Title: Southern States 72 kV-170 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, group operated outdoor reactor switcher with vertical interrupters. This switcher is to be rated for 3 phase reactors of ≤ 67 MVAR at 72 kV, ≤ 135 MVAR at 123 kV, ≤ 158 MVAR at 145 kV, and ≤ 185 MVAR at 175 kV.

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 foundation and anchor bolts and with flexible connections to the terminal pads. The device shall perform its specified functions during and after the seismic event

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.) shall be defined in the quotation request.

3.02 Ratings

3.02.01 General Specifications

RATINGS			
Rated Maximum Voltage*	**72 kV**	**123 kV**	**145 kV**
Rated Power Frequency	60 Hz		
Rated Lightning Impulse Withstand Voltage (BIL)	350 kV	550 kV	650 kV
Rated Continuous Current	630 A		
Rated Short Circuit Interrupting Current	None		
Rated Short-Time Withstand Current	40 kA RMS 3 sec 63 kA RMS 0.3 sec		
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	630 A		

*Consult factory for 170 kV ratings

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: 120 VAC, 240 VAC, 125 VDC
2. Auxiliary Voltage: 120 VAC, 60 Hz, 1∅

3.03 Interrupter

The reactor switcher shall use single gap SF_6 puffer interrupters. Each interrupter shall be housed in a composite insulator that is ANSI 70 gray. Each interrupter shall be provided with an overpressure relief device and shall be field refillable.

3.04 SF_6 Gas System

The reactor 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 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.

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.

3.05 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.

3.06 Operating Mechanism

3.06.01 Spring Operating Mechanism

Each reactor switcher shall be provided with a spring open-spring close mechanisms with a rated duty cycle of O – 0.3 sec – CO – 10 sec - CO capable of operating all three poles. The springs 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.

3.06.02 Mechanism Housing and Control Components

The 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. 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
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

3.07 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.

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. Sized per NFPA-70 except 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 IEEE C37.016-2018 section 8.3

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.

Maximum Voltage Rating	Phase Spacing Options
72 kV	48 in, 84 in, 96 in, or 102 in
123 kV & 145 kV	84 in, 96 in, or 102 in
170 kV	84 in, 96 in, 102 in, or 120 in

4.03 Support Structure

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 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 IEEE C37.016-2018 unless otherwise specified. The testing shall include:

- Dielectric tests
  - 60 Hz power frequency: 72 kV / 123 kV / 145 kV / 170 kV
  - Lightning impulse withstand voltage: 650 kV
- 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: 630 A; per IEC Standard 62271-110 (2005-6)
- Continuous current test: 630 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 IEEE C37.016-2018 Section 8. 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 Leak 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 IEEE C37.016-2018 Section 8)

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 the rated line-to-ground voltage.

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 (120 VAC Motor / 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. Standard column height 8’
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.