

1.0 GENERAL

- 1.1 The circuit-switcher shall conform to the following specification.
- 1.2 The circuit-switcher shall be designed for switching and fault protection of distribution substation transformers and switching and protection of capacitor banks.
- 1.3 The circuit-switcher shall be an outdoor, three-pole, resettable device incorporating single-gap SF₆-gas-filled puffer-type vertical interrupters with integral vertical-break power-operated disconnect.
- 1.4 The circuit-switcher shall consist of three vertical interrupters with a vertical-break power-operated disconnect that may be mounted on either manufacturer-supplied mounting pedestals or user-furnished structures.
- 1.5 Interrupters shall be electronically linked to provide three-phase tripping simultaneity of less than 1/4-cycle. The circuit-switcher will ensure proper sequencing of operation between the interrupters and the disconnect.
- 1.6 The circuit-switcher shall be tripped and closed by a user-furnished external signal or by LOCAL TRIP and CLOSE pushbuttons.
- 1.7 The circuit-switcher shall be designed and tested in accordance with all applicable sections of IEC Standard 56 and IEC Standard 694.
- 1.8 The circuit-switcher shall be designed for use with optional pre-insertion inductors for limiting inrush current and controlling transient overvoltages during capacitor bank switching.



Mark VI Circuit-Switchers

1.9 The ratings and phase spacing for the circuit-switcher shall be as designated below.

kV, Nominal	[]●
kV, Maximum	[]●
kV, BIL	[]●
Hz	50 or 60
Phase Spacing, Inches	[]●
Amperes, Continuous	420
Amperes, Continuous, 4-Hr.	630
Amperes, RMS, Peak Withstand	81 900
Amperes, RMS, 1-Second	31 500
Amperes, Fault Closing, Duty-Cycle, Two-Time	30 000■
Amperes, RMS, Interrupting	
Amperes, RMS, Fault Interrupting, Duty-Cycle, Three-Time	31 500
Amperes, RMS, Fault Interrupting, Duty-Cycle, Five-Time	18 900
Amperes, RMS, Fault Interrupting, Duty-Cycle, 10-Time	9 450
Amperes, RMS, Fault Interrupting, Duty-Cycle, 30-Time	3 150
Transformer Secondary Faults	[]●

For shunt capacitor banks only – grounded banks through 138 kV or ungrounded banks through 138 kV:

Capacitor-Bank Switching, amperes	420
Interrupting Time, Cycles, Maximum	3

1.10 The circuit-switcher shall be installed in accordance with the following specification:

Specify applicable description:

- (a) The circuit-switcher shall be vertically mounted on manufacturer-supplied mounting pedestals of 12-inch-square steel-tube construction of galvanized steel and of []● height. Phase spacing of []● shall be provided.
- (b) The circuit-switcher shall be vertically mounted on a user-furnished structure, meeting the requirements specified in the manufacturer's applicable information bulletin. Mounting provisions shall be provided on each pole-unit.

● Specify values from one of the lines in Table 1 on page 3.

■ Circuit-switchers furnished with optional pre-insertion inductors do not carry a fault-closing rating.

TABLE 1. SELECTION OF VOLTAGE RATINGS AND HEIGHT AND PHASE SPACINGS FOR MOUNTING PEDESTALS

Rating, kV			Amperes, RMS Transformer Secondary Faults	Dimensions, Inches (mm)	
Nom.	Max	BIL		Pedestal Height	Phase Spacing
69	72.5	350	4200	96 (2438) 120 (3048) 144 (3658)	51 or 84 (1295 or 2134)
115	123	550	2600	96 (2438) 120 (3048) 144 (3658)	84, 96, or 102 (2134, 2438, or 2591)
138	145	650	2600	96 (2438) 120 (3048) 144 (3658)	84, 96, or 102 (2134, 2438, or 2591)

- 1.11 The circuit-switcher, when mounted on a user-furnished structure per the manufacturer’s applicable data bulletin, or when on manufacturer-provided mounting pedestals with recommended anchor bolts, and with flexible connections at all six terminal pads, shall be capable of withstanding wind loadings of up to 100 miles (161 kilometers) per hour, as well as performing as intended both during and after seismic loading of 0.2 g ground acceleration in any direction.
- 1.12 The circuit-switcher shall be rated for a temperature range of -35°C (-31°F) to +40°C (+104°F)●.
- 1.13 The circuit-switcher shall be rated for use at altitudes up to 3300 ft. (1006 meters) above sea level.
- 1.14 The circuit-switcher shall be fully compatible with comprehensive protection schemes including differential, sudden-pressure, or overcurrent relays.
- 1.15 Pre-assembly for shipment. Each circuit-switcher shall be shipped with the integral disconnect and its insulating support columns pre-assembled to the pole-unit bases.
- 1.16 The manufacturer shall provide inspection recommendations which, if conformed with, will help ensure the circuit-switcher’s continued proper performance. These inspection recommendations shall include a schedule and procedures for inspecting all of the key circuit-switcher components.

● 138-kV circuit-switchers in ungrounded capacitor bank applications are rated for a temperature range between -15°C (+5°F) to +40°C (+104°F).

2.0 CONSTRUCTION

2.1 Interrupters

- (a) Interrupters shall be constructed with a lightweight, composite-polymer silicone insulation in accordance with IEC Standard 815 for medium insulation.
- (b) Each interrupter shall be factory-filled to full pressure with SF₆ of carefully controlled purity, under controlled conditions, and then permanently sealed. Field filling shall never be necessary, thus eliminating the risk of contaminating the interrupting medium.
- (c) Interrupters shall perform according to IEC 62271-100; very low incidence of restrike.
- (d) Interrupters shall be electrically linked to eliminate the need for field adjustment of mechanical linkage between interrupters.
- (e) The interrupting medium of each interrupter shall be isolated from that of the other interrupters. A common gas manifold shall not be required, eliminating the need to refill or replace other interrupters, should one interrupter require replacement.
- (f) A temperature-compensated gas-pressure gauge shall be provided for each interrupter. Sensors shall be mounted inside the interrupter to ensure reliable measurement of gas density. Each gas-pressure gauge shall provide local indication of normal gas density and two alarm levels.
- (g) Fully pressurized interrupters shall maintain the circuit-switcher's rated dielectric withstand values when open.
- (h) A built-in pressure-relief device shall be furnished.
- (i) Local indication of interrupter position shall be provided.
- (j) Each interrupter shall be equipped with its own spring-charged, stored-energy operating mechanism to open the interrupter. The mechanism shall be housed in the base of the interrupter.
- (k) The interrupter opening mechanism shall be sealed in SF₆, protecting the mechanism from the external environment and providing excellent corrosion resistance.
- (l) Each interrupter shall have an externally attached charging motor to reset the interrupter. The interrupters shall have a built-in limit switch to prevent the interrupter from being overstressed during resetting operations.
- (m) The circuit-switcher shall have an instantaneous trip-free capability. Should the circuit-switcher be inadvertently closed into a fault sensed by purchaser's relaying, the circuit-switcher shall trip immediately. To accomplish this, the opening springs of the interrupter shall be charged before the circuit-switcher is closed.

2.2 Integral Disconnect

- (a) The disconnect shall be integral to the circuit-switcher.
- (b) The integral disconnect shall conform to or exceed the applicable portions of the following standards, as last revised, unless otherwise specified herein:
ANSI C37.30, ANSI C37.32, ANSI C37.34, NEMA SG6, NEMA 107, IEC 129, IEC 265, IEC 694.
- (c) Disconnect-blade contacts shall be of the high-pressure type, self-aligning and self-wiping, and designed to ensure effective contact and low contact resistance. Contact pressure shall not exceed the safe working value for the contact materials and shall cause no abrasion or scoring of the contacts. The disconnect-blade contacts shall be silver to silver. Silver inserts or silver strips, if used, shall be silver-brazed to contact supports. The shape and materials used for the disconnect-blade contacts shall be such that there will be no noticeable galling of the contact metals after the circuit-switcher has been subjected to a mechanical-operations test consisting of 5 000 opening and 5 000 closing operations.
- (d) The integral disconnect shall be capable of opening and closing without hesitation under 3/4-inch (19-mm) ice formation.
- (e) The design of the disconnect operator shall be such that the blades are positively toggled in the fully Closed position.

2.3 Switch Operator

- (a) The operator shall include the following features:
 - (1) TRIP and CLOSE pushbuttons, externally operable, with padlockable cover
 - (2) A laminated safety-plate window for inspection of the built-in internal decoupling mechanism, mechanical position indicators, and operation counter (and position indicating lamps, if furnished as optional equipment)
 - (3) A non-reset electric operation counter
 - (4) An eight-pole auxiliary switch, coupled to the motor, with a fingertip precision adjustment of individual contacts using self-locking spring-biased cams
 - (5) A weatherproof, dust-proof enclosure equipped with a space heater for temperature and moisture control (The enclosure will be of a tamper-resistant design that can be padlocked.)
 - (6) A decoupling mechanism that allows decoupling and locking of the disconnect-blade power train in Open position, permitting operational checkout and inspection of the switch operator motor and relaying equipment without closing the high-voltage circuit

- (b) The operator shall directly drive the integral disconnect.
- (c) The operating mechanism shall effect a smooth, thoroughly controlled movement throughout the entire opening and closing cycles, and there shall be no noticeable deflection of rods, shafts, pipe linkages, connectors, operating levers, supports, and fittings.
- (d) The operator shall be completely wired at the factory and be ready for connection of external wiring to the operator terminal blocks.
- (e) The circuit-switcher, including the operator's contactors, motor, and solenoids, shall be designed and connected for use with a []● control source. The operator space heater shall be designed and connected for use with a []■ control source.
- (f) The operator shall be equipped with a power takeoff which drives a high-speed drive train to rotate the insulating support columns, opening and closing the disconnect blades.
- (g) The operator shall be designed to ensure the blades close only after the interrupter contacts have closed and the disconnect blades open only after the interrupters have opened.
- (h) The insulating support columns shall use rotating bearings of the tapered roller type, fully sealed, with the entire bearing cavity prepacked with grease.

3.0 DESIGN TESTS

3.1 The following design tests shall have been performed by the manufacturer, and certified test reports shall be provided upon request:

- (a) Dielectric withstand: 60-Hertz; impulse
- (b) Radio influence voltage (RIV)
- (c) Temperature rise
- (d) Short-time current withstand: 1-second
- (e) Current-interrupting performance: (select as appropriate)
 - (1) Primary and secondary faults
 - (2) Load dropping
 - (3) Shunt capacitor bank switching and protection
- (f) Internal arc withstand
- (g) Mechanical endurance
- (h) Operation at temperature extremes
- (i) Gas sealing
- (j) Seismic testing to IEEE 693 low level
- (k) Open/close ice performance

● Specify 48 Vdc, 125 Vdc, or 115 Volt, 60 Hz, as required.

■ Specify 120 Volt, 60 Hz or 240 Volt, 60 Hz, as required.

4.0 PRODUCTION TESTING

- 4.1 The following production tests shall be performed on each interrupter before shipment:
 - (a) Trip timing—Each interrupter shall be checked for proper opening speed.
 - (b) SF₆ leak test—Each interrupter shall be subjected to a test to verify an overall leak rate of less than .015 ounces (0.44 ml)/year.
 - (c) Electrical resistance
 - (d) Mechanical operation
- 4.2 The following production tests shall be performed on each integral disconnect before shipment:
 - (a) Electrical resistance
 - (b) Mechanical operation
- 4.3 The following production tests shall be performed on each charging motor before shipment:
 - (a) Electrical operation
- 4.4 The following production tests shall be performed on each switch operator before shipment:
 - (a) Electrical operation
 - (b) Open and close timing

5.0 OPTIONAL EQUIPMENT

5.1 The circuit-switcher shall be furnished with the following optional equipment:

The following optional features should be specified as required.

- (a) Pre-insertion inductors—for circuit-switchers in capacitor switching applications.
- (b) A key interlock located outside the operator enclosure (The key may be removed when the circuit-switcher is tripped, locking the disconnect open and disconnecting the control circuit. The key may then be used to release interlock associated with []●.)
- (c) A remote gas-density indicator to provide remote indication of two-level low-gas-density alarms
- (d) A space-heater thermostat for operator
- (e) Position-indicating lamps—one red, one green—located inside operator for local indication of circuit-switcher position
- (f) A duplex receptacle with a ground-fault circuit interrupter and convenience-light lampholder with switch, located inside the operator enclosure
- (g) A remote-control blocking switch to prevent remote operation of the switch operator when the protective cover for the externally mounted OPEN/CLOSE pushbuttons is open
- (h) Eight or 12 additional individually adjustable single-pole, double-throw auxiliary-switch contacts in the operator that follow the disconnect
- (i) A grounding switch, manual, three-pole, group-operated, 61 000 amperes RMS, momentary rating, with blades parallel to the interrupter bases when in the Open position, for grounding the jaw-contact terminal pads
- (j) A manual trip device to allow manual tripping of the interrupters in the event operator control power is lost
- (k) Deletion of OPEN/CLOSE pushbuttons in the switch operator
- (l) Four individually adjustable extra auxiliary switch contacts in the operator that follow the switch operator motor
- (m) A quick-connect control cable (Plug-style electrical connections between the operator, interrupter charging motors, and interrupters reduce installation time.)

For circuit-switchers furnished with grounding switch.

- (n) A key interlock mounted on the grounding-switch manual operating handle to coordinate with the key interlock specified in paragraph 5.1 (b) to guard against operating the grounding switch with the disconnect blades closed
- (o) Four or eight individually adjustable extra auxiliary switch contacts for the grounding-switch manual operating handle

● Specify grounding switch or other equipment.