SPECIFICATION FOR LOW-VOLTAGE POWER AND CONTROL CABLES

Saudi Electricity Company
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1. SCOPE

This specification defines the minimum technical requirements for design, engineering, manufacturing, testing, inspection and performance of XLPE insulated, unarmored, 3+½ core aluminum, or single-core copper power cables, and PVC insulated multi-core control cable rated up to 750V suitable for direct burial or installation in ducts or in air within cable guard on poles intended to be used in the low-voltage system of Saudi Electricity Company (SEC), Saudi Arabia.

2. CROSS REFERENCES TO OTHER SEC STANDARDS

This specification shall always be read in conjunction with SEC General Specification No. 01-SDMS-01 (latest revision) titled "General Requirements for all Equipment/Materials," which shall be considered as an integral part of this specification. It shall also be read in conjunction with SEC purchase order and/or contract schedules, and scope of work/technical specifications for projects, as applicable.

3. APPLICABLE CODES AND STANDARDS

The latest revision of the following codes and standards shall be applicable for the equipment/materials covered in this specification. In case of any deviation, the vendor/manufacturer may propose equipment/materials conforming to alternate codes or standards. However, the provisions of SEC standards shall supersede the provisions of these alternate standards in case of any difference.

Table 1: List of applicable standards

<table>
<thead>
<tr>
<th>Standard #</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>IEC 60228</td>
<td>Conductors of Insulated Cables</td>
</tr>
<tr>
<td>IEC 60502-1</td>
<td>Power Cables with Extruded Insulation and Their Accessories for Rated Voltages from 1kV ( (U_m=1.2kV) ) up to 30kV ( (U_m=36kV) ) – Part 1: Cables for Rated Voltages of 1kV ( (U_m=1.2kV) ) and 3kV ( (U_m=3.6kV) )</td>
</tr>
<tr>
<td>IEC 60227</td>
<td>Polyvinyl Chloride Insulated Cables Of Rated Voltages Up To And Including 450/750V</td>
</tr>
</tbody>
</table>
4. MATERIAL, DESIGN AND CONSTRUCTION REQUIREMENTS

4.1. GENERAL

4.1.1 The low-voltage power and control cables shall meet or exceed the requirements of this specification in all respects and it shall be manufactured and tested in conformance with relevant international standards.

4.1.2 Manufacturer’s drawing shall show the outline of the cables together with all pertinent dimensions. Any variations in these dimensions due to manufacturing tolerances shall be indicated.

4.2. DESIGN CRITERIA

4.2.1 Unless otherwise specified, the cable shall be manufactured and tested in conformance with the reference standards.

4.2.2 Cables shall be designed for ambient temperature conditions specified in 01-SDMS-01.

4.2.3 The cable shall be designed for a maximum permissible continuous temperature of 90°C, emergency loading temperature of 105°C and maximum conductor short-circuit withstand temperature of 250°C.

4.2.4 The ratings and dimensions shall be as indicated in the technical data schedule.

4.3. MATERIALS

4.3.1 CONDUCTOR

The conductor shall be uncoated annealed copper or aluminum, Class-2 per IEC 60228, and shall be compacted and stranded.

Copper power and control cables shall be softdrawn multi-strands with minimum number of strands as specified in the relevant IEC standard.

The conductor size, shape, and material shall be as specified in the technical data schedule and as shown in Table 2 below:
Table 2: Cable type overview

<table>
<thead>
<tr>
<th>Conductor size, (mm²)</th>
<th>Conductor Material</th>
<th>Cable Design Type</th>
<th>Cores</th>
<th>Insulation</th>
<th>Shape</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.5</td>
<td>Copper</td>
<td>Control</td>
<td>2</td>
<td>PVC</td>
<td>Round</td>
</tr>
<tr>
<td>2.5</td>
<td>Copper</td>
<td>Control</td>
<td>12</td>
<td>PVC</td>
<td>Round</td>
</tr>
<tr>
<td>70, 185, 300</td>
<td>Aluminum</td>
<td>Power</td>
<td>3 + ½</td>
<td>XLPE</td>
<td>Sector</td>
</tr>
<tr>
<td>35, 120, 185, 630</td>
<td>Copper</td>
<td>Power</td>
<td>1</td>
<td>XLPE</td>
<td>Round</td>
</tr>
</tbody>
</table>

4.3.2. **CORE INSULATION**

The insulation of low-voltage power cables shall comply with the applicable requirements of IEC 60502-1.

The insulation of control cables shall comply with the applicable requirements of IEC 60227.

Power cable insulation shall be extruded solid dielectric cross-linked polyethylene (XLPE).

Control cable insulation shall be polyvinyl chloride (PVC).

The nominal insulation thickness shall be as per values specified in the reference standards.

The minimum thickness of the insulation at any point shall not fall below the nominal value by more than 0.1mm + 10% of the nominal value.

4.3.3. **INNER COVERING AND FILLERS**

The inner covering is not required as the power cables are unarmored. However, the outer shape of the cable shall remain practically circular and no adhesion should occur between the core insulation and the outer sheath.

Multi-core, sector shape cables shall have non-hygroscopic film fillers in order to form a compact circular outer shape.

Inner covering in control cables shall be according to relevant standard.

Filler material shall be compatible with the insulation and suitable for the operating temperature of the cable.
4.3.4. **OUTER SHEATH**

The outer sheath shall be black PVC, Type-ST₂ with nominal thickness conforming to IEC 60502-1.

The minimum thickness at any point shall not fall below the nominal value by more than 0.1mm + 10% of the nominal value.

Outer sheath thickness in control cables shall be according to relevant standard.

4.4. **CORE IDENTIFICATION**

4.4.1 The XLPE insulation of the 3+½ core cable shall be colored red, yellow, blue, and black for the reduced neutral.

4.4.2 Single core cables shall have black colored XLPE insulation.

4.4.3 The cores of the control cable shall have black colored PVC insulations marked with indelible clear white print numerals.

5. **FABRICATION**

All cables shall be free of material and manufacturing defects that would prevent it from meeting the requirements of this specification.

6. **MARKING**

The outer sheaths of the all the cables specified herewith shall be marked by embossing at intervals not exceeding 1 meter of the following minimum information:

a. Manufacturer Name or Trademark in English and/or Arabic

b. Voltage Designation in English

c. Type of Insulation in English (XLPE / PVC)

d. Conductor Size and Material in English and Arabic

e. Year of Manufacture in English and Arabic

f. Cumulative length at every 1 meter with the reel length marked on the outer end of the cable.
All cables shall be marked with “PROPERTY OF SAUDI ELECTRICITY COMPANY” in English and Arabic.
All markings/numbering shall be indelible. Marking using a matrix print is not acceptable.

7. TESTING AND INSPECTION

The low-voltage power and control cables shall be tested in conformance with the applicable clauses of the relevant standards. Supplier/manufacturer shall provide all test results for review and approval of SEC.
SEC reserves all the rights to attend and witness the tests.

7.1. ROUTINE TESTS

Routine tests in conformance with the applicable clauses of IEC 60502-1 for power cables and IEC 60227 for control cables shall be carried out on all finished cables at the manufacturing plant’s test facility.

For every batch of delivery, electronic copies of the routine test reports together with the packing lists and sample test reports, shall be submitted to SEC for review and approval prior to issuance of the releases.

Unless otherwise specified, the following routine tests shall be carried out on all finished cables:

7.1.1 Electrical Resistance of Conductors – resistance values shall conform with IEC 60228.

7.1.2 Voltage Test – cables shall be tested for 5 minutes at the following voltages:

- Phase-to-ground = 3.5kV for single-core cables
- Phase-to-phase = 6.0kV for multi-core cables

7.2. TYPE TESTS

Type test shall be performed in complete conformance with the applicable standards. It shall be performed at SEC approved laboratories. Full report including the certification shall be submitted to SEC.

SEC reserves the right to attend and witness the tests.
SEC reserves the right to request the supplier/manufacturer to repeat the type test every five (5) years, or as needed should the supplied cables have frequent faults and failures.

### 7.3. SAMPLE TESTS

Sample tests is generally performed on each type of cable to verify supplier/manufacturer’s compliance with this specification, and actual confirmation of the values proposed in the submitted technical data schedules.

Samples shall be randomly selected by SEC from the available packing list or by actual on-site selection.

Unless otherwise specified, the following tests and inspections shall be performed:

- **7.3.1 Conductor Examination** – examination shall conform with IEC 60228.
- **7.3.2 Dimensional Check** – the minimum measured values shall conform with the applicable clauses of IEC 60502-1 and IEC 60227 for both the insulation and outer sheath.
- **7.3.3 Hot-Set Test for XLPE Insulation** – values shall conform with the applicable clauses of IEC 60502-1.

### 8. PACKING AND SHIPPING

Packing and shipping requirement shall generally be as per latest revision of SEC General Requirements for Equipment/Materials, 01-SDMS-01 or as per purchase order requirements.

Packing and shipping of the low-voltage power and control cables shall conform to the following requirements:

- The cable ends shall be watertight sealed with SEC approved heat-shrinkable end cap lined with waterproof adhesive type sealing compound. Cable ends shall be properly secured to the reel.
- The cable shall be delivered without splices, on standard sized non-returnable wooden reel of sturdy construction, properly packed and lagged externally to prevent possible damage on the cable during transport. Wood lagging or better material shall also be secured with high-tensile low-elongation steel straps to provide physical protection for the cables during transit and customary storage and handling operations.
- The minimum radius of the drum of the shipping reel shall not be less than the bending radius of the cable.
• Cables shall be supplied in reel lengths of 500 meters each with allowable tolerance of ±5%.

• Each cable reels/drums shall be marked in legible and indelible letters on aluminum plate 30cm x 20cm x 1.5mm plate, showing the following information:
  a. Cable Voltage Rating, Conductor Material, and Size
  b. Type of Cable
  c. Length and Weight of the Cable on Reel
  d. Gross Weight
  e. Dimensions of Reel
  f. Manufacturer’s Name and Country of Origin
  g. Purchase Order Number
  h. Tender Number
  i. Serial Number of Reel
  j. Year of Manufacture
  k. SEC Item Code in Bold Numerals
  l. SEC Address (Warehouse)
  m. Roll Direction
  n. 11-SDMS-01
  o. Additional information required per SEC shipping instructions, if applicable.

• All markings shall appear on both sides of the reel.

9. GUARANTEE

The supplier/manufacturer shall guarantee the products against all defects arising out of faulty design or manufacturing defects or defective materials for a period of five (5) years from the date of delivery.


10. SUBMITTALS

The following submittals shall be provided as hard copies, and in electronic formats stored in USB Flash Drive. Unless otherwise specified, e-copies of the files should be in PDF format.

10.1. SUBMITTALS REQUIRED WITH TENDER/INQUIRY

7.5.1 Summary in table form with the following information: list of items offered, manufacturer, origin, catalogue number, and quantity
7.5.2 Clause-by-clause compliance with the latest revision of SEC specification 11-SDMS-01.
7.5.3 Manufacturer’s Catalogue
7.5.4 Certificate stating that the raw material has been sampled, tested and inspected in accordance with relevant standard specifications.
7.5.5 Product type test reports and certificates carried out from SEC approved laboratories
7.5.6 Filled-up technical data schedule on each of the items offered, e-copy in Excel (*.xlsx) format.
7.5.7 Manufacturer CAD drawings, e-copy in AutoCAD 2010 (*.dwg) format, for each of the items offered showing the dimensions and cross-sectional views of each cables and its associated shipping reel/drum.
7.5.8 USB Flash Drive containing e-copy of all the documents mentioned above.

10.2. SUBMITTALS REQUIRED FOLLOWING AWARD OF CONTRACT

7.5.1 Manufacturing and Routine Test Schedules
7.5.2 Quality Assurance Tests
7.5.3 Factory Test Reports
7.5.4 Special tests, if applicable
7.5.5 USB Flash Drive containing e-copies of all the documents mentioned above.
# 11. TECHNICAL DATA SCHEDULE

Table 2: Technical Data Schedule for Low-Voltage Power and Control Cables

<table>
<thead>
<tr>
<th>No</th>
<th>Description</th>
<th>SEC Specified Values (*)</th>
<th>Vendor Proposed Values (**)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Material, Design, and Construction</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.1</td>
<td>Reference Manufacturing Standard</td>
<td>IEC 60502 / IEC 60227-7</td>
<td></td>
</tr>
<tr>
<td>1.2</td>
<td>Maximum Permissible Continuous Conductor Temperature</td>
<td>90°C</td>
<td></td>
</tr>
<tr>
<td>1.3</td>
<td>Maximum Permissible Continuous Temperature of Outer Sheath, (°C)</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>1.4</td>
<td>Rated Voltage (Control/Power Cable)</td>
<td>750/1000 V</td>
<td></td>
</tr>
<tr>
<td>1.5</td>
<td>Number of Cores</td>
<td>As per Table 2</td>
<td></td>
</tr>
<tr>
<td>1.6</td>
<td>Conductor Material</td>
<td>Copper or Aluminum</td>
<td></td>
</tr>
<tr>
<td>1.7</td>
<td>Shape of Conductor</td>
<td>Sector / Round</td>
<td></td>
</tr>
<tr>
<td>1.8</td>
<td>Conductor Cross-Section, (mm²)</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>1.9</td>
<td>Approximate Diameter of Conductor, (mm)</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>1.10</td>
<td>Number of Strands of Conductor</td>
<td>As per IEC</td>
<td></td>
</tr>
<tr>
<td>1.11</td>
<td>Insulation Material</td>
<td>PVC / XLPE</td>
<td></td>
</tr>
<tr>
<td>1.12</td>
<td>Nominal Thickness</td>
<td>As per IEC</td>
<td></td>
</tr>
<tr>
<td>1.13</td>
<td>Diameter Over Insulation</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>1.14</td>
<td>Core Identification (red, yellow, blue, black)</td>
<td>Yes</td>
<td></td>
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<td>1.15</td>
<td>Filler Material</td>
<td>*</td>
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</tr>
<tr>
<td>1.16</td>
<td>Outer Sheath Material</td>
<td>PVC Type-ST₂</td>
<td></td>
</tr>
<tr>
<td>1.17</td>
<td>Thickness of Outer Sheath</td>
<td>As per IEC</td>
<td></td>
</tr>
<tr>
<td>1.18</td>
<td>Color of Outer Sheath</td>
<td>Black</td>
<td></td>
</tr>
<tr>
<td>1.19</td>
<td>Marking Embossed as per specification</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>1.20</td>
<td>Overall Diameter of the Cable</td>
<td>*</td>
<td></td>
</tr>
</tbody>
</table>
### 1.21 Net Weight per Kilometer, (kg/km)
- *

### 1.22 Conductor DC Resistance at 20°C, (ohms/km)
- *

### 1.23 Conductor AC Resistance at Operating Temperature, (ohms/km)
- *

### 1.24 Inductance, (Mh/km)
- *

### 1.25 Inductive Reactance (ohms/km)
- *

### 1.26 Conductor Impedance at Maximum Continuous Operating Temperature, (ohms/km)
- *

### 1.27 Capacitance
- *

### 1.28 Short-Circuit Rating of Cable Based on Maximum Conductor Operating Temperature for 1 second (kA)
- *

### 2 Packing and Shipping

#### 2.1 Drum Type
Non-Returnable

#### 2.2 Length of Cable, (m)
500 meters

#### 2.3 Dimensions, (m)
- *

#### 2.4 Gross Weight, (kg)
- *

#### 2.5 Net Weight, (kg)
- *

#### 2.6 Marking as per the Specification
Yes

### 3 Others

#### 3.1 Product is Type Tested
Yes

#### 3.2 SEC Approved Laboratory
- *

#### 3.3 Date Tested
- *

#### 3.4 Manufacturer
- *

#### 3.5 Country of Origin
- *

#### 3.6 Submittals Required with Tender/Inquiry Included or Not?
- *

(*) – Values to be provided/proposed by the Vendor  
(**) – Please provide explanation for deviations, if any
Low-Voltage Power and Control Cable

SEC Inquiry No: 

Item No:

- Additional Technical Information or Features Specified by SEC

- Additional Supplementary Data or Features Proposed by Bidder/Vendor/Supplier.

- Other Particulars to be filled-up by the Bidder/Vendor/Supplier.

- List of Deviations and Clauses to which exception is taken by the Bidder/Vendor/Supplier. (Use separate sheet, if necessary).

<table>
<thead>
<tr>
<th>Description</th>
<th>Manufacturer of Material/Equipment</th>
<th>Vendor/Supplier</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name of Company</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Location and Office Address</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Name and Signature of Authorized Representative with Date</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Official Seal / Stamp</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>