DOCUMENT NO: KP1/6C/4/1/TSP/11/049



SCADA EQUIPMENT AND ASSOCIATED ADAPTATION MATERIALS - SPECIFICATION

A Document of the Kenya Power & Lighting Co. Ltd

February 2022

TABLE OF CONTENTS

0.1 Circulation List 2
REVISION OF KPLC STANDARDS 2
0.2 Amendment Record 2
FOREWORD 3
1. SCOPE 4
2. NORMATIVE REFERENCES 4
3. DEFINITIONS AND ABBREVIATIONS 5
3.1. ABBREVIATIONS 5
4. REQUIREMENTS 5
4.1. SERVICE CONDITIONS 5
4.2. GENERAL REQUIREMENTS 6
APPENDIX A: TESTING & INSPECTION 14
APPENDIX B: QUALITY MANAGEMENT SYSTEM (NORMATIVE) 14
APPENDIX C: TECHNICAL DOCUMENTATION (NORMATIVE) 15
APPENDIX D: PACKING AND DELIVERY 16
D.1. PACKING 16
D.2. MARKING 16
APPENDIX E: Guaranteed Technical Particulars (GTPS) 18

0.1 Circulation List

COPY NO.	COPY HOLDER
1	Manager, Standards
Electronic copy (pdf) on Kenya Power server (http://172.16.1.40/dms/browse.php?fFolderId=23)	

REVISION OF KPLC STANDARDS

To keep abreast of progress in the industry, KPLC Standards shall be regularly reviewed. Suggestions for improvements to approved standards, addressed to the Manager, Standards department, are welcome.

© Kenya Power & Lighting Co. Ltd.

Users are reminded that by Section 25 of the Copyright Act, 2001 (Revised 2009) Cap 130 of the Laws of Kenya copyright subsists in all KPLC Standards and except as provided under Section 26 of this act, no KPLC Standard produced by KPLC may be reproduced, stored in retrieval system by any means without prior permission from the Managing Director & CEO, KPLC.

0.2 Amendment Record

Rev No.	Date (YYYY-MM-DD)	Description of Change	Prepared by (Name & Signature)	Approved by (Name & Signature)
Issue 1	2022-02-15	NEW ISSUE	F. Gicugu N. Kimnda	Eng. S. Kimitei

FOREWORD

This specification has been prepared by Connectivity & Turnkey projects department of Infrastructure Division in collaboration with Standards Department and lays down specification for design, manufacture and testing of SCADA equipment, and associated adaptation materials.

This specification is intended for procurement of materials and does not include provision of contract.

This specification stipulates the minimum requirements for SCADA equipment and adaptation materials acceptable for use in the company. The suppliers and manufacturers shall ensure adequacy of the design, good engineering practice, adherence to the specification and applicable standards and regulations as well as ensuring good workmanship in the manufacture of the equipment for The Kenya Power & Lighting Company.

The other specification(s) in this series is

KP1/13D/4/1/TSP/11/048: SCADA Requirements for Olkaria II substation additional Transformer

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

The following are members of the team that developed this specification.

Name	Department
Eng. Nicholas Kiminda	Turnkey/ID
Eng. Faith Gicugu	Standards

1. SCOPE

1.1. This specification is for SCADA Equipment and adaptation materials necessary for integrating a substation to KPLC SCADA.

1.2. This specification covers the following equipment: -

a) Remote Terminal Units (RTUs)
b) SDH Multiplexers
c) Transducers-Current, Resistance, Multi Transducers
d) Multiplication Relays
e) Interposing Relays
f) Multi-Function Meters (MFM)
g) DIN Rails

1.3. The specification also covers inspection and test of the equipment as well as schedule of Guaranteed Technical Particulars to be filled, signed by the supplier and submitted with the Bid for evaluation.

1.4. The specification stipulates the minimum requirements for RTUs, SDH Multiplexers, Transducers, Multiplication Relays, Multi-Function Meters, Interposing Relays and DIN Rails.

2. NORMATIVE REFERENCES

The following standards contain provisions, which, through reference in this text, constitute provisions of this specification. Unless otherwise stated, the latest edition of the referenced documents (including any amendments) applies.

IEC 60870-5:	SCADA –Telecontrol equipment and systems, Transmission protocols and Network access
IEC 60870:	Telecontrol equipment and System- Equipment compatibility with ISO and ITU-Equipment performance
IEC 60617:	Graphical symbols for use in electrotechnical diagrams
IEC 81346:	Installations and Equipment - Structuring Principals and reference designations
IEC 61850:	Communication Protocols for Intelligent Electronic Devices (IEDs) at an Electrical substation
IEC 60255-5:	Requirement and tests -Electrical Relays insulation coordination.
IEC 60688:2021	Transducers-Converting AC/DC values to Analog/Digital values

IEC 60255-22-4	Electrical fast transient/burst immunity test
IEC 60332-3	Electric and optical fibre cables under fire conditions
IEC 60793	Specifications for both multimode and single-mode optical fibres.
ITU-T G.655	Geometrical, mechanical, and transmission attributes of a single-mode optical fibre and cable
ANSI/EIA 359-A IEC 60304	Colours for colour Identification and coding
IEC 60793-1	Establishes uniform requirements for measuring the attenuation of optical fibre
ITU G.703, G.704, G.706, G.732	E1 interface compliance-Multiplexing Equipment characteristics

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:

3.1. ABBREVIATIONS

IEC – International Electro technical Commission

ISO – International Organization for Standardization

OSHA - Occupational Safety and Health Act

ASTM - American Society for Testing and Materials

CFM - Cubic feet per minute

ANSI - American National Standards Institute

ITU - International Telecommunication union

KPLC - Kenya Power and Lighting PLC

4. REQUIREMENTS

4.1. SERVICE CONDITIONS

4.1.1. Physical conditions

The equipment shall be tropicalized, designed and constructed for continuous indoor operation in areas with the following atmospheric conditions: -

Maximum ambient temperature:	+40° C
Minimum ambient temperature:	-1° C
Daily average ambient temperature:	+30° C
Relative Humidity (%):	95%
Altitude above sea level (meters):	2200 m
Isockeraunic level (days/year.):	180 thunderstorm days per year
Induced electromagnetic disturbance:	1.6 kV
Pollution class:	"Very Heavy" (Level IV), "Heavy" (Level III) as per IEC/TS 60815
Seismic Zone:	Zone V, as per IEEE 693

4.1.2. Safety and environmental requirements

4.1.2.1 The equipment shall be designed and manufactured in accordance with IEC 601010-1 and OIML D 11 safety and environmental standard requirements such that:

a) Their errors do not exceed the maximum permissible errors under rated operating conditions.
b) When they are exposed to disturbances, either:
   (i) Significant faults shall not occur, or
   (ii) Significant faults shall be detected and corrected by means of inbuilt checking facility.

4.1.2.2 Software controlled equipment that are complex in their functionality shall require that the user is guided for the correct use and for achieving correct measurement results.

4.1.2.3 The manufacturer shall specify the limiting conditions; storage and transport conditions for each specified influence quantity - quantity which is not the subject of the measurement and whose change affects the relationship between the indication and the result of the measurement.

4.1.2.4 Measuring equipment shall have a valid calibration status prior to being confirmed, within a specified metrological requirement.

4.2. GENERAL REQUIREMENTS

4.2.1 Panels, cubicles and marshalling racks shall generally be free standing and shall be constructed of folded sheet steel of adequate thickness to provide rigid support for the control and monitoring equipment which shall be mounted thereon

4.2.2 Panels shall be mounted on channel base frames, which shall provide a toe recess. Panels and cubicles designed for personnel access shall be provided with metal floors and shall be suitably ventilated. Doors shall be provided with a lock, which may be opened by a person within the panel without the use of a key. It shall be possible to open all panels associated with one unit by the use of one master key. Adequate lighting and power points for hand tools shall be provided.

4.2.3 The overall height of cubicles and racks housed in the relay room shall not exceed 2. 20m.The Panel shall be powder coated, pebble grey RAL-7035 Colour. Thickness of the coating shall be ≥80 microns.

4.2.4 Cable connections to panels and cubicles shall be equipped with suitable seals to prevent rodents and ingress. Cable plates shall be factory drilled, but blocked with removable stoppers, easily knocked off at site

4.2.5 Cubicles shall be provided with thermostatically controlled heating elements. Each thermostat shall have an adjustable set point, which can be adjusted to an appropriate value to achieve adequate heating of the panel in order.

4.2.1. Power supplies and fusing

4.2.2.1 Fuse ratings and time characteristics shall be such that in all cases a fault within an individual item or module will cause the fuse associated with that item, to rupture and thus disconnect that item from the power supply, before the main fuse is affected.

4.2.2.2 The design of the electrical power supplies and fusing system shall ensure that any faults in modules or other devices, which may block sequence logic interlocks, automatic control systems or other control systems are restricted to the system in which the fault has occurred.

4.2.2.3 Binary signal conditioning and analogue limit value modules should be fused separately, but may also be fused with the corresponding drive control of the drive control level as long as the signals are used only for remote and logic controls (interlocking, protection) of the drive concerned.

4.2.2. Indicators and Electronic Equipment

4.2.3.1 All indicators for mounted on control desks and panels shall for flush mounting. The minimum size for indicators shall be:

- non-urgent indicators 96 x 96 mm
- important indicators 144 x 144 mm
- mimic diagrams 48 x 48 mm.

4.2.3.2 Indicators for mounting on local gauge boards shall be of circular type and shall have a minimum case diameter of160 mm. All local indicators shall be housed in robust dust and moisture proof cases suitable for open-air installation.

4.2.3.3 The read-out window for indicators, recorders and similar equipment shall be non-reflecting, anti-static and minimize parallax errors.

4.2.3.4 Where possible, plug-in type printed circuit boards shall be used. External connections to the boards shall be by plug and socket connection. All electronic components, including integrated circuits, transistors, resistors, capacitors and inductors shall be selected in order to ensure long life and stable operation. Indication lamps used in conjunction with electronic circuits shall be light emitting diodes.

4.2.3.5 All relay equipment shall use modern plug-in type circuit boards, containing standard type miniature relays, which can be plugged- in and easily replaced on sockets on the circuit boards. Only a few types of standard relays shall be used. All relays shall be of the encapsulated type.

For time relays, transistorized relays shall be used. Time-setting shall be effected by means of setting knobs on the front panel.

4.2.3.6 Switches for mounting in the control panels shall be of the miniature or sub-miniature type. The function of the pushbutton shall be clearly shown. Discrepancy switches or pushbuttons shall be provided for the operation of switchgear and the initiation of drives. Discrepancies between the switch position and the plant state shall be indicated by an integral light, which shall illuminate the switch in a flashing mode of operation.

4.2.3.7 Indicating instruments having maximum and/or minimum contacts shall not be used for any main system. All surfaces used for electrical contacts shall be silver, gold or silver alloy.

4.2.3.8 The connection between low-voltage electronic control circuits and power circuits shall consist of interposing relays for linking the two systems. All relays have to be of the encapsulated type.

4.2.3. Remote Terminal Units (RTUs) Panel

4.2.4.1 The RTU shall have galvanic isolation of all signals from process to RTU through interposing relays.

4.2.4.2 The RTU shall accommodate process signals from Analogue and digital transducers

4.2.4.3 Based on the present and future functional requirements, the RTU shall include the following tele information plan for the SCADA in stations.

a) single command outputs, double command outputs
b) regulation command outputs e.g. raise/lower command outputs for transformer tap changer control
c) analogue set point transmission and output
d) single, double and multiple state digital inputs
e) analogue measured inputs
f) metering pulse inputs for acquisition of energy meter values
g) Sequential Event Recording (SER) with time stamping of events at the RTU
h) RTU time synchronization
i) Self-testing and diagnostic functions for detection and reporting of any error
j) automatic re-starting function
k) Database and parameter setting by menu-controlled dialogues from a local PC and remotely from the corresponding control centre with downloading function.
l) Support encryption and LAN/WAN access
m) Shall support IEC 61850 protocol for process communication

4.2.4.4 Each individual RTU to be supplied shall be fully equipped for the actual amount of data to be acquired and commands to be executed plus a spare capacity of 25% for each type of data. In addition, each RTU shall be expandable in the field by at least 50% of the size of the initial point capacity by addition of Input and Output cards only. The addition of enclosures, internal cabling/wiring, chassis, or power supplies shall not be necessary when adding these I/O cards.

4.2.4.5 The RTU shall be accessible through the communication network for the Supervisory Control & Data Acquisition (SCADA) System at the National Control Centre (NCC) and Regional Control Centres (RCC) to scan.

4.2.4.6 Plug-in type relays shall be used with sockets directly mounted on a DIN rail. All necessary arrangements must be made so that the plugging – in and out are easy and performed without any risk of damaging of relay parts.

4.2.4. RTU firmware requirements

4.2.4.1 The RTUs shall meet the following characteristics of the firmware to support the functions of the RTUs.

(i) The RTU shall have standard firmware.
(ii) All firmware shall be completely and consistently documented.
(iii) It shall not be necessary to perform modification to firmware, logic, or data for expansion within the sizing parameters defined for the RTU.
(iv) Firmware shall be loadable by service notebook locally at minimum, download of firmware and parameter sets trough SCADA system, using the data communication links.
(v) Changing of EPROMs or similar devices shall not be necessary when updating RTUs firmware.

4.2.5. Enclosures Requirements

4.2.5.1 Swing racks supported by heavy gauge hinges such that only front access to components and wiring is required for routine maintenance and troubleshooting.
4.2.5.2 Provisions for top and bottom cable entry. Cable entries shall be provided with protection against insect and animal entry, and sealed to prevent dust and sand contamination.
4.2.5.3 Protection class of the enclosures shall be for indoor cabinets IP52 minimum and for outdoor cabinets IP64 minimum.
4.2.5.4 The panel shall be powder coated with a minimum dimension 1800x740x640 (HXWXD)
4.2.5.5 Suitable signal and safety ground networks within the enclosure.
4.2.5.6 Convenience outlets at 230 V AC, shall be provided.
4.2.5.7 Power supply

a) Any hardware required to convert the 48 V battery voltage to the required internal voltages for the RTU hardware shall be provided and adequate.
b) The RTUs shall be capable of operating with ungrounded or grounded (either polarity) input power.

4.2.5.8 Dielectric strength shall be 2.5kV, 50 Hz-1 min between one circuit and the earthing point and between independent circuits. Impulse test voltage: >2.5 kV (IEC 60255-5).

4.2.6. Interposing Relays

The relays shall be installed in the switch / control gear and shall have the following characteristics:

4.2.6.1 For tele commands:

a) Coil voltage shall be 48 VDC; Coil voltage variation shall be ±20%.
b) Signal voltage on the contact circuit shall normally be 110 VDC
c) The rated contact current shall be minimum 5ADC making/breaking.

4.2.6.2 For tele indications:

a) Coil voltage shall normally be 110 VDC; (other voltages may also exist) coil voltage variation shall be ± 20%.
b) Signal voltage on the contact circuit shall be 48 VDC.
c) The rated contact current shall be minimum 3A DC making/breaking and 1A continuously

4.2.6.3 The interposing relays shall have two (2) normally open and two (2) normally closed contacts. Contact bounce shall be less than 8ms and contact age shall be 10 exp. 6 operations.

4.2.6.4 The relays shall be fitted with a visual operation indicator (either mechanical or LED).

4.2.7. Transducers

4.2.7.1 The digital programmable transducers shall measure electrical parameters including current, voltage, active power, reactive power, apparent power, frequency and power factor.

4.2.7.2 They shall have up to four programmable analogue outputs, two digital outputs and RS-485 Modbus functionality.

4.2.7.3 All the outputs shall be programmed via easy-to-use software compliant with IEC 60688 and have galvanically isolated outputs with the following characteristics in table 1.

Table 1: Characteristics of the digital programmable transducers

	Measurement:	**Minimum requirement**
	Accuracy	Class 0.2, Class 0.5
	Main frequency	45- 65 Hz
b.	**Voltage Circuit:**	
	Nominal measuring voltage (Un)	3×100-693 V (three-wire system) 3×57.7/100 V to 3×400/693 V (four-wire system)
c.	**Current Circuit:**	
	Nominal measuring currently (In)	1-5 A
d.	**Transducer Supply:**	
	Nominal voltage	40-120 DC
e.	**Communication Ports:**	
	Serial USB port Connector Com. protocol Baud rate Or **Serial RS485 port** Connector Com. Protocol Baud rate	 USB Mini-B connector Modbus RTU 38400 baud (auto) Three screw terminals for ≤ 6 mm2 Modbus RTU 1200 – 38400 baud
f.	**Digital outputs:**	
	Number of outputs	2
g.	**Analogue outputs:**	

	Number of outputs Type Max voltage (open output) Range/load (current output)	4 current/voltage bi-polar ±20V ±20mA, ±5mA, ±2mA

4.2.7.4 Transducers shall comply with the following requirements:

a) Accuracy of the measurements for MW, MVAr, voltages shall be better than 0.5% of full scale over a temperature of 0 to 50 °C
b) Maximum ripple shall not exceed 2% peak to peak.
c) Response time to 99% of final value shall not exceed 0.5 sec.

4.2.7.5 The analogue output of the transducer's inputs to the RTU shall be isolated, polar or bipolar, 2 – wire Load independent DC current of 0 to isolated, polar 10 mA, or ±10 mA or 4-20mA

4.2.7.6 Transducer burdens shall not exceed 2 VA per PT element and 2 VA per CT element. The contractor shall provide calculations of the additional burden imposed by the transducer and the associated wiring / cabling for each transducer installed under the project during the detailed design stage of the project.

4.2.7.7 Transducers shall be able to withstand a short period (1 second) overload to 50 A without damage and have a withstand voltage of 4 kV/50 Hz/ 1 min and 5 kV/1.2/50 µs, according to IEC 60255-4 C1. III

4.2.7.8 MW Transducer

The Transducer shall have the following features: -

i. DIN rail mounting
ii. Connection shall be 3-Phase, 4-Wire
iii. Inputs 110V AC and 1Amp
iv. Programmable output characteristic
v. Output shall be 0 - ±20 mA
vi. Auxiliary power supply shall be 110 V AC/DC
vii. Relay Terminals-shall be screw type terminals large enough to accommodate at least 4mm2 cable
viii. Screw type terminals
ix. Terminals indelibly marked

4.2.7.9 MVAr Transducer

The Transducer shall have the following features: -

i. DIN rail mounting
ii. Connection shall be 3-Phase, 4-Wire
iii. Inputs 110V AC and 1Amp
iv. Programmable output characteristic
v. Output shall be 0 - ±20 mA
vi. Auxiliary power supply shall be 110 V AC/DC
vii. Relay Terminals-shall be screw type terminals large enough to accommodate at least 4mm2 cable
viii. Screw type terminals

ix. Terminals indelibly marked

4.2.7.10 Current Transducer

The Transducer shall have the following features: -

i. Input 0- 1Amp
ii. Output 0 – 20 mA
iii. Auxiliary power supply shall be 110 V AC/DC
iv. Relay Terminals-shall be screw type terminals large enough to accommodate at least 4 mm^2 cable

4.2.7.11 Voltage Transducer

The Transducer shall have the following Features:

i. DIN rail mounting
ii. Input 0- 110 V AC
iii. Output 0 – 20 mA
iv. Auxiliary power supply shall be 110 V AC, separately connected.
v. Relay Terminals-shall be screw type terminals large enough to accommodate at least 4mm^2 cable
vi. Screw type terminals
vii. Terminals indelibly marked

4.2.8. MFM

4.2.8.1 This is a power measurement meter for panel mounting. The unit shall be of numerical design
4.2.8.2 The unit shall have a large LCD display for displaying four (4) or more lines of measurands simultaneously.
4.2.8.3 The keypad shall be simple to allow scrolling between the various measurands.
4.2.8.4 The unit shall measure instantaneous values of; rms voltage, both phase – phase and phase to ground, phase currents, active power, reactive power, apparent power, energy, frequency, power factor and phase angle per phase.
4.2.8.5 The Unit shall measure time stamped values of the following parameters

i. Maximum and minimum demand for current and power (MW & MVA)
ii. Unbalance voltage and current
iii. Total harmonic distortion (THD) and Total Demand Distortion (TDD) for current and voltage

4.2.8.6 The unit shall have the following input ratings, 1Amps and 110V AC phase to phase.
4.2.8.7 The unit shall be able to continuously withstand 2Amps and 260 V AC
4.2.8.8 The unit shall be for flush mounting on the front of the panel
4.2.8.9 The unit shall be for 3 phases, 4 –wire connection on the secondary of current and voltage transformers.

4.2.9. SDH Multiplexer Panel

4.2.9.1 The equipment shall conform to the universal platform supporting TDM and packet-switched technology. It should have modular platform ready for future expansion

4.2.9.2 The unit shall have combined access and transport multiplexer from sub rate 64 kBit/s up to SDH TM-16.

4.2.9.3 Full support of legacy data, voice and utility-specific interfaces

(i) Voice: 2/4 wire E&M, FXS, FXO, including conferencing functionality
(ii) Data: V.24/V.28, V.35, V.11, RS-485, RS232/V.28, X.21, G.703 64kBit/s, E1
(iii) Tele protection compliant with IEC 60834-1
(iv) IEEE C37.94 for direct connection of differential protection relays.
(v) Supports multiple optical fiber transmission distances

4.2.9.4 The SDH Multiplexer shall be able to do and have

a) Point-to-multipoint configurations for legacy SCADA protocols
b) Logical bridging instances for real separation of critical user data traffic
c) Bidirectional switching for redundant channel routing of protection signals.
d) Optical interfaces (SFP based) up to 12 cages
e) Electrical interfaces from 4 – 24 ports
f) 10/100/1000 BaseT
g) L2 switching and L3 routing functionality
h) Specific functionality for SCADA applications
i) Redundant CPU, Redundant power feeding, Very high MTBF.
j) Design for the utility substation environment
k) User-friendly network management system

4.2.9.5 Cubicles for SDH Multiplexer shall fulfil the following requirements: -

a) IEC 62208 - General requirement empty enclosures for low-voltage switchgear and control gear assemblies
b) IEC 60529 - Protection degrees provided for enclosures
c) Are indoor free-standing cabinet with front door and lock
d) Ambient conditions for indoor installations only - IEC 60439-1
e) Have the standard dimensions (HxWxD) 2000 x 800 x 600 mm without side panels (2065 x 806 x 605 mm single cubicle with side panels and eye bolts)
f) Are also available in other dimensions: 2000 x 800 x 800 mm or 2000 x 600 x 600 mm
g) Can be assembled and shipped in multiple cubicle combinations of max. four cubicles, supplied with right or left opening doors
h) Are cabinets with structured steel, inside & outside surface colour RAL 7035
i) Have passive convection cooling via ventilation outlets in the lower and upper part of the door
j) Can be supplied with a swing frame or fixed frame for installing 19” racks and modules
k) Have standard protection conforming to protection class IP 54
l) Offer a very good screen attenuation against electromagnetic disturbances over the entire frequency range thanks to their optimum electrical contacts of all individual parts
m) Have power distribution and cabinet alarm system

4.2.9.6 Enclosure frames for SDH Multiplexer shall fulfil the following requirements: -

(i) Enclosure frame shall be of sturdy construction.

(ii) The hollow section frame is made of 16 times rolled steel. The holes on the frame shall be punched in 25 mm DIN pitch pattern. All the edges of the frame shall be rounded. The corners shall be strengthened with welded die cast corner connectors.

(iii) The accessories and internal mounting plates ensure a high degree of flexibility to integrate communication equipment. 19" racks and modules can be mounted either on the swing frame or on dedicated fix frame profiles. In both cases, doors at the front and/or at the rear give access to the wiring.

APPENDIX A: TESTING & INSPECTION

A1. The manufacturers shall carry out all the routine tests of the SCADA equipment on offer at the factory. The tests equipment shall be inspected and tested in accordance with the requirements of IEC 60885-1, IEC61235, IEC 60832-1&2, ASTM F711-02 and OSHA Regulation 1910.269: Part J standards and this specification. It shall be the responsibility of the manufacturer to perform or to have performed all the tests specified.

A2. Tests to be witnessed by KPLC Engineers at the factory before shipment shall be in accordance with IEC 60885-1, 60832-1 & 2, IEC 61235, , ASTM F711-02, ASTM and OSHA Regulation 1910.269: Part J standards and this specification

A3. Copies of test reports shall be packaged together with the respective SCADA equipment before delivery to KPLC.

A4. Copies of previous type test Reports for the SCADA equipment issued by third party testing laboratory that is accredited to ISO/IEC 17025 shall be submitted with the tender for the purpose of technical evaluation. The accreditation certification for the third party laboratory shall also be submitted with the tender (all in English Language).

A5. The SCADA equipment shall be inspected at the store upon delivery. Upon inspection at the store, the supplier shall replace any equipment, which fail to meet any of the requirements during inspection/test.

APPENDIX B: QUALITY MANAGEMENT SYSTEM (NORMATIVE)

B.1. The supplier shall submit a quality assurance plan (QAP) that will be used to ensure that the Equipment design, material, workmanship, tests, service capability, maintenance and documentation, will fulfil the requirements stated in the contract documents, standards, specifications and regulations. The QAP shall be based on and include relevant parts to fulfil the requirements of ISO 9001:2015.

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 manufacturer shall indicate the delivery time of the equipment; manufacturer's monthly & annual production capacity and experience in the production of the type and size of items being offered. A detailed list & contact addresses (including e-mail) of the manufacturer's previous customers for similar type of items 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.

APPENDIX C: TECHNICAL DOCUMENTATION (NORMATIVE)

C.1. The bidder shall submit its tender complete with technical documents required 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 (GTPs)- Appendix D - stamped and signed by the manufacturer.

b) Copies of the Manufacturer's catalogues, brochures, drawings and technical data for the equipment;

c) Details of the manufacturer's experience; Sales records for the last five years and at least four customer reference letters.

d) Copies of previous test certificates and test reports (As given in Clause A.2) by the relevant International or National Testing/Standards Authority of the country of manufacture (or ISO/IEC 17025 accredited independent laboratory) shall be submitted with the offer for evaluation. A copy of accreditation certificate for the laboratory shall also be submitted (all in English Language);

e) Marking & Packaging details (including packaging materials).

C.2. The successful 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 (GTPs) stamped and signed by the manufacturer **(these are not the ones submitted with the tender**);

b) Technical details and design drawings of the equipment to be manufactured for KPLC.

c) Quality assurance plan (QAP) that will be used to ensure that the design, material; workmanship, tests, service capability, maintenance and documentation will fulfil the requirements stated in the contract documents, standards, specifications and regulations.

d) Detailed test program to be used during factory testing;
e) Marking details and method to be used in marking the equipment
f) Manufacturer's undertaking to ensure adequacy of the design, good engineering practice, adherence to the specification and applicable standards and regulations as

well as ensuring good workmanship in the manufacture of the equipment for The Kenya Power & Lighting Company;

g) Packaging details (including packaging materials).

C.3. Each equipment package shall be supplied with detailed user's manual printed in English language to Kenya Power stores. All information shall be unambiguous. All documentation necessary for safety of the equipment as specified in IEC 61010-1 clause 5.4 shall be provided with the equipment.

C.4. The supplier shall submit recommendations for use, care, storage and routine inspection/testing procedures, all in the English Language, during the installation of the Equipment.

APPENDIX D: PACKING AND DELIVERY

D.1. PACKING

(i) Each item shall be packed properly or protected for shipment from the place of manufacture to the KPLC store or designated installation site.

(ii) Each crate of package shall contain a packing list in a waterproof envelope and a copy in triplicate shall be forwarded to KPLC prior to dispatch. All items of material shall be clearly marked for easy identification against the packing list.

(iii) All cases, packages, etc., shall be clearly marked on the outside to indicate the total weight, to show where the weight is bearing and the correct position of the slings and shall bear an identification mark relating them to the appropriate shipping documents.

(iv) All Accessories necessary for mounting the Relays, Instruments and Control Devices on to the panels, for terminations of cables or for labelling of LED indications shall be provided with the Relays, Instruments and Control Devices.

D.2. MARKING

D.2.1 All equipment shall be permanently marked with a manufactures trademark and a serial number on a top part of the equipment for traceability in English Language. The following information shall be indelibly marked on each equipment: -

a) Manufacturer's name and / or Logo
b) Equipment type reference number
c) The standard of manufacture (IEC 60885-1, IEC 60832, IEC 61235, ASTM F711-02, OSHA Regulation 1910.269: Part J)
d) Words "**PROPERTY OF KPLC**".

D.2.2 The packaging shall be marked as detailed below.

(a) Consignee: THE KENYA POWER & LIGHTING CO. LTD.
(b) Name of Project: PROTECTIVE RELAYS AND CONTROL DEVICES AND INSTRUMENTS FOR PROJECTS
(c) Contract No.: ……

(d) Port of destination: ……
(e) Item Number, Package number and quantity per package: ……...
(f) Description of Contents: ……
(g) Net and gross weight, cubic measure: ……

APPENDIX E: GUARANTEED TECHNICAL PARTICULARS (GTPS)

(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, four customer reference letters, the manufacturer's experience and copies of complete type test reports for tender evaluation, all in English Language)

Tender No. ……

CLAUSE NO.	CLAUSE REQUIREMENTS	KPLC REQUIREMENTS	MANUFACTURER/ SUPPLIERS OFFER
	Manufacturers Name and address	State	
	Country of Manufacture	State	
	Bidder's Name and address	State	
1	**Scope**	Specify	
2	Terms and definitions	Specify	
3	Applicable standard(s)	State	
4	**REQUIREMENTS**		
4.1	**SERVICE CONDITIONS**	Specify	
4.1.2	Physical conditions	Specify	
4.1.2	Safety and environmental requirements	State compliance	
4.2	**GENERAL REQUIREMENTS**		
4.2.1	Free standing Panels, cubicles and marshalling racks, constructed from folded sheet steel of adequate thickness	Specify	
4.2.2	Panels and cubicles designed for personnel access shall be provided with metal floors and shall be suitably ventilated. Doors shall be provided with a lock, which may be opened by a person within the panel without the use of a key.	Specify	
	It shall be possible to open all panels associated with one unit by the use of one master key	Specify	
	Adequate lighting and power points for hand tools shall be provided	Specify	
4.2.3	overall height of cubicles and racks	≤2.20 metres	
	Powder coated, pebble grey colour RAL-7035	State	
	Thickness of powder coating	≥80 microns	
4.2.4	Cable connections shall be equipped with suitable seals to prevent rodents and ingress	Specify	

CLAUSE NO.	CLAUSE REQUIREMENTS		KPLC REQUIREMENTS	MANUFACTURER/ SUPPLIERS OFFER
	Cable plates shall be factory drilled, but blocked with removable stoppers, easily knocked off at site		Specify	
4.2.5	Cubicles shall be provided with thermostatically controlled heating elements		Specify	
	Adjustable set point for thermostat		Specify	
4.2.2	**Power Supplies and fusing**			
4.2.2.1-4.3.2.5	Specify all compliance requirements in these clauses		Specify	
4.2.3	**Indicators and Electronic Equipment**			
4.2.3.1	Control desk Indicators		flush mounting	
	Minimum sizes of indicators (mm)	Non-urgent indicators	96 x 96	
		Important indicators	144 x 144	
		Mimic diagrams	48 x 48	
4.2.3.2	Local gauge boards desk Indicators		Circular type	
	Minimum case diameter (mm)		160	
4.2.3.3	The read-out window for indicators, recorders and similar equipment shall be non-reflecting, anti-static and minimize parallax errors		Specify	
4.2.3.4	Use of pug-in type printed circuit boards		Specify	
	All electronic components, including integrated circuits, transistors, resistors, capacitors and inductors shall be selected in order to ensure long life and stable operation		Specify	
	Indication lamps used in conjunction with electronic circuits shall be light emitting diodes		Specify	
4.2.3.5	All relay equipment shall use modern plug-in type circuit boards, containing standard type miniature relays, which can be plugged- in and easily replaced on sockets on the circuit boards.		Specify	
	relays shall be of the encapsulated type		Specify	
	transistorized relays for time relays, with setting knobs for time setting		Specify	
4.2.3.6	Switches for mounting in the control panels shall be of the miniature or sub-miniature type		Specify	
	Provide discrepancy switches or push buttons		Specify	
	Discrepancies between the switch position and the plant state shall be indicated by an integral light		Specify	

CLAUSE NO.	CLAUSE REQUIREMENTS	KPLC REQUIREMENTS	MANUFACTURER/ SUPPLIERS OFFER
	Integral light shall illuminate the switch in a flashing mode of operation.	Specify	
4.2.3.7	surfaces used for electrical contacts shall be silver, gold or silver alloy	Specify	
4.2.3.8	Connection between low-voltage electronic control circuits and power circuits shall consist of interposing relays for linking the two systems.	Specify	
	relays have to be of the encapsulated type	Specify	
4.2.4	**Remote Terminal Units (RTUs) and Interfaces for SCADA**		
4.2.4.1	Galvanic isolation of all signals from process to RTU through interposing relays.	Specify	
4.2.4.2	Accommodate signal from both Analogue and Digital transducers	Specify	
4.2.4.3	Tele information plan requirements		
a)	single command outputs, double command outputs	Specify	
b)	regulation command outputs e.g. raise/lower command outputs for transformer tap changer control	Specify	
c)	analogue set point transmission and output	Specify	
d)	single, double and multiple state digital inputs	Specify	
e)	analogue measured inputs	Specify	
f)	metering pulse inputs for acquisition of energy meter values	Specify	
g)	Sequential Event Recording (SER) with time stamping of events at the RTU	Specify	
h)	RTU time synchronization	Specify	
i)	Self-testing and diagnostic functions for detection and reporting of any error	Specify	
j)	Automatic re-starting function corresponding control centre with downloading function.	Specify	
l)	Support encryption and LAN/WAN access	Specify	
m)	Shall support IEC 61850 protocol for process communication	Specify	
4.2.4.4	RTU to be fully equipped for actual amount of data to be acquire and commands to be executed plus spare capacity of 25% for each type of data	Specify	

CLAUSE NO.	CLAUSE REQUIREMENTS	KPLC REQUIREMENTS	MANUFACTURER/ SUPPLIERS OFFER
	RTU shall be expandable in the field by at least 50% of the size of the initial point capacity by addition of Input and Output cards only	Specify	
	The addition of enclosures, internal cabling/wiring, chassis, or power supplies shall not be necessary when adding these I/O cards.	Specify	
4.2.4.5	RTU shall be accessible through the communication network for the Supervisory Control & Data Acquisition (SCADA) System at the National Control Centre (NCC) and Regional Control Centres (RCC) to scan.	Specify	
4.2.4.6	Plug-in type relays shall be used with sockets directly mounted on a DIN rail.	Specify	
	Plugging – in and out are easy and performed without any risk of damaging of relay parts.	Specify	
4.2.5	**RTU firmware requirements**		
4.2.5.1	RTU firmware characteristics		
(i)	Use of standard firmware	Specify	
(ii)	Firmware shall be completely and consistently documented	Specify	
(iii)	It shall not be necessary to perform modification to firmware, logic, or data for expansion within the sizing parameters defined for the RTU	Specify	
(iv)	all firmware delivered must be up to date and in final form, including all standard firmware changes	Specify	
(v)	Firmware shall be loadable by service notebook locally at minimum, download of firmware and parameter sets trough SCADA system, using the data communication links.	Specify	
(vi)	Changing of EPROMs or similar devices shall not be necessary when updating RTUs firmware	Specify	
4.2.5	**Enclosures Requirements**		
4.2.5.1	Swing racks supported by heavy gauge hinges such that only front access to components and	Specify	

CLAUSE NO.	CLAUSE REQUIREMENTS	KPLC REQUIREMENTS	MANUFACTURER/ SUPPLIERS OFFER
	wiring is required for routine maintenance and troubleshooting.		
4.2.5.2	Provisions for top and bottom cable entry with protection against insect and animal entry.	Provide	
	Sealed to prevent dust and sand contamination		
4.2.5.3	Protection class for indoor cabinets	≥IP 52	
	Protection class for outdoor cabinets	≥IP 64	
4.2.5.4	Suitable signal and safety ground networks within the enclosure.	Provide	
4.2.5.5	230V AC power outlets	Provide	
4.2.5.6	DC Power supply		
a)	Any hardware required to convert the 48 V battery voltage to the required internal voltages for the RTU hardware shall be provided and adequate	Specify	
b)	The RTUs shall be capable of operating with ungrounded or grounded (either polarity) input power.	Specify	
4.2.5.7	Dielectric strength/Impulse voltage test	≥2.5kV, 1 minute	
4.2.6	**Interposing Relays**	Specify	
4.2.6.1	Tele commands	Specify	
a)	Coil voltage shall be 48 VDC; Coil voltage variation shall be ±20%.	Specify	
b)	Signal voltage on the contact circuit shall normally be 110 VDC	Specify	
c)	The rated contact current shall be minimum 5ADC making/breaking.	Specify	
4.2.6.2	Tele indications		
a)	Coil voltage shall be 110 VDC; Coil voltage variation shall be ±20%.	Specify	
b)	Signal voltage on the contact circuit shall normally be 48VDC	Specify	
c)	The rated contact current shall be minimum 3ADC making/breaking.	Specify	

CLAUSE NO.	CLAUSE REQUIREMENTS	KPLC REQUIREMENTS	MANUFACTURER/ SUPPLIERS OFFER
4.2.6.3	2NO and 2NC contacts for interposing relay	Specify	
4.2.6.4	Relays shall be fitted with a visual operation indicator (either mechanical or LED)	Specify	
4.2.7	**Transduces**		
4.2.7.1	Electrical parameters – Current, voltage, active power, reactive power, apparent power, frequency and power factor	Specify	
4.2.7.2	Four programmable analogue outputs, two digital outputs and RS-485 Modbus functionality.	Specify	
4.2.7.3	programmed via easy-to-use software compliant with IEC 60688	Specify	
	Galvanically isolated outputs with the following characteristics in table 1.	Specify	
4.2.7.2	Relays Characteristics of the digital programmable transducers	Specify	
a)	Measurement Accuracy	Class0.2, 0.5	
	Main frequency	45-65Hz	
b)	Voltage Circuit (Un)	3×100-693 V (3-wire system) 3×57.7/100 V to 3×400/693 V (4-wire system)	
c)	Current circuit (In)	1-5 A	
d)	Transducer supply	40-120 VDC	
e)	Communication Ports		

CLAUSE NO.	CLAUSE REQUIREMENTS	KPLC REQUIREMENTS	MANUFACTURER/ SUPPLIERS OFFER
	Serial USB port	USB Mini-B connector Modbus RTU 38400 baud (auto)	
	Serial RS485 port	Three screw terminals for ≤ 6 mm2 Modbus RTU 1200 – 38400 baud	
f)	Digital outputs (No)	2	
g)	Analogue outputs(No)	4	
4.2.7.4	a) Accuracy of the measurements	Voltages 0.5% of full scale Temperature 0 – 50^{o}C	
	b) Maximum ripple	2% pk to pk	
	c) Response time to 99% of final value	<0.5 sec	
4.2.7.5	analogue output of the transducers inputs to the RTU shall be isolated, polar or bipolar, 2 – wire Load independent DC current of 0 to isolated, polar 10 mA, or ±10 mA or 4-20mA	Specify	
4.2.7.6	Transducer burden	<2VA per CT	
4.2.7.7	Short time overload	≥50VA	
4.2.7.8	MW Transducer		
i.	DIN rail mounting	Specify	
ii.	Connection shall be 3-Phase, 4-Wire	Specify	
iii	Inputs 110V AC and 1Amp	Specify	
iv.	Programmable output characteristic	Specify	
v.	Output shall be 0 - ±20 mA	Specify	

CLAUSE NO.	CLAUSE REQUIREMENTS	KPLC REQUIREMENTS	MANUFACTURER/ SUPPLIERS OFFER
vi.	Auxiliary power supply shall be 110 V AC/DC	Specify	
vii.	Relay Terminals-shall be screw type terminals large enough to accommodate at least 4mm2 cable	Specify	
viii.	Screw type terminals	Specify	
ix.	Terminals indelibly marked	Specify	
4.2.7.9	MVAr Transducer		
i.	DIN rail mounting	Specify	
ii.	Connection shall be 3-Phase, 4-Wire	Specify	
iii	Inputs 110V AC and 1Amp	Specify	
iv.	Programmable output characteristic		
v.	Output shall be 0 - ±20 mA	Specify	
vi.	Auxiliary power supply shall be 110 V AC/DC	Specify	
vii.	Relay Terminals-shall be screw type terminals large enough to accommodate at least 4mm2 cable	Specify	
viii.	Screw type terminals	Specify	
ix.	Terminals indelibly marked	Specify	
4.2.7.10	Current Transducer		
i.	Input 0- 1Amp	Specify	
ii.	Output 0 – 20 mA	Specify	
iii	Auxiliary power supply shall be 110 V AC/DC	Specify	

CLAUSE NO.	CLAUSE REQUIREMENTS	KPLC REQUIREMENTS	MANUFACTURER/ SUPPLIERS OFFER
iv.	Relay Terminals-shall be screw type terminals large enough to accommodate at least 4 mm^2 cable	Specify	
4.2.7.10	Voltage Transducer		
i.	DIN rail mounting	Specify	
ii.	Input 0- 110 V AC	Specify	
iii.	Output 0 – 20 mA	Specify	
iv.	Auxiliary power supply shall be 110V AC, separately connected.	Specify	
v.	Relay Terminals-shall be screw type terminals large enough to accommodate at least 4mm^2 cable	Specify	
vi.	Screw type terminals	Specify	
vii.	Terminals indelibly marked	Specify	
4.2.8	MFM	Specify	
4.2.8.1	Unit shall be of numerical design	Specify	
4.2.8.2	LCD display – Lines of measurands displayed simultaneously	≥4	
4.2.8.3	Keypad shall be simple to allow scrolling between the various measurands	Specify	
4.2.8.4	The unit shall measure instantaneous values of; rms voltage, both phase – phase and phase to ground, phase currents, active power, reactive power, apparent power, energy, frequency, power factor and phase angle per phase.	Specify	
4.2.8.5	Measurement of time stamped values		

CLAUSE NO.	CLAUSE REQUIREMENTS		KPLC REQUIREMENTS	MANUFACTURER/ SUPPLIERS OFFER
i.	Maximum and minimum demand for current and power (MW & MVA)		Specify	
ii.	Unbalance voltage and current		Specify	
iii.	harmonic distortion(THD) and Total Demand Distortion(TDD) for current and voltage		Specify	
4.2.8.6	Input ratings	Current	1 A AC	
		Voltage	110V AC	
4.2.8.7	Continuously withstand	Current	2 A AC	
		Voltage	260V AC	
4.2.8.8	Flush mounted		Specify	
4.2.8.9	3-phase , 4-wire on the secondary current and voltage		Specify	
4.2.9	**SDH Multiplexer Panel**			
4.2.9.1	conform to the universal platform supporting TDM and packet-switched technology		Specify	
	should have modular platform ready for future expansion		Specify	
4.2.9.2	Have combined access and transport multiplexer from sub rate 64 kBit/s up to SDH TM-16.		Specify	
4.2.9.3	Full support of legacy data, voice and utility-specific interfaces		Specify	
(i)	Voice: 2/4 wire E&M, FXS, FXO, including conferencing		Specify	
(iii)	Data: V.24/V.28, V.35, V.11, RS-485, RS232/V.28, X.21, G.703 64kBit/s, E1		Specify	
(iii)	Tele protection compliant with IEC 60834-1		Specify	

CLAUSE NO.	CLAUSE REQUIREMENTS	KPLC REQUIREMENTS	MANUFACTURER/ SUPPLIERS OFFER
(iv)	IEEE C37.94 for direct connection of differential protection relays	Specify	
(v)	Supports multiple optical fiber transmission distances	Specify	
4.2.9.4	SDH Multiplexer shall be able to do and have		
a)	Point-to-multipoint configurations for legacy SCADA protocols	Specify	
b)	Logical bridging instances for real separation of critical user data traffic	Specify	
c)	Bidirectional switching for redundant channel routing of protection signals	Specify	
d)	Optical interfaces (SFP based) up to 12 cages	Specify	
e)	Electrical interfaces from 4 – 24 ports	Specify	
f)	10/100/1000 BaseT	Specify	
g)	L2 switching and L3 routing functionality	Specify	
h)	Specific functionality for SCADA applications	Specify	
i)	Redundant CPU, Redundant power feeding, Very high MTBF	Specify	
j)	Design for the utility substation environment	Specify	
k)	User-friendly network management system	Specify	
4.2.9.5	Cubicles for SDH Multiplexer shall fulfil the following requirements		
(i)	Standard - IEC 62208	Specify	
(ii)	Standard - IEC 60529	Specify	
(iii)	indoor free standing cabinet with front door and lock	Specify	
(iv)	Ambient conditions for indoor installations only - IEC 60439-1	Specify	

CLAUSE NO.	CLAUSE REQUIREMENTS		KPLC REQUIREMENTS	MANUFACTURER/ SUPPLIERS OFFER
(v)	standard dimensions	HxWxD) 2000 x 800 x 600 mm without side panels	Specify	
		2065 x 806 x 605 mm single cubicle with side panels and eye bolts		
(vi)	Other dimensions - 2000 x 800 x 800 mm or 2000 x 600 x 600 mm		Specify	
(vii)	Can be assembled and shipped in multiple cubicle combinations of max. four cubicles, supplied with right or left opening doors		Specify	
(viii)	cabinets with structured steel, inside & outside surface colour RAL 7035		Specify	
(ix)	Have passive convection cooling via ventilation outlets in the lower and upper part of the door		Specify	
(x)	Can be supplied with a swing frame or fixed frame for installing 19” racks and modules		Specify	
(xi)	standard protection conforming to protection class IP 54		Specify	
(xii)	very good screen attenuation against electromagnetic disturbances over the entire frequency range		Specify	
(xiii)	Have power distribution and cabinet alarm system		Specify	
4.2.9.6	Enclosure frames for SDH Multiplexer shall fulfil the following requirements		Specify	
(i)	frame shall be of sturdy construction		Specify	
	hollow section frame is made of 16 times rolled steel		Specify	
	holes on the frame shall be punched in 25 mm DIN pitch pattern		Specify	
	ers shall be strengthened with welded die cast connectors		ify	
	accessories and internal mounting plates ensure a high degree of flexibility to integrate communication equipment		Specify	

CLAUSE NO.	CLAUSE REQUIREMENTS	KPLC REQUIREMENTS	MANUFACTURER/ SUPPLIERS OFFER
	Responsibility of carrying out tests	State	
	Acceptance tests to be witnessed by KPLC at factory before shipment	State	
	Copies of test reports shall be packaged together with the respective SCADA equipment	State	
	Copies of Type Test Reports submitted with tender	State	
	Inspection at the stores and replacement of rejected items	State	

Note: *Words like 'agreed', Yes, 'confirmed', 'As per KPLC specifications', etc. shall not be accepted and shall be considered non-responsive.*

…….

Manufacturer's Name, Signature, Stamp and Date