

# SCADA CONTROLLED PAD-MOUNTED SWITCHGEAR

## LIVE-FRONT - TYPE SCPSI/II

## DEAD-FRONT - TYPE SCPSE

### 15KV • 25KV

#### Federal Pacific SCADA Switchgear for Distribution Automation and Smart Grids

Due to the growth of Distribution Automation and Smart Grid technologies, implementation of SCADA (Supervisory Control and Data Acquisition) compatible switchgear has become increasingly important to both utilities and end users in order to better optimize the use of existing system resources and to affect improvements to reliability both at the system level and for the end user.

Federal Pacific SCADA controlled Live-Front SCPSI/II and Dead-Front SCPSE Pad-Mounted Switchgear permit automated switching and provide both supervisory control of switching operations and the data acquisition of system status, while still providing the still important function of fault protection and isolation for the URD / Underground distribution systems.

Specification of SCADA (or remotely controlled) Pad-Mounted Switchgear typically provides for a completely integrated, self-powered switching and protection package for automated distribution installations. The SCADA controlled switchgear would normally include interrupter switches, switch operator(s) and associated wiring, low-voltage compartments, and wiring. Some SCADA switchgear designs are available as UL® Listed, consult with the factory for details if this feature is desired.

#### Inclusions

The SCADA automation equipment typically includes current sensors (optional); a self-contained 120-volt 60-hertz power source (optional); battery with charger; and provisions for a remote terminal unit (RTU) that may be integrated, as selected by customer, with a modem for direct connection to a SCADA master computer by means of an optional land-line communication channel, an optional 900-Mhz transceiver or an optional fiber-optic transceiver. The switchgear may be optionally equipped with controls to provide automatic sectionalizing following overcurrents in excess of a preselected level and the subsequent loss of source-side voltage.

#### Federal Pacific Auto-Jet® II Switches

The 600-ampere and 1200-ampere Auto-Jet® II Switches provide three-pole live switching of three-phase circuits. One, two, three, or four Auto-Jet® II Switches may be power operated depending on the design selected. All live-front switch terminal pads can accommodate a variety of cable-terminating devices for cable sizes to 1000 kc mil. All dead-front switch terminals include a 600-ampere bushing to accommodate 600-ampere non-loadbreak elbow connectors.

#### Federal Pacific Motor Operators

Federal Pacific Motor Switch Operators provide power operation of the associated Auto-Jet® II Switch in response to a remote or local pushbutton signal. Federal Pacific Motor Operators include the following features as standard:

- An integral motor for power operating the quick-make quick-break mechanism of the Auto-Jet® II Switch.
- Open-close toggle switch for local electrical operation.
- Operation selector switch which permits local control using toggle switches while precluding remote operations, with remote indication of selector-switch position.
- Auxiliary-switch contacts for remote indication of switch position.
- Decoupler to permit operation of motor operator without affecting the position of the switch.
- Operation counter.
- A manual operating handle allows local manual operation of the Auto-Jet® II Switch in the event control power is not available.



*Motor operator allows remote operation of switch.*



*Switch-termination compartment of a dead-front SCADA Controlled unit is pictured above.*



*Fuse compartment of dead-front SCADA Controlled unit is pictured above.*



*Motor operator on SCADA Controlled unit of pad-mounted switchgear.*

SCADA-Controlled  
Pad-Mounted Switchgear

## Automation Equipment Groups

Federal Pacific SCADA Controlled Pad-mounted Switchgear may be purchased with the communication and automation control group to provide a completely self-sufficient automated distribution switching and protection unit. Alternately, they may be purchased with either a switch-automation group for use with RTU by others or with a switch-automation group for use without RTU. One of the automation control groups must be specified when ordering. Consult factory for optional controls to additionally provide automatic sectionalizing following overcurrents in excess of a preselected level and the subsequent loss of source voltage.

## Enclosure Construction

All low-voltage wiring is shielded from medium voltage and is routed either in a 24-inch control-wiring base spacer for live-front models or in a roof section on dead-front models, which are included with each model of Federal Pacific SCADA Pad-Mounted Switchgear and which increases enclosure height accordingly.

Enclosures containing medium voltage meet the requirements of ANSI C57.12.28 (Enclosure Integrity) and are of free-standing, self-supporting construction— not for bolting directly to transformers—with provisions for cable entrance and exit through the bottom. Access to the interiors of medium-voltage compartments is controlled by the standard self-latching mechanism. The latching mechanism provides automatic three-point door latching on closing and permits padlocking only when the door is securely latched. The door can be opened only with a pentahead socket wrench or tool. Enclosures for low-voltage components (i.e. switch operators, RTU, etc.) are typically a NEMA 4 enclosure with padlock and security tabs.

The enclosure roof over each medium-voltage compartment is undercoated with an insulating “no-drip” compound. A resilient closed-cell gasket on the bottom flange of the pad-mounted gear protects the finish from being scratched during installation and isolates it from direct contact with the concrete foundation. Similar gasketing is provided between the switch operators or low-voltage compartment and the medium-voltage compartments. Enclosures are protected from corrosion by the Federal Pacific finishing system with the standard color of Munsell No. 7GY3.29/1.5, dark green.

Interphase and end barriers of fiberglass-reinforced polyester are provided with each switch and each set of fuses where required to achieve published BIL ratings. Additional barriers (where furnished) of the same material separate front and rear medium-voltage compartments and isolate the tie bus. Full-length steel barriers separate adjoining switch and fuse compartments (where applicable) in live-front models.

## Optional Features

- K3** – **Key Interlock** — Prevents access to fuse-compartment unless associated switch is locked open.
- T1** – **Installation of RTU** — User provided RTU.
- T11** – **Installation of FP RTU** — FP purchased and installed (type as specified by user).
- T2** – **Installation of Radio** — User provided Radio.
- T21** – **Installation of Radio** — FP provided and installed Radio (type as specified by user).
- T3** – **Installation of Antenna** — User provided Antenna.
- T31** – **Installation of Antenna** — FP provided and installed Antenna (type as specified by user).
- X1** – **Cold-Temperature Package** — Modification to allow operation under low-temperature condition to -40°F (-40°C).
- X2** – **Temperature Compensation for Battery** — Device to cool battery in hot climates to extend battery life and warms the battery to improve performance under cold conditions.

**For other Optional Features please consult the factory.**

# STANDARD SPECIFICATION FOR LIVE-FRONT SCADA-CONTROLLED PAD-MOUNTED SWITCHGEAR

## A. General

### 1. Plans

The Pad-Mounted gear shall be the SCPSI/II design as manufactured by Federal Pacific and shall conform to these specifications.

### 2. Assembly

The basic pad-mounted gear shall consist of a single self-supporting enclosure, containing interrupter switches and power fuses and separate, integral enclosure(s) including switch operator(s), controls, and control-power supply. It shall also provide the necessary accessory components, including sensing, controls, and control power input, all completely factory-assembled and operationally checked.

### 3. Ratings

a) Ratings for the integrated pad-mounted switchgear assembly shall be as designated below: (Select 15kV or 25kV sets of ratings from the tables below)

System Voltage Class			
	15kV†	25kV†	
kV, Nominal	14.4	25	
kV, Maximum Design	17.5	27½	
kV, BIL	95	125	
Main Bus Continuous, Amps	600	600	
Switch Load-Interrupting, Amps	600	600	
Switch Fuse Load-Interrupting, Amps	200	200	
Switch Short-Circuit Ratings ①②			
Amps, RMS Symmetrical	Standard	14,000	12,500
	HFC	25,000	25,000
Peak Withstand Current, Amperes	Standard	36,400	32,500
	HFC	65,000	65,000
MVA, 3-Phase Symmetrical at Rated Nominal Voltage	Standard	350	540
	HFC	620	1,080
Fault-Closing Amps, RMS, Asym., 3-Time Duty-Cycle ③	Standard	22,400	20,000
	HFC	40,000	40,000

① These are nominal switch ratings. Integrated pad-mounted unit may be limited by fuse ratings. Use fuse rating chart in next column to select proper short circuit ratings.

② Select one set of the ratings shown. (Standard or High Fault Current - HFC)

③ The three-time duty-cycle fault-closing rating means that the switch can be closed three times into rated fault amperes and remain operable and able to carry and interrupt its rated load current.

‡Maximum design of the 27kV switch is 29kV.

†For UL® Listed units, ratings are 15.5kV, 14,000 or 25,000 amperes rms symmetrical, 350 MVA, 22,400 or 40,000 amperes fault closing; and 27kV, 25,000 amperes rms symmetrical, 1080 MVA, 40,000 amperes asymmetrical fault closing.

b) The momentary and three-time duty-cycle fault-closing ratings of switches, momentary rating of bus, interrupting ratings of fuses with integral load interrupter shall equal or exceed the short-circuit ratings of the pad-mounted switchgear.

### 4. Certification of Ratings:

The manufacturer shall be completely and solely responsible for the performance of the basic switch components as well as the complete integrated assembly as rated.

The manufacturer shall furnish, upon request, certification of ratings of the basic switch components and/or the integrated pad-mounted switchgear assembly consisting of the switch and fuse components in combination with the enclosure.

The following optional feature may be specified:

a) The pad-mounted switchgear shall be UL® Listed. Consult factory for details if this feature is desired.

Fuse Ratings						
Fuse Manufacturer	Fuse Type	Three-Phase MVA Sym	Amps RMS Asym	3-Time Fault-Close Asym ①	Cont. Amps	Load-Break Amps ②
<b>14.4 kV Nominal Voltage</b>						
S&C ③	SM-4	310	20000	20000	200	200
S&C	SMU-20	350	22400	22400	200	200
S&C ④	SM-5‡	—	—	—	—	—
Eaton	DBU	350	22400	22400	200	200
Cooper (M-E)	NX	620	40000	40000	100*	100
Cooper (CT)	X-Limiter	620	40000	40000	140	140
Cooper ⑤	CMU	350	22400	22400	200	200
<b>25 kV Nominal Voltage</b>						
S&C ③	SM-4†	540	20000	20000	200	200
S&C	SMU-20	540	20000	20000	200	200
S&C ④	SM-5‡	—	—	—	—	—
Eaton	DBU	540	20000	20000	200	200
Cooper (M-E)	NX	1,080	40000	40000	40	40
Cooper (CT)	X-Limiter	1,080	40000	40000	40	40
Cooper ⑤	CMU	540	20000	20000	200	200

① When assembled with appropriate end fittings.

② Models with this fuse type are not UL® Listed.

③ Check with the factory for UL® Listing.

\* 100 amp @ 13.5 kV max or 80 amp @ 15 kV.

† Applicable to solidly-grounded-neutral systems only with fuses connected by a single conductor concentric neutral type cable to a transformer or transformers. Rating is 9,400 amperes RMS symmetrical, 15,000 amperes RMS asymmetrical (405 MVA symmetrical) for all other applications.

‡ Please contact factory for SM-5 applications.

### 5. Compliance with Standards and Codes

The pad-mounted switchgear shall conform to or exceed the applicable requirements of the following standards and codes:

- All portions of ANSI C57.12.28, covering enclosure integrity for pad-mounted equipment.
- Article 490.21(E) "Load Interrupters" in the National Electrical Code, which specifies that the interrupter switches in combination with power fuses shall safely withstand the effects of closing, carrying, and interrupting all possible currents up to the assigned maximum short-circuit rating.
- All portions of IEEE C37.74 covering design and testing of the distribution switchgear, components and ways.
- All portions of ANSI and IEEE standards applicable to the basic switch components.

### 6. Enclosure Design

- To ensure a completely coordinated design, the pad-mounted gear shall be constructed in accordance with the minimum construction specifications of the fuse and/or switch manufacturer to provide adequate electrical clearances and adequate space for fuse handling.
- In establishing the requirements for the enclosure design, consideration shall be given to all relevant factors such as controlled access, tamper resistance, and corrosion resistance.

## B. Construction - Assembly

### 1. Insulators

The interrupter-switch and fuse-mounting insulators shall be of a cycloaliphatic epoxy resin system with characteristics and restrictions as follows:

- a) Operating experience of at least 20 years under similar conditions.
- b) Ablative action to ensure non-tracking properties.
- c) Adequate leakage distance established by test per IEC Standard 60507.
- d) Adequate strength for short-circuit stress established by test.
- e) Conformance with applicable ANSI standards.
- f) Homogeneity of the cycloaliphatic epoxy resin throughout each insulator to provide maximum resistance to power arcs. Ablation due to high temperatures from power arcs shall continuously expose more material of the same composition and properties so that no change in mechanical or electrical characteristics takes place because of arc-induced ablation. Furthermore, any surface damage to insulators during installation or maintenance of the pad-mounted gear shall expose material of the same composition and properties so that insulators with minor surface damage need not be replaced.
- g) Each insulator shall be x-rayed to assure it is void free. An alternate testing method may be used only by approval of the engineer.

### 2. High-Voltage Bus

- a) Bus and interconnections shall consist of aluminum bar with an oxide-inhibiting agent on all bus joints.
- b) Bus and interconnections shall withstand the stresses associated with short-circuit currents up through the maximum rating of the pad-mounted switchgear.
- c) Bolted aluminum-to-aluminum connections shall be made with a suitable number of non-corrosive bolts and with two Belleville spring washers per bolt, one under the bolt head and one under the nut, or with a wide, flange-head bolt and one Belleville spring washer under the nut per bolt. As an alternate, bolted aluminum-to-aluminum connections shall be made with a suitable equivalent surface area, (i.e. l-bolt and spring washer). Bolts shall be tightened to an appropriate torque to assure good electrical connection.
- d) Before installation of the bus, all electrical contact surfaces shall first be prepared by abrading to remove any aluminum-oxide film. Immediately after this operation, the electrical contact surfaces shall be coated with a uniform coating of an oxide inhibitor and sealant.

### 3. Ground-Connection Pads

- a) A ground-connection pad shall be provided in each compartment of the pad-mounted gear.
- b) The ground-connection pad shall be constructed of 1/4" thick stainless steel, which shall be welded to the enclosure, and shall have a short-circuit rating equal to that of the pad-mounted gear.

### 4. Low-Voltage Components

- a) All low-voltage components, including switch operators, controls, and control-power source shall be located in a grounded, steel-enclosed compartment separate from high voltage to provide isolation and shall be arranged to allow complete accessibility for test and/or maintenance without exposure to high voltage.

- b) Low-voltage wiring, except for short lengths such as at terminal blocks and the secondaries of sensing devices, shall be shielded where necessary for isolation from high voltage.

## C. Construction - Enclosure & Finish

### 1. Enclosure

- a) The pad-mounted gear enclosure shall be of unitized monocoque (not structural-frame-and-bolted-sheet) construction to maximize strength, minimize weight, and inhibit corrosion.
- b) Separate integral, grounded, steel-enclosed low-voltage control compartments shall be provided for the switch operators, controls, and related communication equipment.
- c) The basic material shall be 11-gauge hot-rolled, pickled and-oiled steel sheet.
- d) All structural joints and butt joints shall be welded, and the external seams shall be ground flush and smooth. Bolted structural joints are not permitted.
- e) To guard against unauthorized or inadvertent entry, enclosure construction shall not utilize any externally accessible hardware.
- f) The base shall consist of continuous 90-degree flanges, turned inward and welded at the corners, for bolting to the concrete pad.
- g) The door openings shall have 90-degree flanges, facing outward, that shall provide strength and rigidity as well as deep overlapping between doors and door openings to guard against water entry.
- h) Three resilient material cushions shall be placed on door-opening edges to prevent metal-to-metal contact that would damage finish and lead to premature corrosion.
- i) Flanges at door openings on the low-voltage control compartment shall be provided with resilient compression gasketing around the entire door opening, and shall provide strength and rigidity for effective compression of the gasketing to prevent water entry.
- j) Enclosure top-side edges shall overlap with roof-side edges and form an internal maze to create an interface which shall allow ventilation of high-voltage compartments to help keep the enclosure interior dry while discouraging tampering or insertion of foreign objects.
- k) A heavy coat of insulating "no-drip" compound shall be applied to the inside under surface of the roof to minimize condensation of moisture thereon.
- l) Insulating interphase and end barriers of NEMA GP0-3 grade fiberglass-reinforced polyester shall be provided for each interrupter switch and each set of fuses where required to achieve BIL ratings.
- m) Full-length steel barriers shall separate side-by-side compartments and barriers of the same material shall separate the front compartments from the rear compartments.
- n) Lifting tabs shall be removable and sockets for the lifting-tab bolts shall be blind-tapped. A resilient protective material shall be placed between the lifting tabs and the enclosure to help prevent corrosion by protecting the finish against scratching by the tabs. To further preclude corrosion, this material shall be an open mesh to prevent moisture from being absorbed and held between the

tabs and the enclosure in the event that lifting tabs are not removed.

- o) A steel-compartmented base spacer shall be provided to increase the elevation of live parts in the pad-mounted gear above the mounting pad by 24 inches and to house voltage transformer(s) required for control voltage input to battery charger or other optional sensors.
- p) A closed-cell gasketing material shall be placed on the bottom flange as a protective interface between the steel enclosure and the mounting pad.
- q) Interrupter switches shall be provided with dual-purpose front barriers. These barriers, in their normal hanging positions, shall guard against inadvertent contact with live parts. It shall also be possible to lift these barriers out and insert them (but only for a temporary time interval not to exceed one week) into the open gap when the switch is open. A window panel shall be provided to allow viewing of the switch position without removing the barriers. These barriers shall meet the requirements of Section 381G of the National Electrical Safety Code (ANSI Standard C2).
- r) Each fuse with an integral load-interrupter shall be provided with a dual-purpose front barrier. These barriers, in their normal hanging positions, shall guard against inadvertent contact with live parts. It shall also be possible to lift these barriers out and insert them (but only for a temporary time interval not to exceed one week) into the open gaps when the fuses are in the disconnect position. These barriers shall meet the requirements of Section 381G of the National Electrical Safety Code (ANSI Standard C2).
- s) To prevent moisture ingress, the roof shall be one-piece construction and shall not include any gasketed joints or any unground weld butt joints exposed to the exterior.

## 2. Doors

- a) Doors providing access to high voltage shall be constructed of 11-gauge hot-rolled, pickled-and-oiled steel sheet.
- b) Doors providing access to high voltage shall have door-edge flanges that shall overlap with door-opening flanges and shall be formed to create an interface that shall guard against water entry and discourage tampering or insertion of foreign objects, but shall allow ventilation to help keep the enclosure interior dry.
- c) Doors providing access to the low-voltage control compartment shall have 90-degree flanges providing a deep overlap with the door openings. To keep low-voltage components clean and dry, these doors shall be fully gasketed.
- d) Doors shall have a minimum of three (for the basic enclosure) or two (for the low-voltage enclosure) stainless-steel hinges with stainless-steel hinge pins to provide strength, security, and corrosion resistance. Mounting hardware shall be stainless steel or zinc-plated steel, and shall not be externally accessible to guard against tampering.
- e) In consideration of controlled access and tamper resistance, each set of double doors providing access to high voltage shall be equipped with an automatic three-point latching mechanism.
  - 1) The latching mechanism shall be spring-loaded and shall latch automatically when the door is closed. All latch points shall latch at the same time to preclude partial latching.

2) A penta-head socket wrench or tool shall be required to actuate the mechanism to unlatch the door and, in the same motion, recharge the spring for the next closing operation.

3) The latching mechanism shall have provisions for padlocking that incorporate a means to protect the padlock shackle from tampering and that shall be coordinated with the latches such that:

i) It shall not be possible to access the penta-head actuator until the padlock is removed.

ii) It shall not be possible to unlatch the mechanism until the padlock is removed.

iii) It shall not be possible to insert the padlock until the mechanism is completely latched closed.

f) Doors providing access to low-voltage components may be equipped with a three-point latching mechanism that need not be automatic and a door holder at the top or bottom of the door.

g) Doors providing access to solid-material power fuses shall have provisions to store spare fuse units or refill units.

h) Each door providing access to high voltage shall be provided with a stainless steel door holder located above the door opening. The holder shall be hidden from view when the door is closed, and it shall not be possible for the holder to swing inside the enclosure.

## 3. Ventilation Openings

a) Rain-resistant vents shall be provided on doors providing access to the low-voltage control compartment.

b) Each vent shall have an inside stainless steel screen and a baffle to protect against insertion of foreign objects and entry of insects.

## 4. Finish

a) Full coverage at joints and blind areas shall be achieved by processing enclosures independently of components such as doors and roofs before assembly into the unitized structures.

b) All exterior seams shall be filled and sanded smooth for neat appearance.

c) All surfaces shall undergo a chemical cleaning, phosphatizing or zirconization and sealing before any protective coatings are applied in order to remove oils and dirt, form a chemically and anodically neutral conversion coating, improve the finish-to-metal bond, and retard underfilm propagation of corrosion.

d) The finishing system shall be applied without sags or runs for a pleasing appearance.

e) After the enclosure is completely assembled and the components (switches, bus, etc.) are installed, the finish shall be inspected for scuffs and scratches.

f) Blemishes shall be carefully touched up by hand to restore the protective integrity of the finish.

g) Unless otherwise specified, the color shall be Munsell No. 7GY3.29/1.5, dark green.

h) To assure that the finishing system is capable of resisting corrosion, the manufacturer shall provide, on request, certification that representative test panels, protected by the manufacturer's finish system, have passed the coating system performance requirements in section 5.5

of ANSI C57.12.28 as verified by an independent third party certifier, such as UL®.

- i) To guard against corrosion, all hardware (including door fittings, fasteners, etc.), all operating-mechanism parts, and other parts subject to abrasive action from mechanical motion shall be of either nonferrous materials, or galvanized or zinc chromate plated ferrous materials. Cadmium-plated ferrous parts shall not be used.

- j) Arc extinction shall not rely on gases generated by ablative action of the arc playing on any interrupter switch components or materials which will carbonize, deplete or erode such components and materials.
- k) Ground studs shall be provided at all switch terminals. Ground studs shall also be provided on the ground pad in each interrupter switch compartment. The momentary rating of the ground studs shall equal or exceed the short-circuit ratings of the pad-mounted gear.

## D. Basic Components

### 1. Interrupter Switches

- a) Interrupter switches shall meet the preferred ratings in IEEE C37.74, including a three-time duty-cycle fault-closing rating equal to or exceeding the short-circuit rating of the pad-mounted gear. These ratings define the ability to close the interrupter switch three times against a three-phase fault with asymmetrical current in at least one phase equal to the rated value, with the switch remaining operable and able to carry and interrupt rated current. Tests substantiating these ratings shall be performed at maximum voltage with current applied for at least 10 cycles. Certified test abstracts establishing such ratings shall be furnished upon request.
- b) Interrupter switches shall be operated by means of switch operators installed by the switch manufacturer.
- c) Each interrupter switch shall be completely assembled and adjusted by the switch manufacturer on a single rigid mounting frame. The frame shall be of welded steel construction such that the frame intercepts the leakage path which parallels the open gap of the interrupter switch to positively isolate the load circuit when the interrupter switch is in the open position.
- d) Interrupter switches shall be provided with a single-arm blade construction with parallel current paths for each phase for circuit closing including fault-closing, continuous current carrying, and separate contacts for circuit interrupting. Spring-loaded auxiliary blades that can become out of sequence with a main blade shall not be permitted.
- e) Interrupter switch blade supports shall be permanently fixed in place in a unified hinge contact assembly utilizing a louvered contact band configuration that provides expansion and, therefore, increased pressure at the contact transfer point for a stable interface during momentary currents.
- f) Switch-blade hinge contacts that have wiping contacts directly connected to switch terminals and can be pulled apart by cable connected to the switch terminals are specifically prohibited, such designs can present potential arcing faults if cables are pulled.
- g) Circuit interruption shall be accomplished by use of an interrupter which is positively and inherently sequenced with the blade position. It shall not be possible for the blade and interrupter to get out of sequence. Circuit interruption shall take place completely within the interrupter with essentially no external arc or flame.
- h) To increase contact separation speed, interrupter switch contacts on both sides of the arcing area shall be spring assisted to reduce arcing time.
- i) To further ensure arc extinction, air shall be compressed and simultaneously injected into the arcing area to cool the arc and, thereby, not rely solely on blade travel to ensure arc extinction.

### The following optional components can be selected:

- j) Bracket-mounted distribution-class surge arresters, metal-oxide type (specify rating), shall be provided at all source switch terminals.
- k) Switch terminals shall be provided with adapters to accommodate two cables per phase.
- l) Mounting provisions shall be provided to accommodate one three-phase fault indicator with three single-phase sensors in each interrupter switch compartment.
- m) Mounting provisions to accommodate LED-Type fault indicators. Holes for such fault indicators shall be plugged with a tamper-resistant arrangement for shipment.

### 2. Fuses

- a) Fuses shall be solid-material power fuses or current-limiting fuses as specified by the equipment purchaser.
- b) Fuse-mounting jaw contacts shall incorporate an integral load-interrupter that shall comply with all the preferred and optional test requirements in IEEE C37.74 to permit live switching of fuses with a hookstick equipped with a grapple tool and shall have a 3-time duty-cycle fault-closing capability at the interrupting rating of 22,400 amperes symmetrical.
  - 1) The integral load-interrupter housing shall be of the same cycloaliphatic epoxy resin as the insulators.
  - 2) The integral load-interrupter shall be in the current path continuously during circuit interruption. Auxiliary blades or linkages shall not be used.
  - 3) Live switching shall be accomplished by a firm, steady opening pull on the fuse pull ring with a hookstick. No separate load-interrupting tool shall be required.
  - 4) The integral load-interrupter shall require a hard pull to unlatch the fuse to reduce the possibility of an incomplete opening operation.
  - 5) Internal moving contacts of the integral load-interrupter shall be self-resetting after each opening operation to permit any subsequent closing operation to be performed immediately.
  - 6) Circuit interruption shall take place completely within the integral load-interrupter with essentially no external arc or flame.
  - 7) The integral load-interrupter and the fuse shall be provided with fault-closing contacts and current-carrying contacts and separate contacts for circuit interrupting. The fuse hinge shall be self-guiding and, together with the fault-closing contacts, shall guide the fuse into the current-carrying contacts during closing operations. Circuit-closing inrush currents and fault currents shall be picked up by the fault-closing contacts, not by current or interrupting contacts.

- 8) Integral load interrupters for fuses shall have a three-time duty-cycle fault-closing capability equal to the interrupting rating of the fuse at 14.4kv or 25kv. The duty-cycle fault-closing capability defines the level of available fault current into which the fuse can be closed the three-times without a quick-make mechanism and when operated vigorously through its full travel without hesitation at any point, with the integral load-interrupter remaining operable and able to carry and interrupt currents up to the emergency peak-load capabilities of the fuse.
  - 9) To further ensure arc extinction, air shall be compressed and simultaneously injected into the arcing area to cool the arc and, thereby, not rely solely on blade travel to ensure arc extinction.
  - 10) Arc extinction shall not rely on gases generated by ablative action of the arc playing on any interrupter switch components or materials which will carbonize, deplete or erode such components and materials.
- c) Fuse terminal pads shall be provided with a two-position adapter, making it possible to accommodate a variety of cable-terminating devices.
  - d) Ground studs shall be provided at all fuse terminals. One ground stud shall also be provided on the ground pad in each fuse compartment. The momentary rating of the ground studs shall equal or exceed the short-circuit ratings of the pad-mounted gear.
  - e) Fuse-mounting interrupter housing shall be provided with a target that protrudes and becomes visible only after the fuse has become fully latched, secured closed, and ready for opening.
  - f) Fuse-mounting interrupter housing shall incorporate a mechanical latching arrangement that shall capture the fuse contact rod on closing and on opening the latching arrangement shall not release until after the circuit has been interrupted. The mechanical latching arrangement shall make certain that the fuse-contact rod does not rely solely on friction to keep the contacts engaged and to avoid premature contact separation during the circuit interrupting sequence.

### 3. Switch Operators for Remote-Supervisory Control

- a) Switch-operators for remote-supervisory control shall be provided to operate the high-voltage source-interrupter switches. They shall be motor charged to trip-open and trip-close the switches.
- b) Switch operators shall charge and trip a quick-make quick-break mechanism on the switch installed by the switch manufacturer, and shall have sufficient mechanical energy to open or close the associated interrupter switch. The quick-make quick-break mechanism shall swiftly and positively open and close the interrupter switch independent of the speed of the charging motor or manual handle.
- c) Switch operators shall charge and trip the associated source-interrupter switch in response to a remote control signal.
- d) Toggle switches or pushbuttons shall be provided to permit local electrical trip-open and trip-closed operation. Local pushbutton electrical operation shall be prevented when the operator is in the remote mode.
- e) Switch operators shall be provided with a charging shaft and a removable manual handle to allow manual

charging and tripping of the quick-make quick-break mechanism in the event that control power is lost.

- f) Switch operators shall be located in a grounded, aluminum-enclosed low-voltage compartment. The compartment shall provide complete isolation from high voltage to help protect operating personnel.
- g) Switch operators shall be equipped with indicators to show whether the associated source-interrupter switch is in the open or closed position.
- h) Switch operators shall be provided with a decoupling feature to permit decoupling of the operator from the associated interrupter switch for testing and exercising of the switch operator and controls without opening or closing the interrupter switch and without exposure to high voltage.
- i) When the switch operator is decoupled, the associated interrupter switch shall be locked in the position it was in at the time of decoupling. It shall not be possible to recouple the switch operator to the source-interrupter switch unless the switch operator is in the same position (open or closed) as the interrupter switch.

### The following optional feature can be selected:

- j) Switch operators shall be provided with an extra 4-PST auxiliary switch coupled to the source-interrupter switch.

## 4. Interface For Remote Operation

### a) Interface Connections

- 1) The switch operator shall provide space for and shall allow for interfacing with a remote-terminal unit (RTU). The RTU shall be provided and installed by the user or may be optionally provided and installed by the supplier of the pad-mounted switchgear, or provided by the user and installed by the switchgear supplier, as designated in the user's specification.
- 2) The interface shall include terminal points for connection to the RTU that allow for determination of whether the switch is in the open position or in the closed position.
- 3) The interface shall include terminal points for connection to the RTU that allow for determination of whether the battery (if so equipped) is providing adequate voltage for operating the system.
- 4) The interface shall include terminal points for connection to the RTU that allow for remote operation of the switch operator to open and close the switch when coupled.
- 5) The interface shall include terminal points for connection to the RTU that allow for remote indication of the status of the Local/Remote Selector Switch (if furnished) — either in the LOCAL or REMOTE position.

### b) Control Features

- 1) A Local/Remote Selector Switch shall be furnished for choosing operating mode. In the "local" mode, electrical trip-open and trip-closed operation by means of pushbuttons shall be enabled while remote switching shall be inhibited.
- 2) The battery and battery charger, if furnished, shall be located in a grounded, steel-enclosed low-voltage compartment. The control compartment shall provide isolation from high voltage.

**The following optional features can be selected:**

- 3) Light-emitting lamps shall be furnished for indicating the presence of acceptable voltage on the high-voltage source.
  - 4) Separate light-emitting lamps shall be furnished for indicating the switch positions and the control operating mode (Local/Remote).
- c) Voltage Sensing and Control Power
- 1) Voltage sensing and control power input shall be provided by one or more voltage transformers on the load side of the source-interrupter switch.
  - 2) The output of the voltage transformers shall be directly proportional to line-to-ground voltage and shall have accuracy over an ambient temperature range suitable for the application.
  - 3) Constant-current devices vulnerable to being open circuited and requiring a protective device for such eventuality and shorting-type terminal blocks shall not be used to provide voltage sensing or power for operation.
- d) Current Sensing
- 1) Current sensing shall be provided to detect the level of load current as well as for fault detection and measurement. The feature shall include a light-emitting lamp for indicating when a fault condition has occurred, a reset button for manually resetting the overcurrent condition, and three current sensing devices for each source.
  - 2) Provisions shall be furnished for manually resetting the overcurrent condition from a remote location.

**The following optional features can be selected:**

- e) Voltage Sensing
- Three-phase voltage sensing shall be provided. Voltage sensing devices for three-phase sensing shall be furnished on phases where voltage transformers are not utilized.
- f) Remote Indication
- Remote-indication provisions shall be provided to permit remote monitoring of the presence or absence of source voltage and the operating mode — Local/Remote.
- g) Supervisory Control
- Supervisory control provisions shall be provided to permit switch operation from a remote location.

- d) Both sides of each barrier providing access to a fuse shall be provided with a sign indicating that "Fuses May Be Energized in Any Position".
- e) Any barriers used to guard against access to energized live parts shall be provided with a "Danger" sign on both sides.
- f) Dual-purpose barriers shall be provided with a label indicating that such barriers shall not be left inserted into the open gap for more than one week.
- g) Doors to fuse compartments shall include a label illustrating the correct latched condition for the integral load interrupter.
- h) Doors to fuse compartments shall include a label illustrating correct opening/closing switching operation for fuses with integral load interrupters.
- i) Removable barriers shall include a label stating that barrier should not be removed when the equipment is energized.

**2. Nameplate, Ratings Labels, & Connection Diagrams**

- a) The outside of both the front and back shall be provided with nameplates indicating the manufacturer's name, catalog number, model number, and date of manufacture.
- b) The inside of each door shall be provided with a ratings label indicating the following: voltage ratings; main bus continuous rating; short-circuit ratings (amperes, RMS symmetrical and MVA three-phase symmetrical at rated nominal voltage); the type of fuse and its ratings including duty-cycle fault-closing capability; and interrupter switch ratings, including duty-cycle fault-closing capability and amperes, short-time, RMS (momentary asymmetrical and one-second symmetrical).
- c) A three-line connection diagram showing interrupter switches, fuses and bus along with the manufacturer's model number shall be provided on the inside of both the front and rear doors, inside the door of each motor operator, and on the inside of each switch-operating hub access cover.

## F. Accessories

1. Furnish fuse components of the type specified by the purchaser. No fuse units shall be supplied unless actually noted by the purchaser in the specifications available to the switchgear manufacturer at the time of quotation.
2. A fuse-handling tool (for use on a customer furnished hotstick) as recommended by the fuse manufacturer shall be furnished.

## E. Labeling

1. Hazard-Alerting Signs & Labels
  - a) All external doors providing access to high voltage shall be provided with suitable hazard-alerting signs.
  - b) The inside of each door providing access to high voltage shall be provided with a "Danger—High Voltage—Keep Out — Qualified Persons Only" sign.
  - c) Each barrier providing access to an interrupter switch shall be provided with a sign indicating that "Switch Blades May Be Energized in Any Position" on both sides.

# STANDARD SPECIFICATION FOR DEAD-FRONT SCADA CONTROLLED PAD-MOUNTED SWITCHGEAR

## A. General

### 1. Plans

The pad-mounted gear shall be the SCPSE design as manufactured by Federal Pacific and shall conform to the following specification.

### 2. Assembly

The basic pad-mounted gear shall consist of a single self-supporting enclosure, containing interrupter switches and power fuses and separate, integral enclosure(s) including switch operator(s), controls, and control-power supply; and shall also provide the necessary accessory components, including sensing, controls, and control power input, all completely factory-assembled and operationally checked.

### 3. Ratings

a) Ratings for the integrated pad-mounted switchgear assembly shall be as designated below:

System Voltage Class			
	15kV †	25kV †	
kV, Nominal	14.4	25	
kV, Maximum Design	17.5	27½	
kV, BIL	95	125	
Main Bus Continuous, Amps	600	600	
Switch Load-Interrupting, Amps	600	600	
Switch Fuse Load-Interrupting, Amps	200	200	
Switch Short-Circuit Ratings ① ②			
Amps, RMS Symmetrical	Standard	14,000	12,500
	HFC	25,000	25,000
MVA, 3-Phase Symmetrical at Rated Nominal Voltage	Standard	350	540
	HFC	620	1,080
Fault-Closing Amps, RMS, Asym., 3-Time Duty-Cycle ③	Standard	14,000	12,500
	HFC	40,000	40,000

① These are nominal switch ratings. Integrated pad-mounted unit may be limited by fuse ratings. Use fuse rating chart in next column to select proper short circuit ratings.

② Select one set of the ratings shown. (Standard or High Fault Current-HFC)

③ The three-time duty-cycle fault-closing rating means that the switch can be closed three times into rated fault amperes and remain operable and able to carry and interrupt its rated load current.

‡ Maximum design of the 27kV switch is 29kV.

† For UL® Listed units, ratings are 15.5kV, 14,000 or 25,000 amperes rms symmetrical, 350 MVA, 22,400 or 40,000 amperes fault closing; and 27kV, 25,000 amperes rms symmetrical, 1080 MVA, 40,000 amperes asymmetrical fault closing.

b) The momentary and three-time duty-cycle fault-closing ratings of switches, momentary rating of bus, interrupting ratings of fuses shall equal or exceed the short-circuit ratings of the pad-mounted switchgear.

### 4. Certification of Ratings

The manufacturer shall be completely and solely responsible for the performance of the basic switch components as well as the complete integrated assembly as rated.

The manufacturer shall furnish, upon request, certification of ratings of the basic switch components and/or the integrated pad-mounted switchgear assembly consisting of the switch and fuse components in combination with the enclosure.

The following optional features may be specified:

a) The pad-mounted switchgear shall be UL® Listed. Consult factory for details if this feature is desired.

### 5. Compliance with Standards and Codes

The pad-mounted switchgear shall conform to or exceed the applicable requirements of the following standards and codes:

Fuse Ratings				
Fuse Manufacturer	Fuse Type	Three-Phase MVA Sym.	Amps RMS Asym. ①	Cont. Amps
<b>14.4 kV Nominal Voltage</b>				
S&C ④	SM-4	310	20000	200
S&C	SMU-20	350	22400	200
S&C ⑤	SM-5†	—	—	—
Eaton	DBU	350	22400	200
Cooper ④	CMU	350	22400	200
Cooper (M-E) ②	NX	620	40000	100*
Cooper (CT) ②	X-Limiter	620	40000	140
Thomas & Betts ② ③	Hi-Tech	620	40000	140
<b>25 kV Nominal Voltage</b>				
S&C ④	SM-4†	540	20000	200
S&C	SMU-20	540	20000	200
S&C ⑤	SM-5†	—	—	—
Eaton	DBU	540	20000	200
Cooper ④	CMU	540	20000	200
Cooper (M-E) ②	NX	1080	40000	40
Cooper (CT) ②	X-Limiter	1080	40000	40
Thomas & Betts ② ③	Hi-Tech	1080	40000	50

① The fuse mounting can withstand rated fault amperes up to three times and remain operable and able to carry its rated load current. For rating applicable to fault-closing capability of the separable connector (elbow), refer to elbow manufacturer.

② Maximum current rating of the fuse mounting is 22,400 amperes rms asymmetrical. Fuse mounting ratings can be increased to the fuse-interrupting rating ONLY if the current-limiting fuse limits the let-through current to a value equal to or less than the short-circuit rating of the fuse mounting. Refer to current-limiting fuse manufacturer.

③ Models with this fuse-type are not UL® Listed.

④ Check with the factory for UL® Listing.

\* 100 amp @ 13.5 kV max or 80 amp @ 15 kV.

† Applicable to solidly-grounded-neutral systems only with fuses connected by a single conductor concentric neutral type cable to a transformer or transformers. Rating is 9,400 amperes RMS symmetrical, 15,000 amperes RMS asymmetrical (405 MVA symmetrical) for all other applications.

‡ SM-5 fuses cannot be used in ATPSE Pad-mounted Switchgear. Contact factory for SM-5 applications.

a) All portions of ANSI C57.12.28, covering enclosure integrity for pad-mounted equipment.

b) Article 490.21(E) "Load Interrupters" in the National Electrical Code, which specifies that the interrupter switches in combination with power fuses shall safely withstand the effects of closing, carrying, and interrupting all possible currents up to the assigned maximum short-circuit rating.

c) All portions of IEEE C37.74 covering design and testing of the distribution switchgear, components and ways.

d) All portions of ANSI and IEEE standards applicable to the basic switch components.

### 6. Enclosure Design

a) To ensure a completely coordinated design, the pad-mounted gear shall be constructed in accordance with the minimum construction specifications of the fuse and/or switch manufacturer to provide adequate electrical clearances and adequate space for fuse handling.

b) In establishing the requirements for the enclosure design, consideration shall be given to all relevant factors such as controlled access, tamper resistance, and corrosion resistance.

## B. Construction - Assembly

### 1. Insulators

The interrupter-switch and fuse-mounting insulators shall be of a cycloaliphatic epoxy resin system with characteristics and restrictions as follows:

- a) Operating experience of at least 20 years under similar conditions.
- b) Ablative action to ensure non-tracking properties.
- c) Adequate leakage distance established by test per IEC Standard 60507.
- d) Adequate strength for short-circuit stress established by test.
- e) Conformance with applicable ANSI standards.
- f) Homogeneity of the cycloaliphatic epoxy resin throughout each insulator to provide maximum resistance to power arcs. Ablation due to high temperatures from power arcs shall continuously expose more material of the same composition and properties so that no change in mechanical or electrical characteristics takes place because of arc-induced ablation. Furthermore, any surface damage to insulators during installation or maintenance of the pad-mounted gear shall expose material of the same composition and properties so that insulators with minor surface damage need not be replaced.
- g) Each insulator shall be x-rayed to assure it is essentially void free. An alternate testing method may be used only by approval of the engineer.

### 2. High-Voltage Bus

- a) Bus and interconnections shall consist of aluminum bar with an oxide-inhibiting agent on all bus joints.
- b) Bus and interconnections shall withstand the stresses associated with short-circuit currents up through the maximum rating of the pad-mounted switchgear.
- c) Bolted aluminum-to-aluminum connections shall be made with a suitable number of non-corrosive bolts and with two Belleville spring washers per bolt, one under the bolt head and one under the nut, or with a wide, flange-head bolt and one Belleville spring washer under the nut per bolt. As an alternate, bolted aluminum-to-aluminum connections shall be made with a suitable equivalent surface area, i.e. 1-bolt and spring washer. Bolts shall be tightened to an appropriate torque to assure good electrical connection.
- d) Before installation of the bus, all electrical contact surfaces shall first be prepared by abrading to remove any aluminum-oxide film. Immediately after this operation, the electrical contact surfaces shall be coated with a uniform coating of an oxide inhibitor and sealant.

### 3. Ground-Connection Pads

- a) A ground-connection pad shall be provided in each compartment of the pad-mounted gear.
- b) The ground-connection pad shall be constructed of 1/4" thick steel (stainless steel or galvanized), which shall be welded to the enclosure, and shall have a short-circuit rating equal to that of the pad-mounted gear.

### 4. Low-Voltage Components

- a) All low-voltage components, including switch operators, controls, and control-power source shall be located in a grounded, steel-enclosed compartment separate from

high voltage to provide isolation and shall be arranged to allow complete accessibility for test and/or maintenance without exposure to high voltage.

- b) Low-voltage wiring, except for short lengths such as at terminal blocks and the secondaries of sensing devices, shall be shielded where necessary for isolation from high voltage.

## C. Construction - Enclosure & Finish

### 1. Enclosure

- a) The pad-mounted gear enclosure shall be of unitized monocoque (not structural-frame-and-bolted-sheet) construction to maximize strength, minimize weight, and inhibit corrosion.
- b) Separate integral, aluminum low-voltage control compartments shall be provided for the switch operators, controls, and related communication equipment.
- c) The basic switchgear enclosure material shall be 11-gauge hot-rolled, pickled-and-oiled steel sheet.
- d) All structural joints and butt joints shall be welded, and the external seams shall be ground flush and smooth. A welding process shall be employed that eliminates alkaline residues and minimizes distortion and spatter.
- e) To guard against unauthorized or inadvertent entry, enclosure construction shall not utilize any externally accessible hardware.
- f) The base shall consist of continuous 90-degree flanges, turned inward and welded at the corners, for bolting to the concrete pad.
- g) The door openings shall have 90-degree flanges, facing outward, that shall provide strength and rigidity as well as deep overlapping between doors and door openings to guard against water entry.
- h) Three resilient material cushions shall be placed on door-opening edges to prevent metal-to-metal contact that would damage finish and lead to premature corrosion.
- i) Flanges at door openings of the low-voltage control compartment shall be provided with resilient compression gasketing around the entire door opening, and shall provide strength and rigidity for effective compression of the gasketing to prevent water entry.
- j) A heavy coat of insulating "no-drip" compound shall be applied to the inside surface of the roof to reduce condensation of moisture thereon. The roof shall be removable with bolts accessible in termination compartments.
- k) Lifting tabs shall be removable and sockets for the lifting-tab bolts shall be blind-tapped. A resilient protective material shall be placed between the lifting tabs and the enclosure to help prevent corrosion by protecting the finish against scratching by the tabs. To further preclude corrosion, this material shall be an open mesh to prevent moisture from being absorbed and held between the tabs and the enclosure in the event that lifting tabs are not removed.
- l) To prevent moisture ingress, the roof shall be one-piece construction and shall not include any gasketed joints or any unground weld butt joints exposed to the exterior.
- m) A steel-compartmented base spacer shall be provided to increase the elevation of live parts in the pad-mounted

gear above the mounting pad by 12 inches and to accommodate optional sensors that may be required.

- n) A closed-cell gasketing material shall be placed on the bottom flange as a protective interface between the steel enclosure and the mounting pad.

## 2. Doors

- a) Doors providing access to high voltage shall be constructed of 11-gauge hot-rolled, pickled-and-oiled steel sheet.
- b) Doors providing access to high voltage shall have door-edge flanges that shall overlap with door-opening flanges and shall be formed to create an interface that shall guard against water entry and discourage tampering or insertion of foreign objects, but shall allow ventilation to help keep the enclosure interior dry.
- c) Doors providing access to the low-voltage control compartment shall have 90-degree flanges providing a deep overlap with the door openings. To keep low-voltage components clean and dry, these doors shall be fully gasketed.
- d) Doors shall have a minimum of three (for the basic enclosure) or two (for the low-voltage enclosure) stainless-steel hinges with stainless-steel hinge pins to provide strength, security, and corrosion resistance. Mounting hardware shall be stainless steel or zinc-plated steel and shall not be externally accessible to guard against tampering.
- e) In consideration of controlled access and tamper resistance, each set of double doors providing access to high voltage shall be equipped with an automatic three-point latching mechanism.
  - 1) The latching mechanism shall be spring loaded and shall latch automatically when the door is closed. All latch points shall latch at the same time to preclude partial latching.
  - 2) A penta-head socket wrench or tool shall be required to actuate the mechanism to unlatch the door and, in the same motion, recharge the spring for the next closing operation.
  - 3) The latching mechanism shall have provisions for padlocking that incorporate a means to protect the padlock shackle from tampering and that shall be coordinated with the latches such that:
    - i) It shall not be possible to access the penta-head actuator until the padlock is removed.
    - ii) It shall not be possible to unlatch the mechanism until the padlock is removed.
    - iii) It shall not be possible to insert the padlock until the mechanism is completely latched closed.
- f) Doors providing access to low-voltage components may be equipped with a three-point latching mechanism, that need not be automatic and a door stop at the top or bottom of the door.
- g) Doors providing access to solid-material power fuses shall have provisions to store spare fuse units or refill units.
- h) Each high-voltage compartment door shall be provided with a door holder located above the door opening. The holder shall be hidden from view when the door is closed and it shall not be possible for the holder to swing inside the enclosure.

## 3. Ventilation Openings

- a) Rain resistant vents shall be provided on doors providing access to the low-voltage control compartment.
- b) Each vent shall have an inside stainless-steel screen and a baffle to protect against insertion of foreign objects and entry of insects.

## 4. Finish

- a) Full coverage at joints and blind areas shall be achieved by processing enclosures independently of components such as doors and roofs before assembly into the unitized structures.
- b) All exterior seams shall be filled and sanded smooth for neat appearance.
- c) All surfaces shall undergo a chemical cleaning, phosphatizing or zirconization, and sealing process before any protective coatings are applied in order to remove oils and dirt, to form a chemically and anodically neutral conversion coating, to improve the finish-to-metal bond, and to retard underfilm propagation of corrosion.
- d) The finishing system shall be applied without sags or runs.
- e) After the enclosure is completely assembled and the components (switches, bus, etc.) are installed, the finish shall be inspected for scuffs and scratches.
- f) Blemishes shall be carefully touched up by hand to restore the protective integrity of the finish.
- g) Unless otherwise specified, the color shall be Munsell No. 7GY3.29/1.5, dark green.
- h) To assure that the finishing system is capable of resisting corrosion, the manufacturer shall provide on request, certification that representative test panels, protected by the manufacturer's finish system, have passed the coating system performance requirements in section 5.5 of ANSI C57.12.28 as verified by an independent third party certifier, such as UL®.
- i) To guard against corrosion, all hardware (including door fittings, fasteners, etc.), all operating-mechanism parts, and other parts subject to abrasive action from mechanical motion shall be of either nonferrous materials, or galvanized or zinc chromate plated ferrous materials. Cadmium-plated ferrous parts shall not be used.

## D. Basic Components

### 1. Interrupter Switches

- a) Interrupter switches shall have a three-time duty-cycle fault-closing rating equal to or exceeding the short-circuit rating of the pad-mounted gear. These ratings define the ability to close the interrupter switch three times against a three-phase fault with asymmetrical current in at least one phase equal to the rated value with the switch remaining operable and able to carry and interrupt rated current. Tests substantiating these ratings shall be performed at maximum voltage with current applied for at least 10 cycles. Certified test abstracts establishing such ratings shall be furnished upon request.
- b) Interrupter switches shall be operated by means of switch operators installed by the switch manufacturer.
- c) Each interrupter switch shall be completely assembled and adjusted by the switch manufacturer on a single

rigid mounting frame. The frame shall be of welded steel construction such that the frame intercepts the leakage path which parallels the open gap of the interrupter switch to positively isolate the load circuit when the interrupter switch is in the open position.

- d) Interrupter switches shall be provided with a single-arm blade construction with parallel current paths for each phase for circuit-closing including fault-closing, and continuous current carrying, and separate contacts for circuit interrupting. Spring-loaded auxiliary blades that can become out of sequence with a main blade shall not be permitted. Interrupter switch blade supports shall be permanently fixed in place in a unified hinge contact assembly utilizing a louvered contact band configuration that provides expansion and, therefore, increased pressure at the contact transfer point for a stable interface during momentary currents.
- e) Circuit interruption shall be accomplished by use of an interrupter which is positively and inherently sequenced with the blade position. It shall not be possible for the blade and interrupter to get out of sequence. Circuit interruption shall take place completely within the interrupter with essentially no external arc or flame.
- f) To increase contact separation speed, interrupter switch contacts on both sides of the arcing area shall be spring assisted to reduce arcing time.
- g) To further ensure arc extinction, air shall be compressed and simultaneously injected into the arcing area to cool the arc and, thereby, not rely solely on blade travel to ensure arc extinction.
- h) Arc extinction shall not rely on gases generated by ablative action of the arc playing on any interrupter switch components or materials which will carbonize, deplete or erode such components and materials.
- i) Switch terminals shall connect to 600-ampere bushings to accommodate 600-ampere elbows.

**The following optional components can be selected:**

- j) Mounting provisions shall be provided to accommodate one three-phase fault indicator with three single-phase sensors in each interrupter switch compartment.
- k) Provision to padlock switch-operating hub in open or closed position shall be provided.
- l) Cable guides shall be provided to help orient cables at switch and bus compartment terminals.

**2. Switch Compartments**

- a) Switch terminals shall be equipped with 600 ampere rated bushings that include removable silver-plated copper threaded studs to accommodate a choice of termination systems.
- b) Bushings and bushing wells shall have interfaces in accordance with ANSI/IEEE Standard 386 (ANSI Standard C119.2) to accept all standard separable insulated connectors and inserts.
- c) Parking stands are provided adjacent to each bushing and bushing well to accommodate horizontal feed-throughs and standoff insulators.
- d) All medium-voltage switch and fuse components are completely encased in an inner grounded steel compartment. The component compartment floor shall be of 18-gauge galvanized steel sheet to exclude foliage

and animals. The floor shall be cross-kinked and shall have a small stainless-steel screen in each corner.

- e) Viewing windows are provided within the termination compartments to allow visual verification of switch position, observation of switch-position open/close labels and inspection of blown-fuse indicators on power fuses.

**3. Fuse Compartments**

- a) Fuse terminals are equipped with 200 ampere rated bushing wells designed to accept 200 ampere bushing inserts and shall have removable, silver-plated copper studs.
- b) Bushings and bushing wells shall have interfaces in accordance with ANSI/IEEE Standard 386 (ANSI Standard C119.2) to accept all standard separable insulated connectors and inserts. Parking stands are provided adjacent to each bushing and bushing well to accommodate horizontal feed-throughs and standoff insulators.
- c) Fuse access panels shall have a mechanical interlock that guards against gaining access to the fuse before opening the load-break separable insulated connector at the fuse terminal.
- d) The fuse shall be accessible only when de-energized and isolated — for full-view non-loadbreak disconnection and removal with a shotgun stick. This mounting features positive latching in both the energized and de-energized positions. When latched in the open position, the de-energized fuse is electrically isolated and readily accessible to operating personnel for removal with full visibility of contact interfaces on both sides of the fuse.
- e) Access to the compartment containing energized components when fuses are being changed shall be blocked by a GPO-3 panel that is secured in position.
- f) Individual parking stands shall be provided for each fuse mounting to allow convenient installation of elbow accessories to accommodate grounding. A ground rod shall be installed across the full width of the fuse compartments for connecting of cable concentric neutrals. Fuse phases shall be equipped with cable guides to assist in cable training and to prevent cables from interfering with movement of the fuse-access panel.
- g) To provide maximum service life and to prevent corrosion of moving parts, all latches and pivots in the fuse-handling mechanism shall be either painted steel, stainless steel, or zinc-plated.

**The following optional features may be specified:**

- h) Fuse storage hooks shall be provided on fuse-termination compartment access door(s). Each set of hooks shall allow the storing of three complete fuse assemblies for power fuses. Storage hooks shall be for two holders when current-limiting fuses are used.

**4. Switch Operators for Remote-Supervisory Control**

- a) Switch-operators for remote-supervisory control shall be provided to operate the high-voltage source interrupter switches. They shall be motor charged to trip-open and trip-close the switches.
- b) Switch operators shall charge and trip a quick-make quick-break mechanism on the switch installed by the switch manufacturer, and shall have sufficient mechanical energy to open or close the associated interrupter switch.

The quick-make quick-break mechanism shall swiftly and positively open and close the interrupter switch independent of the speed of the charging motor or manual handle.

- c) Switch operators shall charge and trip the associated source interrupter switch in response to a remote control signal.
- d) Pushbuttons shall be provided to permit local electrical trip-open and trip-closed operation. Local pushbutton electrical operation shall be prevented when the operator is in the remote mode.
- e) Switch operators shall be provided with a charging shaft and a removable manual handle to allow manual charging and tripping of the quick-make quick-break mechanism in the event control power is lost.
- f) Switch operators shall be located in a grounded, steel-enclosed low-voltage compartment. The compartment shall provide complete isolation from high voltage to help protect operating personnel.
- g) Switch operators shall be equipped with indicators to show whether the associated source interrupter switch is in the open or closed position.
- h) Switch operators shall be provided with a decoupling feature to permit decoupling of the operator from the associated interrupter switch for testing and exercising of the switch operator and controls without opening or closing the interrupter switch and without exposure to high voltage.
- i) When the switch operator is decoupled, the associated interrupter switch shall be locked in the position it was in at the time of decoupling. It shall not be possible to recouple the switch operator to the source interrupter switch unless the switch operator is in the same position (open or closed) as the interrupter switch.

**The following optional feature can be selected:**

- j) Switch operators shall be provided with an extra 4-PST auxiliary switch coupled to the source interrupter switch.

**5. Interface For Remote Operation**

- a) Interface Connections
  - 1) The switch operator shall provide for interfacing with a remote-terminal unit (RTU). The RTU shall be provided and installed by the user or may be optionally provided and installed by the supplier of the pad-mounted switchgear, or provided by the user and installed by the switchgear supplier, as designated in the user's specification.
  - 2) The interface shall include terminal points for connection to the RTU that allow for determination of whether the switch is in the open position or in the closed position.
  - 3) The interface shall include terminal points for connection to the RTU that allow for determination of whether the battery (if so equipped) is providing adequate voltage for operating the system.
  - 4) The interface shall include terminal points for connection to the RTU that allow for remote operation of the switch operator to open and close the switch when coupled.
  - 5) The interface shall include terminal points for connection to the RTU that allow for remote indication

of the status of the Local/Remote Selector Switch (if furnished)—either in the LOCAL or REMOTE position.

**b) Control Features**

- 1) A Local/Remote Selector Switch shall be furnished for choosing operating mode. In the "local" mode, electrical trip-open and trip-closed operation by means of pushbuttons shall be enabled while remote switching shall be inhibited.
- 2) The battery and battery charger, if furnished, shall be located in a grounded, steel-enclosed low-voltage compartment. The control compartment shall provide isolation from high voltage.

**The following optional features can be selected:**

- 3) Light-emitting lamps shall be furnished for indicating the presence of acceptable voltage on the high-voltage source.
- 4) Separate light-emitting lamps shall be furnished for indicating the switch positions and the control operating mode (Local/Remote).

**c) Voltage Sensing and Control Power**

- 1) Voltage sensing and control power input shall be provided by one or more voltage transformers on the load side of the source interrupter switch.
- 2) The output of the voltage transformers shall be directly proportional to line-to-ground voltage and shall have accuracy over an ambient temperature range suitable for the application.
- 3) Constant current devices vulnerable to being open circuited and requiring a protective device for such eventuality and shorting-type terminal blocks shall not be used to provide voltage sensing or power for operation.

**d) Current Sensing**

- 1) Current sensing shall be provided to detect the level of load current as well as for fault detection and measurement. The feature shall include a light-emitting lamp for indicating when a fault condition has occurred, a reset button for manually resetting the overcurrent condition, and three current sensing devices for each source.
- 2) Provisions shall be furnished for manually resetting the overcurrent condition from a remote location.

**The following optional features can be selected:**

**e) Voltage Sensing**

Three-phase voltage sensing shall be provided. Voltage sensing devices for three-phase sensing shall be furnished on phases where voltage transformers are not utilized.

**f) Remote Indication**

Remote-indication provisions shall be provided to permit remote monitoring of the presence or absence of source voltage and the operating mode — Local/Remote.

**g) Supervisory Control**

Supervisory control provisions shall be provided to permit switch operation from a remote location.

## E. Labeling

### 1. Warning Signs

- a) Each external door providing access to high voltage shall be provided with a suitable hazard-alerting sign.
- b) The inside of each door providing access to high voltage shall be provided with a "Danger-High Voltage — Keep Out — Qualified Persons Only" sign.
- c) Any barrier used to prevent access to energized live parts shall be provided with a "Danger-High Voltage-Keep Out-Qualified Persons Only" sign on both sides.

### 2. Nameplate, Ratings Labels, & Connection Diagrams

- a) The outside of both the front and back shall be provided with nameplates indicating the manufacturer's name, catalog number, model number, and date of manufacture.
- b) The inside of each door shall be provided with a ratings label indicating the following: voltage ratings; main bus continuous rating; short-circuit ratings (amperes, RMS symmetrical and MVA three-phase symmetrical at rated nominal voltage); the type of fuse and its ratings including duty-cycle fault-closing capability; and interrupter switch ratings, including duty-cycle fault-closing capability and amperes, short-time, RMS (momentary asymmetrical and one-second symmetrical).
- c) A three-line connection diagram showing interrupter switches, fuses and bus along with the manufacturer's model number shall be provided on the inside of both the front and rear doors, inside the door of each motor operator, and on the inside of each switch operating hub access cover.

## F. Accessories

1. Furnish fuse components of the type specified by the purchaser. No fuse units shall be supplied unless actually noted by the purchaser in the specifications available to the switchgear manufacturer at the time of quotation.
2. A fuse handling tool (for use on a customer furnished hotstick) as recommended by the fuse manufacturer shall be furnished.
3. Grounding elbows as recommended by the switchgear purchaser.