



Title: Southern States 15 kV & 38 kV <i>RLSwitcher</i> <sup>®</sup> Tertiary 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 designed for switching tertiary shunt reactors.

## 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, moderate, high) 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 thru 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

Rated Maximum Voltage	38 kV
Rated Power Frequency	50/60 Hz
Rated Lightning Impulse Withstand Voltage (BIL)	200 kV
Rated Short-Time Withstand Current	40 kA RMS 2 sec
Rated Short-Circuit Making Current	40 kA
Peak Withstand Current	108 kA Peak
Minimum Gas Fill Pressure	52 psig @ 20°C
Nominal Fill Gas Pressure	76 psig @ 20°C
Rated Duty Cycle	CO – 15 sec - CO
Mechanical Endurance	CSM3 (10,000 Operations)

Voltage	Continuous Current	Reactor Switching Current		Temperature Rating
		Min	Max	
15.5 kV	2000 A	1000 A	2000 A	-40°C to +50°C
	3000 A*	1000 A	3000 A	
38 kV	1600 A	500 A	1600 A	

\* At ambient temperatures greater than +40°C, the 15 kV / 3000 A design as a maximum current of 2700 A.

3.02.02 Additional

The RLSwitcher switcher shall have a mechanical endurance of 10,000 Operations.

3.02.03 Source Supply Voltages

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

- 1. Motor Voltage:                   48 VDC, 125 VDC, 230 VDC, 120 VAC
- 2. Control Voltage:               48 VDC, 125 VDC, 120 VAC
- 3. Auxiliary Voltage:              120 VAC, 240 VAC

3.03 Interrupter

The reactor switcher shall use single gap SF<sub>6</sub> interrupters. The interrupter shall be designed to minimize the probability and magnitude of high power re-ignitions which can lead to damage of the Reactor insulation and reduce reactor life. The contact and nozzle design shall be optimized for reactor switching duty in order to minimize damage and repair requirements over the life of the equipment. 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<sub>6</sub> 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 or tin plated brass 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 a spring open-spring close mechanisms with a rated duty cycle of CO – 15 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.

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. (Gauge is located in baseframe but is accessible from mechanism Cabinet)
3. Trip-close pistol grip switch
4. Close coil
5. Trip coil
6. Anti-pump relay
7. Time delay relay
8. Local-remote selector switch
9. 12 spare non-adjustable auxiliary switch contacts factory set as 6 normally open (NO) and 6 normally closed (NC) contacts
10. Thermostatically controlled cabinet heater
11. Circuit breakers for protection of motor circuit, control circuit, and heater circuit
12. Spring charged-discharged indicator
13. Manual closing spring charging handle
14. Open-Close position indicator
15. Manual trip and close lever
16. Operations counter
17. 120 VAC cabinet light with door actuated switch
18. 120 VAC duplex receptacle with GFCI
19. View window in cabinet door
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.

#### 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.

Phase spacing is 48 inches.

##### 4.03 Support Structure

Each RLSwitcher shall be provided with a manufacturer supplied support structure consisting of one hot dipped galvanized tubular steel 12" x 8" vertical column (mounting pedestal) 46-<sup>3</sup>/<sub>4</sub>" tall with a 1" thick base plate measuring 24" x 24" with a 4 hole bolt pattern on 20" x 20" centers and furnished for use with 1" x 2'-9" "J" type anchor bolts.

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 and IEC standards unless otherwise specified. The testing shall include:

- Dielectric tests (ANSI C37.100.1 & C37.016-2006)
  - 50/60 Hz power frequency
  - Lightning impulse withstand voltage
- Power tests (C37.016 and C37.09-1999)
  - Peak Current Withstand
  - Short-time withstand current
  - Short-circuit making current
- Shunt Reactor Switching Tests (C37.015-1993 and IEC 62271-110)
  - Shunt reactor bank switching current – Test Duties 1,2,3,&4
- Continuous current test (C37.09-1999)
- Mechanical Endurance (IEC 62271-100)

## 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 C37.09 Section 5. The tests shall include:

### 6.01 Mechanical Operation Tests

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 SF<sub>6</sub> Tightness Test

An SF<sub>6</sub> 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

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 at least 3 times rated line-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<sub>6</sub>, eliminating the need to pull a vacuum on them in the field. An SF<sub>6</sub> fill kit shall be provided to fill the common gas system to rated pressure during installation.

10.0 WARRANTY

All reactor switchers and their accessories furnished under this specification shall be covered by a five year warranty from date of invoice or 2,000 operations; whichever comes first; against failure due to design or to defects in workmanship or material.

11.0 SPECIFIC QUOTE REQUIREMENTS

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

1. Maximum Rated Voltage in kV
2. Motor / Control voltage (48 VDC; 125 VDC; 250 VDC; 120 VAC, 60 Hz, 1Ø; or 240 VAC, 60 Hz, 1Ø)
3. Heater voltage (120 VAC, 60 Hz, 1Ø or 240 VAC, 60 Hz, 1Ø)
4. If manufacturer is to supply anchor bolts
5. Additional requirements, if applicable (see section 3.01.05)
6. Wind loading requirements
7. Seismic requirements per IEEE 693-2005

12.0 ACCEPTABLE REACTOR SWITCHER

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

*RLSwitcher*<sup>®</sup> is a registered trademark of Southern States, LLC.