FP AUTOMATIC-TRANSFER PAD-MOUNTED SWITCHGEAR
LIVE-FRONT - TYPE ATPSI/II
DEAD-FRONT - TYPE ATPSE
15kV • 25kV

Federal Pacific (FP) of Bristol, Virginia offers Live-Front and Dead-Front Automatic Source Transfer Pad-Mounted Switchgear for those applications where alternate sources of power are essential for continued operation of critical loads. This switchgear features the FP Touch Screen Automatic Transfer Micro-Processor Control (ATMPC) that monitors system conditions. The ATMPC automatically initiates transfer to an alternate power source if voltage on the preferred source reduces below a preset level. FP Type PM motor operators activate opening and closing of the FP Auto-jet® II Load-Interrupter Switches and complete an automatic source-transfer operation in approximately eight (8) seconds.

FP automatic-transfer pad-mounted switchgear provides automatic two-way source transfer with the ability to connect either of the two utility sources (or a utility source and a standby generator) to the switchgear bus. In automatic transfer switchgear, one incoming line switch is closed (preferred source) and the other incoming line switch is open (alternate source).

The FP automatic control monitors the condition of both power sources and initiates automatic switching when preferred-source voltage drops below a preset level for a selected length of time (field selectable) that is sufficient to establish that the voltage drop is not transitory. The switch connected to the preferred source automatically opens and the switch connected to the alternate source automatically closes, restoring voltage to the load.

The FP Automatic-Transfer Micro-Processor Control utilizes a state-of-the art electronic micro-processor to perform control operations that are directed by settings programmed into the device at the factory and in the field. Such parametric characteristics as voltage-, current- and time-related operating parameters are entered into the control by means of a front-panel touch screen. The entries are readily viewed on the large color graphic backlit LCD screen display. Internal memory with back-up battery records events and maintains a log, allowing diagnostic capability.

To simplify entry of this information and to permit its quick review on the liquid-crystal display, the functions associated with the micro-processor are grouped as a series of categories in the "Main Menu." Category groupings on the "Main Menu" are: Status Screen, Local Operation, Test Menu, Parameters Setup, Communication Settings, View Voltage/Current Levels, View/Edit Event Logger, Fixed Factory Settings, Screen Resolution, Time (24 Hr), and Date.

Status Screen

The Status Screen provides a consolidated synopsis of the positions and conditions of both sources, switches and mechanisms. Passive indicators displayed as items on the Status Screen are as listed below.

Operating Mode:

Manual/Auto Mode – Capability displays whether control is in "Manual" or "Automatic" mode.

Local/Remote Mode – Optional capability to display for units furnished with SCADA interface whether the control is in "Local" or "Remote" mode. The control is by default in "Local" mode and can only be placed in "Remote" mode through user-remote communication connections at terminal block within the control enclosure.

Figure 1. *Exterior view of FP Automatic-Transfer, Pad-Mounted Switchgear ATPSE-9 shows the motor operator and control compartment on each side. The control compartment contains the FP Automatic Transfer Micro-processor. The FP Switch Operators are in separate compartments. The automatic transfer system provides the customer with two independent power sources to assure service continuity for critical loads. The FP Live-Front Automatic-Transfer Pad-Mounted Switchger Type ATPSI/II-9 is configured in a similar manner. For views of switch and fuse compartments for FP Live-Front Pad-Mounted Switchgear refer to pages 9 and 11 for FP Dead-Front Pad-Mounted Switchgear refer to pages 31-33.*

Source 1 (and Source 2):

Preferred (or Alternate) – Capability displays for each source whether the associated source switch is providing service as the "Preferred" source, which provides power to the load under normal conditions, or as the "Alternate" source, which provides power to the load when the preferred source is not available.

Available (or Not Available) – Capability displays for each source whether the associated source voltage is "Available" (above minimum conditions) or "Not Available" (below minimum conditions).

Switch Open (or Switch Closed) – Capability displays for each source the actual switch position ("Switch Open" or "Switch Closed") of the associated switch.

Mech Coupled (or Mech Decoupled) – Capability displays for each mechanism whether the mechanism is coupled ("Mech Coupled") to the associated switch or decoupled from the switch ("Mech Decoupled").

Mech Cycles — Capability displays actual number of mechanical open/close cycles that have been performed by the associated mechanism whether coupled or decoupled.

Switch Cycles— Capability displays actual number of mechanical open/close cycles that have been performed by the associated switch when coupled.

Local Operation Screen

The Local Operation Screen consolidates active touch screen areas of the micro-processor control that allow actual switch operations (as well showing switch position), change of modes or reset of conditions. Active functions allowed from the Local Operation Screen are as follows:

"Source 1" (or "Source 2") – Provides actual position status label for the associated switch ("Switch Open" or "Switch Closed").

"Open Switch 1" (and "Open Switch 2") – Touching either of these screen areas enables switching logic that initiates an actual switch opening of the associated switch. "Source 1" (or "Source 2") position indicator will change state accordingly.

"Close Switch 1" and "Close Switch 2" — Touching either of these screen areas enables switching logic that initiates an actual switch closing of the associated switch. "Source 1" (or "Source 2") position status label will change state accordingly.

"Operating Mode" – Actual mode is displayed with word "Automatic" or "Manual" in a green color, designating the present mode. Applicable display screen area is touched to change mode to desired condition.

"Local/Remote Reset" — Furnished as an optional feature, the control is by default in "LOCAL" mode. The control can only be placed in "REMOTE" through user-remote communication connections at terminal block within the control enclosure. Actual condition is displayed in a green color.

"Reset Hold Return" – Touch the active display screen area to return to the preferred source from the alternate source when the control is programmed for a "Hold" return condition.

"Reset Overcurrent Lockout" — Touch the active display screen area to reset the control following an overcurrent lockout condition. Active display screen area is red when an overcurrent lockout condition exists.

Test Menu Screen

The Test Menu screen allows access to the active touch screens that permit testing of the automatic transfer scheme and the (optional) overcurrent lockout scheme. The Test Menu screen includes the touch screen areas as follows:

SOURCE LOSS

"Sim Src1 Loss" — Touching this screen area will simulate a loss of voltage on Source 1. If Source 1 is designated as the preferred source and if the screen is touched continuously throughout the programmed time delay set-on the Preferred Source Loss Timer, it will initiate a transfer operation. If Source 1 is not the preferred source or if the screen area is not touched continuously throughout the programmed time delay, only the associated touch screen area will lose brightness and no operation will occur.

NOTE: To avoid an actual transfer operation in which switches open and close, both switch operators must be decoupled from the associated switches.

"Sim Src2 Loss" — Touching this screen area will simulate a loss of voltage on Source 2. If Source 2 is designated as the preferred source and if the screen is touched continuously throughout the programmed time delay set-on the Preferred Source Loss Timer, the control will initiate a transfer operation. If Source 2 is not the preferred source or if the screen area is not touched continuously throughout the programmed time delay, only the associated touch screen area will lose brightness and no operation occurs.

NOTE: To avoid an actual transfer operation in which switches open and close, both switch operators should be decoupled from the associated switches.

OVERCURRENT LOCKOUT

"Sim OC Without Source Loss" — Touching this screen area will simulate an overcurrent that is not followed by a loss of source voltage, which represents a transient overcurrent. The Overcurrent Lockout screen area will illuminate but extinguish after expiration of the time-delay setting on the Overcurrent Lockout Timer.

"Sim OC With Source Loss" – Touching this screen area will simulate an overcurrent that is followed by a loss of source voltage and touching this screen area continuously for the time-delay setting on the Overcurrent Lockout Timer will effect an Overcurrent Lockout condition.

NOTE: To avoid an actual lockout condition, both switch operators should be decoupled from the associated switches.

Parameters Setup Screen

The Parameters Setup screen (Page 1 and Page 2) allows access to password protected operating parameters that establish the functional operating sequence and timing for initiating the automatic-transfer sequence. The Parameters Setup screen includes the touch screen areas as follows:

Preferred Source Loss Timer – Allows input of the time delay in seconds considered adequate to establish that preferred source voltage is lost or reduced below the acceptable low-voltage level. Touching the screen area makes the alpha-numeric keypad appear to allow entry of the appropriate source loss timer value.

Preferred Source Return Timer — Allows input of the time delay in seconds considered adequate to establish that preferred source voltage has returned to an acceptable level and to initiate a transfer to return to the preferred source. Touching the screen area makes the alpha-numeric keypad appear to allow entry of the appropriate return timer value.

Return Voltage – Provides field selectable function to set the minimum voltage level (in volts) that, once reached, indicates that the preferred source is available and the Preferred Source Return Timer will be activated. Touching the screen area makes the alpha-numeric keypad appear to allow entry of the appropriate return voltage level.

Low Voltage – Allows input of the field selectable minimum voltage level below which the control considers a source as not available and, once reached, the Preferred Source Loss Timer will be activated. Touching the screen area makes the alpha-numeric keypad appear to allow entry of the appropriate low voltage level.

Unbalance Voltage — Allows input of the field selectable maximum voltage difference (magnitude) between phases above which the control considers a source as unbalanced and not available and,once reached, the Preferred Source Loss Timer will be activated. Touching the screen area makes the alpha-numeric keypad appear to allow entry of the appropriate unbalance voltage level.

Preferred Source ("Source 1" or "Source 2) – Allows field selection of either Source 1 or Source 2 as the Preferred Source that will supply power to the load under normal conditions. Touching the screen area toggles the selection between "Source 1" and "Source 2."

Open/Close Return — Allows selection of Open transition on return of preferred-source voltage (i.e. alternate-source switch opens and then preferred-source switch closes) or Close transition on return of preferred-source voltage (i.e. preferred-source switch closes and then alternate-source switch opens). Touching the screen area toggles the selection between "Open" and "Close".

Auto/Hold Return — Allows selection of automatic return ("Auto Return") to preferred source when voltage has reached the set level for the applicable period of time or HOLD return which prevents

transfer back to the preferred source until performed locally at the unit. If the alternate source is lost while the preferred-source voltage is present, the control will override the HOLD return function and transfer to the preferred source. Touching the screen area toggles the selection between "Auto" and "Hold".

PT Ratio – Allows entry of the PT ratio for the actual system voltage. Touching the screen area makes the alpha-numeric keypad appear to allow entry of the appropriate PT ratio.

CT Ratio – Allows entry of the CT ratio for the components being used. Touching the screen area makes the alpha-numeric keypad appear to allow entry of the appropriate CT ratio.

Overcurrent Lockout Timer — Because the time duration is in seconds, an overcurrent condition is allowed to exist before the control considers an overcurrent condition to have occurred. This allows control to avoid actuating on transformer in-rush currents and avoid operation on transient conditions. Touching the screen area makes the alpha-numeric keypad appear to allow entry of the appropriate Overcurrent Lockout Timer setting.

Overcurrent Value — The level of current in amperes above which the control establishes that an overcurrent condition has occurred. Touching the screen area makes the alpha-numeric keypad appear to allow entry of the appropriate Overcurrent Value.

Overcurrent Lockout "Disabled"/"Enabled" – Provides ability for users of the optional Overcurrent Lockout facility to enable or disable the function. If the option is not purchased, the facility is disabled and cannot be enabled.

Communications Settings Screen

The Communications Settings is an optional facility, which when purchased, allows the customer to set up the micro-processor for remote operations through a communications medium. The control includes an RS-485 port connected to a terminal block, which is isolated in a low-voltage control compartment, for customer connections. The Communications Settings screen allows the following functionality:

Set Unit ID – Allows customer to identify each particular unit with a specific Number Node.

Modbus Communications – Provides indication of the status of the Modbus Communications "Failed" or "Good".

View Write Register Values — Provides customer capability to write and initiate action by sending an integer value to the function memory location. If communication is lost, Modbus Write Table registers revert to zero for security. The control must be in the Remote Mode and the following write functions are allowed: Open/Close Switch, Local/Remote Mode, Automatic/Manual Mode, and Overcurrent Reset.

View Read Register Values — Provides Register Value to view and establish various control status conditions (Source Available, Switch Positions, Real-Time Phase Voltages, Real-Time Phase Currents, Mechanism Position, Local or Remote Mode, System Lockout, Manual or Automatic Mode, and Overcurrent Lockout).

View Modbus Status Register — Displays status of Modbus Communications in bit format with translation to allow customer to perform troubleshooting functions.

View Voltage/Current Levels Screen

The View Voltage/Current Levels screen allows viewing of real-time voltage and, if optional overcurrent lockout is furnished, current levels for all phases on both Source 1 and Source 2. Voltages are viewed in volts and current is viewed in amperes.

Fixed Factory Settings Screen

The Fixed Factory Settings screen is password protected facility that allows service personnel the ability to view and access factory settings. Settings displayed are the System Key ("On" or "Off"); Motor Operator type ("Stored Energy" or "Run-Trip"); System Config ("Delta" or "Wye"); and Transfer Type ("Util – Util" or "Util-Gen"). These settings are not accessible by the customer.

View/Edit Event Logger Screen

The View/Edit Event Logger screen provides instructions on connecting and downloading events into a PC and on erasing the Event Log. There is a "View Event Logger Data" touch screen area that, when touched, allows viewing the date/time stamp and description of each event with a capacity of 115 events. And, there is a "Clear Event Logger Data" touch screen area that, when touched, displays the "Clear All Event Log Data" key, which, when pressed, erases all events in the event log. A listing of possible events displayed is included in the table below:

Function	Event Description	Function	Event Description
OCS	OCS Power UP	**Mode**	Automatic Mode
Source Availability	Src 1 Available		Manual Mode
	Src 1 Not Available		Auto Return
	Src 2 Available		Hold Return
	Src 2 Not Available		Open Transition
Switch	Src 1 Sw Open		Close Transition
	Src 1 Sw Closed		Pref Src Set to Src 1
	Src 2 Sw Open		Pref Src Set to Src 2
	Src 2 Sw Closed	**Overcurrent**	OC Detect Src 1, Ph1
	Press to Open Sw 1		OC Detect Src 1, Ph2
	Press to Close Sw 1		OC Detect Src 1, Ph3
	Press to Open Sw 2		OC Detect Src 2, Ph1
	Press to Close Sw 2		OC Detect Src 2, Ph2
Mechanism	Mech 1 Open		OC Detect Src 2, Ph3
	Mech 1 Close		OC Lockout Timer
	Mech 2 Open		OC Detect Reset
	Mech 2 Close		OC Lockout Disabled
	Mech 1 Coupled		OC Lockout Enabled
	Mech 1 Decoupled		OC Lockout
	Mech 2 Coupled	**Test/ Simulations**	Sim Src 1 Volt Loss
	Mech 2 Decoupled		Sim Src 2 Volt Loss
			OC w/ Src Loss Sim
			OC w/o Src Loss Sim
		Resets	Reset Hold Return
			Reset OC Lockout
			Reset Local/Remote

Figure 2. *Low-voltage control compartment containing the FP automatic-transfer micro-processor control.*

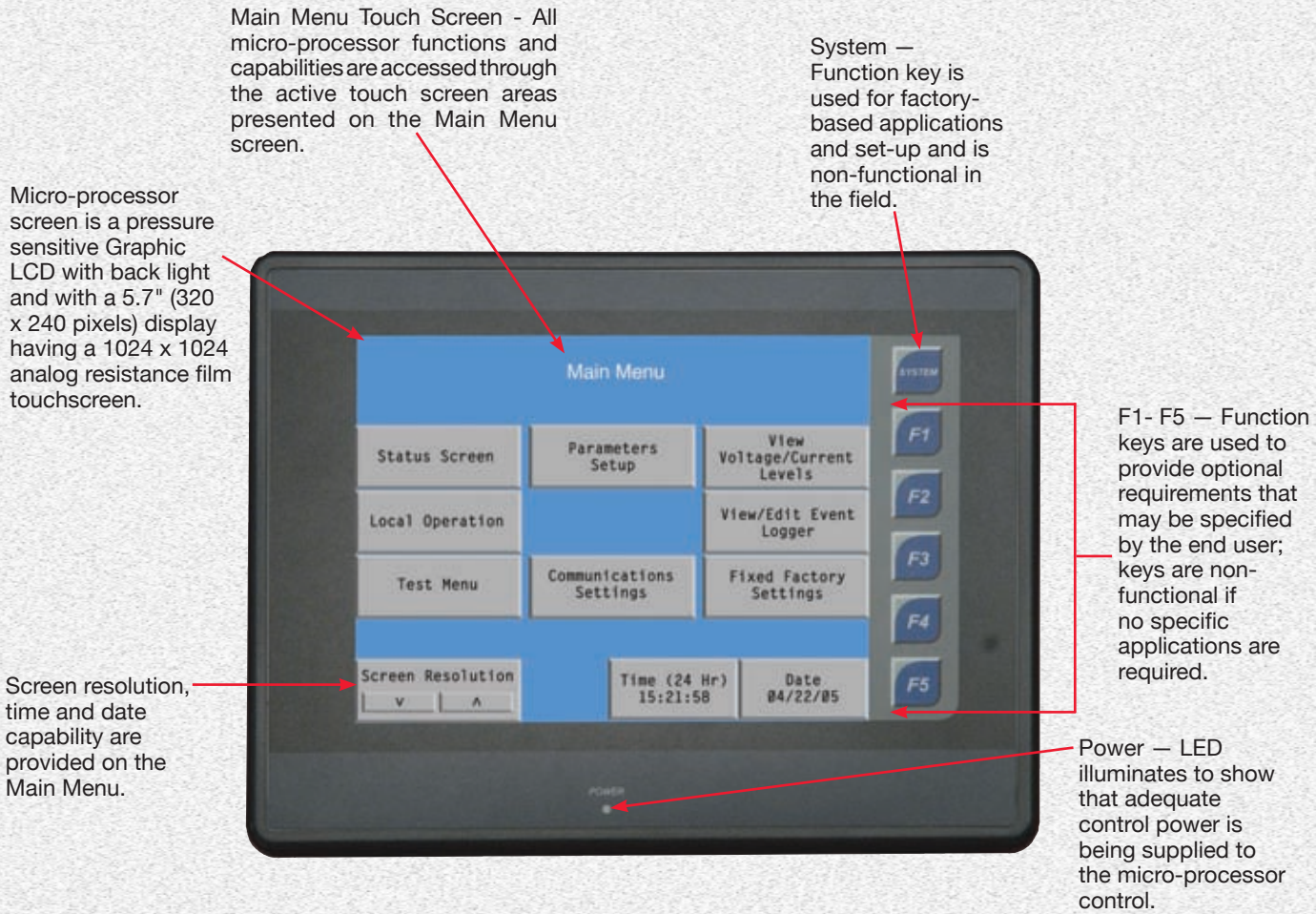

Figure 4. *Federal Pacific Touch Screen Automatic-Transfer Micro-Processor Control features a large color graphic, backlit, LED display with all functions accessible through a "Main Menu" screen. The touch screen functions allow setting of field adjustable timers and operating parameters — automatic or hold return, open or closed transition return and preferred-source selection. The micro-processor control is mounted on a hinged panel allowing access to connections and associated wiring.*

Automatic Source-Transfer Applications

The FP Type PM run-and-trip motor operator will also be the primary device to affect switching operations in automatic source-transfer applications for FP Pad-Mounted Switchgear. Each switch in the source-transfer scheme will be automated using a run-and-trip motor operator. The control providing the intelligence for automatic switching operations will be the revolutionary FP Touch-Pad OCS-300 Micro-processor Control.

In automatic source-transfer applications, the motor operators charge the spring of the associated Auto-jet® switch and synchronously effect a transfer operation from one (preferred) source to the second (alternate) source following loss-of-source voltage (or reduction of voltage below a predetermined, field selectable level) on the preferred source. Switching functions are all pre-programmed and controlled by the OCS 300 micro-processor and certain functions are field selectable.

Run-and-trip motor operators are employed in automatic-transfer applications where speed of operation is not a significant consideration.

There are only two transfer times of significance: (a) 1/4 cycle (5 milliseconds) and (b) 2 cycles (33 milliseconds). For the former, transfer operations in 1/4 cycle allow computers and relay circuits to remain intact without losing power. For the latter, transfer operations in 2 cycles will allow metal halide lamps to remain illuminated, keeping stadium and arena lights on. Beyond these two extremely short time duration requirements, speed of operation is not a significant application consideration; therefore, motor operators effecting a transfer operation in 10-cycles, which does not include the minimum required 1/4 second time delay to establish that an outage is extended, is of little advantage over one that effects a transfer operation in a few seconds. Consequently, run-and-trip motor operators are more than adequate for the vast majority of automatic-transfer operations. Operating time for the Federal Pacific automatic source-transfer scheme using run-and-trip motor operators is approximately eight (8) seconds. Consult the factory for applications requiring transfer to occur in less than one second.

Figure 3. *FP Motor Operator. The reliable FP motor operator contains the many features for local automatic operation, including a long-life battery and charger for power to DC circuits.*

Optional Features for Federal Pacific Automatic-Transfer Micro-Processor Control and Motor Operators

Microprocessor Control

Suffix	Description
-Y2	Overcurrent Lockout & Reset (1) An overcurrent-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 overcurrent-lockout feature from a remote location. 3) Test keys shall be provided for simulating an overcurrent condition on each source.
-Y4	**Supervisory Control** provisions shall be provided to permit switch operation from a remote location.
-Y6	**Remote Indication** provisions shall be provided to permit remote monitoring of the presence or absence of preferred- and alternate-source voltage and the operating mode of the source-transfer control (i.e., automatic or manual).
-Y8	**Communications Card —** permits local uploading of Event Log recordings and microprocessor settings to a customer-furnished computer
-Y9	**Event Log —** provides date/time stamped sequence of all switching functions
-Y10	**Generator Interface —** includes start/run and cool-down output relay functions, allows connection of utility source as preferred source and generator as the alternate source
-Y11	**Multi-Level Security Pass Coding —** provides addition of up to three (3) additional password protected menu item listings

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

A. General

1. Product

The pad-mounted switchgear shall be Live-Front ATPSI/II 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: (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§	27§
kV, BIL	95	125
Main Bus Continuous, Amps	600	600
Load-Interrupting, Amps	600	600
Fuse Load-Interruption, Amps	200	200
Switch Short-Circuit Ratings*		
Amps, RMS Symmetrical	25,000	25,000
MVA, 3-Phase Symmetrical at Rated Nominal Voltage	620	1,080
Fault-Closing Amps, RMS, Asym., 3-Time Duty-Cycle**	40,000	40,000

* *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.*
** *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 voltage rating of 15-kV class load-interrupter switch is 17.5kV and of 27-kV class switch is 29kV.*

b) The momentary and three-time duty-cycle fault-closing ratings of switches, momentary rating of bus, interrupting ratings of fuses with integral load-interrupters 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.

Fuse Ratings						
Fuse Manufacturer	**Fuse Type**	**Three-Phase MVA Sym.**	**Amps RMS Asym.**	**3-Time* Fault-Close Asym.**	**Cont. Amps**	**Load-Break Amps ①**
14.4 kV Nominal Voltage						
S&C	SM-4	310	20000	20000	200	200
S&C	SMU-20	350	22400	22400	200	200
S&C	SM-5‡	Consult Factory for Availability				
S&C	Fault-Fiter §	Consult Factory for Availability				
Cutler-Hammer	DBU	350	22400	22400	200	200
Cooper (M-E) §	NX	620	40000	40000	100**	100
Cooper (CT) §	X-Limiter	620	40000	40000	140	140
25 kV Nominal Voltage						
S&C	SM-4†	540	20000	20000	200	200
S&C	SMU-20	540	20000	20000	200	200
S&C	SM-5‡	—	—	—	—	—
Cutler-Hammer	DBU	540	20000	20000	200	200
Cooper (M-E) §	NX	1080	40000	40000	40	40
Cooper (Kearney)	Q	Discontinued				
Cooper (CT) §	X-Limiter	1080	40000	40000	140	140

① *When assembled with Auto-jet end fittings.*
** *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.*
‡ *Contact factory for SM-5 and Fault-Fiter applications.*
§ *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.*

5. Compliance with Standards & Codes

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

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 interupting all possible currents up to the assigned maximum short-circuit rating.

c) All preferred and optional ratings in IEEE C37.74.

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

6. Enclosure Design

a) 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.

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 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 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 bare aluminum bar with an oxide-inhibiting agent at 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 gear.

c) Bolted aluminum-to-aluminum connections shall be made with a suitable number of 1/2"-13 stainless steel bolts and with two Belleville Spring washers per bolt, one under the bolt head and one under the nut. 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). Bolts shall be tightened to an appropriate torque.

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 motor operators and source-transfer control, 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 grounded, steel-enclosed or aluminum low-voltage control compartments shall be provided for the micro-processor control and motor operators.

c) The basic 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.

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

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. 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 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 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 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 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 accommodate sensing components.

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 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 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 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). These barriers must not be left in the inserted position for more than one week.

2. 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 enclosure interior dry. Flange corners shall be welded and ground smooth unless formed without a seam.

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 gasketed.

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-nickel-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 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 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) Doors providing access to solid-material power fuses shall have provisions to store spare fuse units or refill units in a glavanized-steel compartment.

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

The following optional features may be specified:

h) If specified, an optional storage arrangement accommodating three complete fuse assemblies shall be provided on each fuse-compartment door.

3. Ventilation Openings

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

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

The following optional features may be specified:

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

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 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 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 or have passed the coating system performance requirements in section 5.4 of 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 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 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.

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 otherwise 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.

The following optional features may be specified:

l) Bracket-mounted distribution-class surge arresters, metal-oxide type (specify rating), shall be provided at all source switch terminals.

m) Switch terminals shall be provided with adapters to accommodate two cables per phase.

n) 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 a system of tamper-resistance hardware.

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 permit live switching of fuses with a hookstick.

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 and to meet frequent switching requirements.

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 separate fault-closing contacts and current-carrying contacts. 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 the current-carrying contacts 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 and have other ratings consistent with the preferred ratings in IEEE C37.74. The duty-cycle fault-closing capability defines the level of available fault-current into which the fuse can be closed 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 assist operator identification, the integral load-interrupter shall have a positive latch indicator that shall present a visible target to show that the fuse is completely latched closed and ready for the next opening operation.

10) To increase contact separation speed, interrupter contacts shall be spring assisted to retract and thereby reduce arcing time.

11) To further insure arc extinction, air shall be compressed and simultaneously injected into the arcing area to cool the arc and thereby not rely solely on contact travel to insure arc extinction.

12) 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.

13) Fuse terminal pads shall be provided with a two-position adapter, making it possible to accommodate a variety of cable-terminating devices.

14) 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.

3. Motor Operators

a) The motor operators shall be provided to operate the high-voltage source-interrupter switches. They shall be run-and-trip, which charges and trips the switch quick-make quick-break mechanism when operation is initiated.

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 control 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 or steel-enclosed 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 and each switch to show the number of operations that have been performed.

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 micro-processor control 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. An indicator label shall be provided to show whether the operator is coupled or decoupled.

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) The motor operators shall be provided with an extra 4-PST auxiliary switch coupled to each source-interrupter switch.

o) The motor operators shall be provided with an extra 4 PST auxiliary switch coupled to each operator mechanism.

4. Control for Automatic Transfer

a) Operating Description

1) Transfer on Loss and Return of Source Voltage

i) The micro-processor control 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 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 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 retransfer to the preferred source if in the automatic-return mode, or await manual retransfer if in the hold-return mode. In the hold-return mode, if the alternate source fails and the preferred source has been restored, the control shall initiate automatic retransfer to the preferred source.

iii) In the automatic-return mode, the micro-processor control shall provide field selectivity of either open transition (nonparalleling) or closed transition (paralleling) on retransfer.

2) Transfer on Unbalance Condition

i) An unbalance detection feature 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 shall continuously monitor the voltage to detect any 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 sufficient to confirm that the condition is not transient.

ii) If automatic return retransfer has been selected when normal phase voltage return to preferred source, the control shall initiate retransfer to the preferred source as described in 4. (a) (1) (ii) and (iii).

b) Control Features

1) The operating characteristics of the micro-processor control and its voltage-, current-, and time-related operating parameters shall be field programmable and entered into the control by a keypad. To simplify entry of this information, a menu arrangement shall be utilized including keys dedicated to the operating characteristics and to each of the operating parameters. Entry of an access code password shall be necessary before any operating characteristic or operating parameter can be changed.

2) All operating characteristics and operating parameters shall be noted in instruction bulletins or otherwise available for review on an LCD display with backlighting.

3) The control shall utilize screen technology using STN color LCD with 5.7" (320 x 240 pixels) display and touch-screen resolution with 1024 x 1024 analog resistance film.

4) An LCD touch-screen area shall be furnished for indicating the presence of acceptable voltage on each high-voltage source.

5) A separate LCD touch-screen area shall be furnished for indicating the control operating mode (automatic or manual).

6) Separate LCD touch-screen areas shall be furnished for indicating the position of each switch and whether each switch is coupled to the associated motor operator.

7) A separate LCD touch-screen area shall be furnished for choosing manual or automatic operating mode. 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.

8) A separate test LCD touch-screen area shall be furnished for simulating loss of voltage on each of the two sources.

9) A light-emitting lamp shall provide indication that the micro-processor CPU is functioning properly.

10) The micro-processor control shall provide for:

i) Field selection by means of a touch-screen 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 touch-screen 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 shall incorporate an event log and shall have a bright color LCD display with adjustable screen intensity to view settings and the event log entries.

c) Construction Features

1) The micro-processor control 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.

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 sensing devices 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 overcurrent-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 overcurrent-lockout feature from a remote location.

3) Test buttons shall be provided for simulating an overcurrent 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., automatic 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 compartments.

b) The inside of each door providing access to high voltage shall be supplied with a "Danger—High Voltage — Keep Out — Qualified Persons Only" sign.

c) Both sides of each barrier providing access to an interrupter switch shall be supplied with a sign indicating that "Switch Blades May Be Energized in Any Position" on both sides.

d) Both sides of each barrier providing access to a fuse shall be supplied with a sign indicating that "Fuses May Be Energized in Any Position".

e) Barriers used to slide into the open gap when switch or fuse is in the open position shall include a label indicating that the barrier should not be left in the slide-in position for more than one week.

f) An instruction label explaining correct operation of integral load interrupters for fuses shall be included on the inside of each door providing access to fuses.

2. Nameplate, Ratings Labels, and Connection Diagrams

a. The outside of both the front and the back shall be provided with nameplates indicating an equipment description, name of manufacturer and type designation, catalog number, model number, serial number, date of manufacture, maximum voltage, BIL, rated power-frequency, rated power-frequency withstand voltage, rated short-circuit current, total weight, and a schematic diagram.

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

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. A fuse handling tool as recommended by the fuse manufacturer shall be furnished.
3. Grounding clamps as recommended by the end user.

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§	27§
kV, BIL	95	125
Main Bus Continuous, Amps	600	600
Switch Load-Interrupting, Amps	600	600
Switch Short-Circuit Ratings*		
Amps, RMS Symmetrical	25,000	25,000
MVA, 3-Phase Symmetrical at Rated Nominal Voltage	620	1,080
Fault-Closing Amps, RMS, Asym., 3-Time Duty Cycle**	40,000	40,000

* *These are nominal switch ratings. Integrated pad-mounted unit may be limited by ratings of fuses, bushings, and bushing wells. Use fuse rating chart in next column to select proper short circuit ratings.*

** *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 voltage rating of 15-kV class load-interrupter switch is 17.5kV and of 27-kV class switch is 29kV.*

Fuse Ratings						
Fuse Manufacturer	Fuse Type	Three-Phase MVA Sym.	Amps RMS Asym.	Fault-Close Asym.*	Cont. Amps	Load-Break Amps
14.4 kV Nominal Voltage						
S&C	SM-4	310	20000	Refer to manufacturer of the separable insulated connector (elbow).	200	200
S&C	SMU-20	350	22400		200	200
S&C	SM-5‡	—	—		—	—
Cutler-Hammer	DBU	350	22400		200	200
Cooper (M-E)§	NX	620	40000		100**	100
Cooper (CT)§	X-Limiter	620	40000		140	140
25 kV Nominal Voltage						
S&C	SM-4†	540	20000	Refer to manufacturer of the separable insulated connector (elbow).	200	200
S&C	SMU-20	540	20000		200	200
S&C	SM-5‡	—	—		—	—
Cutler-Hammer	DBU	540	20000		200	200
Cooper (M-E)§	NX	1080	40000		40	40
Cooper (CT)§	X-Limiter	1080	40000		140	140

* *The duty-cycle fault-closing rating means that 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.*

** *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.*

§ *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.*

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 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 gear to the fault-close requirements of the specification to assure the bus support system and components are adequate.

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 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. Futhermore, 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.

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 steel 1/4" thick stainless steel 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 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 micro-processor control, 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 secondaries 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 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 micro-processor control and motor operators.

c) The basic 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.

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 base shall consist of continuous 90-degree flanges, turned inward and welded at the corners, for bolting to the concrete pad. A closed-cell gasketing material shall be placed on the bottom flange as a protective interface between the steel enclosure and the mounting 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. 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 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 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 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 to increase the elevation of live parts in the pad-mounted gear to accommodate sensors.

o) In consideration of tamper resistance, the enclosure shall conform to or exceed the requirements of ANSI C57.12.28.

2. Barrier Assembly:

Insulating interphase and end barriers of NEMA GPO-3 grade fiberglass-reinforced polyester 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 enclosure interior 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 doors shall be gasketed.

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 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.

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

h) Each door 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 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.

4. Ventilation Openings

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

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 momentary currents.

f) 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 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.

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 loadbreak bushing wells.

3. Motor Operators

a) The motor operators shall be provided to operate the high-voltage source-interrupter switches. They shall be run-and-trip, which charges and trips the switch quick-make quick-break mechanism when operation is initiated.

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 control 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 or steel-enclosed 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 and each switch to show the number of operations that have been performed. The operation counter may be included in the micro-processor control.

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 micro-processor control 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) The motor operators shall be provided with an extra 4-PST auxiliary switch coupled to each source-interrupter switch.

o) The motor operators shall be provided with an extra 4 PST auxiliary switch coupled to each operator mechanism.

4. Control for Automatic Transfer

a) Operating Description

1) Transfer on Loss and Return of Source Voltage

i) The micro-processor control 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 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 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 retransfer to the preferred source if in the automatic-return mode, or await manual retransfer if in the hold-return mode. In the hold-return mode, if the alternate source fails and the preferred source has been restored, the control shall initiate automatic retransfer to the preferred source.

iii) In the automatic-return mode, the micro-processor control shall provide field selectivity of

either open transition (nonparalleling) or closed transition (paralleling) on retransfer.

2) Transfer on Unbalance Condition

i) An unbalance detection feature 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 shall continuously monitor the voltage to detect any 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 sufficient to confirm that the condition is not transient.

ii) If automatic return retransfer has been selected when normal phase voltages return to the preferred source, the control shall initiate retransfer to the preferred source as described in 4. (a) (1) (ii) and (iii).

b) Control Features

1) The operating characteristics of the micro-processor control and its voltage-, current-, and time-related operating parameters shall be field programmable and entered into the control by a keypad. To simplify entry of this information, a menu arrangement shall be utilized including keys dedicated to the operating characteristics and to each of the operating parameters. Entry of an access code password shall be necessary before any operating characteristic or operating parameter can be changed.

2) All operating characteristics and operating parameters shall be noted in instruction bulletins or otherwise available for review on an LCD display with backlighting.

3) The control shall utilize screen technology using STN color LCD with 5.7" (320 x 240 pixels) display and touch-screen resolution with 1024 x 1024 analog resistance film.

4) An LCD touch-screen area shall be furnished for indicating the presence of acceptable voltage on each high-voltage source.

5) A separate LCD touch-screen area shall be furnished for indicating the control operating mode (automatic or manual).

6) Separate LCD touch-screen areas shall be furnished for indicating the position of each switch and whether each switch is coupled to the associated motor operator.

7) A separate LCD touch-screen area shall be furnished for choosing manual or automatic operating mode. 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.

8) A separate test LCD touch-screen area shall be furnished for simulating loss of voltage on each of the two sources.

9) A light-emitting lamp shall provide indication that the micro-processor CPU is functioning properly.

10) The micro-processor control shall provide for:

i) Field selection by means of a touch-screen 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 touch-screen 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 shall incorporate an event log and shall have a bright color LCD display with adjustable screen intensity to view settings and the event log entries.

c) Construction Features

1) The micro-processor control 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.

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 overcurrent-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 overcurrent-lockout feature from a remote location.

3) Test buttons shall be provided for simulating an overcurrent 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., automatic 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 on 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 prevent 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 the back shall be provided with nameplates indicating an equipment description, name of manufacturer and type designation, catalog number, model number, serial number, date of manufacture, maximum voltage, BIL, rated power-frequency, rated power-frequency withstand voltage, rated short-circuit current, total weight, and a schematic diagram.

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

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. A fuse handling tool as recommended by the fuse manufacturer shall be furnished when specified.

3. Grounding elbows as recommended by the switchgear purchaser.

Notes