



The Kenya Power & Lighting Co. Ltd.

TITLE: **SPECIFICATION FOR TRANSMISSION SPARES: Part 3: 132kV CAPACITOR VOLTAGE TRANSFORMERS**

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Doc. No.	KPLC1/3CB/TSP/10/034-3
Issue No.	1
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Issued by: Head of Section, Tech Stds & Specs

Authorized by: Head of Department, R&D

Signed: *[Signature]*

Signed: *[Signature]*

Date: 2008-04-18

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0.1 Circulation List

COPY NO.	COPY HOLDER
1	Research & Development Manager
2	Supplies Manager
3	Stores & Stock Control Manager
4	Technical Services Manager
5	Transmission Manager
6	Assistant Manager, Technical Audit

0.2 Amendment Record

Rev No.	Date (YYYY-MM-DD)	Description of Change	Prepared by (Name & Signature)	Approved by (Name & Signature)

Issued by: Head of Section, Tech Stds & Specs

Signed:

Date:

2008-04-18

Authorized by: Head of Department, R&D

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FOREWORD

This specification has been prepared by the Research and Development Department in liaison with the Energy Transmission Division and Telecoms Department all of The Kenya Power and Lighting Company Limited (KPLC) and it lays down requirements for 132kV Capacitor Voltage Transformers (132kV CVT). It is intended for use by KPLC in purchasing Transmission Spares.

It shall be the responsibility of the manufacturer to ensure adequacy of the design and good engineering practice in the manufacture of the capacitor voltage transformers for KPLC. The manufacturer shall submit information, which confirms satisfactory service experience with products, which fall within the scope of this specification.

1. SCOPE

- 1.1 This specification is for newly manufactured single-phase capacitor voltage transformers for connection between line and ground for system highest voltage of 145kV at power frequency of 50Hz.
- 1.2 The capacitor voltage transformer shall be suitable for supplying a low voltage for measurement, control and system protection functions.
- 1.3 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 (when required) will be attached as ANNEX B to this specification.
- 1.4 This specification covers capacitor voltage transformer of ratings and service conditions given in clause 4.2.6.

2. REFERENCES

The following documents were referred to during the preparation of this specification; in case of conflict, the requirements of this specification shall take precedence.

IEC 60044-5: Instrument Transformers – Part 5: Capacitor Voltage Transformers

IEC 60815: Guide for the selection of insulators in respect of polluted conditions

3. TERMS AND DEFINITIONS

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For the purpose of this specification the definitions given in the reference standards shall apply.

4. REQUIREMENTS

4.1 SERVICE CONDITIONS

4.1.1 Site Conditions

The site conditions under which the capacitor voltage transformers shall operate are specified in clause 4.2.6. The mean keraunic level is up to 180 thunderstorm days per year and average ambient temperature is +30°C with a minimum of -1°C and a maximum of +40°C.

4.1.2 System Conditions

4.1.2.1 The capacitor voltage transformer will be connected between line and earth of a 3-phase 3-wire system with the neutral point solidly earthed.

4.1.2.2 The overhead system is of earthed construction i.e. with aerial earth wire. The system nominal voltage is 132 000 Volts with system highest voltage of 145 000 Volts at a frequency of 50Hz.

4.2 DESIGN AND CONSTRUCTION

4.2.1 The capacitor voltage transformer shall be single phase, capacitor type and shall be designed and constructed to IEC 60044-5 and the requirements of this specification.

4.2.2 The capacitor voltage transformer shall be outdoor oil-immersed type mounted in one insulator made of high-grade brown glazed porcelain.

4.2.3 The oil of the capacitor voltage transformer shall be hermetically sealed against the ambient air.

4.2.3 The capacitor voltage transformer shall be suitable for installation on a steel structure.

4.2.4 All external parts of the capacitor voltage transformer shall be resistant to atmospheric corrosion and suitable for specified site conditions.

4.2.5 The capacitor voltage transformer shall be supplied complete fitted with primary, secondary and earth terminals.

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The primary terminal shall be clamp type, tin-plated and suitable for connection of both copper and aluminium conductors.

The secondary terminals shall be brought out to a separate dust proof and watertight terminal box, complete with protection fuses and links.

4.2.6 Ratings

4.2.6.1 The capacitor voltage transformer shall be capable of carrying 50% burden above the rated capacity without damage for 30 seconds.

4.2.6.2 The ratings of the capacitor voltage transformer shall be as indicated herein:-

Description	Requirement																			
Site Conditions	Outdoors in tropical areas at altitudes of up to 2200m above sea level, humidity of up to 90%, average ambient temperature of +30°C with a minimum of -1°C and a maximum of +40°C and heavy saline conditions along the coast.																			
Rated Primary Voltage	132000/ $\sqrt{3}$ volts																			
Rated Secondary Voltage	110/ $\sqrt{3}$ volts																			
Rated Frequency	50 Hz																			
Minimum Creepage Distance of Insulator	3625mm																			
Lightning impulse withstand voltage, primary winding	750kV (peak)																			
Power frequency withstand voltage, primary winding	325kV (r.m.s.)																			
Power frequency withstand voltage, secondary winding	5kV (r.m.s.)																			
Rated Voltage Factor	1.2 Continuous 1.5 for 30 seconds																			
	<table border="1"><thead><tr><th>Terminal Markings</th><th>Voltage Output</th><th>Class</th><th>Burden</th></tr></thead><tbody><tr><td>Core 1</td><td>1a-1n</td><td>110/$\sqrt{3}$</td><td>0.5</td><td>100VA</td></tr><tr><td>Core 2</td><td>2a-2n</td><td>110/$\sqrt{3}$</td><td>3P</td><td>100VA</td></tr><tr><td>Core 3</td><td>da-dn</td><td>110/3</td><td>3P</td><td>100VA</td></tr></tbody></table>	Terminal Markings	Voltage Output	Class	Burden	Core 1	1a-1n	110/ $\sqrt{3}$	0.5	100VA	Core 2	2a-2n	110/ $\sqrt{3}$	3P	100VA	Core 3	da-dn	110/3	3P	100VA
Terminal Markings	Voltage Output	Class	Burden																	
Core 1	1a-1n	110/ $\sqrt{3}$	0.5	100VA																
Core 2	2a-2n	110/ $\sqrt{3}$	3P	100VA																
Core 3	da-dn	110/3	3P	100VA																

5. TESTS AND INSPECTION

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- 5.1 The capacitor voltage transformer shall be inspected and tested in accordance with the requirements of this specification and IEC 60044-5. It shall be the responsibility of the manufacturer to perform or to have performed the tests specified.
- 5.2 Certified true copies of previous type and routine test reports by the relevant International or National Testing/Standards Authority of the country of manufacture (or ISO/IEC 17025 accredited laboratory) shall be submitted with the offer for evaluation (all in English Language). A copy of the accreditation certificate for the laboratory shall also be submitted.

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

Copies of Type Test Reports to be submitted shall include the following tests as per IEC 60044-5:

- 5.2.1 Temperature rise test;
- 5.2.2 Capacitance and tan δ measurement at power-frequency;
- 5.2.3 Short-circuit withstand capability test;
- 5.2.4 Lightning impulse test (with both positive and negative polarity – fifteen consecutive impulses of each polarity);
- 5.2.5 Chopped impulse test (sequence – one full impulse, two chopped impulses, fourteen full impulses);
- 5.2.6 Wet test for outdoor capacitor voltage transformers;
- 5.2.7 Ferro-resonance tests;
- 5.2.8 Tightness of liquid-filled electromagnetic unit;
- 5.2.9 Accuracy tests;
- 5.2.10 Transient response test;
- 5.2.11 Radio interference voltage test.

- 5.3 Routine test reports for the capacitor voltage transformers to be supplied shall be submitted to KPLC for approval before shipment/delivery of the goods. KPLC Engineers (2) shall witness acceptance tests at the factory before shipment.

Acceptance tests shall include Routine Tests as per IEC 60044-5 as follows:

- 5.3.1 Tightness of the liquid-filled capacitor voltage divider;
- 5.3.2 Power-frequency withstand test and measurement of capacitance, tanδ and partial discharge;
- 5.3.3 Verification of terminal markings;
- 5.3.4 Power-frequency withstand tests on the electromagnetic unit;

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- 5.3.5 Ferro-resonance check;
- 5.3.6 Accuracy check.

6. MARKING AND LABELLING

6.1 The capacitor voltage transformer shall be fitted with a permanent rating plate indicating the following:

- a) The manufacturer's name or identification mark;
- b) The type reference number and serial number;
- c) The rated primary and secondary voltage;
- d) The rated capacitance in Pico farads;
- e) The rated frequency;
- f) The burden and accuracy class;
- g) The highest system voltage (e.g. 145kV);
- h) The insulation level;
- i) The rated voltage factor and corresponding rated time.

6.2 The terminals shall be marked clearly and indelibly. All marking shall be in accordance with IEC 60044-5.

6.3 All markings shall be by engraving or superior method.

6.4 A set of Three (3) Original Hard Cover Installation and Maintenance Manuals for the capacitor voltage transformers shall be supplied with the equipment.

Note: *The schedule in Annex A does not in any way substitute for detailed information required elsewhere in the specification.*

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ANNEX A: Technical Particulars (to be filled and signed by the Manufacturer for all clauses and submitted together with catalogues, brochures, drawings, technical data and test reports for tender evaluation)

Tender No.....

Clause	Description	Bidder's offer
	Manufacturer, Country & Type Reference No./Model	
4.1	Site Conditions	
4.2	Applicable Standard(s)	
4.2.2	Type and insulators	
4.2.3	Installation	
4.2.5	Terminals	Primary
		Secondary
4.2.6	RATINGS	
	Rated Primary Voltage	
	Rated Secondary Voltage	
	Rated Frequency	
	Minimum Creepage Distance of Insulator	
	Lightning impulse withstand voltage, primary winding (peak)	
	Power frequency withstand voltage, primary winding, r.m.s.	
	Power frequency withstand voltage, secondary winding, r.m.s.	
	Rated Voltage Factor	Continuous
		30 seconds
	Secondary Windings (indicate terminal markings, voltage output, class & VA rating)	Core 1
		Core 2
		Core 3
5.2	List of Type Test Reports submitted (indicate Test Report Numbers, Testing Authority & contact addresses)	
5.3	List of Tests to be witnessed at factory	
6	Marking	
	List of catalogues, brochures, drawings, technical data, test reports and customer sales records submitted to support the offer	
	Statement of Compliance with Specifications	

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

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ANNEX B: Details for carrier-frequency accessories for power line carrier-frequency (PLC) application (to be attached by KPLC when required)

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Details for Coupling Capacitors and carrier-frequency accessories for power line carrier-frequency (PLC) application (to be attached by KPLC when required):

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.

