40 99 00 - Package Control Systems

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

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Total pages: 15
1.01 PART 1 GENERAL REFERENCES

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

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. IA2, Programmable Logic Controllers.
   d. ICS 2, Industrial Control Devices, Controllers and Assemblies.
5. Factory Mutual.

1.02 SYSTEM DESCRIPTION

A. Assemble panels and install instruments, plumbing, and wiring in equipment supplier’s factories.

B. Test panels and panel assemblies for proper operation prior to shipment from equipment supplier’s factory.

1.03 SUBMITTALS

A. All submittal information shall be provided in English.

B. Approval Required Prior to Work 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. Panel elementary diagrams of prewired panels. Include in diagrams control devices and auxiliary devices, for example, relays, alarms, fuses, lights, fans, and heaters.
5. Plumbing diagrams of preplumbed panels and interconnecting plumbing diagrams.
6. Interconnection wiring diagrams that include numbered terminal designations showing external interfaces.
7. Drawings shall be submitted in electronic AutoCAD format.
8. Submit complete heat dissipation calculations for all control enclosures.

C. Approval Required Submittals:
   1. Programmable Controller and Distributed I/O Panels Submittals:
      a. Complete set of user manuals.
      b. Fully documented ladder logic listings.
      c. Function listing for function blocks not fully documented by ladder logic listings.
      d. Cross-reference listing.
   2. Supplier’s list of proposed spares, expendables, and test equipment.
   3. Supplier’s Certificate of Proper Installation.

1.04 DELIVERY, STORAGE, AND HANDLING
   A. Prior to shipment, include corrosive-inhibitive vapor capsules in shipping containers and related equipment as recommended by capsule supplier.

1.05 EXTRA MATERIALS
   A. Spares, Expendables, and Test Equipment:
      1. Fuse: 100 percent, 5 minimum, of each type used.
      2. Surge Suppressors: 20 percent, one minimum, of each type used.

PART 2 PRODUCTS

2.01 GENERAL
   A. Provide control functions shown on Drawings and required in process equipment specifications. Provide materials, equipment, and software necessary to effect system and loop performance.
2.02 SIGNAL CHARACTERISTICS

A. Analog Signals:
   1. Analog Inputs: Optically isolated, channel-to-channel, 4 to 20 mA dc signals from powered transmitters at 24V dc loop powered.
   2. Analog Outputs: Isolated 4 to 20 mA dc signals.

B. Discrete Signals:
   3. Alarm Signals: Shelf state open, open to alarm, isolated contacts rated for 2 amperes at 30V dc.
   4. Alarm circuits for life safety and equipment protection shall be hardwired to motor circuits.

2.03 CORROSION PROTECTION

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

2.04 CONTROL PANEL

A. Panel Construction and Interior Wiring: In accordance with the National Electrical Code (NEC), UL 508, state and local codes, and applicable sections of NEMA, ANSI, and ICECA.

B. Conform to NEMA ratings as specified in individual equipment sections.

C. Minimum Metal Thickness: 14 gauge.

D. Based on environmental design requirements and referenced in individual equipment specifications, provide the following as noted:
   1. Panels Listed as Inside, Air Conditioned:
      a. Enclosure Type: NEMA 12.
      b. Materials: Steel.
   2. Other Panels:
      a. Enclosure Type: NEMA 4X, for indoor/outdoor corrosive environments; NEMA 4 for outdoor non-corrosive environments.
      b. Materials: Type 316 stainless steel.
3. **Panel Doors:**
   a. Rubber-gasketed with continuous hinge.
   b. Stainless steel lockable quick-release clamps.

E. **Doors:**
   1. Three-point latching mechanisms in accordance with NEMA 250 Type 1 and 12 panels with doors higher than 18 inches.
   2. For other doors, stainless steel quick release clamps.

F. Cutouts shall be cut, punched, or drilled and finished smoothly with rounded edges.

G. Access: Front, suitable for installation with back and sides adjacent to or in contact with other surfaces, unless otherwise specified.

H. **Temperature Control:**
   1. Size panels to adequately dissipate heat generated by equipment mounted on or in the panel.
   2. Furnish cooling fans with air filters if required to dissipate heat.
   3. For panels outdoors or in unheated areas, furnish thermostatically controlled heaters to maintain temperature above 40 degrees F.

I. **Push-to-Test Circuitry:** For each push-to-test indicating light, provide a fused push-to-test circuit.

J. Where lighting is necessary within the enclosure, lighting shall be 24V dc powered from an external source.

K. **Finish:**
   1. Metallic External Surfaces (Excluding Aluminum and Stainless Steel): Supplier’s standard gray unless otherwise specified.
   2. Internal Surfaces: White enamel.

L. **Panel Suppliers:**
   1. Hoffman.
   2. Rittal.
2.05 CONTROL PANEL ELECTRICAL

A. General:

1. UL Listing Mark for Enclosures: Mark stating “Listed Enclosure Industrial Control Panel” per UL 508A.
2. Panel electrical components, terminals wires ad enclosures, UL listed.
3. All Control and instrument wiring shall be 24V dc.
4. Power supplies fed by 120V ac or other voltage sources more than 50V shall be located in a separate enclosure from the control and instrument low voltage and communications wiring.
5. Field wiring from control and instrument devices to Distributed I/O modules or PLC modules or other secondary panel mounted devices shall be wired directly without auxiliary or intermediate terminal blocks. All 24VDC field wiring may be wired according to NEC Class 2.

B. Wiring:

1. AC Power Circuits:
   a. Type: 600-volt, Type MTW stranded copper.
   b. Size: For current to be carried, but not less than 14 AWG.
2. Analog and Digital Signal Circuits:
   a. Type: 300-volt, Class 2 stranded copper, twisted shielded pairs.
   b. Size: 24 AWG, minimum.
   a. Type: 300-volt, Class MTW stranded copper.
   b. Size: 24 AWG, minimum (maximum AWG is limited by I/O module terminals).
4. Wire Identification: Numbered and tagged at each termination using fuse number or device tag as identifier.
   a. Wire Tags: Machine printed, heat shrink.
   b. Suppliers:
      1) Brady PermaSleeve.
      2) Tyco Electronics.

C. Grounding: Internal copper grounding bus for ground connections on panels, consoles, racks, and cabinets.

D. Intrinsic Safety Barriers:

1. Intrinsically Safe Relays: Monitor discrete signals that originate in hazardous area and are used in a safe area.
2. Intrinsically Safe Barriers: Interface analog signals as they pass from hazardous area to safe area.

E. Programmable Logic Controller (PLC):

   1. Provide a complete PLC system including but not limited to mounting rack, processor, power supply, I/O modules distributed I/O panels, communications modules and applications software.
   2. The PLC shall be sized to accommodate the required functionality of the finished system plus 50 percent spare memory capacity.
   3. Provide all power, programming, and interconnecting cables required.
   4. Provide all I/O and communications modules necessary to provide a complete and functional system. Provide 25 percent installed spare I/O capacity for each type of I/O. Provide an installed spare module where necessary to meet the spares requirement.
   5. Provide a minimum of one spare slot for each type of I/O whether the I/O type is used or not.
   6. PLC components shall have UPS battery power sized for minimum of 20 minutes run time.
   7. Local Operator Interface Terminal (OIT) Where Specified: The PLC system shall be complete with Operator Interface Terminal (OIT) for local monitoring and control functions and to place the system into automatic operation as is appropriate for the system.
      a. The OIT shall be completely compatible with the PLC system and interface directly with the package system PLC.
      b. The OIT display screen shall be sized to adequately depict the information required for the process system.
   8. Operator Interface Graphics:
      a. Provide menu driven operator interface displays graphically depicting the process. As a minimum, displays shall be included for:
         1) An Overview with monitoring and alarm indications for each piece of equipment and function.
         2) Alarms summary screen shall identify affected equipment and instrumentation by location.
         3) Provide process displays to depict the operation and control of the processes and ancillary devices.
         4) Control popups or screens shall be provided for each operator function required i.e.; EMERGENCY STOP, ON/OFF control, OPEN/CLOSE control, PID control, LEAD/LAG selection, etc.
5) Setpoints shall be changeable from the operator interface. If necessary, this function shall be password protected.

6) Each Graphic and alarm screen shall show the date and time and shall be changeable from the operator interface.

9. Applications Software:
   a. The applications program shall be fully documented.
   b. Provide one copy of the programming software used for both PLC and OIT applications. Software shall be licensed to the end user.
   c. Provide one electronic copy of the developed applications program. Program shall have no password or protection disallowing future programming by others. Include a listing of the software used to develop the program with version and revision numbers for the native package, installed patches and installed firmware.

10. Communications:
   a. The package system shall communicate to the plant control system via PROFIBUS communicating with Siemens S7.
   b. Contractor shall provide all hardware and programming necessary for communications with the plant control system.

11. Manufacturer:
   a. The preferred PLC manufacturer is Siemens; Simatic S7 system. This corresponds to installed systems at the facility
   b. The Contractor may submit other manufacturers, per requirements of these specifications based on off-the-shelf or the proprietary nature of the process and associated software.

F. Distributed (Remote) I/O Panels

1. Provide distributed I/O panels to service I/O local to a process skid or to a limited functional area so as to minimize the number and lengths of I/O wiring runs to less than approximately 50 feet.

2. Distributed I/O panels shall be Siemens ET200S series with compatible I/O modules as required; refer to the example below of commonly installed modules currently in use on-site. Vendor is not limited exclusively to these modules.
   Example modules
   24V power distribution module - 6ES7 138-4CA01-0AA0 with 6ES7193-4CE10-0AA0 Terminal Block
Four Analog In, two wire - 6ES7134-4GD00-0AB0 with 6ES7193-4CA50-0AA0 Terminal Block

Two Analog In, not loop powered - 6ES7134-4GB01-0AB0 with 6ES7193-4CA50-0AA0 Terminal Block

Four Analog Out - 6ES7135-4GB01-0AB0 with 6ES7193-4CA50-0AA0 Terminal Block

Four Discrete In - 6ES7131-4BD01-0AA0 with 6ES7193-4CB30-0AA0 Terminal Block

Two relay output fail open contact - 6ES7132-4HB01-0AB0 with 6ES7193-4CB10-0AA0 Terminal Block

3. Distributed I/O Profibus Communications shall be:
   a. IM 151 Basic for distributed I/O panels with less than twelve I/O modules – p/n 6ES7 151-1AA00-0AB0
   b. IM 151 Standard for distributed I/O panels with twelve or more I/O modules – p/n 6ES7 151-1CA00-0AB0
   c. Profibus cable connectors shall be the “quick connect” style.

G. Power Supplies:

1. Furnish as required to power devices, including controllers, 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 devices can operate within their required tolerances.
3. Provide output over voltage and over current protection devices to:
   a. Protect instruments from damage due to power supply failure.
   b. Protect power supply from damage due to external failure.
4. Enclosures: NEMA 1, NEMA 4X or NEMA 12 to match installation environment.
5. Mounting: DIN-RAIL.
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.
8. Power supplies shall be Type NEC Class 2.
9. Supplier: Phoenix Contact; No. 2866336.

2.06 INSTRUMENTATION COMPONENTS

A. Standard manufacturer supplied components shall meet the quality and performance requirements listed as a minimum. The components in Section 40 91 00, Instrumentation and Control Components, provide these quality and performance requirements supplied components shall meet.

B. Where components are listed as preferred, the listed manufacturer should be considered by the specific systems provided.

2.07 INSTRUMENT TAG NUMBERS

A. Reference P&IDs.

2.08 NAMEPLATES, NAMETAGS, AND SERVICE LEGENDS

A. Nametags: Permanently mounted bearing entire ISA tag number.

1. Panel Mounted: Plastic, mounted to instrument behind panel face.

2. Field Mounted:
   SIZE - 1” x 3”
   SHAPE - rectangular with 1/8” attachment hole
   THICKNESS - 1/16”
   MATERIAL - phenolic/lamacoid resin or equivalent non-corrosive material, white w/ black layer exposed by character engraving
   CHARACTER SIZE - 1/4” [Tag ID line], 3/16” [second informational line]
   CHARACTER FONT - ARIAL (ALL CAPS)
   CHARACTER PROCESS – engraved
   INFORMATION: Engrave tag line #1 with the full tag ID from the P&ID drawing.
   For analytical instruments, the tag shall include the chemistry or measurement type.
Devices in the chemical room shall include the chemical in a second, informational, line in a smaller font:

E.g. AIT-Y50A-PH (analytical instrument Tag ID)

CAP-Y55A (chem. room pump Tag ID)

CITRIC ACID (informational line)

ATTACHMENT - stainless steel “S” hook, SS aircraft cable or corrosion resistant “zip-tie”

EXAMPLE TAG:

B. Service Legends (Integrally Mounted with Instrument) and Nameplates:

1. Engraved, rigid, laminated plastic type with adhesive back. Furnish service legends and nameplates to adequately describe functions of panel face mounted instruments.
2. Color: White with black letters.
3. Letter Height: 3/16 inch.
4. For each panel, face mounted laminated nameplate inscribed with the panel name and tag number. Color shall be white with black letters 1/2 inch high.
C. Standard Field Indicator Light Colors (pilot lights or field OITs) and Inscriptions: Unless otherwise specified in individual equipment specifications, use the following color code and inscriptions:

<table>
<thead>
<tr>
<th>Tag</th>
<th>Inscription(s)</th>
<th>Color</th>
</tr>
</thead>
<tbody>
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<td>Red</td>
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<tr>
<td>REMOTE</td>
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<tr>
<td>FORWARD</td>
<td>FORWARD</td>
<td>Red</td>
</tr>
<tr>
<td>REVERSE</td>
<td>REVERSE</td>
<td>Blue</td>
</tr>
</tbody>
</table>

2.09 ELECTRICAL SURGE AND TRANSIENT PROTECTION

A. General: Equip control panels with surge-arresting devices to protect equipment from damage due to electrical transients induced in interconnecting lines from lightning discharges and nearby electrical devices.

B. Suppressor Locations:

1. At point of connection between each equipment item, including ac powered transmitters and its power supply conductors (direct wired equipment).
2. On analog pairs at each end when the pair travels outside of building.
3. In other locations where equipment sensitivity to surges and transients requires additional protection beyond that inherent to design of equipment.

C. Power Supply Suppressor Assemblies:

1. Suitable for connection to 120-volt, single-phase power supplies EDCO “HSP SERIES.”
2. Suitable for connection to 480-volt, three-phase power supplies; Square D J9200-9A.

D. Analog Signal Cable Suppressor Assemblies:

1. Epoxy encapsulated within a phenolic enclosure.
2. Flame retardant.
3. Four lead devices; include a threaded mounting/grounding stud.
4. Suppliers and Products:
   a. EDCO; SRA-64 Series.
   b. Joslyn; Series 1800 and 1669.

PART 3 EXECUTION

3.01 ELECTRICAL POWER AND SIGNAL WIRING

A. Restrain control and signal wiring in control panels by plastic ties or ducts. Secure hinge wiring at each end so bending or twisting will occur around the longitudinal axis of wire. Protect bend area with a sleeve.

B. Arrange wiring neatly, cut to proper length, and remove surplus wire. Install abrasion protection for wire bundles passing through holes or across edges of sheet metal.

C. No intermediate terminal strips shall be used in the wiring system. All wiring shall connect from originating source to the specific device terminals.

D. Do not splice or tap wiring except at device terminals.

3.02 PROTECTION

A. Protect enclosures and other equipment containing electrical, instrumentation and control devices, including spare parts, from corrosion through the use of corrosion-inhibiting vapor capsules.

B. During Work, periodically replace capsules in accordance with capsule supplier’s recommendations. Replace capsules at Substantial Completion.

3.03 FACTORY TESTING

A. As specified in the specific packaged system requirements.

3.04 FIELD QUALITY CONTROL

A. As specified in the specific packaged system requirements.