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Kenya Power

220KV CABLE TERMINATIONS AND JOINTS - SPECIFICATION

A Document of the Kenya Power & Lighting Co. Plc
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TITLE:
**220kV CABLE TERMINATIONS
 AND JOINTS - SPECIFICATION**

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0.1 CIRCULATION LIST

| COPY NO. | COPY HOLDER |
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REVISION OF KPLC STANDARDS

To keep abreast of progress in the industry, KPLC Standards shall be regularly reviewed. Suggestions for improvements to approved Standards, addressed to the Manager, Standards Department, are welcome.

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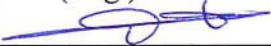
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0.2 AMENDMENT RECORD

| Rev No. | Date (YYYY-MM-DD) | Description of Change | Prepared by (Name & Signature) | Approved by (Name & Signature) |
|-------------------|-------------------|-----------------------|--------------------------------|--|
| Issue 1, Rev 0 | 2020-05-04 | New issue | Eng. S. K Nguli | Dr. (Eng.) P. Kimemia  |
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FOREWORD

This specification has been prepared by the Standards Department in collaboration with Network Management Division, both of The Kenya Power and Lighting Co. Plc. (KPLC) and it lays down requirements for 220kV Cable Terminations and Joints for indoor and outdoor applications.

The 220kV Terminations and Joints specification covers training requirements for installation of the joints and terminations, both locally and in the Country of origin.


This specification stipulates the minimum requirements for the 220kV Cable Terminations and Joints acceptable for use in the company to ensure environmental friendliness, safety and reduce installation times. It shall be the responsibility of the supplier and manufacturer to ensure that the offered design is of the highest quality and guarantees excellent service to KPLC, good workmanship and good engineering practice in the manufacture of the 220kV Cable Terminations and Joints for use by KPLC.

The following are members of the team that developed this specification:

| Name | Division |
|--------------------|----------------------------|
| Patrick Maguta | Network Management |
| Eng. Stephen Nguli | Infrastructure Development |
| Godfrey T.Gakumu | Infrastructure Development |

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1. SCOPE

- 1.1. This specification is for 220kV Cable Terminations and Joints stipulating service conditions, electrical parameters and design and construction requirements.
- 1.2. The specification also covers inspection and test of the Terminations and Joints as well as schedule of Guaranteed Technical Particulars to be filled, signed by the manufacturer and submitted for tender evaluation.
- 1.3. The range of accessories covered in this specifications are for the following applications:
 - (i) Self-supporting outdoor terminations, porcelain or composite
 - (ii) Flexible outdoor terminations
 - (iii) Terminations for gas-insulated switchgears(GIS)
 - (iv) Transformer terminations
 - (v) Straight-through joints
 - (vi) Insulating joints/cross-bonding joints
 - (vii) Transition joints, XLPE-insulated/oil-filled cables
 - (viii) Sealing Ends
- 1.4. The specification stipulates the minimum requirements for Cable Terminations and Joints acceptable for use in the company and it shall be the responsibility of the Manufacturer to ensure adequacy of the design, good workmanship and good engineering practice in the manufacture of the Terminations and Joints for KPLC.
- 1.5. Training requirements for the cable jointing and terminations.
- 1.6. The specification does not purport to include all the necessary provisions of a contract.

2. NORMATIVE REFERENCES

The following standards contain provisions which, through reference in this text, constitute provisions of this specification. For dated editions, the cited edition will apply; for undated editions the latest edition of the referenced document shall apply.

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- IEC 62067: Power cables with extruded insulation and their accessories for rated voltages above 150 kV ($U_m = 170$ kV) up to 500 kV ($U_m = 550$ kV) – Test methods and requirements
- IEC 62271-209: Cable connections for gas-insulated metal-enclosed switchgear for rated voltages above 52 kV - Fluid-filled and extruded insulation cables (Fluid-filled and dry-type cable terminations).
- DIN EN 50299: Oil-immersed cable connection assemblies for transformers and reactors having highest voltage for equipment U_m from 72.5 kV to 550 kV - part 1: fluid-filled cable terminations
- IEC 60287: Calculation of the continuous current rating of cables (100% load factor)

3. DEFINITIONS AND ABBREVIATIONS

For the purpose of this specification the definitions given in the reference standards shall apply and the following abbreviations:

- EPR: Ethylene Propylene Rubber
 GIS: Gas Insulated Switchgear
 IEC: International Electro-Technical Commission
 ISO: International Organization for Standardization
 KPLC: Kenya Power & Lighting Company Plc
 LSR: Liquid Silicon Rubber
 XLPE: Cross-linked polyethylene

4. REQUIREMENTS

4.1. Service and System Conditions

4.1.1. Service Conditions

- At altitudes of up to 2200m above sea level
- Humidity of up to 95%,
- Average ambient temperature of +30°C with a minimum of -1°C and a maximum of +40°C;
- Pollution: Design pollution level to be taken as “Heavy” (Pollution level III) for inland and “Very Heavy” (Pollution level IV) for coastal applications.
- Isokeraunic levels of up to 180 thunderstorm days per year.

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4.1.2. Cable Application

4.1.2.1. The cable for which the 220kV Terminations and Joints are to be installed has characteristics defined in the specification KP1/6C/4/1/TSP/05/010-3: 220kV Single Core XLPE Insulated Copper Cables – Specification. The terminations and joints shall also be suitable for 220kV Single Core XLPE Insulated Aluminium Cables.

4.1.3. Equipment Application

Table 1: System Parameters

| S/N | Technical parameters | Units | Value |
|-----|---|----------------|--|
| 1 | Nominal system Voltage | kV rms | 220 |
| 2 | Rated Maximum Voltage | kV rms | 245 |
| 3 | Rated Frequency | Hz | 50±5% |
| 4 | System Earthing | Ω | Solidly Earthed |
| 5 | Rated Power Frequency Withstand Voltage (wet) | kV rms, 1 min. | 460 |
| 6 | Lightning Impulse withstand Voltage (1.2/50µs) | kVp | 1050 |
| 7 | Rated short time withstand current (1 sec) | KA, rms /s | 40 |
| 8 | Rated peak withstand current (1 sec) | kA rms /s | 100 |
| 9 | Partial Discharge | pF | <5 |
| 10 | Maximum allowable temperature for cable and accessories | °C | 90-Continuous operation |
| | | °C | 250 – after rated short circuit as no. 7 above |

4.2. Technical Parameters for 220kV Joints, Terminations and Sealing Ends

4.2.1. The minimum Technical Parameters for the straight through joints, indoor and outdoor terminations and sealing ends shall be as per Table 2 below:

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Table 2: Technical Parameters of the 220KV Straight Joints, indoor and outdoor terminations and sealing ends

| S/N | Technical parameters | Units | 220KV system | |
|---|--|-------------------|---|----|
| 1 | Rated Max. Voltage | kV rms | 245 | |
| 2 | Rated Frequency | Hz | 50 | |
| 4 | Power Frequency Withstand Voltage, wet | kV rms, 1min. | 460 | |
| 5 | Lightning Impulse withstand Voltage | kVp | 1050 | |
| 6 | Rated short time withstand current (1 sec) | KA, rms | 40 | |
| 7 | Rated peak withstand current (1 sec) | kA rms | 100 | |
| II Cable Sheath Withstand Voltages | | | | |
| 1 | AC Voltage | kV/1 Min | 20 | |
| 2 | DC voltage | kV/1 min | 20 | |
| 3 | Impulse Discharge Voltage | kV | 60 | |
| III Cable Sheath Interruption Withstand Voltages | | | | |
| 1 | AC Voltage | kV/1 Min | 38 | |
| 2 | DC voltage | kV/1 min | 20 | |
| 3 | Impulse Discharge Voltage | kV | 95 | |
| IV Stress Cone Electrical Routine Tests | | | | |
| 1 | AC withstand Test | kV/30 Min | 318 | |
| 2 | Partial Discharge | pF | Free of discharges @220kV | |
| 3 | Tensile Strength for conductor connection | N/mm ² | Cu | 60 |
| | | | Al | 40 |
| 4 | Cable conductor cross-section range | mm ² | 400, 500, 800, 1000, 1200, 1400, 1500, 1800, 2000, 2500 | |

4.3. Terminations - Silicone rubber and Stress control

- 4.3.1. Silicone rubber shall be the preferred material for cable accessories due to its excellent mechanical and electrical properties.
- 4.3.2. The Silicone rubber used in the manufacture of termination shall be of high quality electrical insulation, superior corona and tracking resistance, combined with high elasticity.

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4.3.3. The silicon rubber shall facilitate multi range application, where one silicone rubber body can be used for various conductor cross sections.

4.3.4. Optimal flexibility shall ensure easy assembly of the accessories. The other features of silicone rubber shall be as follows: -

- (i) UV and ozone resistant
- (ii) Durable water rejection
- (iii) Weather and aging resistance
- (iv) Non-flammable, self-extinguishing,
- (v) Heat resistant/applicable for use at temperatures between -1°C and $+40^{\circ}\text{C}$
- (vi) High degree of elasticity
- (vii) High tracking resistance
- (viii) Unlimited shelf life
- (ix) Eco- friendly

4.4. Outdoor Termination - Outdoor (OD) termination at substation

4.4.1. The different types of the outdoor termination shall be designed for operation under several outdoor conditions as detailed in clause 4.1

4.4.2. The main components of the termination shall be;

- (i) The insulator with upper metalwork, metal base plate with supporting insulators and pre-moulded stress cone for electrical field control and silicone oil for electrical insulation.
- (ii) Integrated pre-moulded stress control system made of silicone rubber
- (iii) All metal parts made of corrosion resistant aluminum alloy
- (iv) Termination shall be standing on supporting pedestal insulators, so that the cable screen can be isolated from earth
- (v) Top bolt available in two versions, screw type or compression type
- (vi) Appropriate top bolt diameters available suiting to the cable dimensions as specified in the tender.
- (vii) Type test certificates in accordance with IEC 62067.
- (viii) Cold applied insulating fluid.
- (ix) The termination base plate and the cables metallic sheath shall be electrically insulated from the supporting structure by means of self-supporting stand-off insulators or any other self-supporting means designed to withstand both mechanical and electrical stresses in services.

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- 4.4.3. The stress cone shall inhibit possible mechanical stress and deformation of the cable insulation surface during operation and also shall be capable of accommodating minor radial and longitudinal movement without detriment to the dielectric stress in the insulation shield.
- 4.4.4. For Outdoor Termination at substation, the termination shall be within polymeric or porcelain hollow insulator of brown or grey colour.
- 4.4.5. The arcing horn and shield ring shall be supplied as required. The termination shall be filled with an insulating compound up to a level where the electric field is substantially reduced.
- 4.4.6. For composite towers, dry type outdoor termination kits shall be supplied.
- 4.4.7. Main components of the termination shall be the push-on silicone components with integrated stress cone for electrical field control and the liquid free epoxy resin insulator with silicone sheds. These shall have the following features;
- (i) Free of insulation liquid, no filling procedure
 - (ii) Less parts to be assembled therefore faster installation
 - (iii) Prefabricated capacitive silicone stress control system
 - (iv) Plug-in part comprising four components (stress cone made of silicone rubber, cable gland, connection bolt, spring loaded compression device)
 - (v) Easy to fit screw type conductor connector
 - (vi) All metal parts made of corrosion resistant aluminium alloy
 - (vii) Type test certificates in accordance with IEC 62067
 - (viii) Explosion proof
- 4.4.8. The outdoor termination shall be suitable for very heavily polluted atmospheric conditions with total creepage distance of 31 mm/ kV and protected creepage distance of not more than 50% of the total creepage distance.
- 4.4.9. The cable end terminals for terminating the cables shall be fully compatible with the cables to be supplied. This shall be specified in the tender.
- 4.5. Dry Type Plug-in GIS/Transformer termination**
- 4.5.1. The dry plug in GIS /transformer termination shall be of dry-type, designed for installation in SF6 gas insulated switchgear (GIS) or for installation in oil filled cable box of transformers.
- 4.5.2. The complete termination shall consist of epoxy resin insulator with embedded electrode, fixing ring which is fitting to the cable, metal cable gland, compression device and pre-moulded plug-in stress cone for electrical field control.

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4.5.3. Features of this shall be as follows:

- (i) Plug-in part comprising four components (stress cone made of silicone rubber, cable gland, connection bolt, spring loaded compression device).
- (ii) Insulator according to IEC 62271-209 for GIS and DIN EN 50299 for transformer termination.
- (iii) Conductor connection bolt designed as mechanical screw type connector.
- (iv) Type test certificate in accordance with IEC 62067.

4.6. Fluid filled GIS/transformer termination

4.6.1. These terminations shall be designed for direct installation in SF6 gas insulated switchgear (GIS) or in oil filled cables box of transformer.

4.6.2. Major components of the termination shall be the pressure tight epoxy resin insulator with embedded electrode, metal fixing ring, metal cable gland and prefabricated stress cone for electrical field control and silicone oil for electrical insulation.

4.6.3. The fluid filled GIS /transformer termination shall have the following features:

- (i) Integrated prefabricated stress control system with silicone rubber
- (ii) Pressure tight epoxy resin insulator is cast in one piece with integrated insulation ring at the bottom allowing to separate the cable screen from earth
- (iii) Cable gland made of corrosion resistant aluminium alloy
- (iv) Possible installation position vertical up to 45° then up to 90° oil expansion vessel required
- (v) Type test according to IEC 62067
- (vi) Cold applied silicone oil
- (vii) According to DIN EN 50299 (Transformers)
- (viii) According to IEC 62271-209 (GIS)

4.7. Straight through joint

4.7.1. The straight through joints shall be pre-moulded straight joint in compact design dimensions, made of silicone rubber.

4.7.2. The straight through joint shall have the following features;

- (i) Different conductor material (Copper and Aluminum) and/or cross section
- (ii) Different insulation material (XLPE and EPR) and/or diameter
- (iii) One piece pre-moulded silicon rubber Joint insulator, with integrated screen interruption

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- (iv) Plug-in connection system
- (v) Solid insulation (no gas or liquid insulating medium)
- (vi) Protective watertight covering
- (vii) Easy installation
- (viii) Maintenance free

4.7.3. The Joint casing shall include:

- (i) Tinned copper casing with epoxy insulating ring
- (ii) Polymeric outer sheath (waterproof tape layer and heat shrinkable tube)
- (iii) Connections for single core bonding cables

4.7.4. Main components/characteristics of the standard straight joint complete kit shall be;

- (i) Screen connector
- (ii) Vapour barrier
- (iii) Conductor connector
- (iv) Conductor connection sleeve, main joint sleeve and outer protective covering.
- (v) Very short and compact design
- (vi) Easy push on installation
- (vii) Minimum tools and installation space needed
- (viii) Easy conductor connection by bimetallic connectors, with shear bolts
- (ix) Available as cross bonding or straight through application
- (x) Wide range of applications, from 40 to 120mm insulation diameters
- (xi) Screen interruption integrated in the joint insulator
- (xii) Metal coupling bush inside joint insulator for mechanical connection of prepared cable ends
- (xiii) Optimized cover housing in size and material
- (xiv) Routine tested piece by piece
- (xv) Insulating material LSR silicone rubber of the highest quality
- (xvi) Type test certificate in accordance with IEC 62067
- (xvii) Available as straight through, cross bonding or grounded version.

4.8. The Indoor Termination & Joint

4.8.1. The Indoor Cable Termination (ID) at GIS SF6 Housing

- 4.8.1.1. The ID terminations shall be dry type. There shall be mechanical devices to maintain the interface pressure as required in IEC 62271-209.
- 4.8.1.2. The ID terminations shall be based on the EPR (Ethylene-Propylene Rubber) based or silicon based stress relief cone.
- 4.8.1.3. Stress relief cone and mechanical devices shall be designed to fit with controlled interference over the cable insulation and shall follow the cable's diameter variations while

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guaranteeing under any service condition a sufficient positive pressure to control the electric field concentration.

- 4.8.1.4. The Plug-in type leading conductors shall be supplied (normal type or blind type shall be specified as required in the tender).
- 4.8.1.5. The design shall comply with newest editions of IEC 62271-209 and possibly adjusted to the various specific needs of the project.
- 4.8.1.6. The main insulation components shall be fully examined and tested in the factory during Factory Acceptance Tests (FAT) and be witnessed by two KPLC Engineers.
- 4.8.1.7. The bidder shall furnish the detailed description on jointing procedure during detailed engineering that shall be submitted to KPLC for approval before manufacture.

4.8.2. Transition joint for single core XLPE cables

- 4.8.2.1. The transition joint connects a single core oil filled cable with a single core CU/AL XLPE cable.
- 4.8.2.2. The main components of the joint shall be epoxy resin insulator with embedded electrode, the XLPE plug-in part from switchgear termination, oil-stress cone made of insulation paper, carbon paper and copper mesh and stress relief ring and outer protective covering
- 4.8.2.3. The joints shall also have the following features: -
- (i) Common epoxy resin insulator for XLPE and oil filled cables
 - (ii) Plug-in system from switchgear termination
 - (iii) Pre-moulded stress-cone of silicone rubber for tight fit in epoxy insulator
 - (iv) Easy conductor connection screw or compression type for XLPE-side shall be possible
 - (v) Insulation with oil-impregnated crepe- and/or Kraft papers
 - (vi) Stress cone electrode made of carbon paper, copper mesh and stress relief ring at end of the winding
 - (vii) Screen separation shall be possible
 - (viii) All necessary assembling accessories for the kit
 - (ix) Connection of different cable cross sections shall be possible
 - (x) GRP housing for outer protection
 - (xi) Flexible and time-independent installation of both types of cables

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4.9. Sealing Ends

4.9.1. General Requirements

- 4.9.1.1. The sealing ends shall be used to connect the power cable to the network via the substations or overhead and underground connections.
- 4.9.1.2. The cables connected to gas-insulated substations shall have sealing ends with epoxy insulators.
- 4.9.1.3. They shall be used to control the leakage path from the cable insulation to the insulating medium of the station (air in the case of an air-insulated substation or SF6 in the case of a gas-insulated substation).
- 4.9.1.4. They shall be able to mould themselves directly onto the substation pipes.
- 4.9.1.5. Sealing ends shall be categorized into Outdoor sealing ends, GIS/Circuit Breaker Sealing ends and Transformer sealing ends. The required type shall be specified in the Tender.

4.9.2. Outdoor Sealing Ends

- 4.9.2.1. The type of insulator and its leakage path and whether or not a dielectric fluid is used defines these. The leakage path is directly in contact with the surrounding air
- 4.9.2.2. The leakage path is the insulation distance measured along the surface separating the voltage point and the earthed screens. It avoids direct conduction by diverting the voltage into the surrounding fluid (air, gas or oil).
- 4.9.2.3. The leakage path shall be applicable to both indoor and outdoor type sealing ends.
- 4.9.2.4. The leakage path shall be calculated as Pollution factor in mm/kV x maximum voltage= leakage path of the termination.
- 4.9.2.5. The electrical resistance depends on environmental factors, such as relative humidity, salinity and atmospheric pollution. Thus for outdoor sealing ends, the leakage path shall be designed in line with environmental conditions specified in clause 4.1.
- 4.9.2.6. The insulators for the sealing ends shall be insulating fluid filled type or a type without insulating fluid. Insulating fluid filled type insulators shall be glazed porcelain insulators or synthetic insulators. Insulators without insulating fluid shall be rigid (self-supporting) type or flexible type.

4.9.3. Insulators with Insulating Fluid

The insulators with insulating fluid shall be glazed porcelain insulators or synthetic/composite type.

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4.9.3.1. Glazed Porcelain Insulators

- 4.9.3.1.1. The insulators shall be made of brown or grey glazed porcelain and closed by two aluminium flanges. This porcelain-sealing end is self-supporting and does not require any top fastening system.
- 4.9.3.1.2. The surface shall be self-cleaning to ease usage in severely polluted environments and highly saline atmospheres.

4.9.3.2. Synthetic/Composite Insulator

- 4.9.3.2.1. For composite or rigid synthetic sealing ends, the insulator shall be made of an epoxy resin glass-fiber reinforced tube with silicon sheds and closed with two aluminum flanges.
- 4.8.5.2.2. The composite sealing ends shall be suitable for usage in industrial sites where the risks of explosion must be limited.

4.9.3.3. Insulators without Insulating Fluid

- 4.9.3.3.1. These sealing ends shall be "dry type" as they shall not contain any dielectric fluid. They shall be rigid (self-supporting) or flexible.

4.9.3.4. Flexible Type Ends

- 4.9.3.4.1. The insulator shall be fabricated as a stack of "skirts" made of silicon or a derived product.
- 4.9.3.4.2. These shall be lightweight and suitable for being installed on pylons.
- 4.9.3.4.3. These shall be environment-friendly.
- 4.9.3.4.4. These insulators shall have a means of fastening system in order to suspend them.

4.9.3.5. Rigid Type Sealing End

- 4.9.3.5.1. The insulator shall be solid and the cable shall be connected directly by means of a deflector cone.
- 4.9.3.5.2. The design shall be similar to that of the sealing ends used in gas-insulated substations.

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4.9.4. GIS /Circuit-Breaker Sealing Ends

- 4.9.4.1. These shall be dry type sealing ends (without fluid). They shall also be inner cone or outer cone type
- 4.9.4.2. These shall be used to connect the cable to the insulated set of bars. The sealing end of the cable shall be compatible with the type of connection at the substation.
- 4.9.4.3. The standard interfaces between a GIS substation and the cable-sealing end are defined in standard IEC 62271-209.

4.9.5. Transformer Sealing Ends

- 4.9.5.1. These shall be dry type sealing ends (without fluid). They shall also be inner cone or outer cone type.
- 4.9.5.2. It shall be mandatory to check the transformer design in order to determine the suitable sealing end.

5. TESTS REQUIREMENTS

The terminations and joints shall be inspected and tested in accordance with the requirements of the relevant standards, including those in the referenced specification, and provisions of this specification

6. MARKING, LABELLING AND PACKING

6.1. The terminations and joints shall be marked legibly and indelibly in English with the following information. The information shall also be provided in fixed permanent bar code on the complete items.

- a) Name and trade mark of the manufacturer;
- b) Country of origin;
- c) Type/model;
- d) Serial number
- e) The inscription "Property of The Kenya Power & Lighting Co. Plc"
- f) Month and year of manufacture.

6.2. The terminations and joints shall be packaged in such a manner as to minimize damage and entry of moisture during transportation and handling.

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APPENDICES

A. TESTS AND INSPECTION (Normative)

- A.1 It shall be the responsibility of the manufacturer to perform or to have performed all the tests specified in IEC 62271-209, IEC 62067 and this specification and other appropriate standards. Tenderers shall confirm the manufacturer's capabilities in this regard when submitting tenders. Any limitations shall be clearly specified.
- A.2 Copies of Type Test Certificates and Type Test Reports issued by a third-party testing laboratory that is accredited to ISO/IEC 17025 shall be submitted with the tender for the purpose of technical 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.
- A.3 The 220kV Terminations and joints shall be subject to acceptance tests at the manufacturer's premises before dispatch. Two or more Engineers appointed by The Kenya Power and Lighting Company Limited (KPLC) shall witness tests.
- A.4 **Testing Facility**
- A.4.1 The bidder shall provide current e-mail address, fax and telephone numbers and contact person at the Testing Laboratory where Type Tests and Special Tests were carried out.
- A.4.2 All test and measuring equipment to be used during acceptance testing shall have been calibrated and copies of valid calibration certificates shall be provided to KPLC Engineers. A detailed list of workshop tools, test/measuring equipment and list of tests that can be carried out by the manufacturer shall be submitted with the tender for evaluation.
- A.5 **Test reports**
- Test reports for the 220kV Terminations and Joints shall be submitted to The Kenya Power and Lighting Company for approval before shipment.
- A.6 **Inspection on Delivery**
- During delivery of the 220kV Terminations and Joints, KPLC will inspect them and may perform or have performed any of the relevant tests in order to verify compliance with the specification. The supplier shall replace without charge to KPLC, any of the terminations or joints that fail to meet any or all of the requirements in the specification.

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B. QUALITY MANAGEMENT SYSTEM (Normative)

- B.1 The bidder shall submit a quality assurance plan (QAP) that shall be used to ensure that the 220kV Terminations and Joints 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 9001:2015.
- B.2 The Manufacturer's Declaration of Conformity to applicable standards, this specification and copies of quality management certifications including copy of valid and relevant ISO 9001 certificate shall be submitted with the tender for evaluation.
- B.3 The bidder shall indicate the delivery time of the 220kV Terminations and Joints. A detailed list and contact addresses (including e-mail) of the manufacturer's previous customers outside the country of manufacture for exact or similar Terminations and Joints sold in the last five years shall be submitted with the tender for evaluation.

C. DOCUMENTATION AND DEMONSTRATION (Normative)

- C.1 The bidder shall submit its tender complete with technical documents required by Appendix E (Guaranteed Technical Particulars) for tender evaluation. The documents to be submitted (all in English language) for tender evaluation shall include the following:
- Fully filled clause by clause Guaranteed Technical Particulars (GTP) signed by the manufacture. The exact value(s) must be filled in.
 - Copies of the manufacturer's catalogues, brochures, terminations/ joints drawings and wiring diagrams and technical data showing description leaflet, installation/termination procedures and installation manuals,
 - Sales records for the last five years and at least four customer reference letters,
 - Details of manufacturing capacity and the manufacturer's experience.
 - Copies of required type test certificates and type test reports by a third-party testing laboratory accredited to ISO/IEC 17025,
 - Copy of accreditation certificate to ISO/IEC 17025 for the third-party testing laboratory,
 - Manufacturer's warranty and guarantee; subject to 5 years from date of delivery to KPLC stores.
 - Manufacturer's letter of authorization, copy of the manufacturer's ISO 9001:2015 certificate, ISO 17025:2005 certificate.
- C.2 The successful bidder (supplier) shall submit the following documents/details to The Kenya Power & Lighting Company for approval before manufacture:

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- a) Fully filled clause by clause Guaranteed Technical Particulars (GTP) signed by the manufacturer,
- b) Design drawings, component list per kit, special tools and installations procedures
- c) A training schedule of the terminations/ joints for KPLC staff operators on site,
- d) Detailed test program to be used during factory testing,
- e) Marking details and method to be used in marking the termination/joints,
- f) Manufacturer's undertaking to ensure adequacy of the design, good engineering practice, adherence to the specification and applicable standards and regulations as well as ensuring good workmanship in the manufacture of the terminations and joints for The Kenya Power & Lighting Company,
- g) Packaging details (including packaging materials).

C.3 The successful bidder and manufacturer shall demonstrate at their cost to at least two KPLC staff at the manufacturers' factory the installation procedure of the terminations/joints

D TRAINING

D.1 TRAINING AT THE MANUFACTURER'S PREMISES

- (a) During the factory acceptance testing (FAT), the manufacturer shall conduct complete training for the 220kV Terminations and Joints for two KPLC Engineers/Technicians.
- (b) This shall include theory followed by practical demonstrations. All the operational and installation procedures shall be exhaustively explained and demonstrated.
- (c) The manufacturer shall plan adequate time for the training separate from the FATs. The duration of the training shall however not be less than one (1) eight-hour working day. The employer may send a separate team from the team witnessing the FATs to attend the training. The duration and the cost of the training shall be indicated in the bid.
- (d) The Training shall be considered to have been successful once the engineers/Technicians are able to: -
 - (i) Competently carry out all the safety procedures and installation instructions
 - (ii) Correctly install the 220kV Terminations and Joints including effective earthing of the equipment and cables being terminated/jointed

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(e) The manufacturer shall conduct evaluation tests and give a feedback report on the training to the employer for each of the engineers/technicians.

D.2 LOCAL TRAINING (IN KENYA)

- (a) Following the delivery of the terminations /joints /sealing ends, the manufacturer shall conduct complete training for the complete set of terminations/joints for a total of (20) KPLC Engineers/Technicians, in Nairobi Kenya. The training shall be conducted in two sessions of 10 engineers/technicians each. Each session shall last at least one day (eight hours).
- (b) The Training shall include theory on how the equipment works followed by practical demonstrations on safety, installation procedures and instructions and parameter settings. All steps in installation, jointing and terminating shall be exhaustively explained and demonstrated, including normalizing the system and documenting the site events
- (c) The Training shall be considered to have been successful once the engineers are able to -
- (i) Competently carry out all the installations, i.e. terminateng and jointing
 - (ii) Correctly install the 220kV Terminations and Joints, including effective earthing of the cable, joints and terminations

NB: All the cost of conducting the training including the venue, refreshments and meals shall be borne by the manufacturer/Supplier.

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E. GUARANTEED TECHNICAL PARTICULARS (Normative)

To be filled and signed by the manufacturer and submitted together with relevant copies of the Manufacturer's catalogues, brochures, drawings, technical data, sales records for previous five years, four customer reference letters, details of suppliers' capacity and experience; and copies of complete type test certificates and test reports for tender evaluation, all in English Language)

Tender No.
Bidder's name and Address.....

| Clause number | KPLC requirement | Bidder's offer |
|---------------|--|------------------------|
| | Description of item on offer | Specify |
| | Manufacturer's Name and address | Specify |
| | Country of Manufacture | Specify |
| | Bidder's Name and address | Specify |
| 1 | Scope | State |
| 2 | Reference Standards | State |
| 3 | Specific requirements | State |
| 4.1.1 | Service Conditions a) At altitudes of up to 2200m above sea level b) Humidity of up to 95%, c) Average ambient temperature of +30°C with a minimum of -1°C and a maximum of +40°C and d) Pollution: Design pollution level to be taken as "Heavy" (Pollution level III) for inland and "Very Heavy" (Pollution level IV) for coastal applications. e) Isokeraunic levels of up to 180 thunderstorm days per year. | Specify |
| | Cable application: As per KP1/6C/4/1/TST/05/010: 220kV Single Core XLPE Insulated Copper Cables - Specification | State |
| | Cable design parameters to which the terminations /joints are designed. | Specify |
| 4.1.2 | Equipment application | Specify as per table 1 |

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| 4.2 | Technical Parameters for straight joints, indoor and outdoor terminals and sealing ends | Specify offer as per table 2 |
| 4.3 | Terminations - Silicone rubber and Stress control | |
| 4.3.1 | Material used in the manufacture of terminations and the technical parameters for the material | Specify |
| 4.3.2 | High quality electrical insulation, superior corona and tracking resistance, combined with high elasticity | Specify |
| 4.3.3 | Shall facilitate multi range application, where one silicone rubber body can be used for various conductor cross sections. | Specify |
| 4.3.4 | Material features that ensure quality of service of termination/joints | Specify and list |
| 4.4 | Outdoor Termination - Outdoor (OD) termination at substation | |
| 4.4.1 | Type of outdoor termination offered | Specify |
| 4.4.2 | The main components of the outdoor termination | List |
| 4.4.3 | Mechanical stress capacity of the stress cones | State |
| 4.4.4 | Material of insulator for outdoor termination | Specify |
| 4.4.5 | (i) Provision for arcing horns and shield ring. (ii) Insulating compound used for electric field suppression | Specify |
| 4.4.6 | Type of termination for towers | Specify |
| 4.4.7 | List the main components of the termination and list the main features | List |
| 4.4.8 | Applicable Pollution level for the outdoor terminations | Specify |
| 4.4.9 | Compatibility of the cable end terminals for terminating the cables with the cables to be supplied. | State |
| 4.5 | Dry type plug-in GIS/transformer termination | |
| 4.5.1 | Type of GIS /transformer termination kit offered | Specify |
| 4.5.2 | Detail the main components of the GIS/Transformer termination kit | State |
| 4.5.3 | List the main features of this termination kit | List |
| 4.6 | Fluid filled GIS/transformer termination | |
| 4.6.1 | Type of GIS /transformer termination kit offered | Specify |
| 4.6.2 | Detail the main components of the GIS/Transformer termination kit | State |
| 4.6.3 | List the main features of this termination kit | List |

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| 4.7 | Straight through Joint | |
| 4.7.1 | Type of straight through joint | specify |
| 4.7.2 | Main components of the straight through joint | List |
| 4.7.3. | Components of the casing | List |
| 4.8 | Indoor terminations | |
| 4.8.1 | The Indoor Termination (ID) at GIS SF6 Housing | |
| 4.8.1.1 | Type of indoor terminations offered and standard of manufacture | specify |
| 4.8.1.2 | Material of manufacture of indoor terminations | specify |
| 4.8.1.3 | Dimensions of the terminations offered and fit | specify |
| 4.8.1.4 | Conductors suitable for the terminations | specify |
| 4.8.1.5 | Standards of manufacture | specify |
| 4.8.1.6 | Testing during Factory Acceptance Tests - FAT | state |
| 4.8.1.7 | Jointing procedure | state |
| 4.8.2 | Transition joint for single core XLPE cables | |
| 4.8.2.1 | Functionality of the transition joint | specify |
| 4.8.2.2 | Main components of the transition joints | List |
| 4.8.2.3 | Main features of the joint | specify |
| 4.9 | Sealing Ends | |
| 4.9.1 | General Requirements | |
| 4.9.1.1 | Functionality of the sealing end | specify |
| 4.9.1.2 - 4 | Sealing Ends and insulators offered | specify |
| 4.9.2 | Outdoor Sealing Ends | |
| 4.9.2.1 | Type of sealing end offered | state |
| 4.9.2.2-4.9.2.4 | The insulator used and leakage path | specify |
| 4.9.2.5 | Resistance to environment, Creepage distance | specify |
| 4.9.3 | Insulators with Insulating Fluid | |
| | Type | specify |
| 4.9.3.1. | Glazed porcelain insulator | |
| 4.9.3.1.1 | Type design of insulator offered | specify |
| 4.9.3.1.2 | Self-cleaning characteristics of the Insulators | specify |
| 4.9.3.2 | Synthetic/Composite Insulator | |
| 4.9.3.2.1 | Material of manufacture | specify |

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| | Design | |
| 4.9.3.2.2 | Application for industrial environment | specify |
| 4.9.3.3 | Insulators without Insulating Fluid | |
| | Type | state |
| 4.9.3.4 | Flexible Type Ends | specify |
| 4.9.8.4.1 | Material of manufacture & design | specify |
| 4.9.8.4.2 | Installed on pylons | specify |
| 4.9.8.4.3 | Environmental applicability | specify |
| 4.9.8.4.4 | Means of fastening for suspension | specify |
| 4.9.3.5 | Rigid Type Sealing End | |
| 4.9.3.5.1 | Design | specify |
| 4.9.3.5.2 | Design to be similar to the sealing ends for GIS | specify |
| 4.9.4 | GIS /Circuit-Breaker Sealing Ends | |
| 4.9.4.1 | Type of sealing end offered | specify |
| 4.9.4.2 | Compatibility of sealing ends with other terminations in substation | specify |
| 4.9.4.3 | Standard of manufacture | specify |
| 4.9.5 | Transformer Sealing Ends | |
| 4.9.5.1 | Type of sealing end offered | specify |
| 4.9.5.2 | Compatibility of sealing ends with transformer design | specify |
| 5 | Tests Requirements | |
| | The terminations/joints shall be inspected and tested in accordance with the requirements of IEC 62271-209 | List the Tests to carried out at the factory during FAT |
| 6 | MARKING, LABELLING AND PACKING | |
| 6.1 | The terminations and joints shall be marked legibly and indelibly in English | Specify the marking to marked on the terminations and method of marking to be used |
| 6.2 | Packaging | Specify the method of packaging to be used |
| A | TESTS AND INSPECTION (Normative) | |
| A.1 | The responsibility of the manufacturer to perform or to have performed all the tests specified and the manufacturer's capabilities in this regard when submitting tenders. Any limitations shall be clearly specified. | State and clarify any limitations |

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| A.2 | Copies of Type Test Certificates and Type Test Reports issued by a third-party testing laboratory that is accredited to ISO/IEC 17025 shall be submitted with the tender for the purpose of technical 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. | Attach a copy of accreditation certificates |
| A.3 | The 220kV Terminations and joints shall be subject to acceptance tests at the manufacturer's premises before dispatch. Acceptance tests shall be witnessed by two Engineers appointed by The Kenya Power and Lighting Company Limited (KPLC) | List routine tests to be performed |
| | Tests and test conditions Acceptance tests | Specify tests conditions |
| A.4 | Testing Facility | |
| A.4.1 | The bidder shall provide current e-mail address, fax and telephone numbers and contact person at the Testing Laboratory where Type Tests and Special Tests were carried out. | List |
| A.4.2 | All test and measuring equipment to be used during acceptance testing shall have been calibrated and copies of valid calibration certificates shall be provided to KPLC Engineers. A detailed list of workshop tools, test/measuring equipment and list of tests that can be carried out by the manufacturer shall be submitted with the tender for evaluation. | Give lists of tools and equipment to be used for this purpose |
| A.5 | Test reports Test reports for the terminations /joints shall be submitted to The Kenya Power and Lighting Company for approval before shipment. | State compliance |
| A.6 | Inspection on Delivery During delivery of the terminations/joints, KPLC will inspect them and may perform or have performed any of the relevant tests in order to verify compliance with the specification. The supplier shall replace/rectify without charge to KPLC, failure of the terminations/joints to meet any or all of the requirements in the specification. The supplier shall | State compliance |

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| | conduct training on installations of the terminations/joints | |
| B | QUALITY MANAGEMENT SYSTEM (Normative) | |
| B.1 | The bidder shall submit a quality assurance plan (QAP) that will be used to ensure that the termination and joints 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 9001:20015 | Attach copy of ISO certificate |
| B.2 | The Manufacturer's Declaration of Conformity to applicable standards, this specification and copies of quality management certifications including copy of valid and relevant ISO 9001:2015 certificate shall be submitted with the tender for evaluation. | Statement of declaration |
| B.3 | The bidder shall indicate the delivery time of the terminations/joints. A detailed list and contact addresses (including e-mail) of the manufacturer's previous customers outside the country of manufacture for exact or similar products sold in the last five years shall be submitted with the tender for evaluation. | Indicate |
| C | Documentation and Demonstration (Normative) | |
| C.1 | Documents submitted with tender for evaluation | List |
| C.2 | Documents to be submitted for approval before manufacture | List |
| C.3 | Demonstration of the principle of operation at the factory | Specify |
| D | TRAINING | |
| D.1 | Detail and provide a program of the training to be conducted at the factory and evaluation to carried out to ensure staff are conversant with product | provide |
| D.2 | Detail and provide a program of the training to be conducted locally at KPLC training school and evaluation to carried out to ensure staff are conversant with product | provide |

NOTE:

- 1) Bidders shall give full details of the items on offer as per the specification and applicable standards. The details provided shall conform to the test reports and their certificates, as well as labeled

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drawings complete with dimensions, catalogues and/or brochures for the purpose of tender evaluation.

2) Bidders should note that the above Guaranteed Technical Particulars Schedules must be fully completed and submitted with the bid. Wherever there is conflict between the GTPs and the clauses in the specification, the clauses in the specification take precedence. Failure to complete the schedules shall lead to rejection of the bid.

3) Guaranteed values shall be specified.

** Words like 'agreed', 'confirmed', 'As per KPLC specifications', 'Yes', etc. shall not be accepted and shall be considered non-responsive.*

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

Issued by: Head of Section, Standards Development

Authorized by: Head of Department, Standards

Signed:

Signed:

Date: 2020-05-04

Date: 2020-05-04