PIP ELSSG01
Design and Fabrication of Low-Voltage Metal-Enclosed AC Power Circuit Breaker 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.

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1. **Scope**

This Practice describes the requirements for metal-enclosed power switchgear assemblies employed in three-phase AC electrical systems having a voltage not greater than 1000 volts and located in a nonclassified area.

2. **References**

Applicable parts of the following Practices and industry codes and standards 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 ELSGS01 - *Design and Fabrication of High-Resistance Grounding System (600 Volts or below)*
- PIP ELSGS01D - *Data Sheet for Design and Fabrication of High-Resistance Grounding System (600 Volts or below)*
- 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 Materials (ASTM)
  - ASTM D1535-08 - *Standard Practice for Specifying Code by the Munsell System*
- American Society of Civil Engineers
  - ASCE/SEI 7 - *Minimum Design Loads for Building and Other Structures*
- Institute of Electrical and Electronic Engineers (IEEE)
  - IEEE C37.13 - *Standard for Low-Voltage AC Power Circuit Breakers Used in Enclosures*
  - IEEE C37.16 - *Standard for Preferred Ratings, Related Requirements, and Application Recommendations for Low Voltage AC (635 V and below) and DC (3200 V and below) Power Circuit Breakers*
  - IEEE C37.17 - *Standard for Trip Systems for Low Voltage (1000V and below) AC and General Purpose (1500 V and below) DC Power Circuit Breakers*
  - IEEE C37.20.1 - *Standard for Metal-Enclosed Low-Voltage Power Circuit-Breaker Switchgear*
3. Definitions

arc resistant: Equipment designed to withstand the effects of an internal arcing fault, in accordance with the test requirements of IEEE 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 low voltage metal-enclosed switchgear shall be used

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 low-voltage metal-enclosed AC power circuit breaker switchgear

self-tapping thread forming screw: Removes no material when installed, displaces material

self-tapping thread cutting screw: Removes material when installed

4. Requirements

4.1 Service Conditions

4.1.1 Unless otherwise specified on the purchaser’s PIP ELSSG01D Data Sheet, equipment shall be designed to perform satisfactorily under the following ambient conditions:

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

b. Altitude of installation is not greater than 1000 m (3300 feet)

c. Humidity within the limits of 0 - 95% non-condensing

4.1.2 If specified on the purchaser’s PIP ELSSG01D Data Sheet, electrical components and their support to the site’s structure shall meet the seismic design requirements of ASCE/SEI 7 for nonstructural components. Unless otherwise specified on the purchaser’s PIP ELSSG01D Data Sheet the following shall apply if seismic design is required:

a. Risk Category IV

b. Component Importance Factor (IP) of 1.5
c. Site Class D

4.1.3 Electrical system parameters shall be as shown on the attached purchaser’s PIP ELSSG01D Data Sheet.

4.1.4 External power connections to the low voltage switchgear shall be as shown on the purchaser’s one-line diagram(s).

4.2 Switchgear Design

4.2.1 The switchgear shall consist of metal-enclosed freestanding self-ventilated vertical steel structures containing power buses, a ground bus, low-voltage power circuit breakers, auxiliary control devices, and other items in accordance with the attached purchaser’s PIP ELSSG01D Data Sheet, one-line diagram(s) and, when supplied additional project related documentation.

4.2.2 The switchgear shall be designed such that:

a. Breakers can be tripped and closed with the doors closed.

b. During closed-door breaker racking there is an externally visible mechanical indicator of breaker position (racked in, test, racked out).

c. There is an externally visible mechanical indicator of breaker status (tripped, closed) with the door closed.

4.2.3 All enclosures shall be fabricated from freestanding steel frames, steel panels, and doors to provide a strong and rigid structure. The design shall permit the switchgear to be rolled across a floor on pipes or other means without causing the structure to deform or otherwise be damaged.

4.2.4 Internal and external panels shall have minimum metal thickness in accordance with IEEE C37.20.1.

4.2.5 Unless otherwise specified on the purchaser’s PIP ELSSG01D Data Sheet, enclosures shall be NEMA Type 1.

4.2.6 Outdoor switchgear installations shall be in accordance with PIP ELSSG12.

4.2.7 Maximum number of feeder circuit breakers in each vertical section shall be as indicated in the purchaser’s PIP ELSSG01D Data Sheet.

4.2.8 All bolted doors and removable panels shall be secured with captive slotted fasteners, machine screws, or machine bolts engaging captive nuts or tapped holes in structural members. For panels that are not removed for regular maintenance, self-tapping thread forming screws in structural members can be used. All fasteners shall employ vibration-resistant devices. Self-tapping thread cutting screws shall not be permitted.

4.2.9 Unless otherwise specified on the purchaser’s PIP ELSSG01D Data Sheet, rear access to cable compartments shall be by removable panels.

4.2.10 Removable panels shall:

a. Have two lifting handles per panel

b. Be either full height or split, as specified on the purchaser’s PIP ELSSG01D Data Sheet.
c. Be provided with a means to support the weight of the panel during removal and installation of the panel fasteners.

4.2.11 If rear access doors are specified on the purchaser’s PIP ELSSG01D Data Sheet, they shall be full height, bolted, and have provisions for padlocking.

4.2.12 All doors shall have hinges. The hinges may be either continuous or separate. If separate hinges are used, a minimum of three hinges shall be provided on full height doors.

4.2.13 Provisions shall be made for the addition of vertical sections with future breakers at open ends of the line-up. This shall include removable plates or side sheets furnished on the end of vertical sections.

4.2.14 Breaker compartment doors shall have door handle latches and shall remain closed when racking the breaker to any of three positions: disconnected, test or connected. Breaker compartment doors shall not have ventilation louvers.

4.2.15 Provisions shall be made for padlocking breakers in the test and disconnected positions. Padlocking shall not interfere with removal or operation of the breaker or its mechanism.

4.2.16 If specified on the purchaser’s PIP ELSSG01D Data Sheet, an interlock shall be provided to prevent opening of the breaker compartment door unless the breaker is in the disconnect position. This interlock shall have an override mechanism for authorized entry.

4.2.17 Interlocks shall prevent moving the breaker to or from the operating position unless its main contacts are in the open position. As a further safety precaution, the operating springs shall be discharged automatically when a breaker is rolled fully into the compartment or is moved into the disconnect position.

4.2.18 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 specified ampere rating without shutdown of the switchgear.

b. 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.

c. Unequipped spaces shall be provided with doors but without other equipment for future use except the power stabs. Unequipped spaces shall not be used for mounting control switches and other auxiliary equipment.

d. Power stabs, both line and load side, shall be provided with covers to prevent accidental contact with live parts when door is opened.

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

4.2.19 Unless otherwise specified on the purchaser’s PIP ELSSG01D Data Sheet, shutters shall be provided to automatically isolate the primary line and load disconnects as the breaker is removed from the connected position. Shutters shall
be nonmetallic. The line and load shutters shall operate by movement of the circuit breaker truck or racking mechanism. The shutters shall also be capable of being operated by hand with the breaker removed from the cell.

4.2.20 If uninsulated buses are specified in Section 4.5 of this practice, removable vertical barriers shall be provided in the rear cable compartments to prevent accidental contact of personnel with all energized buses. The barriers shall not cover load connections.

4.2.21 All components operating at voltages above 240V shall be guarded and insulated.

4.2.22 Sheet steel barriers shall be provided between power and control compartments.

4.2.23 Unless otherwise specified on the purchaser’s PIP ELSSG01D Data Sheet, full height and depth barriers shall be provided between adjacent vertical sections in the rear load terminal compartments.

4.2.24 If specified on the purchaser’s PIP ELSSG01D Data Sheet, sheet steel barriers shall be provided between breaker compartments in vertical sections.

4.2.25 Unless otherwise specified on the purchaser’s PIP ELSSG01D Data Sheet, enclosure vent openings shall be provided with stainless steel screens having a maximum opening size of 1/16 inch (1.6 mm).

4.2.26 Breaker control and charging motor power shall be as specified on the purchaser’s PIP ELSSG01D Data Sheet.

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

4.2.28 A remote racking device to electrically rack the breaker shall be provided if specified on the purchaser’s PIP ELSSG01D 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.

4.2.29 If specified on the purchaser’s PIP ELSSG01D Data Sheet, thermography windows shall be provided. Location of windows shall be as specified on the purchaser’s PIP ELSSG01D Data Sheet.

4.2.30 If specified on the purchaser’s PIP ELSSG01D Data Sheet, fixed thermal sensors and associated equipment shall be provided.

4.2.31 If specified on the purchaser’s PIP ELSSG01D Data Sheet, the switchgear assembly shall be UL 1558 labeled.

4.3 Additional Requirements for Arc-Resistant Switchgear

If specified on the purchaser’s PIP ELSSG01D Data Sheet, the switchgear shall be arc-resistant design as described below:
4.3.1 Switchgear shall be tested in accordance with IEEE C37.20.7.

4.3.2 Unless otherwise specified on the purchaser’s PIP ELSSG01D Data Sheet, Switchgear shall be arc-resistant construction Type 2B.

4.3.3 A written certificate of successful type testing, including all the parameters used in the testing, shall be submitted to the purchaser. Testing shall be based on prospective current of the highest rated circuit breaker without insertion of any current limiting device in the test circuit.

4.3.4 Switchgear shall be designed for closed door racking. Arc-resistant integrity shall be maintained during closed door racking.

4.3.5 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 can prevent openings from closing.

4.3.6 Unless otherwise specified on the purchaser’s PIP ELSSG01D 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

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

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

4.3.9 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.

4.3.10 Personnel shall be protected from arc products and noise expelled from the switchgear enclosure. Unless otherwise specified on the purchaser’s PIP ELSSG01D Data Sheet, a plenum system shall be provided as described below:
   a. Plenum system shall exhaust arc products from the switchgear room.
   b. Exhaust outlet shall be weatherproof and directed to an area that minimizes personnel exposure.
   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.

4.4 Power Circuit Breakers

This section defines general requirements for Main breakers, Tie Breakers, and Feeder Breakers. The PIP ELSSG01D Data Sheet contains separate sections that define the specific requirements for each breaker type.
4.4.1 Low-voltage power circuit breakers shall be air break type and shall be designed, rated, manufactured, and tested in accordance with IEEE C37.13, IEEE C37.16, IEEE C37.17, and ANSI/NEMA C37.50.

4.4.2 Breakers shall be of the stored-energy type with draw-out construction for both power and control circuits.

4.4.3 Unless otherwise specified on the purchaser’s PIP ELSSG01D Data Sheet interchangeability of breakers must be maintained. All breakers of like ratings shall be able to be installed in any cubicle with the same rating in the switchgear.

4.4.4 Breakers shall be three-pole unless otherwise specified on the purchaser’s PIP ELSSG01D Data Sheet.

4.4.5 Breakers shall be operated electrically or manually as specified on the purchaser’s PIP ELSSG01D Data Sheet. Electrically operated breakers shall also be capable of manual operation.

4.4.6 Circuit breakers shall have continuous current ratings as specified on the purchaser’s PIP ELSSG01D Data Sheet. Ratings shall not be dependent upon the use of cooling fans. Ratings stated are those when installed and working under the service conditions as specified in Section 4.1.

4.4.7 Unless otherwise specified on the purchaser’s PIP ELSSG01D Data Sheet, circuit breaker shall have a maximum interrupting time of 5 cycles, excluding sensing mechanism time.

4.4.8 Circuit breaker shall have interrupt rating as specified on the purchaser’s PIP ELSSG01D Data Sheet.

4.4.9 If required, current-limiting fuses shall be provided to extend the breaker rating and shall cause the breaker to trip if any of the fuses operate. The purchaser shall be notified if these fuses are required.

4.4.10 Each low-voltage power circuit breaker or each breaker in combination with current-limiting fuses shall be capable of interrupting the available short-circuit current in accordance with the purchaser’s PIP ELSSG01D Data Sheet.

4.4.11 Closing and tripping circuits shall be individually protected by fuses. If specified on the purchaser’s PIP ELSSG01D Data Sheet other control and indication circuits (such as breaker trip indication) shall be individually protected by fuses.

4.4.12 Sensor/solid state protective devices shall be provided with a method of easily changing ratings by way of sensor taps or other means, such as breaker ampere rating plugs, so a breaker continuous rating can be changed for alternate service. Vendor shall provide details of the method to be employed with the proposal.

4.4.13 Laminated plastic nameplates shall be provided above lights defining function and above group of lights and switch to indicate service of breaker.

4.4.14 Unless otherwise specified on the purchaser’s PIP ELSSG01D Data Sheet, direct-acting overcurrent trip devices shall be solid state RMS sensing, and shall incorporate time delay characteristics and under voltage trip as specified on the purchaser’s PIP ELSSG01D Data Sheet.

4.4.15 The trip device display shall be visible with the cubicle door closed and shall have trip indication.
4.4.16 The circuit breakers shall be equipped with secondary self-aligning disconnecting contacts which automatically engage in the housing sockets in the operating and test positions. All wiring from the removable breaker to the stationary structure shall pass through these contacts.

4.4.17 Breaker operating controls and indicators shall include mechanical provisions for trip and close, open/close indicator, and charge/dischARGE indicator. The open/closed indicator(s) shall be visible from the front of the equipment when the breaker is in the operating or disconnected/test position(s).

4.4.18 An operations counter shall be furnished for any breaker if specified on the purchaser’s PIP ELSSG01D Data Sheet.

4.4.19 The physical position of the breaker: connected, test, or disconnected, shall be indicated and clearly visible with the cubicle door closed.

4.4.20 Circuit breakers shall be operated by a mechanically and electrically trip-free stored energy system with provisions for manual charging. Breaker operation shall be anti-pumping. Unless otherwise specified on the purchaser’s PIP ELSSG01D Data Sheet, the stored energy system shall be electrically charged using a spring charging motor.

4.4.21 If specified on the purchaser’s PIP ELSSG01D Data Sheet, all circuit breakers shall be equipped with under-voltage trip coil.

4.4.22 Unless otherwise specified on the purchaser’s PIP ELSSG01D Data Sheet, spare auxiliary contacts shall be provided as follows: four mechanism operated contacts (MOCs) and four truck operated contacts (TOCs) shall be provided as two normally open (N.O.) and two normally closed (N.C.) each, all of which shall be wired out to terminal blocks so they can be easily accessed for test purposes.

4.4.23 As specified on the purchaser’s PIP ELSSG01D Data Sheet, each electrically operated circuit breaker shall be controlled (open-close) by a switch located on the breaker cubicle door or group-mounted with other breaker switches on an auxiliary compartment door.

4.4.24 If specified on the purchaser’s PIP ELSSG01D Data Sheet, remote control to open/close electrically operated circuit breaker shall be provided. Manufacturer to wire to field wiring terminal blocks.

4.4.25 If specified on the purchaser’s PIP ELSSG01D Data Sheet, remote indication of electrically operated circuit breaker shall be provided. Manufacturer to wire to field wiring terminal blocks.

4.4.26 If specified on the purchaser’s PIP ELSSG01D Data Sheet, provision to remotely open and close the circuit breakers shall be provided by a hardwired remote control/mimic panel, human-machine interface (HMI) panel, or hand-held control station.

4.4.27 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.

4.4.28 If specified on the purchaser’s PIP ELSSG01D Data Sheet, a HMI system shall be supplied in accordance with the following minimum functional requirements and any other specification as indicated in purchaser’s PIP ELSSG01D.

   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

4.4.29 If a hand-held control station is specified on the purchaser’s PIP ELSSG01D Data Sheet, the station shall include open and close pushbuttons and heavy duty umbilical cord, minimum 25 feet (7.6 m) in length, with self-aligning plug. The plug shall be able to be connected without the need to open the compartment door.

   a. The control station shall have two guarded pushbuttons, a green button for opening and a red button for closing.

   b. A matching receptacle complete with a threaded cover shall be installed in the breaker compartment door.

4.5 Bus Work

4.5.1 Unless otherwise specified on the purchaser’s PIP ELSSG01D Data Sheet, all bus material shall be copper.

4.5.2 Bus rating shall be as specified on the purchaser’s PIP ELSSG01D Data Sheet. All bus shall be fully rated (non-tapered).

4.5.3 Buses and taps of feeder circuit breakers shall be rated to carry the maximum rating of the breaker, not of the current transformer or sensor rating.

4.5.4 If specified on the purchaser’s PIP ELSSG01D data sheets, the main buses, vertical buses and cable compartments shall be completely isolated from each other.
4.5.5 All horizontal and vertical bus and bus supports shall be designed and braced as specified on the purchaser’s PIP ELSSG01D Data Sheet and in accordance with IEEE C37.20.1.

4.5.6 Unless otherwise specified on the purchaser’s PIP ELSSG01D Data Sheet, all horizontal and vertical bus bars shall be fully insulated with a high dielectric flame retardant nonhygroscopic fluidized bed epoxy insulation system. Sleeve type or heat shrink tubing type insulating systems shall not be permitted.

4.5.7 All bus bar joints shall be covered with formed insulating boots with minimum 1/4-inch (6.4 mm) overlap that allows for ease of inspection of the joint.

4.5.8 The breaker primary disconnect assemblies, including bus and fingers, shall be constructed of copper.

4.5.9 Unless otherwise specified on the purchaser’s PIP ELSSG01D Data Sheet, bolted joints and breaker primary disconnect assembly finger connections shall be tin-plated.

4.5.10 Buses shall be designated by the Letters A-B-C and located A-B-C reading left to right, top to bottom, or front to rear when viewed from the front of the assembly. If specified on the purchaser’s PIP ELSSG01D Data Sheet phasing of buses shall be physically and permanently labeled at all purchaser connection points with a minimum of 1-inch high letters.

4.5.11 The ground bus shall be designed to carry rated short time current of the highest rated device in the assembly for minimum 2 seconds. As a minimum 1/4-inch by 2-inch copper ground bus shall be provided at the rear in the cable termination compartments and for the entire length of the assembly.
   a. The bus shall be drilled at each end for a NEMA two-hole lug.
   b. 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.
   c. If specified on the purchaser’s PIP ELSSG01D Data Sheet, copper compression type lugs shall be provided.
   d. If specified on the purchaser’s PIP ELSSG01D Data Sheet, additional pre-drilled holes shall be provided. Locations of additional holes shall be determined during drawing approval.

4.5.12 The ground bus shall be secured in each vertical section.

4.5.13 Safety ground connections shall be provided if specified on the purchaser’s PIP ELSSG01D Data Sheet.
   a. Each power and neutral bus 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.
   b. The ground clamp cable connection shall be a grounding ball stud with removable insulating cover, mounted as close as possible to each bus cable termination point.

4.5.14 The power buses and ground bus shall be arranged and drilled for future extension.
4.5.15 If a neutral bus is specified on the purchaser’s PIP ELSSG01D Data Sheet, the bus shall extend the full length of the switchgear, be insulated from ground and shall be arranged and drilled for future extension.

4.5.16 Unless otherwise specified on the purchaser’s PIP ELSSG01D Data Sheet, the neutral bus shall have the same continuous current rating as the phase bus.

4.5.17 Neutral bus location shall be as specified on the purchaser’s PIP ELSSG01D Data Sheet.

4.5.18 All bolted power bus connections shall be solidly bolted using silicon-bronze through bolts, nuts and Belleville washers. Use of self-tapping screws or bolts shall not be permitted for power bus connections.

4.5.19 Connections shall be made with a minimum of two bolts.

4.5.20 Bus connections with contact area of 9 square inches or greater (5800 mm²) or 2000 amperes or higher shall have a minimum of four bolts.

4.5.21 All busbar joints shall be fully accessible for field tightening of bolts.

4.5.22 A label shall be posted inside each section listing torque requirements for bolted connections.

4.6 Voltage Transformers

4.6.1 Voltage, configuration, and quantities shall be as specified on the purchaser’s one-line diagram and PIP ELSSG01D Data Sheet.

4.6.2 Voltage transformers (VT) for metering or protective relaying purposes shall be protected by disconnecting-type current-limiting primary fuses.

4.6.3 Transformers and their primary protective fuses shall be located in the same low-voltage control compartment. All components within this compartment shall be guarded and insulated.

4.6.4 Secondary voltage shall be 120 volts line-to-line, with primary voltage line-to-line as specified on the one-line diagram.

4.6.5 Voltage transformers shall be cast resin insulated or approved equal.

4.6.6 Each transformer shall have a fused secondary winding.

a. Secondary fuses shall be located in the low-voltage control compartment.

b. Fuse holders shall be labeled to indicate size and type of fuse and to identify the transformer (e.g., Phase “A” VT).

4.7 Control Power Transformers

4.7.1 Configurations and quantities shall be as specified on the purchaser’s one-line diagram and PIP ELSSG01D Data Sheet.

4.7.2 The primary fuses shall coordinate with the magnetizing inrush current and the secondary protection of the control power transformer (CPT).

4.7.3 The kVA rating of the control power transformer(s) shall be determined, taking into account any additional loads external to the switchgear specified on the purchaser’s PIP ELSSG01D Data Sheet.

4.7.4 A form C contact shall be provided for remote alarming of any loss of control power.
4.7.5 Secondary voltage shall be 240/120 volts single phase, with primary voltage as specified on the one-line diagram.

4.7.6 Primary and secondary windings shall be protected by disconnect-type fuses.

4.7.7 Transformers and their primary protective fuses shall be located in the same low-voltage control compartment. All components within this compartment shall be guarded and insulated.

4.8 Current Transformers

4.8.1 Current transformers (CT) for metering or protective relaying purposes shall be ANSI rated in accordance with purchaser’s PIP ELSSG01D Data Sheet and the one-line diagram.

4.8.2 CT’s shall be window type and installed in a manner that can be readily maintained or replaced.

4.8.3 All CT’s shall be designed to mechanically withstand the short circuit stresses imposed by the rating of the associated circuit breaker for a minimum of two seconds.

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

4.8.5 CT polarity marker shall be visible from the front of the switchgear with shutters open or rear of the switchgear with the door or panel open.

4.8.6 CT’s used for differential schemes shall not be used for other relaying or metering circuits.

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

4.8.8 The secondary side of current transformers shall be grounded on one side through a removable link. Where current transformers are connected in wye, the wye point shall be grounded through a removable link at one point only. Ground connections shall be made at the first terminal (short-circuiting type) block and not at the current transformer.

4.8.9 Where matching current transformers are required to be mounted on other equipment, they shall be provided by supplier.

4.9 Control Devices, Indicating Lights and Metering

4.9.1 If specified on the purchaser’s PIP ELSSG01D Data Sheet, control switches shall be provided. Switches shall be rotary cam type with engraved dial plates. Switch manufacture type shall be as listed on the purchaser’s PIP ELSSG01D Data Sheet unless approved otherwise by the owner and shall meet the following requirements:

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 “pistol grip” handles.
d. Unless otherwise specified on the purchaser’s PIP ELSSG01D Data Sheet, four-position rotary type switches shall be used when voltmeters and/or ammeters are installed.

4.9.2 If grouped breaker control switches are specified on purchaser’s PIP ELSSG01D Data Sheet, indicating lights for the functions specified in Data Sheet shall be located for each breaker directly above this switch. Laminated plastic nameplates shall be provided above lights defining function, and another nameplate above group of lights and switch to indicate service of breaker.

4.9.3 Indicating lights shall be LED lamps with front replaceable lamps and colored caps. The dropping resistor, if required, shall be integral with the lights and not mounted external to the lights. Push to test lights shall be provided if specified on the purchaser’s PIP ELSSG01D Data Sheet.

4.9.4 Test switches to isolate potential and current inputs shall be provided to permit safe removal for calibration and repairs. Unless otherwise specified on the purchaser’s PIP ELSSG01D 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.

4.9.5 If specified on the purchaser’s PIP ELSSG01D Data Sheet, wiring of closed and open lights shall provide the following visual checks of the control circuitry:

a. The closed light on when the breaker is closed indicates trip coil continuity and control power to trip circuit.

b. The open light on when the breaker is open indicates trip circuit control power fuses are not burned out.

4.9.6 If specified on the purchaser’s PIP ELSSG01D Data Sheet, each breaker shall be provided with a Trip Circuit Monitoring (TCM) relay or light.

4.9.7 If switchgear metering shall be provided in accordance with the purchaser’s PIP ELSSG01D Data Sheet, the following applies:

a. Communication capabilities shall be provided if specified on the purchaser’s PIP ELSSG01D Data Sheet.

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

c. If analog-type metering is specified on the purchaser’s PIP ELSSG01D Data Sheet, the meter shall be of the circular 250-degree-scale switchboard type, 1% accuracy, 4-1/2 inch square, and flush mounted.

d. Control power for microprocessor-type metering shall be as specified on the purchaser’s PIP ELSSG01D Data Sheet.

e. Microprocessor metering package shall include the following features:

1. Phase RMS current

2. Phase to neutral RMS voltage
3. Phase to phase RMS voltage
4. Energy reading (kWh)
5. Demand (kW/kVA)
6. Peak demand (kW/kVA)
7. Real power (kW)
8. Reactive power (kVAr)
9. Total power (kVA)
10. Power factor (pf)
11. Peak capacity (% of device rating)
12. Frequency (Hz)
13. Event reporting of a minimum of 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 because of an overcurrent.
14. Total Harmonic Voltage Distortion (THVD)
15. Total Harmonic Current Distortion (THCD)

4.9.8 If specified on the purchaser’s PIP ELSSG01D Data Sheet, control communications through intelligent electronic devices shall be provided.

4.10 Protective Relaying

4.10.1 Relaying shall be as specified on the one-line diagram, on attachments, or as specified on the purchaser’s PIP ELSSG01D Data Sheet as to manufacture, type, quantity, and style numbers.

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

4.10.3 All software and complete documentation shall be provided for configuration, analysis, and monitoring of all protective relays and related auxiliary devices required by the purchaser.

4.10.4 If specified on the purchaser’s PIP ELSSG01D Data Sheet, provisions shall be made for remote monitoring of the equipment operation.

4.10.5 If bus differential protection is specified on the one-line diagram or purchaser’s PIP ELSSG01D Data Sheet, separate protective relays shall be provided.

4.10.6 If specified on the purchaser’s PIP ELSSG01D Data Sheet, trip units shall have two sets of protection parameters. The second set of parameters shall have lower settings in breaker trip unit for use during maintenance activities. Selecting the second set of parameters can be accomplished by using a local switch, remote switch or communication device. Enabling this maintenance mode shall initiate an alarm contact or communication status point.
4.10.7 If specified on the purchaser’s PIP ELSSG01D Data Sheet, trip units shall be equipped with arc flash sensing optics that can be used to operate the breaker and reduce incident energy.

4.10.8 For protective relays that are not integral with the circuit breaker, the following features apply:

a. Shall be mounted on the front of the switchgear panels. They shall be semi flush case mounted. All relays and targets shall be labeled as to function in accordance with identification agreed to at the drawing approval stage.

b. Unless approved by purchaser, it shall be possible to withdraw relays when all circuits are energized without open-circuiting the current transformer secondary’s or causing protective relays to operate.

c. Relays that cannot be withdrawn shall have provisions for testing and calibrating the relay using an external power source without the need to disconnect permanent wiring.

d. Except for solid state relays integral with the breakers, all protective relay functions shall be provided with hand reset flag indicators, which can be reset from the outside without the need to open the relay case. All flag indicators shall be visible from the front of the relay panel without the need to open relay cases or panel doors.

e. Where specified on data sheets or drawings, selected circuit breakers shall have manually reset lockout devices (Device 86) mounted on breaker control doors to prevent circuit breakers from being closed following a trip actuated by protective relays until the lockout relay is manually reset. Each lockout relay shall be furnished with a white indicating light wired to monitor the lockout relay operating coil integrity and trip voltage availability.

4.11 Breaker Interlocking and Transfer Schemes

4.11.1 If a breaker interlocking scheme is specified on the purchaser’s PIP ELSSG01D Data Sheet and one-line diagram, the scheme shall be arranged to operate as specified on the diagram and any supplemental descriptions furnished by the purchaser.

4.11.2 A transfer scheme shall be provided if specified on the purchaser’s PIP ELSSG01D Data Sheet. Unless otherwise specified on purchaser’s PIP ELSSG04 Data Sheet, the transfer scheme shall be in accordance with one-line diagrams and PIP ELSSG04.

4.11.3 A zone interlocking scheme shall be provided if specified on purchaser’s PIP ELSSG01D Data Sheet.

4.12 Space Heaters

4.12.1 Unless otherwise specified on the purchaser’s PIP ELSSG01D Data Sheet, space heaters shall be provided in each vertical section of the assembly to minimize condensation.

4.12.2 Unless otherwise indicated on the purchaser’s PIP ELSSG01D 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.
for purchaser connection. The number and ampacity of external supply circuits
shall be agreed upon with the purchaser.

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

4.12.4 Space heaters shall be bar type, steel jacketed, with rigid terminals, mounted on stand-
off insulators and provided with an expanded metal cage for personnel protection.

4.12.5 Warning label(s) shall be provided on each compartment door which contains
space heaters. Labels shall be laminated plastic with black lettering, a minimum
of ¼ inch high, on an orange background. The label shall read ‘WARNING:
EXTERNAL SPACE HEATER POWER SOURCE’.

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

4.12.7 If specified on the purchaser’s PIP ELSSG01D Data Sheet, space heaters shall be
controlled by a humidistat or thermostat. The humidistat or thermostat shall be
equipped with an ammeter and a test switch as specified. The ammeter shall be
provided with “normal current” range specified on the ammeter scale.

4.12.8 The heaters shall be rated at 240 volts and shall be sized to provide the required
heat output when operated on a 120-volt system.

4.13 **Wiring and Terminations**

4.13.1 Control wiring shall be:
   a. Flame retardant, 600-volt, type SIS switchboard copper wire (or an
equivalent in accordance with IEEE C37.20.1 - 2015, Section 7.1.3)
   b. Continuous from terminal to terminal without splices.
   c. Locking fork-type lugs shall be provided.
   d. Minimum conductor size shall be 14 AWG.

4.13.2 Wiring between sections shall be run through dedicated covered wiring raceways
or openings designed for this purpose. Wiring installed from the control
compartment to a cable compartment or which passes through the bus area shall
be installed within conduit or a covered wiring raceway.

4.13.3 A separate control power bus shall be furnished for each horizontal bus. The
control power bus shall be split at tie breakers(s).

4.13.4 Wiring for current transformer secondary leads shall have crimped self-insulated
ring-type lugs and terminated on shorting screw-type terminal blocks at the first
connection after the transformer. Unless otherwise specified on the purchaser’s
PIP ELSSG01D Data Sheet, minimum conductor size shall be 10 AWG.

4.13.5 All wiring harnesses shall be securely bundled and shall be protected from
rubbing against other parts within the enclosure.
   a. Bushings, grommets, or other mechanical protection shall be provided if
   wiring is installed through barriers, around edges of metal sheets, or raceways.
   b. Wiring which crosses hinged joints shall be protected by PVC or nylon spiral
   wrapping wire protection.
c. Adhesive-type supports shall not be permitted.

4.13.6 Internal wiring shall be connected to only one side of all field wiring terminal blocks. Terminal blocks for internal wiring only shall be segregated from those required for external wiring.

4.13.7 Terminal blocks for field wiring to breakers and for any transfer scheme shall not be located in the bus bar or power terminal compartments.

4.13.8 Terminal blocks for field control wiring shall be located in the control compartment and separate from wiring with voltages greater than 125V.

4.13.9 Circuits and terminals operating at different voltages and/or performing different functions shall be segregated on separate terminal blocks. Purchaser terminations shall be on separate blocks and separated by voltage and type of use. Supplier utilized terminal blocks shall not have different voltage levels on adjacent terminals.

4.13.10 All externally powered wiring to the switchgear line-up units shall be grouped together as much as possible and connected to a terminal block labeled in accordance with Section 4.15. Grouping shall be agreed between purchaser and supplier.

4.13.11 Terminal blocks shall be provided for wiring between shipping sections. All terminal block groups shall be labeled and all terminals in a group shall be permanently numbered or identified. Identification shall match supplier drawings.

4.13.12 The terminal blocks shall be NEMA style general industrial type for internal panel application:

a. All blocks shall be 600 volt, 20A, 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. Unless otherwise indicated on the purchaser’s PIP ELSSG01D Data Sheet, a minimum of 20% spare terminals shall be provided.

f. Terminations over 125V shall have finger safe separation.

4.13.13 Wire tagging shall meet the following requirements:

a. Each wire shall be permanently identified with heat-shrink markers at both ends in accordance with the wiring diagrams

b. Tagging shall indicate both the origin and destination points.

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

4.13.14 Each circuit breaker, fuse block, or isolating knife switch shall be clearly identified to indicate the source and its purpose.
4.13.15 Fuse holders rated 30 amperes or less, shall be modular type and dead front construction.
   a. If specified on the purchaser’s *PIP ELSSG01D* Data Sheet, fuse holders shall provide an open fuse indication light and/or an NC contact.
   b. Fuse holders shall provide IP-2x protection (finger safe).

4.13.16 Power cable terminations shall:
   a. Provisions for cable terminations shall be provided for each breaker as defined on the one-line diagram.
   b. The cable entry shall be as specified on the purchaser’s *PIP ELSSG01D* Data Sheet.
   c. Cable lugs shall be supplied as specified on the purchaser’s *PIP ELSSG01D* 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.
   d. The size and quantity of cables shall be as specified on the one-line diagram or purchaser’s *PIP ELSSG01D* Data Sheet.
   e. Unless otherwise specified on the purchaser’s *PIP ELSSG01D* Data Sheet, insulating boots for incoming and outgoing cables shall be provided by the supplier.

4.13.17 Cable termination facilities shall give particular attention to the space and bending radii required for large power cables.

4.13.18 Internal cable supports shall be provided within the switchgear to permit cables to be tied down between entry and termination points.

4.13.19 Cable or bus terminals shall be located in a cable termination compartment and the available space shall be maximized.

4.13.20 Locations of cable entrances shall be as specified on the purchaser’s *PIP ELSSG01D* Data Sheet. Removable cover(s) shall be provided for drilling in the field.

4.13.21 Non-magnetic cable entrance covers are required unless otherwise specified on the purchaser’s *PIP ELSSG01D* Data Sheet.

4.14 **Bus Ducts and Cable Bus**

4.14.1 If specified on the purchaser’s *PIP ELSSG01D* Data Sheet, the bus ducts or cable bus shall be furnished and coordinated with the respective switchgear assemblies, the supply transformers, and other associated equipment.

4.14.2 Dimensions and details of transformer throats or other equipment connections shall be provided by the party specified on the purchaser’s *PIP ELSSG01D* Data Sheet.

4.14.3 Design of the bus duct shall be in accordance with *PIP ELSBD01* and *PIP ELSBD01D*.

4.14.4 Design of the cable bus shall be in accordance with *PIP ELSBD02* and *PIP ELSBD02D*.
4.15 Nameplates

4.15.1 Safety signs and labels shall be in accordance with ANSI Z535.4.

4.15.2 Permanent nameplates shall be provided to identify each circuit breaker, source disconnect point, instrument, instrument switch, relay, and auxiliary component and to identify all equipment and terminal blocks within each assembly.

4.15.3 All nameplates shall be made of laminated plastic a minimum of 3/32 inch thick.

4.15.4 External nameplates shall be affixed with stainless steel hardware. Internal nameplates may be double sided, automotive type adhesive type.

4.15.5 Switchgear assembly-identifying nameplate may be supplier’s standard showing as a minimum:
   a. Manufacturer’s name
   b. Owner’s name
   c. Purchaser’s purchase order number
   d. Manufacturer’s shop order number
   e. Date of manufacture
   f. Switchgear designation (purchaser’s tag number)
   g. System voltage, phases, wires
   h. System frequency
   i. Busbar rating
   j. Equipment short circuit rating

4.15.6 Door-mounted devices shall be identified inside the compartment, in addition to the external identification.

4.15.7 Nameplates for each circuit breaker compartment shall be laminated plastic, white background with 1/4-inch-high engraved black lettering.

4.15.8 A warning label shall be provided on each compartment door in which an external voltage source is terminated. The label shall be laminated plastic with black lettering, a minimum of ¼ inch high, on an orange background. The label shall read ‘WARNING: EXTERNAL POWER SOURCE’.

4.15.9 Equipment service descriptions shall be as specified on the purchaser’s one-line diagram.

4.15.10 A 6 inch by 6 inch (150 mm by 150 mm) blank space shall be provided on cubicle doors for installation of arc-flash warning labels by the purchaser.

4.16 Finish

4.16.1 Unless otherwise specified on the purchaser’s PIP ELSSG01D Data Sheet, finish color for switchgear shall be ANSI 6I light gray in accordance with ASTM D1535-08 (Munsell notation 8.3.G6.10/0.54).

4.16.2 For outdoor and indoor service in noncorrosive environments, the manufacturer’s standard surface preparation and coating system are acceptable.
4.16.3 For service in corrosive environments, the finish and protective coatings shall be in accordance with the specification shown on the purchaser’s PIP ELSSG01D Data Sheet.

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

4.16.5 The topcoat shall provide complete hiding, consistent coverage and thickness, and uniform color.

4.16.6 Three one pint (0.5 L) aerosol cans of touch-up paint for each five vertical sections and for each paint color used shall be furnished.

4.17 Secondary System Grounding

4.17.1 If specified on the purchaser’s PIP ELSSG01D Data Sheet, a high-resistance grounding system shall be provided and incorporated in the switchgear assembly in accordance with PIP ELSGS01.

4.17.2 If specified on the purchaser’s PIP ELSSG01D Data Sheet, a ground detection system on individual feeder breakers shall be provided in accordance with the one-line diagram.

4.18 Accessories

The following switchgear accessories shall be provided:

a. A breaker-lifting device provided at one per switchgear assembly. Lifting capacity shall be shown on the lifting device.

b. Hand crank or handle for moving the breaker into the “connected,” “test,” or “disconnected” position

c. Device for manually charging the stored energy operating mechanism of electrically operated breakers

d. Test plugs for draw-out relays

e. Portable test kit for solid-state trip units (quantity of kits as specified on the purchaser’s PIP ELSSG01D Data Sheet)

4.19 Shipping

4.19.1 Unless otherwise specified on the request for quotation and/or purchase order, preparation for shipment shall be in accordance with supplier’s standards. The supplier shall be solely responsible for the preparation for shipment. As a minimum, the switchgear shall be firmly attached to a rigid wood-framed shipping skid.

4.19.2 Each shipping section shall be equipped with lifting facilities so that it may be easily unloaded and handled by crane.

4.19.3 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 switchgear.

4.19.4 All moving parts shall be securely blocked and braced, contactors, and other components with moving parts that might be damaged in shipment. Power fuses shall be removed before shipment and packaged separately.
4.19.5 All temporary shipping braces shall be painted yellow and marked as shown below.

REMOVED BEFORE EQUIPMENT IS PLACED IN SERVICE

4.19.6 Instruction for storage of equipment shall be attached to the equipment.

4.19.7 Equipment shall be protected from weather elements during shipping. As a minimum, when switchgear is shipped by open transport it shall be fully covered with a heavy tarp.

4.19.8 Additional shipping and handling requirements that appear in the individual equipment specifications shall be strictly adhered to, if applicable.

4.19.9 Equipment shall be designed to be shipped completely assembled, if practical.

4.19.10 If equipment is required to be disassembled for shipment, material and instructions shall be provided for assembling shipping sections, including making main power bus connections at shipping splits.

4.19.11 All openings and where the switchgear is shipped in more than one section, each opening shall be protected with plywood or other approved method.

4.19.12 Provisions shall be made to energize space heaters during storage. This requirement shall include making a connection point readily available without uncrating the equipment. Space heater wiring shall be extended to shipping skid for connection to external power during storage. Connection point shall be labeled as follows: “For connection to 120-volt AC to power space heaters during storage.”

4.20 Inspection and Testing

4.20.1 The entire switchgear shall be electrically and mechanically assembled into one single line-up before final testing, inspection and shipment. The actual circuit breakers to be shipped with the order shall be installed in the appropriate switchgear sections.

4.20.2 Equipment shall be inspected to verify conformance to these specifications and the approval drawings. All components shall be checked. Wiring identification shall be spot checked. Separation of voltage levels on terminal blocks shall be verified. The supplier shall remove the shutters which cover the breaker stabs so that the CT wiring and CT polarity may be inspected. CT wiring shall be inspected to verify ring-tongue lugs have been installed.

4.20.3 Check the alignment and penetration of the breaker stabs with bus connection and breaker cell alignment.

4.20.4 The following tests shall be performed:

a. A complete functional and operational test of all components, including wiring, control devices, relays, and breaker trip and close circuits, any remote control and/or remote racking devices For devices such as power relays, auto-synchronizing relays and sync check relays, the supplier shall have available the required three phase power supplies.

b. A dielectric test on the control wiring at 1500 volts 60 hertz for 1 minute per IEEE C37.20.1

c. Supplier’s standard routine tests
d. Production tests defined in IEEE C37.20.1-2015, Section 6.3. Tests shall be conducted with all draw-out elements racked in and breakers closed.

e. VT’s and CT’s shall receive certified test for ratio, phase angle and polarity.

f. Current shall be injected at the current transformer secondary to check for relay functioning. Current injection shall also be used to check operation of devices such as ammeters and transducers.

4.20.5 A copy of the installation, operating and maintenance instruction book, including protective relay instruction books, shall be on the test floor at time of witness testing. A complete unmarked set of final full size drawings shall be available for use by the inspector at time of witness testing.

4.20.6 The purchaser shall be notified 2 weeks in advance of testing. Where witness testing has been specified, it shall be done only after the supplier’s pre-witness tests and corrections have been completed. Notification of witness testing shall include a list of tests and acceptable range of values.

4.20.7 The purchaser or the purchaser’s representative reserves the right to inspect and observe the tests at the factory.

4.21 Documentation and Data Requirements

4.21.1 Unless otherwise specified on the purchaser’s PIP ELSSG01D Data Sheet, one electronic set of documents in PDF format shall be provided.

4.21.2 Unless otherwise specified on the purchaser’s PIP ELSSG01D Data Sheet, final certified and as-built drawings shall be submitted in DWG format and PDF format.

4.21.3 Drawings and data requirements shall be as shown in Table 1.

4.22 Conflict Resolution

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

a. Purchase order
b. One-line diagram and associated drawings
c. Purchaser’s PIP ELSSG01D Data Sheet
d. This Practice
e. Referenced standards
Table 1. Documentation Requirements

<table>
<thead>
<tr>
<th>A With Bid</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>One-line diagram, three-line diagram, control elementary, and connection diagrams showing all terminals, wire numbers and device connection information for each instrument, relay, and control circuit.</td>
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<tr>
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<td>General layout of equipment, showing all dimensions, weights, and required clearances</td>
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<td>X</td>
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<td>Circuit breaker data, including detailed description of breakers, rated insulation level (BIL), and rated short-circuit current</td>
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<td>Bus data, including the insulation and bracing materials and methods</td>
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<td>Current transformer data, including type, class, accuracy, saturation curves, and calculations to verify class and accuracy where CT’s are sized by the switchgear manufacturer / supplier.</td>
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<td>Potential transformer data, including the type, class, and accuracy</td>
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<td>Detailed plans and elevation drawings showing location of all components, including interface details for bus duct, etc.</td>
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<td>Protection Relay Solid-state trip unit data (including the model number, technical information, and time-current curves), setting software and firmware (if applicable).</td>
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<td>Meter data, including the model number and technical information of all meters and transducers</td>
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<td>Certified type test reports</td>
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<td>Foundation loading diagrams and soleplate details</td>
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<td>Individual cell schematics</td>
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<td>Individual cell connection wiring diagrams</td>
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<td>Detailed (E) or general (G) bill of material including name of the manufacturer and catalog number of all components, rating and/or limiting parameters.</td>
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<td>Installation, operation, and maintenance manuals</td>
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<td>Switchgear installation drawings showing dimensions, weights including weights of each shipping section, location, and type of all connections, and location of shipping splits</td>
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<td>Recommended spares parts list</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.
**ASSOC. PIP**  
**ELSSG01**  
**DATA SHEET**  
**ELSSG01D-D**  
**LOW VOLTAGE METAL ENCLOSED AC POWER**  
**CIRCUIT BREAKER SWITCHGEAR**  
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**JULY 2018**

<table>
<thead>
<tr>
<th>DOCUMENT NO.</th>
<th>ALTERNATE DOCUMENT NO.</th>
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</table>

**ISSUED FOR:**  
- Proposal  
- Purchase  
- As Built

**FACILITY NAME/LOCATION:**

**ITEM NAME:**

**PURCHASER/LOCATION:**

**ITEM TAG NO.:**

**JOB NO:**

**SERVICE:**

**PURCHASER ORDER NO.:**

**UNIT:**

**SUPPLIER/LOCATION:**

**DWG. NO.:**

**SUPPLIER ORDER/SERIAL NOS.:**

**DATA PROVIDED BY:**  
- **PURCHASER**  
- **SUPPLIER**  
- **SUPPLIER IF NOT BY PURCHASER**

**REFER TO PIP ELSSG01 FOR GENERAL REQUIREMENTS**

**APPLICABLE STATE AND LOCAL CODES:**

**SERVICE CONDITIONS (4.1):**

- **AMBIENT TEMPERATURE:**  
  - MAX: 40 °C  
  - MIN: -30 °C
  - HUMIDITY: 0-95 %

- **ALTITUDE:** 1000 M

- **AREA CLASSIFICATION:**  
  - NON-CLASSIFIED  
  - CLASSIFIED

- **CLASS:**
  - **DIVISION:**
  - **GROUP:**
  - **AUTO IGNITION TEMP:**

- **SEISMIC DESIGN:**  
  - REQUIRED  
  - NOT REQUIRED

- **SITE LOCATION:**  
  - LATITUDE
  - LONGITUDE

**RISK CATEGORY:**  
- X IV  
- III  
- OTHER:

- **SITE CLASS:**  
  - D  
  - OTHER:

- **SEISMIC CERTIFICATE:**  
  - REQUIRED  
  - NOT REQUIRED

- **EXPOSED TO A MOIST/MODERATE CORROSIVE ENVIRONMENT**

- **SITE ENVIRONMENTAL DATA SHEET ATTACHED**

**OTHER:**

**ELECTRICAL SYSTEM PARAMETERS (4.1.3):**

- **VOLTS:** kV
  - **PHASE:** 3
  - **HERTZ:** 60  
  - **THREE WIRE**
  - **FOUR WIRE**

- **WYE**  
- **DELTA**

- **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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<th>REVISION DESCRIPTION</th>
<th>BY</th>
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</table>
SWITCHGEAR DESIGN (4.2):

- Enclosure Type (4.2.5):
  - NEMA 1
  - NEMA 3R
  - Other:

- Outdoor Installation (4.2.6):
  - Required
  - Not Required

- Max. No. of Feeder Breakers in a Vertical Section (4.2.7):
  - 4
  - 3
  - Other:

- Rear Access Means (4.2.9, 4.2.10, & 4.2.11):
  - Removable Panels
  - Full Height
  - Split
  - Doors
  - Full Height
  - Split

- BKR. Compartment Door Interlock Required (4.2.16):
  - Required
  - Not Required

- Automatic Shutters (4.2.19):
  - Required
  - Not Required

- Full Height and Depth Barriers Between Rear Sections (4.2.23):
  - Required
  - Not Required
  - Metal
  - Glass
  - Polyester

- Barriers Between Breaker Compartments (4.2.24):
  - Required
  - Not Required

- Ventilation Openings (4.2.25):
  - Stainless Steel Screened
  - Filtered
  - Mfg. Std.

- Breaker Control Power (4.2.26):
  - Closing: 480V AC
  - Tripping: 480V AC, DC
  - Charging: 480V AC

- Remote Racking Device Required (4.2.28):

- ThermoGraphy Windows Required (4.2.29):
  - Front
  - Rear

- Fixed Thermal Sensors & Associated Equipment Required (4.2.30):

- Assembly UL Label (4.2.31):
  - Required
  - Not Required

- Other:

Arc Resistant Additional Requirements (4.3):

- Arc Resistant Design (4.3):
  - Required
  - Not Required

- Arc-Resistant Construction Type (4.3.3):
  - Type 2B

- Door Interlocks (4.3.6):
  - Required
  - Not Required

- Plenum System Design (4.3.10):
  - Per Practice
**MAIN CIRCUIT BREAKER (4.4):**

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<thead>
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</table>

**One Line Diagram:**

- Breaker Interchangeability (4.4.3):  
  - **x** Required  
  - **☐** Not Required

**Circuit Breaker (4.4.4 & 4.4.5):**

- **x** Three Pole  
  - **☐** Other:

- **☐** Electrically Operated  
  - **☐** Manually Operated

**Continuous Rating (4.4.6):**

- **1600 Amps**  
- **2000 Amps**  
- **3200 Amps**  
- **4000 Amps**  
  - **☐** Other:

**Maximum Interrupting Time (4.4.7):**

- **5 Cycle**  
  - **☐** Other:

**Interrupt Rating kA (4.4.8):**

- **☐** 50  
- **☐** 65  
- **☐** 85  
- **☐** 100  
  - **☐** Other:

**Current Limiting Fuses (4.4.9):**

- **☐** Yes  
  - **☐** No

**Control & Indication Ckts Individually Fused Protected (4.4.11):**

- **☐** Required  
  - **☐** Not Required

**Breaker Tripping Devices (4.4.14):**

- **x** Solid-State Trip Units  
  - **☐** Solid-State Relays

**Trip Unit Characteristics (4.4.14):**

- **☐** Rating Plug:  
  - **☐** Sensor Rating:

  - **☐** Long Time  
  - **☐** Short Time  
  - **☐** Instantaneous  
  - **☐** In Time

- **☐** Ground Fault Protection
  - **☐** Other:

**Breaker Operation Counter (4.4.18):**

- **☐** Required  
  - **☐** Not Required

**Spring Charging Motor (4.4.20):**

- **x** Required  
  - **☐** Not Required

**Under Voltage Trip Coil (4.4.21):**

- **☐** Required  
  - **☐** Not Required

**Spare Auxiliary Contacts (4.4.22):**

- **x** MOC Switches  
  - **☐** 2 - N.O. and 2 - N.C.

- **x** TOC Switches  
  - **☐** 2 - N.O. and 2 - N.C.

- **☐** Other:

**Electrically Operated Breaker Controls:**

- **☐** Switch Location (4.4.23):

  - **☐** Breaker Cubicle  
  - **☐** Auxiliary Compartment Door

- **☐** Remote Control (4.4.24):

  - **x** Required  
  - **☐** Not Required

- **☐** Remote Indication (4.4.25):

  - **x** Required  
  - **☐** Not Required

- **Remote Control by Means of (4.4.26, 28, 29):**

  - **☐** Remote Control/Mimic Panel  
  - **☐** Other:

  - **☐** Remote HMI Panel  
  - **☐** Other:

  - **☐** Remote Hand Held Control Station  
  - **☐** Other:

  - **☐** Other:
**TIE CIRCUIT BREAKER (4.4):**

**TAG NO'S:**

**ONE LINE DIAGRAM:**

**BREAKER INTERCHANGEABILITY (4.4.3):**
- **X** REQUIRED
- **☐** NOT REQUIRED

**CIRCUIT BREAKER (4.4.4 & 4.4.5):**
- **X** THREE POLE
- **☐** OTHER:
- **☐** ELECTRICALLY OPERATED
- **☐** MANUALLY OPERATED

**CONTINUOUS RATING (4.4.6):**
- 1600 AMPS
- 2000 AMPS
- 3200 AMPS
- 4000 AMPS
- **☐** OTHER:

**MAXIMUM INTERRUPTING TIME (4.4.7):**
- **X** 5 CYCLE
- **☐** OTHER:

**INTERRUPT RATING kA (4.4.8):**
- 50
- 65
- 85
- 100
- **☐** OTHER:

**CURRENT LIMITING FUSES (4.4.9):**
- **☐** YES
- **☐** NO

**CONTROL & INDICATION CKTS INDIVIDUALLY FUSED PROTECTED (4.4.11):**
- **☐** REQUIRED
- **☐** NOT REQUIRED

**BREAKER TRIPPING DEVICES (4.4.14):**
- **X** SOLID-STATE TRIP UNITS
- **☐** SOLID-STATE RELAYS
- **☐** OTHER:

**TRIP UNIT CHARACTERISTICS (4.4.14):**

**RATING PLUG:**
- **☐** LONG TIME
- **☐** SHORT TIME
- **☐** INSTANTANEOUS
- **☐** PT

**GROUND FAULT PU**
- **☐** OTHER:

**BREAKER OPERATION COUNTER (4.4.18):**
- **☐** REQUIRED
- **☐** NOT REQUIRED

**SPRING CHARGING MOTOR (4.4.20):**
- **X** REQUIRED
- **☐** NOT REQUIRED

**UNDER VOLTAGE TRIP COIL (4.4.21):**
- **☐** REQUIRED
- **☐** NOT REQUIRED

**SPARE AUXILIARY CONTACTS (4.4.22):**
- **X** MOC SWITCHES
- **X** TOC SWITCHES
- **☐** 2 - N.O. AND 2 - N.C.

**ELECTRICALLY OPERATED BREAKER CONTROLS:**

**SWITCH LOCATION(4.4.23):**
- **☐** BREAKER CUBICLE
- **☐** AUXILIARY COMPARTMENT DOOR

**REMOTE CONTROL (4.4.24):**
- **X** REQUIRED
- **☐** NOT REQUIRED

**REMOTE INDICATION (4.4.25):**
- **☐** REQUIRED
- **☐** NOT REQUIRED

**REMOTE CONTROL BY MEANS OF (4.4.26, 28, & 29):**
- **☐** REMOTE CONTROL/MIMIC PANEL
- **☐** REMOTE HMI PANEL
- **☐** REMOTE HAND HELD CONTROL STATION

**OTHER:**
- **☐** OTHER:

**ASSOC. PIP**

**DATA SHEET**

**LOW VOLTAGE METAL ENCLOSED AC POWER**

**CIRCUIT BREAKER SWITCHGEAR**

**ELSSG01D-D**

**PAGE 4 OF 11**

**JULY 2018**
**FEEDER CIRCUIT BREAKER (4.4):**

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**One Line Diagram:**

**Circuit Breaker (4.4.4 & 4.4.5):**

- [X] Three Pole
- [ ] Other:
- [ ] Electrically Operated
- [ ] Manually Operated

**Continuous Rating (4.4.6):**

- [X] 800 Amps
- [ ] 1600 Amps
- [ ] 2000 Amps
- [ ] Other:

**Maximum Interrupting Time (4.4.7):**

- [X] 5 Cycle
- [ ] Other:

**Interrupt Rating kA (4.4.8):**

- [ ] 30
- [X] 42
- [ ] 50
- [ ] 65
- [ ] 85
- [ ] Other:

**Current Limiting Fuses (4.4.9):**

- [ ] Yes
- [ ] No

**Control & Indication CKTS Individually Fused Protected (4.4.11):**

- [ ] Required
- [ ] Not Required

**Breaker Tripping Devices (4.4.14):**

- [X] SOLID-STATE TRIP UNITS
- [ ] SOLID-STATE RELAYS
- [ ] Other:

**Trip Unit Characteristics (4.4.14):**

- [ ] Rating Plug:
- [ ] Sensor Rating:
  - [ ] Long Time
  - [ ] Short Time
  - [ ] Instantaneous
  - [ ] I2t
  - [ ] Other:

**Breaker Operation Counter (4.4.18):**

- [ ] Required
- [ ] Not Required

**Spring Charging Motor (4.4.20):**

- [X] Required
- [ ] Not Required

**Under Voltage Trip Coil (4.4.21):**

- [ ] Required
- [ ] Not Required

**Spare Auxiliary Contacts (4.4.22):**

- [X] MOC Switches
- [X] 2 - N.O. and 2 - N.C.
- [ ] Other:

- [X] TOC Switches
- [X] 2 - N.O. and 2 - N.C.
- [ ] Other:

**Electrically Operated Breaker Controls:**

- [ ] Switch Location (4.4.23):
  - [ ] Breaker Cubicle
  - [ ] Auxiliary Compartment Door
- [ ] Remote Control (4.4.24):
  - [X] Required
  - [ ] Not Required
- [ ] Remote Indication (4.4.25):
  - [X] Required
  - [ ] Not Required

**Remote Control by Means of (4.4.26, 28, & 29):**

- [ ] Remote Control/Mimic Panel
- [ ] Other:

- [ ] Remote HMI Panel
- [ ] Other:

- [ ] Remote Hand Held Control Station
- [ ] Other:
### BUS WORK (4.5):

- **BUS MATERIAL (4.5.1):**
  - X COPPER
  - ALUMINUM

- **BUS RATING (4.5.2):**
  - 800 AMPS
  - 1200 AMPS
  - 1600 AMPS
  - 2000 AMPS
  - 3000 AMPS
  - 3200 AMPS
  - 4000 AMPS
  - OTHER: ____________________

- **BUS & CABLE COMPARTMENT ISOLATION (4.5.4):**
  - REQUIRED
  - NOT REQUIRED

- **BUS BRACING kA (4.5.5):**
  - 42
  - 65
  - 85
  - 100
  - OTHER: ____________________

- **BUS INSULATION (4.5.6):**
  - X FLUIDIZED BED EPOXY
  - NOT REQUIRED
  - OTHER: ____________________

- **BOLTED JOINTS AND DISCONNECT ASSEMBLY FINGERS (4.5.9):**
  - X TIN PLATED JOINTS
  - SILVER PLATED JOINTS
  - X TIN PLATED FINGERS
  - SILVER PLATED FINGERS

- **BUS PHASE LABELING REQUIRED (4.5.10):**
  - REQUIRED
  - NOT REQUIRED

- **GROUND BUS LUGS REQUIRED (4.5.11.c):**
  - SIZE: __________ AWG
  - QUANTITY: __________

- **ADDITIONAL GROUND BAR CONNECTION PROVISIONS REQ'D (4.5.11.d):**
  - REQUIRED
  - NOT REQUIRED

- **SAFETY GROUND CONNECTIONS (4.5.13):**
  - REQUIRED
  - NOT REQUIRED

- **NEUTRAL BUS (4.5.15 & 4.5.16):**
  - REQUIRED
  - AMPS: __________

- **NEUTRAL BUS LOCATION ADJACENT TO:**
  - A PHASE
  - C PHASE

- **OTHER:**

### VOLTAGE TRANSFORMERS (4.6):

- **VOLTAGE TRANSFORMERS:**
  - REQUIRED
  - NOT REQUIRED

- **QUANTITY:**
  - TWO
  - THREE

- **RATIO:**

- **CONFIGURATION:**

- **OTHER:**

### CONTROL POWER TRANSFORMERS (4.7):

- **CONTROL POWER TRANSFORMERS:**
  - REQUIRED
  - NOT REQUIRED

- **kVA:**

- **RATIO:**

- **CONFIGURATION:**

- **EXTERNAL LOADS:**

- **OTHER:**

---

**DATA PROVIDED BY:**
- PURCHASER
- SUPPLIER
- SUPPLIER IF NOT BY PURCHASER

**BUS WORK (4.5):**
- COPPER
- ALUMINUM

**BUS RATING (4.5.2):**
- 800 AMPS
- 1200 AMPS
- 1600 AMPS
- 2000 AMPS
- 3000 AMPS
- 3200 AMPS
- 4000 AMPS

**BUS & CABLE COMPARTMENT ISOLATION (4.5.4):**
- REQUIRED
- NOT REQUIRED

**BUS BRACING kA (4.5.5):**
- 42
- 65
- 85
- 100

**BUS INSULATION (4.5.6):**
- FLUIDIZED BED EPOXY
- NOT REQUIRED

**BOLTED JOINTS AND DISCONNECT ASSEMBLY FINGERS (4.5.9):**
- TIN PLATED JOINTS
- SILVER PLATED JOINTS

**BUS PHASE LABELING REQUIRED (4.5.10):**
- REQUIRED
- NOT REQUIRED

**GROUND BUS LUGS REQUIRED (4.5.11.c):**
- SIZE: __________ AWG

**ADDITIONAL GROUND BAR CONNECTION PROVISIONS REQ'D (4.5.11.d):**
- REQUIRED
- NOT REQUIRED

**SAFETY GROUND CONNECTIONS (4.5.13):**
- REQUIRED
- NOT REQUIRED

**NEUTRAL BUS (4.5.15 & 4.5.16):**
- REQUIRED

**NEUTRAL BUS LOCATION ADJACENT TO:**
- A PHASE
- C PHASE

**VOLTAGE TRANSFORMERS (4.6):**
- REQUIRED
- NOT REQUIRED

**QUANTITY:**
- TWO
- THREE

**RATIO:**

**CONFIGURATION:**

**CONTROL POWER TRANSFORMERS (4.7):**
- REQUIRED
- NOT REQUIRED

**kVA:**

**RATIO:**

**CONFIGURATION:**

**EXTERNAL LOADS:**

**OTHER:**
CURRENT TRANSFORMER DATA (4.8):

METERING CT'S

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<th>Ratio</th>
<th>Configuration</th>
<th>Lead Wire (AWG)</th>
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OTHER:

PROTECTIVE RELAYING CT'S

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OTHER:
## CONTROL DEVICES, INDICATING LIGHTS & METERING (4.9):

### CONTROL SWITCHES (4.9.1):

- **Required MFG.:**
- **Model:**

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<th>Other</th>
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<td>Ammeter</td>
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### INDICATING LIGHTS (4.9.2):

- **Required:** ☑️
- **Not Required:** ☐️

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<td>☐️</td>
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<tr>
<td>Green (closed) / Red (open)</td>
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</tr>
<tr>
<td>Amber</td>
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<td>White</td>
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<tr>
<td>Blue</td>
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### PUSH TO TEST LIGHTS (4.9.3):

- **Required:** ☑️
- **Not Required:** ☐️

### TEST SWITCHES (4.9.4):

- **Required MFG.:**
- **Test Switch Color:**

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### CONTROL CIRCUIT CONTINUITY INDICATION (4.9.5):

- **Required:** ☑️
- **Not Required:** ☐️

### TRIP CIRCUIT MONITORING (4.9.6):

- **TCM Relay:**
- **Light Color:**

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### METERING (4.9.7):

- **Incoming:**
- **Feeders:**

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### METERING COMMUNICATION (4.9.7.a):

- **Required:**
- **Not Required:**

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CONTROL DEVICES, INDICATING LIGHTS & METERING (4.8) (CONTINUED):

CONTROL COMMUNICATION (4.9.8):

- REQUIRED
- NOT REQUIRED

COMMUNICATION CONNECTION TYPE:

- ETHERNET
- FIBER OPTIC
- RS485
- 4-20 mA
- OTHER:

PROTOCOL:

- OTHER:
- OTHER:

PROTECTIVE RELAYING (4.10):

REQUIRED MFG.:

MODEL: QUANTITY:
- MODEL: QUANTITY:
- MODEL: QUANTITY:
- MODEL: QUANTITY:
- MODEL: QUANTITY:

REMOTE MONITORING PROVISIONS REQUIRED (4.10.4):

- REQUIRED
- NOT REQUIRED

SEPARATE BUS DIFFERENTIAL RELAYS REQUIRED (4.10.5):

- REQUIRED
- NOT REQUIRED

TWO SETS OF PROTECTION PARAMETERS (4.10.6):

- REQUIRED
- NOT REQUIRED

ARC FLASH SENSING OPTICS (4.10.7):

- REQUIRED
- NOT REQUIRED

LOCKOUT RELAY, 86 REQUIRED (4.10.8.e) MAINS TIES FEEDERS

INTERLOCKING AND TRANSFER SCHEME (4.11):

BREAKER INTERLOCKING REQUIRED (4.11.1):

- REQUIRED
- NOT REQUIRED

TRANSFER SCHEME REQUIRED (4.11.2):

- REQUIRED
- NOT REQUIRED

ZONE INTERLOCKING REQUIRED (4.11.3):

- REQUIRED
- NOT REQUIRED

SPACE HEATERS (4.12):

SPACE HEATERS:

- CABLE COMPARTMENT
- BREAKER COMPARTMENT
- NOT REQUIRED

POWER SUPPLY:

- POWER BY PURCHASER
- POWER BY SUPPLIER

SPACE HEATER LOAD: WATTS AT VAC

HEAT LOSS DATA: TOTAL BTU's / HR

THERMOSTAT HUMIDISTAT AMMETER TEST PUSH BUTTON

OTHER:
### Wiring and Terminations (4.13):

- **Minimum 20% Spare Terminals**: [ ] Other:
- **Open Fuse Indication (4.13.15.a)**: [ ] Required [ ] Not Required
- **Light **[ ] NC Contact
- **Incoming Power Connections**:
  - [ ] Top Entry
  - [ ] Bottom Entry
  - [ ] Close Coupled
  - [ ] Bus Duct
  - **Cable Lugs By**: [ ] Supplier
  - [ ] Purchaser
  - **Cable Size**: __________ AWG
  - **Quantity**: ________
  - **Insulating Cable Boots**: [x] Required [ ] Not Required
  - [ ] Other:

- **Feeder Cable Connections**:
  - [ ] Top Entry
  - [ ] Bottom Entry
  - [ ] Close Coupled
  - [ ] Bus Duct
  - **Cable Lugs By**: [ ] Supplier
  - [ ] Purchaser
  - **Cable Size**: __________ AWG
  - **Quantity**: ________
  - **Insulating Cable Boots**: [x] Required [ ] Not Required
  - [ ] Other:

- **Non-Magnetic Covers (4.13.21)**: [x] Required [ ] Not Required

- **Control Cable Entry**:
  - [ ] Top Entry
  - [ ] Bottom Entry
  - [ ] Other:

### Bus Ducts & Cable Bus (4.14)

- [ ] Bus Duct
- [ ] Cable Bus
- **Supplied By**: [ ] Purchaser [ ] Supplier

- **Transformer Throat Connection (4.14.2)**
- **Dimensions By**: [ ] Purchaser [ ] Supplier
- [ ] Other:

### Finish (4.16):

- [ ] MFG. Std.
- [x] ANSI 49
- [ ] ANSI 61
- [ ] ANSI 70
- **Per Paint Spec.**:
- [ ] Other:

### System Grounding (4.17):

- **High Resistance Grounding System**: [ ] Required [ ] Not Required
- **In Switchgear**: [ ] External
- **Other**:

- **Feeder Breaker Ground Detection System (4.17.2)**: [ ] Required [ ] Not Required
- [ ] Other:
**ACCESSORIES (4.18):**

PORTABLE TEST KIT FOR SOLID-STATE TRIP DEVICES (4.18.e):

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**QUANTITY:**

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**SHIPPING (4.19):**

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**PRE-SHIPSMENT SHOP INSPECTION:**

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**INSPECTION & TESTING (4.20):**

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**CERTIFIED TEST REPORTS:**

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**DOCUMENTATION (4.21):**

**Electronic Document Format:**

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**Supplier to Provide:**

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**Copies of All Documents:**

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**OTHER REQUIREMENTS:**

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