APPENDIX I

Kenya Power

SPECIFICATION FOR ONLINE MONITORING SYSTEM FOR POWER TRANSFORMER

A Document of the Kenya Power & Lighting Co. Ltd
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0.1 CIRCULATION LIST

COPY NO.	COPY HOLDER
1	E/Plant
2	

0.2 AMENDMENT RECORD

Rev No.	Date (YYYY-MM-DD)	Description of Change	Prepared by (Name & Signature)	Approved by (Name & Signature)
0	2026-02-11	New issue	George Welimo	

FOREWORD

This specification has been prepared by the Electrical Plant of The Kenya Power and Lighting Company Limited (KPLC) and it lays down requirements for Online Monitoring system for Power Transformer

The Online Monitoring system for Power Transformer is intended for use by the Electrical Plant for monitoring power transformers in whole.

This specification was prepared to establish and promote uniform requirements for Online Monitoring system for Power Transformer to be used at Kenya Power and Lighting Company Ltd.

There are no other specifications in this series.

This specification stipulates the minimum requirements for Online Monitoring system for Power Transformer 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 Online Monitoring system for Power Transformer for KPLC.

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

1. SCOPE

1.1. This specification is for Online Monitoring system for Power Transformer for use by company's Electrical Plant.

1.2. The specification covers requirements, design, inspection and tests and schedule of Guaranteed Technical Particulars of Online Monitoring system for Power 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 61557: Electrical safety in low voltage distribution systems up to 1 000 V a.c. and 1 500 V d.c - Equipment for testing, measuring or monitoring of protective measures - Part 1: General requirements;

IEC 60815: Selection and dimensioning of high voltage insulators intended for use in polluted conditions –Part 1: Definitions, information and general principles

OIML D 11: General Requirements for Measuring Instruments - Environmental Conditions

IEC 61000: Electromagnetic Compatibility (EMC) – Part 4-2: Testing and measurement techniques – Electrostatic discharge immunity test; – Part 6-2: Generic standards – Immunity for Industrial environment.

IEC 60529: Degrees of protection provided by enclosures (IP code)

ISO 9001: Quality Management systems – Requirements

ISO/IEC 17025: General Requirements for the competence of testing and calibration laboratories

IEC 61010 - Safety requirements for electrical equipment for measurement, control, and laboratory use. During a test, software will perform safety checks before applying full test voltage.

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.

LED –Light Emitting Diode

Kg –Kilogram

KV - Kilovolt

IP – Ingress Protection

LV – Low Voltage

EMC – Electromagnetic Compatibility

EU – European Union

AC-Alternating Current

DC-Direct Current

IEC-International Electrotechnical Committee

4. REQUIREMENTS

4.1. SERVICE CONDITIONS

4.1.1 The Online Monitoring system for Power Transformer shall be suitable for use outdoors in tropical areas and harsh climatic conditions including areas exposed to:

a) Altitudes of up to 2000m above sea level;

b) Humidity of up to 95%;

c) Average ambient temperature of +30°C with a minimum of -1°C and a maximum of +40°C

d) Pollution: Degree 2

4.2. DESIGN AND CONSTRUCTION

4.2.1. All control and instrumentation cables shall be screened and armored. All power cables shall be steel armored

4.2.2. All components of the transformer (active part, bushings, cooling system) shall be monitored by one single fan-less Intelligent Electronic Device (IED), so that correlations can be built between the information coming from various components in order to build consistent, comprehensive diagnostics

4.2.3. The monitoring modules for data acquisition shall be installed at the transformer.

4.2.4. The Online Monitoring system for Power Transformer shall support the operation and maintenance of a transformer with regard to at least following aspects:

4.2.4.1. With use of sensors, sophisticated modeling and diagnostic functions it should help to detect incipient faults at an early stage, in order to avoid a catastrophic outage of the transformer

4.2.4.2. It shall provide tools which enable the user to operate a transformer close to its thermal limits, with taking into account thermal aging and avoiding critical hot spot temperature. It shall support advanced management of possible overload conditions. Unit can continuously measure other critical parameters such as oil temperatures, load current, water content in oil, and cooling status which are

complementary to the DGA information. It further incorporates on-board calculations based on the very latest IEC®/IEEE® thermal and moisture models standards and computed from the specific transformer characteristics obtained from the name-plate and test reports of the transformer

4.2.4.3. It shall enable the user to perform condition-based maintenance of the transformer.

4.2.4.4. It shall enable the user to have an overview at a glance about the transformer by clear visualization of transformer condition by traffic lights within software user interface and with LEDs on control cubical in the field.

4.2.5. The Online Monitoring system for Power Transformer shall include Online Monitoring of the following parameters for Power Transformer:

(a) 3 Gas DGA measuring Hydrogen (H_2), Carbon Monoxide (CO) and Acetylene (C_2H_2) plus moisture

(b) Partial Discharge of the Transformer

(c) Tan Delta & capacitance of the Bushings

(d) Ambient temperature

(e) Top oil temperature

(f) Bottom oil temperature

(g) Transformer winding moisture tracking

(h) Radiator Bank Temperature monitoring

4.2.6. All equipment provided by the manufacturer shall be new, free from defects

4.2.7. The Online Monitoring system for Power Transformer shall combine in a single system and measure the following:

4.2.7.1. Partial Discharge (PD) in the transformer main tank and bushings;

4.2.7.2. Relative variations of capacitance and power factor of each bushing;

4.2.7.3. Three Gas contents(Hydrogen (H_2), Carbon Monoxide (CO) and Acetylene) in the insulating oils in the transformer main tank using photo- acoustic spectroscopy or NIR

technology. The equipment shall measure each gas individually and give results in ppm. Moisture should also be measured in ppm.

4.2.8. The monitoring system shall be housed in a single IP56 acquisition box, wall or stand mounted, to be placed near the transformer.

4.2.9. The Online Monitoring system for Power Transformer shall:

(a) Include data storage (>1 year)

(b) web-server and integrated modem

(c) be GPS free and no active electronics placed on the top of transformer

(d) be connected to SCADA or DCS using known protocols such as Modbus, DNP3 or IEC61850

(e) support RS232, RS485, Fiber optic, 3G, Ethernet carriers

(f) include 3 x LED Indicators (Power, Service, Alarm) and Alarm relay contacts

4.3. It shall have the following technical particulars

4.3.1. **Dissolved Gas Analysis**

4.3.1.1. Be capable of correlating 3 fault gases, moisture-in-oil, oil temperature, and ambient temperature to the transformer load

4.3.1.2. Gas Analyzing shall be on the Photo Acoustic Spectroscopy (PAS) or NIR (Near Infra-Red) Spectro-photometry or any other competing technology without the need of any consumables.

4.3.1.3. Be required to have a separate oil inlet pipe and separate oil return pipe to ensure quality of oil sampling.

4.3.1.4. Have an embedded web-server to allow remote access using any smart device (such as smart phone or tablet) based on the user providing access via Ethernet or SIM.

4.3.1.5. Not require download and install of any third party software for communication with the online DGA monitor.

4.3.1.6. Have an on board 7 inch color touchscreen HMI to allow review of data, graphs and the password protected control of settings.

4.3.1.7. Supply access to Instructions on how to take a manual oil sample accessible via the touch screen HMI

4.3.1.8. The user interface shall provide the following Dissolved Gas Analysis via its 7" on board HMI:

a) DGA Graph Trending
b) DGA Instantaneous Values
c) DGA Scheduling
d) DGA Online Monitor Alarm Management
e) Cross Data Trending
f) Data Export to User device

4.3.2. **Bushing Monitoring**

4.3.2.1. Bushing monitoring shall be by direct measurement of bushing capacitance and Tan Delta by Schering bridge principle.

4.3.2.2. It shall be connected at the bushings Test Tap, through properly designed adaptors, including protections in order to disallow the Test Tap pin to remain floating, even with the signal cable disconnected from the adaptors.

4.3.2.3. Provide hourly summary, indicating:

a) Transformer Status (ON/OFF)
b) Current Polar Plot (through web app)
c) Relative (%) and Referenced (pf) Capacitance, Relative (%) and Referenced (%) Power Factor
d) Top oil, Bottom oil, Tap Changer and Environmental Temperatures, plus Humidity. Data shall be provided through additional sensors added to the system

4.3.3. **Partial Discharge Monitoring**

4.3.3.1. Each partial discharge monitoring system shall be based on UHF technique and immune from noise from electrical connections at bushings, line corona etc.

4.3.3.2. PD monitoring should be done by providing 2 nos. of UHF sensors of drain valve type suitable for PD frequency range of 100MHz to 1500MHz with fully shielded sensor and extra port for functionality check and calibration signal.

4.3.3.3. PD monitoring module shall be based on wide band signal processing technique and should be immune from noise by using transformer tank as faraday cage.

4.3.3.4. The PD monitoring system should be provided with PD monitoring software for trending PD activity and generating advance warning.

4.3.4. **Central Server**

4.3.4.1. Shall display the list of all monitored devices

4.3.4.2. Shall display the status of all monitored devices (connected, not connected, alarm active)

4.3.4.3. Allow direct connection to the monitored device

4.3.4.4. Periodically retrieve the data from each monitoring device

4.3.4.5. Display the Condition Group of each monitoring device (good, normal, defective, faulty, failure)

4.3.4.6. Upgrade each device when a new software release is available

4.3.4.7. Notify alarms through email

4.3.4.8. Provide secure connection with proper user credentials and user roles

4.3.5. **Software**

4.3.5.1. The operating software used in the monitoring server shall be the multitasking and real- time operating system

4.3.5.2. The software of the monitoring IED must include and not limiting to the following:

(a) The expert system provides the user with recommendations and information to optimize the operation and maintenance of the

transformer/reactor by means of algorithms for analyzing the on-line acquired variables which are implemented in the software.

(b) Dissolved gas analysis and diagnostic tool according to MSS, Doernenburg, Rogers, extended Rogers, IEC 60599, Duval and Key Gas.

(c) Report generator, which automatically creates protocols with status information about the transformer and its main component.

(d) Each monitoring unit to come with two laptops for report generation and analysis and module shall be equipped with ethernet/USB port and communication cable to facilitate communication to a laptop.

Laptop features.

Description	Mandatory minimum requirement
Operating system	Windows 11Enterprise 64 bits
Processor family	11th Generation Intel(R) core (TM) i7 3GH Processor
Display	15-Inch
Memory	16GB DDR4 SDRAM (Onboard)
Hard drive	954 GB PCIe NVMe M.2 SSD
Ports	2×USB-A 3.2 Gen1,1×USB-C 3.2 Gen 2, 1 headphone/microphone combo, HDMI 2.1 Port, microSD card reader. Ethernet port RJ45
Connectivity	Wi-Fi 5 or 6, Blue tooth R 5.2 combo.
Primary battery	4-cell,53Wh Li ion polymer
Camera	720p HD with webcam privacy shutter.

4.4. It shall have the technical particulars as shown in table 1 below:

Table 1: Technical particulars of Online Monitoring system for Power Transformer

Parameter	Requirement	
Input Power	Mains power supply	90 - 250 VAC, 47 - 63 Hz, 300W max
Dissolved Gas Analysis	H_2	5 - 5,000 PPM
	C_2H_2	0.1 – 50,000 PPM
	CO	1 – 50,000 PPM
	H_20 (RS)	1 - 100% RS
	Accuracy	± 5% or ± LDL (whichever is greater)
Bushing Monitoring	Input channels	2 sets of 3 phases, simultaneous acquisition on all channels
	Simultaneous channels	3 (up to 6)
	Sensors	Bushing Tap Adaptors
	Input measuring range	0 - 200mA
	Accuracy	Amplitude: 0.1%, Relative Phase Angle: 0.05°
	Resolution	12 bit
	Sampling rate	>10 kS/s
	Power system frequency	50 - 60Hz, ± 0.01 Hz
Communication Options	Protocols	Modbus, DNP3 & IEC61850
	Carriers	RS232, RS485, Ethernet, Fiber, 3G
	HMI	7" High Resolution Colour LCD
DATA- Partial Discharge and Bushing	Acquisition mode	Continuous
	Trending	Hourly, daily, weekly, monthly
	Storage	> 1 year
Alarms	High-vis LED's	Red, Amber, Green
	Alarm relay contact	4 x NO or NC, user configurable

Parameter	Requirement	
I/O	Analog inputs	3 x PT100, 3 x 4 - 20 mA, 1 x Load CT
	Digital inputs	5 x 24V isolated

4.5. DOCUMENTATION AND SUPPORT

4.5.1. Warranty and training

4.5.1.1. The Online Monitoring system for Power Transformer shall be backed by a minimum of 12-months factory warranty.

4.5.1.2. Technical support and software upgrade, where applicable shall be provided free of charge to KENYA POWER for a period of not less than 36 months.

4.5.1.3. The Bidder shall submit a clause by clause statement of compliance with the specifications together with copies of the manufacturer's catalogues, brochures, technical data and proven test reports clearly marked to support each clause, all in English for evaluation. The manufacturer's type reference/designation of the item offered shall be indicated

5. TESTS REQUIREMENTS

5.1. The Online Monitoring system for Power Transformer shall be inspected and tested in accordance with standards 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.

6. MARKING AND PACKING

6.1. MARKING

The following information shall be marked legibly and in a permanent manner on the Online Monitoring system for Power Transformer:

a) The manufacturer's name or trade mark;

b) The type reference number / model number;

c) The serial number;

d) Letters "PROPERTY OF KENYA POWER"

e) The instructions for handling and use (in the English Language).

6.2. PACKING

6.2.1. The Online Monitoring system for Power Transformer shall be packed in a carrying case so as to protect it from damage and entry of moisture during transportation, handling and storage.

6.2.2. The carrying case shall shock proof and impact resistant and shall be able to withstand a fall of one meter without damage to Online Monitoring system for Power Transformer.

APPENDICIES

A: TESTS AND INSPECTION (Normative)

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

A.2 On receipt of the Online Monitoring system for Power 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 Online

Monitoring system for Power 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 supplier shall submit a quality assurance plan (QAP) that will be used to ensure that the Online Monitoring system for Power Transformer physical properties, tests 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: 2015.

B.2 The Manufacturer's Declaration of Conformity to applicable standards and copies of quality management certifications including copy of valid and relevant ISO 9001:2015 certificate shall be submitted with the tender for evaluation.

B.3 The bidder shall provide a detailed list & contact addresses (including e-mail) of the manufacturer's previous customers for similar type of the Online Monitoring system for Power Transformer sold in the last five years as well as reference letters from at least four of the customers shall be submitted with the tender for evaluation.

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, Wiring diagram / Schematic Diagram and technical data;

c) Sales records for the last five years and at least four customer reference letters;

d) Details of manufacturing capacity and the manufacturer's experience;

e) Manufacturers letter of authorization, ISO 9001:2015 certificate, and other technical documents required in the tender.

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

g) Operational manual.

h) Service manual.

C.2 The supplier shall submit recommendations for use, care, storage and routine inspection/testing procedures, all in the English Language, during delivery of Online Monitoring system for Power Transformer

D: GUARANTEED TECHNICAL PARTICULARS (Normative)

To be filled and signed by the Manufacturer and submitted together with relevant copies of the Manufacturer's catalogues, brochures, drawings, technical data, sales records for previous five years, four customer reference letters, details of suppliers' capacity and experience; and copies of complete type test certificates and test reports for tender evaluation, all in English Language)

Tender No. .....

Bidder's name and Address.....

Clause number	Requirement	Bidder's offer
Manufacturer's Name and address		State
Country of Manufacture		State
Name and model Number		State
1.	Scope	State
2.	Normative References	State
3.	Definitions and Abbreviations	State
3.1.	Abbreviations	State
4.1.	SERVICE CONDITIONS	
4.1.1	The Online Monitoring system for Power Transformer shall be suitable for use outdoors in tropical areas and harsh climatic conditions including areas exposed to:	
a)	Altitudes above sea level;	State
b)	Humidity ;	State
c)	Average ambient temperature	state
d)	Pollution:	state

Clause number	Requirement	Bidder's offer
4.2.	DESIGN AND CONSTRUCTION	
4.2.1.	Screening and armoring of All control , instrumentation and power cables	State
4.2.2.	All components of the transformer (active part, bushings, cooling system) monitored by one single fan-less Intelligent Electronic Device (IED),	State
4.2.3.	Monitoring modules for data acquisition installed at the transformer	State
4.2.4.	support the operation and maintenance of a transformer with regard to	
4.2.4.1	Use sensors, modeling and diagnostic functions to detect incipient faults at an early stage	State
4.2.4.2	provide tools which enable the user to operate a transformer close to its thermal limits, with taking into account thermal aging and avoiding critical hot spot temperature.	State
4.2.4.3.	Enable the user to perform condition-based maintenance of the transformer.	State
4.2.4.4.	Enable the user to have an overview at a glance about the transformer by clear visualization of transformer condition by traffic lights within software user interface and with LEDs on control cubical in the field.	State
4.2.5.	The Online Monitoring system for Power Transformer include Online Monitoring of the following parameters for Power Transformer:	
(a)	3 Gas DGA measuring Hydrogen (H2), Carbon Monoxide (CO) and Acetylene (C2H2) plus moisture	State
(b)	Partial Discharge of the Transformer	State
(c)	Tan Delta & capacitance of the Bushings	State
(d)	Ambient temperature	State
(e)	Top oil temperature	State
(f)	Bottom oil temperature	State
(g)	Transformer winding moisture tracking	State
(h)	Radiator Bank Temperature monitoring	State
4.2.6.	All equipment provided by the manufacturer shall be new, free from defects	State

Clause number	Requirement	Bidder's offer
4.2.7	The Online Monitoring system for Power Transformer Combine in a single system and measure the following:	
4.2.7.1.	Partial Discharge (PD) in the transformer main tank and bushings	State
4.2.7.2.	Relative variations of capacitance and power factor of each bushing	State
4.2.7.3.	Three Gas contents(Hydrogen (H2), Carbon Monoxide (CO) and Acetylene(C2H2) in the insulating oils in the transformer main tank using photo- acoustic spectroscopy or NIR technology. The equipment shall measure each gas individually and give results in ppm. Moisture should also be measured in ppm.	State
4.2.8	The monitoring system is housed in a single IP56 acquisition box, wall or stand mounted, to be placed near the transformer.	State
4.2.9	The Online Monitoring system for Power Transformer shall:	
(a)	Include data storage (>1 year)	State
(b)	web-server and integrated modem	State
(c)	be GPS free and no active electronics placed on the top of transformer	State
(d)	be connected to SCADA or DCS using known protocols such as Modbus, DNP3 or IEC61850	State
(e)	support RS232, RS485, Fiber optic, 3G, Ethernet carriers	State
(f)	include 3 x LED Indicators (Power, Service, Alarm) and Alarm relay contacts	State
4.3.	It shall have the following technical particulars	
4.3.1.	Dissolved Gas Analysis	
4.3.1.1.	Be capable of correlating 3 fault gases, moisture-in-oil, oil temperature, and ambient temperature to the transformer load	State
4.3.1.2.	Gas Analyzing shall be on the Photo Acoustic Spectroscopy (PAS) or NIR (Near Infra-Red) Spectro-photometry or any other competing technology without the need of any consumables.	State
4.3.1.3.	Be required to have a separate oil inlet pipe and separate oil return pipe to ensure quality of oil sampling.	State
4.3.1.4.	Have an embedded web-server to allow remote access using any smart device (such as smart phone or tablet) based on the user providing access via Ethernet or SIM.	State
4.3.1.5.	Not require download and install of any third party software for communication with the online DGA monitor.	State

Clause number	Requirement	Bidder's offer
4.3.1.6.	Have an on board 7 inch color touchscreen HMI to allow review of data, graphs and the password protected control of settings.	State
4.3.1.7.	Supply access to Instructions on how to take a manual oil sample accessible via the touch screen HMI	State
4.3.1.8.	The user interface to provide the following Dissolved Gas Analysis via its 7" on board HMI	
(a)	DGA Graph Trending	State
(b)	DGA Instantaneous Values	State
(c)	DGA Scheduling	State
(d)	DGA Online Monitor Alarm Management	State
(e)	Cross Data Trending	State
(f)	Data Export to User device	State
4.3.2.	Bushing Monitoring	
4.3.2.1.	Bushing monitoring by direct measurement of bushing capacitance and Tan Delta by Schering bridge principle.	State
4.3.2.2.	Connected at the bushings Test Tap, through properly designed adaptors, including protections in order to disallow the Test Tap pin to remain floating, even with the signal cable disconnected from the adaptors.	State
4.3.2.3.	Provide hourly summary, indicating:	
(a)	Transformer Status (ON/OFF)	State
(b)	Current Polar Plot (through web app)	State
(c)	Relative (%) and Referenced (pf) Capacitance, Relative (%) and Referenced (%) Power Factor	State
(d)	Top oil, Bottom oil, Tap Changer and Environmental Temperatures, plus Humidity. Data shall be provided through additional sensors added to the system	State
4.3.3.	Partial Discharge Monitoring	
4.3.3.1.	Each partial discharge monitoring system is based on UHF technique and immune from noise from electrical connections at bushings, line corona etc.	State
4.3.3.2.	PD monitoring done by providing 2 nos. of UHF sensors of drain valve type suitable for PD frequency range of 100MHz to 1500MHz with fully shielded sensor and extra port for functionality check and calibration signal.	State

Clause number	Requirement			Bidder's offer
4.3.3.3.	PD monitoring module is based on wide band signal processing technique and should be immune from noise by using transformer tank as faraday cage.			State
4.3.3.4.	The PD monitoring system is provided with PD monitoring software for trending PD activity and generating advance warning.			State
4.3.4.	Central Server			
4.3.4.1.	Shall display the list of all monitored devices			State
4.3.4.2.	Shall display the status of all monitored devices (connected, not connected, alarm active)			State
4.3.4.3.	Allow direct connection to the monitored device			State
4.3.4.4.	Periodically retrieve the data from each monitoring device			State
4.3.4.5.	Display the Condition Group of each monitoring device (good, normal, defective, faulty, failure)			State
4.3.4.6.	Upgrade each device when a new software release is available			State
4.3.4.7.	Notify alarms through email			State
4.3.4.8.	Provide secure connection with proper user credentials and user roles			State
4.3.5.	Software			
4.3.5.1.	The operating software used in the monitoring server shall be the multitasking and real- time operating system			State
4.3.5.2.	The software of the monitoring IED must include and not limiting to the following:			
(a)	The expert system provides the user with recommendations and information to optimize the operation and maintenance of the transformer/reactor by means of algorithms for analyzing the on-line acquired variables which are implemented in the software.			State
(b)	Dissolved gas analysis and diagnostic tool according to MSS, Doernenburg, Rogers, extended Rogers, IEC 60599, Duval and Key Gas.			State
(c)	Report generator, which automatically creates protocols with status information about the transformer and its main component			State
(d)	Laptop properties and communication cable			State
4.4	It shall have the technical particulars as shown in table 1 below:			
	Parameter	**Requirement**		
	Input Power	Mains power supply	90 - 250 VAC, 47 - 63 Hz, 300W max	Specify

Clause number	Requirement			Bidder's offer
	Dissolved Gas Analysis	H_2	5 - 5,000 PPM	Specify
		C_2H_2	0.1 – 50,000 PPM	Specify
		CO	1 – 50,000 PPM	Specify
		H_20 (RS)	1 - 100% RS	Specify
		Accuracy	± 5% or ± LDL (whichever is greater)	Specify
	Bushing Monitoring	Input channels	2 sets of 3 phases, simultaneous acquisition on all channels	Specify
		Simultaneous channels	3 (up to 6)	Specify
		Sensors	Bushing Tap Adaptors	Specify
		Input measuring range	0 - 200mA	Specify
		Accuracy	Amplitude: 0.1%, Relative Phase Angle: 0.05°	Specify
		Resolution	12 bit	Specify
		Sampling rate	>10 kS/s	Specify
		Power system frequency	50 - 60Hz, ± 0.01 Hz	Specify
	Communication Options	Protocols	Modbus, DNP3 & IEC61850	Specify
		Carriers	RS232, RS485, Ethernet, Fiber, 3G	Specify
		HMI	7" High Resolution Colour LCD	Specify
	DATA- Partial Discharge and Bushing	Acquisition mode	Continuous	Specify
		Trending	Hourly, daily, weekly, monthly	Specify
		Storage	> 1 year	Specify
	Alarms	High-vis LED's	Red, Amber, Green	Specify

Clause number	Requirement			Bidder's offer
		Alarm relay contact	4 x NO or NC, user configurable	Specify
	I/O	Analog inputs	3 x PT100, 3 x 4 - 20 mA, 1 x Load CT	Specify
		Digital inputs	5 x 24V isolated	Specify
4.4.1.	**Warranty and training**			
4.4.1.1.	The Online Monitoring system for Power Transformer shall be backed by a minimum of 12-months factory warranty.			submit
4.4.1.2.	Technical support and software upgrade, where applicable shall be provided free of charge to KENYA POWER for a period of not less than 36 months.			State
4.4.1.3.	The Bidder shall submit a clause by clause statement of compliance with the specifications together with copies of the manufacturer's catalogues, brochures, technical data and proven test reports clearly marked to support each clause, all in English for evaluation. The manufacturer's type reference/designation of the item offered shall be indicated			state
5	**TESTS REQUIREMENTS**			
5.1.	The Online Monitoring system for Power Transformer shall be inspected and tested in accordance with standards 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.			State
6	**MARKING AND PACKING**			
6.1.	**MARKING**			
a)	The manufacturer's name or trade mark;			State
b)	The type reference number / model number;			State
g)	The serial number;			State
h)	Letters "PROPERTY OF KENYA POWER"			State
i)	The instructions for handling and use (in the English Language).			State
6.2.	**PACKING**			
6.2.1.	The Online Monitoring system for Power Transformer should be packed in a carrying case so as to protect it from damage and entry of moisture during transportation, handling and storage.			State

Clause number	Requirement	Bidder's offer
6.2.2.	The carrying case shall shock proof and impact resistant and shall be able to withstand a fall of one meter without damage to the Online Monitoring system for Power Transformer .	State
	APPENDICIES	
A:	**TESTS AND INSPECTION (Normative)**	
A.1	It shall be the responsibility of the supplier to test or to have all the relevant tests performed.	confirm
A.2	On receipt of the Online Monitoring system for Power 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 Online Monitoring system for Power Transformer which upon examination, test or use fail to meet any or all of the requirements in the specification.	State
B:	**QUALITY MANAGEMENT SYSTEM (Normative)**	
B.1	The supplier shall submit a quality assurance plan (QAP) that will be used to ensure that the Online Monitoring system for Power Transformer physical properties, tests 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: 2015.	submit
B.2	The Manufacturer's Declaration of Conformity to applicable standards and copies of quality management certifications including copy of valid and relevant ISO 9001:2015 certificate shall be submitted with the tender for evaluation.	submit
B.3	The bidder shall indicate the delivery time of the equipment, manufacturer's monthly & annual production capacity and experience in the production of the Online Monitoring system for Power Transformer being offered. A detailed list & contact addresses (including e-mail) of the manufacturer's previous customers for similar type of the Online Monitoring system for Power Transformer sold in the last five years as well as reference letters from at least four of the customers shall be submitted with the tender for evaluation.	State
C:	**DOCUMENTATION AND DEMONSTRATION (Normative)**	

Clause number	Requirement	Bidder's offer
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;	submit
b)	Copies of the Manufacturer's catalogues, brochures, drawings giving all relevant dimensions, Wiring diagram / Schematic Diagram and technical data;	submit
c)	Sales records for the last five years and at least four customer reference letters;	submit
d)	Details of manufacturing capacity and the manufacturer's experience;	submit
e)	Manufacturers letter of authorization, ISO 9001:2015 certificate, and other technical documents required in the tender.	submit
f)	Manufacturer's warranty and guarantee; subject to 12 months from date of delivery to KPLC stores	submit
g)	Operational manual.	submit
h)	Service manual.	submit
C.2.	The supplier shall submit recommendations for use, care, storage and routine inspection/testing procedures, all in the English Language, during delivery of the Online Monitoring system for Power Transformer	State

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Manufacturer's Name, Signature, Stamp and Date

APPENDIX II

Kenya Power

SPECIFICATION FOR CONDITION CONTROLLED MAINTENANCE FREE TYPE BREATHER FOR POWER TRANSFORMER

A Document of the Kenya Power & Lighting Co. Ltd
February 2026

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0.1 CIRCULATION LIST

COPY NO.	COPY HOLDER
1	E/Plant
2	

0.2 AMENDMENT RECORD

Rev No.	Date (YYYY-MM-DD)	Description of Change	Prepared by (Name & Signature)	Approved by (Name & Signature)
0	2026-02-11	New issue	George Welimo	

FOREWORD

This specification has been prepared by the Electrical Plant of The Kenya Power and Lighting Company Limited (KPLC) and it lays down requirements for Condition Controlled Maintenance Free Type Breather for Power Transformer

The Condition Controlled Maintenance Free Type Breather for Power Transformer is intended for use by the Electrical Plant in power transformers.

This specification was prepared to establish and promote uniform requirements for Condition Controlled Maintenance Free Type Breather for Power Transformer to be used at Kenya Power and Lighting Company Ltd.

There are no other specifications in this series.

This specification stipulates the minimum requirements for Condition Controlled Maintenance Free Type Breather for Power Transformer 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 Condition Controlled Maintenance Free Type Breather for Power Transformer for KPLC.

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

1. SCOPE

1.1. This specification is for Condition Controlled Maintenance Free Type Breather for Power Transformer for use by company's Electrical Plant.

1.2. The specification covers requirements, design, inspection and tests and schedule of Guaranteed Technical Particulars of Condition Controlled Maintenance Free Type Breather for Power 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 61557: Electrical safety in low voltage distribution systems up to 1 000 V a.c. and 1 500 V d.c - Equipment for testing, measuring or monitoring of protective measures - Part 1: General requirements;

IEC 60815: Selection and dimensioning of high voltage insulators intended for use in polluted conditions –Part 1: Definitions, information and general principles

OIML D 11: General Requirements for Measuring Instruments - Environmental Conditions

IEC 61000: Electromagnetic Compatibility (EMC) – Part 4-2: Testing and measurement techniques – Electrostatic discharge immunity test; – Part 6-2: Generic standards – Immunity for Industrial environment.

IEC 60529: Degrees of protection provided by enclosures (IP code)

ISO 9001: Quality Management systems – Requirements

ISO/IEC 17025: General Requirements for the competence of testing and calibration laboratories

IEC 61010 - Safety requirements for electrical equipment for measurement, control, and laboratory use. During a test, software will perform safety checks before applying full test voltage.

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.

LED –Light Emitting Diode

Kg –Kilogram

KV - Kilovolt

IP – Ingress Protection

LV – Low Voltage

EMC – Electromagnetic Compatibility

EU – European Union

AC-Alternating Current

DC-Direct Current

IEC-

4. REQUIREMENTS

4.1. SERVICE CONDITIONS

4.1.1 The Condition Controlled Maintenance Free Type Breather for Power Transformer shall be suitable for use outdoors in tropical areas and harsh climatic conditions including areas exposed to:

a) Altitudes of up to 2000m above sea level;

b) Humidity of up to 95%;

c) Average ambient temperature of +30°C with a minimum of -1°C and a maximum of +40°C

d) Pollution: Degree 2

4.2. DESIGN AND CONSTRUCTION

4.2.1. The main Transformer tank and Onload Tap Changer conservators shall be fitted with a Maintenance-Free type silica gel Breathers which shall be equipped with a humidity sensor, a condition based microprocessor control unit and LED status indication.

4.2.2. The desiccant is dehydrated by the built-in heating unit which is controlled by sensors, thus obviating the need for periodic desiccant replacement. The dehydrating breather is mounted on the pipe to the oil conservator at a height of 1200 mm approximately from transformer rail top level.

4.2.3. Material & External Construction of the Breather shall be such that all external parts are suitable for outdoor use & resistive to transformer oil, ultraviolet rays, pollution & salt water and shall work without any trouble for ambient temperature between 0° C to +80°C.

4.2.4. Following LEDs for local display on control unit, and suitable contacts & analog signal shall be provided for wiring to remote location:

a) LED for Power of control unit - ON

b) LED for Filter heater- ON

c) LED for Anti-condensation heater (of control unit) - ON

d) LED & relay contact for "Device Error"

e) LED & relay contact for Regeneration active (De-humidification in process)

f) Analogue output signal (4-20mA) for the Temperature of air (in filter unit / pipe).

4.2.5. The Breather shall be equipped with test button which should allow carry out a self-test and to check the functions like relay circuits, heating or the signal transmission in the control room, etc. at any time.

4.2.6. Control unit shall be equipped with a USB / RS 485 port for downloading the operational data logged by the unit.

4.2.7. All necessary software required for downloading and analyzing the logger data shall also be provided by the supplier.

4.2.8. The moisture and temperature measurement system (sensor) installed should be modular making it easy to replace the same if at all the same is necessary during the service of breather.

4.2.9. The equipment shall operate at input supply of 230V AC, 50 Hz. Any converter if required shall be supplied ,with the equipment.

4.2.10. Degree of Protection shall be at least IP55 for which type Test report shall be submitted.

4.2.11. Necessary protective devices shall be provided in order to protect the equipment against over voltages & high-frequency interference.

4.2.12. The control unit shall be equipped with suitable heater to prevent moisture condensation.

4.2.13. The size of Condition controlled maintenance free dehydrating breather shall be decided based on the volume of transformer oil during detailed engineering.

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, sales records for previous five years, four customer reference letters, details of suppliers' capacity and experience; and copies of complete type test certificates and test reports for tender evaluation, all in English Language)

Tender No. .....

Bidder's name and Address.....

Clause number	Requirement	Bidder's offer
Manufacturer's Name and address		State
Country of Manufacture		State
Name and model Number		State
1.	Scope	State
2.	Normative References	State
3.	Definitions and Abbreviations	State
3.1.	Abbreviations	State
4.1.	SERVICE CONDITIONS	
4.1.1	The Condition Controlled Maintenance Free Type Breather for Power Transformer shall be suitable for use outdoors in tropical areas and harsh climatic conditions including areas exposed to:	
a)	Altitudes above sea level;	State
b)	Humidity ;	State
c)	Average ambient temperature	state
d)	Pollution:	state

Clause number	Requirement	Bidder's offer
4.2.	DESIGN AND CONSTRUCTION	
4.2.1.	The main Transformer tank and Onload Tap Changer conservators shall be fitted with a Maintenance-Free type silica gel Breathers which shall be equipped with a humidity sensor, a condition based microprocessor control unit and LED status indication.	State
4.2.2.	The desiccant is dehydrated by the built-in heating unit which is controlled by sensors, thus obviating the need for periodic desiccant replacement. The dehydrating breather is mounted on the pipe to the oil conservator at a height of 1200 mm approximately from transformer rail top level.	State
4.2.3.	Material & External Construction of the Breather shall be such that all external parts are suitable for outdoor use & resistive to transformer oil, ultraviolet rays, pollution & salt water and shall work without any trouble for ambient temperature between 0° C to +80°C.	State
4.2.4.	Following LEDs for local display on control unit, and suitable contacts & analog signal shall be provided for wiring to remote location:	
a)	LED for Power of control unit - ON	State
b)	LED for Filter heater- ON	State
c)	LED for Anti-condensation heater (of control unit) - ON	State
d)	LED & relay contact for "Device Error"	State
e)	LED & relay contact for Regeneration active (De-humidification in process)	
f)	Analogue output signal (4-20mA) for the Temperature of air (in filter unit / pipe).	State
4.2.5.	The Breather shall be equipped with test button which should allow carry out a self-test and to check the functions like relay circuits, heating or the signal transmission in the control room, etc. at any time.	State
4.2.6.	Control unit shall be equipped with a USB / RS 485 port for downloading the operational data logged by the unit.	State

Clause number	Requirement	Bidder's offer
4.2.7.	All necessary software required for downloading and analyzing the logger data shall also be provided by the supplier.	State
4.2.8.	The moisture and temperature measurement system (sensor) installed should be modular making it easy to replace the same if at all the same is necessary during the service of breather.	State
4.2.9.	The equipment shall operate at input supply of 230V AC, 50 Hz. Any converter if required shall be supplied ,with the equipment.	State
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Bidder's Name, Signature, Stamp and Date