

# **SOUTH CAROLINA ELECTRIC COOPERATIVES' PRIMARY UNDERGROUND POWER CABLE SPECIFICATION**

## **1.0 SCOPE**

- 1.1 This specification covers the construction, mechanical, and electrical requirements of single conductor, 15 kV, 25 kV, and 35 kV rated underground power cables. The cable shall be suitable for installation on grounded-wye distribution systems at the applicable voltage.
- 1.2 Conductor sizes of 1/0 AWG through 1,000 kcmil are included.
- 1.3 The conductor shall be insulated with either ethylene propylene rubber (EPR) or tree retardant crosslinked polyethylene (TR-XLPE) as specified by the purchaser in Attachment A.
- 1.4 The neutral shall consist of concentrically wound copper wires.
- 1.5 Unless otherwise specified in Attachment A, the cable assembly shall include a non-conducting outer jacket.
- 1.6 The cable shall be suitable for direct burial in wet or dry locations.
- 1.7 The cable shall be designed for continuous operating temperature of 90 C, a maximum emergency temperature of at least 130 C, and a maximum allowable short circuit temperature of 250 C.

## **2.0 APPLICABLE SPECIFICATIONS**

- 2.1 The cable shall meet or exceed the requirements of the latest revision of the Rural Utilities Service (RUS) Bulletin 50-70 (U-1), titled RUS Specification for 15, 25, and 35 kV Primary Underground Power Cable. This specification shall be referred to hereafter as the RUS U-1.
- 2.2 The cable assembly shall meet all applicable materials, constructions, and testing requirements of the latest revision of the Insulated Cable Engineers Association, Inc. (ICEA), standard number ICEA S-94-649, titled Standard for Concentric Neutral Cables Rated 5,000 – 46,000 Volts. This standard

has been certified by the American National Standards Institute (ANSI) and will be referred to as ANSI/ICEA hereafter.

- 2.3 Where provisions of the RUS U-1 specification or the ANSI/ICEA standard conflict with this specification, or each other, the provisions of this specification shall apply.

### **3.0 CONDUCTOR CHARACTERISTICS**

- 3.1 The central conductor shall be concentric lay Class B stranded, compressed aluminum as per the ANSI/ICEA and RUS U-1.
- 3.2 The conductor shall consist of round wire strands in  $\frac{3}{4}$  or full hard, 1350 alloy, meeting the requirements of the RUS U-1 and ANSI/ICEA.
- 3.3 The interstices between the strands of the conductor shall be filled with a sealant designed to prevent the longitudinal migration of moisture that might enter the conductor. This material must meet the requirements of RUS U-1 and ANSI/ICEA. The presence of the compound in conductor interstices shall not degrade the performance of compression connectors.
- 3.4 The center strand of the conductor shall be indented with the manufacturer's name and year of manufacture as per ANSI/ICEA.

### **4.0 CONDUCTOR SHIELD**

- 4.1 The conductor shall be covered with an extruded, smooth, extra clean, conductor shield material (stress control layer). The conductor shield shall meet the requirements of the RUS U-1 and ANSI/ICEA, except as specified herein.
- 4.2 The conductor shield shall be semi-conducting for discharge-free EPR insulated cables, non-conducting for discharge-resistant EPR insulated cables, and semi-conducting for TR-XLPE insulated cables. For TR-XLPE insulated cables, the conductor shield shall be a supersmooth compound.
- 4.3 The contact surface between the conductor shield and the insulation shall have no protrusions into the insulation greater than 5 mils (0.127 mm) for EPR insulated cables and 3 mils (.076 mm) for TR-XLPE insulated cables.
- 4.4 The purchaser reserves the right to specify the acceptable compound(s) to be used in the conductor shield; please refer to Attachment A.

## 5.0 INSULATION

- 5.1 The insulation shall be ethylene propylene rubber (EPR) or tree retardant crosslinked polyethylene (TR-XLPE) as specified by the purchaser in Attachment A. The insulation shall meet the requirements of the RUS U-1 and ANSI/ICEA, except as specified herein.
- 5.2 Unless otherwise specified in Attachment A, the thickness of the insulation shall meet the following requirements, in mils, for the rated voltages:

<u>Voltage</u>	<u>Minimum</u>	<u>Nominal</u>	<u>Maximum</u>
15 kV	210	220	250
25 kV	245	260	290
35 kV	330	345	375

- 5.3 The minimum and maximum diameter over the insulation shall meet the requirements of the ANSI/ICEA for the entire length of the cable. To insure conformance, measurements shall be made as per the ANSI/ICEA.
- 5.4 The purchaser reserves the right to specify the acceptable compound(s) to be used in the insulation; please refer to Attachment A.

## 6.0 INSULATION SHIELD

- 6.1 A smooth, extra clean, semi-conducting, thermosetting, polymer material shall be tightly extruded over the insulation to serve as an electrostatic shield and protective covering. The insulation shield shall meet the requirements of the RUS U-1 and the ANSI/ICEA, except as specified herein.
- 6.2 The insulation shield shall be compatible with all materials with which it is in contact, readily distinguishable from the insulation, and plainly identified as semi-conducting. For TR-XLPE insulated cables, the insulation shield shall be extruded over the insulation by a true 3-IN-1 triple extrusion process.
- 6.3 The minimum and maximum diameter over the insulation shield shall meet the requirements of the ANSI/ICEA for the entire length of the cable. To insure conformance, measurements shall be made as per the ANSI/ICEA.

- 6.4 The shield material shall be readily removable as per the ANSI/ICEA, except that the tension necessary to remove the insulation at room temperature shall be as follows: 0-18 lbs. for discharge-resistant EPR cables, 3-18 lbs. for discharge-free EPR cables, and 6-18 lbs. for TR-XLPE cables.
- 6.5 The purchaser reserves the right to specify the acceptable compound(s) to be used in the insulation shield; please refer to Attachment A.

## **7.0 CONCENTRIC NEUTRAL**

- 7.1 The concentric neutral shall be composed of round annealed, uncoated copper wires, meeting the requirements of the RUS U-1, and the ANSI/ICEA as it applies to jacketed cable. Neutral wires shall have uniform spacing between wires with no wires touching.
- 7.2 Cables with central conductors sized 1/0 AWG and 4/0 AWG, shall have full sized neutrals. Cables with central conductors sized 350 kcmil through 1000 kcmil, shall have 1/3 sized neutrals. The size and number of wires shall be according to the tables in the ANSI/ICEA. A reduced neutral design may be specified in Attachment A. If so, the size and number of wires shall be according to the tables in the ANSI/ICEA. For every design, the minimum acceptable wire size used shall be 16 AWG.

## **8.0 OUTER JACKET**

- 8.1 Unless otherwise specified in Attachment A, a non-conducting outer jacket shall be extruded over the concentric neutral wires as per the requirements of the RUS U-1 and the ANSI/ICEA. The outer jacket shall encapsulate the concentric neutral wires.
- 8.2 The non-conducting outer jacket material shall be black, linear low density, polyethylene (LLDPE). If a semi-conducting material is specified in Attachment A, it shall be as per the RUS U-1.
- 8.3 Three red stripes shall be extruded into the outer surface of the jacket as per ANSI/ICEA; the stripes shall be spaced evenly at 120° apart.

- 8.4 The outer surface of the jacket shall be suitably marked throughout its length with clear, durable, indented markings, to indicate the following information: Name of manufacturer, year of manufacture, central conductor size and material, voltage rating, type of insulation, nominal thickness of insulation, jacket type, and the National Electrical Safety Code (NESC) symbol for an electric supply cable. There shall be no more than 6 inches of unmarked space between cable identification.
- 8.5 Sequential footage markings shall be applied to the outer surface of the jacket at regular intervals of 2 feet.

## **9.0 TESTING**

- 9.1 Production tests shall be performed as per the most stringent requirements of the RUS U-1 and ANSI/ICEA specifications. The manufacturer shall provide the purchaser with a certified test report on the production testing at the time of cable delivery. The report shall clearly demonstrate the manufacturer's compliance with all requirements included in this specification.
- 9.2 Upon request, the manufacturer shall provided the purchaser with copies of the results of any or all qualification testing that is required by the RUS U-1 and ANSI/ICEA specifications.

## **10.0 SHIPPING**

- 10.1 The cable shall be shipped on non-returnable wooden reels unless otherwise specified by the purchaser in Attachment A. A weather resistant tag or label shall be securely attached to the reel providing the following information: Cable description, beginning and ending sequential footage, total footage, gross weight and tare weight, and purchaser's name and purchase order number.
- 10.2 Watertight, heat shrink or cold shrink seals shall be applied to the cable ends to prevent the entrance of moisture during transit or storage. Each cable end shall be firmly secured to the reel. A weather resistant covering shall be applied over the outer layer of the cable on the reel. If specified in Attachment A, protective wood lagging shall be installed on reels containing cable with conductor sizes of 350 kcmil through 1000 kcmil.

- 10.3 The cable must be shipped with the reels in an upright position supported by both outside flanges. Delivery should be via a flat bed truck with provision for side unloading.
- 10.4 Unless otherwise specified in Attachment A, the maximum outside dimensions for all reels shall be as follows:

<u>Cable Size</u>	<u>Width</u>	<u>Diameter</u>
1/0 AWG and 4/0 AWG	38"	66"
350 kcmil through 1000 kcmil	48"	72"

- 10.5 The total gross weight of the reel and cable shall not exceed 5,000 pounds; a tolerance of +/- 5% shall be allowed.

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**ATTACHMENT "A"**

Cooperative Name: \_\_\_\_\_ Contact: \_\_\_\_\_

Phone #: \_\_\_\_\_ Fax #: \_\_\_\_\_ E-Mail: \_\_\_\_\_

Conductor Size: 1/0 4/0 350 500 750 1000

Voltage Rating: 15 KV 25 KV 35 KV

Conductor Shield Compound(s): \_\_\_\_\_

Insulation Type: EPR Only TR-XLPE Only EPR or TR-XLPE

Alt. Insulation Thickness: Min. \_\_\_\_\_ Nominal \_\_\_\_\_ Max. \_\_\_\_\_

Insulation Compound(s): \_\_\_\_\_

Insulation Shield Compound(s): \_\_\_\_\_

Alt. Neutral Design: Full 1/3 1/6 1/8 1/12

Alt. Outer Jacket Type: Semi-Conducting: Yes \_\_\_\_\_ No \_\_\_\_\_

Alt. Reel Type: Returnable: Yes \_\_\_\_\_ No \_\_\_\_\_

Wood Lagging: Required: Yes \_\_\_\_\_ No \_\_\_\_\_

Alt. Reel Size (inches): Width \_\_\_\_\_ Diameter \_\_\_\_\_

Shipping Address: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Signature: \_\_\_\_\_ Date: \_\_\_\_\_

Last Revised: 4/10/02