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1.0 SCOPE

This specification covers the design, manufacture, and testing of three pole, gang operated vertical interrupter outdoor circuit switchers without integral disconnect.

2.0 STANDARDS

All outdoor circuit switchers shall be designed, manufactured, assembled, and tested in accordance with the latest applicable ANSI, NEMA, and ASTM standards and guidelines. If there are any conflicts between the ANSI, NEMA, or ASTM standards and this specification the specification shall govern.

3.0 DESIGN REQUIREMENTS

3.01 Service Conditions

The circuit switcher shall be suitable for outdoor installation in electric power substations under the following conditions:

3.01.01 Temperature

The circuit switcher shall perform in an ambient temperature range of -40°C through +50°C or -30°C through +50°C based on ratings specification in section 3.02.

3.01.02 Altitude

The circuit switcher shall perform at elevations up to 3,300 feet.

3.01.03 Seismic

The circuit switcher shall be capable of withstanding seismic loading of 0.2 g ground acceleration in any direction when installed on the manufacturer's furnished support structure and anchor bolts and with flexible connections to the terminal pads. The circuit switcher shall perform its specified functions during and after the seismic event.

3.01.04 Wind Loading

The circuit switcher shall be capable of withstanding wind loads up to 90 mph without loss of function.

3.01.05 Additional Requirements

If any site-specific service conditions not covered in sections 3.01.01 through 3.01.04 exists (e.g. extreme cold temperature installation, corrosive environment, high altitude installation, etc.) they will be defined in the quotation request.

3.02 Ratings

3.02.01 Electrical

Ratings (38 kV – 72.5kV)								
Maximum Voltage Rating (kV)	27	38	38	48.3	72.5	38	48.3	72.5
BIL (kV)	150	200	200	250	350	200	250	350
Continuous Current	1200 A & 1600 A		1200 A			1200 A, 1600 A, 2000 A, & 2500 A		
Primary Fault Interrupting	25 kA		25 kA (31 kA*)			40 kA		
Secondary Thru-Fault Interrupting	4 kA		4 kA			4 kA		
Interrupting Time	3 cycles		5 cycles			3 cycles		
Power Frequency	50/60 Hz		60 Hz			60 Hz		
Short-Time Withstand	25 kA (3 sec)		40 kA (3 sec)			40 kA (3 sec)		
Peak Withstand	62.5 kA		104 kA			104 kA		
Short-Circuit Making	25 kA		40 kA			40 kA		
Insulator Design	Porcelain		Composite			Porcelain		
Ambient Temperature Range	-40°C to +50°C		-40°C to +50°C standard (-50°C to +50°C optional)**			-30°C to +50°C		

* Product can be rated for 31.5 kA interrupting (3 operations)

** -50°C rating is 18 kA (SF₆ / N₂)

Ratings (48.3 kV – 170 kV)					
Maximum Voltage Rating (kV)	48.3	72.5	123	145	170
BIL (kV)	250	350	550	650	750
Continuous Current	1200 A, 1600 A, 2000 A, 3000 A, 4000 A*				
Primary Fault Interrupting	25 kA, 31.5 kA, 40 kA				
Secondary Thru-Fault Interrupting	4 kA				
Interrupting Time	3 cycles				
Power Frequency	60 Hz				
Short-Time Withstand	50 kA (3 sec)				
Peak Withstand	130 kA				
Short-Circuit Making	50 kA				
Insulator Design	Porcelain				
Ambient Temperature Range	-40°C to +50°C standard (-50°C to +50°C optional)				

* Consult factory for 4000 A ratings

Ratings (245 kV)	
Maximum Voltage Rating (kV)	245
BIL (kV)	900
Continuous Current	1600 A*
Power Frequency	60 Hz
Short-Time Withstand Current & Short Circuit Making Current	63 kA, 1 sec
Primary Fault Interrupting	40 kA
Transformer Limited Fault	4.2 kA
Interrupting Time	3 cycles
Duty Cycle	O – 0.3 sec – CO – 15 sec – CO
Creepage Distance	6530 mm / 257.1 in
IEC Pollution Class	IEEE Heavy
Ambient Temperature Range	-35° C to +50° C

* For applications above +40°C, continuous current rating shall be 1200A.

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3.02.02 Additional

1. Rated Interrupting Time: 5 cycles for 27 kV through 72.5 kV units, 3 cycles for 38 kV through 170 kV units, 6 cycles for 245 kV
2. Rated Duty Cycle: O-0.3 sec-CO-15 sec-CO

3.02.03 Source Supply Voltage

Purchaser will supply the following sources for the motor, auxiliary, and control circuits:

1. Motor Voltage 48 VDC, 125 VDC, 250 VDC, 120 VAC, or 240 VAC
2. Auxiliary Voltage 120 / 240 VAC, 60 Hz, 1Ø
3. Control Voltage 48 VDC, 125 VDC, 250 VDC

3.03 Interrupter

The circuit switcher shall use SF₆ single gap interrupters. Each interrupter shall be provided with an overpressure relief device and shall be field refillable. Hermetically sealed interrupters are not acceptable due to the inherent dangers to purchaser's personnel associated with handling fully pressurized SF₆ devices during installation and also due to potential hazards encountered during transportation and offloading.

3.04 Insulators

The support insulators and the interrupter insulators shall be ANSI 70 gray in color and either porcelain or composite in construction.

3.05 SF₆ Gas System

The circuit switcher shall have a gas system constructed of rigid copper piping or a combination of rigid copper piping and flexible stainless steel tubing that allows each interrupter to be pressurized through a fill port.

The gas system shall include the insulator and a color coded, temperature compensated density gauge that is visible from the ground and which is furnished with low-pressure alarm and lockout contacts. The density gauge must be at ground potential. Battery powered gas density monitors are not acceptable.

The system shall be constructed such that the density gauge can be isolated from the interrupter to allow the low-pressure alarm and lockout contact set points to be verified. A means for refilling the system in the field without disassembling the circuit switcher must be provided. The device shall have a leak rate of less than 0.5% per year.

3.06 Terminal Pads

Terminal pads shall be unplated aluminum with 4 hole NEMA drilling pattern for use with purchaser furnished terminal connectors. The terminal pads shall be reversible for mounting at the top, bottom, or either side of the interrupter.

3.07 Operating Mechanism

3.07.01 Spring Operating Mechanism

Each circuit switcher shall be provided with a spring open-spring close mechanism capable of a duty cycle of O-0.3 seconds-CO-15 seconds-CO. The spring shall be charged via an electric motor in 15 seconds or less. Pneumatic, hydraulic, or combination pneumatic/hydraulic mechanisms are not acceptable. Devices utilizing multiple mechanisms are not acceptable.

3.07.02 Mechanism Housing and Control Components

An ANSI 70 gray painted steel mechanism housing shall be furnished and shall be provided with the following accessories:

1. Electric spring charging motor
2. Color coded, temperature compensated gas density gauge with low-pressure alarm contact and low-pressure lockout contact
3. Trip-close pistol grip switch
4. Close coil
5. Dual trip coils
6. Anti-pump relay
7. Local-remote selector switch
8. A minimum of 10 spare non-adjustable auxiliary switch contacts factory set as 5 normally open (NO) and 5 normally closed (NC) contacts
9. Thermostatically controlled cabinet heater
10. Molded case circuit breakers for protection of motor circuit, control circuit, and heater circuit
11. Spring charged-discharged indicator
12. Manual closing spring charging handle
13. Open-Close position indicator
14. Position indicating lights (green=open, red=closed)
15. Manual trip lever (*not included with 245kV units*)
16. Operations counter
17. 120 VAC cabinet light with door actuated switch
18. View window in cabinet door
19. 120 VAC duplex receptacle with GFCI
20. Hinged cabinet door with 3 point latch, open position door stop, and padlocking provisions

3.08 Ground Pads

Two NEMA 2 hole ground pads shall be supplied for grounding the structure to the station ground grid.

4.0 MANUFACTURING REQUIREMENTS

4.01 Wiring

Wiring shall be:

1. Point-to-point without splices or tee connections.
2. Bundled using cable ties.
3. Clearly identified with permanently affixed markers.
4. Sized per NFPA-70 except being No. 14 AWG.

4.02 Base Frame

Each circuit switcher shall be provided with a manufacturer furnished base frame which houses the gas piping for the three support/interrupter insulators which form the gas system while also housing the interpole linkage that connects the three interrupters to the spring operating mechanism. Phase spacing shall be as shown in the following table:

Maximum kV Rating	Phase Spacing Options (inches)
15.5, 27, and 38	29 ½
48.3 and 72.5	48 or 84
123 and 145	84, 96, or 102
170	84, 96, 102, or 120
245	120"

4.03 Support Structure

Each circuit switcher shall be provided with a manufacturer supplied support structure consisting of one vertical column (mounting pedestal) for phase spacings through 48 inches, two vertical columns (mounting pedestals) for phase spacings of 84 inches through 102 inches, and two or three vertical columns (mounting pedestals) for 120-inch phase spacing. The mounting pedestal shall be hot dipped galvanized steel, shall be manufacturer's standard height offering for the specific kV rating unit requested, and shall allow convenient ground level access to the control components. Unless otherwise specified in the quotation request anchor bolts will be provided by the purchaser. All anchor bolts shall be sized as required for the operational loads generated by the circuit switcher. The manufacturer shall determine anchor bolt sizing and anchor bolt plan details when providing the anchor bolts.

5.0 DESIGN TESTS

The circuit switcher shall be design tested in accordance with ANSI C37.09-2001. The testing shall include a dielectric test, a power test, a continuous current test, and a mechanical endurance test. The dielectric test shall include 60 Hz power frequency, lighting impulse withstand, and visual corona (*not included with 245kV units*). The power test shall include short circuit interrupting, fault closing, and short time withstand.

6.0 PRODUCTION TESTS

Each circuit switcher shall be fully assembled as a three-phase unit at the factory, adjusted, tested, and timed per ANSI C37.09 section 5.

The tests shall include:

6.01 Mechanical Operation

There shall be at least 50 mechanical operations performed at the factory. Timing tests, opening and closing operations at minimum and maximum operating voltage, and spring recharge time shall be recorded.

6.02 Leak Test

An SF₆ leak test shall be performed to confirm the leak rate is less than 0.5% per year.

6.03 Resistance Tests

6.03.01 Current Path Resistance Test

A terminal-to-terminal micro-ohm resistance check shall be performed on each interrupter using a 100 A DC source and the values shall be recorded.

6.03.02 Heater, Coil, and Relay Resistance Test

The resistance of each heater, coil, and relay shall be confirmed to be within specifications and the value(s) shall be recorded.

6.04 Dielectric Tests

6.04.01 Control Circuit Dielectric Test

The completely assembled and wired operator control circuit shall pass a dielectric test of 1500 V for 1 minute.

6.04.02 Interrupter Dielectric Test

Each interrupter shall pass a power frequency withstand test at 60 Hz for one minute. The required test value shall be at least three times rated line-to-ground voltage.

7.0 SPARE PARTS

No spare parts shall be required to be purchased at the time of circuit switcher purchase. Stock shall be maintained at the manufacturer available for rush shipment in the event of an emergency need.

8.0 DOCUMENTATION REQUIREMENTS

8.01 Approval Drawings

The manufacturer shall furnish approval drawings in AutoCAD .DWG format via e-mail. The purchase order will designate the name and e-mail address of the individual where the drawings should be forwarded. If there are no comments to the approval drawings purchaser will respond via e-mail that drawings are approved as submitted with no changes. If comments are required then one copy of the drawings will be returned to the manufacturer within 10 days from the date of transmittal marked “approved with comments as noted”.

8.02 Final Drawings

The manufacturer shall furnish final drawings in AutoCAD .DWG format via e-mail. Unless otherwise specified in the purchase order, the final drawings will be forwarded to the same individual that the approval drawings were sent to.

8.03 Instruction Books

The manufacturer shall furnish an electronic copy of each applicable instruction book in Adobe Acrobat .PDF format via e-mail. Unless otherwise specified in the purchase order, the instruction book(s) will be forwarded to the same individual that the approval drawings were sent to.

8.04 Additional Documentation

One complete set of final drawings and one copy of each applicable instruction book shall be shipped in a weatherproof envelope with each circuit switcher.

9.0 SHIPPING and DELIVERY

The circuit switcher shall be match-marked and disassembled as necessary to accommodate shipping dimensional clearance restrictions. Each interrupter shall be shipped with a positive pressure of 5–10 psi of SF₆, eliminating the need to pull a vacuum on the interrupters in the field. An SF₆ fill kit shall be provided to fill the interrupters to rated pressure during installation.

10.0 SPECIFIC QUOTE REQUIREMENTS

Information furnished by purchaser at time of quote request will include:

1. kV rating
2. Continuous current rating
3. Fault interrupting rating
4. Motor / Control voltage (48 VDC, 125 VDC, 250 VDC, 120 VAC, or 240 VAC)

5. Heater voltage (120 VAC or 240 VAC)
6. Phase spacing
7. If manufacturer is to supply anchor bolts
8. Additional requirements, if applicable (see section 3.01.05)

11.0 ACCEPTABLE CIRCUIT SWITCHER

Supply Southern States type CSV or acceptable equal. Any equal proposed must meet or exceed this specification.