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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 3 Rev 1	2014-09-15	Corrected arithmetic errors, parameters and reviewed component losses & sound power levels as per BS EN 50464-1		

FOREWORD

This specification has been prepared by the Standards Department of The Kenya Power & Lighting Company Ltd (abbreviated as KPLC) and it lays down requirements for ground mounted three phase oil type 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 newly manufactured oil-immersed, air-cooled, outdoor type ground 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:

- 11000/420V: 100-1000 KVA
- 33000/420V: 315 KVA, 630 KVA, 1000 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 ground mounted three phase distribution transformers acceptable for use in the company (KPLC) and it shall be the responsibility of supplier to ensure adequacy of the design, good workmanship, good engineering practice and adherence to standards, specifications and applicable regulations in the manufacture of the transformers for The Kenya Power & Lighting Company Ltd.

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, ***all parts***

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

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

IEC 60512: Connectors for electronic equipment

IEC 60137: Insulated Bushings for alternating voltages above 1000V

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

BS 2562: Cable boxes for transformers and reactors

BS EN 50464-1: Three-phase oil-immersed distribution transformers 50Hz, from 50KVA to 2500KVA with highest voltage for equipment not exceeding 36kV – Part 1: General requirements

Manual on Transformers – Publication No. 295 CBIP 2006

ESI 35-1: Distribution Transformers (from 16KVA to 1000KVA)

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 service conditions

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

(a) Altitude: up to 2,200m above sea level;

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

(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 420 volts three phase 4-wire. The target three phase voltage at the consumer terminals is 400V±6% 50Hz.

4.1.2.3 The Transformer shall be operated at a high loading factor. Loading shall be as per IEC 60076.

4.2 General Requirements

4.2.1 The transformer shall be outdoor, oil-immersed, of ONAN classification and core type or shell type (lamination stackings / wound core). 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 designed for service life of twenty five years.

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

4.2.4 The transformer shall be either free breathing type or hermetically sealed type each with bolted top cover.

4.2.4.1 The hermetically sealed type shall have a gas cushion of 100mm filled with dry air and bolted top cover. The gas cushion of 100mm dry air shall be under the bolted top cover.

4.2.4.2 The free breathing type shall be provided with a conservator and cobalt free dehydrating breather. The conservator shall be in such a position as not to obstruct the electrical connections. The oil gauge shall be provided at one end of the conservator marked with oil levels. The conservator shall have feed valve.

4.2.5 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.

4.2.6 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.

4.2.7 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.

4.2.8 Corresponding parts liable to be replaced shall be interchangeable.

4.2.9 The design of fittings and accessories shall not allow for siphoning of oil by vandals. All fittings and accessories shall be secured from the inside of the transformer and or have openings that do not allow for oil siphoning.

4.2.10 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 the gaskets shall be concealed by an overlap between the top cover and tank flange of 10mm.

4.2.11 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.

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

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 BS EN 50464-1 and guaranteed values shall be stated in the bid.

4.2.15 Each transformer shall be suitable for ground mounting. It shall be complete with two steel channel underbase.

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

4.2.17 Design drawings (by the manufacturer) complete with manufacturer's technical specifications shall be submitted to KPLC for approval before manufacture. The design drawings shall be detailed and shall include the following:

a) Overall dimensions of the transformer and relevant electrical clearances. This shall include all perspectives and respective weights of oil, core steel, copper/aluminium, paper and steel tank/core clamp structure.
b) Core/coil/insulation dimensions, clearances and stacking/coil winding sequence detail.
c) Drawing of nameplate to scale.
d) Dimensional drawing of bushings, tap-changer and clamps.
e) Legend for all technical engineering drawings with manufacturer name, logo, model number, revision/drawing number and key
f) All design drawings MUST BE stamped and signed by the manufacturer.

4.3 Ratings

4.3.1 The transformers shall be of the following ratings:

(a) 11000/420V: 100KVA, 200KVA, 315KVA, 630KVA and 1000KVA.
(b) 33000/420V: 315KVA, 630KVA and 1000KVA.

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 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. 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.

4.3.4 The thermal ability of the offered transformer design to withstand short circuit shall be demonstrated by calculation carried out in accordance with the requirements of clause 4.1.1 to 4.1.5 of IEC 60076-5.

The calculation showing details and compliance with the requirements of clause 4.1.1 to 4.1.5 of IEC 60076-5 shall be submitted with tender. The duration of the current to be used for the calculation of the thermal ability to withstand short circuit shall be 2 seconds as per IEC 60076-5.

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 with the bid 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 (420V) as per IEC 60076. The star point of the low voltage winding shall be brought out to a neutral bushing of the same size as the phase bushing and rod.

4.4.2 The transformer shall be capable of operation without danger on any particular tapping at the rated KVA when the voltage may vary by + 15% and -5% 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 or aluminium coil as opposed to segmented winding and the secondary windings shall be coil or foil/strip of copper or foil/strip of aluminium. The conductor shall be enameled /paper insulated (double layer insulation). The temperature class of insulation shall be >105°C.

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 and inter layer insulation shall be in kraft paper.

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 where used shall 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 80mm from the minimum oil level mark.

4.4.11 KPLC will inspect built-up winding for its quality, weight of copper or aluminium, 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.

4.4.12 The current density in LV and HV windings shall not exceed 2.8A/mm^2 for copper winding and 1.4A/mm^2 for aluminium winding. This will be checked through the relationship: Conductor area = Current per phase/Current density.

4.5 Tapping

4.5.1 Tapping Range

The high voltage winding shall have tappings at ± 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**

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

4.5.2.2 The tap changer shall be located on the side of the transformer with sufficient electrical clearance and well submerged in oil. The tap switch shall be rotary type with provision for padlock of 8mm shank diameter and 50mm height.

4.5.2.3 Switch position No. 1 shall correspond to highest voltage on the HV side.

4.5.2.4 The tap changer shall be designed in such a way that oil will not come out of it even after the removal / forceful breakage of the tap switch handle.

4.5.2.5 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 high grade cold rolled non-aging, grain oriented silicon steel of maximum thickness of 0.27mm OR superior grade core steels of proven design and of thinner laminations suitable for transformer core. The grade/type of core material to be used in the manufacture of the transformers for The Kenya Power & Lighting Company 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 U-shape mild steel clamps or 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 before painting. 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. The lower limit shall be determined by the manufacturer and provided in the bid documents.

4.6.12 Tenderers shall indicate in their bid the continuous allowable maximum flux density 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 Kenya Power for being satisfied that flux density is as desired.

4.7 Short-circuit Impedance

The short-circuit impedance measured at the principal tap at 75°C shall be as per Table 1.

Table 1: Short-circuit Impedance

	Rating KVA	Short-circuit Impedance %, at 75°C
11/0.420kV Transformers	100	4
	200	4
	315	4
	630	6
	1000	6
33/0.420kV Transformers	315	4
	630	6
	1000	6

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 Table 2. Measured values of full load losses shall be corrected to 75 degree Celsius.

Table 2: Total Transformer Losses

	Rating KVA	**TOTAL LOSSES (no-load + load losses) at 75°C (100% loading, unity power factor) Watts**
11/0.420kV Transformers	100	1395
	200	2685
	315	3690
	630	6280
	1000	9940
33/0.420kV Transformers	315	4990
	630	7800
	1000	12200

4.8.2 The sound power level, no-load losses and full load losses at 75°C (unity power factor) shall be as per Table 3:

Table 3: Sound Power Level, No-load and Load Losses at 75°C

	Rating KVA	Sound Power Level (L_{WA}), dB(A)	No-load Losses, Watts	Load losses at 75°C (100% loading, unity power factor), Watts
11/0.420kV Transformers	100	41	145	1250
	200	49	310	2375
	315	52	440	3250
	630	55	680	5600
	1000	58	940	9000
33/0.420kV Transformers	315	63	790	4200
	630	67	1300	6500
	1000	68	1700	10500

4.8.3 No-load and Load Losses shall be submitted in the tender and shall be treated as maximum values. Any increase in these values after tender award and at the time of factory acceptance testing and inspection and acceptance to stores shall not be accepted.

4.9 Cable Boxes, Bushings and Clearances

4.9.1 The windings shall be brought out separately through bushings to IEC 60137.

11/0.420kV ground mounted distribution transformers shall have cables boxes on both HV and LV sides while 33/0.420kV transformers shall have open bushing on HV side and cable box on LV side.

4.9.2 Cable Boxes

4.9.2.1 Requirements applicable to both LV and HV cable boxes:

a) The cable boxes shall be suitable for operating indoors or outdoors under conditions given in clause 4 of this specification.
b) The high voltage (11kV) and low voltage (0.42kV) cable boxes shall be mounted on opposite sides of the tank by bolting.
c) The design shall minimize the effects of eddy currents.
d) Cores of cables shall terminate within the cable box and shall be connected to terminals fixed therein.
e) The cable boxes shall be unfilled type.
f) The cable boxes shall be arranged for cables entering vertically from below. The bottom plate of the cable box shall have knock-outs for the size and number of cables specified.

g) Bushings shall be oil-tight.
h) Each HV and LV cable box shell shall be at least 4mm thick with minimum thickness of the cover plate and bushing plate of 5mm and 6mm respectively, all in mild steel.
i) Each HV & LV cable box shall have a treated hard wood cable cleat/box-base drilled to accommodate specified cables.
j) The minimum size of fixing studs or bolts for cable box shell, securing cover plate and for the hardwood cable cleat shall be M10.
k) The cable boxes shall have gaskets of not less than 5mm thickness made of synthetic rubber or synthetic rubber bonded cork.
l) The construction shall be such that each cable box is effectively sealed against weather and insects. A 12mm diameter breathing hole covered with corrosion resistant wire gauze shall be provided in the bottom of the cable box.
m) All internal surfaces of cable boxes shall be cleaned of all scale and rust by shot blasting or other approved method. The internal surfaces of the boxes and their covers shall, after cleaning, be given a priming coat and one coat of air drying anti-condensation paint.
n) The HV bushings shall be made of porcelain while LV bushings may be made of porcelain material or toughened epoxy insulator material all brown in colour.
o) The continuous current rating of each bushing shall not be less than 120% of the rated current of the transformer.
p) 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.
q) Creepage distance of bushings shall not be less than 25mm/kV, based on the maximum phase to phase voltage.
r) Terminal arrangement and marking on the HV and LV sides shall be A, B, C and n, a, b, c respectively.
s) The HV and LV cable boxes shall be nested within the radiators.

4.9.2.2 LV (0.42kV) cable boxes

a) Bushing stems/conductor for LV (0.42kV) cable box shall be made from hard-drawn high conductivity copper bar. The copper bar shall be at least 63x12.5mm in dimensions and have fully radiused corners. The whole of the outer ends of the bushing conductors shall be hot dipped tinned. Both ends of the bushing conductor shall be clean and free from resin (where resin is used) for the whole of their length from 3mm clear of the moulding.
b) The LV (0.420kV) cable boxes shall be in two sizes:
    i. LV cable box for four cables – A four pole cable box for use with four single core cables on 100 – 315KVA transformers.
    ii. LV cable box for seven cables – A four pole cable box for use with seven single core cables on 630KVA and 1000KVA transformers.

iii. The bushing conductor (copper bar) shall have holes adequate for the number and size of cables specified.

c) The LV cable box for 630KVA and 1000KVA transformers shall be suitable for terminating up to 7No single core 630mm² PVC cables and 4No single core 630mm² PVC cables for 100-315KVA transformers.
d) The LV neutral bushing of the transformer shall be identical to the corresponding LV phase terminal bushings and bushing conductor (copper bar).

4.9.2.3 HV (11kV) cable boxes

a) The HV cable box (11kV) shall be suitable for three core cables up to 185mm² in size.
b) The HV cable box shall have the following additional features:
   i. It shall be suitable for heat/cold terminations.
   ii. The bushing shall be made of porcelain material.
   iii. The bushing rod (conductor) shall be high conductivity copper alloy hot dip tinned and at least 12mm diameter.
   iv. The termination shall be suitable for cable sockets (lugs) and three core copper/aluminium XLPE insulated SWA armoured cables.

4.9.3 The 33kV bushings shall be open type and shall have outdoor two part bushing with bottom portion made with toughened epoxy insulator and top portion made with porcelain material, brown colour, glazed weather proof bushings. Each bushing shall be complete with clamp bolted type connector suitable for ACSR conductor sizes from 7.8mm to 18.2mm diameter. The 33kV bushings shall be mounted on the tank top cover.

4.9.4 Air Clearance (applicable to all ratings of ground mounted distribution transformers)

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

4.9.4.2 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.

4.9.4.3 Minimum external air clearances (with terminal clamps fitted) shall be as shown in Table 5 for HV.

Table 5: External Clearances in Air

Nominal System Voltage between Phase centres		11kV	33kV
Minimum clearance phase-to-earth and phase-to-neutral	mm	200	400
Minimum clearance phase-to-phase between phases of the same winding	mm	200	400
Minimum Creepage distance	mm	300	900

Note: *As per clause 16.1 of IEC 60076-3:2013, the clearances in air specified by the standard are only applicable when clearances in air are not specified by the purchaser. In addition, the standard does not consider the risk from intrusion of birds and other animals.*

4.9.4.4 Distance between centres of low voltage bushings shall be as follows:

a) For currents up to 250A: 80mm
b) For currents above 250A and up to 2000A: 175mm
c) For currents above 2000A: 190mm

4.10 Insulation Levels

The complete transformer arranged for service, shall be capable of withstanding the voltages indicated in Table 6 and shall comply fully with the requirements of IEC 60076 Part 3.

Table 6: Insulation Levels

Nominal system voltage **(kV, rms)**	Highest system voltage **(kV, rms)**	Internal Insulation	
		Lightning Impulse withstand voltage, positive **(kV, peak)**	Power frequency withstand voltage **(kV, rms)**
0.42	1.1kV	-	5
11	12	75	28
33	36	170	70

Note: 1) The insulation levels specified are for the internal insulation as per IEC 60076
2) Altitude correction applied on the external clearances and bushings selection to attain required external insulation as per IEC 60076-3.

3) Surge arresters shall be fitted by KPLC on the HV bushings for overvoltage protection of the transformer.

4.11. Transformer Tank and Tank Cover

4.11.1 The tank shall be bolted top cover type 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 & 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.

4.11.3. The main tank body shall be pressure tested and a certificate issued/signed by an ISO/IEC 17025 Accredited Laboratory ascertaining the soundness of all welded joints. A copy of the certificate shall be submitted with the transformers during delivery to KPLC stores.

4.11.4 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).

4.11.5 Steel radiators (corrugations) 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.

4.11.6 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 at least Qty 4 non-standard bolts of dome shaped head with non-standard profile and that cannot be opened by use of standard Allen-screws, pipe wrenches, spanners etc. to deter un-authorized opening. The required key/tool for opening the special bolts shall be provided to KPLC during delivery.

4.11.7 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 25mmx1.2mm and shall be secured by stainless steel bolt & nut.

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. The manufacturer shall demonstrate this for inside of radiators and pipe connections.

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:
   i. Hermetically sealed transformers shall be equipped with a pressure relief device preset such that when a pressure exceeding design pressure occurs inside the transformer, the pressure relief device opens to evacuate the pressure.
   ii. The pressure relief device shall be mounted on top cover and its design shall prevent rain water entering into the transformer. It shall not protrude

higher than the height of the transformer bushings above the top cover (for 33kV transformer).

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 oil level gauge shall have maximum and minimum oil level markings which shall fall within range of the gauge. The nominal oil level shall be at the centre of the range. The oil level gauge shall be mounted on the side of the transformer for sealed type transformer and on the side of the conservator for the free breathing type transformer.

c) Two earthing terminals (with cable lug) on the body of the transformer at the bottom diagonally opposite each other. Each terminal shall have two flat washers, one spring washer and lock nut, all in stainless steel. The earthing terminal lugs shall be in tinned copper and shall be suitable for $50mm^2$ conductor.

d) Separate lifting lugs for core, top cover and complete transformer (as per requirements given in this specification).

e) Off-circuit tap changer; mounted as per this specification. The tap changer shall be rotary type, shall not allow water ingress or oil leakage and have mechanical interlock at each tap corresponding to each tap position. It shall have provision for padlock as per this specification.

f) Tinned copper jumper of 25x1.2mm fixed between tank and top cover with stainless steel bolt.

g) Rating and diagram plate (as per IEC 60076 and this specification)

h) Clamp connectors (as per requirements given in this specification).

i) Thermometer pocket to be used during temperature rise test.

j) Jacking lugs

k) Combined drain plug and sampling device.

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. There shall be no oil leaks from the fittings and accessories.

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

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

4.14.2 The transformer shall be supplied filled with new oil.

4.14.3 The oil shall be new, unused and shall comply with all the requirements of IEC 60296 (class 1: un-inhibited oil) and as per current KPLC Specification No. KP1/3CB/08/001.

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 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 9001:2008.

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.

4.15.3 The bidder shall indicate the delivery time of each type of transformer, manufacturer's monthly & annual production capacity and experience in the production of the type and size of transformer being offered. A detailed list & contact addresses (including e-mail) of the manufacturer's previous customers outside the country of manufacture for exact or similar rating of transformers sold in the last five years together with four customer reference letters 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 Type Test Certificates & Type Test Reports issued by a third party testing laboratory that is accredited to ISO/IEC 17025 shall be submitted with the tender for the purpose of technical evaluation. A copy of the accreditation certificate to ISO/IEC 17025 for the testing laboratory shall also be submitted. Any translations of certificates and test reports into English language shall be signed and stamped by the Testing Laboratory that carried out the tests.

Copies of type test certificates and type test reports for the transformer offered to be submitted for tender evaluation shall include:

- Dielectric tests to IEC 60076 (Lightning Impulse Withstand Voltage Test).
- 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 identical or higher KVA rating and within the range of 11/0.420kV – 36/0.420kV AND 500KVA- 2500KVA shall be accepted as representative for any of the pole mounted three phase distribution transformer on tender. The type test reports shall be for a transformer of the same core design and construction as the transformer being offered.

Note: Temperature rise test to IEC 60076 if conducted at the manufacturer's premises (factory) shall be in the presence of representatives of ISO/IEC 17025 accredited third party testing laboratory; who shall sign and stamp the certificates and test reports.

5.3 The transformer shall be subject to acceptance tests at the manufacturer's works before dispatch. Acceptance tests shall be witnessed by two Engineers appointed by 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
- Any other test not listed above but specified by the latest edition of IEC 60076.

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 on samples 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

5.3.4 Sampling for routine tests and additional tests shall be as per IEC 60410.

5.4 The manufacturer shall provide current e-mail address, fax and telephone numbers and contact person at the Testing Laboratory where the type tests were obtained.

5.5 Complete Test Reports for each transformer (including its individual components) shall be submitted to KPLC for approval before shipment.

5.6 On receipt of the transformers KPLC will inspect them before acceptance to stores and may perform or have performed any of the relevant tests (including verification of losses) in order to verify compliance with the specification. The supplier shall replace/rectify without charge to KPLC, transformers and components/fittings which upon examination, test or use fail to meet any 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 wooden base blocks and then covered with a polythene cover. The transformer with the wooden base blocks 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 & 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) and shall be legible and permanent.

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 and legibly as in 6.4.

7. DOCUMENTATION

7.1 The bidder shall submit its tender complete with technical documents required by Annex A (Guaranteed Technical Particulars) for tender evaluation. The documents to be submitted (all in English language) for tender evaluation shall include the following:

a) Guaranteed Technical Particulars fully filled and signed by the manufacturer;
b) Copies of the Manufacturer's catalogues, brochures, drawings and technical data;
c) Sales records for previous five years and reference letters from at least four of the customers;
d) Details of manufacturing capacity and the manufacturer's experience;
e) Copies of required type test certificates and 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) Manufacturer's warranty and guarantee;
h) Manufacturer's letter of authorization, copy of the manufacturer's ISO 9001:2008 certificate and other technical documents required in the tender.

7.2 The successful bidder (supplier) shall submit the following documents/details (from the manufacturer as per tender) to The Kenya Power & Lighting Company for approval before manufacture:

a) Guaranteed Technical Particulars fully filled and signed by the manufacturer;
b) Design drawings & construction details of the transformer including 3-D views and as per the requirements of clause 4.2.17;
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 9001:2008;
d) Test Program to be used after manufacture;
e) Marking details and method to be used in marking the transformer;
f) Manufacturer's undertaking to ensure adequacy of the design, adherence to applicable regulations, standards and specification, ensure good workmanship and good engineering practice in the manufacture of the transformers for The Kenya Power and Lighting Company Limited;
g) Packaging details (including packaging materials and marking and identification of component packages).

ANNEX A: SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS FOR OFFERED TRANSFORMER

(to be filled and signed by the Manufacturer and submitted together with relevant copies of the Manufacturer's catalogues, brochures, drawings, technical data & calculations, sales records for past five years, four customer reference letters, details of manufacturing capacity, the manufacturer's experience, copies of complete type test reports and accreditation certificate to ISO/IEC 17025 for the third party testing laboratory for tender evaluation, all in English Language)

TENDER NO. .....BIDDER'S NAME & ADDRESS .....

Clause Number	Description *Indicate KVA & voltage ratings in columns on the right →*	BIDDER'S OFFER				
-	Name and address of the Manufacturer					
	Country of manufacture					
	Manufacturer's Letter of Authorization					
	Model/Type Reference No. of the offered transformer					
	Drawing Reference Number					
	Manufacturer's warranty and guarantee certificate for the offered transformer					
1.	Scope: a) Design, manufacture, test, ship and deliver ground mounted three phase distribution transformer to KPLC store/site as per specification and terms of contract. b) Ensure adequacy of the design, good workmanship, good engineering practice and adherence to standards, specifications and applicable regulations in the manufacture of the transformers for KPLC					
2	Applicable Standards					
3	Terms and Definitions					

Clause Number	Description *Indicate KVA & voltage ratings in columns on the right →*	BIDDER'S OFFER				
4.1.1	Operating Service Conditions: *indicate altitude, temperature range, humidity, pollution and isokeraunic level)*					
4.1.2.1 - 4.1.2.3	System Characteristics					
4.2	General Requirements	-	-	-	-	-
4.2.1	Outdoor, oil type, ONAN, core or shell type					
4.2.2	Design Service Life					
4.2.3	Two winding, three phase integral unit					
4.2.4	Types of transformers offered					
4.2.4.1	Hermetically sealed type each with bolted top cover and 100 mm gas cushion of dry air.					
4.2.4.2	Free breathing type, conservator with cobalt free dehydrating breather & oil gauge					
4.2.5	Design to facilitate operation, inspection, maintenance & repairs					
4.2.6	Safety & Regulatory Requirements					
4.2.7	All materials shall be new and of best quality and class					
4.2.8	Corresponding parts to be interchangeable					
4.2.9	Fittings & accessories secured from inside or have openings that do not allow oil siphoning					
4.2.10	No water pockets, rain water do not collect on top, cover with 10mm overlap to conceal gasket					
4.2.11	All connections & contacts of ample section and					

Clause Number	Description *Indicate KVA & voltage ratings in columns on the right →*		BIDDER'S OFFER				
	surface for required currents						
4.2.12	Designed to minimize short circuits by birds & vermin						
4.2.13	Materials used do not lead to acidity in oil						
4.2.14	State value of maximum noise level (BS EN 50464-1)						
4.2.15	Suitable for ground with mounting, steel channel underbase						
4.2.16	Drawings of offered transformer						
	Overall dimensions of offered transformer (length, width & height) in mm						
4.2.17a) to g)	Design drawings for approval before manufacture						
4.3.1	KVA, no-load voltage ratings and frequency						
4.3.2 (a)	Temperature Rise	Top Oil					
		Windings					
4.3.2 (b)	Temperature Rise Test						
4.3.3	Fault level for 2 seconds						
4.3.4	Demonstration of thermal ability of offered transformer design to withstand short circuit (submit detailed calculation in accordance with clause 4.1.2 and 4.1.5 of IEC 60076-5)						
	Value of symmetrical short-circuit current I as per clause 4.1.2 of IEC 60076-5						
	Duration of the symmetrical short-circuit current as per clause 4.1.3 of IEC 60076-5						
	Maximum permissible						

Clause Number	Description *Indicate KVA & voltage ratings in columns on the right →*	BIDDER'S OFFER				
	values of the average temperature of each winding after short circuit as per clause 4.1.4 of IEC 60076-5					
	Short circuit current density (A/mm^2) HV winding					
	Short circuit current density (A/mm^2) LV winding					
	Average temperature θ_1 attained by each winding after short circuit (calculation of temperature as per clause 4.1.5 of IEC 60076-5)					
	Overload capacity for 2 hours after continuous full load run (indicate clause & standard)					
4.3.5	Type test report for the ability of the offered transformer to withstand dynamic effects of short circuit					
4.4	Windings and connections	-	-	-	-	-
4.4.1	Vector group					
4.4.2	Voltage variations					
4.4.3	Insulating material shall not soften, ooze, shrink or collapse during service. The material shall be non-catalytic & chemically inert in transformer oil					
4.4.4	Primary windings					
	Secondary windings					
	Temperature class of insulation					
4.4.5	Separation of windings for cooling and ease of repair					
	Insulation sleeves					

Clause Number	Description *Indicate KVA & voltage ratings in columns on the right →*		BIDDER'S OFFER				
	Interlayer insulation						
4.4.6	Windings & connections braced?						
4.4.7	Drying in vacuum & impregnating with hot oil						
4.4.8	Material of spacer blocks						
4.4.9	All joints to be brazed/ crimped						
4.4.10	Active parts submerged in oil by at least 80mm from minimum oil level mark						
4.4.11	Stage inspection by Kenya Power						
4.4.12	Current density, A/mm^2	HV winding					
		LV winding					
	Material of winding	HV winding					
		LV winding					
	Conductor area of winding mm^2	HV winding					
		LV winding					
	Resistance at 20^0C	HV winding					
		LV winding					
4.5	Tapping		-	-	-	-	-
4..5.1	Tapping range						
4.5.2	Tapping method and design (4.5.2.1 to 4.5.2.5)						
	Padlock facility						
4.6	Core and Flux Density		-	-	-	-	-
4.6.1	Grade of core steel						
	Thickness of each single lamination						
	Net core area, mm^2						
	Number of turns on LV, per phase						
	Stack factor/Building factor						
	Weight of core, kg						
	Specific loss in watts/kg (at 1.6T flux density)						

Clause Number	Description *Indicate KVA & voltage ratings in columns on the right →*		BIDDER'S OFFER				
4.6.2	Static discharges & local heating						
4.6.3	Assembled core free from distortion						
4.6.4	Cooling for core						
4.6.5	Movement of core during transportation or in service						
4.6.6	Core clamping						
4.6.7	Lifting lugs for core, winding and complete transformer. Factor of safety at least 2.						
4.6.8	Oil pockets & trapping of air						
4.6.9	Insulation withstand of core to bolts and core to frame						
4.6.10	Effect of primary voltage variations on flux density						
4.6.11	Maximum flux density						
	Lowest limit of flux density						
4.6.12	Allowable maximum flux density	1 min					
		5 s					
4.6.13	Flux density at which core saturates						
4.6.14	Magnetization curve and design calculations						
4.7	Short-circuit Impendence, %						
	Resistance at 75°C of HV Winding in ohms (at normal & extreme taps)						
	Resistance at 75°C of LV Winding in ohms						
4.8.1	Minimum efficiency at 100% load (unity power factor), at 75°C						
4.8.2	Total losses (no-load + load losses) at 100% load						
4.8.3	No-load Losses at 75°C						
	Load Losses at 50% load,						

Clause Number	Description *Indicate KVA & voltage ratings in columns on the right →*		BIDDER'S OFFER				
	75°C						
	Load Losses at 75% load, 75°C						
	Load Losses at 100% load, 75°C						
	I^2R component of load losses at 100% load, 75°C						
	Load Losses at 125% load, 75°C						
	Stray Losses at 50% load, 75% load, 100% load and 120% load, all at 75°C						
	No increase in no-load and load losses after award & during factory acceptance testing & during inspection/test before acceptance to stores						
4.9	Cable Boxes, Bushings and Clearances		-	-	-	-	-
4.9.1	Bushings	11/0.42kV					
		33/0.42kV					
4.9.2	Cable boxes						
4.9.2.1	Requirements applicable to both HV and LV cable boxes						
4.9.2.2	Requirements applicable to LV (0.42kV) cable boxes						
4.9.2.3	Requirements applicable to HV (11kV) cable boxes						
4.9.3	33kV Bushings						
4.9.4	Air clearances		-	-	-	-	-
4.9.4.1	Adequate to withstand impulse withstand test voltages						
4.9.4.2	Position of fittings & accessories not to interfere with external connection to bushing terminals						
4.9.4.3	Minimum external clearances & creepage		-	-	-	-	-

Clause Number	Description *Indicate KVA & voltage ratings in columns on the right →*		BIDDER'S OFFER				
	LV, mm (cable box)	Phase to phase					
		Phase to earth					
		Creepage distance					
	11kV, mm (cable box)	Phase to phase					
		Phase to earth					
		Creepage distance					
	33kV, mm (open)	Phase to phase					
		Phase to earth					
		Creepage distance					
4.10	Insulation Levels (internal)		-	-	-	-	-
	LV: Power frequency withstand voltage						
	11kV: Lightning impulse & power frequency withstand voltages						
	33kV: Lightning impulse & power frequency withstand voltages						
	External insulation level and altitude correction (indicate offered insulation and altitude correction applied)						
4.11	Transformer Tank & Tank Cover						
4.11.1	Bolted top cover design						
	Minimum thickness of top cover, bottom and sides of offered transformer respectively						
4.11.2	Inside clearance and painting						
4.11.3	Pressure test of tank and test report during delivery						

Clause Number	Description *Indicate KVA & voltage ratings in columns on the right →*	BIDDER'S OFFER				
4.11.4	Lifting lugs and factor of safety					
4.11.5	Steel radiators					
4.11.6	Top cover design, non-accumulation of rain water, gasket & non-standard bolts and nuts					
4.11.7	Removable jumper of 25mm x 1.2mm tinned copper & stainless steel bolt & nut					
4.12	Paint Work	-	-	-	-	-
4.12.1	Method of cleaning before painting					
4.12.2	Final colour of exterior surfaces and paint thickness					
4.12.3	Cleaning and painting of interior of tank and other oil filled chambers					
4.12.4	Degreasing & treatment of radiators with anti-rust inhibitor					
4.12.5	Final colour of exterior of radiators & paint thickness					
4.13	Fittings and Accessories	-	-	-	-	-
4.13 (a)	Pressure Relief Device & location					
	Pressure at which pressure relief device operates					
4.13 (b)	Oil Level Gauge & location					
4.13 (c)	Earthing Terminals: location & to have stainless steel bolt, nut & washer and tinned copper terminal lug for 50mm^2 conductor					
4.13 (d)	Separate Lifting lugs for core, top cover, conservator & complete transformer					
4.13 (e)	Off-circuit tap changer & location					

Clause Number	Description *Indicate KVA & voltage ratings in columns on the right →*	BIDDER'S OFFER				
	Padlock facility for tap changer					
4.13 (f)	Tinned copper jumper size and materials					
4.13 (g)	Rating and diagram plate					
4.13 (h)	Clamp connectors					
4.13 (i)	Thermometer pocket					
4.13 (j)	Jacking Lags					
4.13 (k)	Combined drain plug and sampling device					
	Features to deter oil vandalism					
4.14	Transformer Oil	-	-	-	-	-
4.14.1	ONAN					
4.14.2	Transformer to be supplied filled with new oil					
4.14.3	Class and standard of oil					
	Quantity of oil in liters					
4.15	Quality Management System	-	-	-	-	-
4.15.1	Quality Assurance Plan to be based on ISO 9001:2008					
4.15.2	Declaration of conformity to IEC 60076					
	Copy of ISO 9001:2008 certificate submitted					
	Monthly & annual production capacity					
	List of previous customers					
	Reference letters from at least four previous customers					
5.	Tests and Inspection	-	-	-	-	
5.1	Test Standard					
	Responsibility of testing transformer & manufacturer's capability to carry out specified tests					
5.2	Copies of type test reports	-	-	-	-	-

Clause Number	Description *Indicate KVA & voltage ratings in columns on the right →*	BIDDER'S OFFER				
	to IEC 60076					
	Lightning impulse withstand test					
	Short circuit withstand test					
	Temperature rise test *Note: Temperature rise test to IEC 60076 if conducted at the manufacturer's premises shall be in the presence of representatives of ISO/IEC 17025 accredited third party testing laboratory; who shall sign and stamp the certificates and test reports*					
5.3	Acceptance tests at manufacturers premises	-	-	-	-	-
5.3.1	Routine tests to IEC 60076					
5.3.2	Type tests to IEC 60076					
	Temperature rise test					
	Lightning impulse withstand test					
5.3.3	Additional tests (sample test)					
	Sampling					
5.4	Contact details for testing authority					
5.5	Complete test reports for approval before shipment					
5.6	Inspection or test by KPLC during delivery before acceptance to stores					
6.	Marking, Labeling & Packing	-	-	-	-	-
6.1	Packing: mounted & bolted on wooden base blocks					
6.2	Dispatch fully assembled & oil filled					
6.3	Assemble & package of items suitably marked					
6.4	Permanent Rating & Diagram plate indelibly marked (by etching,					

Clause Number	Description *Indicate KVA & voltage ratings in columns on the right →*	BIDDER'S OFFER				
	engraving or stamping)					
6.5	Content of marking					
Other details required with the tender	Weight of complete transformer, kg					
	Weight of tank, kg					
	Material of tank					
	Weight of oil, kg					
	Weight of core, kg					
	Weight of windings (without insulation), kg					
	Weight of insulation, kg					
	Manufacturer's experience					
	Detailed list of all the required fittings and accessories indicating type/model number, manufacturer and quantities					
	List catalogues, brochures and technical data submitted to support offer					
	Deviations from tender specifications (indicate supporting documents submitted)					

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Manufacturer's Name, Signature, Stamp and Date