STANDARD SPECIFICATION FOR DEAD-FRONT AUTOMATIC-TRANSFER PAD-MOUNTED SWITCHGEAR

A. General

1. Product

The pad-mounted switchgear shall be Dead-Front ATPSE design as manufactured by Federal Pacific and shall conform to the following specification.

2. Assembly

The pad-mounted switchgear shall consist of a single self-supporting enclosure, containing interrupter switches and power fuses with the necessary accessory components, including sensing, controls, and control power supply, 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	27§
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
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.

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.

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

4. Certification of Ratings:

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

The manufacturer shall furnish, upon request, certification of ratings of the basic switch and fuse components and/or the integrated pad-mounted switchgear assembly consisting of the switch and fuse components in combination with the enclosure. This certification of the integrated unit shall include testing the pad-mounted switchgear to the fault-close requirements of the specification to assure the bus support system and components are adequate. Spacing between bus-support insulators in the unit furnished shall not exceed the spacing in the unit tested.

5. **Compliance with Standards and Codes:**

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

   a) Applicable safety and health standards promulgated pursuant to Federal Occupational Safety and Health Act of 1970.

   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 ANSI C57.12.28 covering enclosure integrity for pad-mounted equipment.

   d) All portions of IEEE C37.74, including all preferred and optional ratings.

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

6. **Enclosure Design:**

   To ensure a completely coordinated design, the pad-mounted switchgear 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 and tamper resistance.

B. Construction – Assembly

1. **Insulators**

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

   a) Operating experience of at least 15 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/IEEE standards.

   f) Homogeneity of the cycloaliphatic epoxy resin throughout each insulator to provide maximum resistance to power arcs. Ablation due to high temperature 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 cycloaliphatic epoxy insulator, including bushings and bushing wells, shall be x-rayed to assure it is essentially void free. An alternate testing method may be used only by approval of the engineer.

   h) Insulating operating arms, such as pushrods, not of a cycloaliphatic epoxy shall be of a non-hygroscopic material and must have 15 years exposure in environments subject to moisture ingress such as in pad-mounted switchgear installed over a cable pit subject to standing water for extended intervals

2. **High-Voltage Bus:**

   a) Bus and interconnections shall consist of bare aluminum bar of 56% IACS conductivity with an oxide-inhibiting agent at all bus joints.

   b) Bus and interconnections shall withstand the stresses associated with short circuits up through the maximum rating of the pad-mounted gear, including proper allowance for transient conditions.

   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. Bolts shall be tightened to an appropriate torque to assure good electrical connection. As an alternate, aluminum-to-aluminum connections shall be made with a suitable equivalent surface area of an integrated and flanged carriage-bolt head and one Belleville washer (i.e. a one-piece carriage-bolt with spring washer).

   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.

   e)Where necessary, such as to achieve BIL or for enhanced isolation from the environment, the bus may be covered by a heat-shrink insulating material proven to be suitable for the voltage and the phase spacing involved.

The following optional feature may be specified:

   f) Copper bus instead of aluminum bus

3. **Ground Connections Pads:**

   a) A ground connection pad shall be provided in each termination compartment of the pad-mounted gear.

   b) The ground-connection pad shall be constructed of galvanized steel or stainless steel 1/4" thick and have a NEMA 2-hole pattern for ground connections. The pad shall be welded to the enclosure and shall have a short-circuit rating equal to that of the integrated assembly.

   c) A copper grounding rod, with each end bolted to the ground connection pad, shall be provided across the full width of each cable terminating compartment.

4. **Low-Voltage Components**

   a) All low-voltage components, including motor operators and relays, shall be located in a grounded, steel-enclosed or aluminum 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 secondary of sensing devices, shall be shielded, where necessary, for isolation from high voltage.

C. Construction Enclosure and Finish

1. **Enclosure:**

   a) The pad-mounted enclosure shall be of unitized welded construction (not structural frame and bolted sheet) to maximize strength, minimize weight, and inhibit internal corrosion.

b) Separate grounded, steel-enclosed or aluminum low-voltage control compartments shall be provided for the relay and motor operators.

c) The basic pad-mounted enclosure materials shall be 11-gauge hot-rolled, pickled-and-oiled steel sheet. Enclosures of motor operators and micro-processor control may be of heavy-gauge aluminum sheet or steel.

d) All structural joints and butt joints shall be welded, and the external seams shall be ground flush and smooth.

e) To guard against unauthorized or inadvertent entry, enclosure construction shall not utilize any externally accessible hardware that allows penetration inside the enclosure.

f) The enclosure base shall consist of continuous 90-degree flanges, turned inward and welded at the corners, for bolting to the concrete pad. A closed-cell gasket material shall be placed on the bottom flange as a protective interface between the steel enclosure and the mounting pad.

g) The enclosure 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. Flange corners shall be welded and ground smooth unless formed without a seam.

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 gasket around the entire door opening, and shall provide strength and rigidity for effective compression of the gasket to prevent water entry.

j) Enclosure top side edges shall overlap with roof side edges and a gasket shall be provided at the top flange around the high-voltage component compartment to isolate that section from environmental conditions.

k) A heavy coat of insulating "no-drip" compound shall be applied to the inside surface of the roof to minimize condensation of moisture thereon.

l) Full-length steel barriers shall separate side-by-side termination compartments and barriers of the same material shall separate the termination compartments from the high-voltage compartments.

m) 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 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.

n) The enclosure shall provide space in the pad-mounted gear to accommodate sensors.

o) In consideration of tamper resistance, the enclosure shall conform to or exceed the requirements of IEEE C57.12.28 – Pad-Mounted Equipment Enclosure Integrity.

2. Barrier Assembly:

Insulating interphase and end barriers shall be of NEMA GPO-3 grade fiberglass-reinforced polyester and shall be provided for each interrupter switch and each set of fuses where required to achieve BIL ratings.

3. Doors

a) Doors 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 interior of termination compartments dry. Flange corners shall be welded and ground smooth unless formed without seams.

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 door openings shall include gasket on all sides.

d) Doors providing access to high voltage shall have a minimum of three hinges and doors providing access to low-voltage components shall have a minimum of two hinges or continuous hinges. Door hinges shall be of stainless steel 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 or termination compartments 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 placed on a penta-head bolt 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 actuating penta-head bolt shall have a cover that is padlockable and the bolt shall not require excessive force to turn.

4) 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.

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.

iv) All moving parts of the latches and all latch springs and bushings shall be of stainless steel

f) As an alternate, doors providing access to low-voltage components may be equipped with a padlockable door handle and a door holder at the bottom.

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 door holder located above the door opening. The holder shall be of stainless steel and be hidden from view when the door is closed; it shall not be possible for the door holder to swing inside the enclosure.

The following optional feature may be specified:

i) If specified, an optional storage arrangement accommodating three complete fuse assemblies shall be provided on each fuse-compartment door. Fuse storage arrangements in the switch-termination compartments are not acceptable.

4. Ventilation Openings

a) A vent shall be provided in each corner of the floor plate in the high-voltage compartment. Each vent shall have an inside stainless steel screen to protect against entry of insects.

b) Screened ventilation openings shall be provided in the bottom of the low-voltage compartments.

The following optional feature may be specified:

c) If specified, rain-resistant vents shall be provided on the enclosure to provide increased ventilation of termination or high-voltage compartments as specified by the purchaser.

5. 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 sanded or ground smooth for neat appearance.

c) All surfaces shall undergo a chemical cleaning, phosphatizing, and sealing process 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.

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 ANSI C57.12.28-1999.

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. Peak currents shall be consistent with the requirements of IEEE standard C37.74. Certified test abstracts establishing such ratings shall be furnished upon request.

b) Interrupter switches shall be operated by means of motor 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, and with contacts for circuit closing including fault closing, continuous current carrying, and circuit interrupting. Spring-loaded auxiliary blades that can be 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 high momentary and fault currents.

f) Circuit interruption shall be accomplished by use of an interrupter that 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 within the interrupter with essentially no external arc or flame.

g) To increase contact separation speed, interrupter switch contacts on both sides of the arcing area shall be spring assisted to reduce arcing time.

h) 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.

i) 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 otherwise erode such components and materials.

j) Switch terminals shall connect to 600 ampere bushings to accommodate 600 ampere elbows.

The following optional feature may be specified:

k) Mounting provisions shall be provided to accommodate either one three-phase fault indicator with three single-phase sensors in each interrupter switch compartment and (with or without, select one) a viewing window in the door or an LED-Type fault indicator with 5/16" diameter hole on each switch-compartment door with each hole plugged for shipment using s system of tamper-resistant hardware.

l) Switch terminals shall connect to 200 ampere bushing wells to accommodate 200 ampere load-break elbows inserts (elbows and inserts not included). Bushing wells replace 600 ampere bushings.

m) An independent set of three (3) 200 ampere bushing wells (one per phase) shall be provided at each switch position with one bushing well positioned adjacent to each 600 ampere bushing. Accommodation of this set of 200 ampere bushing wells shall not require an increase in the height of the unit and shall be used to accommodate load-break inserts with grounding elbows or surge arresters (inserts, grounding elbows and surge arresters not included).

2. Fuses

a) Fuses shall be solid-material power fuses or current-limiting fuses as specified by the equipment purchaser.

b) Fuse terminals shall incorporate 200 ampere load-break bushing wells.

The following optional feature may be specified:

c) Fuse storage hooks shall be provided on the inside of each fuse-termination compartment door. These hooks shall accommodate a complete fuse assembly consisting of a fuse holder with fuse units or end fittings with silencer plus the fuse unit. Fuse storage provisions shall not be inside switch termination-compartment doors.

3. Motor Operators

a) The motor operators shall be provided to operate the high-voltage source-interrupter switches. They shall be run-and-trip style, which charges and trips the switch quick-make quick-break mechanism in 6-8 seconds after operation is initiated. (Optional Fast-Trip Motor Operators are available see section below headed: "The following optional feature may be specified:"

b) The motor operators shall charge and trip the switch, which has an integral quick-make quick-break mechanism 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 source-interrupter switch independent of the speed of the charging motor or manual crank handle.

c) The motor operators shall charge and trip the mechanism to release the stored energy to open or close the associated source-interrupter switch in response to a control signal.

d) The motor operators shall be equipped with a motor that shall charge the quick-make quick-break mechanism, even when voltage is present on only one source.

e) Toggle switches or pushbuttons shall be provided to permit local electrical trip-open and trip-closed operation. Local toggle switch or pushbutton electrical operation shall be prevented when the controlling relay is in the automatic mode.

f) The motor operators shall be provided with a charging shaft and a removable manual crank handle to allow manual charging and tripping of the quick-make quick-break mechanism in the event that control power is lost.

g) The motor operators shall be located in grounded, aluminum low-voltage control compartments. The control compartments shall provide complete isolation from high voltage to help protect operating personnel.

h) There shall be indication to show if the mechanism is coupled or decoupled, if the associated source-interrupter switch is in the open or closed position, and if the motor operator is in the switch-open or switch-closed position.

i) There shall be an operation counter provided for each motor operator to show the number of operations that have been performed by the motor.

j) The motor operators shall be provided with a decoupling feature to permit decoupling of the motor operator output shaft from the associated source-interrupter switch for testing and exercising of the motor operator and control relay without opening or closing the interrupter switch and without exposure to high voltage. A tool other than the manual crank handle shall not be required for decoupling or coupling the switch and switch operator.

k) When the motor operator is decoupled, the associated source-interrupter switch shall be locked in the position it was in at the time of decoupling. It shall not be possible to couple the motor operator to the source-interrupter switch unless the motor operator is in the same position (open or closed) as the source-interrupter switch.

l) Electrical functionality of the transfer system shall be enabled only when both motor operators are either coupled to or decoupled from their associated switch. Electrical functionality of the transfer system shall be disabled when one motor operator is coupled and the other motor operator is decoupled.

m)The motor operator shall be provided with visual indication in order to establish the condition of the motor operator as either open or closed.

The following optional feature may be specified:

n) Each source interrupter switch shall be provided with an extra 4-PST auxiliary switch coupled to the source-interrupter switch with a minimum of one contact pair available for customer connection.

o) The motor operators shall be provided with an extra 4-PST auxiliary switch coupled to each motor with a minimum of one contact pair available for customer connection.

p) The motor operators shall be fast-trip style, which charges and trips the switch mechanism in approximately 18-19 cycles after operation is initiated. As a result, a complete transfer operation (one switch opening and the other switch closing) can be accomplished in 25-29 cycles.

4. Control for Automatic Transfer

a) Operating Description

1) Transfer on Loss and Return of Source Voltage

i) The control relay shall be the SEL-451 relay and shall utilize the common-bus primary-selective system. The normal condition shall be with one source-interrupter switch (for the preferred source) closed to energize the high-voltage bus and with the other source-interrupter switch (for the alternate source) open with its associated power source available as a standby. The control in AUTO shall monitor the conditions of both power sources and shall initiate automatic switching when the preferred-source voltage has been lost (or reduced to a predetermined field-selectable level) for a period of time (field selectable) sufficient to confirm that the loss is not transient. Automatic switching shall open the preferred-source-interrupter switch and then close the alternate-source-interrupter switch to restore power to the high-voltage bus.

ii) When normal voltage returns to the preferred source for a field-selectable preset time, the control shall initiate re-transfer to the preferred source if in the Auto Retransfer function is enabled, or await manual re-transfer if the Auto Retransfer function is disabled. When the Auto Retransfer function is disabled and if the alternate source fails and the preferred source has been restored, the control relay shall override the hold function and initiate an Auto Retransfer to the preferred source.

iii) In the Auto Retransfer enabled mode, the control relay shall provide field selectivity of either Source Paralleling enabled (closed transition return) or Source Paralleling disabled (open transition) on re-transfer.

2) Transfer on Unbalance Condition

i) An unbalance detection feature with a field selectable voltage level shall initiate automatic switching on detection of source-side open-phase conditions at the same system voltage level as the pad-mounted gear, whether caused by utility-line burndown, broken conductors, single-phase switching, equipment malfunctions, or single-phasing resulting from blown source-side fuses. The control relay shall continuously monitor the voltage to detect any based on a zero-sequence voltage unbalance present as a result of an open-phase condition. Automatic switching shall occur when the system unbalance-detect voltage is present for a period of time (field selectable) sufficient to confirm that the condition is not transient.

ii) If Auto Retransfer enabled has been selected when normal phase voltages return to the preferred source, the control shall initiate re-transfer to the preferred source as described in 4. (a) (1) (ii) and (iii).

b) Control Features

1) The operating characteristics of the control relay and its voltage-, current-, and time-related operating parameters shall be field programmable and entered into the control by a laptop computer. To simplify entry of this information, a listing of all the field selectable functions shall be included in a single MM Transfer Settings file with tabs to all navigation to all the settings to allow changing the parameter setting using the laptop computer keyboard.

2) All operating characteristics and operating parameters shall be noted in instruction bulletins or otherwise available for review on the laptop computer.

3) The control relay shall have a large LCD screen to display the relay primary display points, which shall automatically scroll on the screen every five (5) seconds.

4) An LED with an appropriate label shall be furnished for indicating the presence of acceptable voltage on each phase of each high-voltage source.

5) A separate LED with an appropriate label shall be furnished for indicating the control relay operating mode (AUTO OR MANUAL) along with a soft key to allow direct selection of the applicable setting. In the manual mode, local electrical trip-open and trip-closed operation by means of pushbuttons shall be enabled while automatic switching shall be inhibited.

6) Separate LEDs shall be furnished for indicating the position of each switch.

7) Separate LEDs shall be furnished for indicating whether the motor operator is decoupled from the associated switch.

8) A separate test area shall be furnished with pushbuttons for simulating loss of voltage on each of the two sources.

9) A light-emitting lamp shall provide indication that the control relay is enabled and functioning properly.

10) The control relay shall provide for:

i) Field selection by means of a laptop computer keypad of the timer setting that establishes the time delay between reduction of source voltage below the activation level and initiation of opening of the preferred source switch.

ii) Field selection by means of a laptop computer keypad of the timer setting that establishes the time delay between return of source voltage to a value above the activation level and initiation of opening of the alternate source and reclosing of the preferred source.

11) The control relay shall incorporate an event log and shall have a LCD display to view settings and the event log entries.

12) The control relay shall allow for pushbutton selection of either source switch as the preferred source switch and shall provide an LED that illuminates to indicate the status

13) The control relay shall provide a pushbutton and LED to allow reset of the Hold Return condition and the pushbutton shall have to be pressed and held pressed for three (3) seconds before the Hold Return is deactivated and the switch will subsequently initiate an immediate return transfer to the preferred source. The return transfer shall either be open return or closed return depending on the field selectable setting that has been chosen.

14) The control relay shall provide a pushbutton and LED to allow activation of the Remote Enabled function.

15) The control relay shall provide an LED to Indicate that the motor operator are not in the same position (MISMATCH).

16) The control relay shall provide LEDs to indicate whether or not a motor operator is in a NO GO condition.

17) The control relay shall provide an LED to indicate whether the control is in Remote or Is in Local.

18) A uninterruptable power supply (UPS) shall be provided to provide power to the control relay when both sources are lost and there shall be an LED that illuminates when the battery or battery charger are not functioning properly.

c) Construction Features

1) The control relay shall use components to provide the superior reliability required for use in power equipment. All components shall be selected to minimize the number of interconnections for increased reliability.

2) The control shall be located either in the grounded, aluminum or steel-enclosed low-voltage compartment with a motor operator or in a separate low-voltage compartment. The control compartment shall provide isolation from high voltage.

3) The control shall provide a ten (10) year warranty from the date of its manufacture.

d) Voltage Sensing and Control Power

1) Voltage sensing and control power shall be provided by a combination of voltage sensors or by fused voltage transformers on the line side of each phase of the source-interrupter switches.

2) The output of the voltage sensors or voltage transformers shall be directly proportional to system 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 and power for operation.

The following optional features may be specified:

e) Overcurrent Lockout

1) An over-current lockout feature shall be provided to prevent an automatic-transfer operation that would close a source-interrupter switch into a fault. The feature shall include a light-emitting lamp for indicating when a lockout condition has occurred, a reset key for manually resetting the lockout condition, and three current sensors for each source.

2) Provisions shall be furnished for manually resetting the over-current lockout feature from a remote location.

3) Test pushbutton shall be provided for simulating an over-current lockout condition on each source.

f) Remote Indication

Remote-indication provisions shall be provided to permit remote monitoring of the presence or absence of preferred- and alternate-source voltage as well as the operating mode of the source-transfer control (i.e., Auto or Manual).

g) Supervisory Control

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

E. Labeling

1. Warning Signs

a) All external doors providing access to high voltage shall be supplied with suitable hazard-alerting signs warning of the electrical hazard inside the compartment.

b) The inside of doors to compartments in which bushings or bushing wells are mounted shall be supplied with a "Danger – High Voltage – Keep Out – Qualified Persons Only" sign.

c) Any barriers used to guard against access to energized live parts shall be supplied 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 rear doors shall be provided with nameplates indicating an equipment description, name of manufacturer and type designation, catalog number, model number, serial number and date of manufacture.

b. The inside of each door shall be provided with a ratings label indicating the following: voltage ratings including maximum voltage rating and BIL; 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 – continuous and interrupting; and interrupter switch ratings, including duty-cycle fault closing capability and amperes, short-time, RMS (momentary asymmetrical and one-second symmetrical; the total weight; and a schematic diagram.

c. The schematic diagram shall be a three-line connection diagram showing interrupter switches, motor operators, current sensors (or current transformers), voltage transformers, 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

The following optional features may be specified:

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. Grounding elbows as recommended by the switchgear purchaser.
3. Load-break inserts as required by the switchgear purchaser.