

SECTION 40 92 01 CONTROL PANELS

PART 1 GENERAL

1.01 DESCRIPTION

- A. This section gives requirements for furnishing custom fabricated control panels. PIC to provide labor, hardware, wiring and specialty cables, tools, documentation, and testing to control and operate the proposed Grand Canyon South Rim Wastewater Treatment Plant.

1.02 RELATED SECTIONS

- A. Related sections include the following:
 - 1. Division 01, General Requirements.
 - 2. Section 09 90 00, Painting and Coating.
 - 3. Section 40 91 00, Instrumentation and Control Components.

1.03 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. American National Standards Institute (ANSI).
 - 2. ASTM International (ASTM):
 - a. A182/A182M, Standard Specification for Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service.
 - b. A276, Standard Specification for Stainless Steel Bars and Shapes.
 - c. A312/A312M, Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes.
 - d. B32, Standard Specification for Solder Metal.
 - e. B88, Standard Specification for Seamless Copper Water Tube.
 - 3. Deutsche Industrie-Norm (DIN): VDE 0611, Specification for modular terminal blocks for connection of copper conductors up to 1,000V ac and up to 1,200V dc.
 - 4. Institute of Electrical and Electronics Engineers, Inc. (IEEE): C62.41, Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.
 - 5. The Instrument, Systems, and Automation Society (ISA):
 - a. RP12.06.01, Recommended Practice for Wiring Methods for Hazardous (Classified) Locations Instrumentation Part 1: Intrinsic Safety.
 - b. S5.1, Instrumentation Symbols and Identification.
 - c. S5.4, Instrument Loop Diagrams.

- d. S50.1, Compatibility of Analog Signals for Electronic Industrial Process Instruments.
- e. TR20.00.01, Specification Forms for Process Measurement and Control Instruments, Part 1: General.
- 6. International Conference on Energy Conversion and Application (ICECA).
- 7. National Electrical Code (NEC).
- 8. National Electrical Manufacturers Association (NEMA):
 - a. 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).
 - b. ICS 1, Industrial Control and Systems General Requirements.
- 9. National Fire Protection Association (NFPA):
 - a. 79, Electrical Standard for Industrial Machinery.
 - b. 820, Standard for Fire Protection in Wastewater Treatment and Collection Facilities.
- 10. UL: 508A, Standard for Safety, Industrial Control Panels.

1.04 DEFINITIONS

A. Abbreviations:

- 1. FDT: Factory Demonstration Test.
- 2. I&C: Instrumentation and Control.
- 3. I/O: Input and Output.
- 4. O&M: Operation and Maintenance.
- 5. P&ID: Process and Instrument Diagram.
- 6. PIC: Process Instrumentation and Control.
- 7. PLC: Programmable Logic Controller.
- 8. SCADA: Supervisory Control and Data Acquisition.

1.05 SUBMITTALS

A. General:

- 1. In accordance with Section 01 33 23, Submittal Procedures.
- 2. Identify proposed items, options, installed spares, and other provisions for future work (for example, reserved panel space; unused components, wiring, and terminals).

B. Action Submittals:

- 1. General: Manufacture of the control panels shall not commence until related submittals have been approved by the Contracting Officer.

2. Submittal Requirements:
 - a. Catalog Cuts and Product Information:
 - 1) For I&C components, electrical devices, and mechanical devices:
 - a) Catalog information, marked to identify proposed items and options.
 - b) Descriptive literature.
 - c) External power and signal connections.
 - d) Scaled drawings showing exterior dimensions and locations of electrical and mechanical interfaces.
 - b. Layout Drawings:
 - 1) Control panel layout drawings, including the following information, is to be provided by the PIC System Integrator:
 - a) Front, rear, and internal panel views to scale.
 - b) Dimensional information.
 - c) Tag number and functional name of components mounted in and on the panel.
 - d) Product information on panel components.
 - e) Nameplate location and legend including text, letter size and colors to be used.
 - f) Location of external wiring and/or piping connections.
 - g) Mounting and installation details.
 - h) Subpanel layouts and mounting details for all items located inside control panels.
 - c. Wiring and/or Piping Diagrams:
 - 1) Control panel wiring and/or piping diagrams, including the following information is to be provided by the PIC System Integrator:
 - a) Name of panel, console or cabinet.
 - (1) Wiring sizes and types.
 - (2) Piping sizes and types.
 - (3) Terminal strip numbers.
 - (4) Color coding.
 - (5) Functional name and manufacturer's designation for components to which wiring and piping are connected.
 - (6) Wires: Wire number and color. Cable number if part of multiconductor cable.
 - (7) Terminals: Location (enclosure number, terminal junction box number, or MCC number), terminal strip number, and terminal block number.
 - (8) 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), set point value and units, and process variable description (for example, Sump Level High).
 - (9) I/O Points: PLC unit number, I/O tag number, I/O address, terminal numbers, and terminal strip numbers.
 - (10) Relay Coils:
 - (a) Tag number and its function.
 - (b) On right side of run where coil is located, contact location by ladder number and sheet number. Underline normally closed contacts.
 - (11) Relay Contacts: Coil tag number, function, and coil location (ladder rung number and sheet number).
 - (12) Communications and Networks: Network type, address or node identification, port or channel number, and type of connector.
 - (13) Ground wires, surge protectors, and connections.
 - (14) Wire and Cable Names: Names, wire number, and wire color for circuits entering and leaving a panel.
- d. Bill of Materials:
 - 1) The PIC System Integrator will provide a Bill of Materials for each panel including tag number, functional name, manufacturer's name, model number and quantity for all components mounted in or on the panel or enclosure.
 - 2) Submit updated Bill of Materials for components shown.
- e. Submit electronic copies of drawings markups in pdf format.

C. Informational Submittals:

- 1. Manufacturer's O&M manuals for components, electrical devices, and mechanical devices:
 - a. In accordance with Section 01 78 23, Operation and Maintenance Data.
 - b. Content for Each O&M Manual:
 - 1) Table of Contents.
 - 2) Operations procedures.
 - 3) Installation requirements and procedures.
 - 4) Maintenance requirements and procedures.
 - 5) Troubleshooting procedures.
 - 6) Calibration procedures.
 - 7) Internal schematic and wiring diagrams.

2. Testing Related Submittals:
 - a. Factory Demonstration Test:
 - 1) Proposed test procedures, forms, and checklists.
 - 2) Test Documentation: Copy of signed off test results.
3. Record Drawings and Documentation:
 - a. Submit final markups of the panel drawings, wiring diagrams, and documentation to reflect any updates made to the panels during fabrication and testing.
 - b. Provide electronic copies of the markups in AutoCad Version 2015.
4. Submit anchorage and bracing calculations as required by Section 01 88 15, Anchorage and Bracing.

1.06 QUALITY ASSURANCE

- A. General: The PIC System Integrator shall supply its company's Quality Assurance Plan. The plans shall include but not necessarily be limited to method of testing, raw material criteria, methods of documentation, station control, "Burn-In," final tests and serialization coding and packaging.
- B. Qualifications:
 1. Financially sound with minimum of 5 years' experience in designing and manufacturing similar control panels as required for this Project.
 2. Have a UL approved panel shop.
 3. Have a record of prompt shipments in accordance with contract obligations required for previous projects.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. In accordance with Section 01 67 00, Product Requirements.
- B. Packaged at the factory prior to shipment to protect each item from damage during shipment and storage. Containers protected against impact, abrasion, corrosion, discoloration and/or other damages. Clearly label contents of each container and provide information on the required storage conditions necessary for the equipment.
- C. Notify the Contracting Officer of the storage requirements and recommendations for the equipment prior to shipment.
- D. Prior to shipment, include corrosive inhibitive vapor capsules in shipping containers, and related equipment as recommended by capsule manufacturer.

1.08 SEQUENCING AND SCHEDULING

A. Prerequisite Activities and Lead Times:

1. Do not start following key Project activities until prerequisite activities and lead times listed below have been completed and satisfied:
 - a. Test Prerequisite: Associated test procedures Submittals completed.
 - b. Factory Demonstration Test Prerequisite:
 - 1) Approval of Control Panel submittals.
 - 2) Test procedures submittals completed.
 - c. Control Panels Shipment to Site:
 - 1) Prerequisites:
 - a) Approval of Shop Drawings.
 - b) Factory Demonstration Test (FDT) completed.

PART 2 PRODUCTS

2.01 GENERAL

- A. Provide control panels listed in the Control Panel Schedule in Article Supplement at end of this section, and in accordance with the control panel layout drawings and wiring diagrams.
- B. Like Equipment Items: 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.

2.02 CONTROL PANEL COMPONENTS

- A. Provide all components and hardware necessary to make each control panel fully operational and in conformance with requirements specified in this section.

2.03 SERVICE CONDITIONS

A. Service Conditions for Panels:

1. As noted in Control Panel Schedule located in Article Supplement at end of this section. Design panels for continuous operation in these environments:
 - a. Freestanding Panel and Consoles:
 - 1) Inside: NEMA 12.
 - 2) Inside Chemical Room: NEMA 4X.
 - 3) Outside: NEMA 4.

- b. Smaller Panels and Assemblies (that are not freestanding):
 - 1) Inside: NEMA 12.
 - 2) Inside Chemical Room: NEMA 4X.
 - 3) Outside: NEMA 4.

2.04 NAMEPLATES AND TAGS

- A. Panel Nameplates: For identification of panels and components mounted thereon.
 - 1. Nameplate Size and Material: 3/32-inch thick laminated phenolic type with black matte finish surface and white letter engraving.
 - 2. Panel Identification Nameplates: 1/2-inch high letter engravings.
 - 3. Panel Mounted Component (e.g., Control Devices, Indicating Lights, Selector Switches, etc.) Identification Nameplates: 1/4-inch high letter engravings.
 - 4. Attached to the panel face with two stainless steel self-tapping screws.
 - 5. Nameplate Engravings: Include the instrument or equipment tag number and descriptive title as shown and specified.
- B. Internally Mounted Instruments Tags:
 - 1. Tag Numbers: As listed in the Contract Documents.
 - 2. Identifying Tag Number: Permanently etched or embossed onto a stainless steel tag which shall be fastened to the device housing with stainless steel rivets or self tapping screws of appropriate size.
 - 3. Where neither of the above fastenings can be accomplished, tags shall be permanently attached to the device by a circlet of 1/16-inch diameter stainless steel wire rope.
 - 4. Identification Tag: Installed so that the numbers are easily visible to service personnel.
 - 5. Front of Panel Mounted Instruments: Tag attached to rear of device.
- C. Tagging of the following items shall be accomplished with the use of adhesive plastic Brady USA, Inc. labels, or equal.
 - 1. Tag all electrical devices (such as: relays, timers, power supplies) mounted within control panels and enclosures.
 - 2. Tag all pneumatic lines.
 - 3. Numerically tag all terminal blocks.
 - 4. Numerically tag wiring at each end.
- D. Legend Plates for Panel Mounted Pushbuttons, Lights, and Switches.
 - 1. Materials: Stainless steel, keyed legend plates. Secured to panel by mounting nut for pushbutton, light, or switch.
 - 2. Letters: Black on gray or white background.

- E. Service Legends: Component identification nameplate located on face of component.
 - 1. Inscription: As shown on panel drawing.
 - 2. Materials: Adhesive-backed, laminated plastic.
 - 3. Letters: 3/16-inch high, white on black background, unless otherwise noted.
- F. Nametags: Component identification for field devices.
 - 1. Inscription: Component tag number.
 - 2. Materials: 16-gauge, Type 304 stainless steel.
 - 3. Letters: 3/16-inch high, imposed.
 - 4. Mounting: Affix to component with 16-gauge or 18-gauge stainless steel wire rope or stainless steel screws.

2.05 MECHANICAL SYSTEM COMPONENTS

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

2.06 ELECTRICAL REQUIREMENTS

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

2.07 PANEL FABRICATION

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

2.08 CORROSION PROTECTION

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

2.09 SOURCE QUALITY CONTROL

- A. General:
 - 1. The Contracting Officer may actively participate in the tests.
 - 2. The Contracting Officer's decision will be final regarding acceptability and completeness of testing.
 - 3. Procedures, Forms, and Checklists:
 - a. Except for Unwitnessed Factory Test, conduct tests in accordance with, and documented on, reviewed and 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 Test Documentation: Test procedures, forms, and checklists signed by the Contracting Officer.

5. Conducting Tests:
 - a. Provide special testing materials and equipment.
 - b. Provide suitable means of simulation of test inputs and outputs.
 - c. Define simulation techniques in test procedures.
 - d. Test Format: Cause and effect.
 - 1) Person conducting test initiates an input (cause).
 - 2) Specific test requirement is satisfied if correct result (effect), occurs.
 - e. Provide sufficient temporary software configuring to allow FAT testing.
- B. Unwitnessed Factory Test:
 1. Scope: Inspect and test panels to ensure it is operational, ready for FAT.
 2. Location: Panel Supplier's facility.
- C. Factory Acceptance Tests (FAT):
 1. Notify the Contracting Officer of test schedule 4 weeks prior to start of test.
 2. Contracting Officer reserves the right to participate in FAT.
 3. Scope: Test entire control panel to demonstrate it is operational.
 4. Location: Panel Supplier's facility.
 5. Temporary Application Software: Provide application software to allow PLC and network testing including communications and input/output tests.
 6. 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.
 7. Operation of communications between PLCs and remote I/O and between PLCs and Ethernet devices including other PLCs, computers, and power monitors.
 8. Correct deficiencies found and complete prior to shipment to Site.
 9. Failed Tests: Repeat and witnessed by the Contracting Officer.
 10. Make following documentation available to the Contracting Officer at test site both before and during FAT:
 - a. Drawings, Specifications, Addenda, and Change Orders.
 - b. Master copy of FAT procedures.
 - c. List of equipment to be tested including make, model, and serial number.
 - d. Approved hardware Shop Drawings for equipment being tested.
 11. Daily Schedule for FAT:
 - 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.

2.10 SUPPLEMENT

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

1. Control Panel Schedule.

PART 3 EXECUTION (NOT USED)

END OF SECTION