Southern States

Title: Southern States 550 kV ***RLSwitcher***® Vertical Interrupter Style Reactor Switcher	Product Specification Guide

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1.0 SCOPE

This specification covers the design, manufacture, and testing of a three pole, independent pole operated (IPO) outdoor reactor switcher with vertical interrupters. This switcher is to be rated for 550 kV 3 phase reactors of 400 MVAR (440 A) or less.

2.0 STANDARDS

All outdoor reactor 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 shall govern.

3.0 DESIGN REQUIREMENTS

3.01 Service Conditions

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

3.01.01 Temperature

The reactor switcher shall perform in an ambient temperature range of -40°C through +50°C.

3.01.02 Altitude

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

3.01.03 Seismic

The reactor switcher shall be capable of withstanding seismic loading categorized as low seismic per IEEE 693-2005 when installed on the manufacturer's furnished support structure and anchor bolts and with flexible connections to the terminal pads. The device shall perform its specified functions during and after the seismic event. The reactor switcher will have the option of being fitted for service to withstand a high seismic event per IEEE 693-2005.

3.01.04 Wind Loading

The reactor 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 exist (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 General Specifications

Rated Maximum Voltage	550 kV
Rated Power Frequency	50/60 Hz
Rated Lightning Impulse Withstand Voltage (BIL)	1800 kV
Rated Continuous Current	440 A
Rated Short Circuit Interrupting Current	None
Rated Short-Time Withstand Current	40 kA RMS 3 sec 63 kA RMS 18 cycles
Rated Short-Circuit Making Current	63 kA
Peak Withstand Current	164 kA Peak
Rated Duty Cycle	O-CO
Environmental Rating	-40°C to +50°C
REACTOR SWITCHING RATING	
Rated Reactor Switching Current	440 A

3.02.02 Additional

The RLSwitcher shall have a mechanical endurance life of 5,000 operations.

3.02.03 Source Supply Voltages

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

1. Motor / Control Voltage: 240 VAC / 125 VDC;
2. Auxiliary Voltage: 120 VAC, 60 Hz, 1∅

3.03 Interrupter

The reactor switcher shall use double gap SF_6 puffer interrupters. Each interrupter shall be housed in a composite insulator that is ANSI 70 gray. Arc assist type interrupters are not acceptable. Each interrupter shall be provided with an overpressure relief device and shall be field refillable. Hermetically sealed interrupters are not acceptable. Each pole will have a voltage limiter (arrestor) in parallel with each interrupter for proper voltage distribution and to control reignitions.

3.04 SF_6 Gas System

The gas system shall include the insulators, connecting tubing, and color-coded, temperature compensated gas density gauges that are visible from the ground and have low-pressure alarm and lockout contacts. The density switch 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 interrupters 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 reactor switcher must be provided. The reactor switcher shall have a leak rate of less than 0.5% per year.

3.05 Terminal Pads

Terminal pads shall be unplated aluminum with 4 hole NEMA drilling pattern for use with purchaser furnished terminal connectors.

3.06 Operating Mechanism

3.06.01 Spring Operating Mechanism

Each reactor switcher shall be provided with IPO (Independent Pole Operated) spring open-spring close mechanisms with a rated duty cycle of CO – 5 min – CO – 5 min – CO. The springs shall be charged via an electric motor in 15 seconds or less. Pneumatic, hydraulic, or combination pneumatic/hydraulic mechanisms are not acceptable.

3.06.02 Mechanism Housing and Control Components

Each mechanism housing shall be painted ANSI 70 gray and shall be furnished 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. Close coil (qty 1) per IPO mechanism
4. Trip coil (qty 2) per IPO mechanism
5. The control circuits Trip 1, Trip 2 and Close will each be on its own independent circuit. This will insure that if one circuit fails the others can operate on their own.
6. Trip coils will be connected in parallel in each of the Trip 1 and Trip 2 circuits
7. Each trip and close circuit will have provisions for coil monitoring.
8. 12 spare non-adjustable auxiliary switch contacts factory set as 6 normally open (NO) and 6 normally closed (NC) contacts
9. All auxiliary switches will be connected in such a way that the switches can be changed from parallel to series connected by field personnel

10. Thermostatically controlled field adjustable cabinet heater
11. Spring charged-discharged indicator
12. Manual closing spring charging handle
13. Open-Close position indicator
14. Manual trip1, trip2 and close push button
15. Local-remote selector switch
16. 52 Y Relay
17. Electrical operations counter
18. 120 VAC cabinet light with door actuated switch
19. 120 VAC duplex receptacle with GFCI
20. View window(s) in cabinet door for the counter, gage and indicator light
21. Circuit Breakers will be used for circuit protection
22. Hinged cabinet door with 3 point latch, open position door stop, and padlocking provisions
23. Pole disagreement circuit provided as standard

3.06.03 Control Cabinet Housing

The control cabinet will be painted ANSI 70 Gray and be furnished with the following components.

1. Open-Close position indicator
2. Thermostatically controlled cabinet heater
3. Ultrasafe fusible disconnect class J fuse protection of control, motor, heater and utility circuit.
4. Operations counter
5. 120 VAC cabinet light with door actuated switch
6. 120 VAC duplex receptacle with GFCI
7. Hinged cabinet door with non corrosive 3 point latch, open position door stop and padlocking provisions

3.07 Ground Pads

Two galvanized steel NEMA 2 hole ground pads shall be supplied for grounding the structure to the station ground grid. Each individual mechanism will have separate NEMA 2 hole ground pads. The common IPO control cabinet will have its own ground pad.

4.0 MANUFACTURING REQUIREMENTS

4.01 Wiring and Control System

Wiring shall be:

1. Point-to-point without splices or tee connections.
2. Bundled using cable ties or inside wiring duct.
3. Clearly identified with permanently affixed markers.
4. SIS wire No. 14 AWG minimum.
5. Crimped with calibrated crimpers and tested with a 100% pull test.
6. Dielectric test will be performed on the control circuits per ANSI C07.016-2006 section 7.1

4.02 Mechanism Frame

Each reactor switcher shall be provided with a manufacturer furnished base frame which houses the gas piping and gauge that forms the gas system while also housing the linkage that connects the interrupter to the spring operating mechanism. The base frame shall be ANSI 70 gray painted steel.

Minimum phase spacing is 300 inches when applied at 550 kV.

4.03 Support Structure

Each support column shall be made from galvanized steel. The columns shall be capable of bolting directly to a 4 hole bolt pattern on 20” x 20” centers and furnished for use with 1” x 2’-9” “J” type anchor bolts. *(Note these values are for 362 kV and may change for 550 kV*)

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 reactor switcher. The manufacturer shall determine anchor bolt sizing and anchor bolt plan details when providing the anchor bolts.

5.0 DESIGN TESTS

The RLSwitcher shall be design tested in accordance with ANSI C37.09-1999 unless otherwise specified. The testing shall include:

- Dielectric tests
  - 60 Hz power frequency: 860 kV
  - Lightning impulse withstand voltage: 1800 kV
  - Chopped wave lighting impulse withstand voltage: 2320 kV
  - RIV: per NEMA SG4

- Power test shall include
  - Short-circuit making current: 164 kV Peak (63 kA rms)
  - Short-time withstand current: 40 kA for 3 sec
  - Shunt reactor bank switching current: 440 A; per IEC Standard 62271-110 (2005-6)
- Continuous current test: 440 A

6.0 PRODUCTION TESTS

Each reactor switcher shall be fully assembled as a three-phase unit at the factory, adjusted, tested, and timed per ANSI C37.016-2006 Section 7. The tests shall include:

6.01 Mechanical Operation Tests

There shall be at least 120 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 SF_6 Tightness Test

An SF_6 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 Tests

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

6.03.02 Heater, Coil, and Relay Resistance Tests

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 per ANSI C37.016-2006 Section 7

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 phase shall pass a power frequency withstand test at 60 Hz for one minute. The required test value shall be 860 kV.

7.0 SPARE PARTS

No spare parts shall be required to be purchased at the time of reactor 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 reactor switcher.

9.0 SHIPPING and DELIVERY

The reactor switcher shall be match-marked and disassembled as necessary to accommodate shipping dimensional clearance restrictions. The interrupters shall be shipped with a positive pressure of 10 psi of SF_6, eliminating the need to pull a vacuum on them in the field. An SF_6 fill kit shall be provided to fill the common gas system to rated pressure during installation.

10.0 SPECIFIC QUOTE REQUIREMENTS

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

1. Maximum Rated Voltage in kV
2. Motor / Control voltage (240 VAC Motor / 125 VDC Control)
3. Heater voltage (120 VAC, 60 Hz, 1∅ or 240 VAC, 60 Hz, 1∅)
4. Who will supply anchor bolts manufacturer or purchaser
5. Column height 7'6"
6. Additional requirements, if applicable (see section 3.01.05)
7. Wind loading requirements
8. Seismic requirements per IEEE 693-2005

11.0 ACCEPTABLE REACTOR SWITCHER

Supply Southern States type ***RLSwitcher®*** or acceptable equal. Any equal proposed must meet or exceed this specification.

RLSwitcher® is a registered trademark of Southern States, LLC.