PIP ELSSG12
Design and Fabrication of Outdoor Enclosures for Motor Controllers and Switchgear
PURPOSE AND USE OF PROCESS INDUSTRY PRACTICES

In an effort to minimize the cost of process industry facilities, this Practice has been prepared from the technical requirements in the existing standards of major industrial users, contractors, or standards organizations. By harmonizing these technical requirements into a single set of Practices, administrative, application, and engineering costs to both the purchaser and the manufacturer should be reduced. While this Practice is expected to incorporate the majority of requirements of most users, individual applications may involve requirements that will be appended to and take precedence over this Practice. Determinations concerning fitness for purpose and particular matters or application of the Practice to particular project or engineering situations should not be made solely on information contained in these materials. The use of trade names from time to time should not be viewed as an expression of preference but rather recognized as normal usage in the trade. Other brands having the same specifications are equally correct and may be substituted for those named. All Practices or guidelines are intended to be consistent with applicable laws and regulations including OSHA requirements. To the extent these Practices or guidelines should conflict with OSHA or other applicable laws or regulations, such laws or regulations must be followed. Consult an appropriate professional before applying or acting on any material contained in or suggested by the Practice.

This Practice is subject to revision at any time.

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# PIP ELSSG12
Design and Fabrication of Outdoor Enclosures for Motor Controllers and Switchgear

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## Data Form

**ELSSG12D** – Electronic Entry Data Sheet for Outdoor Enclosures for Motor Controllers and Switchgear
1. **Scope**

This Practice describes the requirements for the design, fabrication, inspection, testing, and shipping of free-standing outdoor enclosures. This equipment is used for housing low and medium voltage motor controllers and switchgear.

The requirements of this Practice shall apply to walk-in and non-walk-in enclosures located in a non-classified area. This Practice is not intended for enclosures that will be located in classified areas.

These enclosures are not intended for climate-controlled or pressurized applications. When pressurized or insulated climate-controlled enclosures are required, see *PIP ELSSG11*.

2. **References**

Applicable parts of the following Practices and industry codes and standards should be considered an integral part of this Practice. The edition in effect on the date of contract award should be used, except as otherwise noted. Short titles are used herein when appropriate.

2.1 **Process Industry Practices (PIP)**

- PIP CVC01017 - *Plant Site Data Sheet*
- PIP STC01015 - *Structural Design Criteria*

2.2 **Industry Codes and Standards**

- American Society of Civil Engineers (ASCE)
  - ASCE 7 - *Minimum Design Loads for Buildings and Other Structures*
- American Society for Testing Materials (ASTM)
  - ASTM A36/A36M - *Standard Specification for Carbon Structural Steel*
  - ASTM B 117 - *Practice for Operating Salt Spray (Fog) Apparatus*
  - ASTM D 714 - *Test Method for Evaluating Degree of Blistering of Paints*
  - ASTM D 1654 - *Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments*
  - ASTM D 2244 - *Standard Practice for Calculation of Color Tolerance and Color Differences from Instrumentally Measured Color Coordinates*
- National Fire Protection Association (NFPA)
  - NFPA 70 - *National Electrical Code (NEC)*
- Institute of Electrical and Electronics Engineers (IEEE)
  - IEEE C37.20.2 – *IEEE Standard for Metal-Clad Switchgear*
  - IEEE C37.20.3 - *IEEE Standard for Metal Enclosed Interrupter Switchgear*
  - IEEE C37.100.1 - *IEEE Standard of Common Requirements for High Voltage Power Switchgear Rated Above 1000 V*

3. **Definitions**

*owner:* The party that owns the facility where the equipment will be used or installed
**purchaser:** The party who awards the contract to the supplier. The purchaser may be the owner or the owner’s authorized agent.

**supplier:** The party responsible for furnishing the enclosure

### 4. Requirements

#### 4.1 Service Conditions

Unless otherwise specified on the purchaser’s PIP ELSSG12 Data Sheet, equipment shall be designed to perform satisfactorily under the following ambient conditions:

a. Ambient condition within the limits of -30°C (-18°F) and 40°C (104°F)

b. Altitude of installation does not exceed 3300 feet (1000 m)

c. Humidity within the limits of 0 - 95% non-condensing, over a 24-hour period and 0-90% non-condensing, over a 1-month period

d. For seismic and wind and snow loading requirements, see PIP CVC01017 and PIP STC01015 and ASCE 7.

#### 4.2 Base

4.2.1 Enclosure shall be provided with a totally enclosed base constructed of 4-inch (102-mm) minimum channel or I-beam.

4.2.2 Where bottom entry is used, removable floor plates shall be provided in rear cable compartment.

4.2.3 The design shall meet all load combinations for enclosure, equipment, and contents.

4.2.4 The structural steel base shall be designed to withstand all shipping and erection loads in addition to normal dead and live loads.

4.2.5 Structural steel for the base of the power center shall be in accordance with ASTM A36.

4.2.6 Structural steel members shall be rigidly braced with structural steel cross-members for installation on a concrete slab or piers furnished by others.

4.2.7 Suitable lifting lugs rated for the load and lift of enclosure and contents shall be furnished by supplier.

#### 4.2.8 Access Panels and Cable Entry

4.2.8.1 Outside equipment access panels behind equipment shall be provided if shown on the layout drawing.

a. Panels shall be capable of being opened with equipment in place.

b. Panels shall be insulated, weatherproof and gasketed, full-height and hinged.

c. Panels shall have a three-point latching mechanism with padlockable handle.
d. Panels shall be a minimum (Manufacturer’s Standard Gauge) MSG No. 11.

4.2.8.2 If indicated on the layout drawing, side entrance metal framed bulkhead openings or other purchaser-approved methods shall be provided by the supplier. Entry plates shall be removable and minimum 3/16-inch (4.8 mm) galvanized steel plate. Threaded bolts shall be the means of attachment of the plates to the structural framing.

4.2.8.3 If bottom entrance is indicated on the layout drawing for cable entry, removable nonferrous metal plates shall be provided to facilitate drilling for conduit and cable openings. Conduit entry plates to cover the openings shall be provided and constructed of 3/16-inch (4.8 mm) thick aluminum plate bolted to the floor by means of threaded bolt holes in the floor plate. Neoprene gaskets shall be attached to the removable plates.

4.3 Walls and Roof

4.3.1 Enclosures shall be Category B as described in Table B.1 of ANSI/IEEE C37.20.2-2015. Enclosures shall also comply with requirements listed in Section B.3.8 of ANSI/IEEE C37.20.2-2015.

4.3.2 Enclosures shall be constructed of steel with a minimum thickness of MSG No. 11.

4.3.3 Joints in the outer steel housing shall be designed and fabricated to prevent the entry of dust, moisture, and vermin. All gaskets shall be continuous and held in metal retainers (channel, etc.).

4.3.4 Locations of incoming and outgoing bus duct and cable shall be coordinated with equipment to be enclosed.

4.3.5 The roof shall be sealed and sloped to provide drainage in a direction away from personnel doors and any front access doors.

4.3.6 Side paneling shall stop at a minimum of 3 inches (76 mm) above bottom of base.

4.4 Doors

4.4.1 Walk-in enclosures with protected aisles shall be provided with an outer personnel door. The width of the door shall be 36 inches (914 mm) minimum. The minimum aisle width in walk-in enclosures shall comply with the requirements of NFPA 70, unless a greater dimension is specified on the purchaser’s PIP ELSSG12D Data Sheet.

4.4.2 Enclosures more than 72 inches (1.8 m) wide shall have a door at each end. The door width shall be large enough to remove the largest controller or breaker element. The doors shall swing outward and be equipped with panic bars or other devices that are normally latched and designed to open under simple pressure. The door shall have provisions for the purchaser’s lockset as specified on the purchaser’s PIP ELSSG12D Data Sheet. All personnel doors shall be equipped with windows.

4.4.3 Door stops on personnel doors and equipment access doors shall be provided to maintain doors in the open position.
4.4.4 Equipment access doors on the front of the enclosure shall be equipped with
gasketed, hinged doors with a 3-point latching mechanism.

4.4.4.1 Latches on equipment access doors shall engage the steel frame at three
points (top, bottom, and side) to latch the door closed and shall have a
rolling or smooth sliding action when engaging the frame to aid in
operating the latches.

4.4.4.2 All equipment access doors shall be suitable for pad locking.

4.4.4.3 All outdoor handles and hardware shall be Series 300 stainless steel.

4.4.4.4 Dust sealing on all doors shall be achieved using a compression type
neoprene strip. The use of foam rubber or foam plastic as a dust sealing
strip will not be accepted.

4.5 Screens and Filters

4.5.1 Enclosures shall have louvered ventilation openings at the top and bottom.

4.5.2 Ventilation openings shall not be provided in personnel doors.

4.5.3 Ventilation openings shall be equipped with screens and reusable, washable filter
elements. The filter element shall be safely accessible for replacement while the
equipment is in normal service.

4.6 Electrical Accessories

4.6.1 Panelboards
Supplier shall provide a circuit breaker panel with main circuit breaker and
minimum of six branch circuit breakers, or as specified on the purchaser’s PIP
ELSSG12D Data Sheet. These branch circuits will serve equipment space heaters,
lighting, receptacles, fans, personnel space heaters, etc. Power supply voltage
shall be as specified on the purchaser’s PIP ELSSG12D Data Sheet.

4.6.2 Heaters
If specified on the purchaser’s PIP ELSSG12D Data Sheet, walk-in enclosure
shall include personnel space heaters with hand-off-auto switches and
thermostats to activate at preset temperatures. One form C contact shall be
provided for use as a remote alarm to indicate over- or under-temperature
conditions inside the enclosure.

4.6.3 Fans
If specified on the purchaser’s PIP ELSSG12D Data Sheet, walk-in enclosure
shall include ventilation fans with hand-off-auto switches and thermostats to
activate at a preset temperature. One form C contact shall be provided for use as
a remote alarm to indicate over-temperature.

4.6.4 Lighting
4.6.4.1 Lighting shall be provided in all walk-in enclosures and the lighting shall
be suitable for service conditions listed on the purchaser’s PIP
ELSSG12D Data Sheet.
4.6.4.2 Minimum illumination shall be 30 foot candles on the vertical panels, 42 inches (1.1 m) above the floor.

4.6.4.3 Light switches shall be identified with engraved nameplates indicating the power source and shall be located on the non-hinged side of the door(s).

4.6.4.4 In walk-in enclosures, three-way switches for lighting shall be installed and located beside each door.

4.6.4.5 Unless otherwise specified on the purchaser’s PIP ELSSG12D Data Sheet, lighting fixtures shall be LED.

4.6.4.6 Bottom of lighting fixtures shall be a minimum of 6 feet 8 inches (2.03 m) above the floor in walk-in enclosures.

4.6.4.7 Unless otherwise specified on the purchaser’s PIP ELSSG12D Data Sheet, lighting fixtures shall have guards.

4.6.4.8 Supplier shall furnish self-contained battery operated emergency lights and lighted exit signs if specified on the purchaser’s PIP ELSSG12D Data Sheet.

4.6.4.9 Supplier shall furnish external lighting near doors if specified on the purchaser’s PIP ELSSG12D Data Sheet.

4.6.5 Receptacles

If specified on the purchaser’s PIP ELSSG12D Data Sheet, walk-in enclosure shall include a 120-volt GFCI-type receptacle outlet located near each personnel door.

4.6.6 Wiring Methods

Wiring methods, including raceways, cable systems, grounding, and bonding, shall comply with NFPA 70.

4.6.7 Fire Safety

4.6.7.1 If specified on the purchaser’s PIP ELSSG12D Data Sheet, a minimum of one fire extinguisher shall be.

4.6.7.2 Fire extinguishers shall be Type C for energized electrical equipment.

4.6.7.3 If specified on purchaser’s PIP ELSSG12D Data Sheet, a fire detection system shall be supplied.

4.6.8 Breaker Aux Equipment

If specified on the purchaser’s PIP ELSSG12D Data Sheet, provisions for remote breaker racking, breaker testing, PPE storage, etc.

4.7 Equipment Grounding

A NEMA standard 2-hole stainless steel ground pad shall be located on outside of the building on diagonally opposite corners of the enclosure skid (total of 2 ground pads). Supplier shall connect equipment ground bus to the ground pads.

4.8 Labeling and Tagging

4.8.1 The power center and all equipment shall be tagged.
1. Power center tag shall be made of laminated plastic, with black lettering, ¼ inch (6.4 mm) minimum height, on white background and permanently attached to each piece of equipment.

2. Equipment labels shall be installed with stainless steel hardware.

3. Device markers and shrink sleeve wire markers shall be provided at both ends to identify all circuits and equipment.

4.8.2 Nameplates shall be provided for panelboards, annunciator panels, dry-type transformers, specialty equipment, all other equipment and accessories, and exterior access panels not otherwise covered by the equipment specifications. The power center manufacturer shall create a nameplate schedule for review and approval of the Owner’s Engineer. Nameplate schedule shall show nameplate background and letter color, physical size, font size and engraving.

4.8.3 Lighting fixtures, receptacles, HVAC, and other electrical equipment shall be identified with power source (panel name and circuit number).

4.9 Coatings

4.9.1 All above floor structural framing members shall be cleaned to near white metal. The use of chemical or solvent cleaning of structural steel shall not be permitted. Following cleaning, one shop coat of epoxy primer (3.0 mils minimum dry thickness) shall be applied.

4.9.2 Floor surface shall be finished with a durable, scuff-resistant, non-skid epoxy or enamel coating.

4.9.3 All seams outside the enclosure shall be sealed with 25-year silicone sealant to preclude crevice corrosion and assure the environmental integrity of the enclosure against blowing rain, dust, dirt, or sand.

4.9.4 All interior and exterior exposed metal surfaces shall receive factory paint that meets or exceeds the requirements of a 2000-hour salt spray test as defined by ASTM B 117 and evaluated in accordance with ASTM D 1654 and ASTM D 714.

4.9.5 Interior and exterior color coating design shall meet the following performance standards after 10 years continuous exposure in normal atmospheric conditions:

a. Panels shall show no evidence of blistering, peeling, or chipping.

b. Panels shall show no surface chalking.

c. Panels, after cleaning, shall show no color change in excess of seven (7) units when measured in accordance with the ASTM D 2244 standard.

4.9.6 Unless specified otherwise on the purchaser’s PIP ELSSG12D Data Sheet, exterior and interior of enclosure shall be painted white.

4.9.7 All structural members under the flooring shall be coated with an additional 20-25 mils of bitumastic or equal undercoating to eliminate base rusting and subsequent corrosion.

4.9.8 Two (2) 1-quart (0.94L) cans of touch-up paint shall be supplied per equipment assembly for each color used.
4.10 Inspection and Testing

4.10.1 All tests and inspections shall be conducted that are necessary to determine that all equipment and wiring is installed in accordance with this Practice and is in satisfactory condition to be energized. All test results shall be documented and submitted to the purchaser for record.

4.10.2 All equipment shall be inspected for compliance with all parts of this Practice.

4.10.2.1 The supplier’s inspection and testing guide shall be used to test the entire assembly (wired power center).

4.10.2.2 The supplier’s inspection and testing guide shall be submitted to the purchaser for approval.

4.10.2.3 In addition to testing required by individual equipment specifications, a functional test shall be performed to ensure proper operation of all auxiliaries, devices and components.

4.10.3 Unless otherwise specified on the purchaser’s PIP ELSSG12D Data Sheet, the purchaser shall witness all post production and functional tests. A 2-week notice shall be given to purchaser for required inspection and testing date to meet shipment deadlines.

4.10.4 If specified on the purchaser’s PIP ELSSG12D Data Sheet, a weatherproofing test shall be quoted according to IEEE C37.100.1.

4.11 Shipping

4.11.1 Preparation for shipment shall be in accordance with supplier’s standards unless otherwise noted in the job specifications.

4.11.2 The supplier shall be solely responsible for the preparation for shipment.

4.11.3 Loose equipment, such as auxiliary test devices, charts, replacement parts, manual operating handles, packing devices, etc., shall be appropriately packaged, tagged for easy identification, and secured for shipment inside the power center.

4.11.4 Moving parts shall be securely blocked and braced in relays, contactors, and other components in which these moving parts might be damaged during shipment. Blocking shall be identified (tagged) for removal.

4.11.5 Additional shipping and handling requirements that appear in the individual equipment specifications shall be strictly followed, if applicable.

4.11.6 If the enclosure is shipped in more than one section, each open shipping split shall be protected with plywood or other purchaser approved method.

4.11.7 Provisions shall be made for the purchaser to energize the space heaters without uncrating the equipment during storage at the jobsite. Electrical connections to the space heaters shall be readily accessible and clearly identified.

4.12 Documentation

4.12.1 Documentation Content

4.12.1.1 Drawings and data requirements shall be as shown in Table 1, and purchaser’s PIP ELSSG12D Data Sheet.
4.12.1.2 All engineering data provided for the equipment shall represent the actual equipment specified and ordered.

4.12.1.3 Generic drawings shall not be acceptable unless the drawings are revised to show only the equipment being furnished.

4.12.1.4 Approval drawings (documents listed in column B of Table 1) shall be provided and approved by purchaser before start of manufacturing.

4.12.1.5 Final factory drawings and data (as listed in column D of Table 1), completed to owner’s satisfaction, shall be provided no later than 2 weeks after shipment of equipment.

4.12.1.6 The following drawings and details for building and support facilities shall be provided:

a. Structural drawings shall include the following:
   
   (1) Complete dimensions
   (2) Arrangement
   (3) Plan and elevation views
   (4) Support locations and weight on each support
   (5) Other details as required for civil/structural design for installation of the enclosure
   (6) Conduit and bus duct entrance locations
   (7) Lifting and jacking provisions
   (8) Grounding connections
   (9) Estimated weight and centers of gravity of each shipped piece of equipment
   (10) Total weight of enclosure and included equipment, including layout of floor beams

b. Electrical drawings shall include schematics for lighting and power circuits.
Table 1 – Documentation Requirements

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<th>D</th>
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<td>Support locations, and weight on each support; and final assembled configuration and instructions for assembly of equipment and enclosure</td>
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<td>Assembly, inspection, and testing guide</td>
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<td>Electrical Drawings, including connection wiring diagrams, three-line and control schematic diagrams</td>
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<td>Installation, operation, and maintenance manual</td>
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<td>Final as-built drawings</td>
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<td>Recommended priced spare parts list</td>
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Notes:
A. These documents shall be provided with proposal.
B. These documents shall be provided for purchaser’s review and authorization to proceed before fabrication.
C. These documents shall be provided as part of the final certified document submittal.
   (1) Equipment shall be shipped with one set of installation, operation, and maintenance manuals.
D. Final as-built drawings shall be provided within 2 weeks after shipment.

4.12.2 Conflict Resolution

Any conflicts between the following documents shall be identified to the purchaser in writing for resolution. If resolving conflicts, the following order of precedence shall apply:

a. One-line diagram(s)
b. *PIP ELSSG12D* Data Sheet
c. This Practice, *PIP ELSSG12*
d. Referenced standards
## Service Conditions (4.1):

- **Ambient Temperature:**
  - MAX: _____ °C
  - MIN: _____ °C
  - Humidity: _____ %

- **Altitude:** _____ M

- **Area Classification:**
  - Non-Classified
  - Classified

- **Class:** _____
  - Division: _____
  - Group: _____
  - Auto Ignition Temp: _____ °C

- **Wind, Snow, & Seismic Loading Requirements (4.1.d):**
  - Required
  - Not Required

- **Site Location:**
  - Latitude: _____
  - Longitude: _____

- **Seismic Certificate:**
  - Required
  - Not Required

- **Design Wind Velocity:** _____ MPH

- **Pollution Level (PER IEEE C37.100.1-2007 TABLE C.1):**
  - I Light
  - II Medium
  - III Heavy
  - IV Very Heavy

- **Exposed to a Moist/Moderate Corrosive Environment

- **Site Environmental Data Sheet Attached**

- **Other:**

## Electrical System Parameters:

- **Volts:** _____ kV
  - Phase: 3
  - Hertz: 60
  - Three Wire
  - Four Wire

- **Wye**
  - Delta
  - Other:

- **System Grounding:**
  - Solid
  - Ungrounded
  - High Resistance
  - Low Resistance

- **Ground Fault Current:** _____ Amps

- **Available Fault Current:** _____ kA Asymmetrical
  - X/R Ratio: _____

- **One Line Diagram**

- **Other:**

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**DOORS (4.4):**

- ENCLOSURE (4.4.1):
  - WALK-IN
  - MINIMUM AISLE WIDTH: ☒ PER NFPA 70 INCHES
  - NON WALK-IN
  - OTHER:

- DOOR LOCKSET (4.4.2):
  - BRAND:
  - CATALOG NUMBER:

**ELECTRICAL ACCESSORIES (4.6):**

- POWER SUPPLY SOURCE (4.6.1):
  - EXTERNAL SOURCE BY PURCHASER
  - INTERNAL SOURCE BY SUPPLIER
  - VOLTAGE: ☑ THREE PHASE ☐ SINGLE PHASE
    - 120/240 VAC
    - 120/208 VAC
    - 480 VAC
    - OTHER:
  - TOTAL LOAD: _______ VA

- PANELBOARDS (4.6.1):
  - ☑ MINIMUM 6 BRANCH CIRCUITS
  - OTHER:

- PERSONNEL SPACE HEATERS (4.6.2):
  - REQUIRED
  - NOT REQUIRED

- VENTILATION FANS (4.6.3):
  - REQUIRED
  - NOT REQUIRED

- LIGHTING (4.6.4):
  - LED
  - OTHER:
    - LIGHTING FIXTURE GUARDS: ☒ REQUIRED ☐ NOT REQUIRED

- EMERGENCY LIGHTING (4.6.4.8):
  - REQUIRED
  - NOT REQUIRED

- LIGHTED EXIT SIGNS (4.6.4.8):
  - REQUIRED
  - NOT REQUIRED

- EXTERNAL LIGHTING AT DOORS (4.6.4.9):
  - REQUIRED
  - NOT REQUIRED

- GFCI RECEPTACLE (4.6.5):
  - REQUIRED
  - NOT REQUIRED

- BREAKER AUXILIARY EQUIPMENT (4.6.8):
  - REQUIRED
  - NOT REQUIRED

**FIRE SAFETY (4.6.7):**

- FIRE EXTINGUISHERS:
  - BY PURCHASER
  - BY SUPPLIER
  - QUANTITY:
  - LOCATION:

- FIRE DETECTION:
  - REQUIRED
  - NOT REQUIRED
  - TYPE:
  - MANUFACTURE:
  - MODEL NO.:
  - OTHER:

**COATINGS (4.9):**

- EXTERIOR PANTING: ☒ WHITE
  - OTHER:
    - PER ATTACHED PAINT SPECIFICATION

- INTERIOR PANTING: ☒ WHITE
  - OTHER:
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### Nameplates (4.8.2):
- **Nameplate Mounting:**
  - [ ] Self-Tapping Screws
  - [ ] Other: [ ]
- **Color:**
  - [x] Black Lettering / White Background
  - [ ] Other: [ ]
- **Nameplate Engraving:** [ ]

### Inspection & Testing (4.10):
- **Manufactures Std.** [ ]
- **Witnessed** [ ]
- **Not Witnessed** [ ]
- **Certified Test Reports:**
  - [ ] Required
  - [ ] Not Required
- **Quote Weatherproofing Test (4.10.4):**
  - [ ] Required
  - [ ] Not Required

### Shipping (4.11):
- **Suppliers Std. Preparation** [ ]
- **Other:** [ ]
- **Pre-shipment Shop Inspection:**
  - [ ] Required
  - [ ] Not Required

### Documentation (4.12):
- **Electronic Document Format:**
  - [x] DWG
  - [x] PDF
  - [ ] Other: [ ]
- **Supplier to Provide:**
  - 1 Reproducible Plus
  - Copies of all Documents Plus
  - Copies of Operating Manuals

### Other Requirements:

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