



Title: Southern States 362 kV <b>Capswitcher</b> <sup>®</sup> Vertical Interrupter Style Capacitor Switcher	Product Specification Guide
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## 1.0 SCOPE

This specification covers the design, manufacture, and testing of a three pole, independent phase operated (IPO) outdoor capacitor bank switcher with vertical interrupters.

## 2.0 STANDARDS

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

#### 3.01.01 Temperature

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

#### 3.01.02 Altitude

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

#### 3.01.03 Seismic

The capacitor 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.

#### Wind Loading

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

#### 3.01.04 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	362 kV
Rated Power Frequency	50/60 Hz
Rated Lightning Impulse Withstand Voltage (BIL)	1300 kV
Rated Power Frequency Withstand Voltage	555 kV
Rated Chopped Wave Lightning Impulse Withstand Voltage	1680 kV
Rated Switching-Impulse Withstand Voltage Open Closed	900 kV 825 kV
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 RMS
Peak Withstand Current	164 kA Peak
Interrupting Time	3 cycles
Rated Duty Cycle	O-CO
Environmental Rating	-40°C to +50°C
<b>CAPACITOR SWITCHING RATINGS</b>	
Shunt Capacitor Bank Switching Current	810 A
Back to Back Capacitor Bank Breaking Current	810 A
Peak Capacitive Inrush Current	20 KA @ 4600 Hz
Resistor Value	As Required Pre-insertion time 6-10ms

3.02.02 Additional

The Capswitcher 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, 1Ø

### 3.03 Interrupter

The capacitor switcher shall use double gap SF<sub>6</sub> puffer interrupters. Each interrupter shall be housed in a porcelain insulator that is ANSI 70 gray. 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 across the two gaps during opening.

### 3.04 Resistors

The capacitor switcher shall be constructed with pre-insertion (closing) resistors for damping transients that occur during the switching of capacitor banks. The resistor contacts and the main contacts shall make and break in SF<sub>6</sub> gas.

The resistor must be able to withstand closing into a fault and continue to perform its specified function without damage. Resistor insertion time shall be between 4 ms and 10 ms.

The resistor and interrupter must be contained in a common housing. The interrupter must directly activate the resistor. Designs using separate housings for the interrupter and resistor (or other transient suppression device) are not acceptable. Designs that insert the transient suppression device in air are not acceptable.

### 3.05 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 capacitor switcher must be provided. The capacitor switcher 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.

### 3.07 Operating Mechanism

#### 3.07.01 Spring Operating Mechanism

Each capacitor switcher shall be provided with IPO (Independent Phase 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.

#### 3.07.02 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

#### 3.07.03 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

#### 3.08 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 capacitor 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 150 inches when applied at 362 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.

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

### 5.0 DESIGN TESTS

The Capswitcher shall be design tested in accordance with ANSI C37.09-2001 unless otherwise specified. The testing shall include:

- Dielectric tests
  - 60 Hz power frequency: 555 kV
  - Lightning impulse withstand voltage: 1300 kV
  - Switching impulse withstand voltage: 900/825
  - Chopped wave lighting impulse withstand voltage: 1680 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 capacitor bank switching current: 630 A; per IEC Standard 62271-110 (2005-6)
- Continuous current test: 630 A

### 6.0 PRODUCTION TESTS

Each capacitor 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<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 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 555 kV.

## 7.0 SPARE PARTS

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

8.05 SHIPPING and DELIVERY

The capacitor 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.

9.0 WARRANTY

All capacitor 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.

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, 1Ø or 240 VAC, 60 Hz, 1Ø)
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 CAPACITOR SWITCHER

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

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