

Metal-Enclosed Switchgear



Electro-Mechanical Corporation Overview

Federal Pacific is a division of Electro-Mechanical Corporation, a privately held, American-owned company founded in 1958. It is headquartered in Bristol, Virginia (USA) and for more than 53 years has manufactured a wide variety of products used in the generation, transmission, distribution and control of electricity. These products, along with various electrical equipment repair and maintenance services, are used by a diverse mix of Energy (coal, oil and gas), Electric Utility and Industrial customers worldwide.

Electro-Mechanical Corporation has earned a "customer oriented" reputation by keeping its focus on providing the best value to its customers through quality products and services. With six manufacturing companies and two repair and service companies, Electro-Mechanical Corporation has over 650,000 square feet of modern manufacturing facilities, located in Virginia, Tennessee and Mexico.

The Electro-Mechanical Corporation consists of:

Line Power Manufacturing Corporation - Custom engineered electrical distribution and control apparatus including low and medium voltage metal-enclosed switchgear, power control centers, motor controls, and substations. Electrical power distribution systems and components used in mining. ISO 9001:2008 Registered.



Line Power Manufacturing Corporation



Federal Pacific

Federal Pacific - Dry-type transformers from .050 KVA through 10,000 KVA single and three phase, up to 34.5 kV, 150 kV BIL with UL® approval through 15 kV; Vacuum pressure impregnation and epoxy shielded transformers ISO9001:2008 Registered. Medium voltage switchgear including air-insulated livefront, deadfront, SCADA-controlled, automatic transfer, primary metering and wall-mounted padmounted and metal-enclosed switchgear.

MAFESA is Electro-Mechanical Corporation's manufacturing facility in Mexico for stock low-voltage transformers.

The Electro-Mechanical Corporation Research and Technology Center (RTC) - a facility dedicated to developing new and innovative products for electrical power distribution. The mission of RTC is to develop, engineer, prototype and test products that will provide practical solutions to enhance the safety and productivity of electrical distribution equipment.

Metal Castings Company - Permanent mold and sand cast aluminum products.



Metal Castings Company

EMC Custom Solutions -The Custom Solutions Group specializes in the innovative design and creation of custom medium voltage switchgear for Data Center, Solar Energy and other alternative energy, mission-critical projects worldwide.

Machinery Components Division - Manufactures prototype and machined component products.

Electric Motor Repair & Sales Company - Electric motor and apparatus repair and new equipment sales. Equipment for the Electric Motor Repair and Transformer Manufacturing Industries including winding machines, coil spreaders, dynamometers and transformer core cutting machines.

Line Power Parts & Rebuild - Complete electrical equipment remanufacturing and onsite electrical equipment service. The parts service department provides replacement components manufactured by Electrical Group companies as well as commonly used OEM parts.

MANUAL METAL-ENCLOSED SWITCHGEAR INDOOR AND OUTDOOR DISTRIBUTION 5kV THROUGH 38 kV



Automatic Source Transfer



**Manual with Metering Bay
Category B Enclosure**

Metal-Enclosed Switchgear - Advantages

Around industrial plants, universities, waste water treatment facilities, convention centers and similar other large facilities usually there is a need to distribute electrical power located below the ground surface at medium voltage (5kV - 38kV) via cable circuits. Typically, these circuits are connected to a central assembly of switchgear, fed by a main circuit from the local utility, and arranged in lineups of multiple cubicles.

The fuses used in Metal-Enclosed equipment can be either **expulsion** or **current-limiting**. Figure 1 represents the relative energy-limiting capabilities of MV breakers, expulsion fuses and current-limiting fuses, which in the case of Metal-Enclosed Switchgear utilizes expulsion and current-limiting fuses for protection to provide the best energy limitation.

Figure 2 below is a summary table of features favoring the selection of Metal-Enclosed lineups with switches and fuses:

While Metal-Enclosed Switchgear using load-interrupter switches and fuses has many economic and protective advantages Federal Pacific, whose predominant construction is Metal-Enclosed, will use a fixed or drawout circuit breaker to handle high **continuous** load-currents, frequent switching, over-current interruption, or automatic operation. Since faults on industrial power systems are often "permanent", automatic reclosing is not desirable because subsequent reclosing will only cause further damage to cables and equipment.

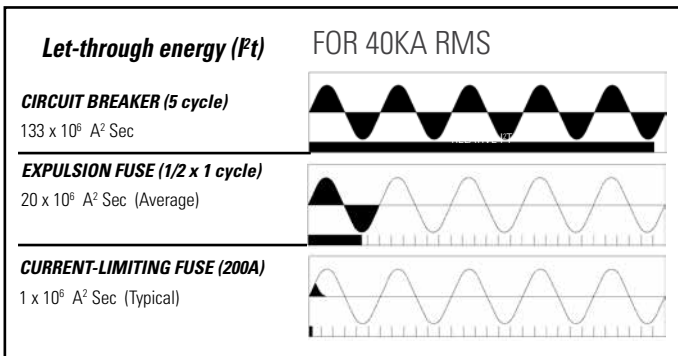


Figure 1. The dark area under each curve represents the relative energy limitation of damaging let-through currents provided by various protective devices. The curves illustrate that fuses allow through much less damaging let-through currents and, therefore, do a much better job of protecting cables and transformers.

Advantages of Metal-Enclosed

- Low Initial Cost per cubicle
- Superior protection for cables and transformers
- Low let-thru currents (mechanical energy)
- Low let-thru I²T (thermal energy)

(Breakers take 5 cycles from relay sensing to circuit interruption. Power fuses require no more than 1 cycle for circuit interruption.)

- Lower installation cost (simple field assembly)
- No auxiliary power or VTs are needed
- No maintenance required for fuses
- No possibility of reclosing on a fault with fuses
- Single-phase protection: Shunt trip of three-phase switch in feeder cubicle when a fuse operates

Figure 2. Advantages of Metal-Enclosed Switchgear .

Metal-Enclosed Switchgear Application

Federal Pacific Metal-Enclosed Load-Interrupter Switchgear provides a secure, convenient method for switching and overcurrent protection of high-voltage cable systems. The switchgear may be located indoors or outdoors. Typical applications include:

- Service entrance switching.
- Transformer primary and secondary switching.
- Isolation and protection of feeder circuits.
- Loop circuit sectionalizing.
- Manual and automatic transfer from preferred to emergency circuits.

Federal Pacific Metal-Enclosed Switchgear has been designed to meet the most rigid requirements for this class of equipment. High-grade 11-gauge steel panels are designed so that each switchgear bay is an individual self-supporting unit with double walls between bays on multiple bay lineups.

Corrosion-resistant cabinets are assured by chemical cleaning and phosphatizing (or zirconization) followed by a rust-resistant baked powder epoxy prime coat followed by a baked-on polyester finish coat that is UL® Listed for Type 1 (indoor) and Type 3R (outdoor) installations. Powder coats are applied using electrostatic deposition. Standard color is light gray, ANSI 61.

The Auto-Jet® II load-break switch is equipped with a quick-make, quick-break stored-energy mechanism. The operating handle is mounted on the right front of the unit at a convenient level with a maximum upward swing of 78" above ground level. The maximum operating force is 60 pounds. The standard manual operating handle may be padlocked either open or closed. A mechanical interlock is provided as standard to prevent opening the door with the switch closed or closing the switch with the door open. Optional key interlocks to replace mechanical interlocks as well as other key-interlock systems are available. Inspection windows are located so that the position of the switch blades may be checked with the exterior bulkhead door closed.

Switch Ratings						
kV		Amperes				60 HZ Withstand kV
Nom.	Max. Design	Continuous & Interrupting	Momentary RMS ASYM†	Fault-Closing RMS ASYM†	BIL kV	
4.8	5.5	600	40,000	40,000	60	19
4.8	5.5	1200	40,000	40,000	60	19
14.4	17.0	600	40,000	40,000	95	36
14.4	17.0	1200	40,000	40,000	95	36
14.4	15.5	1200	61,000†	61,000†	110	36
25	27	600	40,000	40,000	125	60
25	27	1200	40,000	40,000	125	60
34.5	38	600	40,000	40,000	150	80
34.5	38	600*	61,000	40,000	200	60

† The Auto-jet® Switch has a three-time fault-close capability at 40kA and a single-time fault-close capability at 61kA per ANSI standards.

* The switch has a load-break rating of 600 amperes and a continuous current rating of 1200 amperes.

- UL® Listed (5 & 15kV)
- Meets ANSI C57.12.28 enclosure security requirements
- 11-gauge steel
- Auto-jet® II puffer-type load-interrupter switch
- Three-time duty-cycle fault-closing switch
- No rear access required
- Easy inspection and maintenance
- A Portable Remote Operating Mechanism is available as a separate purchase to permit operating manual switches outside the arc flash hazard zone.



Cabinet Security Classifications

ANSI/IEEE C37.20.3 Category Types

Category A

Category A enclosures are intended to provide a degree of protection against contact with enclosed equipment in ground-level installations subject to deliberate unauthorized acts by members of the unsupervised general public.

Category B

Category B enclosures are intended for use in installations not subject to deliberate unauthorized acts by members of the unsupervised general public primarily to provide a degree of protection to unauthorized and untrained personnel against incidental contact with enclosed equipment.

Category C

Category C enclosures are intended to provide a degree of protection against contact with enclosed equipment in secured installations intended to be accessible only to authorized persons. (Category C will only be constructed after factory consultation and required signed waivers)

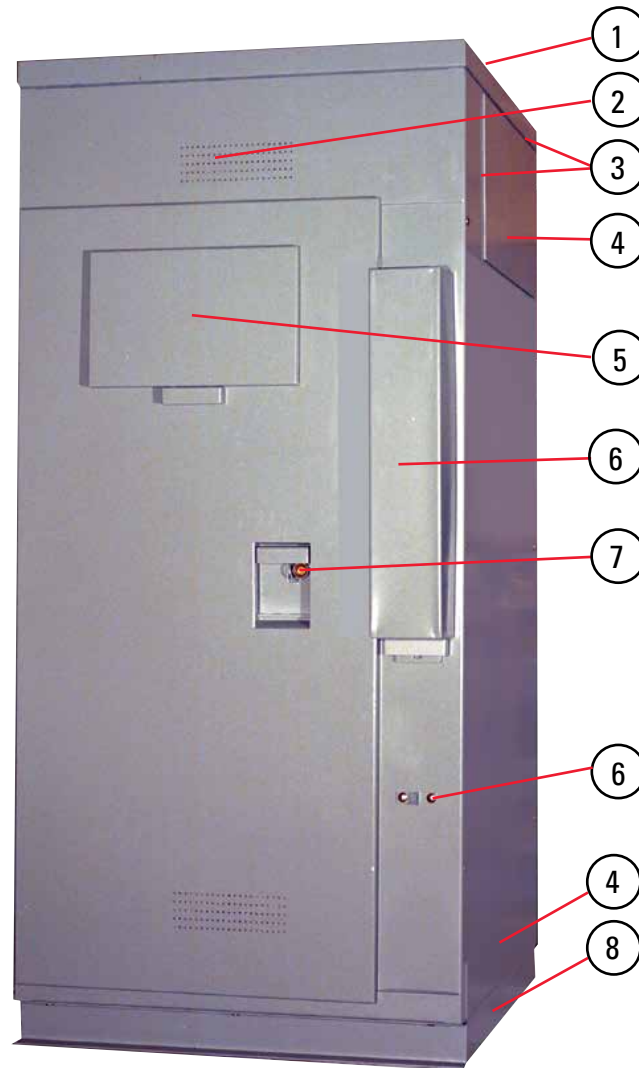
Single-Bay Manual Metal-Enclosed Switchgear - Construction

Most single-bay Metal-Enclosed Switchgear is applied for the HV Switch and Fuse protection of medium-voltage industrial transformers either liquid filled or dry type in the 500-5000 KVA range. This switchgear can be furnished in Type 1 (indoor) and Type 3R (outdoor) construction in the cabinet security classifications of Category A, Category B or Category C.

There are two important economic considerations for selecting the design of single-bay assemblies for transformer switching applications. First, there will be considerable savings by having the switchgear cubicle "close coupled" to the transformer primary either by flange connection or throat connection. This configuration eliminates the need for additional cable and stress relieving terminations in both the switchgear and transformer

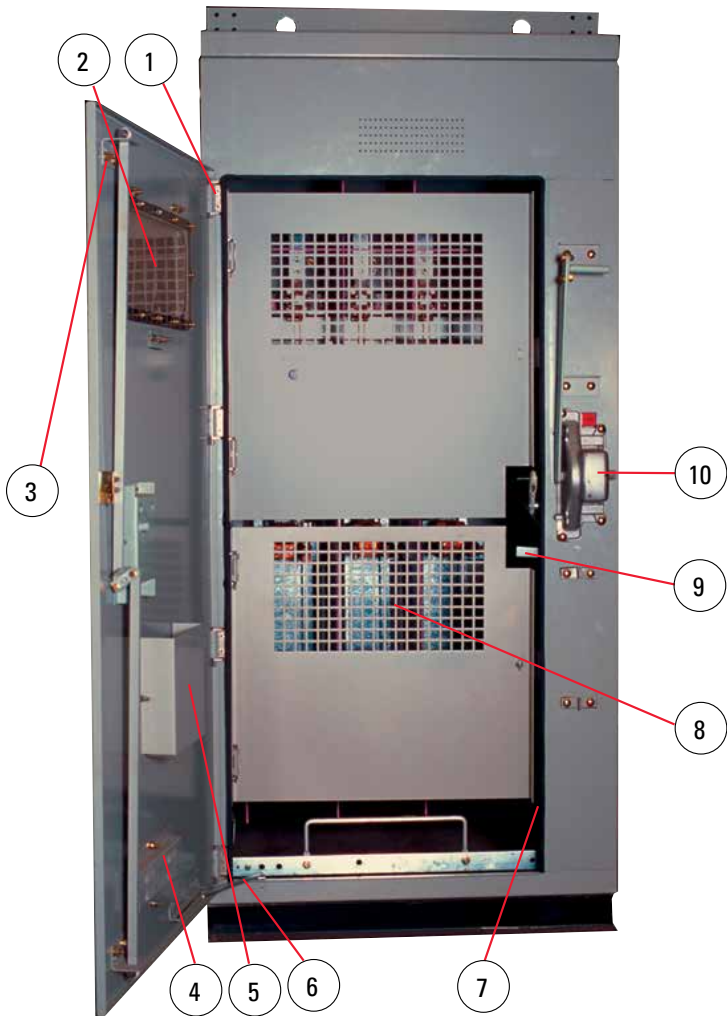
and also eliminates the need for an additional rear-entry compartment when bottom cable entry and bottom cable exit are required from a "stand-alone" cubicle.

Second, strong consideration should be given to selecting current-limiting fuses for circuit protection inside the cubicle. Current-limiting fuses provide significantly better fault energy limitation than expulsion fuses in terms of lower "peak let-thru current" (mechanical energy that deforms windings) and lower I²T energy (thermal energy that damages insulation). The initial cost of current-limiting fuses is about 25% less than expulsion fuses, which during operation can leave significant residue on insulating barriers and cabinet walls.

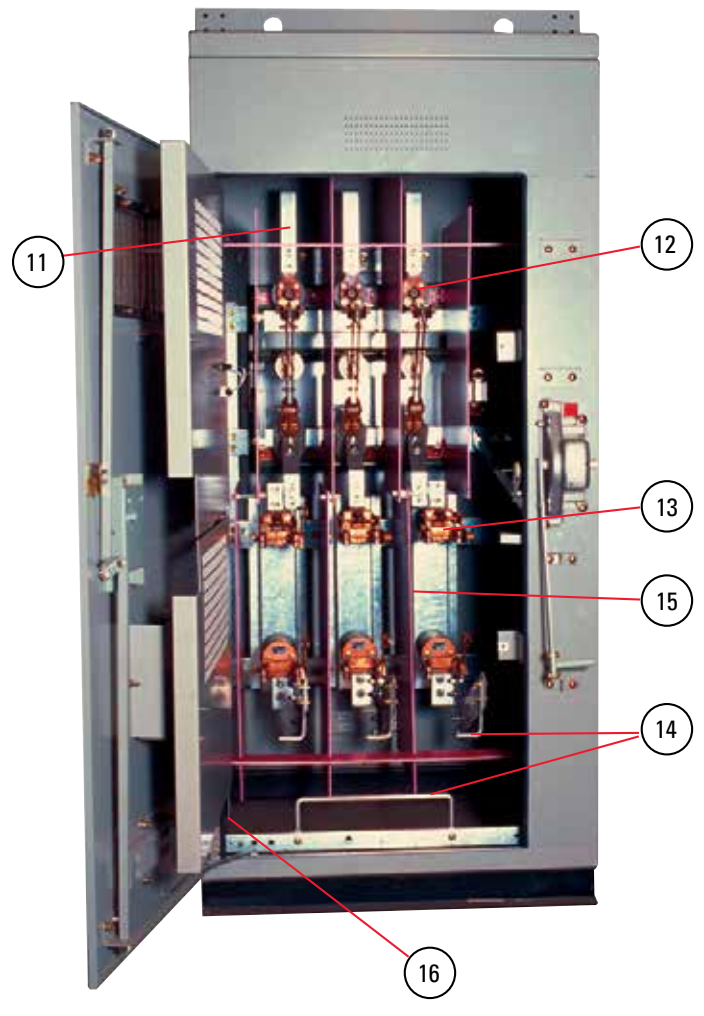


1. Lifting angles, at top of enclosure (shown on next page) are removable with bolt holes blind-tapped.
2. Screened ventilation perforations include an internal backup plate.
3. Weather sealant between roof and enclosure and between bus extension cover plate and enclosure.
4. Heavy-gauge steel cover plates over main and ground bus openings.
5. Security cover (optional) over viewing window is hinged and padlockable for Category A installations.
6. Security cover (optional) over switch operating handle can be positioned over handle in either the open or closed position and is padlockable in either location for Category A installations. Lower location shows bottom position of cover when switch handle is in open position.
7. Door handle is recessed, includes penta-head bolt and is padlockable. (Category A only).
8. Channel base of heavy-gauge steel supports enclosure of outdoor units only.

Exterior view of an outdoor, Category A, single-bay 15 kV metal-enclosed switchgear enclosure containing an Auto-jet® II load-interrupter switch with power fuses.



Enclosure door is open to show internal screens with openings for viewing switch position and blown-fuse indicators.



Door and screens open showing clear space for terminating cables and replacing fuses.

1. Stainless-steel door hinges and pins ensure easy movement of doors throughout equipment life.
2. Windows of a polycarbonate material are weather-sealed using gasketing and sealants on outdoor units.
3. Three-Point high-strength door latches and door rods.
4. Backup plate for ventilation openings on outdoor units.
5. Storage box for replacement fuses.
6. Self-latching door holder keeps door fixed open.
7. Gasketing around enclosure entry on outdoor units compresses against back of door when closed to prevent water entry.
8. Sturdy internal screens provide a second barrier to shield against accidental contact and perforated to allow visual inspection.
9. Door interlock prevents access to fuses unless switch is open.
10. Sturdy operating handle with cast-aluminum housing includes provisions for padlocks and key interlocks.

11. Main bus is rated for 600 amperes, 1200-ampere bus is also available.
12. Auto-Jet® load-interrupter switches, rated 600 and 1200 amperes, are UL® recognized and feature an industry-leading three-time duty-cycle fault-closing rating of 40,000 amperes asymmetrical and a one-time duty-cycle fault-closing rating of 61,000 amperes asymmetrical.
13. Unit can be furnished with a variety of power fuses which are current-limiting or expulsion fuses.
14. Ground studs on fuse terminal and provisions on ground bus.
15. GPO-3 fiberglass barriers isolate phases and ground plane.
16. Heater in fused circuit inside outdoor units (not visible on sidewall of enclosure).

Features (Single-Bay & Multi-Bay)

- Standard doors are full height. Inner screen doors control access to fuses and other energized components.
- Metering transformers may be located in switch-fuse compartment or may be located in a separate adjacent compartment.
- Switch position can be seen through sealed, clear polycarbonate window and perforated inner screen.
- Bulkhead doors feature 3-point latching, a captive hex-head security bolt, padlockable flush mounted handle, self-latching doorstop and stainless steel concealed hinges. Category A security features are available as an option.
- Switch handles have provisions for padlocking in the opened or closed positions and can accommodate a Portable Remote Operating Mechanism (see optional features).
- Standard ventilation louvers are included at top and bottom on front and back of each bay. All louvers on outdoor assemblies are tamper resistant and have internal screens with filters.
- Mechanical interlock prevents opening door with switch closed or closing switch with door open.
- Bus bars are aluminum (copper optional).
- Ground bus in each compartment is aluminum (copper optional).
- Hinged inner steel door guards against contact with the switch and is perforated to allow view of switch blades.
- "Danger — High Voltage" signs are located on inside on screen doors.
- Rear access is not required except to accommodate special entrance requirements.
- Fuses may be current limiting or expulsion type with exhaust control devices.

Outdoor Units (Type 3R outdoor)

- Roof weather sealed to enclosure.
- Adjacent bays are sealed to keep water out from between the double walls.
- Roof caps over joints between bays are provided as an added measure to exclude water.
- A space heater (on a fused circuit) in each unit eliminates excessive condensation.
- Externally removable filters provided with outdoor features.
- Formed steel channel base on each individual unit has an insulating coating applied.
- Underside of all roofs have a heavy coat of anti-condensation compound.

Optional Features and Accessories

- Portable Remote Operating Mechanism - fits over manual handle and allows switch to be opened or closed from outside the arc-flash boundary.
- Mimic Bus
- Single-Phase Protection
- Blown Fuse Indication
- Analog or Digital Customer Metering
- Utility Metering
- Drawout VTs or CPTs
- Undervoltage Trip
- Overvoltage Trip
- Type 3R (outdoor) Enclosure
- UL Listing (5 and 15kV)
- Station, Intermediate and Distribution Class Surge Arresters
- Key Interlocks
- Motor Operator, Auxiliary Switches, Operation Counter
- Current Transformers
- Special Paint
- Special Enclosure Material (304 or 304L Stainless Steel)
- Close Coupling to Transformers, Existing Switchgear, or Retrofit
- Floor Plates

STANDARD SPECIFICATIONS FOR MANUAL METAL-ENCLOSED SWITCHGEAR

A. General

1. Product

The metal-enclosed switchgear shall be in accordance with the applicable plans, drawings and one-line diagrams and shall conform to these specifications.

2. Assembly

The metal-enclosed switchgear assembly shall consist of one or more indoor, outdoor self-supporting bays, containing interrupter switches and/or power fuses with the necessary accessory components, all completely factory assembled and operationally checked.

3. Ratings

a) Ratings for the integrated switchgear assembly shall be as designated below. **Select appropriate column.**

	System Voltage Class						
	5kV	15kV	25kV	25kV	35kV	35kV	
kV, Nominal	4.16	14.4	24.9	24.9	34.5	34.5	
kV, Maximum Design	5.5	17.5	27	27	38	38	
kV, BIL	60	95	125	125	150	200	
Main Bus Continuous Amp	600	1200	600	1200	600	1200	
Switch Load Interrupting	600	1200	600	1200	600	—	
Short-Circuit Ratings ①							
Amps, RMS Symmetrical	25,000	38,000	25,000	38,000	25,000	25,000	38,000*
MVA 3-Phase Symmetrical at Rated Nominal Voltage	180	275	625	950	1,000	1,000	1,500
Fault-Closing Amps, RMS Asym 3-Times Duty-Cycle ②	40,000	40,000	40,000	40,000	40,000	40,000	—
Fault-Closing Amps, RMS Asym 1-Time Duty-Cycle ③	—	61,000	—	61,000	—	—	—

① These are nominal switch ratings. Integrated switchgear unit may be limited by fuse ratings. Use the fuse ratings charts in this publication to adjust short circuit ratings, when applicable.
 ② The three-time duty-cycle fault-closing rating means that the switch can be closed 3 times into rated fault amperes and remain operable and able to carry and interrupt its rated load current.
 ③ The one-time duty-cycle fault-closing rating means that the switch can be closed 1 time into rated fault amperes and remain operable and able to carry and interrupt its rated load current.
 * The asymmetrical rating is 61,000 amperes, one-second.

b) For cubicles or bays in which overcurrent circuit protection is required on circuits, where the continuous load amperes exceed the maximum continuous ampere rating of a single fuse, a drawout circuit breaker should be specified in preference to employing paralleled expulsion fuses whose arcing products and pressures may be substantial during the interruption of fault current.

4. Certification of Ratings

a) The integrated metal-enclosed switchgear assembly shall be designed and built by the manufacturer of the basic interrupter switch who shall be completely and solely responsible for the performance of these basic components as well as the complete integrated assembly as rated.

b) The manufacturer shall furnish upon request certification of ratings for the basic switch and fuse components and/or the integrated metal-enclosed switchgear assembly consisting of the switch and fuse components in combination with the enclosure(s).

5. Compliance with Standards and Codes

- a) ANSI C37.20.3 and IEEE Standard 27 (Standards for Switchgear Assemblies including Metal-Enclosed Bus).
- b) Applicable safety and health standards promulgated pursuant to Federal Occupational Safety and Health Act of 1970.
- c) Article 490.21(E) "Load Interrupter" 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.
- d) (Optional) The switchgear assembly shall be UL listed. (Available on 5kV and 15kV switchgear only.)

B. Construction — Assembly:

1. Insulators

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

- a) Operating experience of at least twenty (20) years under similar conditions.
- b) Ablative action to ensure non-tracking properties.
- c) Adequate leakage distance established by test per IEC Standard 60507.
- d) Adequate strength for short-circuit stress established by test.
- e) Conformance with applicable ANSI and IEEE 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 metal-enclosed gear shall expose material of the same composition and properties so that insulators with minor surface damage need not be replaced.

2. High-Voltage Bus

- a) Bus and interconnections shall consist of aluminum bar of 56% IACS conductivity.
- b) Bolted aluminum-to-aluminum connections (copper is optional) shall be made with a suitable number of non-corrosive bolts and nuts, and with two Belleville spring washers per bolt, one under the bolt head and one under the nut or with a wide, flange-head carriage bolt and one Belleville spring washer per bolt. As an alternate, bolted aluminum-to-aluminum connections shall be made with a suitable equivalent surface area, i.e. I-bolt and spring washer. Bolts shall be tightened to proper torque for the particular Belleville washer.

3. Ground Bus

- a) A ground bus of short-circuit rating equal to that of the integrated assembly (or a ground connection, in the case of single-bay switchgear) shall be provided, maintaining electrical continuity throughout the integrated assembly.
- b) The ground bus shall consist of aluminum bar of 56% IACS conductivity.
- c) In each bay, the ground bus (or connector) shall be bolted to a stainless steel bracket, which shall be welded to the enclosure (copper is optional).

C. Construction - Enclosure & Finish

1. Enclosure

- a) The enclosure of each bay shall be constructed of heavy-gauge formed steel panels that maximize strength, minimize weight, and inhibit internal corrosion. (Optional all welded construction is also available.) For Category A only: externally removable bolted panels will not be accepted unless specified and when specified must be installed with tamper-resistant hardware.
- b) The basic material for the enclosure, roof and doors shall be 11-gauge, hot-rolled, pickled-and-oiled steel sheet.
- c) Each bay containing high-voltage components shall be a complete unit in itself, with full side sheets resulting in double-wall construction between bays. To guard against unauthorized or inadvertent entry, side and rear sheets shall not be externally attached with removable bolts except where tamper-resistant hardware is specified.
- d) Sufficient space shall be allowed for ease of cable pulling and installation. Space shall be free from fixed structural members or electrical devices.
- e) On multi-bay units when "thru-bushings" between the cubicles are specified, the thru-bushings should be shipped completely assembled to the cubicle and shall not require field assembly of semi-conducting grommets.

2. Doors

- a) Doors shall be constructed of 11-gauge hot-rolled, pickled-and-oiled steel sheet.
- b) Door edge flanges shall overlap with door opening flanges and shall be formed to create a mechanical maze that shall guard against water entry and discourage tampering or insertion of foreign objects.
- c) Doors shall have an appropriate number of hinges based on door height and, in no case, less than three when door height exceeds forty (40) inches. The hinges and hinge pins shall be stainless steel and secured in place to guard against tampering.
- d) In consideration of controlled access and tamper resistance, each door shall be equipped with a positive-action three-point latching system.
- e) Doors providing access to fuses shall have provisions to store spare fuse units or refill units.
- f) Each door is provided with a door holder to hold the door open against inadvertent closing. It shall be integral with the door and frame and shall self-secure when the door is fully opened.

For units specified with optional Category A features:

- g) Each door shall be provided with a recessed stainless-steel door handle. The door handles shall be padlockable and shall incorporate a hood to protect the padlock shackle from tampering. Each handle shall be provided with a recessed (select the hex or penta-head) bolt for additional security.

3. Access Control

- a) Doors providing access to interrupter switches with power fuses shall be mechanically or key interlocked to guard against:
 - 1) Opening the door if the interrupter switch on the source side of the power fuse is closed, and
 - 2) Closing the interrupter switch if the door is open.
- b) Doors providing access to interrupter switches only shall have provisions for padlocking.
- c) Each bay or compartment thereof containing high-voltage components shall be provided with a protective screen or second door, bolted closed, to guard against inadvertent entry to bays containing these components when the enclosure door is open.
- d) Access to the enclosure shall be from the front only, unless otherwise specified (for example) for cable termination at rear.

4. Vents

Ventilation openings shall be provided at the top and bottom of the unit as required for proper air circulation. Vents shall have stainless steel screened interior baffles to prevent entrance of foreign objects.

5. Lifting Eyes

Lifting provisions shall be removable and shall not permit entry into the interior when removed.

6. Finish

- a) Full coverage at joints and blind areas shall be achieved by processing enclosure panels or welded enclosures independently of components such as doors and roofs before assembly into the unitized structures.
- b) All surfaces shall undergo a chemical cleaning, phosphatizing or zirconization and sealing before any protective coatings are applied in order to remove oils and dirt, form a chemically and anodically neutral conversion coating, improve the finish-to-metal bond, and retard underfilm propagation of corrosion.
- c) The finishing system shall be applied without sags or runs for a pleasing appearance.
- d) After the enclosure is completely assembled and the components (switches, bus, etc.) are installed, the finish shall be inspected for scuffs and scratches. Blemishes shall be carefully touched up to restore the protective integrity of the finish.
- e) Unless otherwise specified, the color shall be ANSI 61 Light Gray.
- f) To assure that the finishing system is capable of resisting corrosion, the manufacturer shall provide if requested certification that representative test panels, protected by the manufacturer's finish system, have passed the following tests:
 - 1) **Saltspray** (relates to coastal environments and/or presence of snow-melting salts or fertilizers). Scribe to bare metal and test for 2000 hours in a 5% salt spray per ASTM B-117. Loss of adhesion from bare metal should not extend more than 1/8" from the scribe. Underfilm corrosion should not extend more than 1/16" from the scribe.
 - 2) **Crosshatch adhesion** (relates to adhesion after scratching of the finish). Scribe to bare metal a crosshatch pattern of 100 1/16" wide squares. Apply Scotch 710 tape and rapidly remove. There should be 100% adhesion to the bare metal and between layers.
 - 3) **Humidity** (relates to environments with high humidity). Test for 1000 hours subject to 100% humidity at 45-50°C per ASTM 2247. There should be no blisters.

- 4) **Impact** (relates to transit and handling damage and abuse by public). Impact the test panel with a 160 in.-lb., falling dart per ASTM D-2794. There should be no cracking or chipping of the paint on the impact side of the test panel.
 - 5) **Oil Resistance** (relates to probable contact with mineral oil). Immerse two test panels in mineral oil for 3 days, one at room temperature and one at 100°C (212°F). There should be no apparent changes, such as color shift, blisters, loss of hardness or streaking.
 - 6) **Ultraviolet Accelerated Weathering Test** (Relates to exposure to sunlight and rainfall, loss of gloss, color fading, and chalking). Continuous exposure to ultraviolet light for 500 hours per ASTM G-53 with a cycle of 4 hours ultraviolet followed by 4 hours of condensation. Loss of gloss should not exceed 50% of original gloss per ASTM D-523.
 - 7) **Water Resistance** (relates to rainfall or dew). Immerse a test panel in distilled water for 3 days at room temperature. There should be no apparent changes, such as blistering, color shift, loss of hardness or streaking.
 - 8) **Adhesion** — Fed Spec. 141A, Method 6301.1 (relates to adhesion after scratching the finish). Immerse test panel in distilled water for 24 hours. Make two parallel scratches 1" apart. Apply Scotch 710 tape and rapidly remove. There should be 100% adhesion to the bare metal and between layers.
 - 9) **Abrasion Test** — Taber Abrader (relates to wear encountered during installation). Prepare a panel coated with the component of the finish intended to provide abrasion resistance. Test using a CS-10 wheel, 1000 gram weight, 3000 cycles, per Fed. Spec. 141, Method 6192. This provides a comparative test between samples.
- g. 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 nonferrous materials, 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 integrated switchgear assembly. These ratings define the ability to close the interrupter switch either alone (un-fused) or in combination with the appropriate fuses 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 design voltage with current applied for at least 10 cycles. Certified test abstracts establishing such ratings shall be furnished upon request.
- b) Interrupter switches shall be completely assembled and adjusted by the switch manufacturer on a single rigid mounting frame.
- c) Interrupter switches shall be provided with contact blades and interrupters for circuit closing, including fault-closing, continuous current carrying, and circuit interrupting. Interrupter switches with auxiliary blades shall not be permitted.
- d) Interrupter switches shall be positively and inherently sequenced with the blade position. It shall not be possible for the blade and interrupter to get out of sequence.

- e) Interrupter switches shall have a readily visible open gap when in the open position to allow positive verification of correct switch position.
- f) Each interrupter switch shall be provided with a switch operating handle. The handle shall be non-removable, and provisions shall be provided for padlocking in open or closed position.
- g) Interrupter switches shall utilize a quick-make, quick-break mechanism installed by the switch manufacturer. The quick-make, quick-break mechanism shall be integrally mounted on the switch frame, and shall swiftly and positively open and close the interrupter switch independent of the speed of the switch operating handle.

2. Fuses

- a) Fuses shall be solid-material power fuses or current-limiting fuses as specified by the equipment purchaser.
- b) Each bay containing fuses shall be equipped with grounding provisions on the load side of the fuses and on the ground bus.

3. Metering

- a) Primary-metering compartment shall be provided as required.
- b) Access to metering compartment shall be provided with a protective screen or second door, bolted closed to guard against inadvertent contact with energized parts when the main enclosure door is open.
- c) Metering transformers shall be mounted such that established electrical clearances are maintained.
- d) All low-voltage wiring shall be located as required to minimize exposure to high voltage.

E. Labeling

1. Hazard-Alerting Signs & Labels

- a) All external doors and hinged bolted panels providing access to high voltage shall be provided with suitable hazard-alerting signs.
- b) All internal screens or doors providing access to high voltage shall be provided with "Danger" signs.
- c) All internal screens or doors providing access to interrupter switches shall be provided with danger signs indicating "Switch Blades May Be Energized in Any Position".
- d) All internal screens or doors providing access to fuses shall be provided with danger signs indicating "Fuses May Be Energized in Any Position".

2. Nameplate, Ratings Labels, & Connection Diagrams

- a) The outside of a single or multi-compartment switchgear assembly shall be provided with a nameplate indicating the manufacturer's name, catalog number, date of manufacture, and serial number.
- 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 and short-time (momentary, amperes rms asymmetrical and one-second, amperes rms symmetrical).

- c) A one-line connection diagram showing interrupter switches, fuses, bus, and auxiliary equipment shall be provided as a drawing with each switchgear assembly.

F. Accessories

1. Fuse units or refill units, and voltage-transformer fuses for original installation and for spares shall be furnished as specified by the equipment purchaser.
2. A fuse handling tool as recommended by the fuse manufacturer shall be furnished as specified by the equipment purchaser.

G. Routine Production Tests

Production tests are those tests made to check the quality and uniformity of the workmanship and materials used in the manufacture of the switchgear. The unit shall meet the production tests described below, 1 through 3 inclusive.

1. Circuit Resistance Test

The purpose of this test is to verify that all load-interrupter switch contacts have been properly aligned and current transfer points have been properly assembled.

The DC resistance of the current carrying circuit of each switch phase from terminal to terminal of each pole in the closed position shall be measured with current of at least 10 amperes flowing. The resistance shall not exceed a limit specified by the manufacturer.

2. Dielectric Tests

Insulation withstand tests are made of the completely assembled unit to determine the ability of the insulating materials and spacing to withstand overvoltages for a specified time without flashover or puncture.

3. Operating Assurance Tests

Each switch shall be operated mechanically and tested to verify:

- a) That the switch position indicators and contacts are in correct position for both open and closed positions.
- b) That the unit circuit configuration is shown correctly.

H. Outdoor Units

In addition to the above requirements, outdoor units shall be provided with space heaters in each bay. The space heaters shall be enclosed within a perforated guard. Heater shall be fused and wired to a terminal block.

The edges of the top and sides of adjacent bays shall be covered to prevent water entry. Roof and bay interface shall be covered between each bay to prevent water entry.

For multi-bay units the roof construction shall be made with a roof cap channel where the cubicles are joined as shown in the drawing entitled Outdoor Roof Construction. (See Figure 8.)

Louvers on outdoor units shall include backup plates with stainless steel screens.

Rated Max. Voltage, kV	Rated Withstand Impulse Voltage, kV	Production Test, kV, RMS 60 Hz
5.5	60	19
17	95	34
27	125	40
38	150	80
38	200	80

The Metal-Enclosed Switchgear must comply with the applicable sections in the following ANSI Standards:

- IEEE C37.20.3** – IEEE Standard for metal-enclosed interrupter switchgear
- IEEE C37.20.4** – IEEE Standard for indoor AC Switches (1kV - 38kV) for use in metal-enclosed switchgear
- ANSI C37.22** – Preferred Ratings and Related Capabilities for Indoor AC Medium-Voltage Switches Used in Metal-Enclosed Switchgear
- IEEE C37.30** – Requirements for High-Voltage Air Switches
- ANSI C37.34** – Test Code for High-Voltage Air Switches
- ANSI C37.57** – Metal-Enclosed Interrupter Switchgear Assemblies – Conformance Testing
- ANSI C37.58** – Indoor AC Medium-Voltage Switches for use in Metal-Enclosed Switchgear – Conformance Test Procedures

Dimensions for Federal Pacific Metal-Enclosed Switchgear ①

Voltage Class	Type of O.C. Protection	Width (in inches) ⑤		Height (in Inches) ②	Depth ③ (in Inches)
		Manual	Motor Operated		
5kV	Current Limiting ③	36	46	90	46
	Draw-out VCB	36	—	90	94
	Expulsion Fuse	41	46	90	46
15kV	Current Limiting ③	36	46	90	46
	Draw-out VCB	36	—	90	94
	Expulsion Fuse	41	46	90	46
25kV	Current Limiting ③	—	—	—	—
	Draw-out VCB	48	53	120	48
35kV	Current Limiting ③	—	—	—	—
	Draw-out VCB	60	—	130	60

Notes for Dimensions Table:

- ① Dimensions are for standard production products.
- ② Add 5 inches to the height for Type 3R (outdoor)
- ③ G&W Commutating Current-Limiting fuses are available for all voltages 5-38kV. Contact factory for dimensions.
- ④ If Rear-Entry Compartment is needed, increase the depth of the compartment by the following dimensions:
5kV-add 16 inches
15kV-add 16 inches
25kV-add 24 inches
35kV-add 30 inches
- ⑤ Pull compartments and transition compartments are the following widths:
5kV- 20 inches
15kV- 20 inches
25kV- 20 inches
35kV- 30 inches

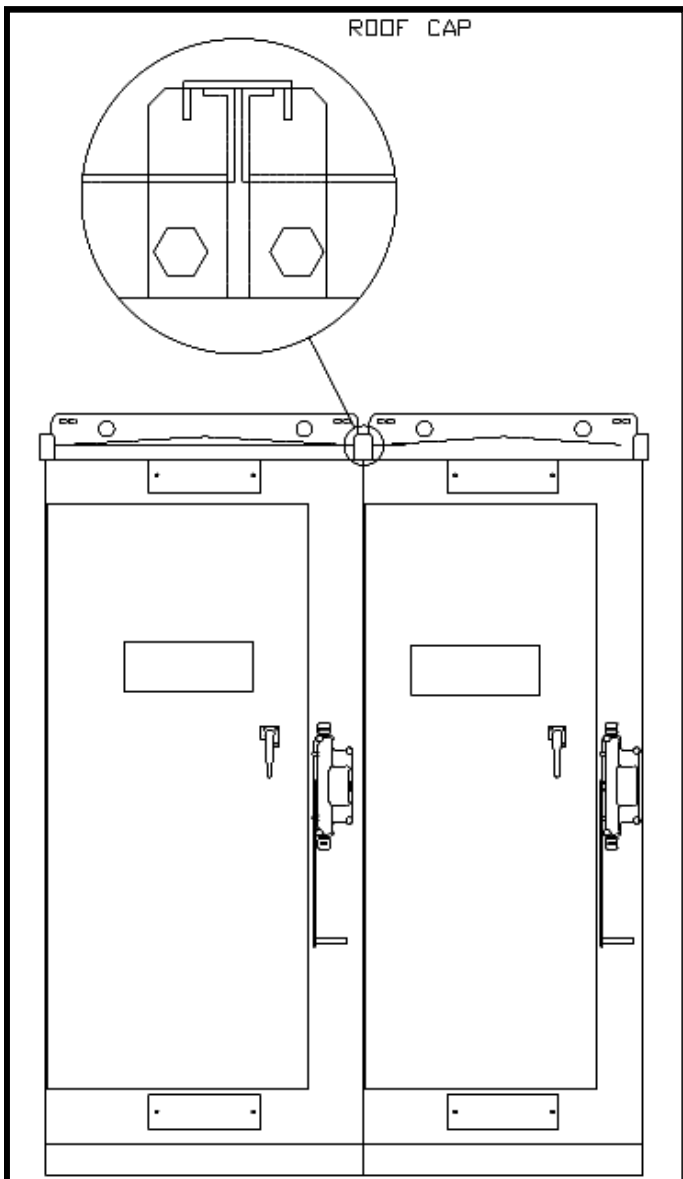


Figure 8. Outdoor Roof Construction with gasket between roof and enclosure flanges.

Circuit Protection Devices Available From Federal Pacific

Power Fuses Ratings - Expulsion Type

Nom. Voltage in kV	Max. Cont. Amps.	Expulsion Fuse Type	Manufacturer	Circuit Max. Available Fault-Current in Amps Sym.	Max. Fault-Current in Amps Asym.	Three-Phase MVA Sym.
4.16	200	DBU	Cutler-Hammer	22,400	14,000	200
4.16	200	RBA-200	Cutler-Hammer	19,000	30,000	237
4.16	200	SM-4	S&C	17,200	27,500	125
4.16	200	SM-5	S&C	37,500	60,000	200
4.16	400	RBA-400	Cutler-Hammer	37,500	60,000	270
14.4	200	DBU	Cutler-Hammer	14,000	22,400	350
14.4	200	RBA-200	Cutler-Hammer	14,400	23,000	350
14.4	200	SM-4	S&C	12,000	20,000	310
14.4	200	SMU-20	S&C	14,000	22,400	350
14.4	400	RBA-400	Cutler-Hammer	29,400	47,000	730
14.4	400	SM-5	S&C	25,000	40,000	620
24.9	200	DBU	Cutler-Hammer	12,500	20,000	500
24.9	200	RBA-200	Cutler-Hammer	6,900	11,100	410
24.9	200	SM-4	S&C	9,400	15,000	410
24.9	200	SMU-20	S&C	12,500	20,000	540
24.9	400	RBA-400	Cutler-Hammer	21,000	33,500	840
24.9	400	SM-5	S&C	20,000	32,000	860
34.5	200	DBU	Cutler-Hammer	10,000	16,000	800
34.5	200	RBA-200	Cutler-Hammer	6,900	11,100	410
34.5	200	SM-4	S&C	6,250	10,000	370
34.5	200	SMU-20	S&C	8,450	13,500	500
34.5	400	RBA-400	Cutler-Hammer	16,800	26,800	1,000
34.5	400	SM-5	S&C	17,500	28,000	1,045

Drawout Vacuum Circuit Breaker

Nominal Voltage in kV	Max. Cont. Amps	Manufacturer	Circuit Max. Available Fault-Current in Amps. Sym.
15	4000	ABB	40,000
15	4000	Siemens GMI	40,000
25	2000	ABB	25,000
34.5	2000	Siemens	31,500



ABB ADVAC® VacuumCircuit-Breaker

Power Fuse Ratings - Current Limiting

Nom. Voltage in kV	Max. Cont. Amps.	Current-Limiting Fuse Type	Manufacturer	Circuit Max. Available Fault-Current in Amps Sym.	Peak Let-Thru Current in Amps on Max. Available Fault-Current Circuit	Three-Phase MVA Sym.
4.16	450	CLE/HLE ①	Cutler-Hammer	63,000	47,000	450
4.16	450	EJO-1	General Electric	50,000	40,000	350
4.16	600	CL-14	Ferraz-Shawmut	63,000	—	450
4.16	600	PAF ②	G&W	40,000	20,000	275
4.16	750	CLE	Cutler-Hammer	40,000	75,000	275
4.16	900	BOLT-AZ055B1DARO	Ferraz-Shawmut	63,000	—	450
4.16	900	EJO-1	General Electric	50,000	80,000	360
4.16	1100	151D870G01	Cutler-Hammer	70,000	85,000	640
4.16	1350	141D870G02	Cutler-Hammer	90,000	85,000	650
14.4	200	CS-3	Ferraz-Shawmut	50,000	14,000	1350
14.4	200	EJO-1	General Electric	50,000	30,000	1350
14.4	600	CL-14	Ferraz-Shawmut	50,000	15,000	1350
14.4	300	CLE/HLE ①	Cutler-Hammer	63,000	35,000	1500
14.4	300	EJO-1	General Electric	50,000	37,000	1342

① Includes CLE, HLE, BHLE, and HCL medium voltage current-limiting fuses.

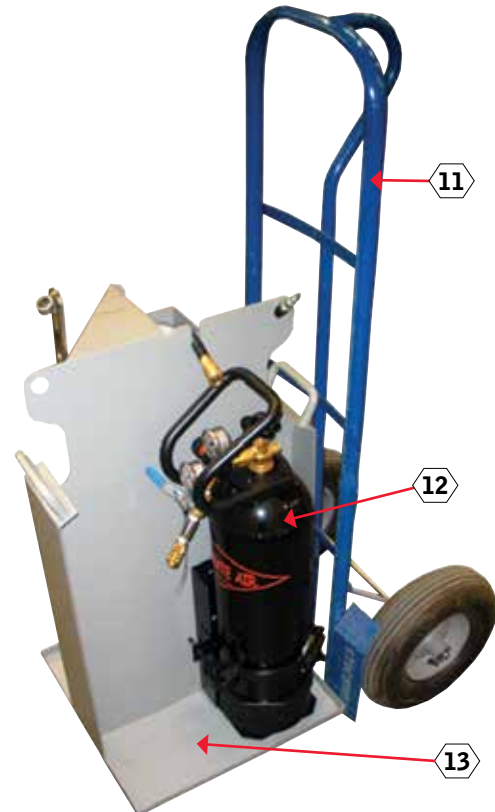
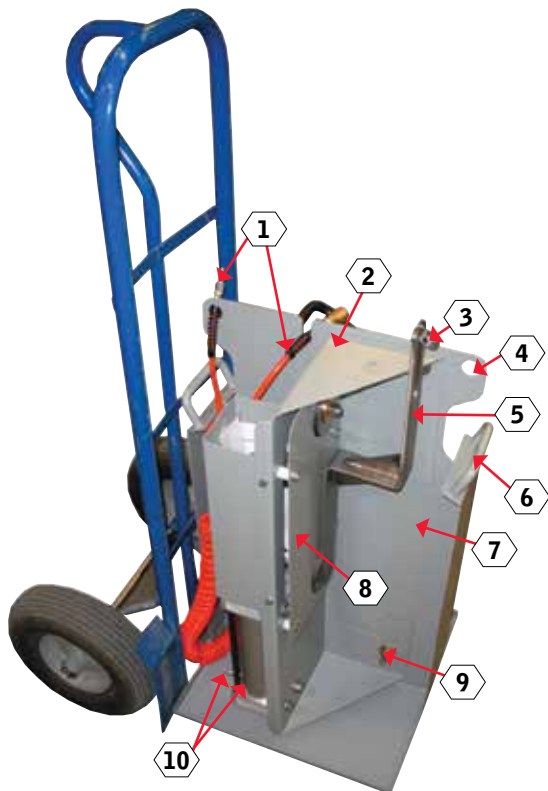
PORTABLE REMOTE OPERATING MECHANISM FOR MANUAL SWITCHES MITIGATES EXPOSURE TO ARC-FLASH HAZARDS

Federal Pacific has developed a portable remote operating mechanism (PROM) that can be applied for operation of manually-operated Auto-jet® switches from a location outside the critical arc-flash boundary zone. The fittings required to accommodate the portable mechanism can be retrofitted onto switchgear already installed in the field. Alternately, the fittings can be provided as an option on new switchgear.

Designs of the Federal Pacific PROM Portable Mechanism are available for operation of Auto-jet® switches rated through 38kV on both metal-enclosed switchgear and pad-mounted switchgear. The portable remote operating mechanism is capable of opening and closing the switch from a distance of up to 50 feet.

Features:

1. Extendable 50-foot Air Hose With Fast-On Pneumatic Coupler for Connection To An Air Cylinder and CO₂ Tank
2. Gusseted Mounting-Frame Weldment of Portable Mechanism
3. Ring Bushing With Set Screw Secures Operating Lever To Switch-Operating Handle
4. Lifting Eyes (2)
5. Operating Lever of Portable Mechanism
6. Handle Grip For Portable Operating Station
7. Portable Operating Station Holds Portable Mechanism and CO₂ Tank
8. Shield Isolates Chain-Drive Assembly
9. Mounting Bolts (2) Secure Portable Mechanism Onto Portable Operating Station
10. Air Cylinder With Fast-On Pneumatic Coupler For Connection Of An Air Hose
11. Optional Two-Wheel Dolly Is Permanently Secured To Portable Operating Station
12. CO₂ Tank, 15 lbs., Provides Approximately 150 Operations
13. Bottom Of Portable Operating Station Is Formed With a Channel Base To Readily Accommodate a Two-Wheel Dolly When That Option Is Not Selected



AUTOMATIC METAL-ENCLOSED SWITCHGEAR INDOOR AND OUTDOOR DISTRIBUTION

5kV through 38kV



Four-bay assembly of Federal Pacific Automatic Source-Transfer Switchgear featuring Federal Pacific Automatic-Transfer Micro-Processor Control, switch operators and load-interrupter switches.

Federal Pacific of Bristol, Virginia offers power-operated metal-enclosed switchgear in two basic styles: Automatic-Transfer Metal-Enclosed Switchgear and Shunt-Trip Metal-Enclosed Switchgear. These two styles can be mixed within a switchgear assembly. In addition, other automatic and supervisory-control switching functions may be integrated into the two basic styles. The basic styles of Federal Pacific Power-Operated Metal-Enclosed Switchgear are discussed in the paragraphs that follow.

Automatic Transfer

Federal Pacific offers Automatic Source-Transfer Switchgear for those applications where alternate sources of power are essential for continued operation of critical loads. This switchgear features an automatic-transfer control relay as shown in Figure 1 on page 19, to monitor system conditions. The automatic-transfer relay is the SEL-451, which automatically initiates transfer to an alternate power source if voltage on the preferred source, reduces below a preset level.

Federal Pacific Automatic-Transfer Metal-Enclosed Switchgear combines Federal Pacific Auto-Jet® II Load-Interrupter Switches with motor operators and the SEL-451 relay. Alternately, Federal Pacific offers Federal

Pacific Auto-Jet®II switches in series with stationary circuit breakers for automatic transfer. These components are all mounted within rigid, panel constructed, self-supporting enclosures. Low-voltage components, such as the source transfer control relay and motor operators, are isolated from medium voltage in the switchgear bay door or side stile. In some applications a Fast-Trip Transfer motor operator may be mounted on the side of the switchgear bay in secure low-voltage enclosures.

Federal Pacific offers two basic types of Automatic-Transfer motor operators: **Run & Trip** and **Fast-Trip Transfer Stored Energy**.

Run & Trip employs a motor operator on the shaft of the standard Auto-jet® switch. When called to operate, the motor charges the spring of the switch in a similar manner to charging the switch manually. As the spring reaches its trip point, the switch blades operate in the direction for which the spring was charged (to open or to close). With the run-and-trip motor operators, transfer is achieved in approximately eight (8) seconds. The motor operators are mounted in the switchgear bay stile (as illustrated in Figure 2 on page 18), replacing the manual handle, and requiring no extra space.

For **Fast-Trip Transfer**, the motor operator is mounted on the side of the switchgear bay in a secure low-voltage compartment and directly coupled to the switch operating shaft. See Figure 3 below. On loss of source voltage, the motor automatically charges and trips the springs of the switch mechanism and instantly trips the switches in approximately 20 cycles. To trip the switch, the motor charges and releases the spring energy, opening or closing the switch blades.

Employing **Fast-Trip Transfer**, the switch will trip faster (by high-speed revolution of the charging motor) after the open or close signal is received, rather than taking a few seconds to charge a spring as is done by the **Run & Trip** mechanism. But, the speed difference may not be a significant consideration for most applications. There are two transfer times that are significant: 1/4 cycle (5 milliseconds) and two cycles (33 milliseconds). The 1/4 cycle (5 millisecond) transfer will allow micro-processor circuits to remain powered and operational. The two cycles (33 millisecond) will allow metal halide lamps serving stadiums and arenas to stay lit. Beyond these two very short duration transfer times, there are limited advantages for the relative transfer-speed difference between **Fast-Trip Transfer** (with an approximate 20-cycle transfer time) and **Run & Trip** transfer.

Run & Trip has the advantage of lower initial cost where speed of operation is not an issue.

The Federal Pacific Automatic Transfer Switchgear is available in ratings through 38 kV for either indoor or outdoor installation and can accommodate a variety of power fuses - both current-limiting fuses and expulsion-type fuses. Federal Pacific automatic-transfer metal-enclosed switchgear provides automatic two-way source transfer with the ability to connect either of two utility sources (or a utility source and a standby generator) to the switchgear bus. In automatic-transfer switchgear, referred to as common-bus primary-selective systems, one incoming line switch is closed (preferred source) and the other incoming line switch is open (alternate source).

Bus-tie configurations requiring operation and control of more than two switches are also available and are referred to as split-bus primary-selective systems. In split-bus systems, two or more incoming source switches are closed each supplying power to an independent bus-section, which are separated by a normally open bus-tie switch. If power to a bus section is lost, the associated incoming source switch opens and the adjacent bus-tie switch closes, restoring power to the bus section. Federal Pacific's core engineering staff can provide various types of other automatic or supervisory switching applications. For example, SCADA control interface is also available with automatic transfer.

Automatic-Trip (Shunt-Trip) Applications

The Federal Pacific Shunt-Trip Switch (UL Listing available for 5kV and 15kV applications) can be applied where there is an automatic tripping requirement in response to system deviations from normal conditions. Applications include: loss of voltage, over-voltage, incorrect phase rotation, transformer-overload and blown fuse (the most common reason).

Federal Pacific employs two very reliable methods for sensing a blown fuse, creating a single-phase condition. The first method is a conventional set of VTs connected to a Phase-Loss Relay (PMR); when sensing a loss of phase output voltage supplied by VTs, the PMR closes the contacts, which actuates the solenoid (powered by a capacitor), to trip the switch open. A switchgear bay equipped with shunt-trip capability is illustrated in the photos below.

Also illustrated is the Federal Pacific standard Auto-Jet® II switch equipped with the shunt-trip solenoid and latch module (shown in Figure 2 on page 19) and an auxiliary switch with contacts for remote indication.



Pictured above are typical feeder bays with automatic-trip (shunt-trip) switches, providing feeder isolation when a single-phase condition (such as a blown feeder fuse) occurs.



Figure 1. Type ME Motor Operators are mounted in the switchgear stile, adjacent to the compartment door opening and allowing the enclosure width to remain at only 36 inches. Federal Pacific's source-transfer relay is mounted on the switchgear in a separate low-voltage enclosure. As pictured above, the SEL-451 relay is mounted on the compartment door of the second bay from right.



Figure 2. Hinged, gasketed cover protects motor operator from the environment and internal heater keeps air circulating to dry the interior.



Figure 3. Automatic-transfer switchgear with Fast-Trip Transfer motor operators is pictured in the photo above. Transfer to the alternate source is achieved in approximately twenty (20) cycles.

Shunt-Trip Employing VTs With Phase-Loss Relay (PMR) for Sensing and Tripping

Operation

Charging Switch:

Before the shunt-trip switch will operate manually or electrically, it is necessary to first close the switch, then charge and latch the switch operating mechanism spring so it is ready to trip open. The switch can then be tripped open manually by pulling a knob located below the handle or electrically either automatically by detecting a phase loss or remotely by initiating a trip signal by supervisory control from a distant location, if the latter option is specified and provided.

Loss of One or Two Phases:

Upon loss of one or two phases, the phase-loss relay will pick up after the preset time delay (2, 4, 6 or 8 seconds field selectable). When the phase-loss relay contact closes, the capacitor-trip device (CTD) discharges into the shunt-trip solenoid (ST). The solenoid pulls the latch holding the previously compressed mechanism spring on the switch (refer to "Charging Switch"). The switch opens, which opens a limit-switch contact (switch-position contact), thereby turning off power to the shunt-trip solenoid. After restoring power to the affected phases, manual closing and charging is then required to reset the switch latched for the next shunt-trip operation.

Automatic-Transfer Relay Control



Figure 1. View of typical low-voltage control cabinet (above) that includes the automatic-transfer control relay and associated components.

Three-Phase Auto-jet® II Switch Equipped with Shunt-Trip Latch and Solenoid

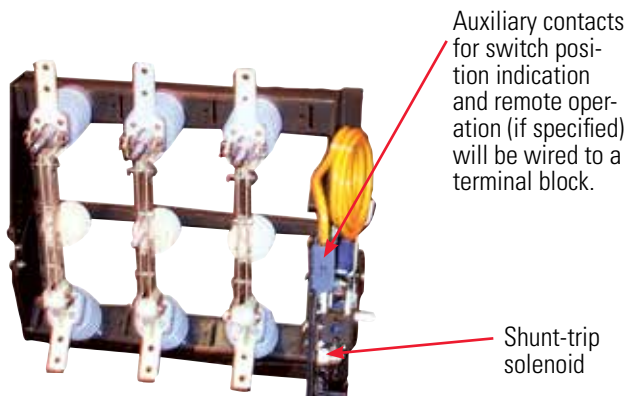


Figure 2

Shunt-trip switch pictured at left is equipped with an auxiliary switch with contacts wired to a terminal block within the switchgear. These contacts reflect switch position (open or closed), allowing the actual switch position to be determined from a remote location. They can also be wired (optionally) to allow trip-open operations to be initiated by supervisory control from a distant location.

Switch Operators for Metal-Enclosed Switchgear

Fast-Trip Switch Operator

Fast-Trip Switch Operator includes switch-position indicator, decoupling lever, decoupling indicator, operation counter, shaft to manually charge switch if control power is lost, emergency manual tripping and pushbuttons for local operation. Decoupling lever isolates switch from the switch operator so that functional testing can be performed without opening and closing the switches . . . the load circuit remains energized.



1. Switch operator crank handle
2. Aluminum enclosure
3. Switch output shaft
4. Switch position indicator
5. Padlockable stainless-steel handle
6. 24V DC battery
7. Battery charger control circuit
8. Removable plate for conduit entry of low-voltage wiring at bottom of enclosure
9. Open/close indicating lamps
10. Operation counter (optional - not shown)
11. Open/close toggle switch
12. Local/remote selector switch
13. Control-source fuses
14. Continuous stainless-steel hinges
15. Gasketed door opening
16. Door holder
17. Fast-Trip Motor - Cover interlocked to prevent motor operation when open
18. Run-and-Trip Motor

Run & Trip Switch Operator



Figure 4. Enclosure of Run-and-Trip motor operator.

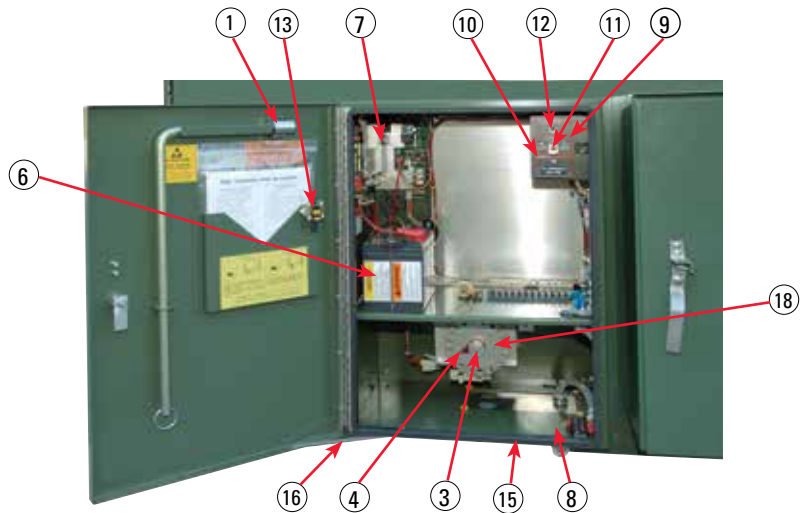


Figure 5. Interior of Run-and-Trip motor operator.

Automatic-Transfer Relay Control

Federal Pacific Automatic-Transfer Metal-Enclosed Switchgear utilizes the Federal Pacific Automatic-Transfer Software Program in the SEL-451 relay. The relay monitors system conditions and automatically initiates transfer to an alternate power source if voltage on the preferred source reduces below a preset level. Federal Pacific switch operators actuate opening and closing of the Federal Pacific Auto-jet® II load-interrupter switches.

The Federal Pacific automatic-transfer relay utilizes a state-of-the art electronic controller to perform 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 laptop computer. The entries are readily viewed on the laptop computer screen display. Internal memory with back-up battery records events and maintains a log, allowing diagnostic capability.

CHECKLIST APPLICATION GUIDELINES

Unit Requirements Matrix - Applies to the entire lineup

Project Name:			
Project Location:			
Customer Name:			
System Voltage: _____ Volts		Short Circuit Rating _____ Amps	
Fusing:	<input type="checkbox"/> Current Limiting	<input type="checkbox"/> Expulsion	
Cable Entry/Exit <input type="checkbox"/> Top <input type="checkbox"/> Bottom			
Enclosure:	<input type="checkbox"/> Type 1 (indoor)	<input type="checkbox"/> Type 3R (outdoor)	<input type="checkbox"/> Type 304 (stainless steel)
Transformer Type (Primary Switches Only) <input type="checkbox"/> Dry <input type="checkbox"/> Cast <input type="checkbox"/> Liquid			
Bus:	<input type="checkbox"/> Aluminum <input type="checkbox"/> Tinplate	<input type="checkbox"/> Copper <input type="checkbox"/> Silver Plate	<input type="checkbox"/> Other
Special Seismic Requirements:	<input type="checkbox"/> None <input type="checkbox"/> Zone 4 <input type="checkbox"/> 300%G		
Category (Cabinet Security):	<input type="checkbox"/> A (most secure)	<input type="checkbox"/> B	C (Consult Factory)
Third Party Listing	<input type="checkbox"/> Yes	<input type="checkbox"/> No	
Finish:	<input type="checkbox"/> ANSI 61	<input type="checkbox"/> Other (Specify) _____	
Mimic Bus <input type="checkbox"/> Yes <input type="checkbox"/> No	Loop Feed <input type="checkbox"/> Yes <input type="checkbox"/> No	Portable Remote Operating Mechanism (PROM) <input type="checkbox"/> Yes <input type="checkbox"/> No	
Key Interlocks: <input type="checkbox"/> Yes <input type="checkbox"/> No			
Metering: <input type="checkbox"/> Customer <input type="checkbox"/> Utility Utility _____			

Enter in space below each bay # at right applicable cubicle number from One-Line Diagrams on Pages 20-21.

	Bay #1	Bay #2	Bay #3	Bay #4	Bay #5	Bay #6	Bay #7	Bay #8	Bay #9	Bay #10	Bay #11
Switch (Amps) for each cubicle											
Fuse (Amps) for each cubicle											
Bushings between Cubicles	(Y or N)										
LA _____ MCOV	(Y or N)										
<input type="checkbox"/> Dist. <input type="checkbox"/> Int. <input type="checkbox"/> Stat.											
Motor Operated	(Y or N)										
Automatic Transfer	(Y or N)										
Fast-Trip Transfer	(Y or N)										
Run & Trip	(Y or N)										
With SCADA	(Y or N)										
1-Phase Protection (Shunt Trip)	(Y or N)										

One-Line Diagrams

One Line Diagram						
	Cubicle #1	Cubicle #2	Cubicle #3	Cubicle #4	Cubicle #5	Cubicle #6
Type	Main Device					
Function	Vacuum Circuit Breaker	Switch	Switch	Switch	Switch and Fuse	Switch and Fuse
Auto-Jet Switch	-	Yes	Yes	Yes	Yes	Yes
Fuse	-	-	-	-	Yes	Yes
Circuit Breaker	Yes	-	-	-	-	-
Metering						
Entry	Rear	Top Bus	Top Bus	Top Cable	Rear	Top Bus
Exit	Top Bus	Bottom Bus	Bottom Cable	Bottom Bus	Bottom Bus	Bottom Bus
Application	Remote Operation, Selectable protection, Frequent Operation	Load isolation, Lock out, Load switching	Load isolation, Lock out, Load switching	Load isolation, Lock out, Load switching	Load isolation, Lock out, Load switching, Cable and transformer protection	Load isolation, Lock out, Load switching, Cable and transformer protection

One Line Diagram					
	Cubicle #7	Cubicle #8	Cubicle #9	Cubicle #10	Cubicle #11
Type	Feeder				
Function	Vacuum Circuit Breaker	Switch & Vacuum Circuit Breaker	Switch	Switch and Fuse	Switch & Fuse with Metering
Auto-Jet Switch	-	Yes	Yes	Yes	Yes
Fuse	-	-	-	Yes	Yes
Circuit Breaker	Yes	Yes	-	-	
Metering					Yes
Entry	Top Bus	Top Bus	Top Bus	Top Bus	Top Bus
Exit	Rear	Rear	Bottom Cable	Bottom Cable	Bottom Cable
Application	Remote Operation, Selectable protection, Frequent Operation	Remote Operation, Selectable protection, Frequent Operation	Load isolation, Lock out, Load switching	Load isolation, Lock out, Load switching, Cable and transformer protection	Load isolation, Lock out, Load switching, Cable and transformer protection, Monitoring

One-Line Diagrams

One Line Diagram					
	Cubicle #12	Cubicle #13	Cubicle #14	Cubicle #15	Cubicle #16
Type	Cable and Bus				
Function	Cable Entry	Cable Entry	Transition	Bus Metering	Transition Metering
Auto-Jet Switch	-	-	-	-	-
Fuse	-	-	-	-	-
Circuit Breaker	-	-	-	-	-
Metering				Yes	Yes
Entry	Bottom Cable	Top Cable	Top or Bottom Bus	Top or Bottom bus	Top or Bottom bus
Exit	Top Bus	Top Bus	Bottom or Top Bus	Top or Bottom bus	Bottom or Top bus
Application	Customer Cable Connection (Left or Right)	Customer Cable Connection (Left or Right)	Transition Through Bus (Left or Right)	Customer Cable Connection	Customer Cable Connection (Left or Right)

One Line Diagram					
	Cubicle #17	Cubicle #18	Cubicle #19	Cubicle #20	Cubicle #21
Type	Single Way				
Function	Switch & Fuse	Switch & Fuse	Switch & Fuse to Transformer	Switch	Switch & Fuse w/ metering
Auto-Jet Switch	Yes	Yes	Yes	Yes	Yes
Fuse	Yes	Yes	Yes	-	Yes
Circuit Breaker	-	-	-	-	-
Metering					Yes
Entry	Cable Rear	Pull Section	Rear	Top Cable	Bottom Rear
Exit	Bottom Cable	Bottom Cable	Transition	Bottom Cable	Bottom Front
Application	Stand alone isolation and protection	Stand alone isolation and protection	Isolation and protection for close coupled transformer	Stand alone isolation	Stand alone isolation and protection with monitoring

Federal Pacific Switchgear Products 5kV through 38kV

Manual - Automated Distribution - Smart Systems
2, 4, 6 or 8 Compartments

Live-Front Pad-Mounted Switchgear

Live-Front/Dead-Front Pad-Mounted Switchgear

Dead-Front Pad-Mounted Switchgear

Vacuum Interrupter Pad-Mounted Switchgear

Primary Metering Switchgear

Pad-Mounted Capacitor Banks

Fused Sectionalizer Dead-Front Switchgear

Metal-Enclosed Switchgear

Wall-Mounted Cabinets

Unit Substations

Portable Substations

Reclosing Vacuum Fault Interrupters

Network Protectors

Custom-Engineered Products

Components

Federal Pacific Dry-Type Transformer Products 120v through 34.5kV, 10kV - 150kV BIL

25va through 10MVA

Single-Phase and Three-Phase

Industrial Control Transformers

Type FB Encapsulated General Purpose and Buck-Boost Transformers

Type FH Ventilated Transformers

High Voltage General Purpose

Pad-Mounted Transformers Per C57.12.28

Unit Substation and High Voltage Power Transformers

Vacuum Pressure Impregnated (VPI) and VPI/Epoxy Shielded

Specialty Transformers

NEMA TP-1, NEMA Premium, and DOE 2010 Efficiencies Transformers



ISO 9001:2008 Registered



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