THE KENYA POWER AND LIGHTING CO. LTD

SPECIFICATIONS

For

OUTDOOR LARGE POWERING METERING SOLUTION

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1.0 Forward

1.0 Foreword

This specification was prepared by Central Office Large Power and Inspection Unit of the Kenya Power & Lighting Company (KPLC). It lays down requirements for Low Voltage, Middle Voltage and High-Tension (H.T.) voltage metering system for use in outdoor Advanced Metering Infrastructure (AMI) system for large industrial and Large Commercial users. The outdoor metering solution is to be provided by tenderers on turnkey basis.

1.1 Terms and definitions

Ib: basic current

Ist: starting current

Imax: maximum current

Un: reference voltage

EMC: Electro-Magnetic Compatibility

IP: Ingress Protection

IEC: International Electro technical Commission

DLMS: Device language Message Specification

CMMI: Capability Maturity Model Integration

AMI: Advanced Metering Infrastructure

HHU: hand-held unit

UPS: Uninterruptable Power Supply

CTs: Current Transformers

PTs: Potential Transformers

LCD: Liquid Crystal Display

COSEM: Companion Specification for Energy Metering

OBIS: Object Identification System defines identification codes

2.0 Introduction

Kenya Power has around 5000 large power customers. These include three phase whole current customers, three phase CT customers, and High Voltage (11KV, 33KV, 66 KV and 132KV) metered customers.

There are 7 typical scenarios of installation for these large power customers, listed as below:

1. Three phase whole current metered customers, indoor installation (415V, 100A)
2. Three phase CT metered connected customers (multi customers per transformer) (415V, 200/1A, 100/5A, 200/5A, 400/5A, 600/5A, 800/5A, 1000/5A)
3. Three phase 11KV CT connected customer (overhead cable connected) outdoor installation
4. Three phase 11KV CT connected customer (underground cable connected) indoor installation
5. Three phase 33KV CT connected customers, indoor installation
6. Three phase 66KV CT connected customer, indoor installation
7. Three phase132KV CT connected customer, indoor installation

KPLC wishes to invite bidders for supply, installation and commissioning of the outdoor metering solution to bid for the above seven scenarios. It shall be a turnkey project and the bidder shall meet the entire works requirement listed in the scope of works.

2.1 Project Objective

The objective of the Project is to reduce electricity losses, increase collections and improve quality of electricity supply in KPLC. The project includes the supply, installation commissioning of all the KPLC's Large Power customer's outdoor metering system together with the central management system and associated Low and High Voltage Equipment.

3.0 Scope of works

The project will provide transition from current metering system to a new more secure metering system. The scope of the project will involve the following major components:

1. Design, supply, installation and commissioning of
   a) tamper resistant electricity metering infrastructure
   b) auditable central data management system and integrated into existing billing system
   c) Electricity meters together with related accessory equipment such as communication equipment, metering cabinets, power distribution cabinets
   d) Low Voltage (LV) and High Voltage cables associated with the meter installation will also be covered in this project.
2. Design, supply, installation and commission of meter monitoring system including the software and hardware supporting meter data collection, meter data analysis functions.
3. Power distribution infrastructure modifications necessary to facilitate installation of the metering equipment.
4. KPLC specifications will be used by the contractor for material used in the reconstruction/s of the infrastructure/s.
5. IT communication infrastructure of the central room and data communication will be provided by KPLC.
6. Training of KPLC staff on the application of the new metering system and the installed equipment.

3.1 Project Implementation

The implementation of the outdoor metering system and auditable central data management system shall cover all customers categorized as large power customers - KPLC tariffs (currently SC, CI1, CI2, CI3, CI4 and CI5).

The expected scenarios in the new metering systems

No	Description	Total
1	LV Whole current metered customer	1044
2	LV CT metered customer	3952
3	11kV CT & PT metered customer with overhead	200
4	11KV CT & PT metered customer with underground cable	130
5	33kV CT& PT metered customer	34
6	66kV CT& PT metered customer	22
7	132kV CT& PT metered customer	28
8	Central system IT infrastructure installation and commissioning	1
9	Central system installation, commission	1

3.2 General specifications for scenarios

3.2.1 LV whole current metered customer

a) The tenderer will supply all equipment including meter, metering enclosure, circuit breaker, communication module, connections, switch, sensors, locks and associated components for full functioning of the metering system.

a) To secure the metering installation, all the metering equipment will be installed inside the same enclosure

b) The tenderer will remove the current installed meters and return to KPLC.

c) The power supply cables to the cabinet and the support structure will be supplied and installed by contractor.

3.2.2 LV CT Metered customer

a) The tenderer will supply all the equipment including SMART meter, metering enclosure, CTs, air insulated circuit breaker, communication module, connections, sensors, locks and associated components for full functioning of the metering system.

b) To secure the metering installation, all the metering equipment will be installed inside the same enclosure.

c) The installation can be done either indoors or outdoors depending on the site conditions.

d) The tenderer will remove the current installed meters and return to KPLC.

e) The power supply cables to the cabinet and the support structure will be supplied and installed by the contractor.

3.2.3 11KV CT and PT metered customer via overhead cable

a) The tenderer will supply an integrated metering unit comprising of SMART meter, enclosure, CTs, PTs, communication module, connections, sensors, locks and all associated components for full functioning of the metering system.

b) The PTs and CTs shall be dry type (cast resin) and together with bushing and shall be a compact single unit.

c) The metering PT and CT unit will be installed on an outdoor concrete H structure.

d) To secure the metering installation, all the metering equipment will be installed inside the same enclosure

e) The tenderer will remove the current installed meters and return to KPLC.

The power supply cables to the cabinet and the support structure will be supplied and installed by the tenderer.

3.2.4 11KV CT and PT Metered customer via underground cable

a) The tenderer will supply an integrated metering unit comprising of SMART meter, metering enclosure, CTs, PTs, communication module, connections, sensors, locks and all associated components for full functioning of the metering system.

b) The PTs and CTs shall be dry type (cast resin) and together with bushing and shall be a compact single unit.

c) The metering PT and CT unit will be installed indoors in the KPLC meter room.

d) To secure the metering installation, all the metering equipment will be installed inside the same enclosure

e) The tenderer will remove the current installed meters and return to KPLC.

3.2.5 33KV CT and PT metered customers

a) The tenderer will supply all equipment including meter, metering enclosure, communication module, connections, sensors, locks and all associated components for full functioning of the metering system.

b) Tenderer shall use the KPLC's existing PT and CT for metering purposes.

c) To secure the metering installation, all the metering equipment shall be installed inside the same enclosure.

d) The metering unit will be installed outdoors in the KPLC substation switch yard.

e) The measuring cables from PTs and CTs to the metering cabinet shall run through tamper resistant steel conduits.

f) The metering cabinet will be installed close or next to the existing CTs and PTs.

3.2.6 66KV CT and PT metered customers

a) The tenderer will supply all equipment including SMART meter, metering enclosure, communication module, connections, sensors, locks and all associated components for full functioning of the metering system.

b) Tenderer shall use the KPLC's existing PTs and CTs for metering purpose.

c) To secure the metering installation, all the metering equipment will be installed inside the same enclosure.

d) The metering unit shall be installed outdoors in the KPLC substation switch yard.

e) The measuring cables from PTs and CTs to the metering unit shall run through tamper resistant steel conduits.

f) The metering cabinet will be installed close or next to the existing CTs and PTs.

3.2.7 132KV CT and PT metered customers

a) The tenderer will supply all equipment including SMART meter, metering enclosure, communication module, connections, sensors, locks and all associated components for full functioning of the metering system.

b) Tenderer shall use the KPLC's existing PT and CT for metering purpose.

c) To secure the metering installation, all the metering equipment shall be installed inside the same enclosure.

d) The metering enclosure will be installed outdoors in the KPLC substation switch yard.

e) The measuring cables from PTs and CTs to the metering unit shall run through tamper resistant steel conduits.

f) The metering enclosure shall be installed close or next to the existing CTs and PTs.

3.3 Installation works

The installation works shall cover the following tasks but not limited to:

a) Installation of all metering enclosure equipment including earthing
b) Installation of Power cables to metering cabinet
c) Installation of Cables/Conductors from metering cabinet to customer
d) Installation of cable conduits
e) Cable trenches for underground cable where necessary.
f) Installation of underground cable and aerial bundled cables
g) All required civil works in building to enable the cable installation to and from the metering cabinets and to the customer such as wall / ceiling penetrations, preparation of cable conduits (slots in walls) and closing of the penetrations. Preferably, the existing cable conduits (slots) in the walls of the buildings shall be used, only where this is not possible, new conduits (slots) shall be prepared.

KPLC will arrange for power outage to facilitate the works as necessary on request by the tenderer

3.4 Work plan

The tenderer shall prepare a work plan for the tasks in the project implementation and submit for approval by the KPLC. The work plan procedures shall address among others following area:

a) Safety, health and environment
b) work procedures
c) Minimize power outages

4.0 Tests and Commissioning

4.1 Site Tests

4.1.1. After the metering equipment has been installed on site, the supplier shall carry out pre-commissioning tests on the metering systems under the supervision of KPLC engineers

Details of site tests shall be agreed with KPLC, but shall include:

a) All KPLC recommended tests on SMART meters
b) Visual checks of all equipment (for damage, leaks etc.).

c) Continuity of Cable Connections and Phasing tests

d) Insulation between Phases, Insulation to Earth tests

e) Testing of communication equipment and related accessories

f) All KPLC recommended tests on PTs & CTs

g) Tests on functionalities of Central system IT infrastructure and central data analysis system

4.1.2.The supplier shall be responsible for carrying out required tests to confirm the correct operation of the metering solution.

5.0 Meter Requirements

The section outlines the requirements of the whole current, LV CT and PT & CT SMART meters required for the turnkey project. As the meters will be housed and sealed in enclosures, the meters should support reading remotely via a HHU.

5.1 LV whole current meter requirements

5.1.1 General Requirements

5.1.1.1 The meters shall be suitable for operation in tropical climate where temperatures may vary from -1 to +60 degrees Celsius.

5.1.1.2 Average Annual Relative humidity reaching 90% and altitude of up to 2,200m.

5.1.1.3 The meters shall be used for measurement of active energy for commercial and industrial loads under tropical climate conditions.

5.1.2 Design and Construction requirements

5.1.2.1 The dimensions of the meter in a vertical position must not exceed 178mm*280mm*89mm

5.1.2.2 The **meters shall be constructed as 3 phase 4-wire meters.**

5.1.2.3 The meters shall have terminals with bottom entry for cables and the arrangement shall be **L1L1: L2L2: L3L3: NN for** 3 phase 4-wire meters.

5.1.2.4 The meter's front cover may be of translucent material but shall have a window (clear glass or

polycarbonate) for reading the display and for observation.

5.1.2.5 The meters shall conform to the degree of protection IP 54 as given in IEC 60529:1989 Degrees of protection provided by enclosures (IP Code) Amendment 1:1999

5.1.2.6 The meters shall be of British Standard (BS) 5685-foot print for standardized mounting for asymmetrical (BS) wiring.

5.1.2.7 The meters shall be for front projection mounting.

5.1.2.8 The meters shall have sealing provisions for the meter body, meter cover and terminal cover and Reset button if the button is outside meter cover. If back-up battery is such connected that its replacement does not require opening meter cover, then provision be provided for sealing the battery cover.

5.1.2.9 The meters shall be equipped with lockable / sealable push buttons where such buttons are used to change some meter parameters.

5.1.2.10 The meter terminal cover shall be of the long type with **cable entry knock-offs**.

5.1.2.11 Terminal holes shall be of sufficient size to accommodate the cables of at least **8mm** diameter.

5.1.2.12 The meters **terminal holes** and **screws** shall be made of **brass** or **nickel-plated brass** for high strength and high conductivity.

5.1.2.13 The meters shall have two separate pulse outputs (LED) indicators for testing and indication of kWh and kvarh- meter operation.

5.1.2.14 The meters shall be equipped with auxiliary terminals for inputs and outputs.

5.1.2.15 The meters shall have a real-time clock controlled by a quartz crystal oscillator. It shall be possible to reset the clock without loss of billing data.

5.1.2.16 The meters shall have a backup power supply to run the calendar clock for a minimum of 1 year without mains voltage. If the backup is by means of Lithium battery it shall have a shelf life of ten years.

5.1.2.17 The meters shall have a non-volatile memory capable of data storage and with long-term data retention for the certified life of the meter or 15 years, whichever is greater without an electrical supply being supplied to the meter.

5.1.2.18 The meters shall be capable of storing load profiles for at least **180 days on** 10 **channels with 20 minutes** integration. Adjustable time interval from 1 to 60 minutes

5.2.19 The channels available for load profiling shall be the following; **Import watts, Export watts, Export VA, Import VA, 4-quadrant Reactive energy Q1, Q2, Q3 & Q4, Phase voltages, Phase currents** and **Power factor.**

5.1.2.20 The meters principal unit for the measured values shall be the kilowatt-hour (kWh). The meter shall be capable of measuring demand in kVA and kW.

5.1.2.21 The meters shall measure active energy and demand in two energy flow directions, i.e. export and import.

5.1.2.22 The meters shall measure reactive energy and demand in four quadrants.

5.1.2.23 The meter shall measure such that kW demand shall be coincidental to kVA maximum demand; i.e. the kW demand registered shall occur at the same date and time with the highest kVA demand in a billing period for power factor calculations.

5.1.2.24 The meters shall measure Energy and Demand correctly even when the phase rotation/sequence is incorrect.

5.1.2.25 The meters shall have independent multipliers on the energy and demand registers.

5.1.2.26 Meter shall support main tariff table and passive tariff table, with the following parameters:

1) Up to 4 seasons, 4 weekend table
2) 8 daily tables
3) up to 8 divisions per day
4) Up to 4 tariff

5.1.2.27 Meter shall support Up to 100 holidays configurable individually

5.1.2.28 The meter shall have at least 8 registers for energy.

5.1.2.29 The meters shall have at least 6 registers for Max. Demand. .

5.1.2.30 The meters shall be able to record reversed units.

5.1.2.31 Meters shall have a facility to indicate reverse connection.

5.1.2.32 The meters shall have a capability of **closing end of billing period** on any selected date of the month selectable by software.

5.1.2.33 The **meter's billing registers shall NOT be re-settable to zero readings.**

5.1.2.34 The meters shall have at least eighteen **billing historical data** stored in memory and retrievable

by software action. The current billing/historical data shall be available on meter display for reading and billing purposes.

5.1.2.35 The meters shall have a **backlight-LCD** with **at least eight (8)**-numerical characters comprising of selectable integers and decimals points for measurement. The display must be associated with push buttons for parameter scrolling. Individual digit size shall be minimum 4 mm wide x 8 mm high. LCD is to be clearly readable within a viewing angle ±15° in either the horizontal or vertical direction. Nominal diminutions of the display shall be 75 mm X 23 mm.

5.1.2.36 The meters LCD shall have **6** digit ID codes that are OBIS compliant. In addition, the meters shall be DLMS/COSEM protocol compliant (IEC 62056).

5.1.2.37 The LCD shall operate in at least two modes, namely, **basic and extended** data list display.

5.1.2.38 Meters shall have provision for reading the meter at site even when mains power supply fails.

5.1.2.39 The meters shall be capable of continuous display of the presence or absence of individual phase voltages.

5.1.2.40 The meters shall be capable of event recording and it should be possible to read them remotely, which shall include but not be limited to:

1) Power ups and power downs with date and time stamp;
2) Individual Phase failure, with date and time stamps;
3) Over and under voltages based on a pre-set threshold with date & time stamp;
4) Battery voltage status;
5) Memory status;
6) Meter Errors,
7) Date and time of last programming/parameterization;
8) Date and time of the last billing reset;
9) Load profile.
10) Terminal and Meter cover removal
11) Existence of current, despite absence of one or two phases
12) Current unbalance, over 30% in one phase or two phases (compare with other phase) should be detected

13) Tariff change

14) Time & Date change

5.1.2.41 The LCD shall display events that have occurred. The events displayed shall include but not be limited to the following:

1) Meter errors;

2) Individual Phase failure;

3) Battery voltage status;

4) Alarms

5) Warning messages etc.

5.1.2.42 The meters shall have the relevant software and hardware for read the data and config.

5.1.2.43 The meters shall be equipped with an RS485 or RS232 port for communication. The meters are to be read automatically through software and hardware to be specified separately in an Automatic Meter Reading (AMR) system. Communication protocol should be according to DLMS/COSEM

5.1.2.44 The meters shall be equipped with an infrared optical port with baud rate of 1200 - 9600 for meter programming and data downloading, according to IEC62056-21, mode E.

5.1.2.45 DLMS certificate should be offered

5.1.2.46 The data communication is with encryption and authentication, mechanism is method 5(GMAC)

5.1.2.47 A **Lap top computer and two optical probes**, details of which shall be provided by the utility, for programming and down loading the meter data shall be provided **at no extra cost.**

5.1.2.48 Access to meter parameters and programming information shall only be through user-level password(s)

5.1.2.49 The meters shall support with 3 access levels:

1) No security - The lowest level of security would allow users to read specified data fields without password.

2) Low level security - The level of security would allow users with the appropriate password to read specified data fields in the meter

3) High level security - The highest level of security would allow users with the appropriate password to reconfigure the meter with a new program

5.1.2.50 The meter program shall be capable of tracking user access to the meter

5.1.2.51 The Meter shall be able to communicate with a **remote central system** using a plug in modem/module, through the **GSM/GPRS,** dual band for operation in the 900/1800 MHz GSM networks.

5.1.2.52 The modem shall support meter communication protocols as per DLMS/COSEM standards.

5.1.2.53 Exchanging the communication modem should be done without power off the meter.

5.1.2.54 Meter's firmware shall be upgradable remotely and locally. Upgrading of firmware shall not stop and affect meter's metrology.

5.1.2.55 Meter shall be equipped with integrated relay to support remotely connection/disconnect with the instruction from data center system. The relay's current rating shall be 100A.

5.1.3 Electrical requirements

5.1.3.1 The meters shall be operated from mains with reference values of: -

3x240 V/415V at 50 Hz.

5.1.3.2The meters shall be connectable for **three phase four wire systems**, drawing of which shall be **printed** on the terminal cover or on the meter base.

5.1.3.3 The meter shall have reference standard currents of: -

Ib= 10 A; Imax = 100 A for the operating conditions stated in clause 5.1.1.

5.1.3.4 The meters Power consumption shall meet IEC 62053-21 7.1-7.4

5.1.3.5 Influence of short-time over-currents meet IEC 62053-21 7.1-7.4

5.1.3.6 Influence of self-heating meet IEC 62053-21 7.1-7.4

5.1.3.7 AC voltage test meet IEC 62053-21 7.1-7.4

Requirements 5.1.3.4 to 5.1.3.7 shall form part of the type test approval to be issued by an international/ national (of the country of manufacture) meter certifying body.

5. 1.4 Accuracy requirements

5.1.4.1 The meter's accuracy shall be class 1.0 for active energy and class 2 for reactive energy measurements as per accuracy requirements as per accuracy requirements such that it meets IEC

62053-21 8.1-8.6.

5.1.4.2 Limits of errors due to variation of the current shall meet requirement IEC 62053-21 8.1-8.6

5.1.4.3 Limits of error due to influence quantities shall meet IEC 62053-21 8.1-8.6 requirements.

5.1.4.4 Test of starting and no-load condition shall meet IEC 62053-21 8.1-8.6 requirements.

5.1.4.5 Meter constant shall meet IEC 62053-21 8.1-8.6 requirements

5.1.4.6 Accuracy test conditions shall meet IEC 62053-21 8.1-8.6 requirements

Requirements of clause 5.1.4 shall form part of the type test approval to be issued by an international/ national (of the country of manufacture) meter certifying body.

5.1.5 Instructions and Marking

5.1.5.1 In addition to IEC 62052-11:2003 nameplate requirements, each meter shall be marked **legibly and indelibly** with the following information:

a) Name or trade mark of the manufacturer;

b) Country of origin;

c) Type/model;

d) Meter number up to ten digits;

e) The inscription "Property of K.P. &. L. Co Ltd."

f) Standard(s) to which the meter complies;

g) Year of manufacture.

All markings to be written in English and with c), d) and e) **at least 4 mm** figure height.

5.1.5.2 Every meter shall be **indelibly** marked with diagrams of connections for which the meter is intended.

5.1.5.3 In addition, the following drawings and information shall be required with the tender:

(a) Meter drawing giving all the relevant dimensions;

(b) Wiring diagrams;

(c) Description leaflet including details of programming of the meters;

(d) Service and Operational manuals.

5.1.5.4 Copies of type approval certificate(s) with test and calibration results of the meter being offered obtained from **KEMA or MID** meter certification body shall be provided. **If type approval certificate(s) is (are) from accredited meter certification laboratories (and not national or international body), then it (they) shall be accompanied with copies of certificates of accreditation from KEMA or MID accredited lab.**

5.1.5.5 The Tenderer shall complete clearly, all the clauses in both columns of the schedule in Appendix B. This shall form the basis of evaluation of the submitted tender. Failure to complete this appendix shall render the tender non-responsive. The tenderers shall indicate the details of their offer where it is different from these requirements. Where the requirement is the same, they shall indicate what is offered. **Insertions such as "noted", "agreed" etc. shall be considered as non-responsive where a specific response is called for.**

5.1.5.6 The manufacturer shall provide proof of conformance to ISO 9001(2008) standard.

5.1.5.7 The manufacturer shall provide a list of at least three previous utilities to which the meter being offered has been supplied (**Brochures shall be attached to support this requirement**). The number of electronic meters (**single and three phase**) sold over a period of 5 years shall not be less than 150,000 meters.

5.2 Requirements for LV CT meter

5.2.1 General Requirements

5.2.1.1 The meters shall be suitable for operation in tropical climate where temperatures may vary from -1 to +60 degrees Celsius.

5.2.1.2 Average Annual Relative humidity reaching 90% and altitude of up to 2,200m.

5.2.1.3 The meters shall be used for measurement of active energy for commercial and industrial loads under tropical climate conditions.

5.2.2 Design and Construction requirements

5.2.2.1 The dimensions of the meter must not exceed the following values:

Width：178 mm

Length：295 mm

Height：77 mm

5.2.2.2 The **meters shall be constructed as 3 phase 3-wire or 3 phase 4-wire meters.**

5.2.2.3 The meters shall have terminals with bottom entry for cables and the arrangement shall be **L1V1L1: V2: L3V3L3** for 3 phase 3-wire meters or **L1V1L1: L2V2L2: L3V3L3: N for** 3 phase 4-wire meters.

5.2.2.4 The meter's front cover may be of translucent material but shall have a window (clear glass or polycarbonate) for reading the display and for observation. The terminal cover should be of transparent material. The external communication modem/module shall be equipped under the terminal cover.

5.2.2.5 The meters shall conform to the degree of protection IP 54 as given in IEC 60529:1989 Degrees of protection provided by enclosures (IP Code) Amendment 1:1999

5.2.2.6 The meters shall be of British Standard (BS) 5685-foot print for standardized mounting for asymmetrical (BS) wiring.

5.2.2.7 The meters shall be for front projection mounting.

5.2.2.8 The meters shall have sealing provisions for the meter body, meter cover and terminal cover and Reset button if the button is outside meter cover. If back-up battery is such connected that its replacement does not require opening meter cover, then provision be provided for sealing the battery cover.

5.2.2.9 The meters shall be equipped with lockable / sealable push buttons where such buttons are used to change some meter parameters.

5.2.2.10 The meter terminal cover shall be of the long type with cable entry knock-offs.

5.2.2.11 Terminal holes shall be of sufficient size to accommodate the cables of at least 4.5mm diameter.

5.2.2.12 The meters **terminal holes** and **screws** shall be made of **brass** or **nickel-plated brass** for high strength and high conductivity.

5.2.2.14 The meters shall have two separate pulse outputs (LED) indicators for testing and indication of kWh and kvarh- meter operation.

5.2.2.15 The meters shall be equipped with auxiliary terminals for inputs and outputs.

For inputs, It shall be equipped with:

1. at least 2 control signal input, the voltage signal can be 240VAC
2. at least 4 Impulse signal input, the Impulse signal should be an open/close signal

For outputs, It shall be equipped with:

1. at least 4 control signal output, the control signal should be an open/close signal, with Maximum 400VAC/DC, 100mA
2. at least 4 Impulse signal output, the Impulse signal should be an open/close signal, with Maximum 250VDC, 27mA.

5.2.2.16 The meters shall have a real-time clock controlled by a quartz crystal oscillator. It shall be possible to reset the clock without loss of billing data.

5.2.2.17 The meters shall have a backup power supply to run the calendar clock for a minimum of 1 year without mains voltage. If the backup is by means of Lithium battery it shall have a shelf life of ten years. The meter shall have a wide range auxiliary power supply: 63.5V~ 240VAC/DC and the meter shall work properly without main voltage

5.2.2.18 The meters shall have a non-volatile memory capable of data storage and with long-term data retention for the certified life of the meter or 15 years, whichever is greater without an electrical supply being supplied to the meter.

5.2.2.19 The meters shall be capable of storing load profiles for at least **180 days on** 10 **channels with 20 minutes** integration. Adjustable time interval from 1 to 60 minutes

5.2.2.20 The channels available for load profiling shall be the following **Import watts, Export watts, Export VA, Import VA, 4-quadrant Reactive energy Q1, Q2, Q3 & Q4, Phase voltages, Phase currents** and **Power factor.**

5.2.2.21 Meter must support Up to 32 times odd harmonic voltage and current measurement

5.2.2.22 The meter shall measure THD. Meter shall support wave capture function, capture data and can be read via software

5.2.2.23 The meters principal unit for the measured values shall be the kilowatt-hour (kWh). The meter

shall be capable of measuring demand in kVA and kW.

5.2.2.24 The meters shall measure active energy and demand in two energy flow directions, i.e. export and import.

5.2.2.25 The meters shall measure reactive energy and demand in four quadrants.

5.2.2.26 The meter shall measure such that kW demand shall be coincidental to kVA maximum demand; i.e. the kW demand registered shall occur at the same date and time with the highest kVA demand in a billing period for power factor calculations.

5.2.2.27 The meters shall **measure Energy and Demand correctly even when the phase rotation/sequence is incorrect.**

5.2.2.28 The meters shall have independent multipliers on the energy and demand registers.

5.2.2.29 Meter shall support main tariff table and passive tariff table, with the following parameters:

5) Up to 4 seasons, 4 weekend table
6) 8 daily tables
7) up to 8 divisions per day
8) Up to 4 tariff

5.2.2.30 Meter shall support Up to 100 holidays configurable individually

5.2.2.31 The meter shall have at least 8 registers for energy.

5.2.2.32 The meters shall have at least 6 registers for Max. Demand.

5.2.2.33 The meters shall be able to record reversed units.

5.2.2.34 Meters shall have a facility to indicate reverse connection.

5.2.2.35 The meters shall have a capability of **closing end of billing period** on any selected date of the month selectable by software.

5.2.2.36 The meter's billing registers shall NOT be re-settable to zero readings.

5.2.2.37 The meters shall have at least eighteen **billing historical data** stored in memory and retrievable by software action. The current billing/historical data shall be available on meter display for reading and billing purposes.

5.2.2.38 The meters shall have a **backlight-LCD** with **at least eight (8)**-numerical characters comprising of selectable integers and decimals points for measurement. The display must be associated with push

buttons for parameter scrolling. Individual digit size shall be minimum 4 mm wide x 8 mm high. LCD is to be clearly readable within a viewing angle ±15° in either the horizontal or vertical direction. Nominal diminutions of the display shall be 75 mm X 23 mm.

5.2.2.39 The meters LCD shall have **6** digit ID codes that are OBIS compliant. In addition, the meters shall be DLMS/COSEM protocol compliant (IEC 62056).

5.2.2.39 The LCD shall operate in at least two modes, namely, **basic and extended** data list display.

5.2.2.40 Meters shall support meter information reading via optical communication port at site even when mains power supply fails.

5.2.2.41 The meters shall be capable of continuous display of the presence or absence of individual phase voltages.

5.2.2.42 The meters shall be capable of event recording and the event can be read remotely via system, which shall include but not be limited to:

1) Power ups and power downs with date and time stamp;
2) Individual Phase failure, with date and time stamps;
3) Over and under voltages based on a pre-set threshold with date & time stamp;
4) Battery voltage status;
5) Memory status;
6) Meter Errors,
7) Date and time of last programming/parameterization;
8) Date and time of the last billing reset;
9) Load profile.
10) Terminal and Meter cover removal
11) Existence of current, despite absence of one or two phases
12) Current unbalance, over 30% in one phase or two phases (compare with other phase) should be detected
13) Tariff change
14) Time & Date change

5.2.2.43 The LCD shall display events that have occurred. The events displayed shall include but not be

limited to the following:

1) Meter errors;
2) Individual Phase failure;
3) Battery voltage status;
4) Alarms
5) Warning messages etc.

5.2.2.44 The meters shall have the relevant software and hardware.

5.2.2.45 The **meters shall be equipped with Two RS485 ports for communication. The meters support remote reading via AMI system specified separately in Article 8. The remote** Communication protocol shall compliant with DLMS/COSEM, IEC62056

5.2.2.46 The meters shall be equipped with an infrared optical port with baud rate of 1200 - 9600 for meter programming and data downloading, according to IEC62056-21, mode E.

5.2.2.47 DLMS certificate and KEMA certificate should be offered

5.2.2.48 The data communication is with encryption and authentication, mechanism is method 5(GMAC)

5.2.2.49 A **Lap top computer and two optical probes**, details of which shall be provided by the utility, for programming and down loading the meter data shall be provided **at no extra cost**.

5.2.2.50 Access to meter parameters and programming information shall only be through user-level password(s).

5.2.2.51 The meters shall support with 3 access levels:

1) No security - The lowest level of security would allow users to read specified data fields without password.
2) Low level security - The level of security would allow users with the appropriate password to read specified data fields in the meter
3) High level security - The highest level of security would allow users with the appropriate password to reconfigure the meter with a new program

5.2.2.52 The meter program shall be capable of tracking user access to the meter.

5.2.2.53 The meters shall be programmable to allow the user to change parameters on the installation configuration and in particular the voltage and current transformation ratios.

5.2.2.54 The Meter shall be able to communicate with a **remote central system** using a plug in modem/module, through the **GSM/GPRS,** dual band for operation in the 900/1800 MHz GSM networks.

5.2.2.55 The modem shall support meter communication protocols as per DLMS/COSEM standards.

5.2.2.56 The communication module can be replaced at site without power off the meter. The communication module shall have the DC power output +13V to support the power to UIU.

5.2.2.57 Meter's firmware shall be upgradable remotely and locally. Upgrading of firmware shall not stop and affect meter's metrology.

5.2.2.58 Meter shall support external UIU and meter information can be obtained via UIU.

5.2.2.59 The communication module shall support both SMS and GPRS modem and support the mode of: on line and on-demand on line.

5.2.2.60 The communication module shall support to report the event automatically via sms.

5.2.2.61 The communication module shall support USSD, CSD communication.

5.2.2.62 The communication module shall equipped with one RJ45 port.

5.2.3 Electrical requirements

5.2.3.1 The meters shall be operated from main power with reference values of: -

3x57.7/100V to 240 V/415V, 3 x 1 (10) A and at 50 Hz.

5.2.3.2 **Primary** currents and voltages for the meters shall be programmable through the software thus allowing Primary metering of Demand and Energy.

5.2.3.3 The meters shall be connectable as **three phase three wire meters** or **three phase four wire systems**, drawing of which shall be **printed** on the terminal cover or on the meter base.

5.2.3.4 The meter shall have reference standard currents of: -

I_n= 1 A; I max = 10 A for the operating conditions stated in clause 5.2.1.

5.2.3.5 The meters Power consumption shall meet IEC 62053-21 7.1-7.4

5.2.3.6 Influence of short-time over-currents meet IEC 62053-21 7.1-7.4

5.2.3.7 Influence of self-heating meet IEC 62053-21 7.1-7.4

5.1.3.8 AC voltage test meet IEC 62053-21 7.1-7.4

Requirements 5.2.3.5 to 5.2.3.8 shall form part of the type test approval to be issued by an international/ national (of the country of manufacture) meter certifying body.

5.2.4 Accuracy requirements

5.2.4.1 The meter's accuracy shall be class 1.0 for active energy and class 2 for reactive energy measurements as per accuracy requirements as per accuracy requirements such that it meets IEC 62053-21 8.1-8.6.

5.2.4.2 Limits of errors due to variation of the current shall meet requirement IEC 62053-21 8.1-8.6

5.2.4.3 Limits of error due to influence quantities shall meet IEC 62053-21 8.1-8.6 requirements.

5.2.4.4 Test of starting and no-load condition shall meet IEC 62053-21 8.1-8.6 requirements.

5.2.4.5 Meter constant shall meet IEC 62053-21 8.1-8.6 requirements

5.2.4.6 Accuracy test conditions shall meet IEC 62053-21 8.1-8.6 requirements

Requirements of clause 5.2.4 shall form part of the type test approval to be issued by an international/ national (of the country of manufacture) meter certifying body.

5.2.5 Instructions and Marking

5.2.5.1 In addition to IEC 62052-11:2003 nameplate requirements, each meter shall be marked **legibly and indelibly** with the following information:

a) Name or trade mark of the manufacturer;
b) Country of origin;
c) Type/model;
d) Meter number up to ten digits;
e) The inscription "Property of K.P. &. L. Co Ltd."
f) Standard(s) to which the meter complies;
g) Year of manufacture.

All markings to be written in English and with c), d) and e) **at least** 4 **mm** figure height.

5.2.5.2 Every meter shall be **indelibly** marked with diagrams of connections for which the meter is intended.

5.2.5.3 In addition, the following drawings and information shall be required with the tender:

(a) Meter drawing giving all the relevant dimensions;

(b) Wiring diagrams;

(c) Description leaflet including details of programming of the meters;

(d) Service and Operational manuals.

5.2.5.4 Copies of type approval certificate(s) with test and calibration results of the meter being offered obtained from **KEMA or MID** meter certification body shall be provided. **If type approval certificate(s) is (are) from accredited meter certification laboratories (and not national or international body), then it (they) shall be accompanied with copies of certificates of accreditation from KEMA or MID accredited lab。**

5.2.5.5 The Tenderer shall complete clearly, all the clauses in both columns of the schedule in Appendix B. This shall form the basis of evaluation of the submitted tender. Failure to complete this appendix shall render the tender non-responsive. The tenderers shall indicate the details of their offer where it is different from these requirements. Where the requirement is the same, they shall indicate what is offered. **Insertions such as "noted", "agreed" etc. shall be considered as non-responsive where a specific response is called for.**

5.2.5.6 The manufacturer shall provide proof of conformance to ISO 9001(2008) standard.

5.2.5.7 The manufacturer shall provide a list of at least three previous utilities to which the meter being offered has been supplied (**Brochures shall be attached to support this requirement**). The number of electronic meters (**single and three phase**) sold over a period of 5 years shall not be less than 150,000 meters.

5.3 HT Meter requirements

5.3.1 General Requirements

5.3.1.1 The meters shall be suitable for operation in tropical climate where temperatures may vary from -1 to +60 degrees Celsius.

5.3.1.2 Average Annual Relative humidity reaching 90% and altitude of up to 2,200m.

5.3.1.3 The meters shall be used for measurement of active energy for commercial and industrial loads under tropical climate conditions.

5.3.2 Design and Construction requirements

5.3.2.1 The dimensions of the meter must not exceed the following values:

Width：178 mm

Length：295 mm

Height：77 mm

5.3.2.2 The meters shall be constructed as 3 phase 3-wire or 3 phase 4-wire meters.

5.3.2.3 The meters shall have terminals with bottom entry for cables and the arrangement shall be L1V1L1: V2: L3V3L3 for 3 phase 3-wire meters or L1V1L1: L2V2L2: L3V3L3: N for 3 phase 4-wire meters.

5.3.2.4 The meter's front cover may be of translucent material but shall have a window (clear glass or polycarbonate) for reading the display and for observation. The terminal cover should be of transparent material. The external communication modem/module shall be equipped under the terminal cover.

5.3.2.5 The meters shall conform to the degree of protection IP 54 as given in IEC 60529:1989 Degrees of protection provided by enclosures (IP Code) Amendment 1:1999

5.3.2.6 The meters shall be of British Standard (BS) 5685-foot print for standardized mounting for asymmetrical (BS) wiring.

5.3.2.7 The meters shall be for front projection mounting.

5.3.2.8 The meters shall have sealing provisions for the meter body, meter cover and terminal cover and Reset button if the button is outside meter cover. If back-up battery is such connected that its replacement does not require opening meter cover, then provision be provided for sealing the battery cover.

5.3.2.9 The meters shall be equipped with lockable / sealable push buttons where such buttons are used to change some meter parameters.

5.3.2.10 The meter terminal cover shall be of the long type with cable entry knock-offs.

5.3.2.11 Terminal holes shall be of sufficient size to accommodate the cables of at least 4.5mm diameter.

5.3.2.12 The meters terminal holes and screws shall be made of brass or nickel-plated brass for high strength and high conductivity.

5.3.2.13 The meters shall have two separate pulse outputs (LED) indicators for testing and indication of kWh and kvarh- meter operation.

5.3.2.14 The meters shall be equipped with auxiliary terminals for inputs and outputs.

For inputs, It shall be equipped with:

1. At least 2 control signal input, the voltage signal can be 240VAC
2. At least 4 Impulse signal input, the Impulse signal should be an open/close signal

For outputs, It shall be equipped with:

1. at least 4 control signal output, the control signal should be an open/close signal, with Maximum 400VAC/DC, 100mA
2. at least 4 Impulse signal output, the Impulse signal should be an open/close signal, with Maximum 250VDC, 27mA.

5.3.2.15 The meters shall have a real-time clock controlled by a quartz crystal oscillator. It shall be possible to reset the clock without loss of billing data.

5.3.2.16 The meters shall have a backup power supply to run the calendar clock for a minimum of 1 year without mains voltage. If the backup is by means of Lithium battery it shall have a shelf life of ten years.

5.3.2.17 The meters shall have a non-volatile memory capable of data storage and with long-term data retention for the certified life of the meter or 15 years, whichever is greater without an electrical supply being supplied to the meter.

5.3.2.18 The meters shall be capable of storing load profiles for at least 180 days on 10 channels with 20

minutes integration. Adjustable time interval from 1 to 60 minutes

5.3.2.19 The channels available for load profiling shall be the following Import watts, Export watts, Export VA, Import VA, 4-quadrant Reactive energy Q1, Q2, Q3 & Q4, Phase voltages, Phase currents and Power factor.

5.3.2.20 Meter must support Up to 32 times odd harmonic voltage and current measurement

5.3.2.21 The meter shall measure THD. Meter shall support wave capture function, capture data and can be read via software

5.3.2.22 The meters principal unit for the measured values shall be the kilowatt-hour (kWh). The meter shall be capable of measuring demand in kVA and kW.

5.3.2.23 The meters shall measure active energy and demand in two energy flow directions, i.e. export and import.

5.3.2.24 The meters shall measure reactive energy and demand in four quadrants.

5.3.2.25 The meter shall measure such that kW demand shall be coincidental to kVA maximum demand; i.e. the kW demand registered shall occur at the same date and time with the highest kVA demand in a billing period for power factor calculations.

5.3.2.26 The meters shall measure Energy and Demand correctly even when the phase rotation/sequence is incorrect.

5.3.2.27 The meters shall have independent multipliers on the energy and demand registers.

5.3.2.28 Meter shall support main tariff table and passive tariff table, with the following parameters:

1) Up to 4 seasons, 4 weekend table
2) 8 daily tables
3) up to 8 divisions per day
4) Up to 4 tariff

5.3.2.29 Meter shall support Up to 100 holidays configurable individually

5.3.2.30 The meter shall have at least 8 registers for energy.

5.3.2.31 The meters shall have at least 6 registers for Max. Demand.

5.3.2.32 The meters shall be able to record reversed units.

5.3.2.33 The meters shall have a facility to indicate reverse connection.

5.3.2.34 The meters shall have a capability of closing end of billing period on any selected date of the month selectable by software.

5.3.2.35 The meter's billing registers shall NOT be re-settable to zero readings.

5.3.2.36 The meters shall have at least eighteen billing historical data stored in memory and retrievable by software action. The current billing/historical data shall be available on meter display for reading and billing purposes.

5.3.2.37 The meters shall have a backlight-LCD with at least eight (8)-numerical characters comprising of selectable integers and decimals points for measurement. The display must be associated with push buttons for parameter scrolling. Individual digit size shall be minimum 4 mm wide x 8 mm high. LCD is to be clearly readable within a viewing angle ±15° in either the horizontal or vertical direction. Nominal diminutions of the display shall be 75 mm X 23 mm.

5.3.2.38 The meters LCD shall have 6 digit ID codes that are OBIS compliant. In addition, the meters shall be DLMS/COSEM protocol compliant (IEC 62056).

5.3.2.39 The LCD shall operate in at least two modes, namely, basic and extended data list display.

5.3.2.40 Meters shall support information reading via optical communication port at site even when mains power supply fails.

5.3.2.41 The meters shall be capable of continuous display of the presence or absence of individual phase voltages.

5.3.2.42 The meters shall be capable of event recording and the event can be read remotely via system, which shall include but not be limited to:

1) Power ups and power downs with date and time stamp;
2) Individual Phase failure, with date and time stamps;
3) Over and under voltages based on a pre-set threshold with date & time stamp;
4) Battery voltage status;
5) Memory status;
6) Meter Errors,
7) Date and time of last programming/parameterization;
8) Date and time of the last billing reset;

9) Load profile.

10) Terminal and Meter cover removal

11) Existence of current, despite absence of one or two phases

12) Current unbalance, over 30% in one phase or two phases (compare with other phase) should be detected

13) Tariff change

14) Time & Date change

5.3.2.43 The LCD shall display events that have occurred. The events displayed shall include but not be limited to the following:

1) Meter errors;

2) Individual Phase failure;

3) Battery voltage status;

4) Alarms

5) Warning messages etc.

5.3.2.44 The meters shall have the relevant software and hardware.

5.3.2.45 The meters shall be equipped with Two RS485 ports for communication. The meters support remotely reading via AMI system specified separately in Article 8. The remote Communication protocol shall compliant with DLMS/COSEM, IEC62056

5.3.2.46 The meters shall be equipped with an infrared optical port with baud rate of 1200 - 9600 for meter programming and data downloading, according to IEC62056-21, mode E.

5.3.2.47 DLMS certificate and KEMA certificate should be offered

5.3.2.48 The data communication is with encryption and authentication, mechanism is method 5(GMAC)

5.3.2.49 A Lap top computer and two optical probes, details of which shall be provided by the utility, for programming and down loading the meter data shall be provided at no extra cost.

5.3.2.50 Access to meter parameters and programming information shall only be through user-level password(s).

5.3.2.51 The meters shall support with 3 access levels:

1) No security - The lowest level of security would allow users to read specified data fields without password.

2) Low level security - The level of security would allow users with the appropriate password to read specified data fields in the meter

3) High level security - The highest level of security would allow users with the appropriate password to reconfigure the meter with a new program

5.3.2.52 The meter program shall be capable of tracking user access to the meter.

5.3.2.53 The meters shall be programmable to allow the user to change parameters on the installation configuration and in particular the voltage and current transformation ratios.

5.3.2.54 The Meter shall be able to communicate with a remote central system using a plug in modem/module, through the GSM/GPRS, dual band for operation in the 900/1800 MHz GSM networks.

5.3.2.55 The modem shall support meter communication protocols as per DLMS/COSEM standards.

5.3.2.56 The communication module can be replaced at site without power off the meter. The communication module shall have the DC power output +13V to support the power to UIU.

5.3.2.57 Meter's firmware shall be upgradable remotely and locally. Upgrading of firmware shall not stop and affect meter's metrology.

5.3.2.58 Meter shall support external UIU or external IHD and meter information can be achieved via UIU or IHD.

5.3.2.59 The communication module shall support both SMS and GPRS modem and support the mode of: on line and on-demand on line.

5.3.2.60 The communication module shall support to report the event automatically via sms.

5.3.2.61 The communication module shall support USSD, CSD communication.

5.3.2.62 The communication module shall equipped with one RJ45 port.

5.3.2.63 The meter shall support report to system when it is power on or power off.

5.3.3 Electrical requirements

5.3.3.1 The meters shall be operated from main power with reference values of: -

3x57.7/100V to 240 V/415V, 3 x 1 (10) A and at 50 Hz.

5.3.3.2 Primary currents and voltages for the meters shall be programmable through the software thus allowing Primary metering of Demand and Energy.

5.3.3.3 The meters shall be connectable as three phase three wire meters or three phase four wire systems, drawing of which shall be printed on the terminal cover or on the meter base.

5.3.3.4 The meter shall have reference standard currents of: - **In= 1 A; I max = 10 A** for the operating conditions stated in clause 5.3.1.

5.3.3.5 The meters Power consumption shall meet IEC 62053-21 7.1-7.4

5.3.3.6 Influence of short-time over-currents meet IEC 62053-21 7.1-7.4

5.3.3.7 Influence of self-heating meet IEC 62053-21 7.1-7.4

5.3.3.8 AC voltage test meet IEC 62053-21 7.1-7.4

Requirements 5.3.3.5 to 5.3.3.8 shall form part of the type test approval to be issued by an international/ national (of the country of manufacture) meter certifying body.

5.3.4 Accuracy requirements

5.2.4.1 The meter's accuracy shall be class 1.0 for active energy and class 2 for reactive energy measurements as per accuracy requirements as per accuracy requirements such that it meets IEC 62053-21 8.1-8.6.

5.2.4.2 Limits of errors due to variation of the current shall meet requirement IEC 62053-21 8.1-8.6

5.2.4.3 Limits of error due to influence quantities shall meet IEC 62053-21 8.1-8.6 requirements.

5.2.4.4 Test of starting and no-load condition shall meet IEC 62053-21 8.1-8.6 requirements.

5.2.4.5 Meter constant shall meet IEC 62053-21 8.1-8.6 requirements

5.2.4.6 Accuracy test conditions shall meet IEC 62053-21 8.1-8.6 requirements

Requirements of clause 5.3.4 shall form part of the type test approval to be issued by an international/ national (of the country of manufacture) meter certifying body.

5.3.5 Instructions and Marking

5.3.5.1 In addition to IEC 62052-11:2003 nameplate requirements, each meter shall be marked legibly and indelibly with the following information:

a) Name or trade mark of the manufacturer;

b) Country of origin;

c) Type/model;

d) Meter number up to ten digits; e) The inscription "Property of K.P. &. L. Co Ltd."

f) Standard(s) to which the meter complies;

g) Year of manufacture.

All markings to be written in English and with c), d) and e) at least 4 mm figure height.

5.3.5.2 Every meter shall be indelibly marked with diagrams of connections for which the meter is intended.

5.3.5.3 In addition, the following drawings and information shall be required with the tender:

(a) Meter drawing giving all the relevant dimensions;

(b) Wiring diagrams;

(c) Description leaflet including details of programming of the meters;

(d) Service and Operational manuals.

5.3.5.4 Copies of type approval certificate(s) with test and calibration results of the meter being offered obtained from KEMA meter certification body shall be provided. If type approval certificate(s) is (are) from accredited meter certification laboratories (and not national or international body), then it (they) shall be accompanied with copies of certificates of accreditation from KEMA accredited lab.

5.3.5.5 The Tenderer shall complete clearly, all the clauses in both columns of the schedule in Appendix B. This shall form the basis of evaluation of the submitted tender. Failure to complete this appendix shall render the tender non-responsive. The tenderers shall indicate the details of their offer where it is different from these requirements. Where the requirement is the same, they shall indicate what is offered. Insertions such as "noted", "agreed" etc. shall be considered as non-responsive where a specific response is called for.

5.3.5.6 The manufacturer shall provide proof of conformance to ISO 9001(2008) standard.

5.3.5.7 The manufacturer shall provide a list of at least three previous utilities to which the meter being offered has been supplied (Brochures shall be attached to support this requirement). The number of electronic meters (single phase and three phase) sold over a period of 5 years shall not be less than 150,000 meters.

6.0 Metering Accessories

6.1 LV CT Requirements

6.1.1 The CTs to be used in LVCT metering shall meet all requirements in **Appendix E.**

6.1.2 The CT's rated current shall be 1.5 times of load current when device is normal running.

6.2 11kV PT/CT Requirements

6.2.1 For convenience during the installation, reduction of commercial losses and reduction is size, the11kV metering system PT/CT and metering enclosure shall be an integrated unit.

6.2.2 The PT/CT to be used in 11kV metering shall meet all requirements in **Appendix F.**

6.3 LV Air Circuit Breaker (ACB) Requirements

6.3.1 The circuit breaker shall comply with IEC 60847-2 standard.

6.3.2 The rated current of circuit breaker shall be configured to be 1.5-2 times of rated capacity.

6.3.3 The circuit breaker controller shall support both manual and automatic mode.

6.3.4 The circuit breaker rated voltage shall be 3phase-600Vac.

6.3.5 The circuit breaker shall automatically trip when the current through it exceeds a pre-determined value.

6.3.6 The breaker shall be equipped with provision for manual trip test

7.0 Metering Enclosures

7.1 LV Metering Enclosure Requirements

7.1.1 General Requirements

The enclosure shall be a smart equipment. The enclosure will house the controllable circuit breaker, smart meter, Communication devices, CTs and connection cables. The data from meter shall be accessed both locally and remotely.

7.1.2 Technical requirements

7.1.2.1 The meter enclosure along with the doors shall be fabricated from stainless steel and capable of withstanding the mechanical, electrical and thermal stress as well as the effects of the humidity.

7.1.2.2 The meter enclosure should have a minimum thickness of 1.0mm

7.1.2.3 The enclosure shall be contrasted with a roof tapering down for easy flow of rainwater

7.1.2.4 The enclosure shall comply with IP 65 standard requirements

7.1.2.5 The enclosure shall be constructed to allow adequate dissipation of heat

7.1.2.6 The enclosure' door shall be vandal proof.

7.1.2.7 The enclosure shall be fixed with inside hinges such that door hinges cannot be removed from outside.

7.1.2.8 The enclosure shall allow for over 120 degrees door opening

7.1.2.9 The enclosure shall be easy to operate when door opened.

7.1.2.10 The enclosure shall be free standing and suitably design with 4 member support.

7.1.2.11 The enclosure shall have provision for pole mounting, wall mounting or free standing on a concrete plinth

7.1.2.12 The enclosure shall be equipped with earth terminal.

7.1.2.13 The cabinet jointing where necessary shall be by use of stainless screw/bolts.

7.1.2.14 The enclosure/ cabinet shall have a provision for sealing and locking.

7.1.2.15 The enclosure/ Cabinet Shall be able to send an alert to the central data analysis Centre if opened

7.1.2.16 The copper bus bars in the enclosure/ cabinet shall be arranged so that it is easy to connect incoming & outgoing cables.

7.1.2.17 The bus bar installation in the enclosure shall always be stable when open/closed and heat stabilized. Good clearance shall be provided and where necessary the bus bar shall be well insulated.

7.1.2.18 The antenna of enclosure shall be extracted through a hole, the antenna shall be fixed outside the enclosure.

7.1.2.19 The antenna should be made from whether resistant materials or protected appropriately.

7.1.2.20 The enclosure shall leave enough space to install meters, LV CTs, Controllable breaker, and related equipment's. Space between meters and cabinet shall more than 60mm, space between meters & controlled breaker shall be more than 80mm.

7.1.2.21 The enclosure shall have a nameplate at the bottom of front, the nameplate should durable clear with the following details - manufacturer, model, main specifications, manufacture date.

7.1.2.22 The enclosure shall display with warning symbol - 'DANGER – HATARI'.

7.1.2.23 The cabinet shall have front transparent provision window for viewing the meter LCD display screen.

7.1.3 Enclosure installation requirements

7.1.3.1 Meter installation

7.1.3.1.1 Meters shall be installed conveniently, safely and firmly:

7.1.3.1.2 Meters shall be installed in the cabinet other than the cabinet door.

7.1.3.1.3 Meters shall be vertical installed and all the mounting hole shall be fixed by bolting.

7.1.3.1.4 The mounting hole shall be of threaded hole or other hole type which assure one operator can fix bolt of the cabinet front.

7.1.3.2 LV CTs installation

7.1.3.2.1 CTs installed for each meter shall be exactly the same i.e. same manufacturer, item type, rated current (voltage), transformation ratio, accuracy class, secondary capacity.

7.1.3.2.2 The incoming cable polarity of the same stoichiometric point of current (voltage) shall be consistent.

7.1.3.2.3 CTs in the cabinet shall be connected directly to the meter.

7.1.3.2.4 The CTs shall be supported appropriately.

7.1.3.2.5 The Nameplate of CT shall be visible after installation.

7.1.3.3 Enclosure installation

7.1.3.3.1 Enclosure shall be installed safely, firmly and easy to operate.

7.1.3.3.2 **Enclosure** shall have accessories to meet different installation scenarios such as hang, embed, ground and pole.

7.1.3.3.3 Enclosure mounting plate shall be with appropriate installation location solution and proper operation space.

7.1.3.4 Life requirements

7.1.3.4.1 The spare parts of the enclosure shall be easily changed/ replaced.

7.1.3.4.2 The Mechanical life of the Hinged lockable door shall not be less than 5,000 times while that for the electric switch shall not be less than 10,000 times.

7.1.3.5 Other Requirements

7.1.3.5.1 The enclosure shall be well packed and damp proof with the following.

（i）Manufacturer certificate

（ii）Installation instruction including the cabinet outline dimensional drawing and installation instruction

（iii）Disassembly and spare parts list

7.2 11KV metering Enclosure

7.2.1 General Requirements

11KV MV Metering enclosure shall be designed as an integral part of the PT, CT such that wires or equipment's shall not be exposed in the open air. During the installation, the whole metering equipment's shall be installed as an integrated part. The data from meter shall be accessed both locally and remotely.

7.2.2 11KV MV metering enclosure technical requirements

7.2.2.1 The enclosure shall comply with IP 65 standard requirements

7.2.2.2 The enclosure shall be constructed to allow adequate dissipation of heat

7.2.2.3 The enclosure shall be easy to operate when door opened.

7.2.2.4 The enclosure/ cabinet shall have a provision for sealing and locking.

7.2.2.5 The enclosure/ Cabinet Shall send an alert if opened

7.2.2.6 The enclosure shall be made from the same material as that of the PT & CT housing.

7.2.2.7 The enclosure frame holder shall be made from hot galvanized steel channel.

7.2.2.8 The enclosure shall have access detection with alarm relaying to Central management system.

7.2.2.9 The time of opening and closing the enclosure cabinet shall be recorded by the system.

7.2.2.10 The enclosure shall have enough space to install smart meter, communication equipment's, connecting terminals and necessary wiring space.

7.2.2.11 The antenna of enclosure shall be extracted through a hole, the antenna shall be fixed outside the enclosure.

7.2.2.12 The wiring in the enclosure shall be neat with each wire clearly labelled and consistent with the connection diagram of the enclosure.

7.3 33KV /66KV/ 132KV metering enclosure

7.3.1 General Requirements

The 33KV, 66KV, 132KV metering enclosure shall be designed to provide a complete outdoor metering enclosure solution. The metering enclosure shall be installed next to the PT & CTs in the substation yard. The data from meter shall be accessed both locally and remotely.

7.3.2 Enclosure requirements

7.3.2.1 The meter enclosure along with the doors shall be fabricated from stainless steel and capable of withstanding the mechanical, electrical and thermal stress as well as the effects of the humidity.
7.3.2.2 The enclosure shall be contrasted with a roof tapering down for easy flow of rainwater
7.3.2.3 The enclosure shall meet IP 65 standard
7.3.2.4 The enclosure shall be constructed to allow adequate dissipation of heat
7.3.2.5 The enclosure' door shall be vandal proof.
7.3.2.6 The enclosure shall be fixed with inside hinges such that door hinges cannot be removed from outside.
7.3.2.7 The enclosure shall allow for over 120 degrees door opening
7.3.2.8 The enclosure shall be easy to operate when door opened.
7.3.2.9 The enclosure shall be designed such that it can be mounted on steel structure in a substation switch yard.
7.3.2.10 The enclosure shall be equipped with earth terminal.
7.3.2.11 The enclosure shall have a provision for sealing and locking.
7.3.2.12 The enclosure shall have access detection with alarm relaying to Central management system.
7.3.2.13 The time of opening and closing the enclosure cabinet shall be recorded by the system.
7.3.2.14 The antenna of enclosure shall be extracted through a hole, the antenna shall be fixed outside the enclosure.

7.3.2.15 The antenna should be made from weather resistant materials or protected appropriately.

7.3.2.16 The cabinet shall have enough space to install smart meter, communication equipment's, connecting terminal and necessary wiring space.

7.3.2.17 The enclosure shall have a nameplate at the bottom of front, the nameplate should durable clear with the following details - manufacturer, model, main specifications, manufacture date.

7.3.2.18 The enclosure shall display a warning symbol - 'DANGER – HATARI'.

7.3.2.19 The cabinet shall have front transparent provision window for viewing the meter LCD display screen

7.3.2.20 The wiring in the enclosure shall be neat with each wire clearly labelled and consistent with the connection diagram of the enclosure.

8.0 Central System

The offered management system shall have the capacity to be integrated into the existing billing system as an overall billing system for all the customers for KPLC. One of the main requirements regarding management system is that manual interventions to these systems shall be avoided wherever possible, in order to minimize the possibility of errors and fraud. However, the systems shall support all manual interventions that are required to maintain the system operability and to correct possible errors. The contractor should have the CMMI3 or above certification to secure the system implementation.

Within the future market trends or mandates, the management system shall provide KPLC with a business-critical solution for storing, validating, aggregating, and processing large volumes of data in preparation for billing, settlements and other reporting and reconciliation obligations. The end-to-end smart meter billing solution shall include features such as:

1) Meter operating system management and parameter setting
2) Synchronization with the primary customer and meter data in the billing system (ICS)
2) Meter remote control or meter management (MM) with management system
3) Meter data analysis
4) Real-time processing
5) Web portal for customers.

8.1 General requirements of the management system

8.1.1 The system shall support multi- operation system, windows and Linux

8.1.2 The system shall support multi database, e.g. oracle database, MySQL database, SQL Server database

8.1.3 The system shall provide incremental backup and disaster recovery solution

8.1.4 The system shall support on-demand meter data reading, including but not limited to: instantaneous consumption, Events/Alarms, Load profile and shall be able to show the instantaneous values in chart.

8.1.5 The system shall support schedule reading, including but not limited to energy consumption, events/alarms, and load profile. The pre-defined schedule period shall be configurable. Usually meter data will be read on daily basis, but it should be possible to configure scheduled reading for hourly or 15 minutes periods for selected meters.

8.1.6 The system shall support remote connect/disconnect for LV customer and monitor the relay status and shall able to issue related report.

8.1.7 The system shall support remote configuration, including but not limited to meter tariff, billing time, load profile parameter, etc. Currently, two tariff rates (low and high) defined in KPLC with the same rate. But system should support up to four tariff rates and remote update of tariff structure in meters should be possible. For example high and low tariff rates for winter and summer.

8.1.8 The system shall support remote clock synchronization of meters periodically and manually.

8.1.9 The system shall support remote firmware upgrade for both metering equipment and communication modules.

8.1.10 The system shall able to send SMS/Email alarm to KPLC authorized engineers, immediately after receiving the alarm reported from the metering equipment.

8.1.11 All alarms and events should be sent to central station instantaneously, the system shall display on a graphical dashboard different areas with their corresponding alarm statuses in different colors （for example in green, yellow and red）. Users will click on specific areas to see the details of alarms.

8.1.12 A phasor diagram should be provided to help engineers analyze the electrical characteristics by tectorial representation（for example poor power factor and imbalanced loads）

8.1.13 The system shall display all the appropriate power parameters-Voltages-Currents in relation to the conventional phases sequence and in distinct colours -Red, Yellow and Blue (RYB)-Colour shades

should be distinct to distinguish each major power parameter.

8.1.14 The system shall support VEE (Validation, Estimation and Editing) - Switching Capability: for User (operator) to select two different estimation methods instead of one. If the first estimation method fails to estimate missing values (due to its configuration) then VEE automatically uses the second method to estimate load.

For validation system should support following rules:

- 1) Missing Consumption
- 2) Below Mean Value
- 3) Max Value Exceeded
- 4) Consumption Changed Within a Period
- 5) Meter Reading is Less than Previous
- 6) Energy Reverse
- 7) Power factor Bad
- 8) Month/Daily Integrity Check
- 9) Billing/Daily Integrity Check
- 10) Tariff/Total Integrity Check
- 11) For Estimation system should support:
- 12) Constant Value
- 13) Copy of Last Value
- 14) Linear Interpolation
- 15) Spline Interpolation
- 16) Regression

8.1.15 A user friendly query tool should be provided to reach to the specific customer data by entering customer number， meter number， customer name, a part of the customer name or customer telephone number.

8.1.16 The system shall support at least 200 different groups (Itineraries) of customers, based on their geographical position and their tariffs.

8.1.17 The system shall support reading selected meters in groups simultaneously at the same time, ~~including but not limited to, accumulated energy, instantaneous parameters and clock.~~

8.1.18 The system shall be able to monitor metering equipment communication status，including the meter online/offline status and GPRS data flow

8.1.19 The system shall comply with IEC61968/IEC61970 CIM (Common Information Model)

interface standard.

8.1.20 The system shall support GIS functionality, to display the terminal locations and meter's events/alarms information on the GIS map. The GIS shall work even when the server is not internet connected.

8.1.21 The system support load profile analysis, including but not limited to: voltage curve, electric current, average power curve, power factor curve, harmonic curve, etc.

8.1.22 The system shall be able to analyze energy consumption including daily consumption based on different tariff, daily consumption by weekly statistic based on different tariff, daily consumption by monthly statistic based on different tariff, monthly consumption based on different tariff.

8.1.23 The system shall support technical and management reports, including but not limited to:

- 1) Daily/Monthly Billing
- 2) Tampering report
- 3) Event report
- 4) Billing data acquisition rate reports;
- 5) Load profile acquisition rate reports;
- 6) Overvoltage/under voltage reports;
- 7) Power outage reports;
- 8) Overload reports;
- 9) Three phase unbalance reports;
- 10) Low Power Factor reports;
- 11) Voltage qualified rate reports;
- 12) Meter offline reports;
- 13) Power abnormal reports;
- 14) GPRS traffic statistics reports;
- 15) Meter archives statistic reports;

8.1.24 The system shall support security authorization management to different operators by their role assignment. Each role defines a limited access right to different functionalities and also can restrict operator's activities for read/write operations.

8.1.25 The system shall support aggregation function, including but not limited to aggregation over time, aggregation over devices (meters).

8.1.26 In case of lack of communication between meters and central station, HHU devices could be used for meter data reading locally/manually.

8.1.27 Two way communication between meters and central station will be provided by GPRS communication. The system shall be able to use any one of the GPRS providers SIM cards for communication whichever KPLC avails.

8.1.28 An interface shall be developed to export billing data (energy, demands and power factor) to existing billing system (ICS) automatically.

8.1.29 Inter-period bills can be generated by on demand meter data reading and exporting data to billing system.

8.1.30 The system shall support meters from other vendors/manufacturers conforming to ***dlms cosem*** communication protocol.

8.2 FDM (Field Device Management System) requirement

8.2.1 The system shall support importing Meter Archives in groups in form of CSV, also support to import from other systems through customized interface.

8.2.2 The system shall support management of meter installation by HHU, including barcode scanning, GPS positioning, meter photo. The collected data and information shall be able to be downloaded to the central office.

8.2.3The system shall support at least 200,000 measurement points/meters

8.2.4 The system shall support to export Meter Archives to CSV files or customized interface

8.2.5 The system shall be able to generate meter installation report, including but not limited to daily report, weekly report and monthly report

8.2.6 The system shall be able to record tracking logs, including but not limited to, Operation log, Meter archives download/upload log, Meter archives import/export log, log-ins.

8.3 Disaster Recovery

The system shall support third party professional system backup and disaster recovery software Symantec Backup Exec to backup and manage disaster recovery for the main server, slave server and database.

8.4 IT hardware

The tenderer is requested to offer their recommended hardware equipment to provide a stable and reliable system required for central system. The performance requirements for equipment should be

designed based on the functions to be performed and amount of data to be processed. In addition, sufficient performance margin should be foreseen for future extensions.

8.4.1 Servers, Network devices and other required hardware for central system should be provided by contractor

8.4.2 Application servers, data base servers and Head End servers should be configured in clustered to provide high availability and load sharing

8.4.3 The tenderer is responsible for cabling, installation and configuration of all hardware required in central center.

8.4.4 Cyber security should be provided by hardware and software like firewalls and anti-viruses.

8.4.5 Storage capacity of servers (hard disks) should be foreseen

8.4.6 Time synchronization of servers shall be done by a GPS clock

8.4.7 Security equipment should be installed for securing the whole devices of central station

8.4.8 Firewalls should be installed and configured to control the access of internal and external users to system.

8.4.9 UPS should be installed to provide the electricity for central center equipment, at least with one hour support in the lack of input electricity.

8.4.10 The contractor should provide 3 sets computer and one 65 inch wall mounted display to show the functions of the central system.

Table 1 Smart Metering Head-end server specification

	Basic Specification	**Mandatory/Minimum Requirements**	**TENDERERS COMPLIANCE /REMARKS**	**REFERENCE PAGE IN THE SUBMITTED DOCUMENTS**
1	Form Factor	Blade Servers complete with a rack		
2	AC power	Dual Supply, 220-240VAC, 50Hz		

	Basic Specification	Mandatory/Minimum Requirements	TENDERERS COMPLIANCE /REMARKS	REFERENCE PAGE IN THE SUBMITTED DOCUMENTS
3	Operating systems provided	Microsoft Windows 2008 Server, Enterprise Edition		
4	Processor type	Dual core Intel xeon 5140 processor FSB with 4MB level 2 cache		
5	Memory(Installed Ram)	4GP PC2-5300 Fully buffered DIMMs memory pair		
6	Storage Controller	Smart Array P4000/512MB BBWC Controller(with RAID0/1/5 support)		
7	Internal Storage	Hot Plug Serial attached SCSI(SAS) 1.168TB		
8	Hard Drive bays	8 driver bays(Serial attached SCSI(SAS) drives supported-SFF)		
9	Hard Drive	72GB 10K HDD(RAID 5 ready i.e. at least three disks, plus 2 spares)		
10	Optical Drive	DVD-ROM/DVD-RW		
11	Expansion slots	Total of 8(2x64 bit/133 MHZ PCI-X and 6X PCI-Express)		
12	Input device type	Standard Keyboard, PS/2-2 button scroll mouse		
13	Network interface	Embedded dual NC373i Multifunctional Gigabit Network adaptors with TCP/IP offload		
14	USD ports	USB2.0 support with six ports		
15	Display size	17 TFT		
16	Color Support	526 bit resolution		
17	Warranty	3 years		

Table 2 Application server specification

	Basic Specification	Mandatory/Minimum Requirements	TENDERERS COMPLIANCE/ REMARKS	REFERENCE PAGE IN THE SUBMITTED DOCUMENTS
1	CPU speed	>= 3 GHz		
2	AC power	Dual Supply, 220-240VAC, 50HX		
3	Operating systems provided	Microsoft Windows 2008 Server, Linux		
4	Hard Drive	>= 1TB, SCSI		
5	Optical Drive	DVD-ROM/DVD-RW		
6	RAM	>= 4GB		
7	Input device type	Standard Keyboard, PS/2-2 button scroll mouse		
8	Network interface	100-1000 Mbps		
9	USB ports	USB2.0 support with six ports		
10	Display size	>= 17 TFT		
11	Color Support	526 bit resolution		
12	Warranty	3 years		

Table 3 Data base server's specification

	Basic Specification	Mandatory/Minimum Requirements	TENDERERS COMPLIANCE/ REMARKS	REFERENCE PAGE IN THE SUBMITTED DOCUMENTS
1	CPU speed	>= 3 GHz		
2	AC power	Dual Supply, 220-240VAC, 50HX		
3	Operating systems provided	Microsoft Windows 2008 Server, Linux		
4	Hard Drive	>= 1TB, SCSI, Raid >= 1		
5	Optical Drive	DVD-ROM/DVD-RW		
6	RAM	>= 4GB		
7	Input device type	Standard Keyboard, PS/2-2 button scroll mouse		
8	Network interface	100-1000 Mbps		
9	USB ports	USB2.0 support with six ports		
10	Display size	>= 17 TFT		
11	Color Support	526 bit resolution		
12	Warranty	3 years		

Table 4 Bill of Quantities

Item	Description	Quantity	TENDERERS COMPLIANCE/ REMARKS	REFERENCE PAGE IN THE SUBMITTED DOCUMENTS
GPRS/EDGE routers	With 1 port V35, 1 port01/100 Base T,GSM/GPRS SIM port	4		
Cisco 2811 router	VPN service, 9-port Ethernet switch 6 port WIC-T	2		
Cisco VPN server	Integrated in router 2811 above	2		
Application server	For system software	2		
Data base server	for DBMS	2		
Communication server	For Head End	2		

9.0 HHU requirements

9.1 Main Functions

9.1.1 KPLC staff shall use handheld unit to read meter equipment and set parameter at site.
9.1.2 During the installation, tenderer shall be able to read longitude and latitude information of the installation site and report to data center with the GIS information and the meter information after the installation.
9.1.3 Navigate user to provided GIS location.

9.2 Hardware requirements

HHU communication mode
9.2.1 HHU shall at least have one USB port to download the task from data center as well as uploading data to the data center.
9.2.2 HHU with wireless communication shall be able to acquire data from the meter at least 50m from the intended meter/s enclosure/s.
9.2.3 HHU shall have high precision GPRS location module.

9.3 Electric requirements

9.3.1 Operation system: Microsoft Windows
9.3.2 LCD display: TFT-LCD，320x240 pixel，with touch screen
9.3.3 Power supply: up-to-100-hours-of-standby time
9.3.4 IP requirements: IP65， can withstand the drop impact of vertical height 1.5 meters.
9.3.5 Working temperature: use:-20°C to 50°C

9.4 Operation system requirements

9.4.1 The HHU shall be able to read meter information via wireless, the information shall include but not limited as follows:

1) Meter consumption reading
2) Instantaneous data reading
3) Billing information reading
4) Event information reading: e.g., Phase loss, over-current, over-voltage, open box and etc.
5) Basic parameter reading, e.g. Meter number, software version no.、assets number and etc.

9.4.2 The HHU shall be able to configure the meter parameters, the configuration shall include but not limited to following:

1) Set the time
2) Set the communication parameter
3) GPS code reading and match the GPS code with meter Number.
4) Import /Export meter information in batch

9.4.3 The HHU shall be able to navigate the user to a desired GIS location

10.0 Meter Data Analysis Center (MDAC)

The MDAC shall offer meter data analysis to allow realization of full benefits from central system thorough analysis of each customer data. The MDAC so established, apart from tamper events shall conduct advance meter data analysis based on load survey and other information.

The MDAC shall be linked to the main control center and be equipped with; additional software for analysis, system compatible display screen-not less than 65 inches. It shall be interpreting the data from the meter and generate desired reports. The data analysis shall not be limited to but include;

- Tamper Exception Reports
  - Terminal Cover Open
  - All potential missing cases
  - Individual potential missing cases
  - Neutral Disturbance cases
  - CT reversal cases
  - CT Open cases
- Instantaneous Parameter Exception Reports
  - Voltage magnitude
  - –ve active energy component
  - Unbalance Current
  - Voltage Unbalance and abnormal angle
  - Abnormal P.f cases
- Load Survey (LS) Exception Reports
  - Consumption drop cases

- No load and no power cases
- Collaborating transformer load and LS data
- Voltage Unbalance and abnormal angle

The MDAC shall be responsible for periodic data analysis of all Large Power customers. This analysis will be separate from the flagged cases based on tamper exceptions. Each large power customer shall be analyzed at least once in a quarter.

The MDAC shall support field inspection teams in identifying suspected cases in their regions by identifying probable reasons of tampering.

The MDAC shall be responsible for generating MIS reports of its activities such as communication status of AMR connections, troubleshooting, exception report analysis, periodic data analysis, revenue recovered due based on insights from data analysis.

11.0 Sample and demonstration requirements

11.1 Sample Requirements

11.1.1 Each supplier shall submit the following samples for tender evaluation.

1) One sample for LV direct customer metering equipment.
2) One sample for LV CT metering equipment
3) One sample of MV metering solution of 11KV (Integrated CT/PT metering equipment)
4) One sample of the 33kV/ 66 kV/ 132 kV metering enclosure

11.1.2 The sample shall be with the nameplate fixed on the bottom of low/ high voltage metering system firmly, including but not limited to following information:

A) Asset number of KPLC
B) Voltage ratio
C) Current ratio
D) The height of the digits shall be more than 10mm.

11.2 Demonstration requirements

Upon receipt of the official notice from KPLC, tenderer shall come to KPLC to offer a live demonstration within 5 working days after the notice. The live demonstration shall present the solution and detailed project plans for all the scenarios described in the background. The tenderer shall demonstrate the solutions proposed, including but not limited to:

a) Live demonstration on the LV whole current enclosure solution
b) Live demonstration on the LV CT metering enclosure solution.
c) Live demonstration on the 11KV metering solution
d) Live demonstration of the 33kV/ 66kV/ 132kV solution

e) Live demonstration on the Central Management system

11.2.1 Bidders are advised that the Laws of Kenya require that the **Kenya Bureau of Standards** must approve any new meter being introduced in the country. To this end Bidders shall furnish the Bureau with 4 (four) samples of each meter type to be supplied. Bids submitted without the meter type approval from **Kenya Bureau of Standards** will **NOT** be considered non-responsive. However the winning Bidder must submit this approval before the signing of the supply contract. Bidders may communicate directly with the **Kenya Bureau of Standards** on this matter through the following address:

The Managing Director,
Kenya Bureau of Standards
P.O. Box 54974, 00200 Nairobi

Tel: +254-20-605490/ 602350

Fax: +254-20-604031
Email: info@kebs.org
Website: http://www.kebs.org

12.0 INFORMATION AND WARRANTY *(In case of Tender Award)*

12.1 Drawings and technical details shall be submitted to KPLC for approval before manufacture of the meters & metering equipment commences. KPLC undertakes to submit their comments or approval for the drawings within three weeks of receiving the draft copies.

12.2 Original software, software manuals and operation manuals shall be submitted in 3 copies. Description leaflets (brochures) shall be submitted in copies of 100 for each meter type.

12.3 The LV/MV/HV metering equipment shall have a warranty against any defects, which may develop due to faulty material, calibration, transportation or workmanship for a period of thirty-six months from the date of delivery. **All defective meters shall be replaced at the supplier's cost.**

12.4 The manufacturer shall make a commitment in writing on the availability of essential spares and other consumables for the certified life of the meter.

12.5 KPLC engineers will inspect manufacturing facilities intending to supply meters, LVCTs, PT/VTs to the company at no extra cost, except the cost of the engineers' transportation to the nearest major airport. Such inspection shall not in any way prejudice the purchaser's rights and privileges.

12.6 The manufacturer shall provide hands-on training on the smart meters and associated equipment in the AMI system at the factory for six KPLC Engineers. The training shall cover and not limited to the following areas:

(a) Meter metrology and features;
(b) Installation and Operation of the AMI system;

(c) AMI Hardware and Software operation.

12.7 The manufacturer shall meet the full costs of four engineers, for meter inspection and acceptance testing at the manufacturer's facility, excepting the cost of engineers' transportation from Kenya to the nearest major airport. The training and factory acceptance tests shall run for a duration of five (5) working days.

12.8 After delivery and installation of meters/ metering equipment to KPLC, the manufacturer shall conduct training for at least 3 days for twenty people in Nairobi, Kenya. The training shall cover and not be limited to:

(a) Meter metrology and features;
(b) Installation and Operation of the AMI system;
(c) AMI Hardware and Software operation;

12.9 The manufacturer shall meet the cost of the training described in clause (12.6) and (12.8).

Appendix A

I Summary Of Technical Specifications for LV CT & HT meter

	Specification	Unit	Requirement	MANUFACTURER'S COMPLIANCE/REMARKS	REFERENCE PAGE IN THE SUBMITTED DOCUMENTS
1	Phase nominal voltage	V	3x57.7/100V to 240 V/415V		
2	Max current	A	10 A		
3	Nominal current Requirements (Ib)	A	5A		
4	Max. power consumption for voltage circuit	VA	Apparent power: < 10VA Active power: < 2W		
5	Max. power consumption for current circuit	VA	0.5 VA		
6	Min.Starting current	A	1 mA		
7	Max. meter's Dimensions with terminal cover (Height * Width *Length)	mm	300x180x80		

	Specification	Unit	Requirement	MANUFACTURER'S COMPLIANCE/REMARKS	REFERENCE PAGE IN THE SUBMITTED DOCUMENTS
8	The total weight not exceed than 2kg	Kg	< 2 kg		
9	protection against Electromagnetic Compatibility (EMC)	-	Meet the IEC 62052-21 2003 standard requirement		
10	Battery material	-	lithium		
11	Battery capacity	mAh	1200 mAh		
12	The battery easy to change	-	The meter has independent cover for battery with seal; do not need open the meter cover.		
13	Min. life cycle of the backup battery in Operating Status	year	8		
14	Min. life cycle of the backup battery without power	year	2.5		
15	The LCD can display battery low voltage alarm	-	When battery flag is flash, that meaning the battery should change		
16	Meter enclosure protection (without suction test)	-	At least IP 51		
17	Operation range	°C	-25< Operation range <+70		
18	Limit Range of Operation range by maintaining its accuracy class without any failure	°C	-40 < Limit range < +70		
19	Tolerable storage range of Operation range	°C	-40< Limit range < +85		
20	Operation range of humidity	%	0 to 95		

	Specification	Unit	Requirement	MANUFACTURER'S COMPLIANCE/REMARKS	REFERENCE PAGE IN THE SUBMITTED DOCUMENTS
21	Accuracy class for active energy	-	Class 0.2S		
22	Min. Accuracy class for reactive energy	-	Class 2		
23	Insulation protection class 2	-	Required		
24	Min.accuracy of meter's clock in 23°c	Sec/day	±0.5S/day		
25	Meter should have a compliance with IEC standards optical port	-	Required		
26	Meter should have two RS485 for extend communication	-	Two RS485 port		
27	Meter should haveR232 port for communication with extend GPRS module	-	Required; The physical connect port type is RJ45 for KPLC easy to install		
28	GPRS module install under the terminal cover, working on 900/1800MHZ dual band	-	900/1800 GPRS		
29	Meter has active, reactive, Second signal impulse output port	-	Passive; Voltage range: DC 5-27V Conduction interval:35ms~50ms		
30	In the meter front has two LED, one for Active, another for Reactive. When the led flash for check the meter accuracy.	-	The LED display red colour		
31	Active energy Constant	-	10000 imp/kWh		

	Specification	Unit	Requirement	MANUFACTURER'S COMPLIANCE/REMARKS	REFERENCE PAGE IN THE SUBMITTED DOCUMENTS
32	Reactive energy Constant	-	10000imp/kWh		
33	The PT,CT rate can be configure by system	-	Required		
34	Meter has input port	-	2 port, for switch signal input		
35	Meter has output control port	-	4 control port; on resistance: Zi < 10Ω; electrical properties: 250VAC 1A。		
36	Meter terminal cover should has two seal at left and right, protect all I/O port	-	Required Only broken the seal can touch the I/O port		
37	Meter has two key, up key for take turn display, down key for reset the Maximum demand. The down key can be independent sealed.	-	Required		
38	The utility can remote update the meter firmware by GPRS way, also update the firmware by optical port	-	Required		
39	The voltage terminal diameter	mm	At least 4.5mm^2		
40	Voltage and current terminal screw quantity	number	2 screws, the screws be made of brass		
41	The mode of connection voltage and current wire	-	Asymmetric type		

	Specification	Unit	Requirement	MANUFACTURER'S COMPLIANCE/REMARKS	REFERENCE PAGE IN THE SUBMITTED DOCUMENTS
42	Meter terminal cover should has two seal at left and right.	-	Required		
43	Meter display Type	-	LCD		
44	Main display number	-	At least 8 number		
45	Digit size	mm	4.2 x 8mm		
46	OBIS code	-	At least 6 number		
47	OBIS code size	mm	5*3 mm		
48	At least LCD view angle	degree	View angle of 15° in top direction and 60° in each direction		
49	How scrolling information on LCD	-	Automatic, change screen can set; Using Meter key to change screen;		
50	LCD can display: 3 phase current direction 3 phase voltage	-	Required		
51	Meter cover is open now, LCD flag should flash.	-	Required		
52	There is magnetic field which is over 0.5mT, LCD flag should flash.	-	Required		
53	When inverse phase sequence happens, LCD flag should flash.	-	Required		

	Specification	Unit	Requirement	MANUFACTURER'S COMPLIANCE/REMARKS	REFERENCE PAGE IN THE SUBMITTED DOCUMENTS
54	Meter can measure each phase voltage and current, Frequency, Power factor.	-	Required		
55	Meter can measure each phase Active power, Reactive power, Apparent power	-	Required		
56	Measure harmonic 3 phases voltage	-	Total, 3-31 odd harmonic		
57	Meter measure each phase forward active power	-	Required		
58	Total forward active power	-	Required		
59	Total reverse active power of three-phase	-	Required		
60	Total forward reactive power of three-phase	-	Required		
61	Total reverse reactive power of three-phase	-	Required		
62	Measure harmonic 3 phases current	-	Total, 3-31 odd harmonic		
63	Data memory size	Bytes	At least 8M		
64	Measure voltage angle	-	BA, CB, AC		
65	Measure voltage angle	-	BA, CB, AC		

	Specification	Unit	Requirement	MANUFACTURER'S COMPLIANCE/REMARKS	REFERENCE PAGE IN THE SUBMITTED DOCUMENTS
66	Meter has TOU function	-	Support 8 tariff register for forward active energy ; Support 8 tariff register for reverse active energy; Support 8 tariff register for forward reactive energy; Support 8 tariff register for reverse reactive energy;		
67	Meter has four quadrant power register	-	Required		
68	Meter has total forward active MD register	-	Required		
69	Meter has forward active each 8 tariff MD register	-	Required		
70	Meter has total reverse active MD register	-	Required		
71	Meter has reverse active each 8 tariff MD register	-	Required		
72	Meter has total forward reactive MD register	-	Required		
73	Meter has forward reactive each 8 tariff MD register	-	Required		
74	Meter has total reverse reactive MD register	-	Required		

	Specification	Unit	Requirement	MANUFACTURER'S COMPLIANCE/REMARKS	REFERENCE PAGE IN THE SUBMITTED DOCUMENTS
75	Meter has reverse reactive each 8 tariff MD register	-	Required		
76	Meter has total forward apparent MD register	-	Required		
77	Meter has forward apparent each 8 tariff MD register	-	Required		
78	Meter has total reverse apparent MD register	-	Required		
79	Meter has reverse apparent each 8 tariff MD register	-	Required		
80	Above mention MD register data can be display on LCD by deploy	-	Required		
81	Meter has RTC function	-	Include Year, Month, Day, Weekdays, □Hours, Minutes, Seconds		
82	Time and data can display on LCD	-	The display format Date: MM:DD:YY Clock: HH:MM :SS		
83	The RTC support DST	-	Required		
84	Meter monitor the quality of power grid: monitor the quality of power grid	-	Record power-off in short time and power-off in long time into register		
85	Monitoring overvoltage and under-voltage	-	Record the starting time of overvoltage, the ending time of overvoltage and the highest voltage		

	Specification	Unit	Requirement	MANUFACTURER'S COMPLIANCE/REMARKS	REFERENCE PAGE IN THE SUBMITTED DOCUMENTS
			value in this process into separate register.		
86	Monitoring loss of phase	-	Record starting time of loss of phase and ending time of loss of phase into separate register.		
87	Monitoring current unbalanced	-	Record starting time of current unbalanced and the ending time of current unbalanced into separate register.		
88	Monitoring voltage unbalanced	-	Record stating time of voltage unbalanced and ending time of voltage unbalanced into separate register.		
89	Terminal cover open and closed	-	Record stating time of open cover and ending time of closed cover into separate register. Active send alarm to master station		
90	Appearance of large magnetic field	-	Record stating time magnetic appearance and ending time into separate register. Active send alarm to master station		
91	Meter cover open and closed	-	Record stating time of open cover and ending time of closed cover into separate register. Active send alarm to master station		

	Specification	Unit	Requirement	MANUFACTURER'S COMPLIANCE/REMARKS	REFERENCE PAGE IN THE SUBMITTED DOCUMENTS
92	Optical visit event	-	When optical communication with meter, event will be recorded		
93	Load record channels	Number	At least 17 channel		
94	The total storage capacity	Bytes	>3.5M Bytes		
95	Calculation cycle	minute	Between 1 minutes to 1440 minutes.		
96	Billing amount	number	The meter could store the latest 18 historical billing		
97	communication standards	-	☐ IEC62056-21 ☐ IEC62056-46 ☐ IEC62056-62 ☐ IEC62056-61 ☐ IEC62056-47		
98	The meter information shows on the meter front by laser	-	Clear and ultraviolet-proof		
99	Detail information		Voltage, current, frequency, Company Name or company logo, KPLC name, constant, Related standards.		
100	The meter base, meter cover, Terminal cover material	-	Opaque PC+ fiber glass, that is good for eve resistant		
101	Meter cover has transparent window for read LCD data	-	Required		
102	Meter sealing	-	Main cover and base must be connected together. Meter should		

	Specification	Unit	Requirement	MANUFACTURER'S COMPLIANCE/REMARKS	REFERENCE PAGE IN THE SUBMITTED DOCUMENTS
			sealed in such way to avoids any type of tamper and illegal use and it is not possible to access the internal components without breaking		
103	Meter should have KEMA or MID certificate	-	Required		

II Summary of Mandatory Technical specifications of whole current Meter

	Specification	Unit	Requirement	MANUFACTURER'S COMPLIANCE/REMARKS	REFERENCE PAGE IN THE SUBMITTED DOCUMENTS
1	Phase nominal voltage	V	3x100/172V to 240 V/415V		
2	Max current	A	100 A		
3	Nominal current Requirements (Ib)	A	5A		
4	Max. power consumption for voltage circuit	VA	Apparent power: < 5VA Active power: < 2W		
5	Max. power consumption for current circuit	VA	2 VA		
6	Min Starting current	A	10 mA		
7	Max. meter's Dimensions with terminal cover (Height	mm	280x180x85		
	* Width *Length)				
8	The total weight not exceed than 2kg	Kg	< 1.7 kg		
9	protection against	-	Meet the IEC 62052-21 2003		

	Specification	Unit	Requirement	MANUFACTURER 'S COMPLIANCE/RE MARKS	REFERENCE PAGE IN THE SUBMITTED DOCUMENTS
	Electromagnetic Compatibility (EMC)		standard requirement		
10	Battery material	-	lithium		
11	Battery capacity	mAh	1000 mAh		
12	The battery easy to change	-	The meter has independent cover for battery with seal; do not need open the meter cover.		
13	Min. life cycle of the backup battery in Operating Status	year	8		
14	Min. life cycle of the backup battery without power	year	2.5		
15	The LCD can display battery low voltage alarm	-	When battery flag is flash, that meaning the battery should change		
16	Meter enclosure protection (without suction test)	-	At least IP 54		
17	Operation range	°C	-25< Operation range <+65		
18	Tolerable storage range of Operation range	°C	-40< Limit range < +75		
19	Operation range of humidity	%	0 to 95		
20	Accuracy class for active energy	-	Class 0.5S		
21	Min. Accuracy class for reactive energy	-	Class 2		
22	Insulation protection class 2	-	Required		
23	Min.accuracy of meter's clock in 23°c	Sec/day	±0.5S/day		
24	Meter should have a	-	Required		

	Specification	Unit	Requirement	MANUFACTURER 'S COMPLIANCE/REMARKS	REFERENCE PAGE IN THE SUBMITTED DOCUMENTS
	compliance with IEC standards optical port				
25	Meter should have RS485 port for extend communication	-	RS485 port Baud rate: 1200~9600 bps(Configurable)for low speed interface Baud rate: 1200~38400 bps(Configurable)for high speed interface		
26	GPRS module install under the terminal cover, working on 900/1800MHZ dual band	-	900/1800 GPRS		
27	Meter has active, reactive impulse output port	-	Passive; Voltage range: DC 5-27V Conduction interval:35ms~50ms Zi<300Ω		
28	In the meter front has two LED, one for Active, another for Reactive. When the led flash for check the meter accuracy.	-	The LED display red colour		
29	Active energy Constant	-	1000 imp/kWh		
30	Reactive energy Constant	-	1000imp/kWh		
31	Meter has one control port	-	Dry-reed relay control output; Maximum 250VAC/1A; Conduction interval:50~1000ms configurable		
32	Meter terminal cover should has two seal at left and right, protect all I/O port	-	Required, Only broken the seal can touch the I/O port		

	Specification	Unit	Requirement	MANUFACTURER 'S COMPLIANCE/REMARKS	REFERENCE PAGE IN THE SUBMITTED DOCUMENTS
33	Meter has two key, up key for take turn display, down key for reset the Maximum demand. The down key can be independent sealed.	-	Required		
34	The utility can remote update the meter firmware by GPRS way, also update the firmware by optical port	-	Required		
35	The terminal diameter	mm	At least 8mm		
36	Number of terminal screw	number	2 screws, the screws be made of brass		
37	The mode of connection voltage and current wire	-	Asymmetric type		
38	Meter terminal cover should has two seal at left and right.	-	Required		
39	Meter display Type	-	LCD		
40	Main display number	-	At least 8 number		
41	Digit size	mm	4.1 x 8mm		
42	OBIS code	-	At least 6 number		
43	OBIS code size	mm	5*3 mm		
44	At least LCD view angle	degree	View angle of 10° in top direction and 45° in each direction		
45	How scrolling information on LCD	-	Automatic, change screen can set; Using Meter key to change screen;		
46	LCD can display: 3 phase current direction 3 phase voltage	-	Required		
47	Meter cover is open,	-	Required		

	Specification	Unit	Requirement	MANUFACTURER 'S COMPLIANCE/REMARKS	REFERENCE PAGE IN THE SUBMITTED DOCUMENTS
	LCD has flag should flash.				
48	There is magnetic field which is over 0.5mT, LCD has flag should flash.	-	Required		
49	When inverse phase sequence happens, LCD flag should flash.	-	Required		
50	Meter can measure each phase voltage and current, Frequency, Power factor.	-	Required		
51	Meter can measure each phase Active power, Reactive power, Apparent power	-	Required		
52	Meter measure each phase forward active power	-	Required		
53	Total forward active power	-	Required		
54	Total reverse active power of three-phase	-	Required		
55	Total forward reactive power of three-phase	-	Required		
56	Total reverse reactive power of three-phase	-	Required		
57	Measure voltage angle	-	BA, CA		
58	Measure voltage angle	-	BA, CA		
59			Support 8 tariff register for forward active energy ;		
	Meter has TOU function	-	Support 8 tariff register for reverse active energy; Support 8 tariff register for forward reactive energy; Support 8 tariff register for		

	Specification	Unit	Requirement	MANUFACTURER 'S COMPLIANCE/RE MARKS	REFERENCE PAGE IN THE SUBMITTED DOCUMENTS
			reverse reactive energy;		
60	Meter has four quadrant power register	-	Required		
61	Meter has total forward active MD register	-	Required		
62	Meter has forward active each 8 tariff MD register	-	Required		
63	Meter has total reverse active MD register	-	Required		
64	Meter has reverse active each 8 tariff MD register	-	Required		
65	Meter has total forward reactive MD register	-	Required		
66	Meter has forward reactive each 8 tariff MD register	-	Required		
67	Meter has total reverse reactive MD register	-	Required		
68	Meter has reverse reactive each 8 tariff MD register	-	Required		
69	Meter has total forward apparent MD register	-	Required		
70	Meter has forward apparent each 8 tariff MD register	-	Required		
71	Meter has total reverse apparent MD register	-	Required		
72	Meter has reverse apparent each 8 tariff MD register	-	Required		
73	Above mention MD register data can be display on LCD by deploy	-	Required		

	Specification	Unit	Requirement	MANUFACTURER 'S COMPLIANCE/RE MARKS	REFERENCE PAGE IN THE SUBMITTED DOCUMENTS
74	Meter has RTC function	-	Include Year, Month, Day, Weekdays, □Hours, Minutes, Seconds		
75	Time and data can display on LCD	-	The display format Date: MM:DD:YY Clock: HH:MM :SS		
76	The RTC support DST	-	Required		
77	Meter monitor the quality of power grid: monitor the quality of power grid	-	Record power-off in short time and power-off in long time into register		
78	Monitoring overvoltage and under-voltage	-	Record the starting time of overvoltage, the ending time of overvoltage and the highest voltage value in this process into separate register.		
79	Monitoring loss of phase	-	Record starting time of loss of phase and ending time of loss of phase into separate register.		
80	Monitoring current unbalanced	-	Record starting time of current unbalanced and the ending time of current unbalanced into separate register.		
81	Monitoring voltage unbalanced	-	Record stating time of voltage unbalanced and ending time of voltage unbalanced into separate register.		
82	Terminal cover open and closed	-	Record stating time of open cover and ending time of closed cover into separate register. Active send alarm to master station		
83	Appearance of large	-	Record stating time magnetic		

	Specification	Unit	Requirement	MANUFACTURER 'S COMPLIANCE/REMARKS	REFERENCE PAGE IN THE SUBMITTED DOCUMENTS
	magnetic field		appearance and ending time into separate register. Active send alarm to master station		
84	Meter cover open and closed	-	Record stating time of open cover and ending time of closed cover into separate register. Active send alarm to master station		
85	Optical visit event	-	When optical communication with meter, event will be recorded		
86	Load record channels	Number	At least 17 channel		
87	The total storage capacity	Bytes	>3.5M Bytes		
88	Calculation cycle	minute	Between 1 minutes to 1440 minutes.		
89	Billing amount	number	The meter could store the latest 18 historical billing		
90	communication standards	-	☐ IEC62056-21 ☐ IEC62056-46 ☐ IEC62056-62 ☐ IEC62056-61 ☐ IEC62056-47		
91	The meter information shows on the meter front by laser	-	Clear and ultraviolet-proof		
92	Detail information		Voltage, current, frequency, Company Name or company logo, KPLC name, constant, Related standards.		
93	The meter base, meter cover, Terminal cover material	-	Opaque PC+ fiber glass, that is good for uvi-resistant		
94	Meter cover has transparent window for read LCD data	-	Required		

	Specification	Unit	Requirement	MANUFACTURER 'S COMPLIANCE/RE MARKS	REFERENCE PAGE IN THE SUBMITTED DOCUMENTS
95	Meter sealing	-	Main cover and base must be connected together. Meter should sealed in such way to avoids any type of tamper and illegal use and it is not possible to access the internal components without breaking		

Appendix B
Summary of Mandatory Technical specifications of Central System

	Specification	MANUFACTURER'S COMPLIANCE/REMA RKS	REFERENCE PAGE IN THE SUBMITTED DOCUMENTS
1	Multi Operating System		
2	Multi Data base support		
3	Backup、restore support		
4	On Demand meter data reading		
5	Scheduled reading		
6	Alarms/Events collection		
7	Remote disconnect/reconnect		
8	Remote tariff update		
9	Remote clock synchronization		
10	Remote firmware upgrade		
11	Send SMS/Email to users		
12	Vector diagrams		
13	Validation rules		
14	Estimation methods		
15	Customer grouping		
16	User friendly query tools		
17	CIM support		
18	GIS functionality		
19	Operator role assignment		
20	Operator access rights		
21	HHU meter data reading		

	Specification	MANUFACTURER'S COMPLIANCE/REMARKS	REFERENCE PAGE IN THE SUBMITTED DOCUMENTS
22	Billing interface		
23	Inter- period billing		
24	FDM functionality		
25	Events/Alarms dash board		

Appendix C

Specifications Matrix for Large Power Outdoor metering solution

CLAUSE	KENYA POWER REQUIREMENT	MANUFACTURER'S COMPLIANCE/REMARKS	REFERENCE PAGE IN THE SUBMITTED DOCUMENTS
6.0	**Metering Accessories**		
6.1	**LV CT Requirements**		
6.1.1	Meets all requirements in **Appendix 1**		
6.1.2	Rated current shall be 1.5 times of load current when device is normal running		
6.2	**11kV PT/CT Requirements**		
6.2.1	PT/CT and metering enclosure shall be an integrated unit		
6.2.2	shall meet all requirements in **Appendix 2**		
6.3	**LV Air Circuit Breaker (ACB) Requirements**		
6.3.1	Comply with IEC 60847-2 standard.		
6.3.2	The rated current configured to be 1.5-2 times of rated capacity.		
6.3.3	Support both manual and automatic mode.		
6.3.4	Rated voltage shall be 3phase-600Vac.		
6.3.5	Automatically trip when the current through it exceeds a pre-determined value.		
6.3.6	Equipped with provision for manual trip test		
7.0	**Metering Enclosures**		
7.1	**LV Metering Enclosure Requirements**		
7.1.1	**General Requirements**		
	SMART equipment		
7.1.2	**Technical requirements**		

CLAUSE	KENYA POWER REQUIREMENT	MANUFACTURER'S COMPLIANCE/REMARKS	REFERENCE PAGE IN THE SUBMITTED DOCUMENTS
7.1.2.1	fabricated from stainless steel and capable of withstanding the mechanical, electrical and thermal stress as well as the effects of the humidity.		
7.1.2.2	Minimum thickness of 1.0mm		
7.1.2.3	Roof tapering down for easy flow of rainwater		
7.1.2.4	Comply with IP 65 standard requirements		
7.1.2.5	Allows adequate dissipation of heat		
7.1.2.6	Vandal proof		
7.1.2.7	Fixed with inside hinges such that door hinges cannot be removed from outside.		
7.1.2.8	Allow for over 120 degrees door opening		
7.1.2.9	Easy to operate when door opened.		
7.1.2.10	Free standing and suitably design with 4 member support		
7.1.2.11	Provision for pole mounting, wall mounting or free standing on a concrete plinth		
7.1.2.12	The enclosure shall be equipped with earth terminal.		
7.1.2.13	The cabinet jointing where necessary shall be by use of stainless screw/bolts.		
7.1.2.14	The enclosure/ cabinet shall have a provision for sealing and locking.		
7.1.2.15	The enclosure/ Cabinet Shall be able to send an alert to the central data analysis Centre if opened		
7.1.2.16	The copper bus bars in the enclosure/ cabinet shall be arranged so that it is easy to connect incoming & outgoing cables.		
7.1.2.17	The bus bar installation in the enclosure shall always be stable when open/closed and heat stabilized. Good clearance shall be provided and where necessary the bus bar shall be well insulated.		
7.1.2.18	The antenna of enclosure shall be extracted through a hole, the antenna shall be fixed outside the enclosure.		
7.1.2.19	The antenna should be made from whether resistant materials or protected appropriately.		
7.1.2.20	The enclosure shall leave enough space to install meters, LV CTs, Controllable breaker, and related equipment's. Space between meters ~~and cabinet shall more than 60mm, space between meters & controlled~~ breaker shall be more than 80mm.		
7.1.2.21	The enclosure shall have a nameplate at the bottom of front, the nameplate should durable clear with the following details - manufacturer, model, main specifications, manufacture date.		

CLAUSE	KENYA POWER REQUIREMENT	MANUFACTURER'S COMPLIANCE/REMARKS	REFERENCE PAGE IN THE SUBMITTED DOCUMENTS
7.1.2.22	The enclosure shall display with warning symbol - 'DANGER – HATARI'.		
7.1.2.23	The cabinet shall have front transparent provision window for viewing the meter LCD display screen.		
7.1.3	**Enclosure installation requirements**		
7.1.3.1	**Meter installation**		
7.1.3.1.1	Installed conveniently, safely and firmly		
7.1.3.1.2	Installed in the cabinet other than the cabinet door		
7.1.3.1.3	Vertically installed and all the mounting holes fixed by bolting		
7.1.3.1.4	Mounting hole threaded hole or other hole type		
7.1.3.2	**LV CTs installation**		
7.1.3.2.1	CTs exactly the same i.e. same manufacturer, item type, rated current (voltage), transformation ratio, accuracy class, secondary capacity.		
7.1.3.2.2	Incoming cable polarity of the same stoichiometric point of current (voltage) consistent		
7.1.3.2.3	CTs connected directly to the meter		
7.1.3.2.4	The CTs shall be supported appropriately.		
7.1.3.2.5	Nameplate of CT visible after installation		
7.1.3.3	**Enclosure installation**		
7.1.3.3.1	Installed safely, firmly and easy to operate.		
7.1.3.3.2	Have accessories to meet different installation scenarios such as hang, embed, ground and pole.		
7.1.3.3.3	Mounting plate with appropriate installation location solution and proper operation space		
7.1.3.4	**Life requirements**		
7.1.3.4.1	Spare parts of the enclosure can be easily changed/ replaced.		
7.1.3.4.2	Mechanical life of the Hinged lockable doors not less than 5,000 times while that for the electric switch not less than 10,000 times.		
7.1.3.5	**Other Requirements**		

CLAUSE	KENYA POWER REQUIREMENT	MANUFACTURER'S COMPLIANCE/REMARKS	REFERENCE PAGE IN THE SUBMITTED DOCUMENTS
7.1.3.5.1	The enclosure well packed and damp proof with the following: （i）Manufacturer certificate （ii）Installation instruction including the cabinet outline dimensional dr installation instruction （iii）Disassembly and spare parts list		
7.2	**11KV metering Enclosure**		
7.2.1	**General Requirements**		
	PT/CT & enclosure Integrated		
7.2.2	**11KV MV metering enclosure technical requirements**		
7.2.2.1	Complies with IP 65 standard requirements		
7.2.2.2	Constructed to allow adequate dissipation of heat		
7.2.2.3	Easy to operate when door opened.		
7.2.2.4	Provision for sealing and locking		
7.2.2.5	Send an alert if opened		
7.2.2.6	Made from the same material as that of the PT & CT housing.		
7.2.2.7	Holder frame made from hot galvanized steel channel.		
7.2.2.8	Access detection with alarm relaying to Central management system		
7.2.2.9	Time of opening and closing the enclosure cabinet shall be recorded		
7.2.2.10	Enough space to install smart meter, communication equipment's, connecting terminals and necessary wiring space.		
7.2.2.11	Antenna extracted through a hole and fixed outside the enclosure.		
7.2.2.12	Wiring neat with each wire clearly labelled and consistent with the connection diagram		
7.3	**33KV /66KV/ 132KV metering enclosure**		
7.3.1	**General Requirements**		
	Provide solution for outdoor metering		
7.3.2	**Enclosure requirements**		
7.3.2.1	Enclosure along with the doors fabricated from stainless steel and capable of withstanding the mechanical, electrical and thermal stress as well as the effects of the humidity		
7.3.2.2	Contrasted with a roof tapering down for easy flow of rainwater		
7.3.2.3	Comply with IP 65 standard		
7.3.2.4	Allows adequate dissipation of heat		
7.3.2.5	Door vandal proof		

CLAUSE	KENYA POWER REQUIREMENT	MANUFACTURER'S COMPLIANCE/REMARKS	REFERENCE PAGE IN THE SUBMITTED DOCUMENTS
7.3.2.6	Ffixed with inside hinges such that door hinges cannot be removed from outside		
7.3.2.7	Allow for over 120 degrees door opening		
7.3.2.8	Easy to operate when door opened		
7.3.2.9	Can be mounted on steel structure in a substation switch yard.		
7.3.2.10	Equipped with earth terminal		
7.3.2.11	Provision for sealing and locking.		
7.3.2.12	Access detection with alarm relaying to Central management system		
7.3.2.13	Recording of time of opening and closing the enclosure		
7.3.2.14	Antenna extracted through a hole, the antenna fixed outside the enclosure.		
7.3.2.15	Antenna made from weather resistant materials or protected appropriately		
7.3.2.16	Enough space to install smart meter, communication equipment's, connecting terminal and necessary wiring space		
7.3.2.17	Have a durable nameplate at the bottom of front with the following details - manufacturer, model, main specifications, manufacture date		
7.3.2.18	Display a warning symbol - 'DANGER – HATARI'.		
7.3.2.19	Have front transparent provision window for viewing the meter LCD display screen		
7.3.2.20	Wiring neat with each wire clearly labelled and consistent with the connection diagram		
8.0	**Central System**		
8.1	**General requirements of the management system**		
8.1.1	Support multi- operation system, windows and Linux		
8.1.2	Support multi database, e.g. oracle database, MySQL database, SQL Server database		
8.1.3	Provide incremental backup and disaster recovery solution		
8.1.4	Support on-demand meter data reading, including but not limited to: instantaneous consumption, Events/Alarms, Load profile and shall be able to show the instantaneous values in chart.		

CLAUSE	KENYA POWER REQUIREMENT	MANUFACTURER'S COMPLIANCE/REMARKS	REFERENCE PAGE IN THE SUBMITTED DOCUMENTS
8.1.5	Support schedule reading, including but not limited to energy consumption, events/alarms, and load profile. The pre-defined schedule period shall be configurable. Usually meter data will be read on daily basis, but it should be possible to configure scheduled reading for hourly or 15 minutes periods for selected meters.		
8.1.6	Support remote connect/disconnect for LV customer and monitor the relay status and shall able to issue related report.		
8.1.7	Support remote configuration, including but not limited to meter tariff, billing time, load profile parameter, etc. Currently, two tariff rates (low and high) defined in KPLC with the same rate. But system should support up to four tariff rates and remote update of tariff structure in meters should be possible. For example high and low tariff rates for winter and summer		
8.1.8	Support remote clock synchronization of meters periodically and manually。		
8.1.9	Support remote firmware upgrade for both metering equipment and communication modules		
8.1.10	Sends SMS/Email alarm to KPLC authorized engineers, immediately after receiving the alarm reported from the metering equipment.		
8.1.11	All alarms and events should be sent to central station instantaneously, the system shall display on a graphical dashboard different areas with their corresponding alarm statuses in different colors (for example in green, yellow and red) .		
8.1.12	Provide phasor diagram		
8.1.13	display all the appropriate power parameters-Voltages-Currents in relation to the conventional phases sequence and in distinct colours -Red, Yellow and Blue (RYB)-Colour shades should be distinct to distinguish each major power parameter.		

CLAUSE	KENYA POWER REQUIREMENT	MANUFACTURER'S COMPLIANCE/REMARKS	REFERENCE PAGE IN THE SUBMITTED DOCUMENTS
8.1.14	Support VEE (Validation, Estimation and Editing) - Switching Capability: for User (operator) to select two different estimation methods instead of one. If the first estimation method fails to estimate missing values (due to its configuration) then VEE automatically uses the second method to estimate load.		
8.1.15	Provide user friendly query tool to display to the specific customer data by entering customer number, meter number, customer name, a part of the customer name or customer telephone number.		
8.1.16	Support at least 200 different groups (Itineraries) of customers, based on their geographical position and their tariffs.		
8.1.17	Support reading selected meters in groups simultaneously at the same time, including but not limited to, accumulated energy, instantaneous parameters and clock.		
8.1.18	Monitor metering equipment communication status, including the meter online/offline status and GPRS data flow		
8.1.19	Comply with IEC61968/IEC61970 CIM (Common Information Model) interface standard.		
8.1.20	Support GIS functionality, to display the terminal locations and meter's events/alarms information on the GIS map. The GIS shall work even when the server is not internet connected.		
8.1.21	Support load profile analysis, including but not limited to: voltage curve, electric current, average power curve, power factor curve, harmonic curve, etc.		
8.1.22	Analyze energy consumption including daily consumption based on different tariff, daily consumption by weekly statistic based on different tariff, daily consumption by monthly statistic based on different tariff, monthly consumption based on different tariff.		
8.1.23	Support technical and management reports, including but not limited to:		
8.1.24	Support security authorization management to different operators by their role assignment. Each role defines a limited access right to different functionalities and also can restrict operator's activities for read/write operations.		

CLAUSE	KENYA POWER REQUIREMENT	MANUFACTURER'S COMPLIANCE/REMARKS	REFERENCE PAGE IN THE SUBMITTED DOCUMENTS
8.1.25	Support aggregation function, including but not limited to aggregation over time, aggregation over devices (meters).		
8.1.26	HHU devices can be used for meter data reading locally/manually		
8.1.27	Able to use any one of the GPRS providers SIM cards for communication whichever KPLC avails for 2 way communication		
8.1.28	Developed interface to export billing data (energy, demands and power factor) to existing billing system (ICS) automatically		
8.1.29	Inter-period bills can be generated by on demand meter data reading and exporting data to billing system。		
8.1.30	Support meters from other vendors/manufacturers conforming to dlms cosem communication protocol.		
8.2	**FDM (Field Device Management System) requirement**		
8.2.1	Support importing Meter Archives in groups in form of CSV, also support to import from other systems through customized interface.		
8.2.2	Management of meter installation by HHU, including barcode scanning, GPS positioning, meter photo. The collected data and information shall be able to be downloaded to the central office.		
8.2.3	Support at least 200,000 measurement points/meters		
8.2.4	Support to export Meter Archives to CSV files or customized interface		
8.2.5	Ggenerate meter installation report, including but not limited to daily report, weekly report and monthly report		
8.2.6	Record tracking logs, including but not limited to, Operation log, Meter archives download/upload log, Meter archives import/export log, log-ins.		
8.3	**Disaster Recovery**		
8.4	**IT hardware**		
8.4.1	Provide Servers, Network devices and other required hardware for central system		
8.4.2	Application servers, data base servers and Head End servers should be configured in clustered to provide high availability and load sharing		
8.4.3	Cable, install and configure all hardware required in central center		
8.4.4	Cyber security should be provided by hardware and software like firewalls and anti-viruses.		
8.4.5	Storage capacity of servers (hard disks) should be foreseen		
8.4.6	Time synchronization of servers shall be done by a GPS clock		

CLAUSE	KENYA POWER REQUIREMENT	MANUFACTURER'S COMPLIANCE/REMARKS	REFERENCE PAGE IN THE SUBMITTED DOCUMENTS
8.4.7	Security equipment should be installed for securing the whole devices of central station		
8.4.8	Firewalls should be installed and configured to control the access of internal and external users to system.		
8.4.9	UPS should be installed to provide the electricity for central center equipment, at least with one hour support in the lack of input electricity.		
8.4.10	Provide 3 sets computer and one 65 inch wall mounted display to show the functions of the central system.		
9.0	**HHU requirements**		
9.1	**Main Functions**		
9.2	**Hardware requirements**		
9.2.1	Have at least one USB port to download the task from data center as well as uploading data to the data center.		
9.2.2	Communicate wirelessly and able to acquire data from the meter at least 50m from the intended meter/s enclosure/s.		
9.2.3	Have high precision GPRS location module.		
9.3	**Electric requirements**		
9.3.1	Operation system: Microsoft Windows		
9.3.2	LCD display: TFT-LCD, 320x240 pixel, with touch screen		
9.3.3	Power supply: up to 100 hours of standby time		
9.3.4	IP requirements: IP65, can withstand the drop impact of vertical height 1.5 meters.		
9.3.5	Working temperature: use:-20°C to 50°C		
9.4	**Operation system requirements**		
9.4.1	Read meters wirelessly		
9.4.2	Configure meter parameters		
9.4.3	Navigate user to desired GIS location		
10.0	**Meter Data Analysis Center (MDAC)**		
11.0	**Sample and demonstration requirements**		
11.1	**Sample Requirements**		
11.1.1	Supplier shall submit the following samples for tender evaluation		
11.1.2	sample shall be with the nameplate fixed on the bottom		
11.2	**Demonstration requirements**		

APPENDIX E

THE KENYA POWER & LIGHTING CO. LTD

SPECIFICATIONS
FOR
LOW VOLTAGE RING TYPE MEASURING CURRENT TRANSFORMERS

	NAME	DESIGNATION
COMPILED BY:	Margaret Kariuki	2nd Assistant Superintendent
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REVISION RECORD

REVISION	DESCRIPTION OF REVISION	DATE
1	3rd Issue	February 2014

CONTENTS

Foreword

This standard specification has been prepared by the Meter Central Laboratory of the Kenya Power & Lighting company Ltd. It lays down requirements for Low voltage ring type measuring current transformers. This specification is intended for procurement of materials and does not include provision of contract.

This specification is based on the IEC 60044-1 standard. It is subject to revision as and when required.

Introduction

This specification was prepared to establish and promote uniform requirements for Low voltage split core measuring current transformers. The specification lays down the minimum requirements for equipment acceptable for evaluation. It is the responsibility of the supplier to obtain copies of the standards referred herein.

1. Scope

This specification applies to newly-manufactured low voltage ring type metering current transformers for use with electrical measuring instruments at frequencies from 15 to 100 Hz. unless otherwise specified, current transformers shall comply with the IEC 60044-1 standard.

2. References

The following documents were referred to during the preparation of this specification; in case of conflict, the requirements of this specification take precedence,

IEC 60044-1: Instrument Transformers- Part 1: Current Transformers and all the standards referred to in this standard.

3. Definitions

The definitions given in the above reference standard apply.

LV: Low voltage

CT: Current transformer

4. Requirements

4.1 Operating conditions

4.1.1 The current transformers shall comply fully with the service conditions for indoor current transformers as per the IEC60044-1 standard.

4.1.2 The current transformers shall be suitable for continuous indoor operation in tropical areas with the following atmospheric conditions:

Humidity: High at Coast, up to 95 % and lower inland, up to 50%;

Temperature: Average ambient of +30°C with a minimum of -1°C and a maximum of +40°C, temperature category –5/40;

4.1.3 The current transformers shall be used for connection of equipment for industrial and commercial loads under tropical climate conditions. The system earthing shall be earthed neutral.

4.2 Design and construction

4.2.1 Dimensions

4.2.1.1 Measuring current transformers shall be of bar primary type, having a hollow diameter (aperture) of not less than 55mm with an external diameter of not more than 110mm for Current Transformer of 100/5A,200/5A,300/5A and 500/5A ratios.

4.2.1.2 .For Current ratios of above 500/5A and up to 2000/5A shall have hollow diameters(aperture) of not less than 120mm with external diameter of not more than 170mm.

4.2.2 Sealing

The current transformer terminals for all types of ratios shall have facility for sealing.

4.2.3 Rated insulation levels

4.2.3.1 The rated insulation level of a primary winding shall be based on its highest voltage for equipment U_m.

4.2.3.2 For current transformer without primary winding and without primary insulation of its own, the value $U_m = 0,72$ kV is assumed.

4.2.3.3 For windings having $U_m = 0,72$ kV or 1,2 kV, the rated insulation level is determined by the rated power- frequency withstand voltage, according to table 3 of the IEC 60044-1 Standard.

4.2.4 Insulation requirements for secondary windings

The rated power frequency-withstand voltage for secondary winding insulation shall be not less than 3 kV (r.m.s.).

4.3 Ratings

4.3.1 Standard values of rated primary current

The standard values of rated primary currents for this tender are:

10, 15, 20, 30, 50, 75 Amperes and their decimal multiples or fractions.

4.3.2 Standard values of rated secondary current

The rated secondary current for these current transformers shall be 5 A while the primary values shall be 200-300-500-1000-1500 and 2000 A.

4.3.3 The standard accuracy class

The accuracy class for these current transformers shall be class 0.2.

4.3.4 Limits of current error and phase displacement

The limits of current error and phase displacement for measuring current transformers of class 0.2 shall be as detailed in clause 11.2 and Table 11 of the IEC 60044-1 standard.

4.3.5 Rated continuous thermal current

Unless otherwise specified, the rated continuous thermal current shall be the rated primary current.

4.3.6 Rated output power

The value of rated output shall be ≥10VA

4.3.7 Rated short-time thermal current (I_{th})

A rated short-time thermal current shall be assigned to the transformer and shall comply with the type test specified in clause 7.1 of the standard.

4.3.8 Rated dynamic rating (I_{dyn})

The value of the rated dynamic current (I_{dyn}) shall normally be 2.5 times the rated short-time thermal current (I_{th}) and it shall be indicated on the rating plate when it is different from this value.

4.3.9 Extended current rating

Current Transformers of accuracy class 0.1 to 0.5 may be marked with extended current rating in compliance with the Standard.

Requirements of clause 4.3.3 to 4.3.4 shall form part of the type test approval to be issued by an International or the National (of country of manufacture) Current Transformer certifying body.

4.4 Tests

The tests specified in this standard are classified as type tests, routine tests, and special tests.

4.4.1 Type tests

Type tests shall be done on each transformer so as to comply with clauses 6.1 and 7 of the IEC 60044-1 Standard.

4.4.2 Routine tests

Routine tests shall be done on each transformer so as to comply with clauses 6.2 and 8 of the IEC 60044-1 Standard.

Requirements of clause 4.4.1 and 4.4.2 shall form part of the type test approval to be issued by an International or the National (of country of manufacture) current transformer certifying body.

4.5 Instructions and markings

4.5.1 Terminal markings

4.5.1.1 General

The terminal markings shall identify:

a) The primary and secondary windings;

b) The winding sections, if any;

c) The relative polarities of windings and winding sections;

d) The intermediate tappings, if any.

4.5.1.2 Method of marking

a) The terminals shall be marked clearly and indelible, either on their surface or in their immediate vicinity.

b) The marking shall consist of letters followed, or preceded where necessary, by numbers. The letters shall be in block capitals.

4.5.1.3 Markings to be used

The markings of current transformers shall be as indicated in table 10 of the IEC 60044-1 Standard.

4.5.2 Rating plate markings

All current transformers shall carry at least the following markings:

a) the manufacturer's name or other mark by which he may be readily identified;

b) a serial number or a type designation, preferably both;

c) the rated primary and secondary current, i.e.:

Kn = Ipn / Isn A (e.g. Kn = 100 / 5 A)

d) the rated frequency (e.g. 50 Hz.);

e) the rated output and the corresponding accuracy class, together with additional information specified in later parts of these recommendations;

f) the highest voltage for equipment;

g) the rated insulation level;

Note-The two items f) and g) may be combined into one marking (e.g. 0,72/3 kV)

h) the accuracy class and instrument security factor following the indication of the corresponding rated output (e.g. 15 VA Class 0,5 FS 10);

i) current transformers having an extended current rating shall have this rating indicated immediately following the class designation (e.g. 15 VA Class 0.5 ext. 150 %);

j) "THE PROPERTY OF K.P. & L. CO. LTD."

All information shall be marked in an indelible manner on the current transformer itself or on a rating plate securely attached to the transformer.

In addition, other information shall be marked whenever space is available as per IEC 60044-1 Standard.

4.5.3 In addition, the following drawings and information shall be required with the tender:

(a) Drawing giving all the relevant dimensions;

(b) Wiring diagrams;

(c) Description leaflets of current transformers;

4.5.4 Copies of type approval certificate(s) with test and calibration results of the current transformers being offered (see clauses 4.2.3, 4.2.4, 4.4.1 & 4.4.2) obtained from an international or the national CT certification body shall be provided. **If type approval certificate(s) is (are) from accredited CT certification laboratories (and not national or international body), then it (they) shall be accompanied with copies of certificates of accreditation from the national or an international certification body.**

4.5.5 **The Tenderer shall complete clearly, all the clauses in both columns of the schedule in Appendix B.** This shall form the basis of evaluation of the submitted tender. Failure to complete this appendix shall render the tender non-responsive. The tenderers shall indicate the details of their offer where it is different from these requirements. Where the requirement is the same, they shall indicate what is offered. **Insertions such as "noted", "agreed" etc. shall be considered as non-responsive where a specific response is called for.**

4.5.6 The tenderer shall submit with the tender, **a sample of each type of current transformer** being tendered.

4.5.7 The manufacturer shall provide proof of conformance to **ISO 9001(2008)** standard. Where proof of conformance to **ISO 9001:2008** standard shall be provided, the certificate shall be valid at the time of tender submission.

4.5.8 The manufacturer shall provide a list of at **least three previous utilities outside the country of manufacture** to which the current transformer being offered has been supplied including addresses and contact person(s) of the utilities.

4.5.9 The tenderer shall give proof that the number of current transformers sold to **utilities outside the country of manufacture** over a period of last **5 years** shall not be less than **5,000 CTs.** The addresses and contact person(s) shall be provided with the tender to facilitate confirmation of this information by the procuring entity.

5. Information and warranty *(In case of tender award)*

5.1 Drawings and technical details shall be submitted to Kenya Power for approval before manufacture of the current transformers commences. Kenya Power undertakes to submit

their comments or approval for the drawings within three weeks of receiving the draft copies.

5.2 Operation manuals shall be submitted in 3 copies. Description leaflets (brochures) shall be submitted in copies of 10 for each current transformer type.

5.3 The current transformers shall have a warranty against any defects, which may develop due to faulty material, calibration, transportation or workmanship for a period of eighteen months from the date of delivery. **All defective current transformers shall be replaced at the supplier's cost.**

5.4 KPLC engineers will inspect CT-manufacturing facilities intending to supply current transformers to the company for the first time at no extra cost, excepting the cost of the engineers' transportation to the nearest major airport. Such inspection shall not in any way prejudice the purchaser's rights and privileges.

5.5 The manufacturer shall meet the full costs of two engineers, for current transformer inspection and acceptance testing at the manufacturer's facility, excepting the cost of engineers' transportation from Kenya to the nearest major airport. The factory inspection and factory acceptance tests shall run for duration of three (3) working days each.

5.6 After delivery of current transformers to Kenya Power, the manufacturer shall conduct training for at least 1 day for twenty people in Nairobi, Kenya. The training shall cover and not be limited to:

1) CT construction;
2) CT features;
3) CT installation;

5.7 The manufacturer shall meet the cost of the training described in clause (5.6).

5.8 **Samples**

The tenderer shall submit one sample for each CT ratio type together with the tender documents. The submitted CT samples shall be subjected to accuracy tests at Kenya Power's Meter Central Laboratory to verify the requirements of IEC 60044-1 clause 11.2 and to verify responsiveness to other clauses of this specification. Sample CTs shall not be returned to the tenderers.

5.9 The current transformers shall be packaged in such a manner as to minimize damage and entry of moisture during transportation and handling.

5.10 The current transformers shall be packed in suitable groups and/or batches with consecutive serial numbers.

5.11 The supplier shall indicate the delivery time versus quantities of each type of current transformer and his production capacity.

5.12 Where test and/or calibration certificates/reports are issued by a laboratory other than the **International/National Certification Authority**, a copy of accreditation certificate shall be attached together with the tender documents.

5.13 The manufacturer shall provide current e-mail addresses, fax and telephone numbers of the national/international testing/calibration laboratories and current transformer certification bodies to facilitate confirmation of the submitted test reports & certificates.

APPENDIX B: **Statement of Compliance** *(to be filled by the Supplier for all clauses and Submitted for tender evaluation)*

Clause Number	Kenya Power Requirements	Bidder's offer	Manufacturer's catalogue, drawing, technical data or tests certificate Reference Page to support the offer.
4.1	**Operating Conditions**		
4.1.1	Shall comply fully with the service conditions for indoor current transformers as per the IEC60044-1		
4.1.2	The current transformers shall be suitable for continuous indoor operation in tropical areas with the following atmospheric conditions: Humidity: High at Coast, up to 95 % and lower inland, up to 50%; Temperature: Average ambient of +30°C with a minimum of -1°C and a maximum of +40°C, temperature category – 5/40;		
4.1.3	The current transformers shall be used for connection of equipment for industrial and commercial loads under tropical climate conditions. The system earthing shall be earthed neutral.		
4.2	**Design & Construction**		
4.2.1	**Dimensions**		
4.2.1.1	Measuring current transformers of current shall be of bar primary type, having a hollow diameter of not less than 55mm with an external diameter of not more than 110mm for 200/5A-,300/5A and 500/A ratios.		

4.2.1.2	For Current ratios of above 500A and up to 2000/5A shall have hollow diameters of not less than 120mm with external diameter of not more than 170mm		
4.2.2	**Sealing**		
4.2.2.1	**Sealing:** The current transformer terminals for all types shall have facility for sealing.		
4.2.3.1	**Rated Insulation Levels** The rated insulation level of a primary winding shall be based on its highest voltage for equipment Um		
4.2.3.2	For current transformer without primary winding and without primary insulation of its own,the value Um = 0.72kV is assumed		
4.2. 3.3:	For winding having Um=0,72Kv or 1,2 Kv,the rated insulation level is determined by the rated power frequency-withstand voltage ,according to table 3 of IEC60044-1 Standard.		
4.2.4	**Insulation requirements for secondary windings** The rated power frequency –withstand voltage for secondary winding insulation shall be not less than 3Kv(r.m.s)		
4.3	**Ratings**		
4.3.1	Standard rated primary currents shall be 10, 5, 20, 30, 50, 60, 75 Amperes and their decimal fractions		
4.3.2	Standard values of rated secondary current. The rated secondary current for these current transformer shall be 5A while the primary values shall be,200-,300-,500-,1500-and 2000A current		
4.3.3	The accuracy class for these current transformers shall be class 0.2		
4.3.4	Limits of current error and phase displacement for measuring current transformers of class 0.2 shall be as detailed in clause 11.2 and Table 11 of the IEC60044-1Standard		
4.3.5	Unless otherwise specified, the rated continuous thermal current shall be the rated primary current.		
4.3.6	The value of rated output shall be ≥10VA		
4.3.7	A rated short time thermal current shall be assigned to the transformer and shall comply with the type test specified in clause 7.1 of the standard		
4.3.8	The value of the rated dynamic current (I_{dyn})shall normally be 2.5times the rated rated short-time thermal current (*Ith*) and it shall be indicated on the plate when it is different from this value.		
4.3.9	Current Transformers of accuracy class 0.1 to 0.2 may be marked with extended current rating in compliance with the Standard		
	Requirements of clause 4.33 to 4.3.4 shall form part of the type test approval to be issued by an international or the National(of country of manufacture)Current Transformer certifying body.		

4.4	**Tests:** The tests specified in this standard are classified as types ,routine tests, and special tests		

4.4.1	**Type tests:**The tests shall be done on each transformer so as to comply with clause 6.1and 7 of IEC60044-1Standard		
4.4.2	**Routine tests:**Routine tests shall be done on each transformer so as to comply with clauses 6.2 and 8 of IEC60044-1 Standard.		
	Requirements of clause 4.4.1 and 4.4.2 shall form part of the type approval to be issued by an International or National (of country of manufacture) current transformer certifying body.		
4.5	**Instructions and markings**		
4.5.1	**Terminal Markings**		
	The terminal markings shall identify		
(a)	Primary and secondary windings		
(b)	Winding sections if any		
(c)	Relative Polarities of winding sections		
(d)	The relative polarities of windings and winding sections		
(e)	Intermediate tappings, if any		
4.5.1.2	**Method of Marking**		
(a)	The terminal shall be marked clearly and indelibly, either on their surface or in their immediate vicinity.		
(b)	Markings shall consist of letters followed by numbers with letters in block capitals		
4.5.1.3	**The marking to be used.** The Markings of current transformer shall be indicated as in table 10 of the IEC 60044-1Standard		
4.5.2	**Rating plate markings** All current transformers shall carry at least the following:		
a)	the manufacturers name or other mark by which he may be readily identified		
b)	Serial number or a type designation, preferably both		
c)	the rated primary & secondary current i.e Kn=Ipn/IsnA(e.g Kn=100/5A		
d)	the rated frequency(e.g. 50Hz)		
e)	the rated output and corresponding accuracy class, together with additional information specified in later parts of these recommendations.		
f)	the highest voltage for equipment		
g)	the rated insulation level. Note-The two items f) and g) may be combined into one marking (e.g0,72/3Kv)		
h)	the accuracy class and instrument security factor following of the corresponding rated output (e.g. 15VA Class 0.5FS10)		
i)	current transformer having an extended current rating shall have this indicated immediately following the class designation (e.g. 15VA Class 0.5 ext,150%) if applicable		
	THE PROPERTY OF K.P. CO. LTD.All information shall be marked in an indelible manner on the current transformer itself or on a rating plate securely attached to the transformer.In additiona ,other information shall be marked whenever space is available as per IEC 60044-1 Standard.		

4.5.3 (a) (b) (c)	In addition, the following drawings and information shall be required with the tender: Drawing giving all the relevant dimensions; Wiring diagrams; Description leaflets of current transformers		
4.5.4	Copies of type approval certificate(s) with test and calibration results of the current transformers being offered(see clauses 4.2.3,4.2.4,4.4.1 &4.4.2) obtained from an international or the national or the national CT certificate body shall be provided. **If type approval certificate(s) is (are) from accredited CT certificate laboratories (and not national or international body),then it (they) shall be accompanied with copies of certificates of accreditation from the national or an international certificate body**		
4.5.5	The Tenderer shall complete Cleary; all the clauses in both columns of the schedule in Appendix B.This shall form the basis of evaluation of the submitted tender. Failure to complete this appendix shall render the tender non – responsive. The tenderers shall indicate the details of their offer where it is different from these requirements. Where the requirement is the same, they shall indicate what is offered. Insertion such as "noted","agreed" etc.shall be considered non-responsive where a specific response is called for.		
4.5.6	The tender shall summit with the tender ,a sample of each type of current transformer being tendered.		
4.5.7	The manufacturer shall provide proof of conformance to ISO 9001(2008) standard. Where proof of conformance to ISO 900:2000 standard shall be provided, the certificate shall be valid at the time of tender submissions.		
4.5.8	The manufacturer shall provide a list of at least three previous utilities outside the country of manufacture to which the current transformer being offered has been supplied including addresses and contact person(s) of the utilities.		
4.5.9	The tenderer shall give proof that the number of current transformers sold to utilities outside the country of manufacture over a period of at least 5years shall not be less than 5000 CTs.The addresses and contact persons shall be provided with the **tender** to facilitate confirmation of this information by the procuring entity.		
5.0	Information and warranty.		
5.1	Drawings and technical details shall be submitted to Kenya Power for approval before manufacture of the current transformers commences. Kenya Power undertakes to submit their comments or approval for the drawings within three weeks of receiving the draft copies.		
5.2	Operation manuals shall be submitted in 3 copies. Description leaflets (brochures) shall be submitted in copies of 10 for each current transformer type.		

5.3	The current transformers shall have a warranty against any defects, which may develop due to faulty material, calibration, transportation or workmanship for a period of eighteen months from the date of delivery. **All defective current transformers shall be replaced at the supplier's cost.**		
5.4	KPLC engineers will inspect CT-manufacturing facilities intending to supply current transformers to the company for the first time at no extra cost, excepting the cost of the engineers' transportation to the nearest major airport. Such inspection shall not in any way prejudice the purchaser's rights and privileges.		
5.5	The manufacturer shall meet the full costs of two engineers, for current transformer inspection and acceptance testing at the manufacturer's facility, excepting the cost of engineers' transportation from Kenya to the nearest major airport. The factory inspection and factory acceptance tests shall run for duration of three (3) working days each.		
5.6	After delivery of current transformers to Kenya Power, the manufacturer shall conduct training for at least 1 day for twenty people in Nairobi, Kenya. The training shall cover and not be limited to: 4) CT construction; 5) CT features; 6) CT installation;		
5.7	The manufacturer shall meet the cost of the training described in clause (5.6).		
5.8	**Samples** The tenderer shall submit one sample for each CT ratio type together with the tender documents. The submitted CT samples shall be subjected to accuracy tests at Kenya Power's Meter Central Laboratory to verify the requirements of IEC 60044-1 clause 11.2 and to verify responsiveness to other clauses of this specification. Sample CTs shall not be returned to the tenderers.		
5.9	The current transformers shall be packaged in such a manner as to minimize damage and entry of moisture during transportation and handling		
5.10	The current transformers shall be packed in suitable groups and/or batches with consecutive serial numbers.		
5.11	The current transformers shall be packed in suitable groups and/or batches with consecutive serial numbers.		

5.12	Where test and/or calibration certificates/reports are issued by a laboratory other than the **International/National Certification Authority**, a copy of accreditation certificate shall be attached together with the tender documents.		
5.13	The manufacturer shall provide current e-mail addresses, fax and telephone numbers of the national/international testing/calibration laboratories and current transformer certification bodies to facilitate confirmation of the submitted test reports & certificates.		

NB: - This schedule does not in any way substitute for detailed information required elsewhere in the specification.

Manufacturer's Declaration: I .....on behalf of.....

Declare that the above specifications matrix conforms to a typical tender item type..... as clearly marked in the attached technical brochures & drawings, and being offered for this tender.

Signature..... Date.....Stamp/Seal.....

APPENDIX F

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FOREWORD

This specification has been prepared by the Energy management department in collaboration with the Technical Services Department both of The Kenya Power and Lighting Company Limited (abbreviated as KPLC) and it lays down requirements for 11kV Current Transformers. It is intended for use by KPLC in purchasing the equipment.

1. SCOPE

1.1 This specification is for newly manufactured current transformers for use with electrical measuring instruments and electrical protective devices for system highest voltage of 12kV at power frequency of 50Hz.

1.2 This specification covers Types/CT Ratios given in clause 4.3.

The Type/CT Ratio required will be stated in the schedule of requirements in the tender.

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

The specification stipulates the minimum requirements for 11kV current transformers acceptable for use in the company and it shall be the responsibility of the supplier 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 current transformers for The Kenya Power & Lighting Company.

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

2. REFERENCES

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

IEC 60044-1: Instrument Transformers – Part 1: Current Transformers

IEC 60815: Guide for the selection of insulators in respect of polluted conditions

3. TERMS AND DEFINITIONS

For the purpose of this specification the definitions given in the reference standards shall apply.

4. REQUIREMENTS

4.1 SERVICE CONDITIONS

4.1.1 Site Conditions

The current transformer shall be suitable for continuous outdoor operation in tropical areas inland, cities and suburbs of cities, along the coast and with the following conditions:

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

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

(c) Humidity: up to 95%,

(d) Pollution: Design pollution level to be taken as "Very *Heavy*" (Pollution level IV) according to IEC 60815.

(e) Isokeraunic level: 180 thunderstorm days per year

4.1.2 System Conditions

The current transformer will be connected to overhead and underground system operating at a nominal voltage of 11kV and maximum voltage of 12kV, 50Hz.

4.2 MATERIALS, DESIGN AND CONSTRUCTION

4.2.1 The current transformer (CT) shall be designed and manufactured to IEC 60044-1 and the requirements of this specification.

4.2.2 All materials used shall be new and of the best quality and of the class most suitable for working under the conditions specified and shall withstand the variations of temperatures and atmospheric conditions arising under working conditions without undue distortion or deterioration or the setting up of undue stresses in any part, and also without affecting the strength and suitability of the various parts for the work which they have to perform.

4.2.3 The design shall ensure satisfactory operation under such sudden variations of load and voltage as may be met with under working conditions on the system, including those due to short circuits.

4.2.4 All parts of the transformer, including insulators with their mountings, shall be designed so as to avoid pockets in which water can collect.

4.2.5 The current transformer shall be dry type (Epoxy/resin cast) and the insulation of the bushing portion of the current transformer shall be made of epoxy resin.

4.2.6 The current transformer shall be suitable for vertical installation in case of outdoor application.

4.2.7 All parts and components of the current transformer shall be resistant to atmospheric corrosion.

4.2.8 The current transformer shall have primary, secondary and earth terminals.

4.2.9 Primary Terminal

4.2.9.1 The primary terminal shall be of high conductivity copper-tin-plated, suitable for connection of both copper and aluminum conductors.

4.2.9.2 It shall have palm clamp connectors suitable for both stranded conductor and tube connection.

4.2.9.3 Conductor overall diameter shall be 18.3mm to 25mm and bus bar tubes of 76.2mm diameter.

4.2.10 Secondary Terminals

4.2.10.1 The secondary terminals of the current transformer shall be wired to a terminal box and earthed at one point.

4.2.10.2 Secondary terminals shall be provided with either screws or studs. Mounting clamps shall be provided where necessary,

4.2.10.3 The terminal box/cover shall be weatherproof with a cable plate at the bottom and shall be covered with removable plate.

4.2.10.4 The terminal box shall be capable of accommodating up to 6 secondary terminals each suitable for conductor size of up to 2.5mm diameter.

4.2.11 The current transformer shall have cores as per clause 4.3. The ratio selection shall be done on the secondary side.

4.3 Ratings

The ratings of the current transformer shall be as indicated in Table 1.

Table 1: Ratings

Description			**Requirements**	
Rated voltage and frequency			12kV, 50Hz	
Minimum creepage of insulator			370mm	
Minimum lightning impulse withstand voltage			95kV (peak)	
Minimum power frequency withstand voltage			38kV (rms)	
Overload factor			1.5	
Rated short circuit withstand			25kA, 3 seconds	
Type of CT		**TYPE I**	**TYPE II**	**TYPE III**
Rated primary current		400A	1200A	2400A
CT ratio		400/200/100/50/1-1-1-1	1200/600/300/1-1-1-1	2400/1200/1-1-1-1
Rated secondary current		1A	1A	1A
Accuracy class and rated burden	Core 1	Class0.2,15VA	Class0.2,15VA	Class 0.2, 15VA
	Core 2	Class 5P20, 15VA	Class 5P20, 15VA	Class 5P20, 15VA

4.4 Quality Management System

4.4.1 The supplier shall submit a quality assurance plan (QAP) that will be used to ensure that the transformer design, material, workmanship, tests, service capability, maintenance and documentation, will fulfill the requirements stated in the contract documents, standards, specifications and regulations. The QAP shall be based on and include relevant parts to fulfill the requirements of ISO 9001:2008.

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

4.4.3 The bidder shall indicate the delivery time of the current transformers, 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 current transformers 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.

5. TESTS AND INSPECTION

5.1 The current transformer shall be inspected and tested in accordance with the requirements of this specification and IEC 60044-1. It shall be the responsibility of the supplier to perform or to have performed the tests specified.

5.2 Copies of previous Type Test Certificates and Type Test Reports issued by a third party testing laboratory that is accredited to ISO/IEC 17025 shall be submitted with the tender for the purpose of technical evaluation. The accreditation certificate for the third party testing laboratory shall also be submitted with the tender (all in English Language).

Copies of Type Test Reports to be submitted shall include the following tests as per IEC 60044-1:

- 5.2.1 Short-time current tests;
- 5.2.2 Temperature rise test;
- 5.2.3 Lightning impulse test (with both positive and negative polarity – fifteen consecutive impulses of each polarity);
- 5.2.4 Wet test for outdoor type transformers;
- 5.2.5 Determination of errors;
- 5.2.6 Accuracy of measuring current transformers.

5.3 Routine test reports for the current transformers to be supplied shall be submitted to KPLC for approval before shipment/delivery of the goods. KPLC Engineers (2) will witness tests at the factory before shipment.

Tests to be witnessed by KPLC Engineers at the factory shall include all tests required by IEC 60044-1 and the the following:

- 5.3.1 Verification of terminal markings;
- 5.3.2 Power-frequency withstand test on primary winding;
- 5.3.3 Partial discharge measurement;
- 5.3.4 Power-frequency withstand tests on secondary winding;
- 5.3.5 Inter-turn overvoltage test;
- 5.3.6 Determination of errors;
- 5.3.7 Visual inspection;
- 5.3.8 Accuracy of measuring current transformers;
- 5.3.9 Rated knee point emf, maximum exciting current, secondary winding resistance and turns ratio of current transformers classes.

5.4 Upon delivery of the current transformers, KPLC 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/rectify without extra or additional charge to KPLC, current transformers which upon examination, test or use fail to meet any of the requirements in the specification.

6. MARKING AND PACKING

6.1 The current transformer rating shall be indicating as follows on the permanent name plate of the integrated measuring transformers unit:

a) The manufacturer's name or identification mark;
b) The type reference number and serial number;
c) The rated primary and secondary current;
d) The rated frequency;
e) The rated output and the corresponding accuracy class of the cores;
f) The rated voltage (12kV);
g) The rated insulation level;
h) The class of insulation;
i) The short-time current ratings and time;
j) The rated continuous thermal current;

All the marking shall be by engraving (or superior method) and shall be permanent and legible.

6.2 The terminals shall be marked clearly and indelibly and in accordance with IEC 60044-1. The terminal marking shall consist of letters followed by numbers. The letters shall be in block capitals.

6.3 The current transformers shall be delivered packed in wooden crates firmly bound together to avoid damage during transportation and storage.

7. DOCUMENTATION

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

a) Guaranteed Technical Particulars;
b) Copies of the Manufacturer's catalogues, brochures, drawings 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) Copies of required type test reports by a third party testing laboratory accredited to ISO/IEC 17025;
f) Copy of accreditation certificate for the testing laboratory.

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

a) Guaranteed Technical Particulars,
b) Design Drawings with details of current transformer 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. The QAP shall be based on and include relevant parts to fulfil the requirements of ISO 9001:2008

d) Detailed test program to be used during factory testing,
e) Marking details and method to be used in marking the current transformers,
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 current transformers for The Kenya Power & Lighting Company
g) Packaging details (including packaging materials).

7.3 A set of three (3) original hard cover installation and technical manuals for the instrument transformers shall be supplied with the equipment during delivery.

ANNEX A: **Guaranteed Technical Particulars** *(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, details of manufacturing capacity, the manufacturer's experience and copies of complete type test certificates and type test reports for tender evaluation, all in English Language)*

Tender No .....

Clause Number	**Description**	**Bidder's Offer** *(indicate details of the current transformer offered)*
-	Name of the Manufacturer, address and Country of manufacture	
	Name & address of Bidder	
	Type/Model Number offered	
Clause Number as per specification *(please refer to the specification)*		
1.	Scope	
	It shall be the responsibility of the supplier 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 current transformers for The Kenya Power & Lighting Company	
2	Applicable Standards	
3	Terms and Definitions	
4.1.1	Site Conditions	
4.1.2	System Conditions	
4.2.1	Design Standard	
4.2.2	Materials	
4.2.3	Variations of load & voltage	
4.2.4	Rain water	
4.2.5	Outdoor and indoor applications-dry type, epoxy resin cast	
	Insulator portion epoxy resin	
4.2.6	Suitable indoor and outdoor application	
4.2.8	Primary, secondary and earth terminals	
4.2.9.1	Primary terminal to be high conductivity copper, tin- plated	
4.2.9.2	Primary terminal to have palm clamp connector with 2-4Nos. U-bolts (outdoor application)	
4.2.9.3	Clamp suitable for conductor overall diameter of 18.3mm to 25mm and tubes of 76.2mm diameter (optional)	
4.2.10.1	Secondary terminals wired to terminal box & earthed	
4.2.10.2	Terminal box cover shall be weather-proof with cable glad plate at bottom	

APPENDIX G

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FOREWORD

This specification has been prepared by the Research and Development Department in collaboration with the Technical Services and energy management Department all of The Kenya Power and Lighting Company Limited (abbreviated as KPLC) and it lays down requirements for 11kV Voltage Transformers. It is intended for use by KPLC in purchasing the equipment.

1. SCOPE

1.1 This specification is for newly manufactured voltage transformers for use with electrical measuring instruments and electrical protective devices on system highest voltage of 12kV at power frequency of 50Hz.

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

The specification stipulates the minimum requirements for 11kV voltage transformers acceptable for use in the company and it shall be the responsibility of the supplier 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 voltage transformers for The Kenya Power & Lighting Company.

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

2. REFERENCES

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

IEC 60044-2: Instrument Transformers – Part 2: Inductive Voltage Transformers

IEC 60815: Guide for the selection of insulators in respect of polluted conditions

3. TERMS AND DEFINITIONS

For the purpose of this specification the definitions given in the reference standards shall apply.

4. REQUIREMENTS

4.1 SERVICE CONDITIONS

4.1.1 Site Conditions

The voltage transformer shall be suitable for continuous outdoor operation in tropical areas inland, cities and suburbs of cities, along the coast and with the following conditions:

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

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

(c) Humidity: up to 95%,

(d) Pollution: Design pollution level to be taken as "Very *Heavy*" (Pollution level IV) according to IEC 60815.

(e) Isokeraunic level: 180 thunderstorm days per year

4.1.2 System Conditions

The voltage transformer will be connected to overhead and underground system operating at a nominal voltage of 11kV with maximum system voltage (highest voltage for equipment) of 12kV, 50Hz and exposed to over voltages of atmospheric origin.

4.2 MATERIALS, DESIGN AND CONSTRUCTION

4.2.1 The voltage transformer shall be designed, manufactured and tested to IEC 60044-2 and the requirements of this specification.

4.2.2 All materials used shall be new and of the best quality and of the class most suitable for working under the conditions specified and shall withstand the variations of temperatures and atmospheric conditions arising under working conditions without undue distortion or deterioration or the setting up of undue stresses in any part, and also without affecting the strength and suitability of the various parts for the work which they have to perform.

4.2.3 The design shall ensure satisfactory operation under such sudden variations of load and voltage as may be met with under working conditions on the system, including those due to short circuits.

4.2.4 All parts of the transformer, including insulators with their mountings, shall be designed so as to avoid pockets in which water can collect.

4.2.5 The voltage transformer shall be for both indoor and outdoor applications; and shall be dry type-epoxy resin cast. Insulation of the bushing portion of the voltage transformer shall be made of epoxy resin.

4.2.6 The voltage transformer shall be suitable for both outdoor and indoor installation.

4.2.7 All parts and components of the voltage transformer shall be resistant to atmospheric corrosion.

4.2.8 The voltage transformer shall have primary, secondary and earth terminals.

4.2.9 Primary Terminal

4.2.9.1 The primary terminal shall be of high conductivity copper, tin-plated, suitable for connection of both copper and aluminum conductors (outdoor application).

4.2.9.2 It shall have palm clamp connectors suitable for both stranded conductor and tube connection. Conductor overall diameter shall be 18.3mm to 25mm and bus bar tubes of 76.2mm diameter.

4.2.9.3 The voltage to be transformed shall be applied to the primary winding.

4.2.10 Secondary Terminals

4.2.10.1 The secondary terminals of the voltage transformer shall be wired to a terminal box.

4.2.10.2 The terminal box shall be weatherproof with a cable plate at the bottom and shall be covered with removable plate.

4.2.10.3 The secondary winding shall supply the voltage circuits of measuring instruments and meters or similar apparatus.

4.2.10.4 The secondary terminal box of the voltage transformer shall be complete with detachable protection fuses.

4.2.11 The voltage transformer shall be designed and constructed to withstand without damage, when energized at rated voltage, the mechanical and thermal effects of an external short-circuit for the duration of 1 s.

4.2.12 The voltage transformer shall have cores and ratings as per clause 4.3.

4.3 Ratings

The ratings of the voltage transformer shall be as indicated in Table 1.

Table 1: Ratings

Nominal primary voltage				11000/√3 volts
Nominal secondary voltage				110/√3 volts
Rated frequency				50 Hz
Minimum creepage distance of insulator				380mm
Minimum lightning impulse withstand voltage, primary winding				95kV (peak)
Minimum power frequency withstand voltage, primary winding, dry				38kV (r.m.s.)
Minimum power frequency withstand voltage, secondary winding, r.m.s.				5kV (r.m.s.)
Maximum temperature rise	Windings			65K
	at top of tank			55K
Rated voltage factor				1.2 Continuous
				1.5 for 30 sec.
Permissible partial discharges (PD)	PD test voltage (r.m.s) = U_m			10pC
	PD test voltage (r.m.s) = $1.2U_m/\sqrt{3}$			5pC
Secondary windings core 1, core 2 and core 3				
	Terminal Markings	Voltage Output	Class	VA (pf 0.8 lagging)
Core 1	1a-1n	110/√3	0.2	75
Core 2	2a-2n	110/√3	3P	150

Notes:

(1) The voltage transformer shall be installed at altitude of 2200m asl and if tests will be carried out at altitudes below 1000m, the limits of temperature rise given in Table 1 above shall be reduced by 0.4% for each 100m that the altitude at the operating site exceeds 1000m (see clause 5.4 of IEC 60044-2.

(2) The voltage transformer shall be installed at altitude of 2200m asl, the arcing distance under the standardized reference atmospheric conditions shall be determined by multiplying

the withstand voltages required at the service location by a factor k in accordance with Figure 1 and clause 4.2.1 of IEC 60044-2 ($k = e^{m(H-1000)/8150} = e^{(2200-1000)/8150} = 1.16$, with m=1 as per IEC 60044-2 and therefore arcing distance shall be $75kV_p * 1.16 = 87kV_p$, the nearest standard value is $95kV_p$).

4.4 Quality Management System

4.4.1 The supplier shall submit a quality assurance plan (QAP) that will be used to ensure that the transformer design, material, workmanship, tests, service capability, maintenance and documentation, will fulfill the requirements stated in the contract documents, standards, specifications and regulations. The QAP shall be based on and include relevant parts to fulfill the requirements of ISO 9001:2008.

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

4.4.3 The bidder shall indicate the delivery time of the voltage transformers, 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 voltage transformers 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.

5. TESTS AND INSPECTION

5.1 The voltage transformer shall be inspected and tested in accordance with the requirements of this specification and IEC 60044-2. It shall be the responsibility of the supplier to perform or to have performed the tests specified.

5.2 Copies of previous Type Test Certificates and Type Test Reports issued by a third party testing laboratory that is accredited to ISO/IEC 17025 shall be submitted with the tender for the purpose of technical evaluation. The accreditation certificate for the third party testing laboratory shall also be submitted with the tender (all in English Language).

Copies of Type Test Reports to be submitted shall include the following tests as per IEC 60044-2:

5.2.1 Temperature rise test;
5.2.2 Short-circuit withstand capability test;
5.2.3 Lightning impulse test (with both positive and negative polarity – fifteen consecutive impulses of each polarity);
5.2.4 Wet test for outdoor type transformers;
5.2.5 Determination of errors;

5.3 Routine test reports for the voltage transformers to be supplied shall be submitted to KPLC for approval before shipment/delivery of the goods. KPLC Engineers (2) will witness tests at the factory before shipment.

Tests to be witnessed by KPLC Engineers at the factory shall be in accordance with IEC 60044-2 and shall include the following:

5.3.1 Verification of terminal markings;
5.3.2 Power-frequency withstand test on primary windings;
5.3.3 Partial discharge measurement;
5.3.4 Power-frequency withstand tests on secondary winding;
5.3.5 Power-frequency withstand tests between sections;
5.3.6 Determination of errors;
5.3.7 Accuracy of measuring voltage transformers at 80%, 100% and 120% of rated voltage, at rated frequency and at 25% and 100% of rated burden;
5.3.8 Temperature-rise test for residual voltage transformer;
5.3.9 Visual inspection of complete voltage transformer.

5.4 Upon delivery of the voltage transformers, KPLC 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/rectify without extra or additional charge to KPLC, voltage transformers which upon examination, test or use fail to meet any of the requirements in the specification.

6. MARKING AND PACKING

6.1 The voltage transformer rating shall be indicating as follows on the permanent name plate of the integrated measuring transformers unit:

a) The manufacturer's name or identification mark;
b) The type reference number and serial number;
c) The rated primary and secondary voltage;
d) The rated frequency (50Hz);
e) The rated output and the corresponding accuracy class of each secondary winding;
f) The highest system voltage (12kV);
g) The rated insulation level (38kV (rms)/95kV$_p$);
h) The class of insulation;
i) The short-time current ratings and time;
j) The use of each secondary winding and its corresponding terminals;

All the marking shall be by engraving (or superior method) and shall be permanent and legible.

6.2 The terminals shall be marked clearly and indelibly and in accordance with IEC 60044-2. The terminal marking shall consist of letters followed by numbers.

6.3 Letters A, B, C denote fully insulated primary winding terminals and the lower-case letters a, b, c and n denote the corresponding secondary terminals. Letters da and dn denote the terminals of windings intended to supply a residual voltage.

6.4 Terminals having corresponding capital and lower-case markings shall have the same polarity at the same instant.

6.5 The integrated measuring transformer unit shall be delivered packed in wooden crates firmly bound together to avoid damage during transportation and storage.

7. DOCUMENTATION

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

a) Guaranteed Technical Particulars;
b) Copies of the Manufacturer's catalogues, brochures, drawings 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) Copies of required type test reports by a third party testing laboratory accredited to ISO/IEC 17025;
f) Copy of accreditation certificate for the testing laboratory.

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

a) Guaranteed Technical Particulars,
b) Design Drawings with details of voltage transformer 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. The QAP shall be based on and include relevant parts to fulfil the requirements of ISO 9001:2008
d) Detailed test program to be used during factory testing,
e) Marking details and method to be used in marking the voltage transformers,
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 voltage transformers for The Kenya Power & Lighting Company
g) Packaging details (including packaging materials and their dimensions).

7.3 A set of three (3) original hard cover installation and technical manuals for the voltage transformers shall be supplied with the equipment during delivery.

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ANNEX A: **Guaranteed Technical Particulars** *(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, details of manufacturing capacity, the manufacturer's experience and copies of complete type test certificates and type test reports for tender evaluation, all in English Language)*

Tender No .....

Clause Number	**Description**	**Bidder's Offer** *(indicate details of the voltage transformer offered)*
-	Name of the Manufacturer, address and Country of manufacture	
	Name & address of Bidder	
	Type/Model Number offered	
Clause Number as per specification *(please refer to the specification)*		
1.	Scope	
	It shall be the responsibility of the supplier 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 voltage transformers for The Kenya Power & Lighting Company	
2	Applicable Standards	
3	Terms and Definitions	
4.1.1	Site Conditions	
4.1.2	System Conditions	
4.2.1	Design Standard	
4.2.2	Materials	
4.2.3	Variations of load & voltage	
4.2.4	Rain water	
4.2.5	Outdoor and Indoor application-Dry type epoxy resin cast	
	Insulator portion of epoxy resin	
4.2.6	Outdoor and indoor installation	
4.2.7	All parts & components to be corrosion resistant	
4.2.8	Primary, secondary and earth terminals	
4.2.9.1	Primary terminal to be high conductivity copper, tin plated	
4.2.9.2	Primary terminal to have palm clamp connector clamp suitable for conductor overall diameter of 18.3mm to 25mm and tubes of 76.2mm diameter (Outdoor application)	
4.2.9.3	The voltage to be transformed shall be applied to the primary winding	
4.2.10.1	Secondary terminals wired to terminal box	
4.2.10.2	Terminal box shall be weather-proof with cable plate at bottom	

Clause Number	Description		Bidder's Offer *(indicate details of the voltage transformer offered)*
4.2.10.3	The secondary winding shall supply the voltage circuits of measuring instruments, meters, or similar apparatus		
4.2.10.4	The secondary terminal box of the voltage transformer shall be complete with protection fuses		
4.2.11	Short-circuit withstand, 1 s		
4.3	**RATINGS**		
a)	Nominal Primary Voltage		
b)	Nominal Secondary Voltage		
c)	Rated Frequency		
d)	Minimum Creepage Distance of Insulator		
e)	Lightning impulse withstand voltage, primary winding (kV_p)		
f)	Power frequency withstand voltage, primary winding, r.m.s, dry		
g)	Power frequency withstand voltage, secondary winding, r.m.s.		
h)	Rated Voltage Factor	Continuous	
		30 seconds	
i)	Permissible partial discharges (PD)	PD test voltage (rms) = U_m	
		PD test voltage (rms) = $1.2U_m/\sqrt{3}$	
j)	Secondary Windings (indicate terminal markings, voltage output, class & VA rating at 0.8pf lagging)	Core 1	
		Core 2	
4.4.1	Quality Assurance Plan to be based on ISO 9001:2008		
4.4.2	Declaration of conformity to IEC 60044-2		
	Copy of ISO 9001:2008 certificate submitted		
4.4.3	Customer reference list for last five years and four customer reference letters		
	Manufacturer's experience		
	Manufacturer's capacity (number of units per month)		
5.1	Test Standard		
	Responsibility of testing of transformer & manufacturer's capability to test		
5.2	Copies of type test reports to IEC 60044-2 submitted with tender for evaluation:		
	5.2.1 Temperature rise test; 5.2.2 Short-circuit withstand capability test; 5.2.3 Lightning impulse test (with both positive and negative polarity – fifteen consecutive impulses of each polarity);		

Clause Number	Description		Bidder's Offer *(indicate details of the voltage transformer offered)*
	5.2.4 Wet test for outdoor type transformers; 5.2.5 Determination of errors		
5.3	Tests to IEC 60044-2 to be carried out during Factory Acceptance Testing: 5.3.1 Verification of terminal markings; 5.3.2 Power-frequency withstand test on primary windings; 5.3.3 Partial discharge measurement; 5.3.4 Power-frequency withstand tests on secondary winding; 5.3.5 Power-frequency withstand tests between sections; 5.3.6 Determination of errors; 5.3.7 Accuracy of measuring voltage transformers at 80%, 100% and 120% of rated voltage, at rated frequency and at 25% and 100% of rated burden; 5.3.8 Temperature-rise test for residual voltage transformer; 5.3.10 Visual inspection of complete voltage transformer.		
5.4	Inspection and test by KPLC during delivery by supplier before acceptance to stores		
6.1	Marking	Items to be marked to include those required by clause 6.1 of this specification	
		Method of marking to ensure it is permanent and legible	
6.2	The terminals shall be marked clearly and indelibly and in accordance with IEC 60044-2. The terminal marking shall consist of letters followed by numbers. The letters shall be in block capitals.		
7.1	List of documents submitted with tender for evaluation		
7.3	List of documents to be submitted by supplier to KPLC for approval before manufacture		
7.4	A set of three (3) original hard cover installation and technical manuals for the instrument transformers shall be supplied with the equipment during delivery		
	Material of terminal box (to suit stated service		

Clause Number	Description	Bidder's Offer *(indicate details of the voltage transformer offered)*
	conditions)	
	Manufacturer's warranty and guarantee for the complete voltage transformer	
	Manufacturer's Letter of Authorization	
	Deviations from tender specifications (indicate supporting documents submitted)	

Manufacturer's Name, Signature, Stamp and Date