## ANNEX A: SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS FOR OFFERED CABLES

*(to be filled and signed by the Manufacturer and submitted together with relevant copies of the Manufacturer's catalogues, brochures, drawings, technical data & calculations, sales records, four customer reference letters, details of manufacturing capacity, the manufacturer's experience, copies of complete type test reports and accreditation certificate to ISO/IEC 17025 for the testing laboratory for tender evaluation, all in English Language)*

**Tender No..... Bidder's Name & Address .....**

| CLAUSE | Description | Bidder's offer |
|---|---|---|
| | Name and address of the Manufacturer | |
| | Country of manufacture | |
| | Manufacturer's Letter of Authorization | |
| | Model/Type Reference No. of the offered cable | |
| | Manufacturer's warranty and guarantee for the offered cable | |
| 1 | Scope: a) Design, manufacture, test, ship and deliver S/C Aluminium XLPE insulated 33kV cables to KPLC store/site as per terms of contract<br>b) Ensure adequacy of the design, good workmanship, good engineering practice and adherence to standards, specifications and applicable regulations in the manufacture of the cables for The Kenya Power & Lighting Co. Ltd | a)<br>b) |
| 2 | Applicable standards | |
| 3 | Terms and definitions | |
| 4.1.1 | Cable Application | |
| 4.1.2 | System Conditions | |
| 4.1.3 | Anti-termite protection | |
| 4.1.4 | Fire Performance (indicate applicable IEC standards) | |
| 4.1.5 | Minimum Design Service Life | |
| 4.2.1.1 | Applicable Standards | |
| 4.2.1.2 | Continuous Operating Temperature | |
| | Short Circuit Temperature (five seconds duration) | |
| 4.2.2 | Conductor | |
| 4.2.3 | Conductor Screen | |
| 4.2.4.1 | Insulation | |
| 4.2.4.2 | Insulation application | |
| 4.2.4.3 | Insulation Colour | |

| CLAUSE | Description | | Bidder's offer |
|---|---|---|---|
| 4.2.5 | Insulation Screen and Metallic Screen | | |
| | 4.2.5.1 | | |
| | 4.2.5.2 | | |
| | 4.2.5.3 | | |
| | 4.2.5.4 | | |
| 4.2.6.1 | Separation sheath | | |
| 4.2.6.2 | Armour | | |
| 4.2.7.1 | Oversheath | | |
| 4.2.7.2 | Embossing on Oversheath | | |
| 4.3 | Conductor nominal sectional area, $mm^2$ | | |
| | Voltage Designation | | |
| | Conductor material & shape | | |
| | Thickness of insulation, mm | | |
| | Thickness of separation sheath, mm | | |
| | Armour wire material & diameter, mm | | |
| | Thickness of oversheath, mm | | |
| | Approximate overall diameter, mm | | |
| | Power frequency single phase test voltage, 5 min, kV | | |
| | Maximum conductor resistance, Ω/km | | |
| | Current carrying capacity | In air | |
| | | In duct | |
| 4.4.1 | Quality Assurance Plan | | |
| 4.4.2 | Manufacturer's Declaration of Conformity to Reference Standards | | |
| | Copy of Manufacturer's ISO 9001:2008 Certificate | | |
| 4.4.3 | Customer sales records and customer reference letters submitted to support the offer. | | |
| 5.1 | Test Standard | | |
| | Responsibility of carrying out tests | | |
| 5.2 | Copies of Type Test Certificates & Type Test Reports to IEC 60502-2 | | |
| | a) Bending test, followed by a partial discharge test; | | |
| | b) Tan δ measurement; | | |
| | c) Heating cycle test, followed by a partial discharge test; | | |
| | d) Impulse test, followed by a voltage test; | | |
| | e) Voltage test for 4 h | | |
| 5.3 | Tests to be witnessed by KPLC Engineers at factory before shipment | | |
| | 1.Routine tests to IEC 60502-2 | | |

| CLAUSE | Description | | Bidder's offer |
|---|---|---|---|
| | a) Measurement of the electrical resistance of conductors; | | |
| | b) Partial discharge test | | |
| | c) Voltage test. | | |
| | 2.Sample tests to IEC 60502-2 | | |
| | a) Conductor examination; | | |
| | b) Check of dimensions; | | |
| | c) Voltage test; | | |
| | d) Hot set test for XLPE insulation and elastomeric sheaths | | |
| | e) Verification of the length on a randomly selected drum | | |
| 5.4 | Sampling | Sample size | |
| | | Acceptance criteria | |
| 5.5 | Inspection & test of cable during delivery before acceptance to KPLC stores/site | | |
| 6.1 | Cable Drums & Wooden Lagging | | |
| 6.2 | Number of lengths on Drum | | |
| | Total Length of Cable on Drum | | |
| 6.3 | Cable end plug sealing & securing on drum | | |
| 6.4 | Marking on Cable Drum Flange | | |
| 7.1 | Documents submitted with tender for evaluation | | |
| 7.2 | Documents to be submitted by supplier to KPLC for approval before manufacture | | |
| - | Manufacturing capacity of similar cable (Qty per month) | | |
| | Manufacturer's experience | | |
| - | Statement of compliance to Tender Specifications | | |
| - | Deviations from Tender Specifications | | |

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**Manufacturer's Name, Signature, Stamp and Date**

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*(to be filled and signed by the Manufacturer and submitted together with relevant copies of the Manufacturer's catalogues, brochures, drawings, technical data & calculations, sales records for past five years, four customer reference letters, details of manufacturing capacity, the manufacturer's experience, copies of complete type test reports and accreditation certificate to ISO/IEC 17025 for the testing laboratory for tender evaluation, all in English Language)*

## 0.1 Circulation List

| COPY NO. | COPY HOLDER |
|---|---|
| 1 | Research & Development Manager |
| 2 | Supply Chain Manager – Procurement |
| Electronic copy (pdf) on The Kenya Power & Lighting Company Server; currently: http://172.16.1.40/dms/browse.php?fFolderId=23 | |

## 0.2 Amendment Record

| Rev No. | Date (YYYY-MM-DD) | Description of Change | Prepared by (Name & Signature) | Approved by (Name & Signature) |
|---|---|---|---|---|
| Issue 1 Rev 0 | 2014-04-24 | New issue | S. Kimitei | C. Owuor |
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## FOREWORD

This specification has been prepared by the Research and Development Department in collaboration with Distribution Division both of The Kenya Power and Lighting Company Limited (abbreviated as KPLC) and it lays down requirements for single core XLPE insulated aluminium cables, 11kV. It is intended for use by KPLC in purchasing the cables.

The bidder shall submit information which demonstrates satisfactory service experience of the manufacturer with products which fall within the scope of this specification.

## 1. SCOPE

This specification is for single core, stranded aluminium conductors, XLPE insulated, aluminium wire armoured, PVC outer sheathed power cables for operation at a.c. voltages of 6350 Volts to sheath, 11000 Volts between conductors and highest system voltage of 12000 Volts for use in KPLC distribution network operated at 50Hz.

The specification is for the following sizes of 11kV single core cables:

1 x 300 mm² AL/XLPE/AWA/PVC

1 x 630 mm² AL/XLPE/AWA/PVC

The specification also covers inspection and test of the cables as well as schedule of Guaranteed Technical Particulars to be filled, signed by the manufacturer and submitted together with other required details for tender evaluation.

The specification stipulates the minimum requirements for single core XLPE insulated aluminium 11kV cables acceptable for use in the company and it shall be the responsibility of the supplier to ensure adequacy of the design, good workmanship, good engineering practice and adherence to standards, specifications and applicable regulations in the manufacture of the cables for The Kenya Power & Lighting Company Ltd.

The specification does not purport to include all the necessary provisions of a contract.

## 2. REFERENCES

The following standards contain provisions which, through reference in this text constitute provisions of this specification. Unless otherwise stated, the latest editions (including amendments) apply.

IEC 60502-2: Power Cables with extruded insulation and their accessories for rated voltages from 1kV (Um=1.2kV) up to 30kV (Um=36kV)- Part 2: Cables for rated voltages from 6kV (Um=7.2kV) up to 30kV (Um=36kV).

IEC 60228: Conductors of insulated cables.

BS 6622: Specification for cables with extruded cross-linked polyethylene or ethylene propylene rubber insulation for rated voltages from 3.8/6.6kV to 19/33kV.

## 3. TERMS AND DEFINITIONS

For the purpose of this specification the definitions given in IEC 60228 and IEC 60502-2 apply, together with the following:

AL: Aluminium
AWA: Aluminium wire armour
PVC: Polyvinyl chloride
XLPE: Cross-linked polyethylene

## 4. REQUIREMENTS

### 4.1. SERVICE CONDITIONS

The cables shall be suitable for the following service conditions and applications:

4.1.1 Cable Application

a) The cable shall be a distribution cable for use in outdoors installations and tropical conditions (temperature range of -1°C to +40°C, humidity of upto 95%, saline conditions and altitudes of upto 2200m above sea level).
b) The cable shall be suitable for laying in cable ducts and directly in the ground in switching stations, between stations and underground to overhead conversion.
c) The cable shall also be suitable for laying on slopes.
d) Permissible continuous loading operating temperature shall be 90°C.
e) Permissible emergency loading temperature shall be 130°C for at least 8 hours.
f) Permissible short circuit temperature shall be 250°C (for short-circuit duration of 5s as per IEC 60502).

4.1.2 The cables shall be connected to underground system operating at a nominal voltage of 11kV, 50Hz and maximum system voltage of 12kV and are solidly earthed at the transformer neutrals. The short circuit fault level shall be taken as 25kA 3s.

4.1.3 The cables shall have suitable anti-termite protection (details to be submitted by supplier to KPLC for approval before manufacture).

4.1.4 The cable shall have an oversheath with a fire performance that conforms to the requirements of IEC standards.

4.1.5 The cable shall be designed for reliable service life of at least 30 years.

## 4.2. MATERIALS AND CONSTRUCTION

### 4.2.1. Design

4.2.1.1 The cable shall be designed and manufactured to BS 6622, IEC 60502-2 and the requirements of this specification.

4.2.1.2 All materials used shall be compatible and the cable shall have continuous operating temperature of 90°C and short circuit temperature of 250°C (5 seconds duration) as per IEC 60502-2.

### 4.2.2. Conductor

The cable shall be made from circular stranded compacted plain aluminium conductor that conforms to IEC 60228.

### 4.2.3. Conductor Screen

4.2.3.1 A conductor screen consisting of an extruded layer of cross-linkable semi-conducting compound shall be applied over the conductor and cover the surface of the conductor completely.

4.2.3.2 The extruded conductor screen shall be applied in the same operation as the insulation and be fully bonded to the insulation.

### 4.2.4. Insulation

4.2.4.1 The insulation shall be cross-linked polyethylene (XLPE) conforming to the requirements of IEC 60502-2.

4.2.4.2 The insulation shall be applied by extrusion and cross-linked to form a compact and homogeneous layer.

4.2.4.3 The colour of the insulation shall be such that it is easily distinguishable from the screening materials.

### 4.2.5. Insulation Screen and Metallic Screen

4.2.5.1 There shall be an insulation screen consisting of a cross-linked extruded semi-conducting layer in combination with a metallic layer.

4.2.5.2 The extruded semi-conducting layer shall consist of a strippable semi-conducting compound capable of removal for jointing and terminating. It shall be applied in the same operation as the insulation, directly over the insulation and shall cover the surface of the core completely.

4.2.5.3 A metallic screen shall be applied around the core. The screen shall consist of helically applied overlapped copper tape. An energy absorbing bedding layer shall be applied.

### 4.2.6. Armour

4.2.6.1 An extruded separation sheath of black polyvinyl chloride (PVC) shall be applied between the metallic screen and the armour.

4.2.6.2 The armour shall consist of a single layer of round aluminium alloy wires applied helically with a left-hand lay.

### 4.2.7. Oversheath

4.2.7.1 There shall be an extruded oversheath of black polyvinyl chloride (PVC) as per IEC 60502-2.

4.2.7.2 The cable shall be clearly and permanently embossed with the following information throughout the length of the oversheath.

(i) 11000 VOLTS XLPE POWER AL CABLE PROPERTY OF KPLC
(ii) Name of the manufacturer
(iii) Year of manufacture
(iv) The number of cores, type and nominal area of conductors

Letters and figures shall be raised and consist of upright block characters. Minimum size of characters shall be not less than 15% of average overall cable diameter and the distance between one set of markings and the next shall not exceed 500mm.

An indelible marking shall also be given at every one meter interval to assist field personal in cutting required length.

## 4.3. STANDARD SIZES AND CHARACTERISTICS

The standard sizes for the XLPE cables shall be as follows:

| | | | |
|---|---|---|---|
| Conductor nominal sectional area | $mm^2$ | 300 | 630 |
| Voltage Designation $U_o/U$ ($U_m$) | 6.35/11 (12) kV | | |
| Conductor shape | Stranded compacted circular | | |
| Thickness of insulation | mm | 3.4 | 3.4 |
| Thickness of separation sheath | mm | 1.9 | 2.0 |
| Nominal armour wire diameter | mm | 3.15 | 3.15 |
| Thickness of oversheath, minimum | mm | 3.6 | 4.0 |
| Power frequency single phase test voltage, 5 min | kV | 21 | 21 |
| Maximum conductor resistance | Ω/km | 0.100 | 0.0469 |

*Note: The Current Carrying Capacity of the cable in the ground and in air shall be stated by the manufacturer in the Guaranteed Technical Particulars as per Annex A.*

## 4.4. QUALITY MANAGEMENT SYSTEM

4.4.1 The bidder shall submit a quality assurance plan (QAP) that will be used to ensure that the cable design, material, workmanship, tests, service capability, maintenance and documentation, will fulfil the requirements stated in the contract documents, standards, specifications and regulations. The QAP shall be based on and include relevant parts to fulfil the requirements of ISO 9001:2008.

4.4.2 The Manufacturer's Declaration of Conformity to reference standards and copies of quality management certifications including copy of valid and relevant ISO 9001: 2008 certificate shall be submitted with the tender for evaluation.

4.4.3 The bidder shall indicate the delivery time of the cables, manufacturer's monthly & annual production capacity and experience in the production of the type and size of cable being offered. A detailed list & contact addresses (including e-mail) of the manufacturer's previous customers for similar rating of cables sold in the last five years as well as reference letters from at least four of the customers shall be submitted with the tender for evaluation.

## 5. TESTS AND INSPECTION

5.1 The cable shall be inspected and tested in accordance with the requirements of this specification, IEC 60228 and IEC 60502-2. It shall be the responsibility of the supplier to perform or to have performed all the required tests.

5.2 Copies of previous test certificates and test reports by a third party testing laboratory that is accredited to ISO/IEC 17025 shall be submitted with the offer for evaluation. A copy of the accreditation certificate to ISO/IEC 17025 for the testing laboratory shall also be submitted. Any translations of certificates and test reports into English language shall be signed and stamped by the Testing Laboratory that carried out the tests.

The type test reports shall include the following as per IEC 60502-2:
a) Bending test, followed by a partial discharge test;
b) Tan δ measurement;
c) Heating cycle test, followed by a partial discharge test;
d) Impulse test, followed by a voltage test;
e) Voltage test for 4 h.

As per IEC 60502-2, when type tests have been successfully performed on a type of cable with a specific conductor cross-sectional area and rated voltage, type approval shall be accepted as valid for cables of the same type with other conductor cross-sectional areas and/or rated voltages, provided the following three conditions are all satisfied:

a) The same materials, i.e. insulation and semi-conducting screens, and manufacturing process are used;
b) The conductor cross-sectional area is not larger than that of the tested cable, with the exception that all cross-sectional areas up to and including 630 $mm^2$ are approved when the cross-sectional area of the previously tested cable is in the range of 95 $mm^2$ to 630 $mm^2$ inclusive;
c) The rated voltage is not higher than that of the tested cable.

Approval shall be independent of the conductor material.

5.3 Routine and sample test reports for the cables to be supplied shall be submitted to KPLC for approval before shipment of the goods. KPLC Engineers will witness these tests at the factory before shipment and shall include the following:

5.3.1 The routine tests as per IEC 60502-2 and are as follows: