLLER		DI	CP09-N-4901_D3299318
99	CP20-CF-801-01	CP20-RIO-801-01B	CP2009450	CP20ATC94501ONUT-A	CAPROCK PS AUTOMATIC TRANSFER CONTROLLER		DI	CP09-N-4901_D3299318
100	CP20-CF-801-01	CP20-RIO-801-01B	CP2009450	CP20ATC94501ONUT-B	CAPROCK PS AUTOMATIC TRANSFER CONTROLLER		DI	CP09-N-4901_D3299318
101	CP20-CF-801-01	CP20-RIO-801-01B	CP2009450	CP20ATC94501TBKR-1	CAPROCK PS AUTOMATIC TRANSFER CONTROLLER		DI	CP09-N-4901_D3299318
102	CP20-CF-801-01	CP20-RIO-801-01B	CP2009450	CP20ATC94501TBKR-2	CAPROCK PS AUTOMATIC TRANSFER CONTROLLER		DI	CP09-N-4901_D3299318
103	CP20-CF-801-01	CP20-RIO-801-01B	CP2009450	CP20ATC94501UTAV-A	CAPROCK PS AUTOMATIC TRANSFER CONTROLLER		DI	CP09-N-4901_D3299318
104	CP20-CF-801-01	CP20-RIO-801-01B	CP2009450	CP20ATC94501UTAV-B	CAPROCK PS AUTOMATIC TRANSFER CONTROLLER		DI	CP09-N-4901_D3299318
105	CP20-CF-801-01	CP20-RIO-801-01B	CP2009750	CP20UPS97501ONBP	CAPROCK PS UPS BYPASS		DI	CP09-N-4902_D3299318
106	CP20-CF-801-01	CP20-RIO-801-01B	CP2204201	CP22BFCV04201CLSD	CAPROCK PS SURGE TANKS VALVE VAULT TANK 1 ISOLATION VALVE		DI	CP09-N-2202_D3299318
107	CP20-CF-801-01	CP20-RIO-801-01B	CP2204201	CP22BFCV04201OPND	CAPROCK PS SURGE TANKS VALVE VAULT TANK 1 ISOLATION VALVE		DI	CP09-N-2202_D3299318
108	CP20-CF-801-01	CP20-RIO-801-01B	CP2204202	CP22BFCV04202CLSD	CAPROCK PS SURGE TANKS VALVE VAULT TANK 2 ISOLATION VALVE		DI	CP09-N-2202_D3299318
109	CP20-CF-801-01	CP20-RIO-801-01B	CP2204202	CP22BFCV04202OPND	CAPROCK PS SURGE TANKS VALVE VAULT TANK 2 ISOLATION VALVE		DI	CP09-N-2202_D3299318
110	CP20-CF-801-01	CP20-RIO-801-01B	CP2204301	CP22LISH04301HIGH	CAPROCK PS SURGE TANKS VALVE VAULT FLOODING		DI	CP09-N-2202_D3299318
						SUM: 71		
111	CP20-CF-801-01	CP20-RIO-801-01A	CP20094401	CP20LIC94401ON	CAPROCK PS LIGHTING CONTRACTOR		DO	CP09-N-4902_D3299318
						SUM: 1		

CAPROCK TANK
I/O LIST HARDWIRED

ITEM	PANEL NO	PLC NO	LOOP NO	TAG NO	LOOP TITLE	ONE STATE	I/O TYPE	P+ID NO
1	CT27-CP-801-01	CT27-PLC-801-01	CT2500101	CT25LT001011VL	CAPROCK TANK COMPARTMENT 1 LEVEL A		AI	CT09-N-2501_D3299318
2	CT27-CP-801-01	CT27-PLC-801-01	CT2500102	CT25LT0010201VL	CAPROCK TANK COMPARTMENT 2 LEVEL A		AI	CT09-N-2501_D3299318
3	CT27-CP-801-01	CT27-PLC-801-01	CT2500301	CT25LT0030101VL	CAPROCK TANK COMPARTMENT 1 LEVEL B		AI	CT09-N-2501_D3299318
4	CT27-CP-801-01	CT27-PLC-801-01	CT2500302	CT25LT0030201VL	CAPROCK TANK COMPARTMENT 2 LEVEL B		AI	CT09-N-2501_D3299318
5	CT27-CP-801-01	CT27-PLC-801-01	CT2750201	CT27TT50201TEMP	CAPROCK TANK ELECTRICAL BUILDING TEMPERATURE		AI	CT09-N-4901_D3299318
6	CT27-CP-801-01	CT27-PLC-801-01	CT2750202	CT27TT50202TEMP	CAPROCK TANK COMPRESSOR ROOM TEMPERATURE		AI	CT09-N-4901_D3299318
7	CT27-CP-801-01	CT27-PLC-801-01	CT2750501	CT27TT50501TEMP	CAPROCK TANK OUTDOOR TEMPERATURE		AI	CT09-N-4901_D3299318
8	CT27-CP-801-01	CT27-PLC-801-01	CT2780101	CT27TT80101CTEMP	CAPROCK TANK MAIN CONTROL PANEL		AI	CT09-N-4901_D3299318
9	CT27-CP-801-01	CT27-PLC-801-01	CT2783101	CT27TT83101TEMP	CAPROCK TANK MAIN NETWORK PANEL		AI	CT09-N-4901_D3299318
						SUM:	9	
10	CT27-CP-801-01	CT27-PLC-801-01	CT2780101	CT27PS8010124V-FAIL	CAPROCK TANK MAIN CONTROL PANEL	24VDC	DI	CT09-N-4901_D3299318
11	CT27-CP-801-01	CT27-PLC-801-01	CT2780101	CT27PS80101RACK-FAIL	CAPROCK TANK MAIN CONTROL PANEL	24VDC	DI	CT09-N-4901_D3299318
12	CT27-CP-801-01	CT27-PLC-801-01	CT2780101	CT27TT80101DDOOR	CAPROCK TANK MAIN CONTROL PANEL	24VDC	DI	CT09-N-4901_D3299318
13	CT27-CP-801-01	CT27-PLC-801-01	CT2783101	CT27NP83101DDOOR	CAPROCK TANK MAIN NETWORK PANEL	24VDC	DI	CT09-N-4901_D3299318
14	CT27-CP-801-01	CT27-PLC-801-01	CT2783101	CT27PS8310148V-FAIL	CAPROCK TANK MAIN NETWORK PANEL	24VDC	DI	CT09-N-4901_D3299318
15	CT27-CP-801-01	CT27-PLC-801-01	CT2797101	CT27UPS97101BATT	CAPROCK TANK UNINTERRUPTIBLE POWER SUPPLY	24VDC	DI	CT09-N-4901_D3299318
16	CT27-CP-801-01	CT27-PLC-801-01	CT2797101	CT27UPS97101FAIL	CAPROCK TANK UNINTERRUPTIBLE POWER SUPPLY	24VDC	DI	CT09-N-4901_D3299318
17	CT27-CP-801-01	CT27-PLC-801-01	CT2797101	CT27UPS97101UTIL	CAPROCK TANK UNINTERRUPTIBLE POWER SUPPLY	24VDC	DI	CT09-N-4901_D3299318
						SUM:	8	
18	CT27-CP-801-01	CT27-PLC-801-01	CT1100101	CT11BFV00101CLSD	CAPROCK TANK INLET VALVE VAULT TANK COMPARTMENT 1 ISOLATION VALVE		DI	CT09-N-1101_D3299318
19	CT27-CP-801-01	CT27-PLC-801-01	CT1100101	CT11BFV00101OPND	CAPROCK TANK INLET VALVE VAULT TANK COMPARTMENT 1 ISOLATION VALVE		DI	CT09-N-1101_D3299318
20	CT27-CP-801-01	CT27-PLC-801-01	CT1100102	CT11BFV00102CLSD	CAPROCK TANK INLET VALVE VAULT TANK COMPARTMENT 2 ISOLATION VALVE		DI	CT09-N-1101_D3299318
21	CT27-CP-801-01	CT27-PLC-801-01	CT1100102	CT11BFV00102OPND	CAPROCK TANK INLET VALVE VAULT TANK COMPARTMENT 2 ISOLATION VALVE		DI	CT09-N-1101_D3299318
22	CT27-CP-801-01	CT27-PLC-801-01	CT1100601	CT11LSH00601HIGH	CAPROCK TANK INLET VALVE VAULT FLOODING		DI	CT09-N-1101_D3299318
23	CT27-CP-801-01	CT27-PLC-801-01	CT2500201	CT25LSHH00201HHI	CAPROCK TANK COMPARTMENT 1 OVERFLOW		DI	CT09-N-2501_D3299318
24	CT27-CP-801-01	CT27-PLC-801-01	CT2500202	CT25LSHH00202HHI	CAPROCK TANK COMPARTMENT 2 OVERFLOW		DI	CT09-N-2501_D3299318
25	CT27-CP-801-01	CT27-PLC-801-01	CT2780101	CT27SPD80101SPD-FAIL	CAPROCK TANK MAIN CONTROL PANEL		DI	CT09-N-4901_D3299318
26	CT27-CP-801-01	CT27-PLC-801-01	CT2783101	CT27SPD83101SPD-FAIL	CAPROCK TANK MAIN NETWORK PANEL		DI	CT09-N-4901_D3299318
27	CT27-CP-801-01	CT27-PLC-801-01	CT2797501	CT27UPS97501ONBP	CAPROCK TANK UPS BYPASS		DI	CT09-N-4901_D3299318
28	CT27-CP-801-01	CT27-PLC-801-01	CT3200101	CT32BFV00101CLSD	CAPROCK TANK OUTLET VALVE AND CHEMICAL INJECTION VAULT TANK COMPARTMENT 1 ISOLATION VALVE		DI	CT09-N-3201_D3299318
29	CT27-CP-801-01	CT27-PLC-801-01	CT3200101	CT32BFV00101OPND	CAPROCK TANK OUTLET VALVE AND CHEMICAL INJECTION VAULT TANK COMPARTMENT 1 ISOLATION VALVE		DI	CT09-N-3201_D3299318
30	CT27-CP-801-01	CT27-PLC-801-01	CT3200102	CT32BFV00102CLSD	CAPROCK TANK OUTLET VALVE AND CHEMICAL INJECTION VAULT TANK COMPARTMENT 2 ISOLATION VALVE		DI	CT09-N-3201_D3299318
31	CT27-CP-801-01	CT27-PLC-801-01	CT3200102	CT32BFV00102OPND	CAPROCK TANK OUTLET VALVE AND CHEMICAL INJECTION VAULT TANK COMPARTMENT 2 ISOLATION VALVE		DI	CT09-N-3201_D3299318
32	CT27-CP-801-01	CT27-PLC-801-01	CT3200601	CT32LSHH00601HIGH	CAPROCK TANK OUTLET VALVE AND CHEMICAL INJECTION VAULT FLOODING		DI	CT09-N-3201_D3299318
						SUM:	15	
33	CT27-CP-801-01	CT27-PLC-801-01	CT2794401	CT27LC94401ON	CAPROCK TANK LIGHTING CONTRACTOR		DO	CT09-N-4901_D3299318
						SUM:	1	

INTAKE PUMP STATION
I/O LIST HARDWIRED

I/ITEM	PANEL NO	PLC NO	LOOP NO	TAG NO	LOOP TITLE	ONE STATE	I/O TYPE	P+ID NO
1	IP20-CP-801-01	IP20-RIO-801-01A	IP1505101	IP15TANK05101LVL	INTAKE PS CHEMICAL FACILITY CARBON DIOXIDE STORAGE TANK 1	AI	AI	IP09-N-1503_D3299318
2	IP20-CP-801-01	IP20-RIO-801-01A	IP1515401	IP15PIT15401PRSS	INTAKE PS CHEMICAL FACILITY CO2 INJECTION SKID W3 WATER INLET PRESSSURE	AI	AI	IP09-N-1504_D3299318
3	IP20-CP-801-01	IP20-RIO-801-01A	IP1550101	IP15TT50101TEMP	INTAKE PS CHEMICAL FACILITY AMBIENT TEMPERATURE	AI	AI	IP09-N-4902_D3299318
4	IP20-CP-801-01	IP20-RIO-801-01A	IP2000101	IP20LT00101LVL	INTAKE PS RAW WATER INTAKE WELL LEVEL	AI	AI	IP09-N-2001_D3299318
5	IP20-CP-801-01	IP20-RIO-801-01A	IP2001801	IP20PIT01801PRSS	INTAKE PS RAW WATER DISCHARGE HEADER PRESSURE	AI	AI	IP09-N-2001_D3299318
6	IP20-CP-801-01	IP20-RIO-801-01A	IP2002701	IP20PIT02701PRSS	INTAKE PS RAW WATER INTAKE PUMP 1 DISCHARGE HEADER PRESSURE	AI	AI	IP09-N-2002_D3299318
7	IP20-CP-801-01	IP20-RIO-801-01A	IP2002703	IP20PIT02703PRSS	INTAKE PS RAW WATER INTAKE PUMP 3 DISCHARGE HEADER PRESSURE	AI	AI	IP09-N-2004_D3299318
8	IP20-CP-801-01	IP20-RIO-801-01A	IP2002705	IP20PIT02705PRSS	INTAKE PS RAW WATER INTAKE PUMP 5 DISCHARGE HEADER PRESSURE	AI	AI	IP09-N-2006_D3299318
9	IP20-CP-801-01	IP20-RIO-801-01A	IP2003101	IP20FEIT03101FLOW	INTAKE PS RAW WATER INTAKE PUMP 1 DISCHARGE HEADER FLOW	AI	AI	IP09-N-2002_D3299318
10	IP20-CP-801-01	IP20-RIO-801-01A	IP2003103	IP20FEIT03103FLOW	INTAKE PS RAW WATER INTAKE PUMP 3 DISCHARGE HEADER FLOW	AI	AI	IP09-N-2004_D3299318
11	IP20-CP-801-01	IP20-RIO-801-01A	IP2003105	IP20FEIT03105FLOW	INTAKE PS RAW WATER INTAKE PUMP 5 DISCHARGE HEADER FLOW	AI	AI	IP09-N-2006_D3299318
12	IP20-CP-801-01	IP20-RIO-801-01A	IP2050101	IP20TT50101TEMP	INTAKE PS ELECTRICAL ROOM TEMPERATURE A	AI	AI	IP09-N-4902_D3299318
13	IP20-CP-801-01	IP20-RIO-801-01A	IP2050102	IP20TT50102TEMP	INTAKE PS ELECTRICAL ROOM TEMPERATURE B	AI	AI	IP09-N-4902_D3299318
14	IP20-CP-801-01	IP20-RIO-801-01A	IP2050401	IP20TT50401TEMP	INTAKE PS PUMP ROOM AMBIENT TEMPERATURE A	AI	AI	IP09-N-4902_D3299318
15	IP20-CP-801-01	IP20-RIO-801-01A	IP2050402	IP20TT50402TEMP	INTAKE PS PUMP ROOM AMBIENT TEMPERATURE B	AI	AI	IP09-N-4902_D3299318
16	IP20-CP-801-01	IP20-RIO-801-01A	IP2050501	IP20TT50501TEMP	INTAKE PS OUTDOOR TEMPERATURE	AI	AI	IP09-N-4902_D3299318
17	IP20-CP-801-01	IP20-RIO-801-01A	IP2200601	IP22LIT00601LVL	INTAKE PS SURGE TANK 1 LEVEL A	AI	AI	IP09-N-2201_D3299318
18	IP20-CP-801-01	IP20-RIO-801-01A	IP3250401	IP32TT50401TEMP	INTAKE PS COMPRESSOR BUILDING TEMPERATURE	AI	AI	IP09-N-4902_D3299318
19	IP20-CP-801-01	IP20-RIO-801-01B	IP1500201	IP15LIT00201LVL	INTAKE PS COPPER SULFATE STORAGE TANK LEVEL	AI	AI	IP09-N-1501_D3299318
20	IP20-CP-801-01	IP20-RIO-801-01B	IP1515101	IP15AIT15101CO2	INTAKE PS CHEMICAL FACILITY CO2 INJECTION SKID ROOM CO2/O2 CONCENTRATION	AI	AI	IP09-N-1504_D3299318
21	IP20-CP-801-01	IP20-RIO-801-01B	IP2002702	IP20PIT02702PRSS	INTAKE PS RAW WATER INTAKE PUMP 2 DISCHARGE HEADER PRESSURE	AI	AI	IP09-N-2003_D3299318
22	IP20-CP-801-01	IP20-RIO-801-01B	IP2002704	IP20PIT02704PRSS	INTAKE PS RAW WATER INTAKE PUMP 4 DISCHARGE HEADER PRESSURE	AI	AI	IP09-N-2005_D3299318
23	IP20-CP-801-01	IP20-RIO-801-01B	IP2003102	IP20FEIT03102FLOW	INTAKE PS RAW WATER INTAKE PUMP 2 DISCHARGE HEADER FLOW	AI	AI	IP09-N-2003_D3299318
24	IP20-CP-801-01	IP20-RIO-801-01B	IP2003104	IP20FEIT03104FLOW	INTAKE PS RAW WATER INTAKE PUMP 4 DISCHARGE HEADER FLOW	AI	AI	IP09-N-2005_D3299318
25	IP20-CP-801-01	IP20-RIO-801-01B	IP2012801	IP20PIT12801PRSS	INTAKE PS AIR RECEIVING TANK HIGH PRESSURE AIR PRESSURE B	AI	AI	IP09-N-2007_D3299318
26	IP20-CP-801-01	IP20-RIO-801-01B	IP2050201	IP20TT50201TEMP	INTAKE PS PLC ROOM AMBIENT TEMPERATURE	AI	AI	IP09-N-4902_D3299318
27	IP20-CP-801-01	IP20-RIO-801-01B	IP2080101	IP20TT80101TEMP	INTAKE PS MAIN CONTROL PANEL	AI	AI	IP09-N-4902_D3299318
28	IP20-CP-801-01	IP20-RIO-801-01B	IP2083101	IP20TT83101TEMP	INTAKE PS MAIN NETWORK PANEL	AI	AI	IP09-N-4902_D3299318
29	IP20-CP-801-01	IP20-RIO-801-01B	IP2200602	IP22LIT00602LVL	INTAKE PS SURGE TANK 2 LEVEL A	AI	AI	IP09-N-2201_D3299318
30	IP20-CP-801-01	IP20-RIO-801-01B	IP1500201	IP15LIT00201LEVEL	INTAKE PS COPPER SULFATE STORAGE TANK LEVEL	SUM: 29	AO	IP09-N-1501_D3299318
31	IP20-CP-801-01	IP20-RIO-801-01B	IP1583101	IP15PS8310124V FAIL	INTAKE PS CHEMICAL FACILITY NETWORK PANEL	SUM: 1	DI	IP09-N-4902_D3299318
32	IP20-CP-801-01	IP20-RIO-801-01B	IP1583101	IP15XS83101DOOR	INTAKE PS CHEMICAL FACILITY NETWORK PANEL	24VDC	DI	IP09-N-4902_D3299318
33	IP20-CP-801-01	IP20-RIO-801-01B	IP1583101	IP15XS83101NET-FAIL	INTAKE PS CHEMICAL FACILITY NETWORK PANEL	24VDC	DI	IP09-N-4902_D3299318
34	IP20-CP-801-01	IP20-RIO-801-01B	IP2080101	IP20PS8010124V-FAIL	INTAKE PS MAIN CONTROL PANEL	24VDC	DI	IP09-N-4902_D3299318
35	IP20-CP-801-01	IP20-RIO-801-01B	IP2080101	IP20PS80101TRACK-FAIL	INTAKE PS MAIN CONTROL PANEL	24VDC	DI	IP09-N-4902_D3299318
36	IP20-CP-801-01	IP20-RIO-801-01B	IP2083101	IP20PS8310148V-FAIL	INTAKE PS MAIN NETWORK PANEL	24VDC	DI	IP09-N-4902_D3299318
37	IP20-CP-801-01	IP20-RIO-801-01B	IP2083101	IP20XS83101DOOR	INTAKE PS MAIN NETWORK PANEL	24VDC	DI	IP09-N-4902_D3299318
38	IP20-CP-801-01	IP20-RIO-801-01B	IP2097101	IP20UPS97101BATT	INTAKE PS UNINTERRUPTIBLE POWER SUPPLY	24VDC	DI	IP09-N-4902_D3299318
39	IP20-CP-801-01	IP20-RIO-801-01B	IP2097101	IP20UPS97101FAIL	INTAKE PS UNINTERRUPTIBLE POWER SUPPLY	24VDC	DI	IP09-N-4902_D3299318
40	IP20-CP-801-01	IP20-RIO-801-01B	IP2097101	IP20UPS97101UTIL	INTAKE PS UNINTERRUPTIBLE POWER SUPPLY	24VDC	DI	IP09-N-4902_D3299318
41	IP20-CP-801-01	IP20-RIO-801-01B	IP3283101	IP32PS8310124V FAIL	INTAKE PS COMPRESSOR BUILDING NETWORK PANEL	24VDC	DI	IP09-N-4902_D3299318

INTAKE PUMP STATION
I/O LIST HARDWIRED

I ITEM	PANEL NO	PLC NO	LOOP NO	TAG NO	LOOP TITLE	ONE STATE	I/O TYPE	P+ID NO
42	IP20-CP-801-01	IP20-RIO-801-01B	IP3283101	IP32XS83101DOOR	INTAKE PS COMPRESSOR BUILDING NETWORK PANEL	24VDC	DI	IP09-N-4902_D3299318
43	IP20-CP-801-01	IP20-RIO-801-01B	IP3283101	IP32XS83101NET-FAIL	INTAKE PS COMPRESSOR BUILDING NETWORK PANEL	24VDC	DI	IP09-N-4902_D3299318
44	IP20-CP-801-01	IP20-RIO-801-01A	IP2003101	IP20FEIT03101TOT	INTAKE PS RAW WATER INTAKE PUMP 1 DISCHARGE HEADER FLOW	24VDC Pulse	DI	IP09-N-2002_D3299318
45	IP20-CP-801-01	IP20-RIO-801-01A	IP2003103	IP20FEIT03103TOT	INTAKE PS RAW WATER INTAKE PUMP 3 DISCHARGE HEADER FLOW	24VDC Pulse	DI	IP09-N-2004_D3299318
46	IP20-CP-801-01	IP20-RIO-801-01A	IP2003105	IP20FEIT03105TOT	INTAKE PS RAW WATER INTAKE PUMP 5 DISCHARGE HEADER FLOW	24VDC Pulse	DI	IP09-N-2006_D3299318
47	IP20-CP-801-01	IP20-RIO-801-01B	IP2003102	IP20FEIT03102TOT	INTAKE PS RAW WATER INTAKE PUMP 2 DISCHARGE HEADER FLOW	24VDC Pulse	DI	IP09-N-2003_D3299318
48	IP20-CP-801-01	IP20-RIO-801-01A	IP2003104	IP20FEIT03104TOT	INTAKE PS RAW WATER INTAKE PUMP 4 DISCHARGE HEADER FLOW	24VDC Pulse	DI	IP09-N-2005_D3299318
49	IP20-CP-801-01	IP20-RIO-801-01A	IP0751001	IP07L5H51001HIGH	INTAKE PS WASTE HOLDING TANK LEVEL	I.S. circuit	DI	IP09-N-4902_D3299318
						SUM: 19		
50	IP20-CP-801-01	IP20-RIO-801-01A	IP1506101	IP15TANK05101PRH	INTAKE PS CHEMICAL FACILITY CARBON DIOXIDE STORAGE TANK 1		DI	IP09-N-1503_D3299318
51	IP20-CP-801-01	IP20-RIO-801-01A	IP1506101	IP15TANK05101PRL	INTAKE PS CHEMICAL FACILITY CARBON DIOXIDE STORAGE TANK 1		DI	IP09-N-1503_D3299318
52	IP20-CP-801-01	IP20-RIO-801-01A	IP1515101	IP15AIT15101ALARM-O2	INTAKE PS CHEMICAL FACILITY CO2 INJECTION SKID ROOM CO2/O2 CONCENTRATION		DI	IP09-N-1504_D3299318
53	IP20-CP-801-01	IP20-RIO-801-01A	IP1550102	IP15T510102TEMP	INTAKE PS CHEMICAL FACILITY CO2 INJECTION SKID ROOM TEMPERATURE		DI	IP09-N-4902_D3299318
54	IP20-CP-801-01	IP20-RIO-801-01A	IP1598101	IP15FAC98101ALARM	INTAKE PS CHEMICAL FACILITY FIRE ALARM CONTROL PANEL		DI	IP09-N-4902_D3299318
55	IP20-CP-801-01	IP20-RIO-801-01A	IP1598101	IP15FAC98101FIRE_WATER	INTAKE PS CHEMICAL FACILITY FIRE ALARM CONTROL PANEL		DI	IP09-N-4902_D3299318
56	IP20-CP-801-01	IP20-RIO-801-01A	IP1598101	IP15FAC98101SUPV	INTAKE PS CHEMICAL FACILITY FIRE ALARM CONTROL PANEL		DI	IP09-N-4902_D3299318
57	IP20-CP-801-01	IP20-RIO-801-01A	IP1598101	IP15FAC98101TRBL	INTAKE PS CHEMICAL FACILITY FIRE ALARM CONTROL PANEL		DI	IP09-N-4902_D3299318
58	IP20-CP-801-01	IP20-RIO-801-01A	IP2000701	IP20FSL00701LOW	INTAKE PS RAW WATER QUALITY ANALYZER PANEL FLOW		DI	IP09-N-2001_D3299318
59	IP20-CP-801-01	IP20-RIO-801-01A	IP2002301	IP20PSH02301HIGH	INTAKE PS RAW WATER DISCHARGE HEADER PRESSURE HIGH		DI	IP09-N-2001_D3299318
60	IP20-CP-801-01	IP20-RIO-801-01A	IP2003201	IP20DBFV03201CCLSD	INTAKE PS RAW WATER INTAKE PUMP 1 DISCHARGE HEADER ISOLATION VALVE		DI	IP09-N-2002_D3299318
61	IP20-CP-801-01	IP20-RIO-801-01A	IP2003201	IP20DBFV03201OPND	INTAKE PS RAW WATER INTAKE PUMP 1 DISCHARGE HEADER ISOLATION VALVE		DI	IP09-N-2002_D3299318
62	IP20-CP-801-01	IP20-RIO-801-01A	IP2003203	IP20DBFV03203CCLSD	INTAKE PS RAW WATER INTAKE PUMP 3 DISCHARGE HEADER FLOW ISOLATION VALVE		DI	IP09-N-2004_D3299318
63	IP20-CP-801-01	IP20-RIO-801-01A	IP2003203	IP20DBFV03203OPND	INTAKE PS RAW WATER INTAKE PUMP 3 DISCHARGE HEADER FLOW ISOLATION VALVE		DI	IP09-N-2004_D3299318
64	IP20-CP-801-01	IP20-RIO-801-01A	IP2003205	IP20DBFV03205CCLSD	INTAKE PS RAW WATER INTAKE PUMP 5 DISCHARGE HEADER ISOLATION VALVE		DI	IP09-N-2006_D3299318
65	IP20-CP-801-01	IP20-RIO-801-01A	IP2003205	IP20DBFV03205OPND	INTAKE PS RAW WATER INTAKE PUMP 5 DISCHARGE HEADER ISOLATION VALVE		DI	IP09-N-2006_D3299318
66	IP20-CP-801-01	IP20-RIO-801-01A	IP2005001	IP20VIB05001WARN	INTAKE PS RAW WATER INTAKE PUMP 1 VIBRATION ALARM		DI	IP09-N-2002_D3299318
67	IP20-CP-801-01	IP20-RIO-801-01A	IP2005003	IP20VIB05003WARN	INTAKE PS RAW WATER INTAKE PUMP 3 VIBRATION ALARM		DI	IP09-N-2004_D3299318
68	IP20-CP-801-01	IP20-RIO-801-01A	IP2005005	IP20VIB05005WARN	INTAKE PS RAW WATER INTAKE PUMP 5 VIBRATION ALARM		DI	IP09-N-2006_D3299318
69	IP20-CP-801-01	IP20-RIO-801-01A	IP2008701	IP20DBFV08701CCLSD	INTAKE PS SURGE TANK 1 RAW WATER ISOLATION VALVE		DI	IP09-N-2201_D3299318
70	IP20-CP-801-01	IP20-RIO-801-01A	IP2008701	IP20DBFV08701OPND	INTAKE PS SURGE TANK 1 RAW WATER ISOLATION VALVE		DI	IP09-N-2201_D3299318
71	IP20-CP-801-01	IP20-RIO-801-01A	IP20065101	IP20L5H65101HIGH	INTAKE PS PUMP ROOM WATER HEATER PAN LEVEL		DI	IP09-N-4902_D3299318
72	IP20-CP-801-01	IP20-RIO-801-01A	IP20086101	IP20IP86101POWER	INTAKE PS INTERLOCK PANEL		DI	IP09-N-2002_D3299318
73	IP20-CP-801-01	IP20-RIO-801-01A	IP2414101	IP24BFLV14101CCLSD	INTAKE PS ISOLATION VALVE VAULT RAW WATER ISOLATION VALVE		DI	IP09-N-2401_D3299318
74	IP20-CP-801-01	IP20-RIO-801-01A	IP2414101	IP24BFLV14101OPND	INTAKE PS ISOLATION VALVE VAULT RAW WATER ISOLATION VALVE		DI	IP09-N-2401_D3299318
75	IP20-CP-801-01	IP20-RIO-801-01A	IP2414201	IP24BFLV14201CCLSD	INTAKE PS ISOLATION VALVE VAULT RAW WATER BYPASS ISOLATION VALVE		DI	IP09-N-2401_D3299318
76	IP20-CP-801-01	IP20-RIO-801-01A	IP2414201	IP24BFLV14201OPND	INTAKE PS ISOLATION VALVE VAULT RAW WATER BYPASS ISOLATION VALVE		DI	IP09-N-2401_D3299318
77	IP20-CP-801-01	IP20-RIO-801-01A	IP2414301	IP24BFLV14301CCLSD	INTAKE PS ISOLATION VALVE VAULT RAW WATER ISOLATION VALVE A		DI	IP09-N-2401_D3299318
78	IP20-CP-801-01	IP20-RIO-801-01A	IP2414301	IP24BFLV14301OPND	INTAKE PS ISOLATION VALVE VAULT RAW WATER ISOLATION VALVE A		DI	IP09-N-2401_D3299318
79	IP20-CP-801-01	IP20-RIO-801-01A	IP2414401	IP24BFLV14401CCLSD	INTAKE PS ISOLATION VALVE VAULT RAW WATER ISOLATION VALVE B		DI	IP09-N-2401_D3299318
80	IP20-CP-801-01	IP20-RIO-801-01A	IP2414401	IP24BFLV14401OPND	INTAKE PS ISOLATION VALVE VAULT RAW WATER ISOLATION VALVE B		DI	IP09-N-2401_D3299318
81	IP20-CP-801-01	IP20-RIO-801-01A	IP2414801	IP24LSH14801HIGH	INTAKE PS ISOLATION VALVE VAULT FLOODING		DI	IP09-N-2401_D3299318
82	IP20-CP-801-01	IP20-RIO-801-01B	IP1500301	IP15FV00301CCLSD	INTAKE PS COPPER SULFATE CHEMICAL DOSING ISOLATION VALVE		DI	IP09-N-1501_D3299318
83	IP20-CP-801-01	IP20-RIO-801-01B	IP1500301	IP15FV00301OPND	INTAKE PS COPPER SULFATE CHEMICAL DOSING ISOLATION VALVE		DI	IP09-N-1501_D3299318

INTAKE PUMP STATION
I/O LIST HARDWIRED

I ITEM	PANEL NO	PLC NO	LOOP NO	TAG NO	LOOP TITLE	ONE STATE	I/O TYPE	P+ID NO
84	IP20-CP-801-01	IP20-RIO-801-01B	IP1500301	IP15FV00301REM	INTAKE PS COPPER SULFATE CHEMICAL DOSING ISOLATION VALVE		DI	IP09-N-1501_D3299318
85	IP20-CP-801-01	IP20-RIO-801-01B	IP1500401	IP15ZSO00401OPND	INTAKE PS CHEMICAL FACILITY TANK FILL CONNECTION VALVE		DI	IP09-N-1501_D3299318
86	IP20-CP-801-01	IP20-RIO-801-01B	IP1500501	IP15FSH00501HIGH	INTAKE PS CHEMICAL FACILITY INDOOR SAFETY SHOWER		DI	IP09-N-1501_D3299318
87	IP20-CP-801-01	IP20-RIO-801-01B	IP1500601	IP15FSH00601HIGH	INTAKE PS CHEMICAL FACILITY OUTDOOR SAFETY SHOWER		DI	IP09-N-1501_D3299318
88	IP20-CP-801-01	IP20-RIO-801-01B	IP1500701	IP15LH00701HIGH	INTAKE PS CONTAINMENT SUMP OVERFLOW		DI	IP09-N-1501_D3299318
89	IP20-CP-801-01	IP20-RIO-801-01B	IP1515101	IP15AIT115101ALARM-CO2	INTAKE PS CHEMICAL FACILITY CO2 INJECTION SKID ROOM CO2/O2 CONCENTRATION		DI	IP09-N-1501_D3299318
90	IP20-CP-801-01	IP20-RIO-801-01B	IP1515101	IP15AIT115101FAULT	INTAKE PS CHEMICAL FACILITY CO2 INJECTION SKID ROOM CO2/O2 CONCENTRATION		DI	IP09-N-1501_D3299318
91	IP20-CP-801-01	IP20-RIO-801-01B	IP1515601	IP15LCP15601FAIL	TBD		DI	IP09-N-1501_D3299318
92	IP20-CP-801-01	IP20-RIO-801-01B	IP1581101	IP15LCP81101RESET	INTAKE PS CHEMICAL FACILITY TRUCK UNLOADING PANEL		DI	IP09-N-1501_D3299318
93	IP20-CP-801-01	IP20-RIO-801-01B	IP1583101	IP15SPD83101SPD-FAIL	INTAKE PS CHEMICAL FACILITY NETWORK PANEL		DI	IP09-N-4902_D3299318
94	IP20-CP-801-01	IP20-RIO-801-01B	IP2003202	IP20DBFV03202CLSD	INTAKE PS RAW WATER INTAKE PUMP 2 DISCHARGE HEADER ISOLATION VALVE		DI	IP09-N-2003_D3299318
95	IP20-CP-801-01	IP20-RIO-801-01B	IP2003202	IP20DBFV03202OPND	INTAKE PS RAW WATER INTAKE PUMP 2 DISCHARGE HEADER ISOLATION VALVE		DI	IP09-N-2003_D3299318
96	IP20-CP-801-01	IP20-RIO-801-01B	IP2003204	IP20DBFV03204CLSD	INTAKE PS RAW WATER INTAKE PUMP 4 DISCHARGE HEADER ISOLATION VALVE		DI	IP09-N-2005_D3299318
97	IP20-CP-801-01	IP20-RIO-801-01B	IP2003204	IP20DBFV03204OPND	INTAKE PS RAW WATER INTAKE PUMP 4 DISCHARGE HEADER ISOLATION VALVE		DI	IP09-N-2005_D3299318
98	IP20-CP-801-01	IP20-RIO-801-01B	IP2005002	IP20DVB05002WARN	INTAKE PS RAW WATER INTAKE PUMP 2 VIBRATION ALARM		DI	IP09-N-2003_D3299318
99	IP20-CP-801-01	IP20-RIO-801-01B	IP2005004	IP20DVB05004WARN	INTAKE PS RAW WATER INTAKE PUMP 4 VIBRATION ALARM		DI	IP09-N-2005_D3299318
100	IP20-CP-801-01	IP20-RIO-801-01B	IP2006702	IP20DBFV06702CLSD	INTAKE PS SURGE TANK 2 RAW WATER ISOLATION VALVE		DI	IP09-N-2201_D3299318
101	IP20-CP-801-01	IP20-RIO-801-01B	IP2006702	IP20DBFV06702OPND	INTAKE PS SURGE TANK 2 RAW WATER ISOLATION VALVE		DI	IP09-N-2201_D3299318
102	IP20-CP-801-01	IP20-RIO-801-01B	IP2060101	IP20HCP60101SMOKE_PUMP_RI	INTAKE PS PUMP STATION FACILITY HVAC CONTROL PANEL		DI	IP09-N-4902_D3299318
103	IP20-CP-801-01	IP20-RIO-801-01B	IP2060201	IP20HCP60201SMOKE_ELECTRI	TBD		DI	IP09-N-4902_D3299318
104	IP20-CP-801-01	IP20-RIO-801-01B	IP2080101	IP20SPD80101SPD-FAIL	INTAKE PS MAIN CONTROL PANEL		DI	IP09-N-4902_D3299318
105	IP20-CP-801-01	IP20-RIO-801-01B	IP2080101	IP20XSB80101DOOR	INTAKE PS MAIN CONTROL PANEL		DI	IP09-N-4902_D3299318
106	IP20-CP-801-01	IP20-RIO-801-01B	IP2083101	IP20SPD83101SPD-FAIL	INTAKE PS MAIN NETWORK PANEL		DI	IP09-N-4902_D3299318
107	IP20-CP-801-01	IP20-RIO-801-01B	IP2094501	IP20OATC94501FAIL	INTAKE PS AUTOMATIC TRANSFER CONTROLLER		DI	IP09-N-4901_D3299318
108	IP20-CP-801-01	IP20-RIO-801-01B	IP2094501	IP20OATC94501GNVAV	INTAKE PS AUTOMATIC TRANSFER CONTROLLER		DI	IP09-N-4901_D3299318
109	IP20-CP-801-01	IP20-RIO-801-01B	IP2094501	IP20OATC94501LOADBNK	INTAKE PS AUTOMATIC TRANSFER CONTROLLER		DI	IP09-N-4901_D3299318
110	IP20-CP-801-01	IP20-RIO-801-01B	IP2094501	IP20OATC94501ONGN	INTAKE PS AUTOMATIC TRANSFER CONTROLLER		DI	IP09-N-4901_D3299318
111	IP20-CP-801-01	IP20-RIO-801-01B	IP2094501	IP20OATC94501ONUT-A	INTAKE PS AUTOMATIC TRANSFER CONTROLLER		DI	IP09-N-4901_D3299318
112	IP20-CP-801-01	IP20-RIO-801-01B	IP2094501	IP20OATC94501ONUT-B	INTAKE PS AUTOMATIC TRANSFER CONTROLLER		DI	IP09-N-4901_D3299318
113	IP20-CP-801-01	IP20-RIO-801-01B	IP2094501	IP20OATC94501TBKR-1	INTAKE PS AUTOMATIC TRANSFER CONTROLLER		DI	IP09-N-4901_D3299318
114	IP20-CP-801-01	IP20-RIO-801-01B	IP2094501	IP20OATC94501TBKR-2	INTAKE PS AUTOMATIC TRANSFER CONTROLLER		DI	IP09-N-4901_D3299318
115	IP20-CP-801-01	IP20-RIO-801-01B	IP2094501	IP20OATC94501UTAV-A	INTAKE PS AUTOMATIC TRANSFER CONTROLLER		DI	IP09-N-4901_D3299318
116	IP20-CP-801-01	IP20-RIO-801-01B	IP2094501	IP20OATC94501UTAV-B	INTAKE PS AUTOMATIC TRANSFER CONTROLLER		DI	IP09-N-4901_D3299318
117	IP20-CP-801-01	IP20-RIO-801-01B	IP2097501	IP20UPS97501ONBP	INTAKE PS UPS BYPASS		DI	IP09-N-4902_D3299318
118	IP20-CP-801-01	IP20-RIO-801-01B	IP3283101	IP32SPD83101SPD-FAIL	INTAKE PS COMPRESSOR BUILDING NETWORK PANEL		DI	IP09-N-4902_D3299318
						SUM:	69	
119	IP20-CP-801-01	IP20-RIO-801-01A	IP2094401	IP20LGC94401TON	INTAKE PS LIGHTING CONTRACTOR		DO	IP09-N-4902_D3299318
120	IP20-CP-801-01	IP20-RIO-801-01B	IP1500301	IP15FV00301CLSE	INTAKE PS COPPER SULFATE CHEMICAL DOSING ISOLATION VALVE		DO	IP09-N-1501_D3299318
121	IP20-CP-801-01	IP20-RIO-801-01B	IP1500301	IP15FV00301OPEN	INTAKE PS COPPER SULFATE CHEMICAL DOSING ISOLATION VALVE		DO	IP09-N-1501_D3299318
122	IP20-CP-801-01	IP20-RIO-801-01B	IP1500701	IP15LH00701HIHI	INTAKE PS CONTAINMENT SUMP OVERFLOW		DO	IP09-N-1501_D3299318
123	IP20-CP-801-01	IP20-RIO-801-01B	IP1581101	IP15LCP81101ALARM	INTAKE PS CHEMICAL FACILITY TRUCK UNLOADING PANEL		DO	IP09-N-1501_D3299318
124	IP20-CP-801-01	IP20-RIO-801-01B	IP1581101	IP15LCP81101HORN	INTAKE PS CHEMICAL FACILITY TRUCK UNLOADING PANEL		DO	IP09-N-1501_D3299318
						SUM:	6	

CAPROCK PUMP STATION
PLC INPUT AND OUTPUT LIST
NETWORKED

ITEM	PANEL NO	SWITCH TAG	LOOP NO	TAG NO	LOOP TITLE	I/O TYPE	P + ID NO
1	CP20-NP-831-01	CP20-SW-831-12A	CP2002501	CP20VFD02501DATA	CAPROCK PS RAW WATER CAPROCK PUMP 1	ET	CP09-N-2002_D3299318
2	CP20-NP-831-01	CP20-SW-831-12A	CP2002503	CP20VFD02503DATA	CAPROCK PS RAW WATER CAPROCK PUMP 3	ET	CP09-N-2004_D3299318
3	CP20-NP-831-01	CP20-SW-831-12A	CP2002505	CP20VFD02505DATA	CAPROCK PS RAW WATER CAPROCK PUMP 5	ET	CP09-N-2006_D3299318
4	CP20-NP-831-01	CP20-SW-831-12A	CP2010101	CP20LCP10101DATA	CAPROCK PS SURGE TANK COMPRESSOR 1	ET	CP09-N-2007_D3299318
5	CP20-NP-831-01	CP20-SW-831-12A	CP20086501	CP20VIB86501DATA	CAPROCK PS VIBRATION MONITORING SYSTEM PANEL 1	ET	CP09-N-2002_D3299318
6	CP20-NP-831-01	CP20-SW-831-12A	CP20091101	CP20SWRG91101DATA	CAPROCK PS SWITCH GEAR	ET	CP09-N-4901_D3299318
7	CP20-NP-831-01	CP20-SW-831-12A	CP20097101	CP20UPS97101DATA	CAPROCK PS UNINTERRUPTIBLE POWER SUPPLY	ET	CP09-N-4902_D3299318
					SUM: 7		
8	CP20-NP-831-01	CP20-SW-831-12B	CP0890501	CP08GEN90501DATA	CAPROCK PS GENERATOR	ET	CP09-N-4901_D3299318
9	CP20-NP-831-01	CP20-SW-831-12B	CP2002502	CP20VFD02502DATA	CAPROCK PS RAW WATER CAPROCK PUMP 2	ET	CP09-N-2003_D3299318
10	CP20-NP-831-01	CP20-SW-831-12B	CP2002504	CP20VFD02504DATA	CAPROCK PS RAW WATER CAPROCK PUMP 4	ET	CP09-N-2005_D3299318
11	CP20-NP-831-01	CP20-SW-831-12B	CP2010102	CP20LCP10102DATA	CAPROCK PS SURGE TANK COMPRESSOR 2	ET	CP09-N-2007_D3299318
12	CP20-NP-831-01	CP20-SW-831-12B	CP20086502	CP20VIB86502DATA	CAPROCK PS VIBRATION MONITORING SYSTEM PANEL 2	ET	CP09-N-2003_D3299318
13	CP20-NP-831-01	CP20-SW-831-12B	CP20092201	CP20MCC92201DATA	CAPROCK PS MOTOR CONTROL CENTER	ET	CP09-N-4902_D3299318
14	CP20-NP-831-01	CP20-SW-831-12B	CP2200101	CP22LCP00101DATA	CAPROCK PS SURGE TANK 1 TEMPERATURE	ET	CP09-N-2201_D3299318
					SUM: 7		

CAPROCK TANK
PLC INPUT AND OUTPUT LIST
NETWORKED

ITEM	PANEL NO	SWITCH TAG	LOOP NO	TAG NO	LOOP TITLE	I/O TYPE	P + ID NO
1	CT27-NP-831-01	CT27-NP-831-12A	CT2988101	CT29LCP88101DATA	CAPROCK TANK PAC DOSING CONTROL PANEL E-STOP	ET	CT09-N-2901_D3299318
2	CT27-NP-831-01	CT27-SW-831-12A	CT2760101	CT27MS60101DATA	CAPROCK TANK COMPRESSOR ROOM EXHAUST FAN	ET	CT09-N-4901_D3299318
3	CT27-NP-831-01	CT27-SW-831-12A	CT2796201	CT27DMP96201DATA	CAPROCK TANK DIGITAL POWER METER	ET	CT09-N-4901_D3299318
4	CT27-NP-831-01	CT27-SW-831-12A	CT2797101	CT27UPS97101DATA	CAPROCK TANK UNINTERRUPTIBLE POWER SUPPLY	ET	CT09-N-4901_D3299318
					SUM: 5		
5	CT27-NP-831-01	CT27-SW-831-12B	CT0890601	CT08GEN90601DATA	CAPROCK TANK GENERATOR	ET	CT09-N-4901_D3299318
					SUM: 1		

INTAKE PUMP STATION
PLC INPUT AND OUTPUT LIST
NETWORKED

ITEM	PANEL NO	SWITCH TAG	LOOP NO	TAG NO	LOOP TITLE	I/O TYPE	P+I/D NO
1	IP15-NP-831-01	IP15-SW-831-13A	IP1508101	IP15LCP08101DATA	INTAKE PS CHEMICAL FACILITY CARBON DIOXIDE INJECTION SKID CONTROL PANEL	ET	IP09-N-1504_D3299318
2	IP15-NP-831-01	IP15-SW-831-13A	IP1502101	IP15PUMP02101DATA	INTAKE PS CHEMICAL FACILITY COPPER SULFATE FEED PUMP 1	ET	IP09-N-1502_D3299318
3	IP15-NP-831-01	IP15-SW-831-13B	IP1502101	IP15PUMP02102DATA	INTAKE PS CHEMICAL FACILITY COPPER SULFATE FEED PUMP 2	ET	IP09-N-1502_D3299318
					SUM: 3		
4	IP20-MCC-922-01	IP20-SW-922-01A	IP2020201	IP20VFD20201DATA	INTAKE PS WET WELL RECIRCULATION PUMP 1	ET	IP09-N-2001_D3299318
5	IP20-MCC-922-01	IP20-SW-922-01B	IP2020202	IP20VFD20202DATA	INTAKE PS WET WELL RECIRCULATION PUMP 2	ET	IP09-N-2001_D3299318
					SUM: 3		
6	IP20-NP-831-01	IP20-SW-831-12A	IP2001001	IP20AIT01001DATA	INTAKE PS RAW WATER QUALITY ANALYZER TURBIDITY AND FLOW TRANSMITTER	ET	IP09-N-2001_D3299318
7	IP20-NP-831-01	IP20-SW-831-12A	IP2002501	IP20VFD02501DATA	INTAKE PS RAW WATER INTAKE PUMP 1	ET	IP09-N-2002_D3299318
8	IP20-NP-831-01	IP20-SW-831-12A	IP2002503	IP20VFD02503DATA	INTAKE PS RAW WATER INTAKE PUMP 3	ET	IP09-N-2004_D3299318
9	IP20-NP-831-01	IP20-SW-831-12A	IP2002505	IP20VFD02505DATA	INTAKE PS RAW WATER INTAKE PUMP 5	ET	IP09-N-2006_D3299318
10	IP20-NP-831-01	IP20-SW-831-12A	IP2010101	IP20LCP10101DATA	INTAKE PS SURGE TANK COMPRESSOR 1	ET	IP09-N-2007_D3299318
11	IP20-NP-831-01	IP20-SW-831-12A	IP20086501	IP20VIB86501DATA	INTAKE PS VIBRATION MONITORING SYSTEM PANEL 1	ET	IP09-N-2002_D3299318
12	IP20-NP-831-01	IP20-SW-831-12A	IP20091101	IP20SWRG91101DATA	INTAKE PS SWITCH GEAR	ET	IP09-N-4901_D3299318
13	IP20-NP-831-01	IP20-SW-831-12A	IP2097101	IP20UPS97101DATA	INTAKE PS UNINTERRUPTIBLE POWER SUPPLY	ET	IP09-N-4902_D3299318
					SUM: 8		
14	IP20-NP-831-01	IP20-SW-831-12B	IP0890501	IP08GEN90501DATA	INTAKE PS GENERATOR	ET	IP09-N-4901_D3299318
15	IP20-NP-831-01	IP20-SW-831-12B	IP2001101	IP20AIT01101DATA	INTAKE PS RAW WATER QUALITY ANALYZER PH/TEMP AND CONDUCTIVITY TRANSMITTER	ET	IP09-N-2001_D3299318
16	IP20-NP-831-01	IP20-SW-831-12B	IP2002502	IP20VFD02502DATA	INTAKE PS RAW WATER INTAKE PUMP 2	ET	IP09-N-2003_D3299318
17	IP20-NP-831-01	IP20-SW-831-12B	IP2002504	IP20VFD02504DATA	INTAKE PS RAW WATER INTAKE PUMP 4	ET	IP09-N-2005_D3299318
18	IP20-NP-831-01	IP20-SW-831-12B	IP2010102	IP20LCP10102DATA	INTAKE PS SURGE TANK COMPRESSOR 2	ET	IP09-N-2007_D3299318
19	IP20-NP-831-01	IP20-SW-831-12B	IP20086502	IP20VFD86502DATA	INTAKE PS VIBRATION MONITORING SYSTEM PANEL 2	ET	IP09-N-2003_D3299318
20	IP20-NP-831-01	IP20-SW-831-12B	IP2092201	IP20MCC92201DATA-B	INTAKE PS PUMP STATION MOTOR CONTROL CENTER	ET	IP09-N-4902_D3299318
21	IP20-NP-831-01	IP20-SW-831-12B	IP2092201	IP20MCC92201DATA-A	INTAKE PS PUMP STATION MOTOR CONTROL CENTER	ET	IP09-N-4902_D3299318
22	IP20-NP-831-01	IP20-SW-831-12B	IP2200101	IP22LCP00101DATA	INTAKE PS SURGE TANK 1 TEMPERATURE	ET	IP09-N-2201_D3299318
23	IP32-NP-831-01	IP20-SW-831-12A	IP3210001	IP32MCP10001DATA	INTAKE PS COMPRESSOR BUILDING MCP100 CONTROL PANEL	ET	IP09-N-1001_D3299318
					SUM: 10		

SECTION 40 90 21
ANALYZER CONTROL PANELS

PART 1 GENERAL

1.01 SUMMARY

- A. This PICS section gives requirements for PICS analyzer control panel and Analyzer Control Panel Components. The PICS analyzer control panels shall be completely coordinated, submitted, installed, executed, and completed by the overall PIC SI in accordance with Section 40 90 00, Instrumentation and Control for Process Systems. For the following items, this subsection shall meet the requirements of, and be in accordance with, Section 40 90 00, Instrumentation and Control for Process Systems.
 - 1. Submittals.
 - 2. References.
 - 3. Definitions.
 - 4. Related Sections.
 - 5. Environmental Requirements.
 - 6. Delivery, Storage, and Handling.
- B. This section shall be in accordance with Section 40 90 00, Instrumentation and Process Control for Process Systems, but may provide additional requirements.
- C. All panel enclosures shall be UL recognized or listed.

1.02 RELATED SECTIONS

- A. Refer to Section 40 90 00, Instrumentation and Control for Process Systems for all related sections.
- B. Refer to Section 40 90 13, Control and Network Panel Components.
- C. Refer to Section 40 90 10, Instrument Components.

1.03 WORK INCLUDED

- A. Major Work Items: Included by is not limited to engineering, furnishing, installing, calibrating, adjusting, testing, documenting, starting up and training for analyzer control panel.
 - 1. Provide all Analyzer Panels as shown on the Drawings and Schedules.

- B. Provide all tools, supplies, materials, equipment, and all labor necessary for furnishing, constructing, installing, terminating, and testing Analyzer Control Panel.
- C. Fabricate analyzer control panel as shown on the Drawings and Schedules.
- D. Refer to Drawings, Bill of Material, and Schedules. Many of these drawings , Bill of Materials, and Schedules are conceptual and not complete with every detail. They are intended to convey overall intent for a given system. The Supplier shall complete the final design of each of these conceptual drawings, schedules, and final bill of materials

1.04 SUBMITTALS

- A. Action Submittals:
 - 1. Bill of Materials: List of required equipment.
 - 2. Catalog Cuts: I&C components, electrical devices, and mechanical devices.
 - 3. Analyzer Control Panel Instrument List.
 - 4. Component Data Sheets: Data sheets for I&C components.
 - 5. Sizing and Selection Calculations:
 - a. Sample flow.
 - b. Sample inlet pressure.
 - c. Analyzer Control Panel power consumption.
 - d. Sun heat gain, Heat Dissipation: and Air Conditioning, where needed.
 - e. Reagent and other consumable products monthly usage, where needed.
 - 6. Preliminary Panel Elevation Drawings: Provide prior to submitting Panel Construction Drawings.
 - 7. Panel Construction Drawings:
 - a. Analyzer Control Panel General Arrangement drawing.
 - 1) Free standing enclosure type panel: Enclosure.
 - 2) Frame mount type panel: Panel and frame.
 - b. Analyzer Control Panel, Panel Layout drawing.
 - 8. Panel Control and Power Wiring Diagrams.
 - 9. Panel Plumbing Diagrams:
 - a. For each panel containing piping and tubing. Show type and size for:
 - 1) Pipes and Tubes: Thickness, pressure rating, and materials.
 - 2) Components: Valves, regulators, and filters.
 - 3) Connections to panel-mounted devices.
 - 4) Panel interface connections.
 - 5) Submit electronic copies of the Drawings.

10. Analyzer Control Panel Flow Diagram:
 - a. For each panel, show information on:
 - 1) Analyzer Control Panel Instrument tag.
 - 2) Analyzer Control Panel Inlet Sample Requirements:
 - a) Maximal Allowable Pressure.
 - b) Set pressure at PRV valve, if needed.
 - c) Flow rate.
 - 3) Analyzer control panel sample distribution, requirements, and settings for each analyzer:
 - a) Set Pressure.
 - b) Set Flow.
 - 4) Mechanical components functions description and components features.
 - 5) Tubing type and size.
 - 6) Auxiliary equipment like strainer, pressure reducer, etc.
 11. Spares, expendables, and test equipment.
 12. Submit anchorage and bracing design drawings, cut sheets, and their installation information for components, distribution systems, and equipment as required by Section 01 88 15, Anchorage and Bracing.

B. Informational Submittals:

1. Operation and Maintenance Data.
2. Instrument calibration procedure.
3. Testing Related Submittals:
 - a. Factory Demonstration Test:
 - 1) Preliminary Test Procedures: Outline of proposed tests, forms, and checklists.
 - 2) Final Test Procedures:
 - a) Proposed test procedures, forms, and checklists.
 - b) Capacity, Timing, and Simulation: Describe simulation and monitoring methods used to demonstrate compliance with capacity and timing requirements.
 - 3) Test Documentation: Copy of signed off test results.
 - b. Performance Acceptance Test:
 - 1) Preliminary Test Procedures: Outline of proposed tests, forms, and checklists.
 - 2) Final Test Procedures: Proposed test procedures, forms, and checklists.
 - 3) Test Documentation: Copy of signed-off test results.
4. Configuration and Setpoints Records:
 - a. Hard copy.
 - b. Electronic copy.

5. Instrument Data Sheets in Microsoft Excel format.
 - a. One file per analyzer panel.
 - b. File name format: Analyzer Panel Tag_Instrument Data Sheets.
6. Drawings in AutoCAD or MicroStation Format.
 - a. One file per Drawing.
 - b. File name format: Analyzer Panel Tag_ Drawing Number_Drawing Title.

1.05 QUALITY ASSURANCE

A. Qualifications:

1. Analyzer Control Panel Builder: Minimum of 5 years' experience providing, integrating, installing, and starting up similar systems as required for this Project.
2. Analyzer Control Panel Builder Site Representative: Minimum of 5 years' experience installing similar systems as required for this Project.

B. Coordination:

1. Analyzer control panels shall be in accordance with analyzer control panel and P&ID Contract Drawings.
2. Coordinate with process mechanical contractor:
 - a. Sample line size and material.
 - b. Sample pressure and flow at inlet to the panel.
3. Process mechanical contractor provide means change sample pressure to meet analyzer control panel design pressure.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. In accordance with Section 01 61 00, Common Product Requirements.
- B. Prior to shipment, include corrosive inhibitive vapor capsules in shipping containers, and related equipment as recommended by 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.
- E. In accordance with analyzer instrument manufacturer requirements.

1.07 EXTRA MATERIALS

A. Expendables:

1. For following items provide manufacturer's recommended 2-year supply, unless otherwise noted:
 - a. Chemical for analyzers.
 - b. Reagents.
 - c. Calibration kits.
 - d. Corrosion-inhibiting vapor capsules.

PART 2 PRODUCTS

2.01 ANALYZER CONTROL PANELS

- A. Function: Provides analyzer instrument and systems equipment mounting and field wiring termination.
- B. Reference Analyzer Control Panel Schedule in Article Supplements.
- C. Reference P&IDs and block diagrams on the Drawings.
- D. Reference all PICS subsections as there may be panel requirements, instruments, or other elements contained in other PICS subsections.

2.02 ANALYZER PANEL FABRICATION

A. General:

1. Panels with external dimensions and instruments arrangement as shown on the Drawings.
 2. Panel Construction and Interior Wiring: In accordance with the National Electrical Code, UL508, state, and local codes, NEMA, ANSI, UL, and ICECA.
- 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. All UL 508A labelling of the panels shall be placed and applied prior to delivery to Site.

D. Analyzer Panel Type:

1. Based on environmental design requirements and referenced in Article Environmental Requirements, provide the following unless otherwise noted in Analyzer Panel Schedule in Article Supplements:
 - a. Panels Indoor, Air Conditioned and Non-Corrosive.
 - 1) Type: Backplate, Wall, or frame mount.
 - 2) Backplate:
 - a) Materials: Stainless steel.
 - b) Metal Thickness: 14-gauge, minimum.
 - 3) Frame:
 - a) Type: Unistrut Channel.
 - b) Materials: Stainless steel.
 - b. Other Panels:
 - 1) Type: Enclosure, Free standing, or Wall mount Enclosure.
 - 2) Materials: Type 316 stainless steel.
 - a) Metal Thickness: 14-gauge, minimum.
 - 3) Enclosure Rating: NEMA 4X, unless otherwise noted.
 - 4) Doors:
 - a) Quantity: One or two.
 - b) Rubber-gasketed with continuous hinge.
 - c) Stainless steel lockable quick-release clamps.
 - 5) Sunshield or Weather Protection Canopy: For outdoor locations.
 - 6) Air Conditioning Unit: Where required based on heat loss calculations or required by sample analysis procedure or instrument operation conditions.
 - 7) Manufacturer: Hoffman Engineering Co.

E. Analyzer Panel Construction:

1. General:
 - a. Provide the following analyzer control panel features unless otherwise noted or shown on analyzer control panel contract drawings like:
 - 1) Analyzer Panel Layout.
 - 2) Analyzer Panel Flow Diagram.
 - b. Sample line to analyzer panel, sample flushing points, sample pressure reducing devices or sample pumps by Mechanical not part of Analyzer panel design.
2. Panel Layout Design and Installation Criteria:
 - a. Analyzer instruments should be grouped based on:
 - 1) Function or sample measuring means. For example, pH/Temp and Conductivity probes in one flow cell.
 - 2) Sample flow or/and sample pressure requirements.

- b. Electrical junction box or/and analyzer transmitters located at top of the panel.
 - c. Sample distribution located at the bottom of the panel.
 - d. Where applicable, the panel divided to sections or modular design to enable easy transportation or modifications.
 - e. Future Extension: 30 percent of free space.
 - f. Instruments and tubing arrangement to comply analyzer manufacturer installation and maintenance guidelines and instruction.
 - g. Cable Routing:
 - 1) Space for probe cable coils.
 - 2) Avoid crossing with tubing.
 - 3) Above tubing.
 - 4) Neat and clear.
 - 5) Use cable straps, which enable cable removal.
3. Sample Inlet:
- a. Sample Line Connection:
 - 1) Location: Left, bottom corner of the panel, unless otherwise shown on the Drawing.
 - 2) Type: 1/2-inch NPT, male, Unless otherwise shown on the Drawings.
 - b. Panel Isolation Valve:
 - 1) Type: 3/8-inch, ball valve, compression fitting.
 - c. Pressure Gauge for Inlet Sample Pressure:
 - 1) Dial Size: 2.5 inch.
 - 2) Connection: 1/4-inch NPT.
 - 3) Class: 2.5, Minimum.
 - 4) Range: To meet sample pressure requirements.
 - d. Sand Filter (strainer):
 - 1) Type: Y-strainer.
 - 2) Mesh: 35.
4. Sample Distribution:
- a. Distribution Points:
 - 1) Quantity: To each analyzer or analyzer group based on sample flow and/or sample pressure requirements plus one for future.
 - 2) Isolation: Stainless steel ON/OFF valve.
 - 3) Flow Adjustments:
 - a) Needle valve.
 - b) Rotameter, if required.
 - c) Applicable for sample flow critical analyzers.
 - 4) Flow Monitoring:
 - a) Flow switch.
 - b) Analyzer flowmeter.
 - c) Applicable for sample flow critical analyzers.

- 5) Pressure Monitoring, if shown on the Drawings or Required by Analyzer Manufacturer:
 - a) Pressure Gauge
 - (1) Dial Size: 2.5 inch.
 - (2) Connection: 1/4-inch NPT.
 - (3) Class: 2.5, Minium.
 - (4) Range: To meet sample pressure requirements.
 - b. Rigid Tubing:
 - 1) Size: 3/8 inch.
 - 2) Material: Type 316 Stainless steel.
 - 3) Connection: Type 316 Stainless steel, compression fitting.
 - c. Flexible Tubing:
 - 1) Size: 1/4 inch.
 - 2) Material: Clear plastic.
 - 3) Pressure rating: As connected instruments or higher.
 - 4) Used: For sample feed or drain.
 - d. Sample Preparation Devices, Elastic Tubing Mount:
 - 1) Sample filter.
 - 2) Sample pressure reducer.
 - 3) Sample flow regulator.
 - 4) Shut-off valve.
 - 5) Installed at elastic tubing.
 - 6) Used: where required by analyzer manufacturer.
5. Sample Drain:
 - a. General: Coordinate with site plumbing.
 - b. Location: Right, bottom corner of the panel.
 - c. Type: Air gap.
 - d. Size: 2 inch.
 - e. Material: PVC pipe, Black.
6. Chemical Drain:
 - a. General:
 - 1) For chemicals, reagent drain, if required and shown on the Drawings.
 - 2) Coordinate with site plumbing.
 - b. Location: right, bottom corner of the panel.
 - c. Type: Air gap.
 - d. Size: 1 inch.
 - e. Material: PVC pipe, Black.
 - f. Used: Where required.
7. Enclosure Drain:
 - a. Applicable for enclosure type analyzer panel.
 - b. Coordinate with site plumbing.
8. Electrical Junction Box:
 - a. General: Used for power and signal circuits terminations, field wiring, power disconnection.
 - b. Enclosure Rating: NEMA 4X.

- c. Components:
 - 1) Main disconnecter.
 - 2) Fuses or circuit breaker for each analyzer transmitter within the panel.
 - 3) Terminals, for power supply and signals.
- d. Field Cabling Entry:
 - 1) Top, or side, as shown on the Drawings.
 - 2) Coordinate with site electrical.
- 9. Instruments, Analyzers and Analyzers Transmitters:
 - a. Enclosure Rating: NEMA 4X, Unless otherwise noted.
 - b. Mounting:
 - 1) In accordance with analyzer manufacturer instructions.
 - 2) As shown on the Drawings.
 - 3) To allow calibration, service, and maintenance.
- 10. Mounting Frame:
 - a. Applicable for backplate type analyzer panel.
 - b. Use: To support heavy analyzer panel backplate type or wall mount analyzer panel backplate type.
 - c. Material: Stainless Steel.
 - d. Type: Unistrut.
 - e. Coordinate with site structure, mechanical, electrical and architecture.
- 11. Analyzer Panel Shade:
 - a. Applicable for Backplate Type Analyzer Panel and where site piping is routed above panel.
 - b. Use: To protect the panel and instruments from spills or piping leakage.
 - c. Material: Stainless steel.
 - d. Coordinate with site structure, mechanical , piping and architecture.
- 12. Sample Pump:
 - a. General:
 - 1) Industry design.
 - 2) Dry-run capability.
 - b. Use:
 - 1) For negative or low-pressure systems.
 - 2) Coordinated with Engineer if sample intake system flow and pressure doesn't meet design criteria.
 - 3) Coordinated with site mechanical, site piping.
 - c. Features:
 - 1) Positive displacement peristaltic pumphead with spring loaded rollers.
 - 2) Multiple tube sizes for flexibility in flow outputs.
 - 3) Dry-run capability.
 - 4) Corrosion resistant.

- d. Flow:
 - 1) 10 gph or higher if required for specific application.
 - 2) Adjustable by tubing size.
- e. Pressure:
 - 1) Discharge Pressure: 30 psi Or higher if required for specific application.
 - 2) Self-priming – suction lift to 30 feet or higher if required for specific application.
- f. Power Supply:
 - 1) Feed from Analyzer Control Panel
 - a) Dedicated circuit breaker.
 - 2) Voltage: 120V ac or 24V dc.
 - 3) Disconnect switch operator accessible at analyzer panel backplate.
- g. Enclosure Rating: NEMA 4X.
- h. Mounting:
 - 1) Analyzer Panel.
 - 2) Protected by drip tray connected to analyzer panel drain.

F. Temperature Control:

- 1. Applicable for enclosure type analyzer panel.
- 2. PICS Enclosure Temperature Control Calculations: Provide heat calculations for all panels at time of panel submittals. If the heat calculations indicate required heating, and/or cooling, provide adequate heating and/or cooling.
- 3. Enclosure Types:
 - 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) Pull inlet air into panel through filters on lower door, providing cooler air over components exhausted through fan at top of panel.
 - c) Fan Motor Power: 120V ac, 60-Hz, thermostatically controlled.
 - 6) Air Filters: Washable aluminum, Hoffman Series A-FLT.

4. Refrigerated System: Furnish where heat dissipation cannot be adequately accomplished with natural convection or forced ventilation. Smaller Panels (that are not freestanding): Size to adequately dissipate heat from equipment mounted inside panel or in panel face.
5. Space Heaters: Thermostatically controlled to maintain internal panel temperatures above dew point.

G. Labeling:

1. Size and format: In accordance with Section 40 90 13, Control and Network Panel Components.
2. Analyzer Panel Tag and Description: As per Supplement Analyzer Control Panel Schedule.
3. Instruments Tag: As per Supplement Analyzer Control Panel Instrument List.
4. Sample Intake:
 - a. Maximum inlet sample pressure acceptable for this analyzer panel components.
 - b. Set inlet pressure.
5. Sample Distribution Point:
 - a. Set flow, where applicable.
 - b. Set pressure, where applicable.
6. Junction Box:
 - a. Main disconnect label.
 - b. Additional Labels: As per UL 508A, NEC requirements.

2.03 INSTRUMENT COMPONENTS

A. General:

1. This article specifies analyzer control panel instrument components to be used for the panel fabrication unless otherwise noted on the Drawings, Lists, Supplements, or Schedules.
2. Component name is preceded, component code, which may be referenced on the Drawings and Schedules.
3. Refer to Supplement Analyzer Panel Instrument List, for analyzer control panel instrument and instruments component code, and Section 40 90 10, Instrument Components specification.

2.04 MECHANICAL SYSTEM COMPONENTS

A. General:

1. This article specifies to be used for the panel fabrication unless otherwise noted on the Drawings or Schedules.
2. Component name is preceded, component code, which may be referenced on the Drawings and Schedules.

- B. A-CP-01 Custom Panel, Stainless Steel:
1. General: Stainless steel plate for analyzer panel fabrication.
 2. Features:
 - a. Thickness: 12 gauge.
 - b. Material: 304 stainless steel.
 3. Country of Origin: United States.
 4. Manufacturer: Any.
- C. A-TR-01 Rigid Tubing 3/8-Inch, Stainless Steel:
1. General: Rigid tubing.
 2. Features:
 - a. Tube OD: 3/8 inch.
 - b. Working Pressure: 3,300 psig.
 - c. Tube Wall: 0.035 inch.
 - d. Material: Type 316/316L.
 3. Standards:
 - a. ASTM A269.
 - b. ASME B31.3.
 - c. ASME B31.1.
 4. Accessories:
 - a. Tube Supports: As required.
 - b. Tube Clamps: As required.
 5. Manufacturer: Swagelok.
- D. A-TF-01 Tubing Flexible, PFA, 1/4 Inch:
1. General:
 - a. Chemically resistant, translucent PFA flexible tubing.
 - b. Sample lines, drains.
 2. Features:
 - a. For Use: Air, water.
 - b. Flexible.
 - c. Color: Clear.
 3. Properties:
 - a. Material: PFA.
 - b. OD: 1/4 inch.
 - c. Wall Thickness: 0.047 inch.
 4. Pressure: Maximum 200 psi at 70 degrees F.
 5. Environmental: Operating Temperature: Minus 40 degrees F to plus 160 degrees F.
 6. Accessory: Groove cutter , required for installation.
 7. Manufacturer: Swagelok.

- E. A-TF-02 Tubing Flexible, Vinyl, 1/4 Inch, Clear, Low Pressure:
1. General:
 - a. General purpose, clear vinyl, flexible tubing .
 - b. Low pressure application or drain.
 - c. Can be used with tube fittings and material insert.
 2. Features:
 - a. For Use: Air, water.
 - b. Flexible.
 - c. Color: Clear.
 3. Properties:
 - a. Material: PVC.
 - b. OD: 1/4 inch.
 - c. Wall Thickness: Standard.
 4. Pressure: Maximum 40 psi
 5. Environmental: Operating Temperature: Minus 40 degrees F to plus 165 degrees F.
 6. Manufacturer: Swagelok
- F. A-PP-01 PVC Pipe, 1-Inch:
1. General: Standard rigid PVC pipe for water.
 2. Pipe Size: 1 inch.
 3. Schedule: 40.
 4. Material: PVC.
 5. Color: Black
 6. Connection: Socket.
 7. Pressure Maximum: 280 psi at 72 degrees F.
 8. Standards:
 - a. ASTM D1784, ASTM D1785.
 - b. NSF/ANSI 61.
 9. Manufacturer: Any.
- G. A-PP-02 PVC Pipe, 2-Inch:
1. General: Standard rigid PVC pipe for water.
 2. Pipe Size: 2 inch.
 3. Schedule: 40.
 4. Material: PVC.
 5. Color: Black
 6. Connection: Socket.
 7. Pressure Maximum: 280 psi at 72 degrees F.
 8. Standards:
 - a. ASTM D1784, ASTM D1785.
 - b. NSF/ANSI 61.

9. Country of Origin: United States.
 10. Manufacturer: Any.
- H. A-PP-03 2-Inch/1-Inch Reducer:
1. General: Reducer.
 2. Size: 2/1 inch.
 3. Schedule: 40.
 4. Material: PVC.
 5. Color: Black.
 6. Connection: Socket.
 7. Pressure Maximum: 280 psi at 72 degrees F.
 8. Standards:
 - a. ASTM D1784, ASTM D1785.
 - b. NSF/ANSI 61.
 9. Country of Origin: United States.
 10. Manufacturer: Any.
- I. A-FC-01 Flow Cell, PG-13.5 Probes:
1. General: Flow through (flow cell) used with PG 13.5 Probes
 2. Features:
 - a. Modular.
 - b. Adaptable for different sensors and process connections.
 - c. Cleaning connections.
 3. Material:
 - a. Body: Type 316 stainless steel.
 - b. Sealing: EPDM.
 4. Process Connection:
 - a. Size: G, 1/4-inch.
 - b. Arrangement: 90 degrees, unless otherwise noted.
 - c. Calibration Breaker: Without, unless otherwise noted.
 5. Pressure: Maximum 145 psi.
 6. Temperature: Minus 31 degrees F to 275 degrees F.
 7. Sensor Adapter:
 - a. Quantity: Three sockets, unless otherwise noted.
 - b. Thread Type and Size: PG 13.5 mm, unless otherwise noted.
 8. Accessories: Protective cap, as noted.
 9. Manufacturer: M4Knick, ARF 210.
- J. A-FC-02 Flow Cell, 1-Inch or 3/4-Inch Probes:
1. General: Flow through (flow cell) used with 1-Inch or 3/4-inch probes with adequate sealing hub.

2. Features:
 - a. Inlet/Outlet connections.
 - b. Drain connection.
 - c. Clear.
 - d. Adjustable position.
 - e. Drain valve included.
 - f. Type: English.
3. Material:
 - a. Body: Polycarbonate .
 - b. Sealing: EPDM.
4. Process Connection:
 - a. Size: 3/8-inch.
 - b. Arrangement: 90 degrees, unless otherwise noted.
5. Pressure: Maximum 0.5 bar psi.
6. Temperature: 41 degrees F to 113 degrees F.
7. Sealing hub Options:
 - a. 1-Inch sensors, as required.
 - b. 3/4 inch sensors, as required.
8. Manufacturer: Hach.

K. A-AFM-01 Adapter Fittings, Male Straight NPT, SS:

1. General:
 - a. Gaugeable tube fittings and adapter fittings.
 - b. Live-loaded, two-ferrule design.
2. Type: Straight.
3. Material: Type 316 stainless steel.
4. OD tube: 3/8 inch.
5. NPT size: 3/8 inch.
6. Manufacturer and Product: Swagelok.

L. A-AFM-01 Adapter Fittings, Male Straight NPT, PFA:

1. General:
 - a. PFA tube fittings.
 - b. Working pressure up to 275 psig
 - c. Temperatures from: 70 degrees F to 400 degrees F.
2. Type: Straight, male connector.
3. Material: PFA.
4. OD Tube: 1/4 inch.

5. NPT Size: 3/8 inch
 6. Manufacturer and Product: Swagelok.
- M. A-AFM-02 Adapter Fittings, Male Straight NPT, PFA:
1. General:
 - a. PFA tube fittings.
 - b. Working pressure up to 275 psig.
 - c. Temperatures from: 70 degrees F to 400 degrees F.
 2. Type: Straight, male connector.
 3. Material: PFA.
 4. OD Tube: 3/8 inch.
 5. NPT Size: 3/8 inch
 6. Manufacturer and Product: Swagelok.
- N. A-AFT-01 Adapter Fittings, Tees, Unions, SS:
1. General:
 - a. Gaugeable tube fittings and adapter fittings.
 - b. Live-loaded, two-ferrule design.
 2. Type: Tees, union.
 3. Material: Type 316 stainless steel.
 4. OD Tube: 3/8 inch.
 5. Manufacturer and Product: Swagelok.
- O. A-AFT-02 Adapter Fittings, Tee Female, SS:
1. General:
 - a. Gaugeable tube fittings and adapter fittings.
 - b. Live-loaded, two-ferrule design.
 2. Type: Tees, female.
 3. Material: Type 316 stainless steel.
 4. OD Tube: 3/8 inch.
 5. NPT Size: 1/4 inch female.
 6. Manufacturer and Product: Swagelok.
- P. A-AFF-01 Adapter Fittings, Cross, SS:
1. General:
 - a. Gaugeable tube fittings and adapter fittings.
 - b. Live-loaded, two-ferrule design.
 2. Type: Cross union.
 3. Material: Type 316 stainless steel.

4. OD Tube: 3/8 inch.
 5. Manufacturer and Product: Swagelok.
- Q. A-AFE-01 Adapter Fittings, 90-degree Elbow, Unions, SS:
1. General:
 - a. Gaugeable tube fittings and adapter fittings.
 - b. Live-loaded, two-ferrule design.
 2. Type: 90 degree elbow, union.
 3. Material: Type 316 stainless steel.
 4. OD Tube: 3/8 inch.
 5. Manufacturer and Product: Swagelok.
- R. A-AFE-02 Adapter Fittings, Male 90-degree Elbow, PFA:
1. General:
 - a. PFA tube fittings.
 - b. Working pressure up to 275 psig.
 - c. Temperatures From: 70 degrees F to 400 degrees F.
 2. Type: Male 90-degrees elbow male connector.
 3. Material: PFA.
 4. OD Tube: 1/4 inch.
 5. NPT Size: 3/8 inch.
 6. Manufacturer and Product: Swagelok.
- S. A-AFC-01 Adapter Fittings, Cap, SS:
1. General:
 - a. Gaugeable tube fittings and adapter fittings.
 - b. Live-loaded, two-ferrule design.
 2. Type: Straight fitting, cap.
 3. Material: Type 316 stainless steel.
 4. OD Tube: 3/8 inch.
 5. Manufacturer and Product: Swagelok.
- T. A-AFI-01 Insert for Soft Plastic Tubing, SS:
1. Type: Insert for soft plastic tubing.
 2. Material: Type 316 stainless steel.
 3. OD Tube: 3/8 inch.
 4. ID Tube: 1/4 inch
 5. Manufacturer and Product: Swagelok.
- U. A-AFA-01 Tube Adapter, Female, SS:
1. Type: Tube adapter, female.
 2. Material: Type 316 stainless steel.

3. OD Tube: 3/8 inch.
4. NPT: 1/4 inch female.
5. Manufacturer and Product: Swagelok.

V. A-VN-01 Needle Valve:

1. General:
 - a. Stainless steel body with 0.218-inch orifice.
 - b. Non-rotating stem needle valve.
2. Material: Stainless steel.
3. End Connections:
 - a. Inlet/Outlet: Tube fittings.
 - b. Size: 3/8 inch.
4. Pattern: Straight.
5. Valve Flow Coefficient (CV): 0.53.
6. Orifice: 0.218 inch.
7. Steam Tip: PCTFE.
8. Handle: Aluminum, Black.
9. Manufacturer and Product: Swagelok; Model D Series.

W. A-VI-01 Isolation (ON/OFF) Valve:

1. General:
 - a. Stainless steel, 3/8 inch, tube fitting.
 - b. One piece ball stem.
2. Type: Ball valve.
3. Materials:
 - a. Body: Stainless steel.
 - b. Packing: PFA.
4. End Connections:
 - a. Inlet/Outlet: Tube fittings.
 - b. Size: 3/8 inch.
5. Pattern: Straight.
6. Valve Flow Coefficient (CV): 6.
7. Handle: Lever, Black.
8. Manufacturer and Product: Swagelok; Series 40, SS-44TS6.

X. A-SF-01 Sand Filter, Y-strainer, Stainless Steel, Size 40:

1. General: For particles reduction, and probe protection.
2. Type: Y.
3. Connection:
 - a. Type: Pipe.
 - b. Size: 3/8 inch.
 - c. Tread Type: NPT.
 - d. Gender: Female.

4. Mesh
 - a. Size: 35, Unless otherwise Noted
 - b. Replaceable
 5. Maximum Pressure: 1,400 psi at 70 degrees F.
 6. Features: Treaded drain with plug.
 7. Country of Origin: United States.
 8. Manufacturer: Any.
- Y. A-MA-01 Mechanical Accessory, Tight-Seal Bolt Clamps:
1. General: Tight-seal bolt clamps for soft hose and tube.
 2. Clamp Type: Bold.
 3. Clamp ID Range: 3/8 inch to 7/16 inch.
 4. Drive Style: Philips, external hex.
 5. Bolt Type: Straight.
 6. Use with firm hose, firm tube, soft hose, soft tube.
 7. Material: Type 304 stainless steel.
 8. Environmental:
 - a. Operating Temperature: Minus 40 degrees F to plus 450 degrees F.
 9. Country of Origin: United States.
 10. Manufacturer: Any.
- Z. A-MA-02 Mechanical Accessory, Routing Clamp, 2-3/8-Inch, Plastic:
1. General: PP, two mounting points, 11/16-inch ID.
 2. Pipe Size: 2-3/8 inch.
 3. Material: Polypropylene plastic.
 4. Mounting: Two points.
 5. Country of Origin: United States.
 6. Manufacturer: Any.
- AA. A-MA-03 Mechanical Accessory, Routing Clamp, 3/8-Inch:
1. General: Type 304 stainless steel, two mounting points, 11/16-inch ID.
 2. Pipe Size: 3/8 inch.
 3. Material: Type 304 stainless steel.
 4. Mounting: Two points.
 5. Country of Origin: United States.
 6. Manufacturer: Any.
- BB. A-MA-04 Mechanical Accessory, Cable Tie, Mount:
1. General: For cable attachment to panel.
 2. Mount Type: Screw in.
 3. Material: Nylon plastic.
 4. For: Cable tie.

5. Color: Black.
6. Country of Origin: United States.
7. Manufacturer: Any.

CC. A-MA-05 Mechanical Accessory, Barbed hose Fitting

1. Features:
 - a. Shape: Straight.
2. Hose Connection:
 - a. Style: Barbed.
 - b. Type: Clamp on, crimp on.
 - c. Barb Style: Standard.
 - d. Gender: Female.
3. Hose ID: 6 mm.
4. Pipe Size: 3/8 inch.
5. Thread Type: NPT.
6. Material: 316 stainless steel.
7. Pressure: Max. 125 psi at 72 degrees F.
8. Environmental:
 - a. Operating Temperature: Minus 30 degrees F to plus 200 degrees F.
9. Country of Origin: United States.
10. Manufacturer: Any.

2.05 ELECTRICAL REQUIREMENTS

- A. In accordance with Division 26, Electrical.

2.06 ELECTRICAL SYSTEM COMPONENTS

- A. General: This article specifies analyzer control panel instrument components to be used for the panel fabrication unless otherwise noted on the Drawings or Schedules.
- B. In accordance with Section 40 90 13, Control and Network Panel Components.
 1. Wires within enclosures.
 2. Terminal blocks and grounding bus.
 3. Breakers.
 4. Grounding.
 5. Signal distribution.
 6. Power distribution.
 7. 24V dc Power supplier.
 8. Internal Panel lights, if applicable.

9. Intrinsic Safety Barriers: Applicable for remote probes located in hazardous environment.
10. Electrical Transient Protection: Applicable for outdoor analyzer panels.

2.07 FACTORY DEMONSTRATION TEST

A. General:

1. This section defines minimal requirements on Analyzer Panel Witness testing at analyzer panel factory. They are obligatory before analyzer panel delivery to Site.
2. Scope:
 - a. Installation:
 - 1) Instruments.
 - 2) Tubing.
 - 3) Cables, wires.
 - 4) Junction box.
 - b. Pressure test.
 - c. Flow Settings for Each Distribution Point: This test will be performed with sample inlet pressure as defined for site operation.
 - d. Alarm Test: Low flow alarm.
 - e. Panel Wiring Test:
 - 1) Loop check.
 - 2) Labeling.
 - f. Analyzer panel and instruments tagging and labeling.
3. Finalization:
 - a. After test completion analyzer panel shall be:
 - 1) Dried.
 - 2) Instruments protected and prepared for shipment.
 - 3) Loose equipment protected.

2.08 CORROSION PROTECTION

- A. Applicable for enclosure type analyzer panel.
- B. In accordance with Section 40 90 13, Control and Network Panel Components.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Material and Equipment Installation: Retain a copy of manufacturers' instructions at Site, available for review at all times.

- B. Electrical Field Wiring: As specified in Division 26, Electrical.
- C. Refer to Instrument Component Manufacturer installation manual.

3.02 EXAMINATION

- A. Verify the following conditions after analyzer panel installation at Site:
 - 1. Proper installation.
 - 2. Calibration and adjustment.
 - 3. Correct control action.
 - 4. Switch settings and dead bands.
 - 5. Opening and closing speeds and travel stops.
 - 6. Input and output signals.
 - 7. Sample pressure settings.
 - 8. Sample flow settings.

3.03 FIELD FINISHING

- A. Refer to Section 09 90 00, Painting and Coating.
- B. Mount loose components.

3.04 QUALITY CONTROL

- A. Provide Instrument Component Calibration Certificate.
- B. For analyzers provide:
 - 1. Installation validation protocol.
 - 2. Functional validation protocol.
 - 3. Calibration Certificate.

3.05 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.

3.06 PROTECTION

- A. In accordance with Section 40 90 13, Control and Network Panel Components.

3.07 SUPPLEMENT

- A. The supplement listed below, following “End of Section,” is a part of this specification:
 - 1. Analyzer Control Panel Schedule.

END OF SECTION

INTAKE PUMP STATION
ANALYZER CONTROL PANEL SCHEDULE

MAXIMUM PANEL SIZE
(INCHES)

ITEM	TAG	LOCATION	NAME	DESCRIPTION	MOUNTING	H	W	D	PANEL RATING	NOTES
1	1P20-ACP-822-01	INTAKE PUMP STATION PUMP ROOM	ANALYZER PANEL	FREE STAND, FRAME MOUNT, BACKPLATE TYPE	FREESTAND	72	60	N/A	N/A	

SECTION 40 90 22
NETWORK PANELS

PART 1 GENERAL

1.01 SUMMARY

- A. This PICS section gives requirements for network panels. The PICS network panels shall be completely coordinated, submitted, installed, and completed by the overall PIC SI in accordance with Section 40 90 00, Instrumentation and Control for Process Systems. For the following items, this subsection shall meet the requirements of, and be in accordance with, Section 40 90 00, Instrumentation and Control for Process Systems.
 - 1. Submittals.
 - 2. References.
 - 3. Definitions.
 - 4. Related Sections.
 - 5. Environmental Requirements.
 - 6. Delivery, Storage, and Handling.
- B. This section shall be in accordance with Section 40 90 00, Instrumentation and Process Control for Process Systems, but may provide additional requirements.
- C. All panel enclosures shall be UL recognized or listed.

1.02 RELATED SECTIONS

- A. Refer to Section 40 90 00, Instrumentation and Control for Process Systems for all related sections.
- B. Refer to Section 40 90 10, Instrument Components.
- C. Refer to Section 40 90 11, Network Components.
- D. Refer to Section 40 90 13, Control and Network Panel Components.

1.03 WORK INCLUDED

- A. Major Work Items: Provide all Network Panels as shown on the Drawings and Schedules.
- B. Provide all tools, supplies, materials, equipment, and all labor necessary for furnishing, constructing, installing, terminating, and testing Network Panel (NP), fiber optic (FO) system, CAT6 system, and network systems.

- C. Fabricate all Network Panels as shown on the Drawings and Schedules.
- D. Refer to Drawings, Bill of Material, and Schedules. Many of these drawings, Bill of Material, and Schedules are conceptual and not complete with every detail. They are intended to convey overall intent for a given system. The Supplier shall complete the final design of each of these conceptual drawings, schedules, and final bill of materials.
- E. System Description:
 - 1. This section specifies the requirements necessary to furnish, install, identify, and test Network Panel including communication network equipment, products, connectors, and materials herein:
 - a. The plant network(s) will be used by several Project systems including the process instrumentation and control system PICS, Security System, and plant business systems to distribute data and coordinate Owner's operations.
 - 1) Fiber Optic System (FOS): Function of FOS is to transmit digital data between network nodes over fiber media. Requirements listed identify minimum acceptable system performance.
 - 2) CAT6: Function of CAT6 is to transmit digital data between network nodes over copper media. Requirements listed identify minimum acceptable system performance.
 - 3) Refer to Network Block Diagrams and Electrical Plans on the Drawings for the networks.
 - a) Detailed PICS network diagrams will be completed by PIC System Integrator in accordance with Section 40 90 00, Instrumentation and Controls for Process Systems.
 - 2. Submit, provide, install, label, and test Network Panel cabling. This shall include all FOS and all CAT6 cabling. Block Diagrams and Electrical plans illustrate the fiber cabling, CAT6 cabling, and network connections to the multiple systems.
 - 3. Provide network cabling, connection, labeling, and testing for the Network Panel.
 - F. The following is a list of standards that may be referenced in this section:
 - 1. Electronic Components, Assemblies, and Materials Association (ECA): 310-E, Cabinets, Racks, Panels, and Associated Equipment.
 - 2. Institute of Electrical and Electronic Engineers, Inc. (IEEE): 802.3, Telecommunications and Information Exchange Between Systems—Local and Metropolitan Networks.

3. Insulated Cable Engineers Association (ICEA):
 - a. S-83-596, Optical Fiber Premises Distribution Cable.
 - b. S-87-640, Optical Fiber Outside Plant Communications Cable.
 - c. S-104-696, Indoor-Outdoor Optical Fiber Cable.
4. International Organization for Standardization (ISO): 9001, Quality Management Systems—Requirements.
5. International Telecommunication Union (ITU): T G.652, Characteristics of a Single-mode Optical Fibre and Cable.
6. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
7. QuEST Forum (QF): TL 9000, Quality Management Systems.
8. Rural Development Utilities Programs (RDUP):
 - a. 7 CFR 1755.902, Minimum Performance Specification for Fiber Optic Cables.
 - b. 7 CFR 1755.903, Fiber Optic Service Entrance Cables.
9. Telecommunications Industry Association (TIA):
 - a. 526-7, OFSTP-7 Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant.
 - b. 526-14, OFSTP-14 Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant.
 - c. 568-C.1, Commercial Building Telecommunications Cabling Standards.
 - d. 568-C.3, Optical Fiber Cabling Components Standard.
 - e. 598, Optical Fiber Cable Color Coding.
 - f. 606, Administration Standard for Commercial Telecommunications Infrastructure.
10. Telecommunications Industry Association/Electronics Industry Association (TIA/EIA):
 - a. 455-78, FOTP-78 - IEC 60793-1-40 Optical Fibres Part 1-40: Measurement Methods and Test Procedures – Attenuation.
 - b. 455-133, FOTP-133 IEC-60793-1-22 Optical Fibres Part 1-22: Measurement Methods and Test Procedures Length Measurement.
 - c. 492AAAA, Detail Specification for 62.5-Micrometer Core Diameter/125-Micrometer Cladding Diameter Class Ia Graded-Index Multimode Optical Fibers.
 - d. 492AAAB, Detail Specification for 50-Micrometer Core Diameter/125-Micrometer Cladding Diameter Class Ia Graded-Index Multimode Optical Fibers.
 - e. 492AAAC, Detail Specification for 850-nm Laser-Optimized, 50-um Core Diameter/125-um Cladding Diameter Class Ia Graded-Index Multimode Optical Fibers.
 - f. 492CAAA, Detail Specification for Class IVa Dispersion-Unshifted Single-Mode Optical Fibers.
 - g. 492CAAB, Detail Specification for Class IVa Dispersion-Unshifted Single-Mode Optical Fibers with Low Water Peak.

- h. 604-2, FOCIS-2 Fiber Optic Connector Intermateability Standard, Type ST.
- i. 604-3, FOCIS-3 Fiber Optic Connector Intermateability Standard, Type SC and SC-APC.
- j. 604-12, FOCIS-12 Fiber Optic Connector Intermateability Standard, Type MT-RJ.
- k. 942, Telecommunications Infrastructure Standard for Data Centers.
- l. TSB-140, Additional Guidelines for Field-Testing Length, Loss and Polarity of Optical Fiber Cabling Systems-Contains Color.
- 11. UL: 94, Tests for Flammability of Plastic Materials for Parts in Devices and Appliances.
- 12. UL 2416, Audio/Video, Information and Communication Technology Equipment Cabinet, Enclosure and Rack Systems.

1.04 DEFINITIONS

- A. ATM: Asynchronous Transfer Mode.
- B. AUI: Attachment Unit Interface.
- C. CAT6: Category 6 Network Cable.
- D. CSFT Communication Systems Functional Test.
- E. dB: Decibel.
- F. EMB: Effective Modal Bandwidth.
- G. ETL: Electrical Test Laboratories.
- H. Flux Budget: Difference between transmitter output power and receiver input power required for signal discrimination when both are expressed in dBm.
- I. Fusion Splice: Connecting ends of two fibers together by aligning fiber ends and applying electric arc to fuse ends together.
- J. FOS: Fiber Optic System.
- K. Hybrid Cable: Cable containing more than one type of fiber.
- L. LAN: Local Area Network.
- M. LIU: Lightguide Innerconnect Unit (patch panel).
- N. m: Micrometer.
- O. Mbps: Megabits per Second.

- P. Mechanical Splice: Connecting ends of two fibers together by means other than fusion.
- Q. Megahertz (MHz): One million cycles per second.
- R. MHz: Megahertz.
- S. micro: $\times 10^{-6}$.
- T. Micron: Micrometer or one millionth meter.
- U. MIS: Management Information System.
- V. n, nano: $\times 10^{-9}$.
- W. N: Newton.
- X. nm: Nanometer—unit of measure equal to one billionth meter.
- Y. OFNP: Nonconductive Optical Fiber Plenum Cable.
- Z. OFNR: Nonconductive Optical Fiber Riser Cable.
- AA. OLTS: Optical Loss Test Sets.
- BB. OTDR: Optical Time Domain Reflectometer.
- CC. PICS: Process Instrumentation and Control System.
- DD. Plenum: Air return path of central air handling system, such as open space above suspended ceiling.
- EE. UPC: Ultra Physical Contact.
- FF. UPS: Uninterruptible Power Supply.
- GG. V ac: Volts Alternating Current.
- HH. WAN: Wide Area Network.

1.05 SUBMITTALS

- A. Action Submittals:
 - 1. Bill of Materials: List of required equipment.
 - 2. Catalog Cuts: Network Components, electrical devices, and mechanical devices.
 - 3. Instrument List.

4. Sizing and Selection Calculations:
 - a. UPS Power, where applicable
 - b. AC and DC power consumption.
 - c. Heat Dissipation: and Air Conditioning, where needed.
5. Preliminary Panel Elevation Drawings: Provide prior to submitting Panel Construction Drawings.
 - a. Panel Construction Drawings General Arrangement Drawings.
 - b. Panel Layout Drawing.
6. Detailed Network Panel Diagrams.
7. Detailed Network Panel Wiring Diagrams.
8. Spares, expendables, and test equipment.
9. Submit anchorage and bracing design drawings, cut sheets, and their installation information for components, distribution systems, and equipment as required by Section 01 88 15, Anchorage and Bracing.

B. Informational Submittals:

1. Operation and Maintenance Data
1. Testing Related Submittals:
 - a. Factory Demonstration Test:
 - 1) Preliminary Test Procedures: Outline of proposed tests, forms, and checklists.
 - 2) Final Test Procedures:
 - a) Proposed test procedures, forms, and checklists.
 - b) Capacity, Timing, and Simulation: Describe simulation and monitoring methods used to demonstrate compliance with capacity and timing requirements.
 - 3) Test Documentation: Copy of signed off test results.
 - b. Performance Acceptance Test:
 - 1) Preliminary Test Procedures: Outline of proposed tests, forms, and checklists.
 - 2) Final Test Procedures: Proposed test procedures, forms, and checklists.
 - 3) Test Documentation: Copy of signed-off test results.
2. Equipment Configuration and Setpoints Records:
 - a. Hard copy.
 - b. Electronic copy.
3. Calculations in Microsoft Excel format.
 - a. One file per Network Panel.
 - b. File Name Format: Network Panel Tag_Calculations.
4. Drawings in AutoCAD or MicroStation Format.
 - a. One file per Drawing.
 - b. File Name Format: Network Panel Tag_Drawing Number_Drawing Title.

1.06 QUALITY ASSURANCE

A. Qualifications:

1. Network Panel Supplier: Minimum of 5 years' experience providing, integrating, installing, and starting up similar systems as required for this Project.
2. Network Panel Supplier Site Representative: Minimum of 5 years' experience installing similar systems as required for this Project.

B. Coordination:

1. Network Panels shall be in accordance with Network Diagrams, Room Layout, Electrical Plans and P&ID contract drawings.
2. Coordinate with electrical contractor for all conduit entry and wiring interfaces including power and signal, all panel locations, and all mounting.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. In accordance with Section 01 61 00, Common Product Requirements.
- B. In accordance with Section 40 90 00, Instrumentation and Controls for Process Systems.

1.08 EXTRA MATERIALS

- A. For following item provide extra materials to enable future system extensions:
 1. Fiber Optic Patch Panel:
 - a. Fiber Optic Panel adapter with sockets.
 - b. Fiber Optic pigtailed.
 - c. Fiber Optic Splice Tray.
 - d. Fiber Optic Fusion Splice holder.
 2. Copper Patch Panel: Ethernet sockets.
- B. Provide spare copper patch cords in quantity of total of spare switch port mounted in the panel.

PART 2 PRODUCTS

2.01 NETWORK PANELS

- A. Function: Provides network components and systems equipment mounting and field wiring termination.
- B. Reference Network Control Panel Schedule in Article Supplements.

- C. Reference P&IDs and block diagrams on the Drawings.
- D. Reference all PICS subsections as there may be panel requirements, instruments, or other elements contained in other PICS subsections.

2.02 NAMEPLATES AND TAGS

- A. In accordance with Section 40 90 13, Control and Network Panel Components.
- B. Panel Component, Patch Panels Ports, Wires, Cables Labels: Follow Network Diagram Drawings and in accordance with Section 40 90 00, Instrumentation and Controls for Process Systems.

2.03 NETWORK PANEL FABRICATION

- A. 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.
- B. Panel to comply with UL 2416 Standard for Safety; Audio/Video, Information and Communication Technology Equipment; Cabinet, Enclosure and Rack Systems.
- C. Network Panel Type: Based on environmental design requirements and referenced in Article Environmental Requirements, provide the following unless otherwise noted in Network Panel Schedule in Article Supplements.
- D. Network Panel Construction:
 - 1. General:
 - a. Provide the following network control panel features unless otherwise noted or shown on Network Panel Drawings:
 - 1) Network panel layout concept drawing.
 - 2) Network panel power supply concept drawing.
 - 3) Network diagram drawings.
 - 2. Network Panel Enclosure:
 - a. Provide Network Panel Enclosure type in accordance with Network Panel Schedule in Article Supplements.
 - b. NEMA: NEMA12 as minimum, unless otherwise noted.
 - c. Standard: Rack 19 inches, unless otherwise noted.
 - 3. Network Panel Components.
 - a. Provide means and methods to install and furnish network components.
 - b. Provide Network Components. In accordance with Section 40 90 11, Network Components, Supplement 1, Network Component List.

- c. Provide space and mounting hardware for Owner-Furnished Network Components. In accordance with Section 40 90 11, Network Components the Supplement 2, Owner-Furnished Components List.
- d. Mounting:
 - 1) According to manufacturer installation manual
 - 2) Allow proper air flow around equipment.
 - 3) Heavy components at bottom of the panel.
- e. Blinds:
 - 1) Provide for all unused rack units in the panel.
 - 2) Quantity: As required.
- 4. Grounding: Provide ground bar for protective earth connection and shield connection.
- 5. Power Supply:
 - a. General: Follow Network Supply Concept Drawings.
 - b. Each panel to be equipped with two power circuits, unless otherwise stated.
 - 1) UPS Power.
 - 2) Auxiliary Power.
 - c. Provide means for power disconnection and power distribution, as show on network panel supply drawings.
 - 1) Main disconnecter.
 - 2) Fuses.
 - 3) Terminals.
 - 4) Wiring.
 - 5) Power distribution units.
 - 6) Service outlet.
 - 7) Redundant power suppliers, where required for network components.
 - d. Size components to supply active provided network components and to enable future network panel extension.
- 6. Light: Provide LED lamp with door open switch.
- 7. Cooling or Cooling/Heating Network Panel: Unless otherwise stated, where required based on heat calculation or environmental requirements provide Air Conditioning unit.
- 8. Cable Routing:
 - a. Provide means and methods for cable routing inside network panel to meet minimum cable bending radius requirement.
 - b. Provide horizontal cable managers equipment for cable routing and cable slack management.
 - c. Use cable fingers for vertical cable routing.
 - d. Use cable managers for horizontal cable routing.
 - e. Group cable based on their function and destination.
 - f. Protect sharp edges.
 - g. Protect fiber optic cable tubes when exposed.

9. Instruments:
 - a. General:
 - 1) Temperature monitoring inside network panel.
 - 2) Doors monitoring.
 - b. Temperature Transmitter:
 - 1) Type: 2 – wire transmitter.
 - 2) Signal: 4 mA to 20 mA
 - 3) Provided by PICS. In accordance with Section 40 90 10, Instrument Components.
 - c. Door Switch
 - 1) Type: Dry contact.
 - 2) Provided by network panel enclosure supplier
 - d. Provide terminal strip for signal wire termination and connection to SCADA.

E. Temperature Control:

1. PICS Enclosure Temperature Control Calculations: Provide heat calculations for all panels at time of panel submittals. If the heat calculations indicate required heating, and/or cooling, provide adequate heating and/or cooling.
2. Panel Type:
 - 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) Pull inlet air into panel through filters on lower door, providing cooler air over components exhausted through fan at top of panel.
 - c) Fan Motor Power: 120V ac, 60-Hz, thermostatically controlled.
 - 6) Air Filters: Washable aluminum, Hoffman Series A-FLT.
3. Refrigerated System:
 - a. Furnish where heat dissipation cannot be adequately accomplished with natural convection or forced ventilation. Smaller Panels (that are not freestanding): Size to adequately dissipate heat from equipment mounted inside panel or in panel face.

- b. Space Heaters: Thermostatically controlled to maintain internal panel temperatures above dew point.

F. Labeling:

- 1. General Requirements:
- 2. Network Panel:
 - a. Network Panel Tag and Description: As per Supplement Network Panel Schedule.
 - b. Component Tag:
 - 1) As per Supplement Network Panel Component List.
 - 2) As per contract Network Diagram Drawings.
 - c. Power Supply Rail:
 - 1) Main disconnect label.
 - 2) Additional Labels: As per UL 508A, NEC requirements.

2.04 NETWORK PANEL ENCLOSURE

A. General: This article specifies enclosure code listed under Network Panel Schedule.

B. N-EFS-01 Free Standing Rack Enclosure, Large:

- 1. General:
 - a. Enclosure for 19-inch rack mount equipment.
 - b. Rack Units: 42.
 - c. Modular, frame mount.
- 2. Features:
 - a. 19-inch rack.
 - b. Front and rear access.
 - c. Ground studs.
 - d. Fully gasketed.
 - e. Three-point locking handles on all doors.
 - f. Keylocking.
 - g. Rack angles infinitely adjustable from front to rear positioning.
 - h. Levers and anti-tip bracket secure cabinet to the floor.
 - i. Optional AC cutout.
 - j. Gland plate.
 - k. Adjustable door opening position.
- 3. Standards:
 - a. UL 508A listed.
 - b. cUL Listed per CSA C22.2.
- 4. Enclose Rating: NEMA Type 12, unless otherwise noted.
- 5. Material: Mild steel.

6. Doors:
 - a. Thickness: 16-gauge.
 - b. Solid type, unless otherwise noted.
7. Body Thickness: 14-gauge.
8. Finish: Powder coated.
9. Color: Light Gray.
10. Size:
 - a. Hight: 82.1 inch.
 - b. Width: 27.87 inch.
 - c. Depth: 31.46 inch.
11. Accessories:
 - a. Door open intrusion switch.
 - b. Keylocking.
 - c. Lighting.
 - d. Filter, fan with thermostat, unless otherwise noted.
 - e. Mounting hardware.
 - f. PDUs.
12. Manufacturer and Product: nVent Hoffman, ProLine V/D Server Cabinet, Solid.

C. N-CC-01 Computer Cabinet, 18RU:

1. General:
 - a. Audio Visual Cabinet for 19-inch rack mount equipment.
 - b. Rack Units: 18.
2. Features:
 - a. 19-inch rack.
 - b. Front access.
 - c. Ground studs.
 - d. Rack angles infinitely adjustable from front to rear positioning.
 - e. Wheels.
 - f. Adjustable door opening position.
 - g. Passive cooling vents located on the top, bottom and sides.
3. Standards: cUL listed.
4. Enclosure Rating: NEMA Type 1, unless otherwise noted.
5. Material: Mild steel.
6. Doors:
 - a. Thickness: 16-gauge.
 - b. Window type.
7. Finish: Powder coated.
8. Color: Black.
9. Size:
 - a. Hight: 38.90 inch.
 - b. Width: 23.67 inch.
 - c. Depth: 23.62 inch.

10. Accessories:
 - a. Door open intrusion switch.
 - b. Key locking.
 - c. Filter.
 - d. PDU and outlet strips.
 - e. Two post sliding rack shelf.
 - f. Mounting hardware.
11. Manufacturer and Product: HAMMOND, RB-AV18.

D. N-EWM-01 Wall Mount, Double Hinge, Small:

1. General:
 - a. Small enclosure for 19-inch rack mount equipment.
 - b. Rack Units: 12.
2. Features:
 - a. 19-inch rack.
 - b. Front and rear access.
 - c. Ground studs.
 - d. Premium seamless, foam-in-place gasket.
 - e. Keylocking.
3. Standards:
 - a. UL 508A listed.
 - b. cUL Listed per CSA C22.2.
4. Enclosure Rating: NEMA Type 12, unless otherwise noted.
5. Material: Mild steel.
6. Doors:
 - a. Thickness: 16-gauge.
 - b. Solid type, unless otherwise noted.
7. Body Thickness: 14-gauge.
8. Finish: Powder coated.
9. Color: Light Gray.
10. Size:
 - a. Hight: 24.09 inch.
 - b. Width: 23.62 inch.
 - c. Depth: 27.95 inch.
11. Accessories:
 - a. Steel panel, if noted.
 - b. Door open switch.
 - c. Keylocking.
12. Manufacturer and Product: nVent Hoffman, ProTek Double-Hinge.

E. N-EWM-02 Wall Mount, Double Hinge, Large:

1. General:
 - a. Large enclosure for 19-inch rack mount equipment.
 - b. Rack Units: 26.

2. Features:
 - a. 19-inch rack.
 - b. Front and rear access.
 - c. Ground studs.
 - d. Premium seamless, foam-in-place gasket.
3. Standards:
 - a. UL 508A listed.
 - b. cUL Listed per CSA C22.2.
4. Enclosure Rating: NEMA Type 12, unless otherwise noted.
5. Material: Mild Steel.
6. Doors:
 - a. Thickness: 16-gauge.
 - b. Solid type, unless otherwise noted.
7. Body Thickness: 14-gauge.
8. Finish: Powder coated.
9. Color: Light Gray.
10. Size:
 - a. Hight: 48.54 inch.
 - b. Width: 27.56 inch.
 - c. Depth: 24.02 inch.
11. Accessories:
 - a. Steel panel, if noted.
 - b. Door open switch.
 - c. Keylocking.
 - d. Fan kit with thermostat.
12. Manufacturer and Product: nVent Hoffman, ProTek Double-Hinge, Window.

2.05 NETWORK CONSOLES

- A. Custom operator control consoles with ergonomically designed operator bays (tabletop with monitors).
 1. Construction:
 - a. Straight worktop, unless otherwise noted.
 - b. 1-inch thick composite wood core worktop with high pressure laminate (HPL) coating.
 - c. Workstation surface color shall be "Titanium EV," with side panel color of "North Sea."
 - d. Ergonomic desktop edge.
 - e. 12-gauge cold rolled steel frame with powdercoat finish.
 - f. Hidden shelving under desktop for computer workstation and electronic equipment.
 - g. Hidden cable management system (no cables visible).
 - h. 39-inch desk depth.
 - i. 8-foot desk width.

- j. Chair.
 - 1) One Tresco Iron Horse 3000 Series chair.
 - 2) Synthetic leather.
- k. Covers:
 - 1) Removable side and rear covers.
 - 2) Perforated ventilation on rear panel cover.
- l. Flat screen monitor mounting ready for mounting of two monitors.
 - 1) Integral monitor mounting to backwall of desk.
 - 2) Monitor mounting brackets and swing arm.
 - 3) Adjustable monitor height, angle, and depth.
- 2. Adjustability: Adjustable work surface height for ergo fit.
- 3. Facility Consoles:
 - a. Provide control console at each of the following facilities:
 - 1) Ute Intake PS SCADA room (IPS).
 - 2) Caprock PS SCADA room (CPS).
 - a. Standards: DIN EN ISO 11064 ergonomic design of control centers.
- 4. Candidate Supplier:
 - a. Tresco, 2400 Series, customized for each system, or facility.
 - b. Knurr Ergocon, customized for each system, or facility.

2.06 NETWORK COMPONENTS

A. General:

- 1. This article specifies network panel components to be used for the panel fabrication unless otherwise noted on the Drawings or Schedules.
- 2. Component name is preceded, component code, which may be referenced on the Drawings and Schedules.
- 3. Refer to Supplement Network Panel Component List for Network Panel components and component code Section 40 90 11, Network Components.

2.07 MECHANICAL SYSTEM COMPONENTS

A. General:

- 1. This article specifies network panel mechanical components to be used for the panel fabrication unless otherwise noted on the Drawings or Schedules.
- 2. Component name is preceded, component code, which may be referenced on the Drawings and Schedules.

B. Screws, cable supports, brackets, shelf.

C. In accordance with Section 40 90 13 Control and Network Panel Components.

2.08 ELECTRICAL REQUIREMENTS

- A. In accordance with Division 26, Electrical.

2.09 ELECTRICAL SYSTEM COMPONENTS

- A. General: This article specifies components to be used for the panel fabrication unless otherwise noted on the Drawings or Schedules.
- B. In accordance with Section 40 90 13, Control and Network Panel Components.
 - 1. Wires within enclosures.
 - 2. Terminal blocks and grounding bus.
 - 3. Breakers.
 - 4. Grounding of enclosures.
 - 5. Signal distribution.
 - 6. Power distribution.
 - 7. Power suppliers.
 - 8. Cable entering or leaving enclosures.
 - 9. Internal panel lights.
 - 10. Electrical transient protection.

2.10 SOURCE QUALITY CONTROL

- A. Factory Demonstration Test:
 - 1. This section defines minimal requirements on Network Panels Witness testing at network panel factory. They are obligatory before network panel delivery to Site.
 - 2. Scope:
 - a. Installation:
 - 1) Instruments.
 - 2) Cables, wires.
 - b. Panel Wiring Test:
 - 1) Loop check.
 - 2) Labeling.
 - c. Network panel and instruments tagging and labeling.
 - 3. Finalization:
 - a. After test completion panels shall be:
 - 1) Instruments protected and prepared for shipment.
 - 2) Loose equipment protected.

2.11 CORROSION PROTECTION

- A. In accordance with Section 40 90 13, Control and Network Panel Components.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Material and Equipment Installation: Retain a copy of manufacturers' instructions at Site, available for review at all times.
- B. Electrical Field Wiring: As specified in Division 26, Electrical.
- C. Refer to Network Component Manufacturer installation manual.
- D. Refer to Room Layout Drawing for panel location and panel door opening direction.
- E. Refer to conduit schedule and/or cable tray diagrams in Electrical Drawings for cable routing.

3.02 EXAMINATION

- A. Verify the following conditions after network panel installation at Site:
 - 1. Proper installation.
 - 2. Proper cabling.
 - 3. Proper grounding and shielding.
 - 4. Proper labeling.
 - 5. Power supply.
 - 6. Signals to SCADA Connection:
 - a. Door opened.
 - b. Panel temperature.
 - 7. Active network component operations.
 - 8. Network panel door orientation.
 - 9. Accessories:
 - a. Patchcords.
 - b. FO LC connector protection plugs for unused ports.
- B. Verification with Owner presence, after network panel installation at Site:
 - 1. Active network components setup and configuration.
 - 2. Network panel key handover.
 - 3. Network panel documentation copy located at the panel.

3.03 FIELD QUALITY CONTROL

- A. Communication Systems Functional Test (CSFT) in accordance with Section 01 91 14, Equipment Testing and Facility Startup, Section 40 90 00, Instrumentation and Controls for Process Systems, Section 40 90 30, Instrumentation Testing and Startup, and Section 26 05 10, Network Communication System.

3.04 TRAINING

- A. Train Owner's staff in the following skills:
 - 1. Network component function and the project configuration.
 - 2. Fiber connector selection.
 - 3. Copper connector selection and termination.
 - 4. Shield cable, grounding.
 - 5. Fiber patchcord selection.
 - 6. Testing quality of connectors, splices, and fibers.
 - 7. Patchcord routing within network panel.
 - 8. Network panel wiring.
 - 9. Network panel maintenance.
 - 10. Network panel future extension procedure.
- B. Schedule: Provide two 8-hour training sessions on consecutive weekdays, to suit Owner's schedule.
- C. Materials: Provide hardware for training, including fibers, connectors, and splice kits.

3.05 SUPPLEMENT

- A. The supplement listed below, following "End of Section," is a part of this specification:
 - 1. Network Panel Schedule:
 - a. Caprock Pump Station (CPS).
 - b. Caprock Tank (CT).
 - c. Intake Pump Station (IPS).

END OF SECTION

CAPROCK PUMP STATION
NETWORK PANEL SCHEDULE

MAXIMUM PANEL SIZE
(INCHES)

ITEM	TAG	LOCATION	NAME	DESCRIPTION	MOUNTING	H	W	D	PANEL RATING	COMPONENT CODE	NOTES
1	CP20-NP-831-01	CAPROCK PUMP STATION PLC ROOM	MAIN NETWORK PANEL	42 RU, 19-inch Rack Enclosure, Double Access, Fan, Key Locking, Lighting, Door switch	FREESTAND	82	28	32	NEMA 12	N-EFS-01	
2	CP20-PCC-811-01	CAPROCK PUMP STATION SCADA ROOM	CONSOLE	Custom operator control consoles with ergonomically designed operator bays (tabletop with monitors)	FREESTAND	Adjustable	96	39	AS REQ	40 90 22 Spec. 2.05 Network console	

CAPROCK TANK
NETWORK PANEL SCHEDULE

MAXIMUM PANEL SIZE
(INCHES)

ITEM TAG	LOCATION	NAME	DESCRIPTION	MOUNTING	H	W	D	PANEL RATING	COMPONENT CODE	NOTES
T1	CAPROCK TANK ELECTRICAL ROOM	MAIN NETWORK PANEL	42 RU, 19-inch Rack Enclosure, Double Access, Fan, Key Locking, Lighting	FREESTAND	82	28	32	NEMA 12	N-EFS-01	

INTAKE PUMP STATION
NETWORK PANEL SCHEDULE

MAXIMUM PANEL SIZE
(INCHES)

ITEM TAG	LOCATION	NAME	DESCRIPTION	MOUNTING	H	W	D	PANEL RATING	COMPONENT CODE	NOTES
1	IP20-NP-831-01 INTAKE PUMP STATION PLC ROOM	MAIN NETWORK PANEL	42 RU, 19-inch Rack Enclosure, Double Access, Fan, Key Locking, Lighting, Door switch	FREESTAND	82	28	32	NEMA 12	N-EFS-01	
2	IP20-PCC-811-01 INTAKE PUMP STATION SCADA ROOM	CONSOLE	Custom operator control consoles with ergonomically designed operator bays (tablettop with monitors)	FREESTAND	Adjustable	96	39	AS REQ	40 90 22 Spec, 2.05 Network console	
3	IP15-NP-831-01 INTAKE PUMP STATION CHEMICAL FACILITY	AUX. NETWORK PANEL	Wall Mount, Double Hinge, 12 RU, Key Locking, Door switch	WALL MOUNT	24	24	28	NEMA 4X	N-EWMI-01	
4	IP32-NP-831-01 INTAKE PUMP STATION COMPRESSOR BUILDING	AUX. NETWORK PANEL	Wall Mount, Double Hinge, 12 RU, Key Locking, Door switch	WALL MOUNT	24	24	28	NEMA 12	N-EWMI-01	

SECTION 40 90 30
INSTRUMENTATION AND CONTROL TESTING AND STARTUP

PART 1 GENERAL

1.01 SUMMARY

A. This PICS section gives requirements for PICS testing and startup. The PICS testing and startup shall be completely coordinated by the overall PIC SI in accordance with Section 40 90 00, Instrumentation and Control for Process Systems. For the following items, this subsection shall meet the requirements of, and be in accordance with, Section 40 90 00, Instrumentation and Control for Process Systems.

1. Submittals.
2. References.
3. Definitions.
4. Related Sections.
5. Environmental Requirements.
6. Delivery, Storage, and Handling.

1.02 RELATED SECTIONS

A. Refer to Section 40 90 00, Instrumentation and Control for Process Systems for all related sections. At a minimum, but not limited to, coordination with the following systems shall be included:

1. Section 01 31 13, Project Coordination.
2. Section 01 91 14, Equipment Testing and Facility Startup.
3. Section 23 09 23, Direct-Digital Control System for HVAC.
4. Section 26 05 10, Network Communication System.
5. Section 26 05 30, Electrical Testing and Startup.
6. Section 26 09 14, Vibration Monitoring System.
7. Section 26 19 23, Medium Voltage Adjustable Frequency Drive System.
8. Section 26 24 19, Low-Voltage Motor Control.
9. Section 26 29 23, Low-Voltage Variable Frequency Drive System.
10. Section 26 32 13.13, Diesel Engine Generator Set.
11. Section 33 12 17.01, Surge Control System Engineer Designed.
12. Section 40 27 02, Process Valves and Operators.
13. Section 40 99 90, Package Control Systems.
14. Section 44 11 25, Powder Activated Carbon Feed System.
15. Section 44 42 56.03, Vertical Turbine Pumps.
16. Section 44 44 13.01, Chemical Metering Pumps.
17. Section 44 44 13.02, Carbon Dioxide Package System.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 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. Component Acceptance Test (CAT): Prior to startup, participate with Division 26, Electrical, to inspect, test, to ensure that entire PICS is ready for operation. Reference Section 01 91 14, Equipment Testing and Facility Startup, Section 26 08 00, Commissioning of Electrical Systems, and Section 26 05 10, Network Communication System. Intent of the CAT is to ensure that each component, element, or device is installed and ready for its intended use.

1. Loop/Component Inspections and Calibrations:

a. Check:

- 1) PICS components, elements, devices for proper installation, calibration, and adjustment on a loop-by-loop and component-by-component.
- 2) Wiring to, and from, all PICS components, elements, devices.
- 3) Wiring, to, and from, all non-PICS components, elements, and devices that interface with the PICS.

2. Network Testing:

a. Coordinate, and participate, with the Contractor, Division 26 Electrical, and Section 26 05 10, Network Communication System.

- a) Test every network cable and network connection in accordance with Section 26 05 10, Network Communication System.
- b) Network connections to, and from, all PICS components, elements, and devices.
- c) Network connections to, and from, all non-PICS components and devices that are connected to the PICS network.
- d) Witness and sign the testing documentation for interfaces to, and from, the PICS.

b. Communication Systems Functional Test (CSFT) in accordance with Section 01 91 14, Equipment Testing and Facility Startup,

Section 40 90 00, Instrumentation and Controls for Process Systems, and Section 26 05 10, Network Communication System.

- 1) CSFT must be completed for all network connections to and from the PICS and all other systems as shown on the block diagrams in the Drawings.
 - 2) CSFT must be completed no later than during the Component Acceptance Test phase.
 - 3) If the CSFT is not completed the Functional Acceptance Test phase cannot commence.
 - 4) The CSFT is a prerequisite to the FAT phase.
3. CAT Procedures, Forms, and Checklists:
- a. Conduct tests in accordance with, and documented on, Engineer accepted procedures, forms, and checklists.
 - b. Describe each test item to be performed.
 - c. Have space after each test item description for sign off by appropriate party after satisfactory completion.
4. Required Component Acceptance Test Documentation: Test procedures, forms, and checklists. All signed by Engineer and Contractor.
- a. 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 of elements.
 - 6) Model number/serial number.
 - b. Summary of component requirements, for example:
 - 1) Indicators and scale ranges.
 - 2) Transmitters/converters, input, and output ranges.
 - 3) Computing elements' function.
 - 4) Switching elements, unit range, differential (fixed/adjustable), reset (auto/manual).
 - c. Space for comments.
5. Leak Test: Provide analyzer panel and instrument tubing leak test.
- C. Functional Acceptance Tests (FAT): Reference Section 01 91 14, Equipment Testing and Facility Startup. Intent of the FAT is to ensure that each subsystem including electrical systems, package systems, mechanical systems, and PICS in their entirety are all working together as a system to meet the required operations and intended use.
1. General:
 - a. Test all PICS components, devices, and elements along with other systems to demonstrate that each system and the PICS are all functional and 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.
 - 3) Calibrations, for example:
 - a) Analog Devices: Actual inputs and outputs at 0 percent, 10 percent, 50 percent, and 100 percent of span, rising and falling.
 - b) Discrete Devices: Actual trip points and reset points.
 - c. FAT 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 Functional Acceptance 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 PICS testing with Owner, Engineer, Contractor, and other Subcontractors.
 - 1) Excessive Test Witnessing: Refer to Contract Documents.
2. Test Requirements:
- a. Test each plant system, equipment, device, or similar that has any connection, interface, or circuit, to the PICS for proper functionality.
 - b. Perform local and manual tests for each loop.
 - c. Verify all equipment with plant PLC controls can be placed in to REMOTE and AUTOMATIC modes. AUTOMATIC controls will be tested during SOAT.
 - d. 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.
 - e. Test all network communications to, and from, PICS.
 - f. Test all PLC interfaces and functionality for each system.
 - g. Test all SCADA interfaces and functionality for each system.

- h. Test all interfaces to motor control center, valves, package systems and any other systems with interfaces, to and from, PICS.
 - i. Test all interlocks for all plant systems, regardless of PICS supply or not.
 - j. Make updated versions of documentation required for FAT available to Engineer at Site, both before and during tests.
 - k. Make one copy of O&M manuals available to Contractor, PIC SI, and the Engineer at the Site both before, and during, testing.
 - l. Reference examples of FAT procedures and forms in accordance with Section 40 90 00, Instrumentation and Control for Process Systems.
- D. Software Operational Acceptance Tests (SOAT): Reference Section 01 91 14, Equipment Testing and Facility Startup. Intent of the SOAT is to ensure that each subsystem including electrical systems, package systems, mechanical systems, and PICS in their entirety are all working together to meet the overall facility operations as defined by the Control Specifications in accordance with Section 40 90 00, Instrumentation and Control for Process Systems. Clean water will be available for use in SOAT testing. The SOAT test will allow testing of the entirety of the PICS and the PLC and SCADA applications software.
- 1. General:
 - a. Test all PICS elements to demonstrate that PICS 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 PICS testing with Owner and affected Subcontractors.
 - 1) Excessive Test Witnessing: Refer to Contract Documents.

2. Test Requirements:
 - a. Once each system within the entire facility has been performance tested as required by individual equipment technical specifications, perform a witnessed SOAT on the entire facility PICS to demonstrate that it is operating as required. Demonstrate each required function for every facility on a paragraph-by-paragraph and loop-by-loop basis.
 - b. Perform REMOTE MANUAL and REMOTE 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 SOAT 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.

END OF SECTION

SECTION 40 99 90
PACKAGE CONTROL SYSTEMS

PART 1 GENERAL

1.01 RELATED SECTIONS

- A. Related sections include, but not limited to, the following:
1. Division 01, General Requirements.
 2. Section 26 05 26, Grounding and Bonding for Electrical Systems.
 3. Section 26 19 23, Medium-Voltage Adjustable Frequency Drive Systems.
 4. Section 40 90 12, PLC Components.
 5. Section 40 90 13, Control and Network Panel Components.
 6. Section 40 90 20, Control Panels.

1.02 REFERENCES

- A. The following is a list of standards which may be referenced in this Section:
1. Instrumentation, Systems, Automation Society (ISA): S50.1, Compatibility of Analog Signals for Electronic Process Instruments.
 2. National Electrical Manufacturers Association (NEMA):
 - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
 - b. AB 1, Molded Case Circuit Breakers and Molded Case Switches.
 - c. ICS 2, Industrial Control Devices, Controllers and Assemblies.
 3. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
 4. UL:
 - a. 508A, Standards for Safety, Industrial Control Panels.
 - b. 489, Standard for Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit Breaker Enclosures.
 - c. UL 698A, Industrial Control Panels Relating to Hazardous (Classified) Locations.

1.03 DEFINITIONS

- A. Abbreviations:
1. CAT: Component Acceptance Test.
 2. DAT: Demonstration Acceptance Test.
 3. FAT: Functional Acceptance Test.
 4. FDT: Factory Demonstration Test.
 5. HMI: Human Machine Interface.
 6. I/O: Input and Output.

7. LCP: Local Control Panel.
8. MCC: Motor Control Center.
9. NIP: Network Interface Panel.
10. O&M: Operation and Maintenance.
11. OIT: Operator Interface Terminal.
12. PAT: Performance Acceptance Test.
13. PCS: Plant Control System.
14. PIC: Process Instrumentation and Control System.
15. PIC SI: Process Instrumentation and Control System Integrator.
16. PLC: Programmable Logic Controller.
17. SCADA: Plant Supervisory Control and Data Acquisition Systems.
18. SOAT: Software Operational Acceptance Test.
19. UPS: Uninterruptible Power Supply.
20. VFD: Variable Frequency Drive.

1.04 SYSTEM DESCRIPTION

- A. Package control system shall be capable of being integrated into the PCS as describe herein. When connectivity is lost to the plant control system or if the plant control system has failed, package control system shall be capable of operating locally without need of the plant control system.
- B. On loss of utility power, package control system shall remain powered via external UPS provided under Division 26, Electrical. Controlled equipment shall be capable of returning to automatic control on generator power or return of utility power without operator intervention.
- C. Assemble panels and install panel mounted instruments, plumbing, and wiring in equipment manufacturer's factories.
- D. Test panels and panel assemblies for proper operation prior to shipment from equipment manufacturer's factory.

1.05 SUBMITTALS

- A. General:
 1. Submit proposed Submittal breakdown consisting of sequencing and packaging of information in accordance with Construction Schedule.
 2. Partial Submittals not in accordance with Construction Schedule will not be accepted.
 3. Submittal Format: In accordance with Section 01 33 00, Submittal Procedures.

B. Action Submittals:

1. Bill of material, catalog information, descriptive literature, wiring diagrams, and shop drawings for components of control system.
2. Catalog information on electrical devices furnished with system.
3. Shop drawings, catalog material, and dimensional layout drawings for control panels, and enclosures.
4. Piping and instrumentation diagrams (P&ID) including all instruments, loop numbers, equipment descriptions, panel numbers, and details shown on the Drawings.
5. Panel elementary diagrams of prewired panels. Include in diagrams control devices and auxiliary devices, for example, relays, alarms, fuses, lights, fans, and heaters. Include numbered terminals and wire labels for all internal and external wires.
 - a. See herein for project field wire tagging standard.
6. Interconnection wiring diagrams that include numbered terminal designations showing external interfaces.
7. Instrument loop diagrams conforming to minimum requirements of ISA Standard S5.4, and the information listed in Subparagraphs 2 and 6, Paragraph 5.3 of ISA S5.4. One drawing per loop, no “typical” loop diagrams will be allowed.
8. Plumbing diagrams of preplumbed panels and interconnecting plumbing diagrams.
9. Component data sheets similar to ISA Standard S20 forms.
10. Panel power requirements including required voltages, currents, and phases.
11. Heat load calculations for panels, including air conditioner sizing calculations where required.
12. Preliminary downloadable version of the PLC and OIT programs configured for software integration with the plant control system testing by the Engineer, 45 days prior to Factory Acceptance Test.
13. Downloadable version of PLC and OIT programs including edits resulting from Factory Acceptance Test 30 days prior to shipping to Site.
14. Anchorage and bracing drawings and cut sheets, as required by Section 01 88 15, Anchorage and Bracing.

C. Informational Submittals:

1. Schedule:
 - a. Prerequisite for all other submittals.
 - b. Update and submit monthly.

- c. General:
 - 1) Include all package system activities including, but not limited to:
 - a) Submittals.
 - b) Panel construction.
 - c) Factory testing.
 - d) Equipment delivery.
 - e) Equipment installation.
 - f) Coordination meetings and workshops.
 - 2. Contact information for attendance at Application Software Development Workshop. Submit telephone numbers and e-mail addresses for individuals participating in workshop.
 - 3. 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 PICS 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 PICS 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) Communications and Digital Networks Diagrams: One reproducible copy.
 - j) Application Software Documentation.
 - k) Submit electronic copies of Drawings, data sheets, and diagrams in final O&M. One file per drawing in AutoCAD.
 - 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.
 - 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.
- 4. As built PLC and OIT Submittals:
 - a. Complete set of user manuals.
 - b. PLC I/O list with content and format as specified herein.
 - c. Fully documented ladder logic listings.
 - d. Function listing for function blocks not fully documented by ladder logic listings.
 - e. Cross-reference listing.
 - f. Fully-documented electronic copy of the as-built PLC software configuration for the package control system that was developed using the PLC's software development tools.
 - g. PLC network communication data exchange documentation.
 - h. PLC electronic files that are downloadable to the PLC hardware provided.
 - i. OIT graphics.
 - j. OIT electronic files that are downloadable to the OIT hardware provided.
 - k. Provide a licensed copy of the programming software with the license registered in the name of the Owner.
- 5. Manufacturer's list of proposed spares, expendables, and test equipment.
- 6. Testing Related Submittals:
 - a. Factory Demonstration Test:
 - 1) Preliminary Test Procedures: Outline of proposed tests, forms, and checklists.
 - 2) Final Test Procedures:
 - a) Proposed test procedures, forms, and checklists.
 - b) Capacity, Timing, and Simulation: Describe simulation and monitoring methods used to demonstrate compliance with capacity and timing requirements.
 - 3) Test Documentation: Copy of signed off test results.
 - b. Component Test:
 - 1) Preliminary Test Procedures: Outline of proposed tests, forms, and checklists.
 - 2) Final Test Procedures: Proposed test procedures, forms, and checklists.

- 3) Test Documentation:
 - a) Copy of signed-off test results.
 - b) Completed component calibration sheets.
- c. Functional Acceptance Test:
 - 1) Preliminary Test Procedures: Outline of proposed tests, forms, and checklists.
 - 2) Final Test Procedures: Proposed test procedures, forms, and checklists.
- d. Performance Acceptance Test:
 - 1) Preliminary Test Procedures: Outline of proposed tests, forms, and checklists.
 - 2) Final Test Procedures: Proposed test procedures, forms, and checklists.
- e. Software Operational Acceptance Test:
 - 1) Preliminary Test Procedures: Outline of proposed tests, forms, and checklists.
 - 2) Final Test Procedures: Proposed test procedures, forms, and checklists.
- 7. Test Documentation: Copy of signed-off test results.
- 8. Manufacturer's Certificate of Proper Installation in accordance with Section 01 43 33, Manufacturers' Field Services.
- 9. Anchorage and bracing calculations as required by Section 01 88 15, Anchorage and Bracing.

1.06 APPLICATION SOFTWARE DEVELOPMENT COORDINATION

- A. Where PLCs or OITs are used, schedule and lead application software delivery coordination meeting as specified hereinafter.
- B. Purpose: Coordinate with Equipment Vendor, Contractor, Owner, Engineer, and PIC Software Integrator to ensure software controls interface requirements are understood and necessary information is exchanged.
- C. Meeting to be split into two separate video teleconference sessions of up to 4 hours each. Session 1 to be held 30 days prior to manufacturer software development. Session 2 schedule to be determined at the conclusion of Session 1.
- D. Meeting Topics:
 - 1. Review Process Control Narratives relating to the package control system, interfaces with equipment supplied by the Contractor and software supplied by the Software Integrator.
 - 2. Review of specific control functions provided by the package control system.
 - 3. Control functions available from the Plant Control System (PCS).

4. Network address assignments.
5. Communications:
 - a. Loss of communications actions.
 - b. PLC to PLC communication approach, communication monitoring and associated alarms.
 - c. Heartbeat approach.
6. PLC functionality including conventions for status and alarms, LOCAL/REMOTE and AUTO/MANUAL control modes.
7. Coordinated alarm acknowledgement approach.
8. Testing methods.

E. Required Attendance:

1. Provide for meeting attendance by video teleconference for the following individuals:
 - a. Manufacturer's software programmer.
 - b. Manufacturer's Project Manager.
 - c. Contractor.
 - d. PCS Software Integrator.
 - e. Owner.

1.07 SIGNAL CHARACTERISTICS

A. Analog Signal, Current Type:

1. 4 mA dc to 20 mA dc signals conforming to ISA S50.1.
 - a. Fully isolated transmitters and receivers.

B. Discrete Signals:

1. Two-state logic signals using 120V ac sources as indicated.
2. Alarm signals from field devices shall be normally closed during normal process conditions, open to alarm, isolated contacts rated for 5-ampere at 120V ac.

C. Special Signals: Other types of signals used to transmit analog and digital information between field elements, transmitters, receivers, controllers, and digital devices.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Prior to shipment, include corrosive-inhibitive vapor capsules in shipping containers and related equipment as recommended by capsule manufacturer.

B. Corrosion-Inhibiting Vapor Capsule Manufacturers and Products:

1. Northern Instruments; Model Zerust VC.
2. Hoffmann Engineering; Model A-HCI.

PART 2 PRODUCTS

2.01 CONTROL PANELS

- A. Panel Construction and Interior Wiring: In accordance with the National Electrical Code (NEC), UL 508A, UL 698A, state and local codes, and applicable sections of NEMA, ANSI, and ICECA.
- B. UL Listing Mark for Enclosures: Mark stating “Listed Enclosed Industrial Control Panel” per UL 508A. All UL 508A labelling of the panels shall be placed and applied prior to delivery to Site.
- C. I&C and electrical components, terminals, wires, and enclosures UL recognized or UL listed.
- D. Conform to NEMA ratings as specified in individual equipment sections.
- E. Panel Size: As shown on the Drawings or as specified in individual equipment sections.
- F. Freestanding Panel:
 1. Materials: Sheet steel, unless otherwise shown on the 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 the 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.
 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 the 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 the Drawings.
- 7. Internal Panel Lights:
 - a. Quantity: One light for every 4 feet of panel width.
 - b. Mounting: Inside and in the top of back-of-panel area.
 - c. Protective shield for lights.
- 8. Service Outlets:
 - a. Type: Three-wire, 120-volt, 15-ampere, GFCI duplex receptacle.
 - b. Quantity:
 - 1) For Panels 6 Feet Wide and Smaller: One.
 - 2) For Panels Wider than 6 Feet: One for every 6 feet of panel width, two minimum per panel.
 - c. Mounting: Evenly spaced along back-of-panel area.
- 9. Enclosure manufacturer: In accordance with Section 40 90 13, Control and Network Panel Components.

G. Non-freestanding Panel:

- 1. Based on environmental design requirements required and referenced in Section 40 90 00, Article Environmental Requirements, provide the following:
 - a. For panels listed as inside, air conditioned:
 - 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. Internal Panel Lights and Service Outlets:
 - a. Internal Panel Light: Switched 120V, 400 Lumen LED panel light.
 - b. Service Outlet: Breaker protected 120-volt, 15-amp, GFCI duplex receptacle:
 - c. Required for package system panels.
- 5. Enclosure Manufacturer: In accordance with Section 40 90 13, Control and Network Panel Components.

2.02 NAMEPLATES AND TAGS

- A. In accordance with Section 40 90 13, Control and Network Panel Components, Article Control Panels.

2.03 PLCS

- A. In accordance with Section 40 90 12, PLC Components, Part 2, Products.
- B. Capable of operating in a hostile industrial environment (for example, heat, electrical transients, RFI, and vibration) without fans, air conditioning, or electrical filtering. Units operate from 0 degree C to 60 degrees C and up to 95 percent humidity, noncondensing.
- C. Minimum of 20 percent excess capacity for inputs, outputs.
- D. Minimum of 50 percent spare memory capacity after completion of final program.
- E. Provide dedicated Ethernet/IP network communications module for connection to plantwide SCADA Network. Plantwide SCADA Network shall be physically separate from the Vendor Package Network.
- F. Provide dedicated Ethernet/IP network communications module for connection to Vendor Package Network.
 - 1. Vendor OIT's shall be connected to Vendor Package Network.
 - 2. Vendor VFD's shall be connected to Vendor Package Network.
- G. All I/P addresses will be managed and provided by the Engineer. No programming or configuration of devices requiring an I/P address shall be supplied that has not been coordinated with the Engineer prior to shipment.

2.04 WIRES WITHIN ENCLOSURES

- A. In accordance with Section 40 90 13, Control and Network Panel Components.

2.05 TERMINAL BLOCKS AND GROUNDING BUS

- A. In accordance with Section 40 90 13, Control and Network Panel Components.

2.06 BREAKERS

- A. In accordance with Section 40 90 13, Control and Network Panel Components.

- 2.07 RELAYS
 - A. In accordance with Section 40 90 13, Control and Network Panel Components.
- 2.08 DC POWER SUPPLIES
 - A. In accordance with Section 40 90 13, Control and Network Panel Components.
- 2.09 INTERNAL PANEL LIGHTS AND SERVICE RECEPTACLES
 - A. In accordance with Section 40 90 13, Control and Network Panel Components.
- 2.10 ANALOG SIGNAL ISOLATORS
 - A. In accordance with Section 40 90 13, Control and Network Panel Components.
- 2.11 INTRINSIC SAFETY BARRIERS
 - A. In accordance with Section 40 90 13, Control and Network Panel Components.
- 2.12 ELECTRICAL TRANSIENT PROTECTION
 - A. In accordance with Section 40 90 13, Control and Network Panel Components.
- 2.13 FRONT OF PANEL DEVICES
 - A. In accordance with Section 40 90 13, Control and Network Panel Components.
- 2.14 CORROSION PROTECTION
 - A. In accordance with Section 40 90 13, Control and Network Panel Components.
- 2.15 ADDITIONAL ANALYZER PANEL REQUIREMENTS, IF REQUIRED IN EQUIPMENT SPECIFICATIONS
 - A. In accordance with Section 40 90 21, Analyzer Control Panels.

2.16 INSTRUMENT TAG NUMBERS

A. Use project standard format as defined as follows:

Format: IP65-FIT-321-01A

Notation	Explanation
IP	Facility code (where IP = Intake Pump Station, CP = Caprock Pump Station, CT = Caprock Tank)
65	Facility/Building/Area number as per project codes
FIT	ISA designator for Flow Indicating Transmitter
321	Loop tag number differentiator (3 digits)
01	Unit number (2 digits)
A	Suffix letter (single and sequential letter) for multiple instances of item on the same loop (not shown when not used).

2.17 EXTERNAL CABLE AND WIRE LABELS

A. Cables:

1. External control and communication cable labels/tags shall be in accordance with Division 26, Electrical.
2. Internal cables labels/tags shall be developed by vendor package system supplier and shown on applicable panel submittal diagrams.

B. External Control Wires: For devices supplied by vendor and wired to the vendor control panel, these tags shall be created by the vendor package system supplier and shown on panel interconnection diagrams.

C. Samples:

1. Communication Cable:
 - a. Source and target terminations point are coded by:
 - 1) Simplified Panel Tag: Equipment Code. Equipment specific Termination Point.
 - 2) Example:
 - a) Communication Cable Running:
 - (1) From: CP-801-01 Control panel at Facility 20 terminated in PLC CPU within this control panel.
 - (2) To: NP-831-01 Network Panel at Facility 20, terminated in CPP-01 copper patch panel within this network panel, in nine-port of this patch panel.

- b. Label:
 - 1) Tag format as:
 - a) Row 1.
 - b) Row 2.
 - 2) Where Tag Appears as:
 - a) 20CP80101:PLC.CPU.
 - b) 20NP83101:CPP01.9.
2. Patchcords:
- a. Source and target terminations point are coded by:
 - 1) Equipment Tag: Equipment specific Termination Point.
 - 2) Example:
 - a) Patch Cable Running:
 - (1) From: SW-01 switch within a panel, terminated at one-port of this switch.
 - (2) To: CPP-01 copper patch panel within a panel, terminated at nine-port of this patch panel.
 - b. Label:
 - 1) Tag format as:
 - a) Row 1.
 - b) Row 2.
 - 2) Where tag appears as:
 - a) SW01.P1.
 - b) CPP01.9S.
3. Instrument Cables:
- a. Source Termination Point is Coded: Field equipment terminal
Equipment Tag Signal tag.
 - b. Target Termination Point is Coded: Field equipment terminal
Equipment Tag Signal tag.
 - c. Example:
 - 1) Instrument Cable Running:
 - a) From: FIT-006-01 Flow meter at Facility 28, terminated at 26 flow meter terminal.
 - b) To: 401 Control Panel, terminated at TB309 terminal strip 00I terminal.
 - d. Label:
 - 1) Tag format as:
 - a) Row 1.
 - b) Row 2.
 - 2) Where tag appears as:
 - a) 26 28FIT00601 FLOW.
 - b) 401 TB309 00I.

2.18 OPERATOR INTERFACE TERMINAL (OIT)

- A. General: Operator interface terminal shall be Allen-Bradley, as specified below.
1. All components shall be current at time of submittal. Items that are obsolete by the manufacturer shall be updated to the nearest model of each item.
 2. OIT shall conform to the following table:

Description	Qty	Model	Manufacturer	Comments
OPERATOR INTERFACE TERMINAL (SSCP HMI, PSU OIT, or Other Systems)				
PanelView Plus 7 w/ Extended Features, 15" Color Display, Touchscreen, 24V dc Input Power, Ethernet Communication	1	2711P-T15C21D8S	Allen-Bradley	

- B. Programming Software: All software and associated licenses necessary for the configuration, testing, and editing of OIT application shall be provided for by the system Supplier for Supplier use and development. License shall be renewed for 3 years and transferred to Owner at time of substantial completion.
- C. All hardware and software models shall be updated to the latest version at time of supply.
- D. The software versions for all PLC and HMI will be provided by the Engineer prior to Supplier configuration of any programmed PLC or HMI equipment.

2.19 NETWORK COMPONENTS

- A. Provide panel space, wiring, power wiring, terminations, mounting and any other necessary appurtenances for Network Components.
- B. Ethernet Switch:
1. 8-Port Switch:
 - a. Eight 10/100/1000BaseT(X) Ports.
 - b. Operating Temperature: Minus 40 degrees C to 85 degrees C.
 - c. Industrial DIN-Rail enclosure.
 - d. Power Input: 12V dc to 48V dc.
 - e. Device configuration shall be in accordance with guidance from Engineer to match project standard network configuration. This shall be coordinated during Application Software Coordination.

- f. Manufacturer and Product:
 - 1) Cisco IE3400.
 - 2) No equal accepted to match project standard.

2.20 VARIABLE FREQUENCY DRIVES

- A. In accordance with Section 26 19 23, Medium-Voltage Adjustable Frequency Drive Systems.
- B. In accordance with Section 26 29 23, Low-Voltage Adjustable Frequency Drive System.

2.21 SPARE PARTS

Description	Percent of Each Type and Size Used	No Less Than
Fuses	20	5
Relays	20	3
Terminal Blocks	10	10
PLC I/O Modules	NA	1 of each type of I/O card used
PLC Power Supply	NA	1 of each type of power supply used.
PLC Communications Modules	NA	1 of each type of Communication Module used

PART 3 EXECUTION

3.01 PLC NETWORK INTERFACE

- A. General:
 - 1. PLCs shall communicate with the plant PLCs and HMI computers.
 - 2. PLC communications shall be via the plant Ethernet control system network.
 - 3. Network connections shall be to a Network Interface Panel by others as shown on the Drawings.
- B. Data Exchange:
 - 1. Use Rockwell Automation ControlLogix Produce-Consume and User Defined Data Types to communicate the specified data points with member names to and from the plant PLC. Coordinate with System Integrator who will provide and maintain the master file for the data exchange.

2. Provide network communication failure monitoring and detection with a HEARTBEAT signal.
3. For data which is not configured in one of the project-specific User Defined Data Types, organize data values to be exchanged into contiguous register blocks. One block for each of the following types:
 - a. Analog data to be sent.
 - b. Analog data to be received.
 - c. Discrete data to be sent.
 - d. Discrete data to be received.
4. Format for Analog Values: Engineering units using double precision floating point format.
5. Format for Discrete Values: 16-bit binary words (representing 16 unique status or alarm conditions).

3.02 PLC I/O LIST AND TAG NAMES

- A. Provide an input/output (I/O) list for each PLC with the following columns:
1. Description: A description of each I/O point.
 2. I/O Type: Choice of Analog Input (AI), Analog Output (AO), Digital Input (DI), Digital Output (DO).
 3. Low (0 Percent): The 0 percent engineering unit value for an analog signal; “zero state” descriptor for a discrete signal denoting the state when the discrete input polarity is 0 (example for a DI would be CLOSED for a valve status input).
 4. High (100 Percent): The 100 percent or full span engineering unit value for an analog signal; “one state” descriptor for a discrete signal denoting the state when the discrete input polarity is 1 (example for a DI would be OPEN for a valve status input).
 5. Eng Units: Example gpm, FT, mgd, scfm, psi, Deg F, A, V, W, VA.
 6. PLC Number: PLC reference number (as assigned for the project).
 7. Building or Area No.: Building or area reference number (two characters).
 8. Loop Sequence Number: A three-digit number defining the loop number.
 9. Equip Number: A two-digit number defining the device number.
 10. Isa Id: The ISA identifier.
 11. Tag Suffix: A tag suffix denoting the IO point function (Example FLOW for an analog flow input).
 12. Tag Name: Tag name for each I/O point.
 13. I/O Name: The point ADDRESS in the PLC Database.
 14. Chassis Slot: Slot the IO Point is terminated.
 15. Point Number: I/O point number.
 16. Comments: Reserved for special instructions.

B. I/O Tag Name Format:

1. <Bldg/Area No.><LLoop tag number><Sequential number.> <ISA Id>_<Tag Suffix>

Example: IP6532101FIT_FLOW

2. Use project standard format as defined. Project tag numbers are included on project P&ID's.

C. Network I/O Points:

1. Assign I/O tag names and provide a listing of I/O points that are communicated via Ethernet networks.
2. Identify network I/O point types as follows:
 - a. Analog Input (NAI).
 - b. Analog Output (NAO).
 - c. Digital Input (NDI).
 - d. Digital Output (NDO).

3.03 FABRICATION

- A. In accordance with Section 40 90 20, Control Panels, Article Fabrication.

3.04 ELECTRICAL REQUIREMENTS

- A. Control Panels without Motor Starters (unless noted in equipment specifications):

1. Furnish main circuit breaker and a circuit breaker on each individual branch circuit distributed from power panel.
2. Locate to provide clear view of and access to breakers when door is open. Group on single subpanel. Provide typed directory.
3. Circuit Breakers:
 - a. UL 489 listed.
 - b. Coordinate such that faults in branch circuits trip branch breakers, and not the main breaker.
 - c. Main breaker(s) shall have a minimum 14 kA short circuit rating.
 - d. Branch Circuit Breakers: 15 amps at 120V ac minimum.

- B. Control Panels with Three-Phase Power Supplies and Motor Starters or Adjustable Frequency Drives (unless noted in equipment specifications):

1. All components and circuits above 120V ac to be mounted in separate compartment or enclosure from components and circuits below 120V ac.

2. Mount main circuit breaker on panel door. Include provisions for padlocking the main circuit breaker in the OPEN position. Interlock the main circuit breaker with the door latch so that the door cannot be opened with the main circuit breaker in the CLOSED position.
3. Mount operator interface devices including, but not limited to, OIT, VFD keypad, selector switches, pushbuttons, indicator lights and overload reset pushbuttons on the front access door(s).
4. Circuit Breakers:
 - a. UL 489 listed.
 - b. Main breaker shall have a minimum 42 kA short circuit rating.
 - c. Interrupting capacity of 65,000A rms symmetrical, at 480 volts.
 - d. Tripping indicated by operating handle position.
 - e. Motor Circuit Branch Circuit Breakers: Molded case, magnetic trip only, with adjustable trip setting.
 - f. Other Circuit Breakers: Molded case, thermal magnetic.
5. Motor Control:
 - a. 120V ac, except for intrinsically safe circuits where applicable.
 - b. Control Power Transformer:
 - 1) Provide sufficient capacity to serve the connected control circuit load, including 200VA for duplex outlet plus 100VA.
 - 2) Furnish primary fuses in ungrounded conductors.
 - 3) Fuse one side of the secondary winding; ground the other.
 - c. Solid State Motor Overload Protection:
 - 1) Current operated, with no need for external power supply.
 - 2) Monitor each ungrounded motor circuit conductor.
 - 3) Manually reset, with externally-operable RESET pushbutton.
 - 4) Inverse time-current characteristic, Class 10, 20, and 30 relay trip, field selectable.
 - 5) Protect against overload, phase loss, and ground fault.
 - 6) Provide one normally-open auxiliary contact for remote monitoring or control.
 - 7) Auxiliary Circuit Fuses: Provide fuses to auxiliary circuits to field devices including, but not limited to, solenoid valves, motor space heaters, power supplies at field devices, convenience receptacles, enclosure lighting circuits, etc.
 - d. Starters: Provide NEMA rated starters for control of motor circuits.
 - e. Power Distribution Blocks: Provide to make parallel connections to outgoing branch circuits.
 - f. Terminations for Power Conductors: Suitable for use with stranded copper conductors, rated 75 degrees C, at full NFPA 70. 75 degrees C ampacity.
6. VFDs: In accordance with Section 26 19 23, Medium-Voltage Adjustable Frequency Drive Systems.

3.05 STARTUP AND TESTING

- A. Provide all testing in accordance with tests and test phases in accordance with Section 01 91 14, Equipment Testing and Facility Startup.
- B. Provide Component Tests, Functional Test, Performance Tests, and Software Operational Acceptance Test, and Demonstration Tests of the complete control system including software functions to support startup of plant.
- C. Prior to facility startup, inspect, test, and document that the control system is ready for operation.
- D. Verify instruments, panels, and components for proper installation, calibration, and adjustment, on a loop-by-loop and component-by-component basis. Document results on loop test status reports, instrument calibration sheets, test forms, and check lists.
- E. Perform Component Tests, Functional Tests, Performance, Systems Operational Acceptance Tests, and Demonstration Tests including software functions and data communications for all control, monitoring and alarm loops, and document test results on test procedure forms.
 - 1. In accordance with Section 01 91 14, Equipment Testing and Facility Startup.
 - 2. Provide onsite testing, as required, and startup time, as required, devoted to data exchange testing, message validation and network timing validation, and all process control actions as determined during the applications software workshops with the plant SCADA.

3.06 PROTECTION

- A. Protect enclosures and other equipment containing electrical, instrumentation and control devices, from corrosion through the use of corrosion-inhibiting vapor capsules.
- B. During Work, periodically replace capsules in accordance with capsule manufacturer's recommendations. Replace capsules at Substantial Completion.

END OF SECTION

