

SOUTH CAROLINA ELECTRIC COOPERATIVES' SPECIFICATION FOR THREE PHASE ELECTRONIC CIRCUIT RECLOSERS

1.0 SCOPE

This specification applies to three phase, **non-series coil** circuit reclosers with a rated *minimum* continuous current of 560 amps and 8.0 / 10 kA symmetrical interrupting rating (8 kA for Oil Interruption, 10 kA for Vacuum Interruption), unless otherwise specified in Attachment A. The recloser shall be designed to operate at nominal system voltages of 14.4 kV, 24.9 kV, or 34.5 kV. The recloser shall be designed for pole mounted or substation installation, unless otherwise specified. All of the unit's protection and metering functions shall be electronically controlled.

All characteristics, definitions, and terminology, except as specifically covered in this specification shall be in accordance with the latest revision of the following standards:

ANSI/IEEE Std. 24- IEEE Standard Performance Characteristics and Dimensions for Outdoor Apparatus Bushings.

ANSI/IEEE C37.60 – ANSI requirements for Overhead, Padmounted, Dry Vault, and Submersible Automatic Circuit Reclosers and Fault Interrupters for Alternating Current Systems.

C37.61 (ANSI), 321- (IEEE) – IEEE Standard Guide for the Application, Operation and Maintenance of Automatic Circuit Reclosers.

C37.85 – ANSI American National Standard Safety Requirements for X-Radiation Limits for AC High-Voltage Power Switchgear.

ANSI/IEEE C37.90 – IEEE Standard for Relays and Relay Systems Associated with Electric Power Apparatus.

ANSI/IEEE C37.90.1 – American National Standard Guide for Surge Withstand Capability (SWC) Tests.

AMCI/IEEE C37.90.2 – Standard Withstand Capability of Relays Systems to Radiated Electromagnetic Interference from Transceivers.

IEC-68-2-30 – IEC Standard for Basic Environmental Testing Procedure – Damp Heat, Steady State.

ANSI/IEEE C37.90.2– Trial-Use Standard Withstand Capability of Relay Systems to Radiated Electromagnetic Interference.

IEC-68-2-30 - International Electromechanical Commission Standard for Basic Environmental Testing Procedures- Damp Heat, Steady State.

IEC 801-2,-3,-4,-5. – International Electromechanical Commission Standards.

EIC 801-3 International electrotechnical Commission Standards for RF Immunity.

NSTA Standard ASTM D – Vibration/shock (transportation spec.)

In addition to the above requirements, the recloser and control shall also meet the following requirements outlined in Attachment A.

2.0 QUALITY

2.1 CERTIFICATION

The manufacturing facility for the recloser shall be ISO9001 certified.

2.2 TESTING

Reclosers shall be capable of meeting the design tests as specified in ANSI C37.60, 6.2 through 6.14 inclusive. The manufacturer shall also perform production tests on each recloser or representative sample at the factory after final assembly. These tests shall include the following as outlined in ANSI C37.60, section 7:

1. Calibration
2. Control, Secondary Wiring and Accessory Device Test
3. Dielectric Withstand Test: One Minute Dry Low Frequency
4. No Load Operation Test
5. Leak Test: submersible reclosers only.

2.3 WARRANTY

The recloser and all of its components shall carry a minimum one-year warranty. Any recloser that does not meet the requirements and/or specifications shall be returned to the supplier and replaced or repaired at no cost to the purchaser.

3.0 GENERAL SPECIFICATIONS

3.1 RATINGS

The recloser shall meet or exceed the following electrical and physical ratings:

TABLE 1: OIL INTERRUPTION, OIL INSULATED, ELECTRONICALLY CONTROLLED

(Table 2, ANSI/IEEE C37.60-1981).

NOMINAL SYSTEM VOLTAGE RATING □	15 kV	27 kV	38 kV
Rated Max. Design Voltage (kV rms)	15.5	27	38
Nominal Voltage (kV rms)	14.4	24.9	34.5
Max. Symmetrical Interrupting Capability at Max. Design Voltage	8.0 kA ¹	8.0 kA ²	16.0 kA ³
Rated Continuous Current	560 A	560 A	560 A
Impulse Voltage Withstand (kV) Crest	110	150	150
Low Frequency Withstand, Dry, 1 minute (kV rms)	50	60	70
Low Frequency Withstand, Wet, 10 second (kV rms)	45	50	60
Ambient Operating Temperature	-30C to +40C	-30C to +40C	-30C to +40C

Note 1: C37.60 interrupt ratings at 15.5 kV and 560 amps min. trip are 4000, 8000, and 16000 amps.

Note 2: C37.60 interrupt ratings at 27 kV and 560 amps min. trip are 8000, and 12000 amps.

Note 3: C37.60 interrupt ratings at 38 kV and 560 amps min. trip are 6000, 12000, and 16000 amps

TABLE 2: VACUUM INTERRUPTION, OIL OR SOLID DIELECTRIC INSULATED, ELECTRONICALLY CONTROLLED.

(Table 4, ANSI/IEEE C37.60-1981).

NOMINAL SYSTEM VOLTAGE RATING □	15 kV	27 kV	38 kV
Rated Max. Design Voltage (kV rms)	15.5	27	38
Nominal Voltage (kV rms)	14.4	24.9	34.5
Max. Symmetrical Interrupting Capability at Max. Design Voltage	12.0 kA ⁴	10.0 kA ⁵	12.0 kA ⁶
Rated Continuous Current	560 A	560 A	560 A
Impulse Voltage Withstand (kV) Crest	110	125	150
Low Frequency Withstand, Dry, 1 minute (kV rms)	50	60	70
Low Frequency Withstand, Wet, 10 second (kV rms)	45	50	60
Ambient Operating Temperature	-30C to +40C	-30C to +40C	-30C to +40C

Note 1: C37.60 interrupt ratings at 15.5 kV and 500 (sic) amps min. trip are 6000, and 12000 amps.

Note 2: C37.60 interrupt ratings at 27 kV and 500 (sic) amps min. trip is 10000 amps.

Note 3: C37.60 interrupt ratings at 38 kV and 500 (sic) amps min. trip is 12000 amps

4.0 CONSTRUCTION AND DESIGN FEATURES

4.1 RECLOSER ASSEMBLY, TANK AND SUPPORTING STRUCTURE

1. The recloser assembly shall be housed in a suitable metal compartment, gasketed and sealed from the environment.
2. Recloser construction shall be of the dead-tank¹ or live tank design, as specified in Attachment A.
3. Recloser and supporting structure clearance to live parts shall meet the current NESC specifications.
4. The recloser tank shall be constructed of mild steel, stainless steel, cast aluminum or forged aluminum as specified in Attachment "A".
5. The recloser tank shall be equipped with a connector, which will accommodate a single conductor between #10 to #2 (minimum) in size. All grounding provisions shall meet ANSI C37.60, Section 8.2.
6. The recloser tank shall include an oil-sampling valve when oil is specified as in interrupting or insulating medium.
7. A dipstick shall be provided for checking oil level *or* a low oil level sight gauge shall be provided.
8. Hardware supplied for pole mount applications shall be galvanized steel or stainless steel as specified.
9. Supporting structures for substation applications shall be made of galvanized steel.
10. Substation racks shall be equipped with a NEMA 2-hole pad or connector, which will accommodate two number 2/0 to 250 MCM conductors, a flat pad connector accommodating 1/0 to 500 MCM conductors, or other connectors as specified in Attachment A..
11. The recloser shall be constructed for pole mounting or substation yard mounting as specified in Attachment A.
12. Elements to be accessible for operations and checking must not be higher than 6 feet on installed recloser for substation applications, except that the manual operating handle may exceed this height.

13. The bottom of the control cabinet shall be a minimum of 18 inches above ground on an installed recloser.
14. External finish shall be ANSI 70 light gray, unless otherwise specified in Attachment A. Standard finish shall withstand the 600-hour salt fog test.
15. When requested, a windlass or other raising/lowering mechanism will be supplied for substation applications. (See Attachment A)
16. The tank construction shall otherwise meet ANSI C37.60, Section 8.1.

Note 1: Dead tank breakers have the interrupting device housed within a grounded metal housing, live tank breakers house the interrupter in the insulator.

4.2 INTERRUPTING MEDIUM

1. The recloser interrupting medium shall be mineral oil, or vacuum as specified in Attachment A.
2. If oil is specified as the interrupting or insulating medium, the recloser shall be shipped filled with oil to the proper level. Oil shall be certified as non-PCB.
3. If vacuum interrupters are specified as the interrupting medium, the recloser must be equipped with oil, solid dielectric or sulfur hexafluoride (SF₆) as an insulating medium as specified in Attachment A.
4. Vacuum interrupters shall conform to ANSI C37.85 and C37.60, Section 8.13.

4.3 INSULATING MEDIUM

1. Reclosers equipped with mineral oil as the interrupting medium shall use the same oil supply as an insulating medium.
2. If solid dielectric material is specified as the insulating medium, it shall be a non-fragmenting material that is highly damage resistant and free from the effects of ozone, tracking, and ultraviolet radiation.
3. If SF₆ gas is specified as the insulating medium, less than 700 grams may be used at a pressure of 1 bar at 20°C

4.4 HIGH VOLTAGE BUSHINGS

High voltage bushings shall be constructed of wet process porcelain, polyurethane, cycloaliphatic epoxy, or EPDM silicone rubber as specified in Attachment A.

The BIL (basic impulse level) of the bushings shall be compatible with the Nominal System Voltage of the recloser unless otherwise specified.

TABLE 3:

NOMINAL VOLTAGE RATING □	14.4 kV	24.9 kV	34.5 kV
Basic Impulse Level (kV) □	110	125	150

TABLE 4: The high voltage bushings shall have the minimum creep distances as shown below. Extra creep distance bushings may be specified in Attachment A.

(Table 1, ANSI/IEEE 24-1984)

INSULATION CLASS / BIL □	15 kV / 110 kV	25 kV / 150 kV	34.5 kV / 200 kV
Minimum Creep Distance (inches)	11.0	17.0	26.0

The high voltage bushings shall be equipped with terminal ends accepting conductor sizes from 1/0 through 500 MCM.

4.5 MECHANISM

1. The recloser shall be mechanically and electrically trip free. Any applied close signal, either mechanically or electrically, shall not inhibit the recloser from tripping on the programmed time-current curve.
2. The recloser shall be designed for three-phase **only** or single-phase/three phase operation as specified in Attachment A.
3. Three-phase **only** reclosers shall be equipped with a spring-solenoid, or electromagnetic actuator, or multiple solenoids or actuators (as specified in Attachment A), which mechanically operates all three recloser poles *simultaneously*.
4. Single-phase/three-phase (“triple-single”) reclosers shall be equipped with three (3) spring-solenoid, or single or dual coil magnetic actuators (as specified in Attachment A), which operate all three recloser poles *independently*.
5. The operating mechanism must be capable of one instantaneous reclose (i.e. 0.5s or less) after an opening operation.

6. The recloser equipment shall include a manual operating device in the event of loss of both internal and external control power. Manual Trip & Lockout shall be via hookstick operable operating handle or other suitable manual operating means. Any subsequent reclose operations will remain disabled until the manual operation handle is manually returned to the normal position (i.e. the recloser cannot be closed electrically while the manual operation handle is in the down position). The manual operating provision shall conform to ANSI C37.60, Section 8.5.
7. Any and all definitions and terms related to Unit Operation shall conform to C37.60, Section 4.
8. All external hardware and fasteners shall be made of galvanized steel or stainless steel unless otherwise specified.
9. Provision shall be made for manual spring compression or recharge of the tripping mechanism.
10. The recloser shall be provided with a position indicator plainly visible on its exterior. The indicator shall clearly indicate the recloser's open or closed position. If colors are used to indicate the open or closed position, red shall signify closed and green shall signify open, with the words OPEN or CLOSED in contrasting colors. The position indicator shall conform to ANSI C37.60.

4.6 CONTROL AND RECLOSER COMPATIBILITY

The recloser shall operate with the control specified in Attachment A.

ATTACHMENT "A"

_____ Electric Cooperative

Date: _____

SCOPE

List Additional Requirements

GENERAL SPECIFICATIONS

List Additional Ratings

CONSTRUCTION AND DESIGN FEATURES

RECLOSER ASSEMBLY

1. Specify Nominal Recloser Voltage (kV) 14.4 24.9 34.5

2. Specify live or dead tank design:

Live Tank Dead Tank Either Live or Dead Tank

3. Specify Tank Material:

Mild Steel Stainless Steel Aluminum

Other (specify) _____

4. Specify Mounting Arrangement:

Pole Mount Substation Yard Mount Pad Mount

5. Specify Tank Finish:

(specify)

6. Specify windlass for substation application

7. Specify Flat Pad Terminals

Two Hole Four Hole Threaded Stud Only
Other _____

8. Specify Line and Load-Side Arrester Mounting Brackets
(POLE APPLICATION)

9. Specify Current Transformers other than standard

Metering		Quantity	Ratio	Class	Class
Bushings 1-3-5	Internal	_____	_____	_____	_____
	External	_____	_____	_____	_____
Bushings 2-4-6	Internal	_____	_____	_____	_____
	External	_____	_____	_____	_____

Additional Information: _____

10. Specify Mechanical Closing Tool (DE-ENERGIZED RECLOSER)

11. Specify Closing Coil Transfer Switch for Energizing Closing Coil
from either Load or Source

12. Specify Factory Assembly of Recloser to Frame

13. Specify Trip to Lockout Operation on Loss of AC Control Power

14. Specify Line and Load-Side Arrester Mounting Brackets (Pole Application)

INTERRUPTING MEDIUM

1. Specify Medium:

Mineral Oil Vacuum

INSULATING MEDIUM

1. Specify medium when interrupting medium above is **vacuum**:

Solid Dielectric SF₆ Mineral Oil

HIGH VOLTAGE BUSHINGS

1. Specify High Voltage Bushing Material:

HIGH VOLTAGE BUSHING MATERIAL	SPECIFIED
Wet Process Porcelain	
Polyurethane	
Epdm	
Cycloaliphatic Epoxy	
Silicone Rubber	

Specify High Voltage Bushing BIL if different from standard (110 kV @ 14.4, 125 kV @ 24.9, 150 @ 34.5):

2. Specify High Voltage Bushing BIL(kv)

3. Specify Extra Creepage Bushings:

Extra Creepage Bushings, _____ inches creepage distance.

4. Specify “CT Length” bushings for use with external “doughnut” CTs.

“CT Length” bushings required

MECHANISM

1. Specify Three-Phase Only or Three-Phase/Single-Phase Operation:

Three-Phase Only Three-Phase/Single-Phase

2. Specify Mechanism Type:

Spring-Solenoid Magnetic Actuator Other

CLOSE AND TRIP COIL RATINGS

1. Specify High or Low Voltage Closing Solenoids

High Voltage

CLOSING SOLENOID kV RATING	SPECIFIED
2.4	
3.3	
4.16-4.8	
6.0	
7.2-8.32	
11.0	
12.0-13.2	
14.4	
17.0	
20.0	
23.0-24.9	
34.5	

Low Voltage

CLOSING SOLENOID LOW VOLTAGE RATING	SPECIFIED
24 VDC	
48 VDC	
125 VDC	
125 VAC	
250 VAC	

CONTROL AND RECLOSER COMPATIBILITY

Specify Control Manufacturer and Model.

OTHER OPTIONS

Current Ratings

1. Specify continuous current rating if other than 560 AMPS.

400 AMPS 800 AMPS Other (Specify)

2. Specify symmetrical interrupting rating at desired operating voltage if other than 8,000 AMPS.

AT _____ kV operating voltage.

4,000 AMPS 6,000 AMPS 10,000 AMPS

12,000 AMPS 16,000 AMPS Other (Specify)