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0.1 Circulation List

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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 2 Rev 1	2010-04-14	Removed restrictions on type of tank construction, specified 90° bent in top cover, the minimum thickness for tank and removed requirement on arcing horns	S. Kimitei	G. Owuor

FOREWORD

This specification has been prepared by the Research and Development Department in collaboration with the Technical Services, Design & Construction and Operations & Maintenance Departments all of the Kenya Power & Lighting Company Ltd (KPLC) and it lays down requirements for pole mounted three phase distribution transformers. The specification is intended for use by KPLC in purchasing the transformers.

It is expected that manufacturers will provide energy efficient standard design transformers that will provide high level of efficiency and significant initial cost saving. The manufacturer shall also submit information which demonstrates satisfactory service experience with products which fall within the scope of this specification.

1. SCOPE

This specification is for oil-immersed, air-cooled, outdoor type pole mounted three phase distribution transformers for 11kV and 33kV distribution systems operated at 50 Hz.

The specification covers transformers of the following voltage ratios and ratings:

- 11000/433V: 50 KVA, 100 KVA, 200 KVA and 315 KVA
- 33000/433V: 50 KVA, 100 KVA, 200 KVA and 315 KVA.

The specification also covers inspection and test of the transformer as well as schedule of Guaranteed Technical Particulars to be filled, signed by the manufacturer and submitted for tender evaluation.

The specification stipulates the minimum requirements (including features to deter vandalism) for pole mounted three phase distribution transformers acceptable for use in the company (KPLC) 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 transformers for KPLC.

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

2. REFERENCES

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

ISO 1461: Hot dip galvanized coatings on fabricated iron and steel articles – Specifications and test methods.

IEC 60076: Power transformers.

IEC 60296: Specification for unused mineral insulating oil for transformers and switchgear.

IEC 60354: Loading guide for oil – immersed power transformers.

IEC 60214: Tap-changers - Part 1: Performance requirements and test methods, Part 2: Application guide

IEC 60512: Connectors for electronic equipment

BS 381C: Specification for colours for identification coding and special purposes

3. TERMS AND DEFINITIONS

The terms and definitions given in the reference standards shall apply.

4. REQUIREMENTS

4.1 Service Conditions

4.1.1 Operating conditions

The transformer shall be suitable for continuous outdoor operation in tropical areas with the following conditions.

(a) Altitude: upto 2,200 metres above sea level.

(b) Temperature: average of +30°C with a minimum of -1°C and max +40 °C

(c) Humidity: up to 95%,

(d) Pollution: Design pollution level to be taken as "*Heavy*" (Pollution level III) according to IEC 815.

(e) Isokeraunic level: 180 thunderstorm days per year

4.1.2 System characteristics

4.1.2.1 The transformer will be connected to overhead system which is of unearthed construction (i.e. without continuous aerial earth wire).

4.1.2.2 The primary system is having a nominal voltage of 11000 volts and 33000 volts and system highest voltage of 12000 volts and 36000 volts respectively. The primary system is three phase 3-wire 50 Hz and the secondary is 433 volts three phase 4-wire.

4.1.2.3 The Transformer shall be operated at a high loading factor.

4.2 General Requirements

4.2.1 The transformer shall be outdoor, oil-immersed, of ONAN classification and core type (lamination stackings). All offers shall comply with the requirements of IEC 60076. Any deviations/additional requirements shall be as stated in this specification.

4.2.2 The transformer shall be a two winding type three-phase integral unit.

4.2.3 The transformer shall be hermetically sealed type with bolted top cover.

4.2.4 The transformer and accessories shall be designed to facilitate operation, inspection, maintenance and repairs. All apparatus shall be designed to 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.

4.2.5 The design shall incorporate every reasonable precaution and provision for the safety of all those concerned in the operation and maintenance of the equipment keeping in view the regulatory requirements in Kenya.

4.2.6 All material used shall be 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.

4.2.7 Corresponding parts liable to be replaced shall be interchangeable.

4.2.8 The design of fittings and accessories shall not allow for oil siphoning by vandals. All fittings and accessories shall be secured from the inside of the transformer and or have small openings that do not allow for oil siphoning. Detailed information on special features of the offered design that make it impossible for vandals to siphon oil from the transformer shall be submitted with the tender. Fittings and accessories other than those required by this specification are prohibited.

4.2.9 All parts of the transformer, including bushings insulators with their mountings, shall be designed so as to avoid pockets in which water can collect. Rain water shall not collect anywhere on the top cover and gaskets shall be concealed by bent in the top cover of 90°.

4.2.10 All connections and contacts shall be of ample section and surface for carrying continuously the specified currents without undue heating and fixed connections shall be secured by bolts or set screws of ample size, adequately locked. Lock nuts shall be used on stud connections carrying current. All leads from the winding to the terminals and bushings shall be adequately supported to prevent injury from vibration including a systematical pull under short circuit conditions.

4.2.11 The transformer shall be designed to minimize the risk or accidental short-circuit caused by animals, birds or vermin.

4.2.12 All bolts, nuts, and washers exposed to atmosphere and in contact with non-ferrous parts which carry current shall be of phosphor bronze.

4.2.13 The design and all materials and processes used in the manufacture of the transformer, shall be such as to reduce to a minimum the risk of the development of acidity in the oil.

4.2.14 Every care shall be taken to ensure that the design and manufacture of the transformers shall be such as to have minimum noise and vibration levels following good modern manufacturing practices. The maximum noise levels shall be in accordance to IEC standards and guaranteed values shall be stated in the bid

4.2.15 Each transformer shall be suitable for 'H' pole mounting. It shall be complete with two steel channel underbase each with two holes (elliptical 20mm x 150mm) for bolting onto a steel channel transformer platform (of similar construction) by KPLC during installation. The spacing of the holes on the platform shall be given to successful bidder during drawings approval before manufacture.

4.2.16 Drawings and documentation for each size of transformer offered shall be submitted with tender, clearly detailing important dimensions, clearances, accessories, fittings any special feature of the offered design and the features of the offered design that make it impossible for vandals to siphon oil from the transformer even after forceful breakage of accessory/fitting.

4.3 Ratings

4.3.1 The transformers shall be of the following ratings:

(a) 11000/433V: 50 KVA, 100 KVA, 200 KVA and 315 KVA
(b) 33000/433V: 50 KVA, 100 KVA, 200 KVA and 315 KVA.

4.3.2 (a) The transformer shall be capable of carrying its full normal rating continuously at any tap under the conditions stated in clause 4.1 without undue stress, overheating, or the temperature rise in the hottest region exceeding 55°C and 60°C in oil and windings respectively.

(b) The loading capabilities shall be demonstrated by a temperature rise test. This test shall be done in the presence of KPLC Representatives during factory acceptance testing.

4.3.3 The transformer shall be capable of withstanding the maximum fault level at its rated voltage and impedance for 2 seconds. The design should cater for the expected lifetime of the transformer.

4.3.4 The thermal ability to withstand short circuit shall be demonstrated by calculation as per IEC 60076-5 and the calculation shall be submitted with the tender. The duration of the current to be used for the calculation of the thermal ability to withstand short circuit shall be 2 seconds while the maximum permissible value of the average temperature of each winding shall be as per IEC 60076-5. As a minimum, the short-circuit apparent power of 11kV and 33kV systems shall be taken as 500MVA and 1000MVA respectively (as per IEC 60076-5) in order to obtain the value of the symmetrical short circuit current to be used for the design and tests.

4.3.5 The ability of the transformer to withstand the dynamic effects of short circuit shall be demonstrated by tests and complete test reports (including oscillograms and records of the condition of the transformer before and after the short-circuit test) shall be submitted for tender evaluation.

4.4 Winding and Connections

4.4.1 The transformer shall be wound **Dyn11** with respect to the 11kV windings (or 33kV as appropriate) and low voltage winding (433V) as per IEC 60076. The star point of the low voltage winding shall be brought out to a neutral bushing.

4.4.2 The transformers shall be capable of operation without danger on any particular tapping at the rated KVA when the voltage may vary by ± 10% of the voltage corresponding to the tapping.

4.4.3 The windings and connections as well as the insulating material shall not soften, ooze, shrink or collapse during service. The materials shall be non-catalytic and chemically inactive in transformer oil during service.

4.4.4 The primary windings shall be of full coil copper wires as opposed to segmented winding and the secondary windings shall be coil or foil of copper or foil of aluminium.

4.4.5 The HV and LV windings shall be separated so as to allow for cooling and ease of repair. Insulating sleeves for the transformer tappings shall be in crepe paper or better.

4.4.6 The windings and connections shall be properly braced to withstand shocks during transportation or due to short circuit and other transient conditions during service.

4.4.7 All windings after being wound and all fibrous hygroscopic materials used in the construction of the transformer shall be dried under vacuum and impregnated with hot oil.

4.4.8 The radial spacer blocks must be made of pre-compressed pressboard material, which will not soften while in contact with oil or fray out into fibers or edges. The slots should be so dimensioned that the blocks will not come out of the slots.

4.4.9 All joints shall be brazed/crimped considering the vibrations due to short circuits and load fluctuations.

4.4.10 The transformer core and all electrical parts inside the transformer shall be sufficiently submerged in oil by no less than 120mm from the minimum oil level mark.

4.4.11 KPLC may inspect built-up winding for its quality, weight of copper, insulation and overall weight of coil assembly. The size of conductor used for different windings shall also be checked during stage inspection to check the current density.

4.5 Tapping

4.5.1 Tapping Range

The high voltage winding shall have tappings at $\pm$ 2 x 2.5% operated by an off-circuit switch with marked position indicators. Tapping details shall be included on the transformer name plate.

4.5.2. Tapping Method

Tapping shall be carried out by means of an off-load tap changer.

The switch shall be located at the transformer top cover with sufficient electrical clearance and well submerged in oil. Switch position No. 1 shall correspond to highest voltage on the HV side

The make contacts of the tap changer shall be robust and of sufficient surface area. The tap switch shall comply with relevant requirements of IEC 60214 & IEC 60512.

4.6 Core and Flux Density

a) Core

4.6.1 The core shall be constructed from the laminations of high grade cold rolled non-aging, grain oriented silicon steel known as M4 or Hi-B Grade or superior grade steels of maximum 0.27mm or less lamination thickness especially suitable for transformer core. The grade/type of core steel shall be stated in the bid.

4.6.2 The design of the magnetic circuit shall be such as to avoid static discharges, development of short-circuit paths within itself or to the earthed or to the clamping structure and the production of flux components at right angles to the plane of the laminations which may cause local heating.

4.6.3 Every care shall be exercised in the selection, treatment and handling of core steel to ensure that as far as practicable, the laminations are flat and the finally assembled core is free from distortion.

4.6.4 Adequate cooling shall be provided for the core.

4.6.5 There shall be no movement of the core assembly relative to the tank during transport, installation as well as in service due to sudden jerks caused by short circuits and fluctuating loads.

4.6.6 The cores shall be clamped effectively with metal cross-arms and be fitted with core lifting lugs. During factory acceptance testing, the manufacturer shall demonstrate experimentally or via a previous test report, that the whole structural frame-work supporting the transformer windings and the core can definitely withstand repeated transformer short-circuits. All steel sections used for supporting the core shall be thoroughly sand blasted or shot blasted after cutting, drilling and welding. Any non-magnetic or high resistance alloy shall be of established and approved quality.

4.6.7 Adequate lifting lugs shall be provided to enable core and winding to be lifted. The lifting lugs shall allow a factor of safety of at least 2.

4.6.8 The supporting framework of the Cores shall be so designed as to avoid the presence of pockets which would prevent complete emptying of the tank, or cause trapping of air during filling.

4.6.9 The insulation structure for the core to bolts and core to clamp plate shall be such as to withstand a voltage of at least 2kV 50Hz for one minute.

(b) Flux Density

4.6.10 The primary voltage variation, which may affect the flux density at every tap, shall be kept in view while designing the transformer.

4.6.11 The transformer shall be so designed that the working flux density shall not exceed 1.6 Tesla at normal voltage, frequency & ratio. Tenders with higher flux density than specified shall not be considered.

4.6.12 Tenderers shall indicate in their bid the continuous allowable maximum flux for one minute and five seconds.

4.6.13 The limit of flux density at which core material used saturates shall also be stated in the tender. The name and grade of core material shall be stated in the tender.

4.6.14 The successful tenderer shall be required to furnish magnetization curve of the core material, design calculations and such other data/documents deemed fit by the purchaser for being satisfied that flux density is as desired.

4.7 Impendence Voltage

The impedance voltage measured at the principal tap shall not exceed the values indicated in the following table:

	Rating KVA	Impedance Voltage %
11/0.433kV Transformers	50	4.35
	100	4.35
	200	4.5
	315	4.5
33/0.433kV Transformers	50	4.5
	100	4.5
	200	4.75
	315	4.75

4.8 Losses

4.8.1 The maximum sum total of the transformer losses, measured at full load operation, unity power factor and rated voltage shall not exceed values indicated in the table below. Measured values of the iron losses and the full load copper losses shall be adjusted to 75 degree Celsius.

	Rating KVA	TOTAL TRANSFORMER LOSSES (Fe + Cu) Watts
11/0.433kV Transformers	50	840
	100	1650
	200	2900
	315	4300
33/0.433kV Transformers	50	940
	100	1800
	200	3050
	315	4500

Transformers with losses exceeding the above values shall be rejected.

4.8.2 No-load and Load Losses submitted in the tender shall be treated as maximum values. Any increase in these values after award and at the time of factory acceptance testing shall not be accepted. Only the minus tolerance given in the IEC 60076 shall be allowed.

4.9 Bushings and Clearances

4.9.1 The windings shall be brought out separately through open type bushings of outdoor, weatherproof design in accordance with IEC 60137.

4.9.2 The bushings shall be constructed, arranged and fitted in such a manner as to be changed without opening the transformer.

4.9.3 All bushings (HV & LV) shall be of porcelain material, brown in colour and shall be on the top cover of the transformer.

4.9.4 The neutral bushing of the transformer shall be identical to the corresponding phase terminal bushings.

4.9.5 Spacing and air clearances shall be so co-ordinated that there shall be no flashover from the terminal of one winding to the terminal of another winding.

4.9.6 Leakage distance of bushings shall not be less than 25mm/kV, based on the maximum phase to phase voltage.

4.9.7 Bushing terminals shall be clamp type suitable for both copper and aluminium conductor.

The terminal connectors shall be clamp type connectors of the following sizes and materials (all bolts shall be in phosphor bronze):

Rating	HV		LV	
	Material	**Size of conductor**	**Material**	**Size of conductor**
50KVA	Aluminium Bronze, electrotinned	75-150mm² ACSR	Aluminium Alloy electrotinned	1x50mm² AAC
100KVA				2x50mm² AAC
200KVA				2x100mm² AAC
315KVA				2x100mm² AAC

4.9.8 Terminal arrangement and marking on the HV and LV sides shall be **A, B, C** and **n, a, b, c** respectively.

4.9.9 Air Clearance

4.9.9.1 When totally assembled, as in service, electrical clearances in air shall be adequate to withstand the assigned impulse withstand test voltages.

4.9.9.2 Care shall be taken to ensure that all fittings/accessories are suitably positioned so as not to interfere with the external connection to the bushing terminals and clearances.

4.9.9.3 Minimum external air clearances shall be as shown under.

Nominal System Voltage between Phases		LV	11kV	33kV
Minimum clearance phase-to-earth and phase-to-neutral	mm	80	300	485
Minimum clearance phase-to-phase between phases of the same winding	mm	100*	250	435
Minimum clearance between a line terminal of the high voltage winding and a line terminal of a lower voltage winding	mm	N/A	300	485
Minimum Creepage distance	mm	60	300	900

*Note: * 100 mm is for the 50kVA transformer. Manufacturer to provide larger clearances for higher KVA rating transformers.*

4.9.10 Provision shall be made in form of a removable jumper, to provide for good electrical connection between the top cover and the transformer tank. The jumper shall be

sufficiently rated to carry the fault currents without damage. It shall be of tinned copper.

4.10 Insulation Levels

The complete transformer arranged for service, shall be capable of withstanding the following voltages and shall comply fully with the requirements of IEC 60076 Part 3, including the latest amendments.

Nominal system voltage **(kV, rms)**	Highest system voltage **(kV, rms)**	Lightning Impulse withstand voltage, positive **(kV, peak)**	Power frequency withstand voltage **(kV, rms)**
11	12	95	38
33	36	200	95

Note: the insulation levels are for both internal and external insulation.

4.11. Transformer Tank and Tank Cover

4.11.1 The tank shall be constructed of tested mild steel plates of sufficient thickness and strength and shall be complete with specified accessories and fittings. It shall be designed so as to allow the complete transformer when filled with oil to be lifted by means of lifting lugs, transported by road, rail or on water without overstraining any joints and without causing subsequent leakage of oil. The minimum thickness of the top cover, bottom and sides of the transformer tank shall be 5mm, 5mm and 3.15mm respectively.

All joints of tank and fittings shall be oil tight and no bulging should occur during service.

4.11.2 The internal clearance of tank shall be such that it shall facilitate easy lifting of core with windings from the tank. Inside of the tank shall be painted with varnish/hot oil resistant paint.

4.11.4. The main tank body shall be pressure tested and a certificate issued by ISO/IEC 17025 Accredited Laboratory ascertaining the soundness of all welded joints. A certified copy of the certificate shall be submitted with the tender for evaluation.

4.11.5 The tank shall be complete with lifting lugs suitable for lifting the complete transformer with oil. The lifting lugs shall be welded on the side walls and shall be heavy duty type

of mild steel plate at least 8mm thick suitably reinforced with a factor of safety of at least 2 (based on weight of complete transformer filled with oil).

4.11.6 Steel radiators of adequate thickness to deter oil vandalism shall be used for cooling. The transformer shall be capable of giving continuous rated output without exceeding the specified temperature rise.

4.11.7 Top tank cover shall be of such a design and construction as to prevent accumulation of water and shall be bolted to the flange on the tank top to form a weatherproof joint. The top cover fixing shall be with hot dip galvanized steel bolts and synthetic rubber-and-cork composition gasket of 6mm minimum thickness. The bolts shall each have two flat washers and one spring washer.

The top cover bolts shall include 8 No. non standard shearing bolts (evenly distributed on top cover) to deter un-authorized opening. The required key/tool for opening the special bolts shall be provided to KPLC during delivery.

4.12. Paint Work

4.12.1 External and internal surfaces of all transformer tanks and other fabricated steel items shall be cleaned of scale, rust and surface dirt by shot blast cleaning or other suitable approved method. After cleaning, these surfaces should be immediately covered with paint.

4.12.2 The exterior shall be thoroughly cleaned by shot blasting or other approved method and given priming coat followed by two coats of contrasting colours of durable weather-resisting paint. The final colour of the exterior surfaces shall be Dark Admiralty Grey colour No. 632 as per BS 381C with a total dry film thickness of between 100 and 130 microns.

4.12.3 The interior of all transformer tanks and other oil-filled chambers shall be cleaned of all scale and rust by shot blasting or other approved method. Hot oil resistant varnish/paint shall be used for painting the inside the transformer tank and oil filled chambers.

4.12.4 Radiators shall be thoroughly degreased and treated externally by phosphating and/or other rust-inhibiting process.

4.12.5 Radiators shall be flood-painted with a primer and two coats of durable weather and oil resisting paint. The final external coat shall be high gloss of shade No. 632 (Admiralty Grey) according to BS 381C. The total paint thickness shall not be less than 85µm at any point.

4.13. Fittings and Accessories

The transformer shall be complete with the following fittings and accessories:

a) Pressure relief device; mounted on top cover and shall not protrude higher than the height of the transformer bushings above the top cover.
b) Oil level gauge; clearly readable by an operator standing at ground level at a distance of 5 meters away from the transformer mounting. The maximum and minimum oil level marks shall fall within range of the gauge. The nominal oil level shall be at the centre of the range. The oil level gauge MUST be mounted on the side of the transformer.
c) Two earthing terminals on the body of the transformer at the bottom diagonally opposite each other.
d) Separate lifting lugs for core, top cover and complete transformer (as per requirements given in this specification).
e) Off-circuit tap changer; mounted on top cover.
f) Tinned copper jumper between tank and top cover
g) Base mounting channel (see clause 4.2.15)
h) Rating and diagram plate (as per IEC 60076 and this specification)
i) Clamp connectors (as per requirements given in this specification).

All fittings and accessories shall be designed and secured in such a manner that makes it impossible for vandals to siphon oil from the transformer even after forceful breakage of the fitting/accessory. No other fittings including oil drain valve, oil filling plug are allowed.

Detailed drawings for the transformer (including internal details), fittings and accessories and showing features that make it impossible for vandals to siphon oil from the transformer even after forceful breakage of the fitting/accessory shall be submitted to KPLC for approval before manufacture.

4.14. Transformer Oil

Cooling of the transformer shall be by natural circulation of oil and natural circulation of air (ONAN).

The transformer shall be supplied filled with oil. The oil shall be new, unused and shall comply with all the requirements of IEC 60296 (class 1: un-inhibited oil).

4.15. Quality Management System

4.15.1 The supplier shall submit a quality assurance plan (QAP) that will be used to ensure that the transformer design, material, workmanship, tests, service capability, maintenance and documentation, will fulfil the requirements stated in the contract

documents, standards, specifications and regulations. The QAP shall be based on and include relevant parts to fulfil the requirements of ISO 9001:2008.

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

5. TESTS AND INSPECTION

5.1 The transformer shall be inspected and tested in accordance with the requirements of IEC 60076 and this specification. It shall be the responsibility of the manufacturer to perform or to have performed all the tests specified. Tenderers shall confirm the manufacturer's capabilities in this regard when submitting tenders. Any limitations shall be clearly specified.

5.2 Copies of previous Type Test Certificates and Type Test Reports issued by the relevant International or National Testing/ Standards Authority of country of manufacture or ISO/IEC 17025/ILAC accredited and independent 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 certificates and type test reports for the transformer to be submitted for tender evaluation shall include:

- Dielectric tests to IEC 60076 (Lightning Impulse and Power Frequency Withstand Voltage Tests).
- Short circuit withstand test to IEC 60076.
- Temperature rise test to IEC 60076.

Type Test Reports for a transformer of identical or higher voltage and KVA rating and within the range of 11/0.433kV – 36/0.433kV and 50KVA to 500KVA shall be accepted as representative for any of the pole mounted three phase distribution transformer on tender. The Type Test Reports shall be for identical or higher KVA rating in the above range – for example Type Test Reports for 200KVA 11/0.433kV will be accepted as representative for 11/0.433kV with KVA ratings of 50, 100 & 200 but not for any of 33/.433kV ratings.

5.3 The transformer shall be subject to acceptance tests at the manufactures' works before dispatch. Acceptance tests shall be witnessed by two Engineers appointed by The Kenya Power and Lighting Company Limited (KPLC) and shall include the following:

5.3.1 **Routine tests to IEC 60076 (to be done during acceptance testing at factory)**

- Measurement of winding resistance
- Ratio test
- Vector group
- Separate source voltage withstand test
- Induced over-voltage
- Insulation resistance
- Oil leakage test on fully assembled transformer for 12 hours
- Measurement of impedance voltage
- Measurement of no-load loss and current
- Measurement of load loss (at normal & extreme taps)
- Tests on off-load tap-changer

5.3.2 **Type Tests to IEC 60076 (to be done on one unit during acceptance testing at factory)**

- Temperature rise test – To be performed on one unit during acceptance testing.
- Lightning impulse withstand test – To be performed on one unit during acceptance testing.

5.3.3 **Additional tests (to be done during acceptance testing at factory)**

- Visual Inspection (verification of dimensions, fittings & accessories, markings & nameplates, paintwork, workmanship and finish)
- Acoustic and sound level
- Paint thickness
- Tank pressure test

5.4 Testing Facility

The manufacturer shall provide current e-mail address, fax and telephone numbers and contact person at the International or National Standards and Testing Facility of the country where the transformer is manufactured and tested.

5.5 Complete Test Reports for each transformer (including its individual components) shall be submitted to The Kenya Power and Lighting Company for approval before shipment.

5.6 On receipt of the transformer KPLC will inspect it and may perform or have performed any of the relevant tests in order to verify compliance with the specification. The manufacturer shall replace/rectify without charge to KPLC, transformers which upon examination, test or use fail to meet any or all of the requirements in the specification.

6. MARKING, LABELLING AND PACKING

6.1 The transformer and associated components shall be packed in a manner as to protect them from any damage in transportation and handling. The transformer shall first be mounted and bolted to a wooden base pallet and then covered with a polythene cover. The transformer with the base pallet shall then be secured tightly in the container to avoid transit movements.

6.2 The transformer shall be dispatched fully assembled and oil-filled.

6.3 Each assembly and package of items associated with the transformer shall be suitably marked.

6.4 In addition to markings and labels required elsewhere in the specification, each transformer shall be provided with a rating and diagram plate of weatherproof material, fitted in a visible position, showing the appropriate details listed in IEC 60076. The entries on the plate shall be indelibly marked (either by etching, engraving or stamping).

6.5 In addition, the rating and diagram plate shall include load and no load losses for the highest, lowest and principle tap positions, temperature class of insulation, connection diagram and the inscription 'PROPERTY OF THE KENYA POWER AND LIGHTING CO.' all marked indelibly as in 6.4.

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Annex A

SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS FOR POLE MOUNTED DISTRIBUTION TRANSFORMER OFFERED

No.	Requirements	BIDDER'S OFFER
1.	Name of the manufacturer and country of origin	
2.	Applicable Standards	
3.	Service (indoor/outdoor), altitude, temperature range, humidity and environment (pollution severity level)	
4.	KVA rating	
5.	Rated no load voltage	
(a)	HV-kV	
(b)	LV-V	
6.	Temperature rise of top oil (deg.C)	
7.	Temperature rise of winding measured by resistance.	
8.	Rated frequency (Hz)	
9.	No. of windings	
10.	Number of phases	
11.	Connection symbol & vector group	
12.	Tap changer type, step and range	
13.	Losses corrected to 75° C as per Clause 4.8	
	a) no-load losses, W b) full load cu losses, W c) full load total losses, W d) 75% Loading, W e) 125% Loading, W	
	Transformer efficiency at unity power factor, rated voltage and full load (75 °C)	
14.	% impedance voltage at rated current & frequency.	
15.	Resistance at 75° C of:	
	HV Winding in ohms (at normal & extreme taps)	
	LV Winding in ohms	
16.	a) Short time thermal rating of HV winding in kA, 2 seconds duration	
	b) Short time thermal rating of LV winding in kA, 2 seconds duration	
17.	a) Overload capacity for 2 hours after continuous	

	full load run	
	b) Thermal time constant in hours	
18.	Internal & external insulation level of offered transformer (as per clause 4.10) a) High voltage side b) Low voltage side	
19.	Test Voltages at factory:	
	i) Lightning impulse kV (peak)	
	ii) Power frequency voltage withstand kV (rms)	
	ii) Altitude of factory	
20.	Noise level when energized at normal voltage and normal frequency at no load.	
21.	Approximate weights	
	i) Core (kg)	
	ii) Windings (kg) (Copper + Insulation) (separately)	
	iii) Tank & Fittings (kg)	
	iv) Oil (kg)	
	v) Total weight (kg)	
22.	Details of oil and quantity in litres	
23.	Net core area in sq. meters	
24.	Type of transformer (stacked core type required)	
25.	Material of Laminations	
	i. Grade of CRGO	
	ii. Thickness of lamination	
	iii. Stack-factor	
	iv. Specific weight/m^3	
	v. Specific loss watts/kg.	
	vi. Core clamping	
26.	Maximum flux density at rated voltage and frequency in Tesla/lines/cm^2	
27.	Conductor area in sq. cm. and current density in Amps/Sq. cm.	
	HV	
	LV	
28.	Type of windings	
	HV	
	LV	
29.	Winding insulation type and class	
	HV	

	LV	
30.	a) Insulating material	
	i) Turn insulation	
	ii) HV side	
	iii) LV side	
	b) Between HV and LV	
	c) For core bolts, washers and end plates	
	d) Tapping connection	
31.	i) Type of axial support: HV & LV windings	
	ii) Type of Radial Coil support :- HV winding LV winding	
32.	Details of Tank	
	i) Material of tank	
	ii) Type of the tank (sealed type required)	
	iii) Thickness of sides in mm	
	iv) Thickness of Bottom in mm	
	v) Thickness of Top Cover in mm	
	vi) Thickness of Radiators in mm	
	vii) Tank sealing (bolted type required)	
33.	Details of Bushings (indicate details for HV, LV & NEUTRAL bushings)	HV LV NEUTRAL
	i) Type (porcelain, brown colour required)	
	ii) One minute dry power frequency withstand voltage kV (rms)	
	iii) One minute wet power frequency withstand voltage kV (rms)	
	iv) 1.2/50 μs lightning impulse withstand voltage kV (peak), positive	
	v) Total creepage distance in Air (mm)	
	vi) Weight of bushings (kg)	
	vii) Phase to earth & phase to phase clearances in air of live parts at the top of bushings.	
	viii) Maximum current rating of each bushing	
	ix) Position of bushings	
34.	Cooling System:	

	i) Grade & standard of oil	
	ii) Quantity of oil in Transformer in litres	
	iii) Weight of oil in Transformer, kg	
	iv) Type and make of material used for radiators.	
	v) Total radiating surface in m^2	
	vi) Total weight of Radiators in kg.	
35.	Overall dimensions of complete transformer	
	a) Length mm	
	b) Breadth mm	
	c) Height mm	
	d) Reference drawing No.	
	e) Transformer external paint	
36.	Type & features of oil level indicator.	
37.	a) Type and make of pressure relief device	
	b) Minimum pressure at which the device operates (kPa)	
38.	Manufacturer's Guarantee and Warranty	
39.	List catalogues, brochures, technical data and drawings submitted to support the offer.	
40.	List customer sales records submitted to support the offer.	
41.	List Type Test Certificates and Type Test Reports submitted with tender (indicate test report numbers, date, voltage & KVA rating, Testing Institution and contact addresses) • Dielectric tests to IEC 60076 (Lightning Impulse and Power Frequency Withstand Tests). • Short circuit withstand test to IEC 60076. • Temperature rise test to IEC 60076.	
42.	List Acceptance Tests to be witnessed by KPLC Engineers at the factory	
43.	List test reports (for transformer and components) to be submitted to KPLC for approval before shipment	
44.	Copy of ISO 9001:2008 Certificate submitted (indicate validity)	
45.	Quality Assurance Plan	
46.	Manufacturer's Declaration of Conformity to Standards (including IEC 60076)	

47.	Statement of compliance to tender specifications	
48.	Comments on tender specifications	
49.	Deviations from tender specifications and supporting data, test reports, technical documents etc.	
50.	Inspection of the transformer and components at KPLC stores/site.	
51.	List and details of fittings and accessories to be fitted and features to be provided to deter oil vandalism (note: fittings & accessories other than those specified are prohibited)	

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Manufacturer's Name, Signature, Stamp and Date