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Kenya Power

**220kV VOLTAGE TRANSFORMER: Part 2: Capacitor Voltage Transformer -
SPECIFICATION**

A Document of the Kenya Power & Lighting Co. Plc.

May 2021



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TRANSFORMER: Part 2:
Capacitor Voltage
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0.1 CIRCULATION LIST

| COPY NO. | COPY HOLDER |
|----------|---|
| 1 | Manager, Standards |
| 2 | Electronic copy (pdf) on Kenya Power server (http://172.16.1.40/dms/browse.php?fFolderId=23) |

REVISION OF KPLC STANDARDS

In order 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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Users are reminded that by virtue of Section 25 of the Copyright Act, 2001 (Revised 2009) Cap 130 of the Laws of Kenya copyright subsists in all KPLC Standards and except as provided under Section 26 of this Act, no KPLC Standard produced by KPLC may be reproduced, stored in retrieval system by any means without prior permission from the Managing Director & CEO, KPLC.

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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 3, Rev 0 | 2021-05-26 | Cancel and replaces all previous editions | Eng. J. Ndirangu | Dr. Eng. P. Kimemia |
| | | | | |

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FOREWORD

This Specification has been prepared by the Standards Department and Technical Services Department of The Kenya Power and Lighting Company Plc (KPLC) and it lays down requirements for 220kV Capacitor Voltage Transformers.

The 220kV Capacitor Voltage Transformers are intended use with electrical measuring instruments, electrical protective devices and similar applications on system highest voltage of 245kV at power frequency of 50Hz.

The capacitor voltage transformer (CVT) shall be suitable for supplying a low voltage for measurement, control and system protection functions.

Specifications in this series are:

- (i) TSP/10/032-1: Specification for 220kV Voltage Transformers: Part 1: Inductive Voltage Transformer

This Specification stipulates the minimum requirements for 220kV Capacitor Voltage Transformers acceptable for use in the company. It shall be the responsibility of the suppliers 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 Capacitor Voltage Transformers for KPLC.

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

Users of this KPLC specification are responsible for its correct interpretation and application.

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

| Name | Department |
|----------------------|--------------------|
| Eng. Paul Mwangi | Technical Services |
| Eng. Kahoro Wachira | Technical Services |
| Eng. Julius Ndirangu | Standards |

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1. SCOPE

This Specification covers the requirements, design, test methods, marking and packing of 220kV Capacitor Voltage Transformers.

The capacitor voltage transformer shall, when specified on schedule of requirements, be equipped with carrier-frequency accessories for power line carrier-frequency (PLC) application. The details of the accessories appear at ANNEX B of this specification

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.

- IEC 61869-1: Instrument Transformers – Part 1: General Requirements
- IEC 61869-5: Instrument transformers - Part 5: Additional requirements for capacitor voltage transformers
- IEC/ISO 17025: General requirements for the competence of testing and calibration laboratories
- ISO 1461: Hot dip galvanized coatings on fabricated iron and steel articles — Specifications and test methods.
- IEC 60529: Degrees of protection provided by enclosures (IP Code).
- IEC/TS 80815: Selection and dimensioning of high-voltage insulators intended for use in polluted conditions
- IEC 60296: Fluids for electro-technical applications – Mineral insulating oils for electrical equipment
- IEC 60417: Graphical symbols for use on equipment

3. DEFINITIONS AND ABBREVIATIONS

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

3.1. ABBREVIATIONS

KPLC- Kenya Power and Lighting Company Plc.

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IEC – International Electro Technical Commission

ISO – International Organization for Standardization.

ISO 9001: 2015 - Quality Management Systems - Requirements

4. REQUIREMENTS

4.1. SERVICE CONDITIONS

4.1.1 The 220kV Capacitor Voltage Transformers shall be suitable for continuous use outdoors in tropical areas with the following conditions:

- a. 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
- 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.

4.1.2 System Conditions

The capacitor voltage transformer will be connected between line and earth on overhead system operating at a nominal line voltage of 220kV with maximum system voltage (highest voltage for equipment) of 245kV, 50Hz and exposed to over-voltages of atmospheric origin. The neutral point is solidly earthed.

4.2. DESIGN AND CONSTRUCTION

4.1.1 The capacitor voltage transformer shall be designed, manufactured and tested to IEC 61869 -1 & 5 and the requirements of this specification.

4.1.2 All materials used shall be new and of the best quality and of the class most suitable for working under the conditions specified and shall withstand the variations of temperatures and atmospheric conditions arising under working conditions without undue distortion or deterioration or the setting up of undue stresses in any part, and also without affecting the strength and suitability of the various parts for the work which they have to perform.

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- 4.1.3 The design shall ensure satisfactory operation under such sudden variations of load and voltage as may be met with under working conditions on the system, including those due to short circuits.
- 4.1.4 All parts of the transformer, including insulators with their mountings, shall be designed so as to avoid pockets in which water can collect.
- 4.1.5 The capacitor voltage transformer shall be outdoor; oil insulated and hermetically sealed type. The insulator portion of the voltage transformer shall be made of high-grade brown-glazed porcelain.
- 4.1.6 The capacitor voltage transformer shall be filled with new Insulating Oil. The Oil shall comply with requirements of IEC 60296
- 4.1.7 The Capacitor Voltage Transformer shall be effectively sealed to prevent liquid loss, as this would lead to contamination of the insulation.
- 4.1.8 The voltage transformer shall be suitable for vertical installation on a steel structure.
- 4.1.9 All parts, components and accessories of the capacitor voltage transformer shall be resistant to atmospheric corrosion, during the service life and shall be suitable for specified service conditions. The visual appearance shall remain acceptable and the paint work shall be protected from weathering due to atmospheric conditions and ultra violet radiation
- 4.1.10 A device shall be provided for checking the oil level and shall indicate whether the oil level is within the operating range for duration of operation.
- 4.1.11 The capacitor voltage transformer shall have primary, secondary and earth terminals.
- 4.1.12 Primary Terminal**
- 4.1.12.1 The primary terminal shall be of high conductivity copper, tin-plated, suitable for connection of both copper and aluminium conductors.
- 4.1.12.2 It shall have palm clamp connectors suitable for both stranded conductor and tube connection. Conductor overall diameter shall be 18.3mm to 25mm and busbar tubular bus/conductor of 76.2mm diameter.
- 4.1.12.3 The voltage to be transformed shall be applied to the primary terminal.
- 4.1.13 Secondary Terminals**

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- 4.1.13.1 The secondary terminals of the voltage transformer shall be wired to a terminal box.
- 4.1.13.2 The terminal box shall be weatherproof with a cable plate at the bottom and shall be covered with removable plate. The degree of protection of enclosure for the secondary terminal box shall be at least IP54 as per IEC 60529.
- 4.1.13.3 The secondary shall supply the voltage circuits of measuring instruments, meters, relays or similar apparatus.
- 4.1.13.4 The secondary terminal box of the voltage transformer shall be complete with protection fuses complete with fuse links.
- 4.1.14 The capacitor voltage transformer shall be designed and constructed to withstand without damage, when energized at rated voltage, the mechanical and thermal effects of an external short-circuit for the duration of 1 s.
- 4.1.15 At any voltage below rated voltage factor \times rated primary voltage and at any burden between zero and rated burden, the ferro-resonance of the CVT incepted by switching operations or transients on the primary or secondary terminals shall not be sustained.
- 4.1.16 The complete capacitor voltage transformer shall be tight in the full temperature range specified.
- 4.1.17 The primary and secondary terminal shall be marked in accordance with IEC 61689-5
- 4.1.18 The Frame of the Capacitor Voltage Transformer shall be provided with reliable earthing terminal for connection to an earthing conductor. The earth connection point shall be marked with the "earth symbol" as indicated by the symbol No. 5019 of IEC 60417.
- 4.1.19 The Capacitor Voltage Transformer Shall be of sufficient mechanical strength. In particular the top cover shall be strong so as to withstand any flying debris resulting from failure of porcelain housing of other nearby equipment in the substation.
- 4.1.20 The voltage transformer shall have cores and ratings as per clause 4.3.

4.2 RATINGS

- 4.2.1.1 The ratings of the capacitor voltage transformer shall be as indicated in Table 1.

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Table 1: Ratings for 220kV Capacitor Voltage Transformer

| Item | Parameters, Units | | Value | | |
|------|---|---|---|-------|---------------------|
| 1. | Nominal primary voltage | | 220000/ $\sqrt{3}$ volts | | |
| 2. | Nominal secondary voltage | | 110/ $\sqrt{3}$ volts | | |
| 3. | Highest Rated Equipment Voltage | | 245kV | | |
| 4. | Rated frequency | | 50 Hz | | |
| 5. | Minimum creepage distance of insulator | | 7595mm | | |
| 6. | Minimum lightning impulse withstand voltage, primary winding | | 1050kV (peak) | | |
| 7. | Minimum power frequency withstand voltage, primary winding, dry | | 460kV (r.m.s.) | | |
| 8. | Minimum power frequency withstand voltage, secondary winding, r.m.s. | | 5kV (r.m.s.) | | |
| 9. | Maximum temperature rise | Windings | 65K | | |
| | | Oil (at top of tank) | 55K | | |
| 10 | Rated voltage factor | Continuous | 1.2 | | |
| | | for 30 sec. | 1.5 | | |
| 11 | Permissible partial discharges (PD) | PD test voltage (r.m.s) = U_m | $\leq 10\text{pC}$ | | |
| | | PD test voltage (r.m.s) = $1.2U_m/\sqrt{3}$ | $\leq 5\text{pC}$ | | |
| 12 | Transmitted overvoltage limits {peak value of applied voltage(U_p) = $1.6 \times \sqrt{2} \times U_m/\sqrt{3}$, Wave-shape characteristics: conventional front time (T_1) = $0.5\mu\text{s} \pm 20\%$, time to half value (T_2) $\geq 50\mu\text{s}$; as per IEC 61869-5 | | 1.6kV (peak value limits) | | |
| 13 | Radio interference voltage at $1.1U_m/\sqrt{3}$ as per IEC 61869-5 | | 2 500 μV | | |
| 14 | Rated Temperature range of Equipment | | -5°C to $+50^\circ\text{C}$ | | |
| 15 | Secondary windings | Terminal Markings | Voltage Output | Class | VA (pf 0.8 lagging) |
| | Cores | | | | |
| | Core 1 | 1a-1n | $110/\sqrt{3}$ | 0.5 | 75 |
| | Core 2 | 2a-2n | $110/\sqrt{3}$ | 3P | 150 |
| | Core 3 | da-dn | $110/\sqrt{3}$ | 3P | 75 |

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Note:

(1) The capacitor voltage transformer shall be installed at altitude of 2200m above sea level and if tests will be carried out at altitudes below 1000m, the limits of temperature rise given in Table 1 above shall be reduced by 0.4% for each 100m that the altitude at the operating site exceeds 1000m (see clause 6.4.2 of IEC 61869-1).

(2) The capacitor voltage transformer shall be installed at altitude of 2200m asl, the arcing distance under the standardized reference atmospheric conditions shall be determined by multiplying the withstand voltages required at the service location by a factor k in accordance with Figure 2 and clause 6.6.2 of IEC 61869-1 ($k = e^{m(H-1000)}/8150 = e^{(2200-1000)}/8150 = 1.16$, with $m=1$ as per IEC 61869-1).

5 TESTS REQUIREMENTS

5.1 The voltage transformer shall be inspected and tested in accordance with the requirements of this specification and IEC 61869-1&5. It shall be the responsibility of the supplier to perform or to have performed the tests specified.

6 MARKING AND PACKING

6.1 MARKING

6.1.1 The nameplates of the capacitor voltage transformers shall be marked in accordance with IEC 61869-1&5 in English language. All markings shall be indelible and legible. Nameplate and their fixings shall be weatherproof and corrosion proof.

6.1.2 The following information shall be indicated in the marking:

- a. Manufacturer's name or abbreviation;
- b. Indication: capacitor voltage transformer;
- c. Type, designation;
- d. Year of manufacture;
- e. Serial number;
- f. Highest voltage for equipment : U_m [kV];
- g. Rated insulation level based on U_m : AC/BIL;
- h. Rated frequency f_R [Hz];
- i. Rated voltage factor FV: continuous time of operation, short time of operation;
- j. Rated capacitance of capacitor divider CR [pF] ;
- k. Rated capacitance of the high voltage capacitor C1 [pF];

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- l. Rated capacitance of the intermediate voltage capacitor C2 [pF];
- m. Number of capacitor units;
- n. Serial number of capacitor units;
- o. Ambient temperature categories;
- p. Capacitor divider: Insulation oil (mineral), mass [kg];
- q. Magnetic unit: insulation oil(mineral), mass [kg];
- r. Mass of complete CVT [kg];
- s. Standard edition (year);
- t. Current I: connection A1-A2;
- u. Rated primary voltage and terminals identification A – N UPR (V);
- v. Indication of each secondary winding terminals: 1a -1n, 2a – 2n, da – dn;
- w. Voltage of each secondary winding USR (V);
- x. Value of rated output VA;
- y. Accuracy class M, P;
- z. Maximum simultaneous output for windings of a complete CVT regarding the accuracy class;
- aa. Thermal limiting output VA;
- bb. Transient response classes
- cc. Carrier frequency accessories Drain coil [mH], Voltage limitation device BIL 1.2/50 μ s [kV]
- dd. Equipment Temperature Category

All the marking shall be by engraving (or superior method) and shall be permanent and legible.

The items concerning the carrier frequency accessories may appear in an additional plate.

6.1.3 The terminals shall be marked clearly and indelibly and in accordance with IEC 61869-1&5.

The terminal marking shall consist of letters followed by numbers.

6.1.4 Letters A, B, C denote fully insulated primary winding terminals and the lower-case letters a, b, c and n denote the corresponding secondary terminals. Letters da and dn denote the terminals of windings intended to supply a residual voltage.

6.1.5 Terminals having corresponding capital and lower-case markings shall have the same polarity at the same instant.

6.2 PACKING

6.2.1 220kV Capacitor voltage transformers shall be packaged for outdoor storage in tropical conditions defined in clause 4.1.

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- 6.2.2 The capacitor voltage transformers shall be delivered packed in wooden crates firmly bound and closely together to avoid damage to the Capacitor voltage transformer and its porcelain insulator during transportation and storage.
- 6.2.3 A set of three (3) Original Hard Cover Installation, Operation and Maintenance Manuals for the capacitor voltage transformers shall be supplied with each complete Capacitor voltage transformer.
- 6.2.4 Recommendations for use, care, storage and routine inspection/testing procedures, all in English language shall be submitted.

6.3 FINAL INSTALLATION AND INSPECTION

Instructions shall be provided for Inspection and tests which should be carried out after the Capacitor Voltage Transformer has been installed and after all connections are completed. These instructions should include: -

- a) A Schedule of Recommended site tests to establish correct operation.
- b) Procedures for carrying out any adjustment that may be necessary to obtain correct operation.
- c) Recommendations for any relevant measurements that should be made and recorded to help with future maintenance decisions.
- d) Instructions for final inspection and putting the capacitor voltage transformer into service.

6.4 MANUFACTURER'S EXPERIENCE AND CAPACITY

- 6.4.1 The manufacturer shall have a minimum of 25 years' experience in the manufacture of 220kV Capacitor voltage transformers.
- 6.4.2 The 220kV Capacitor voltage transformers on offer shall have been in service and given reliable service for a minimum period of 8 years in at least two (2) power utilities in at least three (3) of the following continents/regions:
- i) Europe
 - ii) North America
 - iii) Africa
 - iv) Asia or South America

The manufacturer shall provide references to support requirements of this including export records with copy of contractual letters, Capacitor Voltage Transformer details and date of sale/export, letter of satisfaction from power utilities.

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6.4.3 Capacitor voltage transformer brands that have failed in service or mal-operated while in service on the Kenyan power system shall not be accepted.

6.4.4 The warranty for the offered 220kV Capacitor voltage transformers shall be 5 years from the date of delivery to KPLC store.

APPENDICES

A: TESTS AND INSPECTION (Normative)

A.1 It shall be the responsibility of the supplier to test or to have all the relevant tests performed.

A.2 Copies of Type Test Certificates and Type Test Reports for 220kV Capacitor voltage transformers issued by a third party testing laboratory that is accredited to ISO/IEC 17025 and shall be submitted with the tender for the purpose of technical evaluation. A copy of the accreditation certificate for the testing laboratory shall also be submitted with the tender (all in English Language).

Copies of Type Tests Reports and Special Tests Reports to be submitted with the tender shall not be more than five years old and shall include the following as per IEC 61869-1&5:

- i. Accuracy check;
- ii. Temperature rise test;
- iii. Capacitance and $\tan\delta$ measurement at power-frequency;
- iv. Chopped impulse test;
- v. EMC radio interference voltage (RIV) tests;
- vi. Short circuit withstand capability test;
- vii. Lightning impulse test;
- viii. Wet test for outdoor type transformers with AC voltage;
- ix. Transient response test;
- x. Ferro-resonance test;
- xi. Tightness of electromagnetic unit;
- xii. Accuracy tests.

The type test reports shall include the results of the routine tests as per IEC 61869-1&5

Special Tests Reports shall include:

- i. Measurement of the transmission factor of high frequency overvoltages;
- ii. Mechanical strength test;

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- iii. Determination of the temperature coefficient;
- iv. Tightness design test of capacitor units.

Flow chart test sequence shall be considered mandatory and shall be as per IEC 61869-1&5

NOTE: Any translations of certificates and test reports into English language shall be signed and stamped by the Testing Authority.

A.3 Routine and sample test reports for the 220kV capacitor voltage transformers to be supplied shall be submitted to KPLC before delivery. KPLC Engineers will witness tests at the factory before shipment.

Tests to be witnessed by KPLC Engineers at the factory before delivery shall be in accordance with IEC 61869-1&5 and this specification and shall include the following:

- a) Tightness of capacitor voltage divider;
- b) Capacitance and $\tan\delta$ measurement at power-frequency;
- c) Power-frequency withstand test;
- d) Measurement of partial discharges;
- e) Verification of terminal markings;
- f) Power-frequency withstand tests on the electromagnetic unit;
- g) Power-frequency withstand test on low voltage terminal;
- h) Power-frequency withstand tests on secondary winding;
- i) Ferro-resonance check;
- j) Accuracy check (determination of errors);
- k) Chopped impulse test on primary winding;
- l) Transmitted overvoltage measurement;
- m) Visual inspection of complete voltage transformer;
- n) The protection cores of the CVT shall be tested in accordance with IEC 61869-1&5 for limits of voltage error and phase displacement as well as transient response.
- o) The measuring core of the CVT shall be tested in accordance with IEC 61869-1&5 for limits of voltage error and phase displacement as well as tests for accuracy.

A.4 Upon delivery of the 220kV capacitor voltage transformers, KPLC will inspect them and may perform any of the relevant tests in order to verify compliance with the specification. The supplier shall replace without charge to KPLC, any 220kV capacitor voltage transformers which upon examination, test or use fail to meet any or all of the requirements in the specification.

B: QUALITY MANAGEMENT SYSTEM (Normative)

B.1 The supplier shall submit a quality assurance plan (QAP) that will be used to ensure that the 220kV capacitor voltage transformers physical properties, tests and documentation, will fulfill

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the requirements stated in the contract documents, standards, specifications and regulations. The QAP shall be based on and include relevant parts to fulfill the requirements of ISO 9001.

B.2 The Manufacturer's Declaration of Conformity to applicable standards and copies of quality management certifications including copy of valid and relevant ISO 9001 certificate shall be submitted with the tender for evaluation.

C: DOCUMENTATION (Normative)

C.1 The bidder shall submit its tender complete with technical documents for tender evaluation. The technical documents to be submitted (all in English language) for tender evaluation shall include the following:

- a) Fully filled clause by clause guaranteed technical particulars (GTP) signed and stamped by the manufacturer;
- b) Copies of the Manufacturer's catalogues, brochures, drawings giving all relevant dimensions and technical data;
- c) References letters to support requirements of clause 6.4 including export records with copy of contractual letters, 220kV capacitor voltage transformers details and date of sale/export, letter of satisfaction from power utilities.
- d) Details of manufacturing capacity.
- e) Copies of required type test reports by a third party testing laboratory accredited to ISO/IEC 17025.
- f) Copy of accreditation certificate to ISO/IEC 17025 for the third party testing laboratory;
- g) Contacts and address of third party testing laboratory;
- h) Manufacturers letter of authorization, ISO 9001 certificate and other technical documents required in the tender.

C.2 The successful bidder (supplier) shall submit the following documents/details to The Kenya Power & Lighting Company Plc for approval before manufacture:

- a) Fully filled clause by clause guaranteed technical particulars (GTP) stamped and signed by the manufacturer (these are not the ones submitted with the tender) ;

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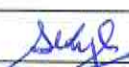
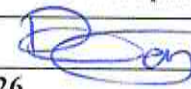
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- b) Detailed Design Drawings with dimensions to be used for manufacture of the 220kV capacitor voltage transformers for KPLC;
- c) Quality assurance plan (QAP) that will be used to ensure that the design, material; workmanship, tests, service capability, maintenance and documentation will fulfill the requirements stated in the contract documents, standards, specifications and regulations. The QAP shall be based on and include relevant parts to fulfill the requirements of ISO 9001;
- d) Detailed test program to be used during factory testing
- e) Marking details and method to be used in marking the 220kV capacitor voltage transformers
- f) Packaging details including packaging materials.
- g) Product samples (where applicable).

C.3 Statement of compliance to specification (indicate deviations if any provide supporting documents)

NOTE: *The drawings to be submitted by the supplier to KPLC for approval before manufacture shall be in standard format clearly indicating the drawing number, parts list with material details and quantities, standard of manufacture, ratings, approval details and identity of the manufacturer (as per manufacturer's authorization submitted during tendering).*

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D: CARRIER-FREQUENCY ACCESSORIES FOR POWER LINE CARRIER-FREQUENCY (PLC) APPLICATION

Coupling Capacitors

Coupling capacitors using capacitor voltage transformers and lattice steel structures to be provided shall be suitable for mounting line traps on them. The capacitor shall have a rated capacitance of not less than 12700pF, phase to phase, an impulse withstand voltage of 650Kv respectively and meet the insulation level and test voltage equivalents of IEC recommendation for the devices, (IEC 60358 coupling capacitors and capacitor dividers).

The coupling devices shall be designed for outdoor installation and shall provide impedance matching between terminal equipment and the transmission line for maximum PLC signal energy transfer. The coupling device shall comprise:

- Tuning device
- Line matching unit (transformer),
- Drain coil
- Protection device (lighting arrestor on primary and secondary sides),
- Grounding switch and all connecting accessories

The 'ON' (grounded) and 'OFF' position of the grounding switch shall be clearly visible from the outside of the device.

The coupling units shall be suitable for a carrier frequency range of 30 to 500 kHz.

The line side impedance of the device shall be matched in such a range that inter-modulation with the final amplifier is reliably prevented. The nominal equipment side impedance shall be 75 Ohms (unbalanced or 150 Ohms (balanced)).

The coupling device shall be fitted with a rating plate according to IEC 60481. Additionally, the type and capacity of the coupling capacitor for re-tuning and re-strapping, shall be indicated on a permanently attached plate.

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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 Requirements | Bidder's offer |
|----------------------|---|-----------------------|
| | Manufacturer's Name and address | Specify |
| | Country of Manufacture | Specify |
| | Name and model Number | Specify |
| 1. | Scope | State |
| 2. | References standards | State |
| 3. | Definitions and Abbreviations | |
| 3.1. | Abbreviations | State |
| 4. | Requirements | |
| 4.1.1 | Service conditions | State |
| 4.1.2 | System Conditions | State |
| 4.2 | Design and Construction | |
| 4.2.1 | Capacitor voltage transformer shall be designed, manufactured and tested to IEC 61869 -1 & 5 and the requirements of this specification | State |
| 4.2.2 | All materials used shall be new and of the best quality | State |
| 4.2.3 | Design shall ensure satisfactory operation under such sudden variations of load and voltage as may be met with under working conditions on the system, including those due to short circuits. | State |
| 4.2.4 | All parts of the transformer, including insulators with their mountings, shall be designed so as to avoid pockets in which water can collect | State |
| 4.2.5 | The capacitor voltage transformer shall be outdoor; oil insulated and hermetically sealed type | State |
| | The insulator portion of the voltage transformer shall be made of high-grade brown-glazed porcelain | State |
| 4.2.6 | The capacitor voltage transformer shall be filled with new Insulating Oil. The Oil shall comply with requirements of IEC 60296 | State |

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| Clause number | KPLC Requirements | Bidder's offer |
|---------------|--|----------------|
| 4.2.7 | The Capacitor Voltage Transformer shall be effectively sealed to prevent liquid loss, as this would lead to contamination of the insulation | Provide |
| 4.2.8 | The voltage transformer shall be suitable for vertical installation on a steel structure. | State |
| 4.2.9 | All parts, components and accessories of the capacitor voltage transformer shall be resistant to atmospheric corrosion, during the service life and shall be suitable for specified service conditions | State |
| | The visual appearance shall remain acceptable and the paint work shall be protected from weathering due to atmospheric conditions and ultra violet radiation | State |
| 4.2.10 | A device shall be provided for checking the oil level and shall indicate whether the oil level is within the operating range for duration of operation. | State |
| 4.2.11 | The capacitor voltage transformer shall have primary, secondary and earth terminals. | State |
| 4.2.12 | Primary Terminal | |
| 4.2.12.1 | The primary terminal shall be of high conductivity copper, tin-plated, suitable for connection of both copper and aluminium conductors. | Provide |
| 4.2.12.2 | It shall have palm clamp connectors suitable for both stranded conductor and tube connection | State |
| | Conductor overall diameter shall be 18.3mm to 25mm and busbar tubular bus/conductor of 76.2mm diameter. | State |
| 4.2.12.3 | The voltage to be transformed shall be applied to the primary terminal. | State |
| 4.2.13 | Secondary Terminals | |
| 4.2.13.1 | The secondary terminals of the voltage transformer shall be wired to a terminal box. | State |
| 4.2.13.2 | The terminal box shall be weatherproof with a cable plate at the bottom and shall be covered with removable plate | State |
| | Degree of protection of enclosure for the secondary terminal box as per IEC 60529. | State |
| 4.2.13.3 | The secondary shall supply the voltage circuits of measuring instruments, meters, relays or similar apparatus | State |
| 4.2.13.4 | The secondary terminal box of the voltage transformer shall be complete with protection fuses complete with fuse links | State |
| 4.2.14 | The capacitor voltage transformer shall be designed and constructed to withstand without damage, when energized at rated voltage, the | State |

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| | mechanical and thermal effects of an external short-circuit for the duration of 1 s. | | |
| 4.2.15 | At any voltage below rated voltage factor x rated primary voltage and at any burden between zero and rated burden, the ferro-resonance of the CVT incepted by switching operations or transients on the primary or secondary terminals shall not be sustained | Provide | |
| 4.2.16 | The complete capacitor voltage transformer shall be tight in the full temperature range specified. | State | |
| 4.2.17 | The primary and secondary terminal shall be marked in accordance with IEC 61689-5 | State | |
| 4.2.18 | The Frame of the Capacitor Voltage Transformer shall be provided with reliable earthing terminal for connection to an earthing conductor. The earth connection point shall be marked with the "earth symbol" as indicated by the symbol No. 5019 of IEC 60417 | Provide | |
| 4.2.19 | Top cover shall be strong so as to withstand any flying debris resulting from failure of porcelain housing of other nearby equipment in the substation | State | |
| 4.3 | Ratings | | |
| 4.2.3.1 | Nominal primary voltage | State | |
| | Nominal secondary voltage | State | |
| | Highest Rated Equipment Voltage | State | |
| | Rated frequency | State | |
| | Minimum creepage distance of insulator | State | |
| | Minimum lightning impulse withstand voltage, primary winding | State | |
| | Minimum power frequency withstand voltage, primary winding, dry | State | |
| | Minimum power frequency withstand voltage, secondary winding, r.m.s. | State | |
| | Maximum temperature rise | Windings | State |
| | | Oil (at top of tank) | State |
| | Rated voltage factor | Continuous | State |
| | | for 30 sec. | State |
| | Permissible partial discharges (PD) | PD test voltage (r.m.s) = U_m | State |
| | | PD test voltage (r.m.s) = $1.2U_m/\sqrt{3}$ | State |
| Transmitted overvoltage limits {peak value of applied voltage(U_p) = $1.6\sqrt{2} \times U_m/\sqrt{3}$, Wave-shape characteristics: conventional front time (T_1) = $0.5\mu s \pm 20\%$, time to half value (T_2) $\geq 50\mu s$; as per IEC 61869-5 | State | | |
| Radio interference voltage at $1.1U_m/\sqrt{3}$ as per IEC 61869-5 | State | | |

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| Clause number | KPLC Requirements | | | | Bidder's offer |
|---------------|--|--------------------------|-----------------------|--------------|----------------------------|
| | Rated Temperature range of Equipment | | | | State |
| | | | | | State |
| | Secondary windings Cores | Terminal Markings | Voltage Output | Class | VA (pf 0.8 lagging) |
| | Core 1 | State | State | State | State |
| | Core 2 | State | State | State | State |
| | Core 3 | State | State | State | State |
| 5 | Test Requirements | | | | |
| | Test standard | | | | State |
| 6 | Marking and Packing | | | | |
| 6.1.1 | The nameplates of the capacitor voltage transformers shall be marked in accordance with IEC 61869-1&5 in English language | | | | State |
| | All markings shall be indelible and legible | | | | State |
| | Nameplate and their fixings shall be weatherproof and corrosion proof. | | | | State |
| 6.1.2 | Information indicated in the marking | | | | State |
| 6.1.3 | The terminals shall be marked clearly and indelibly and in accordance with IEC 61869-1&5. The terminal marking shall consist of letters followed by numbers | | | | State |
| 6.1.4 | Letters A, B, C denote fully insulated primary winding terminals and the lower-case letters a, b, c and n denote the corresponding secondary terminals. Letters da and dn denote the terminals of windings intended to supply a residual voltage | | | | State |
| 6.1.5 | Terminals having corresponding capital and lower-case markings shall have the same polarity at the same instant. | | | | State |
| 6.2 | Packing | | | | |
| 6.2.1 | Shall be packaged for outdoor storage in tropical conditions defined in clause 4.1 | | | | State |
| 6.2.2 | Set of three (3) Original Hard Cover Installation, Operation and Maintenance Manuals for the circuit breakers shall be supplied with each capacitor voltage transformer | | | | State compliance |
| 6.2.3 | Recommendations for use, care, storage and routine inspection/testing procedures, all in English language shall be submitted. | | | | submit |
| 6.2.4 | Recommendations for use, care, storage and routine inspection/testing procedures, all in English language shall be submitted | | | | submit |
| 6.3 | Final Installation and Inspection | | | | |

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| Clause number | KPLC Requirements | Bidder's offer |
|---------------|--|---------------------------|
| | State instructions to be provided for Inspection and tests which should be carried out after the Capacitor Voltage Transformer has been installed and after all connections are completed | List as per specification |
| 6.4 | Manufacturer's Experience and Capacity | |
| 6.4.1 | Minimum of 25 years' experience in the manufacture of 220kV Capacitor voltage transformers. | State |
| 6.4.2 | 220kV Capacitor voltage transformers on offer have been in service and given reliable service for a minimum period of 8 years in at least two (2) power utilities in at least three (3) of the following continents/regions: i) Europe ii) North America iii) Africa iv) Asia or South America | Submit references |
| 6.4.3 | Capacitor voltage transformer failed in service or mal-operated while in service on the Kenyan power system | State |
| 6.4.4 | 5 years warranty | State |
| A | Tests and Inspection | |
| A.1 | Responsibility of the supplier to test or to have all the relevant tests performed | State |
| A.2 | Copies of type test reports submitted for evaluation | list |
| A.3 | Tests to be witnessed by KPLC Engineers at the factory | list |
| A.4 | Inspection at the stores and replacement of rejected items | State compliance |
| B | Quality Management System | |
| B.1 | Quality Assurance Plan | Submit |
| B.2 | Copy of valid ISO 9001:2015 Certificate | Submit |
| C | Documentation | |
| C.1 | Documents submitted with tender for evaluation | List |
| C.2 | Documents submitted for approval before manufacture | List |
| C.3 | Statement of compliance to specification (indicate deviations if any & supporting documents) | State compliance |
| D | Compliance with details for carrier-frequency accessories for power line carrier-frequency (PLC) applications | State compliance |

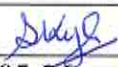
NOTE:

1) Bidders shall give full details of the item(s) 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 drawings complete with dimensions, catalogues and/or brochures for the purpose of tender evaluation.

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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

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