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Kenya Power

GROUNDING TRANSFORMER - SPECIFICATION

A Document of the Kenya Power & Lighting Co. Ltd
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TABLE OF CONTENTS

0.1 CIRCULATION LIST

COPY NO.	COPY HOLDER
1	Snr Engineer, E/plant Nairobi
2	Chief Engineer, E/Plant Nairobi

0.2 AMENDMENT RECORD

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

This specification has been prepared by the E/plant Nairobi of The Kenya Power and Lighting Company Limited (KPLC) and it lays down requirements for Grounding Transformer

Grounding transformer is intended for use by the E/plant to replace faulty transformers in Dandora, Rabai and Kamburu Substations.

This specification was prepared to ensure the adaptability of grounding transformers to the existing operating and climatic conditions in the three Substations in question.

There are no other specifications in this series.

This specification stipulates the minimum requirements for Grounding Transformers acceptable for use in the company and it shall be the responsibility of the suppliers and manufacturer to ensure that the offered design is of the highest quality and guarantees excellent service to KPLC, good workmanship and good engineering practice in the manufacture of the Transformers for KPLC.

Users of Kenya Power specifications are responsible for their correct interpretation and application.

1. SCOPE

1.1. This specification is for Grounding Transformer for use by company's E/plant department.

1.2. The specification covers requirements, design, tests and inspection and schedule of Guaranteed Technical Particulars of Grounding Transformer.

2. NORMATIVE REFERENCES

The following standards contain provision which, through reference in this text, constitute provisions of this specification. For dated editions the cited edition will apply; for undated editions the latest edition of the referenced document shall apply.

IEC International standard 60076: Power Transformers.

IEC 60137: Bushing for alternating voltage above 1000V.

IEC 60156: Methods for determination of Electric strength of insulating oils.

IEC 60296: Specification for unused insulating oils for transformers and switchgears.

IEC 60076-7: Loading guide for oil immersed power transformers.

IEC 60076-8: Terminal and tapping marking for power transformers.

IEEE 32: Requirements, terminology and test, procedure for neutral grounding devices.

3. DEFINITIONS AND ABBREVIATIONS

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

3.1. ABBREVIATIONS

KPLC- Kenya Power and Lighting Company Limited

ISO – International Organization for Standardization.

IEC- International electrotechnical commission

Kg –Kilogram

KV - Kilovolt

LV – Low Voltage

EN – European Standard

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: Up to 2200 meters above sea level.

(b) Temperature: Average of +30°C with minimum of -1°C and Maximum of +40°C.

(c) Humidity: Up to 95%.

(d) Pollution: Design pollution level to be taken as Very Heavy (Pollution level IV) 31mm/kV according to IEC 60815.

(e) Isokeraunic level: 180 thunderstorm days per year.

4.1.2 System characteristics.

(a) The transformer shall be connected to the tertiary winding of 220/132/11kV auto transformer with vector group YNa0d1.

(b) The primary system of the grounding transformer shall be 11kV while the secondary shall be 420V.

(c) The transformer shall be able to continuously carry the core magnetising current plus unbalanced current in the neutral in addition to normal station auxiliary loads.

4.2 General requirements.

4.2.1 The transformer shall be outdoor, Oil immersed, of ONAN cooling classification and core type (lamination stacking).

4.2.2 The transformer shall have two separate windings as interconnected star (zig-zag) on the high voltage side (11kV) and star with neutral on the low voltage side (420V). The HV side shall be directly connected to the main transformer tertiary bushings. The neutral point of the Zig Zag winding shall be grounded through a resistor of 63.5Ω. The resistor element grade shall be stainless steel rigidly supported at each end to allow for expansion due to heating. The resistor shall be mounted in corrosion resistant support frames using stainless steel hardware. The entire resistor frame shall be mounted on insulators rated for the system voltage. The resistor shall be housed in an enclosure whose frames are made from structural steel angles made from heavy gauge steel welded together. Top of the enclosure shall be solid, slightly overhung and slopped. Durable nameplate permanently attached to one side cover shall be provided.

4.2.3 The transformer shall mechanically withstand solid line to ground faults on the low voltage terminal, with fault contributions from the high voltage only.

4.2.4 The transformer and accessories shall be designed and constructed to withstand sufficiently the forces due to shipping, erection and maintenance.

4.2.5 The transformer oil shall be of mineral type without PCB, in accordance to IEC 60296 uninhibitent antioxidant type and with naphthenic base.

4.2.6 The transformer shall be designed and assembled in such a manner that the average sound level will not exceed from the specified value.

4.2.7 The winding of the transformer shall be made from copper and assembled in a manner best suited for the particular application, proper considerations shall be given to all factors of service such as high dielectric and mechanical strength of insulation,

minimum dielectric losses, uniform electrostatic flux distribution and minimum restriction to free circulation of oil.

4.2.8 The entire design, construction and treatment of the winding and their assembly on the core shall embody the latest improvements in the art and conform to the best modern practice.

4.2.9 Coils shall be made up, shaped and braced to provide for expansion and contraction due to temperature changes in order to avoid abrasion of insulation and to provide rigidity to resist movement and distortion caused by abnormal operation conditions.

4.2.10 The zig zag winding of transformer, when at its maximum temperature due to continuous full load on the star low voltage winding, shall be designed to carry for 10 seconds without injurious heating the estimated ground fault current.

4.2.11 The low voltage (star connected) winding shall have specified continuous rating.

4.2.12 The core of the transformer shall be constructed from the highest quality, non aging, cold rolled grain oriented silicon steel especially suitable for the purpose. The steel shall be in thin laminations and rolled to ensure smooth surfaces at the edges. Both sides of each sheet shall have insulated surface treatment or coating providing the required interlamination resistance.

4.2.13 The cores shall be carefully assembled and rigidly clamped to ensure adequate mechanical strength to support the windings and to prevent shifting of the laminations in fault condition and during shipment. All steel sections used for supporting the core shall be shot or sand blasted. Insulated pockets of the core are to be connected so that no potential difference will exist between them.

4.2.14 The transformer shall be equipped with a manually operated tap changer for changing

connections to the taps in the high voltage windings. Taps will be changed only when transformer is de-energised. Tap changer control shall be located above oil level and shall be accessible through the tank cover. An external operating handle, position Indicator and provision for locking in any operating position shall be provided. There shall be a total of 5 tap positions with tap 3 as the nominal tap. The tap range shall be ±2×2.5%.

4.2.15 All outdoor apparatus including bushings insulators with their mountings shall be designed so as to avoid pockets in which water can collect.

4.2.16 All external surfaces shall receive at least four coats of paint. The total dry film thickness shall be between 100 and 130 microns. The final coat shall be high gloss of shade No.632 (Admiralty Grey) according to BS 381C.

4.2.17 All apparatus shall be designed to minimize the risk or accidental short circuit caused by animals, birds or vermin.

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

4.2.19 The transformer shall have winding temperature gauge with alarm and trip contacts as well as oil temperature gauge with alarm and trip contacts.

4.2.20 The magnetic oil gauge with oil level low alarm contact wired and bucholz relay with alarm and trip contacts wired to MK. This applies to transformers with conservator

4.3 Losses, Regulation and Impedance.

4.3.1 Losses of the transformer shall be stated and shall be subject to tolerances in accordance with IEC 60076.The fixed losses shall be as low as is consistent with good design, reliability and economical use of materials.

4.3.2 Voltage regulation from no load to continuous rated output at unity power factor, at 0.8 lagging and 0.8 leading power factors with constant voltage across the higher voltage windings shall be stated.

4.3 3 Impedance voltage at nominal tapping shall be stated and shall be subject to tolerances in accordance with IEC 60076.

4.4 Terminals: Arrangement and Bushing.

4.4.1 The 11kV and 420V windings shall be brought out separately through open bushings of out door, weatherproof design.

4.4.2 The 11kV and 420V bushings shall be solid porcelain type. Each bushing insulator shall be free from defects and shall marked indelibly with manufacturers name or identification mark and year of manufacture.

4.4.3 The neutral bushing shall be identical to the corresponding phase terminal bushings.

4.4.4 The spacing and air clearances shall be so coordinated as to render the probability of flashover from the terminal of one winding to the terminal of another winding negligible.

4.4.5 The bushing creepage distance shall be 31mm/kV.

4.4.6 The terminal arrangement on the HV and LV sides shall be N, A, B, C and n, a, b, c Respectively.

4.5 Current Transformers.

The HV winding (Zig Zag) shall be equipped with inbuilt current transformers

with secondary terminals brought out for connection to the protection relays. The current Transformer shall have the following properties.

	Core	Primary Current	Secondary current	Ratio	Class	ALF	VA
HV Neutral CTs	Core1	25A	1A	25/1	5P	20	15
	Core2	500A	1A	500/1	5P	20	15
	Core 3 WTI	As per design	As per design	-	-	-	-
HV Phase CTs	Core 1	25A	1A	25/1	5P	20	15
	Core 2	500A	1A	500/1	5P	20	15

4.6 Air Clearances.

4.6.1 When totally assembled, as in service, electrical clearances in air shall be adequate to withstand the assigned impulse and power frequency withstand voltages.

4.6.2 Minimum external air clearances shall be as shown under.

	Units	11kV	420V
Phase to earth and Phase Neutral minimum clearance	mm	300	25
Phase to Phase minimum clearance of same winding	mm	300	25
Line terminal of HV and Line terminal of LV	mm	300	25
Live terminal to oil pipe works including conservator and pressure relief device	mm	300	25

4.7 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.

Nominal system voltage (kV, rms)	Highest system voltage (kV, rms)	Lightning Impulse Voltage (kV, Peak)	Power Frequency Withstand voltage (kV,rms)
11	12	95	38
0.42			5

4.8 Technical specification

Secondary winding Power Rating (Continuous rating of auxiliary winding)	315KVA
Number of phases	3 Phases
Voltage Rating	11kV
Continuous Neutral current rating	100A/30S
Frequency	50HZ
Zero sequence Impedance/phase@75°C	35.3Ω
Winding Temperature Rise	65°C
Oil Temperature rise	55°C
Cooling	ONAN
Power Frequency Voltage	38kV
Lightning impulse voltage	95kV
Vector Group	ZNyn11
Neutral Grounding Resistor	63.5Ω
Rated voltage of NER	6350V
Rated current of NER	100A
Insulation Voltage of NER	95kV
Installation Location of NER	Out door
Current duration NER	30S
Temperature rise of NER	750°C
Flux density	1.6T
Impedance of auxiliary winding	4%
Maximum Current Density (A/mm2)	43.2

5. TESTS AND INSPECTION REQUIREMENTS

5.1. The Grounding transformer shall be inspected and tested in accordance with the requirements of this specification and standard IEC 60076 and IEC 60289. 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. The following tests shall be carried out.

5.1.1 Type tests.

Dielectric tests.

Temperature rise test.

5.1.2 Routine Tests.

Measurement of winding resistance.

Measurement of zero sequence impedance.

Measurement of no load and current.

Dielectric Tests.

Sampling and test of insulating oil.

Measurement of voltage ratio and check of voltage vector relationship.

Measurement of impedance voltage and load loss.

Tap changer tests.

Measurement of sound levels.

5.2. Copies of previous Test Reports issued by own or a third party testing laboratory that is accredited to ISO/IEC 17025:2005 or 17025:2017 confirming compliance of the grounding transformer offered shall be submitted with the offer for evaluation (all in English Language). A copy of the **accreditation certificate** and the **scope of accreditation** of the testing laboratory shall also be submitted. Any translations of certificates or test reports into English language shall be signed and stamped by the Testing Authority that carried out tests.

6. PACKING

6.1. PACKING

6.1.1. The transformer and associated components shall be packed in a manner as to protect it from any damage in transportation and handling. It shall be despatched oil filled. Auxiliary equipment and accessories /fittings shall be protected against mechanical damage and oil vandalism.

6.1.2. The transformer shall be provided with a rating plate of weather proof 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.

6.1.3. Each assembly and package of items associated with the transformer shall be suitably marked for ease of identification.

APPENDICIES

A: TESTS AND INSPECTION (Normative)

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

A.2 On receipt of the Transformer Kenya Power will inspect them and may perform or have performed any of the relevant tests in order to verify compliance with the specification. The supplier shall replace without charge to Kenya Power, any Transformer which upon examination, test or use fail to meet any or all of the requirements in the specification.

B: QUALITY MANAGEMENT SYSTEM (Normative)

B.1 The bidder shall indicate the delivery time of the equipment

C: DOCUMENTATION AND DEMONSTRATION (Normative)

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

a) Fully filled clause by clause guaranteed technical particulars (GTP) signed by the manufacturer;

b) Copies of the Manufacturer's catalogues, brochures, drawings giving all relevant dimensions, and technical data;

c) Bidder's warranty and guarantee; subject to 12 months from date of delivery to KPLC stores

d) Assembly manual.

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

a) Fully filled clause by clause guaranteed technical particulars (GTP) stamped and signed by the manufacturer;

b) Design Drawings with details of the Grounding transformer to be supplied to KPLC.

c) Product manuals, operation manuals and brochures,

d) All documentation necessary for safety of the product.

e) Packaging details (including packaging materials).

C.3. The supplier shall submit recommendations for use, care, storage and routine inspection/testing procedures, all in the English Language, during delivery of the diverter switch to KPLC stores.

Issued by: 1st AE , E/plant Nairobi North	Authorized by: Senior Engineer, E-Plant Nairobi
Signed:	Signed:
Date: 2025-02-24	Date: 2025-02-24

D: GUARANTEED TECHNICAL PARTICULARS (Normative)

To be filled and signed by the Bidder and submitted together with relevant copies of the Manufacturer's catalogues, brochures, drawings, technical data, for tender evaluation, all in English Language)

Tender No. ……

Bidder's name and Address……

Clause number	Requirement	Bidder's offer	
Manufacturer's Name		Specify	
Country of Manufacture		Specify	
Name and model Number		Specify	
1.	Scope	State	
4.	Requirements		
4.1	General Requirement	State	
4.1.1	Operating condition	specify	
4.1.2	System characteristics	specify	
4.2.3	Ground fault mechanical withstand		
4.2.4	Withstand of forces due to shipping, erection and maintenance	state	
4.2.5	Type of insulating oil	state	
4.2.6	Transformer sound level	state	
4.2.7	Winding material	state	
4.2.8	Winding design and construction	state	
4.2.9	Provision of coil expansion due to temperature changes.	state	
4.2.10	Transformer heating tolerance when fully loaded and carrying rated fault current	state	
4.2.11	Low voltage continuous rating	state	
4.2.12	Core material	state	
4.2.13	Core assembly	state	
4.2.14	Tap changer type and number of taps	state	

Clause number	Requirement	Bidder's offer	
4.2.15	Design to avoid pockets of water	state	
4.2.16	Paint works and colour code	state	
4.2.17	Design to mitigate against short circuit by birds and animals	specify	
4.2.18	Tap changer operation with tap voltage deviating by 10% from rated voltage	specify	
4.2.19	Winding and oil temperature monitoring	Specify	
4.2.20	Oil level monitoring	Specify	
4.3	Losses, Regulation and Impedance		
4.3.1	Total losses	State	
4.3.2	Voltage regulations	State	
4.3.3	Impedance voltage	State	
4.4	Terminal arrangements and Bushings		
4.4.1	Connection of HV and LV windings	State	
4.4.2	Type of HV and LV Bushing	State	
4.4.3	Type of neutral bushings	State	
4.4.4	Spacing and air clearances	State	
4.4.5	Creepage distance		
4.4.6	Terminal arrangements on HV and LV windings	State	
4.5	Current Transformer parameters	Specify	
4.6	Air Clearance		
4.6.1	Electrical clearance in air		
4.6.2	Minimum external clearances for 11kV and 0.42kV		
4.7	BIL 11kV	State	
	BIL 0.42kV	State	
4.8	Technical specification		
	Secondary winding Power Rating	specify	
	Number of phases	specify	
	Voltage Rating	specify	
	Short time Current Rating	specify	
	Continuous Neutral current rating	specify	
	Frequency	specify	
	Zero sequence Impedance/phase@75°C	specify	

Clause number	Requirement	Bidder's offer	
	Winding Temperature Rise	specify	
	Oil Temperature rise	specify	
	Cooling	specify	
	Power Frequency Voltage	specify	
	Lightning impulse voltage	specify	
	Vector Group	specify	
	Neutral Grounding Resistor	specify	
	Rated voltage of NER	specify	
	Rated current of NER	specify	
	Insulation Voltage of NER	specify	
	Installation Location of NER	specify	
	Current duration NER	specify	
	HV winding current	specify	
	LV winding current	specify	
	Flux density	specify	
	Voltage of Zig Winding	specify	
	Voltage of Zag Winding	specify	
	Estimated kVA from continuous neutral current	specify	
	Short time kVA of the transformer	specify	
	Equivalent kVA	specify	
	Number of turns in LV	specify	
	Maximum permissible current density	specify	
	Minimum conductor area	specify	
	Temperature rise of NER	specify	
5.0	Tests and inspection		
5.1	Test standard and responsibility	Specify	
5.1.1	Type tests	State	
5.1.2	Routine tests	State	
5.2	Copies of previous test reports and accreditation certificate of test lab	Attach	
6	Packing		
6.1	Packing	Specify	
A	TESTS AND INSPECTION		
A.1	Responsibility to test	State compliance	

Clause number	Requirement	Bidder's offer	
A.2	Replacement if it fails to meet any or all of the requirements in the specification.	specify	
B	Quality Management System		
B.1	Delivery time of the product	state	
C	Documentation and demonstration		
C.1	Documents submitted with tender	State	
C.2	Documents to be submitted by supplier to KPLC for approval before supply	State	
C.3	Documents to be submitted during delivery at the store	State	
	Statement of compliance to specification (indicate deviations if any & supporting documents)	State compliance	

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Bidder's Name, Signature, Stamp and Date