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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)

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 220kV Capacitor Voltage Transformers (220kV CVT). It is intended for use by KPLC in purchasing the equipment.

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 245kV 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 the following categories of voltage transformers:

1.4.1 220kV Capacitor Voltage Transformer, Pollution Level: Heavy (specific creepage distance of 25mm/kV) – For installations inland, cities and suburbs of cities.

1.4.2 220kV Capacitor Voltage Transformer, Pollution Level: Very Heavy (specific creepage distance of 31mm/kV)– For installations very close to the coast, areas exposed to sea spray or very strong and polluting winds from the sea.

Note: The category required shall be specified on the schedule of requirements in the tender document.

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

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 isokeraunic 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 220 000 Volts with system highest voltage of 245 000 Volts and a frequency of 50Hz.

4.2 DESIGN AND CONSTRUCTION

4.2.1 The 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 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.

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/Category	**220kV CVT, Pollution Level: Heavy**	**220kV CVT, Pollution Level: Very Heavy**
Site Conditions	Areas inland, cities, suburbs of cities and altitude of 1000-2200m above sea level.	Areas very close to the coast, areas exposed to sea spray or very strong and polluting winds from the sea and altitude less than 1000m above sea level.
Rated Primary Voltage	220 000/√3 volts	220 000/√3 volts
Rated Secondary Voltage	110/√3 volts	110/√3 volts
Rated Frequency	50 Hz	50 Hz
Minimum Creepage Distance of Insulator	6125mm	7595mm
Lightning impulse withstand voltage, primary winding	1050kV (peak)	950kV (peak)
Power frequency withstand voltage, primary winding	460kV (r.m.s.)	395kV (r.m.s.)

Power frequency withstand voltage, secondary winding	5kV (r.m.s.)		5kV (r.m.s.)	
Rated Voltage Factor	1.2 Continuous		1.2 Continuous	
	1.5 for 30 seconds		1.5 for 30 seconds	
Secondary windings core 1, core 2 and core 3 (for both categories)				
	Terminal Markings	Voltage Output	Class	VA
Core 1	1a-1n	110/√3	1	75
Core 2	2a-2n	110/√3	3P	150
Core 3	da-dn	110/3	3P	50

5. TESTS AND INSPECTION

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.

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 tanδ 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;
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 picofarads;
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.

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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..... Category:.....

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)		
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		

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Manufacturer's Name, Signature, Stamp and Date

ANNEX B: 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 **7400pF**, phase to phase, an impulse withstand voltage of 1050 **kV** and meet the insulation level and test voltage equivalents of **IEC** recommendation for the devices, **(IEC 60358** coupling capacitors and capacitor dividers & IEC 60186).

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 (lightning 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.