PIP ELSSG02
Design and Fabrication of Medium-Voltage Metal-Clad Switchgear Above 1000 V to 38 kV
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# PIP ELSSG02

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## Table of Contents

1. **Scope** ............................. 2
2. **References** ......................... 2
   2.1 Process Industry Practices ....... 2
   2.2 Industry Codes and Standards .... 2
3. **Definitions** ....................... 3
4. **Requirements** ..................... 3
   4.1 Service Conditions .................. 3
   4.2 Ratings .................................. 3
   4.3 Basic Construction ..................... 4
   4.4 Additional Requirements for Arc-Resistant Switchgear ............. 7
   4.5 Power Circuit Breaker ............... 8
   4.6 Buses ................................... 10
   4.7 Control and Secondary Circuits and Devices ......................... 12
   4.8 Finish .................................. 21
   4.9 Test and Inspection .................... 22
   4.10 Nameplates ............................ 23
   4.11 Documentation ......................... 24
   4.12 Shipment ............................... 26
   4.13 Conflict Resolution ................. 26

## Data Form

ELSSG02-D – Data Sheet for Design and Fabrication of Medium-Voltage Metal-Clad Switchgear Above 1000 V to 38 kV
1. **Scope**

This Practice covers minimum requirements for design, fabrication, inspection, testing, shipment, and documentation, for metal-clad switchgear containing insulated buses, draw-out power circuit breakers, control, instrumentation, and metering, for installation in unclassified areas. This Practice also covers remote monitoring and control requirements.

2. **References**

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

2.1 **Process Industry Practices (PIP)**

- PIP ELSBD01 – Design and Fabrication of Metal-Enclosed Nonsegregated-Phase Bus Duct Assemblies
- PIP ELSBD01D – Data Sheet for Design and Fabrication of Metal-Enclosed Nonsegregated-Phase Bus Duct Assemblies
- PIP ELSBD02 – Design and Fabrication of Metal-Enclosed Cable Bus Assemblies
- PIP ELSBD02D – Data Sheet for Design and Fabrication of Metal-Enclosed Cable Bus Assemblies
- PIP ELSSG12 – Design and Fabrication of Outdoor Enclosures for Motor Controllers and Switchgear

2.2 **Industry Codes and Standards**

- American National Standards Institute, Inc. (ANSI)
  - ANSI Z535.4 – *American National Standard for Product Safety Signs and Labels*
- American Society for Testing and Materials (ASTM)
  - ASTM B117-16 – *Standard Practice for Operating Salt Spray (Fog) Apparatus*
  - ASTM D1535-14 – *Standard Practice for Specifying Color by the Munsell System*
  - ASTM D3363-05 – *Standard Test Method for Film Hardness by Pencil Test*
- Institute of Electrical and Electronic Engineers (IEEE)
  - IEEE C37.20.2 – *Standard for Metal-Clad Switchgear*
  - IEEE C37.20.7 – *Guide for Testing Medium-Voltage Metal-Enclosed Switchgear Rated up to 38 kV for Internal Arcing Faults*
  - IEEE C37.21 – *Control Switchboards*
  - IEEE C37.100.1 – *Standard of Common Requirements for High-Voltage Power Switchgear Rated Above 1000 V*
3. **Definitions**

*arc resistant equipment:* Equipment designed to withstand the effects of an internal arcing fault, as indicated by meeting test requirements of ANSI C37.20.7

*internal arcing fault:* An unintentional discharge of electrical energy in air within the confines of an electrical equipment enclosure

*owner:* The party who owns the facility wherein the medium-voltage metal-clad switchgear will be used

*metal-clad switchgear:* The term metal-clad switchgear, in this Practice, is in accordance with switchgear features and requirements for metal-clad switchgear given in Section 3 of IEEE C37.20.2-2015.

*purchaser:* The party who awards the contract to the supplier. The purchaser may be the owner or the owner’s authorized agent.

*purchaser’s inspector:* The purchaser’s authorized representative with authority to act in the interest of, and on behalf of, the purchaser in all quality assurance matters

*supplier:* The party responsible for manufacturing, furnishing, and/or installing the medium-voltage metal-clad switchgear

4. **Requirements**

4.1 **Service Conditions**

4.1.1 Unless otherwise specified on the purchaser’s *PIP ELSSG02-D* Data Sheet, equipment shall be designed in accordance with IEEE C37.100.1 to perform satisfactorily under the following conditions:

a. Ambient temperature within the limits of -30°C (-18°F) and 40°C (104°F)
b. Altitude of installation does not exceed 1000 m (3300 feet)
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. Pollution level I “light”

4.1.2 Supplier shall clearly state during proposal any derating factors required to meet the service conditions of Section 4.1.1.

4.1.3 Seismic requirements shall be as specified on the purchaser’s *PIP ELSSG02-D* Data Sheet. If specified on the purchaser’s *PIP ELSSG02-D* Data Sheet, the manufacturer shall provide a type test report demonstrating compliance and anchoring recommendations for all equipment.

4.2 **Ratings**

4.2.1 The ratings of the switchgear assemblies and the system parameters shall be in accordance with the purchaser’s *PIP ELSSG02-D* Data Sheet, attached one line diagram, and as given in this Practice.
4.2.2 Hottest spot temperature rise for the buses and connectors shall not exceed 65°C (149°F) and hottest total temperature shall not exceed 105°C (221°F) at 40°C (104°F) ambient when carrying rated continuous current at rated voltage and rated frequency.

**Comment:** Temperature limitations of air surrounding cables are based on the use of 90°C (194°F) insulated power cables.

4.3 **Basic Construction**

4.3.1 **Switchgear Assembly**

4.3.1.1 The switchgear assembly shall include, but not be limited to, metal-clad free-standing vertical steel structures containing power buses, a ground bus, removable (drawout) vacuum circuit breakers, auxiliary control devices, instrumentation, metering, and protective equipment in accordance with the one-line diagram and the purchaser’s PIP ELSSG02-D Data Sheet.

4.3.1.2 All enclosures shall be fabricated from free-standing steel frames and steel panels with doors formed to provide a strong and rigid structure. The design shall allow the switchgear to be rolled across a floor on pipes or other means without causing the structure to deform or otherwise be damaged.

4.3.1.3 External panels and doors shall be Manufacturer Sheet Gauge (MSG) #14 minimum thickness.

4.3.1.4 Unless otherwise specified on the purchaser’s PIP ELSSG02-D Data Sheet, enclosures shall meet the requirements of NEMA 1.

4.3.1.5 Enclosures for outdoor service shall be in accordance with PIP ELSSG12.

4.3.1.6 Enclosures shall be Category B with requirements as defined in Annex B of IEEE C37.20.2-2015, Table B.1.

**Comment:** Category B enclosures are intended for use in installations that are not subject to deliberate unauthorized acts of the unsupervised general public and for providing a degree of protection to unauthorized and untrained personnel against incidental contact with enclosed equipment.

4.3.1.7 All front, rear, instrument, and control compartments shall have doors with either continuous steel hinges or a minimum of two separate hinges as required to prevent the doors from sagging and shall be provided with door stops.

4.3.1.8 All doors shall be provided with hand-operated latches. High voltage compartment doors shall have provisions for padlocking.

4.3.1.9 Provisions shall be provided for padlocking the breaker racking mechanism to prevent inserting the breaker onto the bus.

4.3.1.10 Incoming breakers and tie breakers shall be one-high configuration, with no Voltage Transformer (VT) compartment physically located in
the vertical section, unless otherwise indicated on the purchaser’s *PIP ELSSG02-D* Data Sheet.

4.3.1.11 Feeder breakers may be one-high or two-high configuration as specified on the purchaser’s *PIP ELSSG02-D* Data Sheet.

4.3.1.12 All ventilation and cooling openings shall be provided with vermin-proof, screens on the inside of the switchgear.

4.3.1.13 An external position indicator to show the breaker position during closed-door breaker racking and breaker mechanical open/close status shall be provided.

4.3.1.14 If specified on the purchaser’s *PIP ELSSG02-D* Data Sheet, a view pane in compliance with *IEEE C37.20.2-2015*, Annex B, Section B.3.6, shall be provided.

4.3.1.15 A light with switch on the door sized to provide sufficient illumination shall be provided inside each cubicle containing a circuit breaker to permit the following:
   a. Viewing the breaker position during closed door breaker racking
   b. Viewing the breaker mechanical open/closed status indicator

4.3.1.16 If specified on the purchaser’s *PIP ELSSG02-D* Data Sheet, infrared viewer ports shall be provided. The viewer ports shall be located to permit infrared scanning of all three phases of the field medium-voltage power cable terminations. Supplier shall state manufacturer and model in supplier’s proposal.

4.3.1.17 If specified on the purchaser’s *PIP ELSSG02-D* Data Sheet, partial discharge sensors and associated equipment shall be provided.

4.3.1.18 If specified on the purchaser’s *PIP ELSSG02-D* Data Sheet, fixed thermal sensors and associated equipment shall be provided.

4.3.1.19 Switchgear shall be designed for expansion on both ends and the enclosures shall be of modular design so that additional units can be safely and readily installed. This shall include, but shall not be limited to predrilled buses, terminal blocks for secondary wiring, and removable enclosure end covers secured by captive hardware on the structure. At least two covers shall need to be removed to access the bus bar.

4.3.1.20 Spaces shall be provided for future use as specified on the one-line diagram. Spaces shall be of three types: equipped, unequipped, and blank. Spaces shall be configured as follows:
   a. Equipped spaces shall be capable of being modified to add future circuit breakers of the same ampere rating without shutdown of the switchgear. Equipped spaces shall be furnished with all hardware, wiring, doors, and miscellaneous equipment including current transformers and monitoring devices required to permit completion of the unit by the addition of only a circuit breaker. Power stabs
(both line and load side) shall be provided with covers to prevent accidental contact with live parts when door is opened.

b. Unequipped spaces shall be provided with doors and power stabs but without other equipment for future use. Unequipped spaces shall not be used for mounting control switches and other auxiliary equipment. Power stabs (both line and load side) shall be provided with covers to prevent accidental contact with live parts when door is opened.

c. Blank spaces shall be completely empty cubicles with doors but without power stabs or other equipment.

4.3.1.21 Unless otherwise specified on the purchaser’s PIP ELSSG01D Data Sheet energized exposed parts mounted on doors shall be provided with guards.

4.3.1.22 Switchgear shall be provided with removable lifting eyes or angles for handling during installation.

4.3.1.23 If specified on the purchaser’s PIP ELSSG01D Data Sheet, the switchgear assembly shall be UL labeled.

4.3.2 Power Cable Terminations

4.3.2.1 Provisions for cable terminations shall be provided for each breaker as defined on the one-line diagram.

4.3.2.2 The depth of all units shall be sufficient to allow top or bottom entrance and bending and termination of shielded power cables.

4.3.2.3 The cable entry shall be as specified on the purchaser’s PIP ELSSG02-D Data Sheet.

4.3.2.4 Non-metallic supports for power cables and cable terminators shall be provided so that the weight of the cables is not imposed on the terminations.

4.3.2.5 Cable lugs shall be supplied by as specified on the purchaser’s PIP ELSSG02-D Data Sheet. All termination pads shall have NEMA standard bolt pattern. Where connectors (lugs) are provided by the supplier, they shall be NEMA two-hole, long barrel type.

4.3.2.6 Unless otherwise specified on the purchaser’s PIP ELSSG02-D Data Sheet, insulating boots for incoming and outgoing cables shall be provided by the supplier.

4.3.2.7 If specified on the purchaser’s PIP ELSSG02-D Data Sheet, all customer power connection points shall be provided with inter-phase barriers, ground barriers, and phase to ground barriers.

a. For bottom entry cables, the barriers shall extend a minimum of 12 inches (305 mm) below and 6 inches (152 mm) above the termination point.
b. For top entry cables, the barriers shall extend a minimum of 6 inches (152 mm) below and 12 inches (305 mm) above the termination point.

c. Phase Barriers shall be removable through cable access door or panels.

4.3.2.8 In a two-high configuration, a metallic enclosure shall be provided for power cable routing to the top (for bottom cable entry) or to the bottom compartment (for top cable entry).

4.3.3 Bus Terminations

4.3.1 If bus duct is specified on the purchaser’s PIP ELSSG02-D Data Sheet, the bus duct shall be in accordance with PIP ELSBD01 and PIP ELSBD01D.

4.3.2 If cable bus is specified on the purchaser’s PIP ELSSG02-D Data Sheet, the bus duct shall be in accordance with PIP ELSBD02 and PIP ELSBD02D.

4.4 Additional Requirements for Arc-Resistant Switchgear

4.4.1 If specified on the purchaser’s PIP ELSSG02-D Data Sheet, the switchgear shall be arc-resistant design as described below.

4.4.2 Switchgear shall be tested in accordance with IEEE C37.20.7 or a written certificate of successful type testing, including all the parameters used in the testing, shall be submitted to the purchaser during bid process. Testing shall be based on prospective current of the highest rated circuit breaker without insertion of any current limiting device in the test circuit.

4.4.3 Unless otherwise specified on the purchaser’s PIP ELSSG02-D Data Sheet, switchgear shall be arc-resistant construction Type 2B.

4.4.4 Circuit breakers, VT and CPT drawers, and switchgear shall be designed for closed door racking. Arc-resistant integrity shall be maintained during closed door racking.

4.4.5 The front and rear compartment doors shall be designed to withstand the effects of an internal arcing fault.

4.4.6 The VT compartment door and the instrument and control compartment doors shall have steel hinged doors that are in accordance with IEEE C37.20.7 testing requirements.

4.4.7 The design of openings shall pass the requirements of IEEE C37.20.7, with respect to the emission of arc flash products.

4.4.8 Openings intended to close on initiation of a fault to preserve arc-resistant construction shall be provided with the necessary guards on top and sides to prevent dropping of any foreign material that will prevent openings from closing.

4.4.9 All opening cover plates provided to preserve arc-resistant construction shall be accessible for inspection when the switchgear is de-energized.
4.4.10 Unless specified otherwise on the purchaser’s PIP ELSSG02-D Data Sheet, door interlocks shall be provided that offer the following functions:
   a. Prevent opening of the breaker compartment door unless the circuit breaker is in the disconnected or test position and the safety shutters are closed.
   b. Prevent racking the breaker from disconnected position unless the door latch is fully closed and latched.

4.4.11 Means to manually trip the breaker without requiring opening the door and compromising the integrity of arc-resistant construction shall be provided.

4.4.12 Provisions for closed door manual racking of the circuit breaker while maintaining the integrity of arc-resistant construction shall be provided.

4.4.13 If specified on the purchaser’s PIP ELSSG02-D Data Sheet a single-handle latch system with position labeling and provision for padlocking shall be provided on each door such that arc-resistant integrity is maintained when the latch is in closed position. For switchgear rated 50 kA and below, no additional tie down bolts or latches shall be required on the doors to maintain arc-resistant construction.

4.4.14 Personnel shall be protected from arc products expelled from the switchgear enclosure. Unless specified otherwise on the purchaser’s PIP ELSSG02-D Data Sheet, a written certificate of successful type testing, including all the parameters used in the testing, shall be submitted to the purchaser during bid process. Testing shall be based on prospective current of the highest rated circuit breaker without insertion of any current limiting device in the test circuit, a plenum system shall be designed and provided by supplier as described below:
   a. Plenum system shall exhaust arc products from the switchgear room.
   b. Exhaust outlet shall be raintight, and suitable for the exterior rating of the building into which it is installed.
      
      Comment: The location selected for the exhaust outlet shall be directed to an area that minimizes personnel and equipment exposure. In addition, the plenum should be sloped to direct rain or condensation away from the switchgear.
   c. Plenum minimum volume shall be tested and certified in accordance with IEEE C37.20.7.
   d. Plenum shall be separate from other plenum systems. If a combined plenum system is desired, manufacturer(s) shall analyze and certify the combined plenum system design.
   e. For dual tie switchgear arrangement, separate plenums shall be provided.
   f. Exhaust plenum shall be screened to exclude birds, trash, and vermin.

4.5 Power Circuit Breaker

4.5.1 Circuit breakers shall be electrically operated, drawout type, and of vacuum interrupter-type design.

4.5.2 Circuit breakers shall be rated for interrupting, close and latch current rating as specified on the purchaser’s PIP ELSSG02-D Data Sheet.
4.5.3 Unless otherwise specified on the purchaser’s PIP ELSSG02-D Data Sheet, circuit breaker internal supports shall be epoxy.

4.5.4 Each circuit breaker shall be equipped with “stored energy operation” type anti-pump operating mechanism.

4.5.5 Grounded metal shutters shall be provided to prevent access to the primary contacts if the circuit breaker is withdrawn or removed. The action of the shutters shall be aligned to the position of the circuit breaker removable element. The mechanism by which the shutters are operated shall be redundant and designed to avoid “wedging” shutters in place.

4.5.6 Shutters shall be clearly marked with an inscription indicating “Connected to incoming or outgoing cable” or “Connected to bus side A or B” as applicable. This inscription shall be minimum 1/2-inch (13 mm) high white lettering on a red background.

4.5.7 Means shall be provided to manually rack the circuit breaker into or out of the compartment with the compartment door closed and latched.

4.5.8 Circuit breaker open and closed positions shall be indicated by means of color coded flags on the front of each circuit breaker.

4.5.8.1 The flag color red shall indicate the “closed” position.

4.5.8.2 The flag color green shall indicate the “open” position.

4.5.9 Circuit breaker padlocking provisions shall be provided for padlocking the removable element in the disconnected and test position only.

4.5.10 Circuit breakers of the same rating shall be interchangeable and interlocked with the breaker cubicle so that a breaker with a lower continuous or interrupting rating cannot be inserted into a higher rated compartment.

4.5.11 A TOC switch and a MOC switch shall be provided for each cubicle:

a. The TOC and MOC switches may be located in the circuit breaker cell. No other devices shall be located in the circuit breaker cell.

b. Unless otherwise specified on purchaser’s PIP ELSSG02-D Data Sheet, each cell switch shall have a minimum four Normally Open (NO) contacts and four Normally Closed (NC) contacts provided for the purchaser’s use.

c. All cell switch contacts shall be wired out to terminal blocks in the instrument and control compartment so that they can be easily accessed for test purposes.

Comment: Where above requirements cannot be met, supplier shall notify purchaser at bid stage.

4.5.12 Unless specified otherwise on the purchaser’s PIP ELSSG02-D Data Sheet, all circuit breakers shall be closed and operated by 125 volts DC nominal voltage. For 125 volt DC systems, the circuit breaker close coil shall be designed to operate within a voltage range of 100 to 140 volts DC and the circuit breaker trip coil shall be designed to operate within a voltage range of 70 to 140 volts DC.

4.5.13 Unless otherwise specified on the purchaser’s PIP ELSSG02-D Data Sheet, breakers shall be provided with a single trip coil. Breakers for generator control
shall be provided with two (2) trip coils, unless otherwise specified on the purchaser’s PIP ELSSG02-D Data Sheet. Each trip coil shall be connected for operation on a separate trip circuit.

4.5.14 Provisions shall be made to manually trip the circuit breaker (on loss of trip circuit) within its short circuit current rating without opening the door.

4.5.15 One set of accessories required for safe operation and maintenance (such as handling device, racking handle, test plugs, test cabinets with a set of secondary couplers, breaker maintenance closing device, manual charging device, transport truck and/or lift truck, etc.) shall be provided for each switchgear lineup, unless otherwise specified on the purchaser’s PIP ELSSG02-D Data Sheet. Supplier shall provide a priced list of required accessories and indicate minimum space clearances for these devices to the purchaser with proposal.

4.6 **Buses**

4.6.1 **Power Bus**

4.6.1.1 All buses and primary connections shall be copper.

4.6.1.2 Phase sequence arrangements shall be “A, B, C” from front to back, top to bottom, or left to right as viewed from front. When specified on the purchaser’s PIP ELSSG01D Data Sheet, buses shall be physically labeled with phase letter at all purchaser connection points with a minimum of 1-inch (25 mm) high letters.

4.6.1.3 All sections of the main bus shall have continuous ampacity equal to the main bus continuous ampere rating.

4.6.1.4 Bus shall be silver-plated or tin-plated as specified on the purchaser’s PIP ELSSG02-D Data Sheet.

4.6.1.5 All bus insulators and bus bar inserts shall utilize either wet-process glazed porcelain or cycloaliphatic epoxy material as specified on the purchaser’s PIP ELSSG02-D Data Sheet.

4.6.1.6 Bus insulation, except at the joints, shall be bonded to the bus bar and shall be either liquid dipped or fluidized bed epoxy.

4.6.1.7 Sleeve type or heat shrink tubing type insulating systems shall not be permitted.

4.6.1.8 All bus bar joints shall be covered with formed insulating boots with minimum 1/4-inch (6.4 mm) overlap.

4.6.1.9 Taping of bolted joints is not acceptable.

4.6.1.10 Insulating materials for buses, barriers, cable supports, and spacers shall be made of flame-retardant, track-resistant, non-hygroscopic materials in accordance with the requirements of insulating materials as defined in IEEE C37.20.2.
4.6.1.11 All connections to VT or CPT primary stationary stabs shall be made with a rigid bus. Where approved by purchaser, cable can be used provided the following is met:

a. Cable damage curve is 150% of the let-through current of the largest fuse in the circuit.

b. Cables must be braced for the same short circuit rating of the switchgear.

c. Conductors from different medium voltage sources shall not be present in the same compartment unless separated by a grounded metallic barrier.

4.6.1.12 All bolted power bus connections shall be secured with corrosion-resistant, zinc coated grade 5 steel hardware, including bolts, Belleville washers, and nuts or jam nuts.

4.6.1.13 Connections shall be made with a minimum of two bolts. Bus connections with 2000 amperes or higher shall have a minimum of four bolts. Alternately, supplier may provide a type-testing report of their standard construction, indicating that temperature rise, with a thermocouple at the joint, is within acceptable limits.

4.6.1.14 A label shall be posted inside each cubicle listing torque requirements for bolted connections.

4.6.2 Ground Bus and Connections

4.6.2.1 A copper ground bus, minimum 2 inches (51 mm) by 1/4 inch (6.4 mm) copper, that extends throughout the length of the stationary structure shall be provided.

4.6.2.2 The ground bus shall be designed to carry rated short time current of the highest rated device in the assembly for minimum 2 seconds.

4.6.2.3 Ground bus shall electrically connect together the structures in a switchgear assembly in or on which primary equipment or devices are mounted.

4.6.2.4 Provisions for connection of NEMA two-hole connectors at each end of the bus shall be provided.

4.6.2.5 Ground connections shall be provided for all removable elements to ensure that the frame and mechanism are grounded until the primary circuit is disconnected and the removable element is moved a safe distance.

4.6.2.6 A separate connection point shall be provided for each ground wire connected to the ground bus.

4.6.2.7 Ground bus connections shall be solidly bolted using through bolts, nuts and Belleville washers. Use of self-tapping screws or bolts shall not be permitted for ground bus connections.
4.6.3 Maintenance Grounding Provisions

4.6.3.1 In each cable compartment, the ground bus shall be extended toward the entrance to the compartment to allow easy access for safety grounding connection of a portable grounding clamp device.

4.6.3.2 Each phase bus power cable termination shall be provided with an apparatus ground clamp cable connection for voltage testing and grounding, and shall be readily accessible for the application.

4.6.3.3 The ground clamp cable connection shall be a grounding ball stud with removable insulating cover, mounted as close as possible to the phase bus cable termination point.

4.6.3.4 Ground and test devices shall be provided if specified on the purchaser’s PIP ELSSG02-D Data Sheet.

4.7 Control and Secondary Circuits and Devices

4.7.1 General

All voltage circuits used for control, relaying, or metering shall be protected within the switchgear as follows:

4.7.1.1 All cubicles supplied from Alternating Current (AC) or Direct Current (DC) external power sources shall have short circuit protection, individual disconnecting means, and provisions for locking in the disconnected or off position.

4.7.1.2 The caution plate shown below shall be provided on the door of each cubicle with external power.

![CAUTION EXTERNAL POWER SOURCE]

4.7.1.3 All circuits supplied from internal power sources (AC) shall have overload and short circuit protection within the same section as the supply source.

4.7.2 Remote Control of Circuit Breakers

4.7.2.1 If specified on the purchaser’s PIP ELSSG02-D Data Sheet, provision to remotely open and close the circuit breakers shall be provided by way of a supplier-provided hardwired remote control/mimic panel or hand-held control station.

4.7.2.2 If a hardwired remote control panel is supplied, it shall meet the following requirements:

a. It shall be tested in accordance with IEEE C37.21.

b. It shall be configured as shown on a layout sketch supplied by the purchaser.

c. It shall contain control switches, metering, mimic bus, and any other devices specified by the purchaser and shown on layout sketch.
d. As a minimum, the mimic bus shall show buswork, circuit breakers, supply sources, load descriptions, voltage transformers, and current transformers.

1. Breaker control switches shall be located beside the breaker symbol.

2. Devices shall be labeled using engraved laminated plastic.

3. The mimic buswork and components shall be attached with stainless steel screws.

e. All auxiliary components used in the control panel shall meet the same requirements as if they were in the main switchgear.

f. Terminal strips shall be mounted inside the control panel with terminal designations matching those of the corresponding terminal strips in the main switchgear. All connections shall be brought to the terminal strips.

4.7.2.3 If a hand-held control station is supplied, it shall include open and close pushbuttons and a cord with plug for connection to the front door of each switchgear cubicle.

a. Cord length shall be a minimum of 25 feet (7.6 m), or a length specified on the purchaser’s PIP ELSSG02-D Data Sheet.

b. A spare hand-held control station shall be provided if specified on the purchaser’s PIP ELSSG02-D Data Sheet.

4.7.2.4 If specified on the purchaser’s PIP ELSSG02-D Data Sheet, a human-machine interface (HMI) system shall be supplied in accordance with the following minimum functional requirements and any other specification as indicated in purchaser’s PIP ELSSG02-D.

a. Mimic bus shall show buswork, circuit breakers, supply sources, load descriptions, voltage transformers, metering and current transformers.

b. Status of circuit breakers

c. Capability to operate circuit breakers with confirmation of action

d. Alarm display

4.7.2.5 A remote racking device to electrically rack the breaker shall be provided if specified on the purchaser’s PIP ELSSG02-D Data Sheet.

a. Operating distance whether by way of cord or communications, shall be a minimum of 25 feet (7.6 m), or a length as specified.

b. Means shall be provided to automatically shut off the remote racking device when breaker is in the “connected” or “disconnected” position.

c. Self-racking device shall be integral to the breaker or a remote racking device as specified.

d. Means shall be provided to operate and lock out the racking device with the compartment door closed.
4.7.3 Power and Control Devices and Wiring

4.7.3.1 All wiring, excluding communications wire, shall be flame-resistant, 600 volts rated insulation, Type SIS flexible insulated stranded copper wire with insulation rated for 90°C (194°F) conductor temperature.

a. Power wiring shall be minimum No. 12 American Wire Gauge (AWG).

b. Control wiring, for use between component devices or parts of switchgear assemblies, shall be No. 14 AWG minimum size.

c. Wire bundles shall be arranged in a spiral configuration, so that the bundle twists rather than bends when door or panel is opened.

d. Wire bundles shall be protected against mechanical damage or contact with sharp edges by plastic spiral wrap.

e. Unless otherwise specified on the purchaser’s PIP ELSSG02-D Data Sheet, wiring, except for Current Transformer (CT) circuits, shall be terminated with insulated locking fork type connectors. Ratchet type crimpers shall be used to positively crimp the connectors.

f. Unless otherwise specified in this Practice or as specified on the purchaser’s PIP ELSSG02-D Data Sheet, manufacturer’s standard color insulation shall be used for power and control wiring.

g. In a two-high configuration, a separate metallic enclosure or raceway shall be provided for LV voltage control and communications cable routing to the top and bottom compartment.

4.7.3.2 CT secondary circuits shall be minimum No. 10 AWG copper conductors Type SIS.

a. The two individual leads from each CT shall be wired to front accessible, shorting terminal blocks. CT grounding shall also be connected on these blocks.

b. CT circuits shall be provided with compression type, insulated sleeve, seamless ring tongue connectors.

4.7.3.3 Unless otherwise specified on the purchaser’s PIP ELSSG02-D Data Sheet, differential circuit CT wiring shall be wired to terminal blocks for connection by way of jumpers between shipping splits.

4.7.3.4 Unless otherwise specified on the purchaser’s PIP ELSSG02-D Data Sheet, all grounding conductors shall be made with green insulated wires.

4.7.3.5 Control and secondary wiring shall be of one continuous length from terminal to terminal.

a. Splicing shall not be permitted.

b. All control wiring leaving a compartment shall leave from terminal blocks, not from devices in the compartment.
4.7.3.6 The terminal blocks shall be NEMA style general industrial type for internal panel application:

a. All blocks shall be 600 volt, 20 amperes minimum, fix mounted design, fully shielded construction to protect live parts.

b. All blocks shall be suitable for insulated locking fork type or ring type connectors.

c. A maximum of two wires may terminate at each terminal.

d. Terminal blocks shall be arranged and positioned to provide easy access for carrying out external cable terminations, testing, inspection, and maintenance.

e. A minimum of 20% spare terminals shall be provided. Where adequate space is not available, supplier shall notify purchaser at bid stage.

f. Customer field connections shall be on the same side of the terminal strip and factory connections shall be on the opposite side of the terminal strip.

g. For multiple switchgear assemblies terminal block layout shall be consistent from cubicle to cubicle where feasible.

4.7.3.7 All wires shall be identified with a unique tag in each assembly. Unless otherwise specified on the purchaser’s PIP ELSSG02-D Data Sheet, the ends of each wire shall be tagged with the origin and destination points.

a. Each wire shall be permanently marked at both ends in accordance with the wiring diagrams.

b. All wires shall be properly identified with permanently printed sleeve type wire markers.

c. Adhesive-back wire markers, labels, and wire holders shall not be permitted.

4.7.3.8 Each relay, fuse block, circuit breaker, terminal block, control switch, auxiliary switch, instrument transformer, and other auxiliary devices shall be permanently labeled in accordance with the schematics, wiring diagrams and Section 4.10 of this Practice.

4.7.3.9 Each circuit breaker, fuse block, or isolating knife switch shall be clearly identified to indicate the source and its purpose.

4.7.3.10 Fuse holders rated 30 amperes or less, shall be modular type, dead front construction, rail or screw panel mounting.

a. Fuse holders shall provide open fuse indication light if specified on the purchaser’s PIP ELSSG02-D Data Sheet.

b. Fuse holders shall provide an NC contact if specified on the purchaser’s PIP ELSSG02-D Data Sheet.

c. Fuse holders shall provide IP-2x protection (finger safe).
4.7.3.11 Unless otherwise specified on the purchaser’s *PIP ELSSG02-D* Data Sheet, wiring for bus differential relays shall be color coded in accordance with manufacturer’s standards.

### 4.7.4 Voltage Transformers

4.7.4.1 VTs shall be specified as described below:

a. Voltage of VTs shall be as specified in the purchaser’s *PIP ELSSG02-D* Data Sheet and the one-line diagram.

b. Configuration of VTs shall be as specified in the purchaser’s *PIP ELSSG02-D* Data Sheet and the one-line diagram.

4.7.4.2 VTs shall be mounted in a separate compartment on a tilt-out or draw-out type carriage with two handles.

4.7.4.3 Shutters or other means shall be provided to limit access to the bus bar contacts if the VT carriage is withdrawn.

4.7.4.4 The VT basic insulation level (BIL) at minimum shall be the same as the switchgear BIL per *IEEE C37.20.2*.

4.7.4.5 All VT primaries shall be protected with current limiting fuses. Secondary circuits shall be protected by fuses or circuit breakers.

4.7.4.6 Provisions to padlock the VT in the disconnected position shall be provided and for arc-resistant gear the padlock shall be visible from outside the door.

4.7.4.7 For arc-resistant switchgear, VT disconnects shall be operable with the door closed while maintaining the integrity of arc-resistant construction.

### 4.7.5 Current Transformers

4.7.5.1 CT for metering or protective relaying purposes shall be rated in accordance with purchaser’s one-line diagram.

4.7.5.2 CTs shall be window type and installed in a manner that can be readily maintained or replaced.

4.7.5.3 All CTs shall be designed to withstand the short circuit stresses (mechanical and thermal) imposed by the rating of the associated circuit breaker as shown in the purchaser’s one line diagram.

4.7.5.4 Current transformers for use in switchgear shall be suitable for use with an internal enclosure air temperature of at least 55°C (131°F).

4.7.5.5 Except for zero sequence CTs, CTs shall have a 5 ampere secondary winding rating, voltage rated insulation, and IEEE metering and relaying accuracy classification to meet the system parameters as shown on the purchaser’s one line diagram. CT accuracy class ratings shall be in accordance with *IEEE C37.20.2-2015*, Table 4.

4.7.5.6 CTs shall be rated and selected for the proper application to avoid relay misoperation due to saturation at the fault current specified on the purchaser’s *PIP ELSSG02-D* Data Sheet.
4.7.5.7 CT polarity marker shall be visible from the front of the switchgear with shutters open or rear of the switchgear with the door open. Supplier’s CT polarity shall be as indicated in the three-line diagrams, and the equipment shall be manufactured accordingly.

4.7.5.8 CTs used for bus differential schemes shall not be used for other relaying or metering circuits.

4.7.5.9 All current transformers used in high impedance differential or partial differential schemes shall be the same tap ratio, shall have compatible excitation and saturation characteristics and shall conform to the relay manufacturers’ requirements. Multi-ratio CTs shall not be used.

4.7.5.10 Opening of zero sequence CTs shall be large enough to accommodate purchaser’s power cables.

4.7.5.11 CT secondary circuits shall be routed away from medium voltage components.

4.7.5.12 Where multi-ratio CTs are supplied, all taps shall be wired to shorting type terminal blocks.

4.7.6 Control Power Transformers

4.7.6.1 CPTs shall be provided in accordance with the purchaser’s one-line diagram.

4.7.6.2 CPT and primary fuses shall be mounted on a tilt-out or draw-out type carriage with two handles. Means shall be provided to ground the unit if the unit is withdrawn.

4.7.6.3 CPTs larger than 15 kVA three-phase or 5 kVA single-phase can be fix-mounted type but their primary protective fuses must be installed in a draw-out truck or tilt-out tray.

4.7.6.4 Means shall be provided to limit access to the bus bar contacts if the CPT carriage is withdrawn.

4.7.6.5 The CPT BIL rating at a minimum shall be the same as the switchgear BIL rating per IEEE C37.20.2.

4.7.6.6 All CPT primaries shall be protected with current limiting fuses. Secondary protection may be either fuses or circuit breakers. Secondary protection shall be mechanically interlocked with the primary fuse compartments to prevent opening of the primary device unless all loads have been removed by the secondary protection device.

4.7.6.7 Provisions to padlock the CPT in the disconnected position shall be provided and for arc-resistant switchgear the padlock shall be visible from outside the door.

4.7.6.8 For arc-resistant switchgear, CPT disconnects shall be operable with the door closed while maintaining the integrity of arc-resistant construction.

4.7.6.9 Where fuse compartment is provided for CPTs that are mounted external to the equipment, space shall be provided for shielded cable terminations and provisions for interlocking with the secondary breaker of the CPT.
4.7.7 Instruments, Meters, Control Devices, and Indicating Lights

4.7.7.1 Each circuit breaker shall be provided with the following devices:
   a. Red indicating light – Breaker closed
   b. Green indicating light – Breaker open
   c. Amber indicating light – Breaker tripped by relaying
   d. Other indicating lights, such as lockout relay coil monitor, trip coil monitors, etc., as described in the purchaser’s PIP ELSSG02-D Data Sheet
   e. Unless otherwise specified on the purchaser’s PIP ELSSG02-D Data Sheet, breaker control switch (open-close) shall be supplied.
   f. When specified on the purchaser’s PIP ELSSG02-D Data Sheet, Local-Remote Control switch shall be supplied.
   g. Metering, protection devices and control switches as shown on the one-line diagram

4.7.7.2 Wiring of red and green lights shall provide the following visual checks of the control circuitry:
   a. The red indicator is on when the breaker is closed.
   b. The green indicator is on when the breaker is open.

4.7.7.3 If specified on the purchaser’s PIP ELSSG02-D Data Sheet, each breaker shall be provided with a Trip Circuit Monitoring (TCM).

4.7.7.4 Test switches to isolate potential and current inputs shall be provided to allow safe removal for calibration and repairs. Unless otherwise specified on the purchaser’s PIP ELSSG02-D Data Sheet, test switch color shall be manufacturer’s standard.
   a. Test jacks and test plugs shall be provided.
   b. Each test jack shall be wired to provide three-phase bus potential and three-phase line current for field monitoring and shall be wired in the current circuits.
   c. Caution: The blades of all test switches may be energized when open.

4.7.7.5 Unless otherwise specified on the purchaser’s PIP ELSSG02-D Data Sheet, space heater ammeters shall be provided, and shall be miniature type, 2% accuracy class, for indicating and monitoring space heater circuits.

4.7.7.6 Control switches shall be rotary cam type with engraved dial plates. Unless otherwise specified on the purchaser’s PIP ELSSG02-D Data Sheet, the manufacture of the control switch may be the switchgear manufacturer’s standard.
   a. Selector type control switches shall have oval handles.
   b. Circuit breaker control switches shall have “pistol grip” handles.
c. Lockout relay (Device 86) shall be manually reset type with oval or pistol grip handles.

d. Unless otherwise specified on the purchaser’s PIP ELSSG02-D Data Sheet, voltmeter switches shall be the four-position rotary type. Ammeter switches shall be the four-position rotary type.

4.7.7.7 Indicating lights shall be standard 16 mm LED lamps with front replaceable lamps and colored caps.

4.7.7.8 If specified on the purchaser’s PIP ELSSG02-D data sheet, an undervoltage relay (27DC) monitoring the DC control circuit in each cubicle shall be supplied.

4.7.7.9 Switchgear metering shall be provided in accordance with the one line diagrams or other information provided by the purchaser.

1. Communication capabilities shall be provided if specified on the purchaser’s PIP ELSSG02-D Data Sheet.

2. All metering and control equipment shall be accessible from the front of the switchgear.

3. Unless otherwise specified on the purchaser’s PIP ELSSG02-D Data Sheet, all meters shall be digital read out type except for the space heater ammeters, synchronous motor field current meters, synchronous motor power factor meters, and synchroscopes.

4. If analog-type metering is specified on the purchaser’s PIP ELSSG02-D Data Sheet, the meter shall be of the circular 250-degree-scale switchboard type, 1% accuracy, 4-1/2 inch square, and flush mounted.

5. Control power for microprocessor-type metering shall be as specified on the purchaser’s PIP ELSSG02-D Data Sheet.

6. Microprocessor metering package shall include the following features.

   a. Phase RMS current
   b. Phase to neutral RMS voltage
   c. Phase to phase RMS voltage
   d. Energy reading (kWh)
   e. Demand (kW)
   f. Peak demand (kW)
   g. Real power (kW)
   h. Reactive power (kVAr)
   i. Total power (kVA)
   j. Power factor (pf)
   k. Frequency (Hz)
1. Event reporting of at least 64 events related to breaker tripping or other troubles. Reporting shall include the date and time of the trouble, the reason for the event, the breaker address, the type of trip when trips are reported, and the current value at the time of the trip if the trip was due to an overcurrent.

7. If specified on the purchaser’s PIP ELSSG02-D Data Sheet, communications through intelligent electronic devices shall be provided.

4.7.8 Protective Relaying

4.7.8.1 Relaying shall be as specified on the one-line diagram or on attachments as to manufacture, type, quantity, and model numbers.

4.7.8.2 Substitution shall not be made of an equivalent relay without the written approval of the purchaser.

4.7.8.3 All microprocessor relays on the same project shall have the same firmware version.

4.7.8.4 The supplier shall supply all software and complete documentation for configuration, analysis, and monitoring of all protective relays and related auxiliary devices required by the purchaser.

4.7.8.5 If specified on the purchaser’s PIP ELSSG02-D Data Sheet, provisions shall be made for remote monitoring of the equipment operation.

4.7.8.6 Separate relays shall be provided for bus differential protection if this requirement is specified on the one-line diagram.

4.7.9 Space Heaters

4.7.9.1 Unless otherwise indicated on the purchaser’s PIP ELSSG02-D Data Sheet, space heaters shall be provided in each vertical section of the assembly to minimize condensation.

4.7.9.2 Unless otherwise indicated on the purchaser’s PIP ELSSG02-D Data Sheet, space heaters shall be externally powered. For externally supplied circuits, the space heater circuit power wiring shall be brought to a single set of interface terminals per bus for purchaser connection. The number and ampacity of external supply circuits shall be as specified on the purchaser’s PIP ELSSG02-D Data Sheet.

4.7.9.3 Space heaters shall have the following characteristics:

a. Rated for 240 volts and sized to provide the heat output to prevent internal condensation when operated on a 120-volt system.

b. The space heater shall be provided with high temperature wiring suitable for the application within 6 inches (152 mm) of the heater terminals.

c. Space heaters shall be mounted on a stand-off insulator and provided with an expanded metal cage to guard against accidental contact for personnel protection.
4.7.9.4 A caution plate, as shown below, shall be provided on the door of each cubicle that contains space heaters supplied from an external power source:

![CAUTION EXTERNAL POWER SOURCE]

4.7.9.5 An over-current protection/disconnect for each space heater circuit shall be provided in each vertical section.

4.7.9.6 If specified on the purchaser’s PIP ELSSG02-D Data Sheet, each vertical section space heater shall be controlled by a humidistat or thermostat.

4.7.9.7 If indicated on the purchaser’s PIP ELSSG02-D Data Sheet, an ammeter shall be provided in the space heater circuit. A normally closed momentary test push button shall be installed in series with the ammeter to allow testing of the space heater.

4.7.9.8 If specified on purchaser’s PIP ELSSG02-D Data Sheet, include access to internal heater from outside the shipping container.

4.7.9.9 The following devices shall be provided for all circuit breakers specified as motor starters:

   a. Where motor space heater power is supplied from the switchgear, a circuit breaker shall be provided in the control compartment for each motor space heater. Circuit breaker shall provide protection for each ungrounded conductor and shall have provisions for locking in the open position.

   b. Unless otherwise specified on the purchaser’s PIP ELSSG02-D Data Sheet, one analog ammeter in each motor space heater circuit to monitor circuit continuity shall be provided.

   c. An auxiliary relay to energize the motor space heater when the breaker is open or in the disconnected position. The relay shall be controlled by the breaker MOC contact with a normally closed relay contact in the motor space heater circuit.

   d. One test switch to momentarily test the motor space heater circuit with the motor running shall be provided.

   e. If specified on the purchaser’s PIP ELSSG02-D Data Sheet, a motor space heater circuit current monitoring relay shall be provided.

4.8 Finish

4.8.1 The inside of the switchgear control compartment shall be coated (paint) as specified on the purchaser’s PIP ELSSG02-D Data Sheet.

4.8.2 Unless otherwise specified on the purchaser’s PIP ELSSG01D Data Sheet, finish color for switchgear shall be ANSI 61 light gray in accordance with ASTM D1535-08 (Munsell notation 8.3.G6.10/0.54).
4.8.3 The switchgear structure’s metal components shall be painted separately before assembly.

4.8.4 The finish coat shall be free from craters, pinholes, holidays, embedded foreign matter, and other visual defects.

4.8.5 The finish coat shall provide complete hiding, consistent coverage and thickness, and uniform color.

4.8.6 Supplier shall submit the following information at proposal:
   a. Painting procedure used
   b. Dry-film thickness (DFT) type test in accordance with ASTM D3363
   c. Pencil hardness type-test in accordance with ASTM D3363
   d. Results of ASTM B117 Salt Spray Type-Test, indicating the duration of the test
   e. Impact type-test in accordance with ASTM D2794

4.8.7 Touch up paint shall be provided as indicated on the purchaser’s PIP ELSSG02-D Data Sheet.

4.9 Test and Inspection

4.9.1 Design Tests

Copies of Certified Reports of all design tests described in IEEE C37.20.2, shall be available for review by the purchaser upon request.

4.9.2 Production Tests

4.9.2.1 The supplier shall submit with proposal, a detailed testing plan outlining mechanical inspections and tests to be performed.

4.9.2.2 The entire switchgear must be electrically and mechanically assembled into one single line-up prior to final testing, inspection and shipment.

4.9.2.3 Certified Reports of all production tests described in IEEE C37.20.2, shall be provided.

4.9.2.4 If specified on the purchaser’s PIP ELSSG02-D Data Sheet, the control wiring insulation test shall be performed by applying 1500 volts to ground, 60 Hertz for 1 minute.

4.9.2.5 All control and protective circuits of breakers shall be checked for functional operation, which shall verify the correctness of wiring.

4.9.2.6 All polarity verification shall be performed using primary injection.

4.9.2.7 If specified on purchaser’s PIP ELSSG02-D Data sheet, partial discharge testing shall be performed in accordance with IEEE C37.20.2-2015 Annex C.

4.9.3 To meet conformance requirements, all assemblies shall successfully pass all tests described above.

4.9.4 The purchaser reserves the right to observe the manufacturing, fabrication, or any part of work which concerns the subject equipment, inspect materials documents
and manufacturing operations, witness the final test, and evaluate results of nondestructive examinations. Requirements for witness testing shall be as specified on the purchaser’s *PIP ELSSG02D* Data Sheet.

4.9.5 The purchaser or purchaser’s inspector shall be provided with free plant access and suitable facilities. Supplier shall notify purchaser at least two weeks before scheduled testing.

4.10 Nameplates

4.10.1 Safety signs (nameplates) and labels shall be in accordance with *ANSI Z535.4*.

4.10.2 Permanent engraved lamacoid nameplates shall be provided identifying each compartment front mounted relays, instruments and devices, including transformers, circuit breaker, and auxiliary compartment.

4.10.3 Equipment and terminal blocks within the compartments shall be suitably identified.

4.10.4 All nameplates, internal and external, shall be made of laminated plastic at least 3/32 inch (2.4 mm) thick.

4.10.5 Unless otherwise specified on the purchaser’s *PIP ELSSG02-D* Data Sheet, nameplates shall be mounted with self-tapping stainless screws.

4.10.6 A caution plate, as shown below, shall be provided on the door of each cubicle that contains devices such as VTs connected to the line side of the incoming main breaker:

```
CAUTION
EQUIPMENT NOT DE-ENERGIZED BY MAIN BREAKER
```

4.10.7 All devices inside the cubicles shall be identified with engraved lamacoid nameplates mounted with stainless steel screws. Adhesive-backed plastic labels shall not be permitted.

4.10.8 A stainless steel nameplate showing supplier’s name, type and identification number, year of manufacture, continuous current rating, interrupting rating in amperes, and maximum voltage rating shall be provided on each circuit breaker and switchgear assembly. Lineup nameplate shall also include ratings based in site conditions, as well as bus bracing in kA (symmetrical and asymmetrical) along with the description of arc-resistant type construction, if applicable.

4.10.9 Nameplates shall be of following background color and engraving:

a. Identification nameplates – White background with black engraving
b. Caution nameplates – Yellow background with black engraving
c. Warning nameplates – Red background with white engraving
d. Grounding VTs and devices – Green background with white engraving

4.10.10 The supplier shall provide a 6 inch by 6 inch (150 mm by 150 mm) blank space on cubicle doors for installation of arc flash warning labels by the purchaser.
4.10.11 If specified on the purchaser’s PIP ELSSG02-D Data Sheet, a mimic bus shall be included on the front doors of the switchgear.

4.10.11.1 As a minimum, it shall show buswork, circuit breakers, supply sources, load designations, voltage transformers, and current transformers.

4.10.11.2 If breaker control switches are located on the doors, they shall be beside the breaker symbol.

4.10.11.3 Devices shall be labeled using engraved laminated plastic.

4.10.11.4 The mimic buswork and components shall be attached with stainless steel screws.

4.10.12 All vertical section rear compartments shall have a nameplate indicating section number and service description.

4.11 Documentation

4.11.1 Documentation Content

4.11.1.1 Drawings for each lineup of the switchgear shall have a unique number provided by the purchaser.

4.11.1.2 Drawings shall have a space on the right hand bottom corner for the purchaser’s title block.

4.11.1.3 Schematic drawings shall include the following information as a minimum:

   a. Complete schematic diagram with item numbers corresponding to bill of materials
   b. Operation and contact arrangement of over-current and control relays, and all switches
   c. Contact position of all components in shelf (normally de-energized) position
   d. Cross-reference to bill of materials and other drawings

4.11.2 Drawing and Data Requirements

4.11.2.1 Unless otherwise specified on the purchaser’s PIP ELSSG02-D Data Sheet, one electronic set of documents, including operating manuals, in Adobe PDF format shall be provided.

4.11.2.2 Unless otherwise specified on the purchaser’s PIP ELSSG02-D Data Sheet, final certified and as-built drawings shall be submitted in DWG format and Adobe PDF format.

4.11.2.3 Drawings and data requirements shall be as shown in Table 1.
### Table 1. Documentation Requirements

<table>
<thead>
<tr>
<th>A</th>
<th>B For Review</th>
<th>C Final Certified</th>
<th>D As Built</th>
<th>Description</th>
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<tbody>
<tr>
<td>X</td>
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<td>Bill of materials giving schematic identification, quantity, make, rating, model, and manufacturer of component</td>
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<td>Extended warranty information</td>
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<td>Proposed layout of equipment, showing estimated dimensions, weights and required aisle clearances</td>
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<td>Proposed infrared view port information including manufacturer and model</td>
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<td>Seismic compliance report and derating factors where applicable</td>
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<td>Priced accessories list</td>
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<td>Proposed Switchgear Assembly finish information</td>
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<td>Proposed Detailed Testing Plan</td>
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<td>Equipment drawings, showing floor plans and support channel locations and tolerances, front view elevations, relay and control device panel layouts, typical sectional views. Drawings shall show all locations of all equipment and devices.</td>
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<tr>
<td>X</td>
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<td>Installation drawings, showing dimensions and weights of all shipping sections and location and type of all interconnections between shipping splits, and transitions such as to bus ducts or cable bus.</td>
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<tr>
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<td>Connection wiring diagrams for all electrical equipment</td>
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<td>3-line, and control schematic diagrams</td>
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<td>Certified Test Reports</td>
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<td>Installation, Operation, and Maintenance Manual</td>
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<td>Complete parts list</td>
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<td>Recommended spare parts list with pricing</td>
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**Notes:**

A. These documents shall be provided with the proposal.
B. These documents shall be provided for the 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. The final as-built documents shall be provided within 2 weeks following shipment.
4.12 Shipment

4.12.1 Details on shipping requirements and site storage conditions shall be furnished in the purchase order.

4.12.2 All temporary shipping braces shall be painted yellow and marked, as shown below.

REMOVE BEFORE EQUIPMENT IS PLACED IN SERVICE

4.12.3 Instructions for storage of equipment shall be attached to the outside of the equipment packaging.

4.12.4 Field assembly materials and parts shall be clearly identified with proper description and location of installation, and shall be shipped inside one or more of the cubicles. The cubicle(s) shall be clearly marked as containing these materials.

4.12.5 Equipment shall be protected from weather elements during shipping.

4.12.6 One set of installation, operation, and maintenance manuals shall be shipped with the equipment.

4.12.7 All breakers shall be shipped separately and shall be clearly identified with proper description and location of installation. If specified on the purchaser’s PIP ELSSG02-D Data Sheet, breakers shall be in weather-tight packaging, suitable for outdoor storage.

4.12.8 If specified on purchaser’s PIP ELSSG02-D Data Sheet, impact recorder shall be provided.

4.13 Conflict Resolution

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

a. Purchase order
b. One-line diagram and associated documents
c. PIP ELSSG02-D Data Sheet
d. This Practice, PIP ELSSG02
e. Referenced standards
## Service Conditions (4.1):

- **Ambient Temperature:** Max: 40 °C, Min: -30 °C, Humidity: 0-95%
- **Altitude:** 1000 M
- **Pollution Level:** Light
- **Seismic Design:** Required
- **Site Location:** Latitude: __________, Longitude: __________
- **Risk Category:** X
- **Seismic Certificate:** Required
- **Exposed to a Moist/Moderate Corrosive Environment**
- **Site Environmental Data Sheet Attached**
- **Other:**

## Ratings & System Parameters (4.2.1):

- **Volts:** __________ kV, Phase: __________, Hertz: 60 Hz
- **System Grounding:** Solid, Ungrounded, High Resistance, Low Resistance
- **Ground Fault Current:** __________ Amps
- **Available Fault Current:** __________ kA Asymmetrical, X/R Ratio: __________
- **Main Bus Continuous Current Rating:** __________ Amps
- **One Line Diagram:**
- **Other:**

## Table

<table>
<thead>
<tr>
<th>No.</th>
<th>Date</th>
<th>Revision Description</th>
<th>By</th>
<th>Approved</th>
</tr>
</thead>
</table>
ITEM TAG NO.:  JOB NO.:  REV. DATE:

SWITCHGEAR ASSEMBLY (4.3.1):
- ENCLOSURE (4.3.1.4):  X  NEMA 1  NEMA 3R PER PIP ELSSG12
- INCOMING & TIE BREAKER SECTION VT COMPARTMENT (4.3.1.10):  NOT PERMITTED  PERMITTED
- FEEDER BREAKER CONFIGURATION (4.3.1.11):  ONE HIGH  TWO HIGH
- VIEW WINDOWS: (4.3.1.14):  REQUIRED  NOT REQUIRED
- IR VIEWER PORTS REQUIRED (4.3.1.16) TYPE:
- PARTIAL DISCHARGE SENSORS REQUIRED (4.3.1.17) TYPE:
- FIXED THERMAL SENSORS REQUIRED (4.3.1.18) TYPE:
- GUARDS: (4.3.1.21) REQUIRED  NOT REQUIRED
- ASSEMBLY UL LABELED (4.3.1.23):  REQUIRED  NOT REQUIRED
- OTHER:

POWER CABLE TERMINATIONS (4.3.2):
- POWER CABLE ENTRY (4.3.2.3):  TOP  BOTTOM  OTHER:
- CABLE LUGS (4.3.2.5):  BY PURCHASER  BY SUPPLIER
- INSULATING BOOTS (4.3.2.6):  BY PURCHASER  X  BY SUPPLIER
- CABLE BARRIERS (4.3.2.7):  REQUIRED  NOT REQUIRED
- OTHER:

BUS TERMINATIONS (4.3.3):
- BUS DUCT (4.3.1):  REQUIRED  NOT REQUIRED
- CABLE BUS (4.3.2):  REQUIRED  NOT REQUIRED
- OTHER:

ARC-RESISTANT ADDITIONAL REQUIREMENTS (4.4):
- ARC-RESISTANT DESIGN (4.4.1):  REQUIRED  NOT REQUIRED
- ARC-RESISTANT CONSTRUCTION TYPE (4.4.3):  TYPE 2B  OTHER:
- BREAKER DOOR INTERLOCKS (4.4.10):  X  REQUIRED  NOT REQUIRED
- SINGLE HAND LATCH (4.4.16):  REQUIRED  NOT REQUIRED
- EXHAUST SYSTEM DESIGN (4.4.14):  PLENUM SYSTEM  EXHAUST TO ROOM
- OTHER:

POWER CIRCUIT BREAKERS (4.5):
- INTERRUPTING RATING (4.5.2):  kA SYMMETRICAL
- CLOSE & LATCH CURRENT (4.5.2):  kA
- SUPPORTS (4.5.3):  X  EPOXY  GLASS POLYESTER
- TOC AND MOC (4.5.11.b):  NORMALLY OPEN CONTACTS: 4  NORMALLY CLOSED CONTACTS: 4
- CONTROL VOLTAGE (4.5.12):  X  125 VDC  OTHER:
- DUAL TRIP COILS FOR ALL BREAKERS (4.5.13):  REQUIRED  NOT REQUIRED
- DUAL TRIP COILS FOR GENERATOR BREAKERS (4.5.13):  X  REQUIRED  NOT REQUIRED
- ACCESSORIES IN SECTION (4.5.15):  REQUIRED  NOT REQUIRED
- OTHER:
**POWER BUS (4.6.1):**
- BUS LABELED WITH PHASE LETTERS (4.6.1.2): [ ] REQUIRED [ ] NOT REQUIRED
- BUS (4.6.1.4): [ ] SILVER PLATED [ ] TIN PLATED
- BUS INSULATORS (4.6.1.5): [ ] PORCELAIN [ ] CYCLOALIPHATIC EPOXY

**MAINTENANCE GROUNDING PROVISIONS (4.6.3):**
- GROUND & TEST DEVICES (4.6.3.4): [ ] REQUIRED [ ] NOT REQUIRED
- [ ] MANUAL [ ] ELECTRICAL

**REMOTE CONTROL OF CIRCUIT BREAKERS (4.7.2):**
- REMOTE CONTROL PROVISIONS (4.7.2.1): [ ] REQUIRED [ ] NOT REQUIRED
- CORD LENGTH (4.7.2.3.a): X 25 FT. [ ] FT.
- SPARE CONTROL STATION (4.7.2.3.b): [ ] REQUIRED [ ] NOT REQUIRED
- HUMAN MACHINE INTERFACE (4.7.2.4): [ ] REQUIRED [ ] NOT REQUIRED

**POWER & CONTROL DEVICES AND WIRING (4.7.3):**
- WIRE TERMINATIONS (4.7.3.1.e): X LOCKING FORK [ ] RING TYPE
- POWER & CONTROL WIRE INSULATION COLOR (4.7.3.1.f): X MFG. STD. [ ] GRAY [ ] OTHER: 
- DIFF. CKT. CT TERMINALS AT SHIPPING SPLITS (4.7.3.3): X TERMINALS REQUIRED
- GROUND WIRE INSULATION COLOR (4.7.3.4): X GREEN [ ] MFG. STD. [ ] OTHER: 
- WIRE TAGS WITH ORIGIN AND DESTINATION POINT (4.7.3.7): X REQUIRED [ ] NOT REQUIRED
- FUSE INDICATOR LIGHT REQD. (4.7.3.10.a) [ ] FUSE INDICATOR NC CONTACT REQD. (4.7.3.10.b)
- DIFFERENTIAL CT WIRE COLOR (4.7.3.11): X MFG. STD. [ ] RED/BLUE/YELLOW

**VOLTAGE TRANSFORMERS (4.7.4):**
- VT VOLTAGE RATING (4.7.4.1.a): 
- CONFIGURATION (4.7.4.1.b): [ ] WYE [ ] OPEN DELTA [ ] OTHER: 

**OTHER:**
- [ ] ASSOC. PIP
- [ ] ELSSG02
- [ ] DATA SHEET
- [ ] ELSSG02-D
- [ ] MEDIUM-VOLTAGE
- [ ] SWITCHGEAR
- [ ] PAGE 3 OF 6
- [ ] AUGUST 2017
### INSTRUMENTS, METERS, CONTROL DEVICES & INDICATOR LIGHTS (4.7.7):

<table>
<thead>
<tr>
<th>Item</th>
<th>Required/Not Required</th>
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<tbody>
<tr>
<td>Breaker Control Switch (4.7.7.1.e)</td>
<td>X Required</td>
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<tr>
<td>Local-Remote Control Switch (4.7.7.1.f)</td>
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</tr>
<tr>
<td>Trip Circuit Monitoring (4.7.7.3)</td>
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<tr>
<td>Test Switch Color (4.7.7.4)</td>
<td>MFG. STD.</td>
</tr>
<tr>
<td>Microprocessor-Based Monitoring Devices (4.7.7.5)</td>
<td>Not Required</td>
</tr>
<tr>
<td>Space Heater Ammeters (4.7.7.5)</td>
<td>X Required</td>
</tr>
<tr>
<td>Control Switches (4.7.7.6)</td>
<td>MFG. STD.</td>
</tr>
<tr>
<td>Voltmeter</td>
<td>Four Position</td>
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<tr>
<td>Ammeter</td>
<td>Four Position</td>
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<tr>
<td>Control Circuit Undervoltage Monitoring (4.7.7.9)</td>
<td>Not Required</td>
</tr>
<tr>
<td>Metering (4.7.7.9)</td>
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<tr>
<td>Metering Communication (4.7.7.9.1)</td>
<td>Not Required</td>
</tr>
<tr>
<td>Communication Connection Type</td>
<td>4-20 mA</td>
</tr>
<tr>
<td>Other</td>
<td>RS485</td>
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<tr>
<td>Protocol</td>
<td>Fiber Optic</td>
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**Additional Requirements:**

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<th>Color</th>
<th>Purpose</th>
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**Test Switch Color (4.7.7.4):**

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<tr>
<th>Current</th>
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<tbody>
<tr>
<td>Voltage</td>
<td>MFG. STD.</td>
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**Microprocessor-Based Monitoring Devices (4.7.7.5):**

- MFG.: Model:
  - Voltmeter
  - Ammeter
  - Watt Transducer
  - Wattmeter
  - Demand Meter Interval: 15 Min. 30 Min. Other:
  - Other:

**Control Power (4.7.7.9.5):**

- Other:

**Control Communication (4.7.7.9.7):**

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<tr>
<th>Communication Connection Type</th>
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<td>Other</td>
<td>Other:</td>
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</table>

**Other:**

- Other:
**PROTECTIVE RELAYING (4.7.8):**
- Remote Monitoring Provisions (4.7.8.5):
  - Required
  - Not Required
- Communication Connection Type:
  - RS485
  - CAT 6
  - Fiber
  - Other:______________
- Protocol:______________
  - Other:______________

**SPACE HEATERS (4.7.9):**
- Vertical Sections (4.7.9.1): X Required
- Externally Powered (4.7.9.2): X By Purchaser
- Rated Volts: 240 VAC
- Operating Volts: 120 VAC
- Rated Ampacity:______________
- Controlled By (4.7.9.6):
  - Thermostat
  - Humidistat
  - Not Required
  - Other:______________
- Ammeter (4.7.9.7):
  - Required
  - Not Required
  - Other:______________
- Access to Internal Heater (4.7.9.8):
  - Required
  - Not Required
  - Other:______________
- Motor Starter Breakers (4.7.9.9):
  - Motor Space Heater Power Source (4.7.9.9.a):
    - Switchgear
    - Other:______________
  - Motor Space Heater Ammeters (4.7.9.9.b):
    - X Required
    - Not Required
  - Motor Space Heater Current Monitoring Relay (4.7.9.9.e):
    - Required
    - Not Required
    - Other:______________

**FINISH (4.8):**
- Interior Finish Color (4.8.1):
  - MFG. STD.
  - White
  - Other:______________
- Exterior Finish Color (4.8.2):
  - ANSI 61 Gray
  - MFG. STD.
  - Other:______________
- Touch Up Paint (4.8.7):
  - Required
  - Not Required
  - One Pint Aerosol Can Qty:______________
  - One Quart Can Qty:______________
  - Other:______________

**TESTING AND INSPECTION (4.9):**
- Control Wiring Insulation Test (4.9.2.4):
  - Required
  - Not Required
- Partial Discharge Testing (4.9.2.7):
  - Manufactures Std.
  - Other:______________
  - Witnessed
  - Not Witnessed
  - Certified Test Reports:
    - X Required
    - Not Required
    - Other:______________
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<tr>
<td>NAMEPLATES (4.10):</td>
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<tr>
<td>NAMEPLATE MOUNTING (4.10.5):</td>
<td>X SELF-TAPPING SCREWS</td>
<td>OTHER:</td>
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<tr>
<td>COLOR:</td>
<td>X BLACK LETTERING / WHITE BACKGROUND</td>
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<td>MIMIC BUS REQUIRED (4.10.11):</td>
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<td>DOCUMENTATION (4.11.2):</td>
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<tr>
<td>ELECTRONIC DOCUMENT FORMAT:</td>
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<td>SHIPMENT (4.12):</td>
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<td>BREAKERS PACKAGED FOR OUTDOOR STORAGE (4.12.7):</td>
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<td>SUPPLIERS STD PREPARATION</td>
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<td>IMPACT RECORDER (4.12.8):</td>
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