DOCUMENT NO.: KP1/13D/4/1/TSP/11/001

Kenya Power

11kV METAL CLAD PROTECTION & METERING SWITCHGEAR PANEL

(Air Insulated with Vacuum Circuit Breaker)-

SPECIFICATION

A Document of the Kenya Power & Lighting Co. Plc

November 2023

0.1 TABLE OF CONTENTS

----------THIS SPACE IS LEFT BLANK----------

0.2 CIRCULATION LIST

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

REVISION OF KPLC STANDARDS

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

Head of Section, Standards Development	Head of Department, Standards
Signed:	Signed:
Date: 2023-11-03	Date: 2023-11-03

0.3 AMMENDMENT RECORD

Rev No.	Date (YYYY-MM-DD)	Description of Change	Prepared by (Name & Signature)	Approved by (Name & Signature)
Issue 3, Rev 1	2010-06-30	Add clause 2.10 on detailed specification for Energy meter requirements	G. K. Gathige	G. Owuor
Issue 3, Rev 2	2023-11-03	Cancels and replaces KPLC1/3CB/TSP/11-001 Issue 3 rev 1 dated 2010-06-30 and all previous issues	Eng. B. Dianga	Dr. Eng. Peter Kimemia

----------THIS SPACE IS LEFT BLANK----------

1.0 FOREWORD

KPLC connects large power consumers at medium and high voltages. These consumers run and manage their own networks, which they reticulate to various load points. As such, energy metering is done at medium and high voltages using equipment designed for medium and high voltage metering. This Specification defines requirements for manufacturing, testing and supplying of an 11kV Metal Clad Protection and Metering Panel.

It shall be the responsibility of the supplier and manufacturer to ensure that the offered design is of the highest quality and guarantees excellent service to KPLC. The offered design should also ensure good workmanship and good engineering practices in the manufacture of the 11 kV Metal Clad Protection and Metering Panel.

This specification has updated the previous revision to realign the design with the current business need. Users of this specification are responsible for its correct interpretation and application. Any clause or declaration that not clear should be referred to KPLC for clarification.

This specification has been reviewed by a team that comprises personnel from Customer Service, Infrastructure, Network, and Standards- all of The Kenya Power and Lighting Company Plc. The following are members of the technical team that reviewed this specification:

Name	Department
Benson Dianga	Standards
Julius Ndirangu	Standards
Samuel Gathege	Protection
Vincent Achongo	Protection
Emmanuel Buluma	Construction
Peter Wanyonyi	Sales

2.0 SCOPE

This specification is for three Pole 11kV indoor Metal Clad Protection and Metering Switchgear panels with vertical or horizontal isolation and horizontal draw out vacuum interrupter circuit breaker.

This specification is intended to cover the design, manufacture, assembly, testing, supply and delivery of 11kV Indoor Metal Clad Protection and Metering Switchgear panel. The specification also covers installation and commissioning of the equipment.

The equipment shall be complete with all components and all associated accessories, necessary for its effective and trouble-free operations. Such components shall be deemed to be within the scope of supply, irrespective of whether they have been specified in this document or not. The equipment shall conform in all respects to the high standard of engineering design and workmanship and shall be capable of continuous service in a manner acceptable to KPLC.

KPLC shall interpret the drawings against the specifications and shall have the power to reject any works or material which in its judgement does not comply to the engineering practices and safety standards requirements. The specification does not imply or purport to include all the necessary provisions of a contract.

3.0 REFERENCES (NORMATIVE)

Ratings, characteristics, tests and test procedures, etc. for the 11kV metal-clad Protection and Metering switchgear panels and all the protection relays, measuring and indicating instruments and the control and monitoring devices and accessories, including current transformers and voltage transformers shall comply with the requirement provisions of the standards of the international electro-technical commission (IEC), and also relevant ANSI standards where specified.

The following documents were referred to during the preparation of this specification, and may be referred to; however, in case of conflict, the provision of this specification shall take precedence. Unless otherwise specified, the latest revision, edition and amendments of the standard shall apply.

IEC 62271-100: High-voltage switchgear and control gear -Part 100: High-voltage alternating-current circuit breakers.

IEC 62271-200:	High-voltage switchgear and control gear - Part 200: A.C. metal-enclosed switchgear and control gear for rated voltages above 1 kV and up to and including 52 kV.
IEC 62271-1	High voltage switchgear and control gear part 1: common specifications
IEC 60071	Insulation Co-ordination
IEC 60051	Direct acting indicating analogue electrical measuring instruments and their accessories.
IEC 60044-1:	Current transformers
IEC 60044-2:	Voltage transformers
IEC 61869:	Instrument transformers
IEC 60255:	Electrical Relays relays and protection equipment having a rated AC voltage up to 1000 V.
IEC 60529:	Degrees of protection provided by enclosures (IP Code).
IEC 60815:	Guide for the selection of insulators in respect of polluted conditions.
BS 1363:	13A plugs, sockets outlets, adaptors and connection units. Specification for rewireable and non-rewireable 13A fused plugs.
BS 381C:	Colours used in identification, coding and other special purpose.
IEC 61870-5-103:	Communication Protocols and interoperability between protection equipment and devices of a control system in a substation.
IEEE 1613:	IEEE Standard Environmental and Testing Requirements for Communications Networking Devices in Electric Power Substations
ANSI 37:	Medium voltage AC metal - enclosed switchgear and control gear
ISO 1461	Hot dip galvanized coating on fabricated iron and steel articles-Specification and test methods

4.0 TERMS AND ABBREVIATIONS

The Terms given in the reference standards and the following Abbreviations and acronyms shall

AC	Alternating Current
AFLR	Accessibility restricted to Authorized personnel only, F for Front side, L for lateral side, R for Rear side
Amps	Amperes
CB	Circuit Breaker
CBCT	Core Balance Current Transformer
CT	Current Transformers
DC	Direct Current
FAT	Factory Acceptance Test
GPS	Global Positioning System
HMI	Human Machine Interface
HV	High Voltage
IEC	International Electrotechnical Commission
IED	Intelligent Electronic Device
I_n	Nominal Current
ISO;	International Organization for Standardization.
ISF	Instrument Security Factor
kA	Kilo amperes
KPLC	Kenya Power and Lighting Company
kV	Kilo Volts
LAN	Local Area Network

LCD	Liquid Crystal Display
LED	Light Emitting Diode
LI	Lightning Impulse
LV	Low Voltage
MCB	Miniature Circuit Breaker
N/C	Normally Closed
N/O	Normally Open
PME	Protective Multiple Earth
PT	Potential Transformer
SEF	Sensitive Earth Fault
TCS	Trip Coil Supervision
TPN	Triple Pole Neutral
VA	Volt Amperes
VT	Voltage Transformer
XLPE	Cross Linked Polyethylene

5.0 SERVICE AND SYSTEM CONDITIONS

The 11kV metal-clad Protection and Metering switchgear panels shall be suitable for continuous indoor operation in tropical, harsh climatic conditions with the following service and system conditions:

5.1 Service Conditions

(a) Altitude: up to 2200m above sea level

(b) Pollution: Heavy saline (Pollution level IV) atmosphere in accordance to IEC 60815

(c) Humidity: up to 95%

(d) Ambient temperatures of +30° C average, (-1° C Min and +40° C Max.).

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

5.2 System Conditions

5.2.1 The design, dimensions and materials of all parts shall be such that they will not suffer damage under the most adverse conditions nor result in deflections and vibrations, which might adversely affect the operation of the equipment. Mechanisms shall be constructed to avoid sticking due to rust or corrosion

5.2.2 The equipment and apparatus shall be designed and manufactured in the best and most substantial and workmanlike manner with materials best suited to their respective purpose and generally in accordance with up-to-date recognized standards of good engineering practice.

5.2.3 The equipment shall be designed to cope with 0.2g horizontal acceleration of seismology on the centres of gravity.

5.2.4 Whenever possible, all similar parts, including spare parts, shall be made interchangeable. Such parts shall be of the same materials and workmanship and shall be constructed to such tolerances as to enable substitution or replacement by spare parts easily and quickly.

5.2.5 All equipment shall be designed to minimize the risk of fire and consequential damage, to prevent ingress of moisture, entry of vermin and effects of dust and accidental contact with electrically energized or moving parts.

5.2.6 The switchgear panels shall be capable of continuous operation with minimum attention and maintenance in the exceptionally severe conditions likely to be obtained in a tropical climate and where the switchgear is called upon to frequently interrupt fault currents on the system and also where the duty of operation is high.

5.3 Switchgear Room Temperature Requirements

The switchgear panels shall be installed in a room without air conditioning but with ventilation to allow natural cooling. Therefore, all the protection and control devices employed shall be capable of operating in this environment without failure for their designed life time. Particularly the power supply modules of the protection and control devices shall be designed for minimum heat generation and effective heat dissipation to ensure that the temperature of these devices enclosed in the relay panels at the above listed ambient temperatures shall not exceed the maximum operating temperature of the device.

5.4 Tropicalization Requirements

5.4.1 From the geographical condition, the area where the switchgear panels shall be installed is categorized into the tropical climate zone. In choosing materials and their finishes, due regard shall be given to the humid tropical conditions under which the switchgear panels will be working. The manufacturer of the switchgear panels shall submit details of his usual practice of tropicalization which have proven satisfactory for application to the switchgear panels and associated equipment serving in tropical climate zones

5.4.2 All equipment must be designed for operations in the severe tropic climate conditions and fully comply with climatic aging tests as per IEC/TS 62271-304 Metals: Iron and Steel are generally to be painted or galvanized as appropriate. Indoor parts may alternatively have chromium or copper-nickel plates or other approved protective finish.

5.4.3 Small iron and steel parts(other than rustless steel) of all instruments and electrical equipment, cores of electromagnets and the metal parts of relays and mechanisms shall be treated in an appropriate manner to prevent rusting.

5.4.4 The use of iron and steels shall be avoided in instruments and electrical relays wherever possible. Steel screws shall be zinc, cadmium or chromium plated or where plating is not possible owing to tolerance limitations, shall be of corrosion resisting steel. Instrument screws(except those forming part of a magnetic circuit) shall be of brass or bronze. Springs shall be of non-rusting material, e.g. phosphor-bronze or nickel silver.

5.4.5 Rubbers: Neoprene and similar synthetic compounds, not subject to deterioration due to the climatic conditions, shall be used for gaskets, sealing rings, diaphragms, etc.

6.0 PANEL ENCLOSURE DESIGN REQUIREMENTS

6.1 General Panel Enclosure Construction Requirements

6.1.1 The design, dimensions and materials of all parts of the switchgear panel shall be such that the stresses to which they may be subjected shall not cause distortion, undue wear, vibrations in service or damage under the most severe conditions encountered in service.

6.1.2 Switchgear shall electrically be designed to avoid local corona formation and discharge likely to cause radio interference

6.1.3 All parts of the switchgear shall conform to the dimensions specified and shall be built in accordance with approved drawings.

6.1.4 All joints, datum surfaces and meeting components shall be machined and all castings shall be spot faced for nuts. All screw, bolts, studs and nuts and threads shall conform to the latest ISO Standards covering these components and shall all conform to the standards for metric sizes.

6.1.5 The design of jointing of adjacent metal parts and surfaces shall be such as to prevent corrosion of the contact surfaces and to maintain good electrical contact under service conditions.

6.1.6 All materials and works that have cracks, flaws or other defects or inferior workmanship will be rejected by KPLC.

6.1.7 All steel castings and welding shall be stress-relieved by heat treatment before machining, and castings shall be stress-relieved again after repair by welding.

6.1.8 Casting shall be true to pattern, of workmanlike finish and of uniform quality and condition, free from blowholes, porosity, hard spots, shrinkage defects, cracks or other injurious defects, shall be satisfactorily cleaned for their intended purpose.

6.1.9 Wherever welding is specified or permitted, a welding process, including stress relieve treatment as required if necessary, conforming to an appropriate and widely recognized professional standard shall be used.

6.2 Specific Panel Enclosure Construction Requirements

6.2.1 The whole switchgear equipment and components shall be designed and constructed in accordance with IEC 60298 Standard. The panels shall be complete with all the relevant components including, busbars, circuit breaker, compartment, instrument transformers, protection relays, instruments and controls.

6.2.2 The switchgear shall be designed such that it is flush-front, for erection with the rear side close to a wall as well as for free standing erection. The manufacturer shall provide a single line layout drawing giving the required minimum dimensions of the switchgear room, and showing the cable trenching requirements.

6.2.3 The plates shall be of high-quality mild steel of at least 2mm thickness thoroughly cleaned by shot blasting or other approved methods.

6.2.4 The switchgear shall be of arc resistant design as per IEEE/ANSI C37.20 to ensure complete safety for a switching personnel standing in-front or at the rear of the switchgear board.

6.2.5 The Switchgear panel shall be given a primary coat and two coats of contrasting colour of durable and weather resisting paint. The final coat shall be gloss and of **RAL 7032.**

6.2.6 The Switchgear panel shall have a final thickness of the paint not be less that 80 Microns at any point of panel body. The paint thickness shall be measured during the Factory Acceptance Tests.

6.2.7 The switchgear encloser panel, shall be constructed to **IP43** degree of protection in accordance with IEC 60529, IEC 60034, IEC 60529 and IEC 60947. Indoor control and relaying equipment shall be constructed to **IP51**. A type test report for the degree of protection of the switchgear panels from third party.

6.2.8 The Switchgear panels shall have restricted dimensions suitable for installation in limited spaces. In particular and without compromising the insulation level, bus - bar current rating and short circuit current performances, the width of the panels shall not exceed **900 mm.**

6.2.9 The depth of the switchgear, i.e., from the front to the back, shall be kept to the minimum and in any case not exceeding **2500 mm.**

6.2.10 The overall height of the protection and metering switchgear panel with the meter compartment installed shall not exceed **2800 mm.**

6.2.11 Hinged and lockable doors with handles shall be provided at the front of each cubicle for the respective LV compartment, circuit breaker compartment and cable connection compartment. There shall be no need for any additional form of locking/unlocking such as screws, bolts etc.

6.2.12 The switchgear panel or cubicle shall be built up of separate compartmented cubicles with earthed metal partitions. The compartments shall be for (i)busbar, (ii) cables, (iii)circuit breaker, (iv) Instrument transformers, (v) LV control and (vi) Energy meter compartments.

6.3 General Design Requirements for Compartments:

6.3.1 The LV section shall be completely separate from the High Voltage section. All the protection relays, auxiliary relays, energy meters indication lamps, instruments, control and selection switches and any other associated accessories shall be mounted in Low Voltage Section.

6.3.2 A drawing showing the layout and dimensions of each of the compartments of the switchgear panel and the devices/components installed in the compartment shall be submitted with the bid for tender evaluation. NB: The incoming and outgoing cables shall NOT be located in the same compartment.

6.3.3 The LV compartment shall not be less than **550 mm** in height, to ensure adequate space for mounting the relays and other devices and accessories and adequate space for the cable trunks, terminal blocks and wiring.

6.3.4 The LV compartment terminal block shall include a test switch (block), which enables the CTs circuits to be isolated from the relay and shorted without opening circuiting the CT, to facilitate relay testing in situ and to allow for isolation of VT circuits, alarm and trip circuits without disconnecting wires at the terminal block.

6.3.5 The LV compartment Terminal Block shall include a test switch (block) which shall enable the CTs circuits to be isolated from the relay and shorted, to facilitate relay testing in site and to allow isolation of VT circuits, Alarm and Trip Circuits. The test block shall be supplied with the plug-in unit and any other accessories required for secondary injection tests. The cables compartment shall have an anti-vermin guard plate giving protection against entry by rats, rodents etcThe circuit breaker compartment, the CT compartment, the LV compartment, the VT compartment and the Energy meter compartment shall be provided with facilities for padlocking and sealing.

6.3.6 The doors for the compartments shall be capable of withstanding the effects of maximum internal arcing fault without being blown off and causing danger to personnel and other equipment as per ANSI C37.20.7 or equivalent IEC standards.

6.3.7 For ease of transportation, the metering compartment can be delivered loose with each panel together with all mounting accessories for installation at site. Provision shall be made for entry

of cables from the current transformers and the voltage transformers into the metering compartment.

6.3.8 The front cubicle door shall be provided with a window through which the mechanical status of the circuit breaker (ON/OFF & SPRING CHARGED/DISCHARGED) can be checked.

6.3.9 Rear cable chamber covers on the cable compartments, shall be provided with handles and all bolts and nuts shall be stainless steel.

6.3.10 Interior illumination lamps operated by door switches shall be provided for LV compartment. The lamps shall be of low power LED type and their fittings shall be standard. They shall be readily available in the local market to ease future replacements.

6.3.11 Space heaters for 230V AC shall be provided inside the switchgear panel, circuit breaker and control compartments to prevent moisture condensation. A hygrostat control unit with variable temperature and humidity control setting shall be installed to control the heater.

6.3.12 The metering compartment shall have a glass window through which the readings for the energy meter can be viewed and accessed, without opening the compartment door. The compartment door shall be provided with padlocking and sealing facilities. The design of the cubicle shall be to the approval of KPLC.

6.3.13 The circuit breakers shall be mounted on an inbuilt carriage to facilitate isolation and withdrawal of the circuit breaker. Each metering breaker unit should also come with the following items

i. Spring charging handle- 3nos
ii. Racking in /out handle-3Nos
iii. Earthing handle- 2Nos
iv. Each set of panel keys – 5Nos
v. Withdrawing Trolley if the CB is not on level ground- 1No.

7.0 ELECTRICAL REQUIREMENTS

6.1 Design and Construction

6.1.1 Low Voltage Equipment

7.1.1.1 The AC supply shall be used for power circuits for lighting, indications, motor control and panel sockets, panel illuminations and panel heaters.

7.1.1.2 Unless otherwise specified, the equipment provided under this tender is to be capable of reliable operation at voltages as low as 85% of the rated voltage, and to withstand continuously up to 110% supply voltage above the rated value of 230V or 420V AC

7.1.1.3 Low voltage equipment and installation shall be designed in accordance with EMC directives. The rating and design criteria for low voltage equipment shall be as shown in Table 1 below;

Table 1: Low Voltage Equipment

No.	Item Description	Requirement
1.	Rated voltage between the phases	420V ac
2.	Connection type	3ph 4 wire
3.	Rated voltage between phase and earth	230V ac
4.	Grounding system	PME
5.	Frequency	50hz
6.	Voltage variation	± 10
7.	Frequency variation	± 2%
8.	Power frequency 1 min test voltage	3kV
9.	Thermal rating of conductors	120%
10.	Maximum short circuit current	1.37 kA, 3s

7.2 Low Voltage DC Auxiliary Supply Rating

7.2.1 The auxiliary DC supply shall be used for controls, indication, alarm, protection relays, motors, circuit breaker tripping and closing circuits and its characteristic shall be as shown in table 2 below.

Table 2: DC Auxiliary Supply Characteristics

No.	Description	Requirement
1.	Equipment/device rated voltage	30V DC
2.	Connection type	2 wire
3.	Voltage variation	24V - 40V DC

7.2.2 All equipment and apparatus including the circuit breakers, protective relays, control devices and accessories, measuring and indicating instruments and other electronic equipment shall be capable of satisfactory operation at 70% to 125% of the rated dc supply voltage.

7.3 Medium Voltage Switchgear Panel

The Indoor Switchgear panels shall be suitable for installation in supply systems of the following characteristics.

7.4 Medium Voltage Switchgear Panel Requirements

7.4.1 All measuring instruments, including energy meters, shall be of flush-mounted, back-connected, dust-proof and heavy-duty switchboard type. Each measuring instrument shall have a removable cover, either transparent or with a transparent window. Each instrument shall be suitable for operation with the instrument transformers detailed in this specification, under both normal and short-circuit conditions.

7.4.2 For analog type instruments, scale plates shall be of a permanent white circular or rectangular finish with black pointer and markings. The scale range shall be determined from the current transformer and voltage transformer ratios and is given in the detailed specifications for each instrument.

7.4.3 All measuring instruments of analog type shall be approximately 110mm^2 enclosures and shall be provided with clearly readable long scale, approximately 240 degrees. The maximum error shall be not more than one and a half (1.5) percent of full-scale range.

7.4.4 The floor-standing switchgear panel shall have provision for bolting to the floor.

7.4.5 Interior illumination lamps operated by door switches shall be provided for the control and energy meter compartments. The Lamps should be easily available in the local market for future replacements. One 230V ac socket outlet of 3-point square terminals shall be provided for each switchgear panel in the control compartment.

7.4.6 Trip circuit supervision for both CB ON and CB OFF.

7.4.7 For the circuit breakers, red indicating lamps shall be used for "ON" position, green lamps for "OFF" position indication and amber for circuit breaker auto trip.

7.4.8 Detailed Nameplate for the Circuit Breaker with all VCB rating and transformer details.

7.4.9 Two sets of NO + NC auxiliary contact of circuit breaker wired to the control cable termination block for status indication.

7.4.10 High voltage presence indicator.

7.4.11 The rating and design criteria for Medium Voltage plant equipment shall be as shown in table 3 below.

Table 3: Medium Voltage Switchgear Panel Ratings

No.	Description		Requirements
1	System description		50Hz, 3 phase, 3 wire
2	Neutral point earthing		Solidly earthed.
3	Highest equipment rated voltage as defined by IEC-60071		17.5kV
4	Maximum rated continuous current of circuit breaker ,incomers and Bus -section		630A
5	Insulation level according to IEC 60071	Minimum Lightning Impulse Withstand Voltage 1.2/50µs +ve, dry (peak)	95kVpk
		Minimum Power Frequency Withstand dry Voltage (rms)(1 min)	38kVrms
6	Bus clearances.	Phase to earth	300mm
		phase to phase	250mm
7	Rated Short time current withstand (3sec)(Ik)		31.5 kA rms
8	Rated peak withstand current (Ip)		78 kA pk
9.	Rated breaking capacity		31.5 kA
10.	Rated making capacity		78 kA
11	Specific creepage distance as per IEC/TS60815:2008 – class		31 m/kV

7.5 Bus Bar

7.5.1 The busbar shall be single, three phase, air insulated. The primary busbars and connections shall be of high conductivity and electrolytic material, high grade copper, and shall be in unit lengths.

7.5.2 Busbars, connections and their support shall be rated 630A continuously under ambient conditions and capable of carrying the short-time current associated with the short circuit ratings of the circuit breakers, for 4 Seconds.

7.5.3 Provision shall be made for locking busbar and circuit shatters separately in the circuit breaker compartment. These shutters shall open and close automatically during the racking in and racking out of the circuit breaker.

7.5.4 All busbars and branch busbars shall be insulated by means of shrink-on sleeves. In conjunction with bushing plates and bushings, busbar will be supported with rated insulation supports

7.5.5 Particular care shall be taken during manufacture of busbars and fittings and during subsequent handling to ensure smooth surface free from abrasion. All joints on the busbars and the circuit within the switchgear board shall be silver or tin-plated to ensure good electrical connection.

7.5.6 The Bus bars shall be marked R, Y, B and all the jointing points/ends shall be tin-plated.

7.5.7 The Bus bar shutters shall be painted in Red shade (Signal colour 537 of BS381C) with "BUSBARS" written in white. The cable shutters shall be painted in lemon colour (355 of BS381C). For Bus coupler panel, both the shutters shall be painted Red shade with 'BUSBARS' written in white.

7.6 Earth Switch

7.6.1 Provision shall be made for integral circuit earthing and for busbar earthing. Means of earthing shall be by circuit breaker or purposely built earth switch. Mechanical & electrical interlocks to ensure correct switching operation shall be provided. It shall not be possible to close the earth switch when the incoming 11kV cable is live and the VTs are energised. The earth switch shall be equipped with a blocking coil energized when the VTs are energized or any other suitable arrangement. It is preferred that earth switch be provided both on the incoming and outgoing cable circuits.

7.6.2 All metallic instrument cases, protective relay, switches etc. shall be properly earthed to the switchgear board steelwork frame.

7.6.3 The material for Earth bus and cable shall be copper of 99.5% purity, and the earth bus shall be extended outside the switchboard panel.

7.6.4 The earth switch shall be easy to operate by one operator and be spring loaded to ensure effective make operation independent of the operator action. The earth switch shall be rated to make and carry for 3 seconds, the rated short-circuit current of the switchgear panel of 31.5 kA.

7.6.5 The Status of the earth switch shall be visible from the front of the Panel. It shall not be possible to rack-in the circuit breaker into the service position with the earth switch in closed position. The mechanical interlock between the circuit breaker and the earth switch shall be strong enough and not easily defeated to guarantee safety of the switching personnel and the switchgear.

7.6.6 The earth switch shall be equipped with auxiliary contacts for local and supervisory indication of the status of the earth switch. The earth switch operating lever shall be covered by a shutter and shall only be accessible when it is permitted to operate the earth switch.

7.6.7 The operation of the Earth Switch shall be set in such a way that during both the close and open operations, a clearance of at least 9 inches shall be maintained between the operating handle and the bottom of the switchgear panel.

7.6.8 It shall not be possible to insert the earth switch operating handle into position except when the circuit breaker is in the test or isolated position. The earth switch shall be equipped with pad-locking facilities when in the closed position.

7.6.9 All earthing facilities shall be rated for fault making at the rated switchgear short-circuit current.

7.6.10 Each switchgear panel shall be provided with Tinned Copper earth bar of adequate cross section area to be able to withstand the rated short-circuit current of 31.5 kA for 3 seconds. Provision shall be made for connection of the switchgear panel earthing bar to the substation earthing grid.

7.7 Medium Voltage Power Cable Termination

7.7.1 11kV cable compartment design shall be suitable either for shrinkable (or equivalent) jointing application termination.

7.7.2 The following provisions shall be made:

i. Three gland fabricated sheet steel cable compartment, complete with gland and armour clamp, suitable for receiving Three single core (3 per phase) 11kV cables each of size up to 630mm2

ii. Single gland fabricated sheet cable compartment complete with gland and armour clamp suitable for receiving three core cable up to 400mm2 11kV XLPE cable (for feeder type panels).

iii. The cable connection terminals shall be located at least 250 mm from the CT primary terminals.

7.8 Electrical Controls, Auxiliaries and Power Supplies

7.8.1 The manufacturer shall provide all control, indication, alarm and protection devices and all auxiliary equipment with wiring and interconnecting cable which are integral parts of or are directly associated with or mounted on the switchgear panels to be supplied.

7.8.2 The Panel wiring for protection, instruments, indication and metering circuits and other control accessories shall be completely done. All circuits for connection to external cables such as DC & AC auxiliary supplies, external tripping, supervisory control and indications shall be wired up to the terminal Block at the Back of the panel where external cables shall be connected.

7.8.3 Suitable terminal blocks shall be provided for all out going power and control cables. All CT and VT terminal blocks shall have a provision for isolation and banana type sockets for inserting test leads. The terminal blocks for the CTs shall be rated for the maximum possible secondary current of CTs provided.

7.8.4 The internal panel wiring for protection, instruments, indications, metering circuits and other control accessories shall be complete with appropriate ferrules and lugs. The panel wiring for protection, instruments, indication, signal/command and metering circuits and other control accessories shall be completely done using flexible stranded copper 2.5mm^2 cables.

7.8.5 Supervisory control and indications shall be wired up to the terminal block at the front of the panel where external cable shall be connected.

7.8.6 All primary power cable terminals shall generally be located at rear bottom entry connection.

7.8.7 Auxiliary 30VDC, 110Vac and 230Vac supplies for circuit breaker control, alarm circuits, protection relays, metering and motor supply for each panel shall be controlled by miniature circuit breakers rated to carry the full load of the equipment.

7.8.8 One 230 Vac socket outlet of 3-point square terminals as per BS 1363 shall be provided for each switchgear panel in the LV compartment.

7.8.9 Auxiliary supplies for panel heating and lighting shall be 230VAC, 50Hz, single-phase 3-wire, while protection, spring charging motor, Control and Circuit Breaker Trip/Close auxiliary supply shall be 30VDC.

7.8.10 The circuit breaker cubicle shall have a limit switch which shall be used to indicate whether the breaker is fully racked in or fully racked out (withdrawn). This shall be indicated on the relay MIMIC

7.8.11 Suitable means shall be provided to monitor the status of HV cables for both the incoming and outgoing cables. The monitoring unit shall be a three-phase device with illumination in red colour for live status visible from the front of the panel without opening any compartment doors. The indication shall be labelled L1 L2 L3. The device shall meet the requirements of IEC 61243-5.

7.8.12 Manual close & open push buttons shall be provided on the circuit breaker compartment door for manual close and open of the circuit breaker both in the service and in the test(withdrawn) position. The manual Close and Open push buttons shall be clearly labelled with CLOSE and OPEN Labels and with I(red) and O(Green) Symbols and colour codes as per the IEC standard.

7.8.13 A single power measurement unit shall be provided for each feeder panel to capture instantaneous and maximum demand values for the following parameters ; I, kV, MW, MVAR and p.f.

i. Circuit breaker control switch(Close, Open &Neutral),with a mechanical Lock
ii. Circuit Breaker ON(red), OFF(green) and auto-trip(amber) indication lamps
iii. Anti-condensation heaters for the Circuit Breaker and the LV compartments
iv. Hygrostat with separate humidity and temperature control setting to control the heaters.
v. Door switch operated lighting point and bulb for the LV compartment and the Meter compartment
vi. 3 Pin - square power socket outlet with red neon indicator .
vii. Suitably rated MCBs for auxiliary 30V DC for control, 30VDC for Trip, 230 V AC for motor , 230V AC for heaters and illumination and VT 110 VAC supplies shall be fitted.

8.0 MEDIUM VOLTAGE COMPONENTS CHARACTERISTICS

8.1 11kV Circuit Breaker

8.1.1 The Manufacturer of the Circuit Breaker shall be identified at the time of tender. Copies of Type Test certificates and routine Test Reports/Certificates as per IEC 62271-100& IEC 62271-200 of type and ratings of similar Circuit breakers as well as the limits of error for the declared operating boundary conditions submitted with the bid for tender evaluation purposes. The specified Circuit Breaker shall be within the product range of the manufacturer. A catalogue of the Circuit Breaker manufacturer shall be supplied with the bid.

8.1.2 The circuit breaker shall be three pole operated, indoor withdrawable type, employing Vacuum Interrupter, with air insulation complying with the requirement of IEC 62271-100& IEC 62271-200

8.1.3 The moving portion of the circuit breaker shall consist of a three-pole contacts, operating mechanism, primary and secondary disconnecting devices, auxiliary switches, position indication and necessary control wiring.

8.1.4 The auxiliary switches shall be of the plug-in type, with the male contacts mounted on the breaker carriage and the female contacts on the plug-in cable connected to the panel wiring.

8.1.5 An extension cable for the plug-in cable shall be provided to allow for testing of a circuit breaker that has been fully extracted from the CB compartment. Other options may be considered where there is adequate proof that the auxiliary contacts will always be making firmly without misalignment. Finger contacts will however not be acceptable.

8.1.6 The circuit breakers shall be interchangeable with other circuit breakers of the same current and voltage ratings, both electrically and mechanically.

8.1.7 The circuit breaker operating mechanism shall be motor wound spring operated, power closing with electrical release and with provision for manual (hand) charge.

8.1.8 The circuit breaker operation sequence shall be O - 0.3 sec – CO- 3min – CO.

8.1.9 The CB shall be provided with two tripping coils and one closing coil all wired to the CB control circuit

8.1.10 Mechanical indication shall be provided to indicate the state of the spring. In addition, two pairs of Auxiliary contacts, which are closed when the springs are charged, shall be provided for local

and supervisory indication. The motor limit switch assembly shall be made of mechanically sound materials which will not lose their mechanical properties over the service life of the CB.

8.1.11 The circuit breaker poles between the interrupter units and the primary plug-in contacts shall be fully insulated with durable material.

8.1.12 A spare set, of at least 8NO and 8NC auxiliary contacts of the circuit breaker shall be provided and shall be wired to a terminal block, for connection to control circuits.

8.1.13 The circuit breaker control circuit shall have an anti-pumping facility.

8.1.14 The control circuits for the circuit breaker shall automatically be connected when inserting the breakers into the cubicle. Alternatively a single plug-in cable for all auxiliary contacts shall be provided. It will not be possible to rack-in the circuit breaker without connecting the plug in cable first.

8.1.15 The operating mechanism shall be completely trip free both mechanically and electrically.

8.1.16 Circuit breaker poles between the interrupters and the primary plug-in contacts shall be fully insulated with durable material.

8.1.17 The circuit breaker maintenance and operations manual shall contain clear instructions on the maintenance requirements of the circuit breaker(if any), to prevent switchgear failure in service, due to excessive fault current clearance or any other cause or during the rack-in and rack-out operations.

----------THIS SPACE IS LEFT BLANK----------

Table 4: Circuit Breaker Ratings

Interrupting Medium	Vacuum
Number of poles	3
Highest equipment Voltage	17.5kV
One minute power frequency withstand voltage	38 kV
Impulse withstand voltage (BIL)	95kV
Frequency	50 Hz
Rated short time current	31.5kA
Rated short time making current (peak)	79kA
Rated Short circuit current withstand, time	31.5 kA, 4 seconds
First pole to clear factor	1.5
Operating sequence	0-0.3 sec-co-3 sec.-co
Auxiliary D.C. voltage for closing and tripping coils	30V
Auxiliary a.c. voltage	230V AC, 50Hz
Tripping/closing coil auxiliary voltage	30 V DC
Spring charging motor supply	230 V AC
Rated normal Current for Busbar & Circuit	630A

8.2 11kV Current Transformers

8.2.1 The Manufacturer of the CTs shall be identified at the time of tender. Copies of Type Test certificates and routine Test Reports/Certificates as per IEC 60044-1 of CTs of similar rating and class, verifying the class and accuracy as well as the limits of error for the declared class similar to those of the specified CTs shall be submitted with the bid for tender evaluation purposes. The specified CTs must be within the product range of the manufacturer. A catalogue of the CT manufacturer shall be supplied with the bid.

8.2.2 The current transformers shall be in accordance with the requirement of IEC 61869-2 and IEC 61869-6 .

8.2.3 The current transformer shall be made of wound epoxy resin casting insulation and fully enclosed support construction. It encloses primary windings, secondary windings and annular core in the epoxy resin casting body.

8.2.4 The current transformers shall be single phase, one for each of the three phases and shall be accommodated inside the cubicle. All the cores of respective CTs shall be wired to the LV compartment of the respective cubicle except for the tariff metering wiring ,which should be done straight from the VTs and CTs to the metering cubicle.

8.2.5 Each current transformer circuit shall be earthed through a removable link at one point only. The common Protection Trip and Alarm circuit for each Panel shall be provided with an isolation link to facilitate testing and breakdown maintenance.

8.2.6 Current transformers shall have a rated burden as specified, sufficient for the connected Numerical Protection relays and Energy meter and Power Measurement Unit. The CT shall not saturate under maximum short-circuit conditions for the connected burden.

8.2.7 The current transformer shall have markings on the secondary and primary terminals as per requirements of the IEC 60044-1 standard. The markings shall be indelibly made. The secondary terminals shall have screw type terminals.

8.2.8 The current transformers shall have the specified accuracy under load conditions and shall be able to withstand the effect of short-circuit fault current rating of the switchgear, of 31.5 kA for 3 seconds.

8.2.9 The current transformer ratings shall be as shown in table 1 below:

Table 5: Current Transformer Ratings

NO.	Description	Requirement
1.	Type	Wound epoxy cast resin
2.	Highest System Voltage, Frequency	17.5kV,50Hz
3.	Short time Current with stand (STC)	31.5kA for 3 sec
4.	Maximum Continuous Thermal Rating (1.5 In)	400A
5.	Lightning Impulse Withstand Voltage	95kVpeak
6.	One-Minute Power Frequency Withstand Voltage	38kVrms

NO.	Description		Requirement
7	**Ratio & Class**		
	Core 1		
		Ratio	300/200/100/1A
		Class	5P20
		Burden	15VA
	Core 2		
		Ratio	300/200/100/1A
		Class	0.2
		Burden	15VA
	Core 3		
		Ratio	300/200/100/1A
		Class	0.5
		Burden	15VA
8	Core 1: Protection, Core 2: Tariff energy meter and Core 3 : Power measurement unit.		

8.3 11kV Voltage Transformers

8.3.1 The Manufacturer of the VTs shall be identified at the time of tender. Copies of Type Test certificates and routine Test Reports/Certificates as per IEC 60044-2, of VTs of similar rating and class as the specified VTs shall be submitted with the tender for evaluation purposes. The Specified VTs must be within the product range of the manufacturer. A catalogue from the VT manufacturer shall be included with the bid.

8.3.2 Voltage transformers shall be suitable for operation of the protection relays, metering and transformer voltage regulation, their design and manufacturing shall meet requirements of IEC 61896-3

8.3.3 The voltage transformer shall be three phase, five limb, star/star connected and complete with HV fuses. Alternatively, three single phase units shall be installed and connected.

8.3.4 The voltage transformer shall be epoxy cast resin type, shall be one for each of the three phases, and, star/star connected complete with removable HV fuses and links.

8.3.5 The voltage transformers shall be mounted on a common withdrawable truck located in the cable compartment.

8.3.6 All the cores of respective VTs shall be wired to the LV compartment of the respective cubicle except for the tariff metering wiring which should be done straight from the VTs to the metering cubicle.

8.3.7 The bus voltage transformer secondary shall be connected to a TPN MCB with auxiliary contacts mounted in LV compartment of the panel and Horizontal draw out type

Table 6: Voltage Transformer Rating

No.	Description		Requirement
	Rated Voltage of the VT		17.5kV
1.	Ratio		11000/√3/110/√3
2.	Burden		150VA
3.	Impulse Withstand Voltage		95kV peak
4.	One-Minute Power Frequency Withstand Voltage		38kVrms
5.	**Ratio & Core**		
	Ratio		11000/√3:110/√3: 110/√3V
	Class	Core 1	0.2
		Core 2	0.5

Note :

a) The rated VA of 30 VA is for a three Phase unit. In case three(3) single phase units are supplied, the minimum acceptable burden for each is unit 50 VA.

b) The core 1(class 0.2) will for connection to the tariff energy meter and the core 2 (class 0.5) for connection to the Power measurement unit.

9.0 PROTECTION RELAYS

9.1 General Requirements

9.1.1 The Manufacturer of the Relay shall be identified at the time of tender. Copies of Type Test certificates and routine Test Reports/Certificates as per to IEC 60255 and EMC 89/336/EEC, of Relays of similar type shall be submitted with the tender for evaluation purposes. The Specified Relay must be within the product range of the manufacturer. A catalogue from the Relay manufacturer shall be included with the bid.

9.1.2 The relays shall be flush mounted in design, and shall be manufactured in accordance to IEC 60255 and shall be EMC 89/336/EEC compliant.

9.1.3 The relays shall be of Numeric design and supports GOOSE messaging and communication protocols 60870-5-103 and 61850-9-2.

9.1.4 Relay shall be software based incorporating features for fault records, event records and diagnostic data downloaded via RS232 serial port, USB-2 and higher versions.

9.1.5 Relay secondary rating shall be 1Amp (three phase) and Power Supply Voltage shall be 30VDC.

9.1.6 Relay contacts shall be suitable for making and breaking the maximum currents, which they are required to control in normal service. Where contacts of the protective relays are not sufficient for Circuit Breaker Tripping, auxiliary Trip relays shall be provided, to prevent damage to relay output contacts.

9.1.7 Operating time for auxiliary tripping relays shall not significantly affect the overall fault clearance time, i.e., the auxiliary Trip relays must have short pick up times (<30 ms).

9.1.8 Relay contacts shall make firmly without bounce and the relay mechanism shall not be affected by panel vibration or external magnetic fields.

9.1.9 Relays shall be provided with clearly inscribed labels describing their functions and Device Function numbers. The labels shall be put on the outside and in the inside when the doors are open.

9.1.10 Relays shall be suitable for operation on 30VDC supply without use of dropping resistors or diodes.

9.1.11 The relay LEDs should be visible from the front of the panel without opening the panel door(s)

9.1.12 The protection relay shall have a minimum of 5 current inputs (1/1A) and 4No. Voltage transformer inputs 110V ac.

9.1.13 To reduce the effect of electrolysis, relay coils operating on DC shall be so connected such that they are not continuously connected from the positive pole of the station battery bank.

9.1.14 The relays thermal rating shall be such that the fault clearance times on any combination of current and time multiplier settings shall not exceed the thermal withstand capability of the relay. (Max. fault current = 31.5kA/3Sec)

9.1.15 Detailed Relay and Device performance specification shall be as per table 6 below.

Table 7: Detailed Relay and Device Performance requirements

No.	Item	Requirement
A.	**Three Phase Overcurrent and Earth Fault Relay**	
i	Type	Numerical design and supports GOOSE messaging and communication protocols 60870-5-103 and 61850-9-2
ii	Current setting range for overcurrent relay	$0.2I_n - 2.4I_n$
iii	Current setting range for earth fault relay	$0.1I_n - 0.8I_n$
	SEF	$0.05I_n - 0.3I_n$
iv	I.D.M.T characteristics according to BS 142 or IEC 60255	SI, VI, EL, LTI, including definite time and instantaneous characteristics for the high –set and SEF elements
v	Time setting multiplier	0.05 – 1.0
vi	Highest element for both overcurrent and earth fault protection with a setting range	1 -$30I_n$
vii	Drop off/picking up ratio	>90%
viii	Low transient overreach	<10%

No.	Item	Requirement
ix.	Features	i. Thermal overload protection ii. Circuit breaker maintenance iii. Fault records, event records and disturbance records iv. Configurable output relays with ability to output starting elements to control v. Tripping of other upstream protection relays
B. Three-phase Directional Overcurrent and Earth Fault Relay		
a	Type	Numerical design and supports GOOSE messaging and communication protocols 60870-5-103 and 61850-9-2
b	Current setting range for overcurrent relay	$0.2I_n - 2.4I_n$
c	Current setting range for earth fault relay	$0.1I_n - 0.8I_n$
d	Quadrature connection for polarizing voltage	Vn=110 V ac
e	High Set Element	$1 - 32I_n$
f	I.D.M.T characteristics	According to IEC 60255 and Definite time characteristic
g	Normal operating boundary	±90 degrees from relay characteristic angle Relay sensitivity shall be 1% of rated value of current and current polarizing voltage at an angle equal to the relay characteristic angle
h	Time setting multiplier	0.05 – 1.0
i	**Features**	i) Applicable on the LV side of a Dyn1 or Dyn11 transformers ii) The phase and the directional elements shall be individually selectable. iii) Broken conductor protection feature. iv) Negative sequence protection feature.

No.	Item	Requirement
		v) Highest element for both overcurrent and earth fault protection, with a setting range of 1-30In. vi) Thermal protection. vii) Dedicated Breaker Fail Protection. viii) Circuit Breaker Maintenance ix) Incorporate Fault record, Event Records and disturbance records (minimum 1000) x) Configurable output relays with ability to output starting elements to control of other upstream Protection relays.
C.	**Trip Relay**	
1.	Instantaneous operation, t	< 12ms
2.	Output contacts	At least 8(eight) No. pairs of output contacts 2 (two) No. of which should be NC contacts
3.	Features	i. High burden ii. Immune to capacitance discharge currents and leakage currents iii. Provision for manual reset iv. Flag or target should be a red LED or bulb and should be electrically reset
D.	**Trip Circuit Supervision Relay**	
1.	Feature	i. Continuous supervision of trip circuit breaker in both OPEN & CLOSE position ii. Trip circuit fail – Red LED iii. Trip circuit healthy – Green LED iv. Two normally closed and three normally open output contacts

9.2. Panel Relay Specific Requirements

9.2.1 The outgoing feeder panels shall have numerical over current and earth fault relay capable of performing both high set and low set operation. The relay shall have additional current input port for sensitive earth fault function.

9.2.2 The relay shall have binary inputs for activation of auto reclose and sensitive earth fault protection functions via external selector switches.

9.2.3 The relay shall include a card for arc flash protection. The arc card shall have three light inputs i.e. from cable compartment, from CB compartment and from the bus bar compartment. Each of the three compartments shall have one light sensor lens linked to the relay inputs through a single mode insulated glass fibre optic cable.

9.2.4 The operation of arc protection shall be programmed to work on two modes; light only and light + current mode.

9.2.5 Two outputs of the arc protection relay shall be programmed for operation purposes; one output to be used for cable compartment arc sensor operation, the other output to be used for circuit breaker and bus bar compartment arc sensor operation.

9.2.6 The arc flash protection operating from the cable compartment shall be wired to trip the feeder circuit breaker only.

9.2.7 The arc flash protection operating from the bus bar and circuit breaker compartments shall trip the incomer circuit breaker, the bus section circuit breaker and the feeder circuit breaker.

9.2.8 The relay front face LED indications shall be programmed to indicate the following

i. 50+50N operated
ii. 51+51N operated
iii. TCS1-unhealthy
iv. TCS 2-unhealthy
v. Trip relay 86 operated
vi. Cable compartment arc sensor operated.
vii. Breaker/Busbar compartment arc sensor operated.
viii. Arc sensor operated in outgoing/bus PT panel.
ix. Incomer PT fuse failure.

9.3 Additional Components for Panel Relay

The outgoing feeder Panel shall additionally be equipped with, but not limited to, the following IEDs:

i. Three phase over current and earth fault relay IEC 61850 compliant
ii. Current test block.
iii. Multifunctional meter.
iv. Local/ remote switch.
v. Energy meter provision
vi. SEF selection switch ON/OFF
vii. Circuit Breaker Control (Close & Open) push buttons
viii. LV Master trip relay
ix. KV meter
x. Voltage selector switch
xi. Master trip relay reset push button.
xii. Current and voltage test blocks.

9.4 Indicating Instruments

9.4.1 All indicating instruments shall be flush mounted and shall be in accordance to requirement of IEC 60051.

9.4.2 Incomer Cubicle LV compartment electrical indications:

i. Circuit breaker ON - Red in colour.
ii. Circuit breaker OFF - Green in colour
iii. Auto Trip-Orange in colour
iv. Trip circuit Healthy - White in colour
v. Spring Charged - Blue in colour

vi. Circuit breaker in Service - Red in colour

vii. Circuit breaker in Test - Green in colour

viii. Earth switch ON - Red in colour

ix. Earth switch OFF - Green in colour

9.4.3 Outgoing feeder cubicle LV compartment electrical indications:

i. Circuit breaker ON - Red in colour.

ii. Circuit breaker OFF - Green in colour

iii. Auto Trip - Orange in colour

iv. Trip circuit Healthy - White in colour

v. Spring Charged - Blue in colour

vi. Circuit breaker in Service - Red in colour

vii. Circuit breaker in Test - Green in colour

viii. Earth switch ON - Red in colour

ix. Earth switch OFF - Green in colour

9.4.4 Circuit breaker mechanical indications

i. One mechanical ON/OFF indicator, with inscription "ON" in white letters on red background and inscription "OFF" in white letters on green background. This should be an integral part of the circuit breaker.

ii. One mechanical indication of the state of the spring inscription, "SPRING CHARGED" (white letters on red background). This should be an integral part of the Circuit Breaker.

9.4.5 Earth Switch mechanical indications

One mechanical ON/OFF indicator, with inscription "ON" white letters on red background and inscription "OFF" white letters on green background. This should be an integral part of the earth switch.

9.5 Relay Programming and Communications

9.5.1 All software must be provided for free, both original and future upgrades for programming and downloading of data for all IEDs supplied. The software User's Guide shall also be supplied.

9.5.2 The Numerical Relays shall be equipped with an Ethernet Communication port to facilitate connection to a PC laptop. Communication facilities shall be provided on each Numerical Relay for Remote Interrogation and Programming of the Numerical Relays.
Three(3) communication cables, shall be provided per panel.

9.5.3 All relevant software and firmware upgrades shall attract no additional cost and shall be readily available from manufacturer websites/support centres. The software and firmware upgrades shall not degrade the fundamental protection and control functionality of the relays.

9.5.4 Besides the communication port, the relays shall have Human –Machine Interface facility (HMI) with LCD screen where one can easily access the relay information. The HMI on the relay shall be fully functional over the service life of the switchgear without degradation in screen and LEDs visibility and sensitivity of navigation keys/buttons.

10.0 PANEL ASSEMBLY DESIGN FEATURES

10.1 Interlocks

The Switchboard shall be equipped but not limited to the following electrical and mechanical interlocks for safe functioning and operation.

10.1.1 The circuit breaker shall not be racked in or out in closed position.

10.1.2 Circuit breaker shall not be racked in with earth switch closed.

10.1.3 The circuit breaker shall not be operated in the intermediate position.

10.1.4 The cable compartment door shall only be opened with the earth switch closed.

10.1.5 The racking in of the circuit breaker shall be done with the CB compartment door closed.

10.1.6 The CB compartment door shall not be opened with the CB in service position.

10.1.7 The earth switch shall only be closed with the CB in test position.

10.1.8 It shall not be possible to insert the earth switch operating handle into position except when the circuit breaker is in test position.

10.2 Wiring

10.2.1 Wiring inside the switchgear panel shall be done with PVC insulated wires not less than 2.5 mm^2, stranded flexible cables for control, voltage transformers and ac auxiliary supply wiring. The current transformer wiring shall be done with PVC insulated wires of 4.0 mm^2 stranded flexible cables.

10.2.2 A suitable wiring duct system firmly fixed on the panel and having covers shall be installed for all inter-panel and front to rear panel wiring as well as for wiring within the panels. This shall provide easy access for inspection and replacement of the wires.

10.2.3 Wiring between terminals of various devices shall be point to point. Splices or tee connections shall not be acceptable. Wire runs from the duct to the devices shall be neatly trunked or clamped.

10.2.4 Exposed wiring shall be kept to a minimum but where used, shall be formed into compact groups suitably bound together in a harness and properly supported.

10.2.5 Instrument transformers secondary circuits shall be grounded only on the terminal block in the control compartment. Facilities for short circuiting the current transformers secondary windings while the switch gear panel is in service shall be provided. The current transformers shall be mounted in such a way that their secondary winding terminals are easily accessible and visible.

10.2.6 Cable supports and clamp type terminal lugs shall be provided for all incoming and outgoing wires terminated at each panel. All wires shall be marked at each point of termination on to the terminal block or device. These wire markers shall be of approved type and permanently attached to the wire. The wire marker or ferrule shall correspond to the device number or terminal block number of origin and the number of terminal where it is connected.

10.3 Wiring Colour Code

All wires shall have ferrules at all terminations to distinguish each wire and terminal. The wires shall have the following colours as shown in table 7 below;

Table 7: Wiring Colour code

No	Circuit	Colour
1	Voltage transformers/Current transformers	Red, Yellow, Blue ,Black
2	Auxiliary AC supply connection cable/bus wire	Red and black
3	DC control wiring within panel	Grey
4	Grounding/earthing cable /wire	Green with yellow stripes.

10.4 Phase Arrangements

10.4.1 The standard phase arrangement when facing the front of the panel shall be R-Y-B-N and L-N from left to right, from top to bottom and front to back for AC 3 phase and single Phase circuits.

10.4.2 For DC circuits it shall be P-N from left to right, top to bottom and front to back.

10.5 Phase Polarity Colour Code

Coloured ferrules shall be provided on each wire in order to identify phase and polarity as shown in table 8 below.

Table 8: Phase and polarity colour code

No	Polarity	Colour
1	AC three phase for CT and VT secondary wiring	First Phase-Red Second Phase-Yellow Third Phase-Blue Neutral-Black
2	AC Single phase	First Phase-Red Neutral-Black Ground-Green with yellow stripes.
3	DC auxiliary supply connection	Positive-Red Negative-Black

10.6 Terminal Block

10.6.1 Terminal blocks for control wiring shall be rated not less than 600V AC.

10.6.2 White or other light-coloured marking strips, fitted to each terminal block, shall be provided for circuit designation.

10.6.3 The terminal arrangement, including the terminal blocks for VT and CT circuit connections, shall be subject to KPLC for approval. A Total of not less than 20 spare terminals shall be provided for future use.

10.6.4 Shorting Links shall be provided on the current transformer(CT) circuits on the terminal block. It shall be possible to short the CTs under live system conditions without open-circuiting the CTs.

10.6.5 Isolation links(sliding Links) shall be provided on the trip circuits, alarm and on the VT circuits to allow easy isolation of these circuits without disconnecting the wires from the terminal block.

10.6.6 Each individual terminal block shall be marked with a distinctive number, which shall be the same number used in the drawings, for identification purposes. The TB number shall be engraved in black numbers in white background and shall be durable so as to last the life time of the switchgear panel.

10.6.7 Each set of terminal block shall be identified by a label to distinguish it from another set of terminal block. The numbers used to mark the terminals on the terminal blocks shall be unique. The labels used will match those used in the drawings.

10.6.8 A test point at the terminal blocks point shall be provided for the front of the panel mounting with automatic short circuiting of the secondary current by means of movement of links from their normal operating position, or a relay test block mounted adjacent to each or any other suitable testing arrangement may also be provided.

11 DRAWINGS

11.1 Before starting manufacture of the Protection and Metering switchgear panels, dimensioned drawings and data showing

all significant details of the equipment and materials to be used shall be submitted to KPLC for approval. Where the drawings are Not approved, the manufacturer shall modify the drawings as per KPLC comments and in line with the specifications and re-submit to KPLC for review. **Manufacturing of the switchgear panels shall not commence under any circumstances**

without receipt of Approved drawings by the manufacturer from KPLC. Any delays in approval of the drawings caused by submission of incorrect drawings by the manufacturer shall be the responsibility of the manufacturer, who shall fully offset any associated costs.

11.2 The manufacture of the Protection and Metering switchgear shall then proceed strictly in accordance with the approved drawings and also in accordance with the detailed specifications as contained herein. Where conflict may arise between the specifications and the approved drawings, the specifications shall take precedence, unless it's specifically indicated in writing on the approved drawings that the conflicting clause in the specifications is superseded, or where following discussions between the manufacturer and KPLC, KPLC gives approval in writing to supersede the conflicting clause in the specifications.

11.3 It is to be understood, however, that approval of the drawings will not relieve the manufacturer of any responsibility in connection with the works that the switchgear will fully comply with the relevant IEC standards and with these specifications.

11.4 All drawings submitted for approval or sent to KPLC for any other reason shall be in hard copy form sent via courier or other means. Drawings for Approval shall not by any means be forwarded via e-mail or any other media except in hard copy form.

Switchgear panel drawings:

- AC single line drawing
- AC Schematics
- DC Schematics
- Functional Drawings
- Panel wiring drawing
- Panel device layout drawing
- General layout drawing for the Protection and Metering switchgear panel

12.0 OPERATING AND MAINTENANCE INSTRUCTIONS

12.1 The manufacturer shall supply detailed instruction manuals concerning the correct manner of assembling/installing, configuring, setting, testing and commissioning, operating and maintaining the equipment and devices constituting the switchgear board, including the board itself. The

maintenance details of each component shall also be described, including the frequency of inspections and tests.

12.2 The instruction manual shall include a separate and complete section describing the normal and emergency operating procedures for the switchgear, and shall include explanatory diagrammatic drawings to facilitate understanding of the instructions.

12.3 The manufacturer shall, in preparing the instruction manuals, take into account the lack of experience and familiarity of the operators with this type of equipment.

12.4 One complete set of the operating and maintenance manuals for all the plant, equipment and accessories to be installed/mounted in the switchgear panels shall be sent to KPLC together with the drawings for approval. The operating and maintenance manuals shall be original copies printed and bound by the manufacturer. Any illegible copies of the operating and maintenance manuals submitted shall be rejected by KPLC.

12.5 Instructions on how to operate the relay shall be engraved on the switchgear panel, on the circuit breaker compartment describing in simple steps how to carry out correct and safe isolation, racking-in and racking-out switching operations on the circuit breaker. Similar details should be provided for the operation of the earth switch.

13.0 SPARES & ACCESSORIES

The following Accessories and Spares shall be supplied in a station in addition to bidding document spares requirements

i. Portable set testing plugs- One set per unit
ii. Spring charging handle- one set per unit
iii. Circuit breaker draw out handle- one set per unit
iv. One of each Circuit breaker TRIP and CLOSE coil

14 TEST REQUIREMENTS

14.1 The Switchgear Panels shall be inspected and tested in accordance with the requirements of IEC 60294and this specification.

14.2 The Circuit Breaker shall be inspected and tested in accordance with the requirement of IEC 62271-200 & 62271-100 and this specification.

14.3 Current Transformers and Voltage Transformers shall be inspected and tested in accordance with the requirement of IEC 61869-2, IEC 61869-3 ,IEC 61869-6 , IEC 60044-1 and IEC 6044-2 respectively and this specification.

14.4 Protection Relays and measuring & Indicating Instruments shall be inspected and tested in accordance with the requirement of IEC 60255 and this specification.

14.5 The following tests shall be carried out during the FATs, by the manufacturer in presence of KPLC Engineers.

14.5.1 Complete Switchgear Board/Panel

a) Dimensional Checks
b) Operational Tests
c) Primary Injection Tests
d) Calibration Tests on Relays and Instruments Power frequency Withstand Test
a) Megger Test
b) Contact resistance test of Primary joints
c) Lightning Impulse withstand test
d) Power frequency Withstand Test on secondary Wiring
e) Check for withdrawal tray for each panel(Ref to clause 6.2.16)

14.5.2 17.5kV Circuit Breaker

Routine tests shall be carried out at the manufacturer's plant as per the requirement of IEC 62271-100& IEC 62271-200, as listed below, in the presence of KPLC Engineers.

Routine tests.

a) Operation test.
b) High Voltage test, dry.
c) Voltage tests on controls and auxiliary circuits.
d) Measurement of resistance of the main circuit.

Type Tests : Submit copies of Type test Reports and Certificate.

e) Mechanical endurance test

f) Temperature rise test.

g) Impulse voltage test

h) Interrupting Capacity

NB: Copies of Type Test Certificates for similar rated Circuit Breakers and Certified by National Standards and Testing Authority body or Reputable Third Party Test Laboratory shall be submitted with the Tender for Evaluation Purposes.

14.5.3 Current Transformer

Routine tests shall be carried out at the manufacturer's plant as per the requirement of IEC 60044-1, as listed below, in the presence of KPLC Engineers.

i. Polarity test and verification of terminal markings test

ii. Ratio and phase angle error test(accuracy class composite error test)

iii. Power frequency tests on primary and secondary windings

iv. Power frequency withstand tests between sections(windings)

v. Inter-turn over voltage tests

vi. Partial discharge measurement

Certificates and type Test report for the following type tests shall be provided during the FATs:-

i. Lightning, Impulse voltage withstand test

ii. Temperature rise test

iii. Short time current test

iv. Determination of Errors test

14.5.4 Voltage Transformer

Routine tests shall be carried out at the manufacturer's plant during FATs as per the requirement of IEC 60044-2, as listed below:-

(a) Polarity tests and verification of terminals

(b) Power frequency withstand tests on Primary windings

(c) Power frequency withstand tests on secondary windings

(d) Power frequency withstand tests between sections

(e) Determination of errors

(f) Partial discharges measurement

Certificates and type Test report for the following type tests shall be provided during the FATs:-

(a) Temperature rise test

(b) Lightning Impulse Test

(c) Determination of errors

(d) Short-circuit withstand test capability

14.4.5 Protection Relay Tests

Routine tests shall be carried out at the manufacturer's plant as per the requirement of IEC 60255 and EMC 89/336/EEC, as listed below, in the presence of KPLC Engineers.

a. Relay Pick-up test for all functions and phases
b. Relay timing test for all functions and phases
c. Relay overcurrent functions
d. Directional characteristic test
e. In-zone and out of Zone tests for unit schemes

15.0 MARKING, LABELLING AND PACKING

15.1 The switchgear panels and associated components shall be packed in a manner as to protect them from any damage in transportation, storage and repeated handling.

15.2 Each assembly and package of items associated with the switchgear shall be suitably marked. A packing and parts list shall be provided

15.3 In addition to markings required elsewhere in the specification, each panel and component shall be marked in accordance with the relevant IEC standard and shall include the following:

i. Name of manufacturer and country
ii. Type/Model reference number
iii. Ratings (voltage, current, insulation, frequency etc.)
iv. Serial number

v. Month and year of manufacture

vi. Property of KPLC

16 SAMPLES

16.1 Following the Approval of the drawings, the manufacturer shall initially manufacture one sample panel. Upon manufacture of the panel, the manufacturer shall invite KPLC to inspect and conduct factory acceptances tests (FATs) on the panel

16.2 The manufacturer shall then rectify any minor defects noted during this initial FATs. Upon successful initial FATs, KPLC shall authorize the manufacturer to proceed with manufacture of all the other switchgear panels.

16.3 Where the manufactured sample panel is unsatisfactory and the manufacturer fails to rectify the switchgear panel to satisfactory standard within four weeks after attendance of the initial FATs, KPLC shall have the option to cancel the tender.

APPENDICES

APPENDIX A: TESTS AND INSPECTION (NORMATIVE)

A.1. It shall be the responsibility of the manufacturer to perform or to have performed all the tests specified.

A.2 Copies of 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. A copy of the accreditation certificate for the testing laboratory clearly stating the scope of accreditation shall also be submitted with the tender (all in English Language).

Copies of type test reports to be submitted with the tender for evaluation shall be for test carried out on the following panel parts :

a) Circuit Breaker

b) Switchgear panels,

c) Current Transformers,

d) Voltage Transformer,

e) Protection Relays and Measuring and Indicating Instruments

A.3. The equipment shall be subject to Factory Acceptance Tests (FATs) at the manufactures' manufacturing plant before dispatch. The routine tests shall be as per relevant manufacturing standards As indicated in Clause 12.0. Acceptance tests will be witnessed by at least two(2) Engineers appointed by Kenya Power and Lighting Company Limited (KPLC). Tests to be witnessed at the factory before shipment/delivery shall be in accordance with IEC 61869-2 and this specification and shall include the following:

a) Verification of markings;
b) Visual inspection;
c) Power-frequency withstand test on primary winding;
d) Partial discharge measurement;
e) Power-frequency withstand tests on secondary winding;
f) Power-frequency withstand tests between sections;
g) Inter-turn overvoltage test;
h) Measurement of Capacitance and dielectric dissipation factor;
i) Partial discharge test;
j) Test for accuracy;
k) Test for rated knee point e.m.f., maximum exciting current, secondary winding resistance
l) Enclosure Tightness Test at ambient temperature.

A.4. Triplicate copies of test reports shall be completed for all the circuit breakers, voltage transformers, current transformers and Protection and Control schemes and submitted to Kenya Power and Lighting Company for approval before shipment.

A.5. On receipt of the equipment, Kenya Power shall inspect and may perform or have performed any of the relevant tests to verify compliance with the specification. The manufacturer shall replace without charge to Kenya Power, equipment which upon examination, test or use fail to meet any or all the requirements in the specification.

APPENDIX B: QUALITY MANAGEMENT SYSTEM (NORMATIVE)

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

B.2. The Manufacturer's Declaration of Conformity to reference standards and copies of Quality Management Certifications including copy of valid and relevant ISO 9001:2015 Certificate shall be submitted with the tender for evaluation.

B.3. The bidder shall indicate the delivery time of the switchgear and control panel, manufacturer's monthly and annual production capacity and experience in the production of the equipment for Kenya Power.

APPENDIX C: TECHNICAL DOCUMENTATION (NORMATIVE)

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

a) Fully-filled clause by clause Guaranteed Technical Particulars (GTPs — Appendix D) stamped and signed by the manufacturer;

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

c) Hard copy design drawings of the equipment done on AutoCAD detailing dimensions, panel layout, wiring and schematic. The drawings shall include 3-D views.

d) Sales records for previous five years outside the country of origin and reference letters from at least four of the customers;

e) Details of manufacturing capacity and the manufacturer's experience as per bidding document;

f) Copies of type test reports and certificates by a third-party testing laboratory accredited to ISO/IEC 17025;

g) Copy of accreditation certificate to ISO/IEC 17025 for the testing laboratory;

h) Manufacturer's warranty and guarantee as per bidding document;

i) Manufacturer's letter of authorization,

C.2. The successful bidder (supplier) shall submit the following documents/details (from the manufacturer as per tender) to The Kenya Power & Lighting Company Plc for approval before manufacture:

a) Fully-filled clause by clause Guaranteed Technical Particulars (GTPs) signed by the manufacturer;

b) Hard copy drawings of the equipment done on AutoCAD detailing dimensions, panel layout, wiring and schematic. The drawings shall include 3-D views. The drawings shall be in standard format clearly indicating drawing number, parts list with material details & quantities, standard of manufacture, ratings, approval details and identify of the manufacturer (as per manufacturer's authorization submitted during tendering). The drawings shall be stamped and signed by the manufacturer.

c) Three sets of operational manuals and drawings detailing dimensions, panel layout, wiring and schematic.

d) 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 9001:2015

e) Detailed Test Program to be used during factory testing;

f) Marking details and method to be used in marking the equipment;

g) Packaging details (including packaging materials and marking and identification of component packages).

C.3. Three copies of as built drawing on A3 or A4paper to be supplied prior to shipment of the switchgear.

C.4. All manuals necessary for Operations & Maintenance, Commissioning, Installation, Testing Configuration and Programming, of the relays and all other equipment shall be provided with the switchgear.

C.5. Foundation /mounting details shall be provided to guide in Civil works.

C.5. All necessary software for configuration, setting and programming and for downloading and analysis of Relay data shall be provided. The software and updates shall be provided at no extra costs.

APPENDIX D: MANUFACTURER'S QUALIFICATION

D.1. The 11 kV Switchgear panel manufacturer shall have a minimum of 15 years experience in the manufacture of 11kV Switchgear panel.

D.2. The 11kV Switchgear panel on offer shall have been in service and given reliable service for a minimum period of 8 years in at least two (2) power utilities in at least three (3) of the following continents/regions:

a) Europe
b) North America
c) Africa
d) Asia or South America

D.3. The 11kV Switchgear panel manufacturer shall provide references to support these requirements including export records with copy of contractual letters, switchgear panel's details and date of sale/export, letter of satisfaction from power utilities shall also be provided with the bid.

D.4. 11kV Switchgear panel that have failed in service or mal-operated while in service on the Kenyan power system shall not be accepted.

D.5. The warranty for the offered 11kV Switchgear panel shall be 5 years from the date of delivery to KPLC store.

APPENDIX E: TRAINING

E.1 TRAINING AT THE MANUFACTURER'S PREMISES

(a) During the factory acceptance testing (FAT), the manufacturer shall conduct complete training for the 11kV Switchgear for the two KPLC Engineers/Technicians attending FATs.

(b) This shall include theory followed by practical demonstrations. All the operational and installation procedures shall be exhaustively explained and demonstrated.

(c) The manufacturer shall plan adequate time for the training separate from the FATs. The duration of the training shall however not be less than one (1) eight-hour working day. KPLC may send a separate team from the team witnessing the FATs to attend the training. The duration and the cost of the training shall be indicated in the bid.

(d) The full cost of the visit, including air tickets and accommodation shall be borne by KPLC. The manufacturer/bidder shall however take care of the local transport.

(e) The manufacturer shall conduct an assessment to ensure that KPLC Engineers/technicians have acquired the necessary knowledge and skills to be able to successfully install the switchgear panels on the power system.

E.2 LOCAL TRAINING (IN KENYA)

(a) Following the delivery of the switchgear panels the manufacturer shall conduct complete training for the complete set of terminations/joints for a total of (20) KPLC Engineers/Technicians, in Nairobi Kenya.

(b) The Training shall include theory on how the equipment works followed by practical demonstrations on safety, installation procedures and instructions and parameter settings. All

steps in installation shall be exhaustively explained and demonstrated, including normalizing the system and documenting the site events

(c) The manufacturer shall meet the total cost of the factory as well as Local Training in Nairobi Kenya.

(d) The supplier shall also meet all the other costs for conducting the local training, including local accommodation and transport for the training staff. The supplier shall provide all the training materials including notes.

(e) The manufacturer shall conduct an assessment to ensure that KPLC Engineers/technicians have acquired the necessary knowledge and skills to be able to successfully install the switchgear panels on the power system.

----------**THIS SPACE IS LEFT BLANK**----------

APPENDIX F: GUARANTEED TECHNICAL PARTICULARS (GTPS) — NORMATIVE

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

Tender No. .....

Bidder's name and Address.....

Clause	Description	KPLC Requirement	Bidders offer*
Manufacturer's Name			State
Country of Manufacture			State
Type Reference/Model Number of item		Complete Panel	State
		Circuit breaker	State
		Voltage Transformer	State
		Current Transformer	State
		Relays	State
2.0	Scope	11kV Metal Enclosed Switchgear and Protection Panels with a Substation Automation System	Specify
3.0	Applicable Standards	Reference for Complete Panel, Circuit breaker, Voltage Transformer, Current Transformer& Relays	List
4.0	Terms and Definitions		State
5.0	Service and System Conditions		

5.1	**Service Conditions**		
	Altitude	Up to 2200m above sea level	Specify
	Pollution	Heavy saline (Pollution level IV) atmosphere in accordance to IEC 60815	Specify
	Humidity	95%	Specify
	Ambient Temperatures	+30° C average, (-1° C Min and +40° C Max.).	Specify
	Isokeraunic Level	Up to 180 thunderstorm days per year	Specify
5.2	**System Conditions**		
5.2.1	Materials of all parts shall be such that they will not suffer damage under the most adverse conditions. Mechanisms shall be constructed to avoid sticking due to rust or corrosion		State
5.2.2	The equipment and apparatus shall be designed and manufactured in the best and most substantial and workmanlike manner in accordance with up-to-date recognized standards of good engineering practice.		State
5.2.3	The equipment shall be designed to cope with 0.2g horizontal acceleration of seismology on the centers of gravity.		State
5.2.4	All spare parts, shall be made interchangeable. Such parts shall be of the same materials and workmanship and shall be constructed to such tolerances as to enable substitution or replacement by spare parts easily and quickly		State
5.2.5	All equipment shall be designed to minimize the risk of fire and consequential damage, to prevent ingress of moisture, entry of vermin and effects of dust and accidental contact with electrically energized		State
5.2.6	The switchgear panels shall be capable of continuous operation where the frequently interruption on fault currents duty of operation is high.		State

5.3	**Tropicalization Requirements**	
	The switchgear power supply modules of the protection and control devices shall be designed for minimum heat generation and effective heat dissipation to ensure that the temperature of these devices enclosed in the relay panels at the above listed ambient temperatures shall not exceed the maximum operating temperature of the device	State
5.4	**Tropicalization Requirements**	
5.4.1	Submit details of his usual practice of tropicalization which have proven satisfactory for application to the switchgear panels and associated equipment serving in tropical climate zones	State
5.4.2	Iron and Steel are generally to be painted or galvanized as appropriate. Indoor parts may alternatively have chromium or copper-nickel plates or other approved protective finish.	State
5.4.3	Small iron and steel parts(other than rustless steel) of all instruments and electrical equipment, cores of electromagnets and the metal parts of relays and mechanisms shall be treated in an appropriate manner to prevent rusting.	State
5.4.4	The use of iron and steels shall be avoided in instruments and electrical relays wherever possible. Steel screws shall be zinc, cadmium or chromium plated or where plating is not possible owing to tolerance limitations, shall be of corrosion resisting steel. Instrument screws(except those forming part of a magnetic circuit) shall be of brass or bronze. Springs shall be of non-rusting material, e.g. phosphor-bronze or nickel silver.	State
5.4.5	Rubbers: Neoprene and similar synthetic compounds, not subject to deterioration due to the climatic conditions, shall be used for gaskets, sealing rings, diaphragms, etc.	State
6.0	**PANEL ENCLOSURE DESIGN REQUIREMENTS**	

6.1	**6.4 General Panel Enclosure Construction Requirements**	
6.1.1	The design shall not cause distortion, undue wear, vibrations in service or damage under the most severe conditions encountered in service.	State
6.1.2	Switchgear shall electrically be designed to avoid local corona formation and discharge likely to cause radio interference	State
6.1.3	All parts of the switchgear shall conform to the dimensions specified and shall be built in accordance with approved drawings.	State
6.1.4	All joints, datum surfaces and meeting components shall be machined and all castings shall be spot faced for nuts. All screw, bolts, studs and nuts and threads shall o the standards for metric sizes	State
6.1.5	Jointing of adjacent metal parts and surfaces shall be such as to prevent corrosion of the contact surfaces and to maintain good electrical contact under service condition	State
6.1.6	All materials and works that have cracks, flaws or other defects or inferior workmanship will be rejected by KPLC.	State
6.1.7	All steel castings and welding shall be stress-relieved by heat treatment before machining, and castings shall be stress-relieved again after repair by welding.	State
6.1.8	Casting shall be true to pattern, of workmanlike finish and of uniform quality and condition, free from blowholes, porosity, hard spots, shrinkage defects, cracks or other injurious defects, shall be satisfactorily cleaned for their intended purpose.	State
6.1.9	Wherever welding is specified or permitted, a welding process, including stress relieve treatment as required if necessary, conforming to an appropriate and widely recognized professional standard shall be used.	State
6.2	**Specific Panel Enclosure Construction Requirements**	

6.2.1	The whole switchgear equipment and components shall be designed and constructed in accordance with IEC 60298 Standard. The panels shall be complete with all the relevant components including, busbars, circuit breaker, compartment, instrument transformers, protection relays, instruments and controls.		State
6.2.2	The switchgear shall be designed such that it is flush-front, for erection with the rear side close to a wall as well as for free standing erection. The manufacturer shall provide a single line layout drawing giving the required minimum dimensions of the switchgear room, and showing the cable trenching requirements.		State
6.2.3	The plates shall be of high quality mild steel of at least 2mm thickness thoroughly cleaned by shot blasting or other approved methods.		State
6.2.4	The switchgear shall be of arc resistant design as per IEEE/ANSI C37.20 to ensure complete safety for a switching personnel standing in-front or at the rear of the switchgear board.		State
6.2.5-6.2.10	**Dimensions**		
	Protection	Outdoor=IP43, Indoor Equipment=IP51	Specify
	Width of Panel	=<900mm	Specify
	Depth of Panel	=<2500mm	Specify
	Height of Panel	=<2800mm	Specify
6.2.11	Hinged and lockable doors with handles shall be provided at the front of each cubicle for the respective LV compartment, circuit breaker compartment and cable connection compartment.		State
6.2.12	The switchgear panel or cubicle shall be built up of separate metal clad-compartmented cubicles with earthed metal partitions. The compartments shall be for (i)busbar,(ii) cables, (iii)circuit breaker,(iv) Instrument transformers, (v)control(LV) and (vi) energy meter compartments.		State

6.3	**General Design Requirements for Compartments:**	
6.3.1	The LV section shall be completely separate from the High Voltage section.	State
6.3.2	A drawing showing the layout and dimensions of each of the compartments of the switchgear panel and the devices/components installed in the compartment shall be submitted with the bid for tender evaluation. NB: The incoming and outgoing cables shall NOT be located in the same compartment	State
6.3.3	The LV compartment shall not be less than **550 mm** in height, to ensure adequate space for mounting the relays and other devices and accessories and adequate space for the cable trunks, terminal blocks and wiring.	State
6.3.4	The LV compartment terminal block shall include a test switch (block), which enables the CTs circuits to be isolated from the relay and shorted without opening circuiting the CT, to facilitate relay testing ,isolation of VT circuits, alarm and trip circuits without disconnecting wires at the terminal block.	State
6.3.5	The LV compartment Terminal Block shall include a test switch (block) which shall enable the CTs circuits to be isolated from the relay and shorted, to facilitate relay testing in site and to allow isolation of VT circuits, Alarm and Trip Circuits. The test block shall be supplied with the plug-in unit and any other accessories required for secondary injection tests.	State
6.3.6	The cables compartment shall have an anti vermin guard plate giving protection against entry by rats, rodents etc	State
6.3.7	The circuit breaker compartment, the CT compartment, the LV compartment, the VT compartment and the Energy meter compartment shall be provided with facilities for padlocking and sealing.	State
6.3.8	The doors for the compartments shall be capable of withstanding the effects of maximum internal arcing fault without being blown off and causing	State

	danger to personnel and other equipment as per ANSI C37.20.7 or equivalent IEC standards.	
6.3.9	For ease of transportation, the metering compartment can be delivered loose with each panel together with all mounting accessories for installation at site. Provision shall be made for entry of cables from the current transformers and the voltage transformers into the metering compartment.	State
6.3.10	The front cubicle door shall be provided with a window through which the mechanical status of the circuit breaker (ON/OFF & SPRING CHARGED/DISCHARGED) can be checked.	State
6.3.11	Rear cable chamber covers on the cable compartments, shall be provided with handles and all bolts and nuts shall be stainless steel.	State
6.3.12	Interior illumination lamps operated by door switches shall be provided for LV compartment. The lamps shall be of low power LED type and their fittings shall be standard. They shall be readily available in the local market to ease future replacements.	State
6.3.13	Space heaters for 230V AC shall be provided inside the switchgear panel, circuit breaker and control compartments to prevent moisture condensation. A hygrostat control unit with variable temperature and humidity control setting shall be installed to control the heater.	State
6.3.14	The metering compartment shall have a glass window through which the readings for the energy meter can be viewed and accessed, without opening the compartment door. The compartment door shall be provided with padlocking and sealing facilities. The design of the cubicle shall be to the approval of KPLC.	State
6.3.15	The circuit breakers shall be mounted on an inbuilt carriage to facilitate isolation and withdrawal of the circuit breaker. One (1) circuit breaker withdrawal trolley shall be supplied with each Protection and Metering Panel supplied.Each metering breaker unit should also come with the following items	State

	i. Spring charging handle- 3nos ii. Racking in /out handle-3Nos iii. Earthing handle- 2Nos iv. Each set of panel keys – 5Nos v. Withdrawing Trolley if the CB is not on level ground- 1No.		
7.0	**ELECTRICAL REQUIREMENTS**		
7.1	Design and Construction		
7.1.1	Low Voltage Equipment		
7.1.1.1	The AC supply shall be used for power circuits for lighting, indications, motor control and panel sockets, panel illuminations and panel heaters.		State
7.1.1.2	Unless otherwise specified, the equipment provided under this tender is to be capable of reliable operation at voltages as low as 85% of the rated voltage, and to withstand continuously up to 110% supply voltage above the rated value of 230V or 420V AC		State
7.1.1.3	**Low Voltage Equipment**		
	Rated voltage between the phases	420V ac	Specify
	Connection type	3ph 4 wire	Specify
	Rated voltage between phase and earth	230V ac	Specify
	Grounding system	PME	Specify
	Frequency	50hz	Specify
	Voltage variation	± 10	Specify
	Frequency variation	± 2%	Specify
	Power frequency 1 min test voltage	3kV	Specify
	Thermal rating of conductors	120%	Specify
	Maximum short circuit current. 3s	31.5kA	State
	AC supply application	Power circuits, panel sockets, panel illuminations and panel heaters.	State
7.2	**DC Auxiliary supply rating**		
7.2.1	Equipment/device rated voltage	110V DC	State

	Connection type	2 wire	State
	Voltage variation	24V - 40V DC	State
7.2.2	All equipment and apparatus including the circuit breakers, protective relays, control devices and accessories, measuring and indicating instruments and other electronic equipment shall be capable of satisfactory operation at 70% to 125% of the rated dc supply voltage.		State
7.3	**Medium Voltage Switchgear Panel**		
7.4	**Medium Voltage Switchgear Panel Requirements**		
7.4.1	All measuring instruments, including energy meters, shall be of flush-mounted, back-connected, dust-proof and heavy-duty switchboard type. Each measuring instrument shall have a removable cover, either transparent or with a transparent window		State
7.4.2	For analog type instruments, scale plates shall be of a permanent white circular or rectangular finish with black pointer and markings. The scale range shall be determined from the current transformer and voltage transformer ratios and is given in the detailed specifications for each instrument.		State
7.4.3	All measuring instruments of analog type shall be approximately 110mm2 enclosures and shall be provided with clearly readable long scale, approximately 240 degrees. The maximum error shall be not more than one and a half (1.5) percent of full-scale range.		State
7.4.4	The floor-standing switchgear panel shall have provision for bolting to the floor.		State
7.4.5	Interior illumination lamps operated by door switches shall be provided for the control and energy meter compartments. One 230V ac socket outlet of 3-point square terminals shall also be provided for each switchgear panel in the control compartment.		State

7.4.6	Trip circuit supervision for both CB ON and CB OFF.		State
7.4.7	For the circuit breakers, red indicating lamps shall be used for "ON" position, green lamps for "OFF" position indication and amber for circuit breaker auto trip		**State**
7.4.8	Detailed Nameplate for the Circuit Breaker with all VCB rating details.		**State**
7.4.9	Two sets of NO + NC auxiliary contact of circuit breaker wired to the control cable termination block for status indication.		**State**
7.4.10	High voltage presence indicator.		**State**
7.4.11	**Medium Voltage Switchgear Panel Ratings**		
Table 1	Frequency	50 Hz	Specify
	Highest System voltage	17.5kV	Specify
	Rated Normal current(Ir) – Bus bars	630A	Specify
	Rated Normal current(Ir) – Feeder Circuit Breaker	630A	**Specify**
	Rated Short time current withstand (3sec)(Ik)	31.5 kA rms	Specify
	Rated peak withstand current (Ip)	78 kA pk	Specify
	Rated breaking capacity	31.5 kA	Specify
	Rated making capacity	78 kA	Specify
	Minimum Lightning Impulse Withstand Voltage 1.2/50µs +ve, dry (peak)	95 kV pk	**Specify**
	Minimum Power Frequency Withstand (Dry) Voltage (rms)(1 min)	38 kVrms	Specify
	Internal Arc Classification (IAC) in accordance to IEC 62271-200	31.5kA, 1 Sec	**Specify**
	IAC Class	AFLR	Specify

	Class IV Site pollution severity (SPS) as per IEC/TS 60815	Very heavy	Specify
	Specific creepage distance as per IEC/TS 60815:2008 – class	31mm/kV	Specify
7.5	**Bus Bar**		
7.5.1	The busbar shall be single, three phase, air insulated. The primary busbars and connections shall be of high conductivity and electrolytic material, high grade copper, and shall be in unit lengths.		State
7.5.2	Busbars, connections and their support shall be rated 630A continuously under ambient conditions and capable of carrying the short-time current associated with the short circuit ratings of the circuit breakers, for 4 Seconds.		State
7.5.3	Provision shall be made for locking busbar and circuit shatters separately in the circuit breaker compartment. These shutters shall open and close automatically during the racking in and racking out of the circuit breaker.		State
7.5.4	All busbars and branch busbars shall be insulated by means of shrink-on sleeves. In conjunction with bushing plates and bushings, busbar will be supported with rated insulation supports		State
7.5.5	Particular care shall be taken during manufacture of busbars and fittings and during subsequent handling to ensure smooth surface free from abrasion. All joints on the busbars and the circuit within the switchgear board shall be silver or tin-plated to ensure good electrical connection.		State
7.5.6	The Bus bars shall be marked R, Y, B and all the jointing points/ends shall be tin-plated.		State
7.5.6	The Bus bar shutters shall be painted in Red shade (Signal colour 537 of BS381C) with "BUSBARS" written in white. The cable shutters shall be		State

	painted in lemon colour (355 of BS381C). For Bus coupler panel, both the shutters shall be painted Red shade with 'BUSBARS' written in white.	
7.6	**Earth Switch**	
7.6.1	Provision shall be made for integral circuit earthing and for busbar earthing. Means of earthing shall be by circuit breaker or purposely built earth switch. Mechanical & electrical interlocks to ensure correct switching operation shall be provided.	State
7.6.2	All metallic instrument cases, protective relay, switches etc. shall be properly earthed to the switchgear board steelwork frame.	State
7.6.3	The material for Earth bus and cable shall be copper of 99.5% purity, and the earth bus shall be extended outside the switchboard panel.	State
7.6.4	The earth switch shall be easy to operate by one operator and be spring loaded to ensure effective make operation independent of the operator action. The earth switch shall be rated to make and carry for 3 seconds, the rated short-circuit current of the switchgear panel of 31.5 kA.	State
7.6.5	The Status of the earth switch shall be visible from the front of the Panel.	State
7.6.6	The earth switch shall be equipped with auxiliary contacts for local and supervisory indication of the status of the earth switch.	State
7.6.7	The operation of the Earth Switch shall be set in such a way that during both the close and open operations, a clearance of at least 9 inches shall be maintained between the operating handle and the bottom of the switchgear panel.	State
7.6.8	It s The earth switch shall be equipped with pad- locking facilities when in the closed position.	State

7.6.9	All earthing facilities shall be rated for fault making at the rated switchgear short-circuit current.	State
7.6.10	Each switchgear panel shall be provided with Tinned Copper earth bar of adequate cross section area to be able to withstand the rated short-circuit current of 31.5 kA for 3 seconds. Provision shall be made for connection of the switchgear panel earthing bar to the substation earthing grid.	State
7.7	**Medium Voltage Power Cable Termination**	
7.7.1	11kV cable compartment design shall be suitable either for shrinkable (or equivalent) jointing application termination.	State
7.7.2	(i)Three gland fabricated sheet steel cable compartment, complete with gland and armour clamp, suitable for receiving Three single core (3 per phase) 11kV cables each of size up to 630mm2	State
	(ii)Single gland fabricated sheet cable compartment complete with gland and armour clamp suitable for receiving three core cable up to 400mm2 11kV XLPE cable (for feeder type panels).	State
	(iii)The cable connection terminals shall be located at least 250 mm from the CT primary terminals.	State
7.8	**Electrical Controls, Auxiliaries and Power Supplies**	
7.8.1	**The manufacturer shall provide all control, indication, alarm and protection devices and all auxiliary equipment with wiring and interconnecting cable which are integral parts of or are directly associated with or mounted on the switchgear panels to be supplied.**	State
7.8.2	All circuits for connection to external cables such as DC & AC auxiliary supplies, external tripping, supervisory control and indications shall be wired up to the terminal Block at the Back of the panel where external cables shall be connected.	State

7.8.3	All CT and VT terminal blocks shall have a provision for isolation and banana type sockets for inserting test leads. The terminal blocks for the CTs shall be rated for the maximum possible secondary current of CTs provided.	State
7.8.4	The panel wiring for protection, instruments, indication, signal/command and metering circuits and other control accessories shall be completely done using flexible copper 2.5mm^2 cables.	State
7.8.5	Supervisory control and indications shall be wired up to the terminal block at the front of the panel where external cable shall be connected.	State
7.8.6	All primary power cable terminals shall generally be located for rear bottom entry connection.	State
7.8.7	Auxiliary 30V dc, 110Vac and 230Vac supplies for circuit breaker control, alarm circuits, protection relays, metering and motor supply for each panel shall be controlled by miniature circuit breakers rated to carry the full load of the equipment.	State
7.8.8	One 230 Vac socket outlet of 3-point square terminals as per BS 1363 shall be provided for each switchgear panel in the LV compartment.	State
7.8.9	Auxiliary supplies for panel heating and lighting shall be 230VAC, 50Hz, single-phase 3-wire, while protection, spring charging motor, Control and Circuit Breaker Trip/Close auxiliary supply shall be 30VDC.	State
7.8.10	The circuit breaker cubicle shall have a limit switch which shall be used to indicate whether the breaker is fully racked in or fully racked out (withdrawn). This shall be indicated on the relay MIMIC	State
7.8.11	The monitoring unit shall be a three-phase device with illumination in red colour . The indication shall be labelled L1 L2 L3. The device shall meet the requirements of IEC 61243-5.	
7.8.12	Manual close & open push buttons shall be provided on the circuit breaker compartment door for manual close and open of the circuit breaker both in the service and in the test(withdrawn) position.	State

7.8.13	A single power measurement for ; I, kV, MW, MVAR and p.f. Shall be provided		State
	i. Circuit breaker control switch(Close, Open &Neutral),with a mechanical Lock		State
	ii. Circuit Breaker ON(red), OFF(green) and auto-trip(amber) indication lamps		State
	iii. Anti-condensation heaters for the Circuit Breaker and the LV compartments		State
	iv. Hygrostat with separate humidity and temperature control setting to control the heaters.		State
	v. Door switch operated lighting point and bulb for the LV compartment and the Meter compartment		State
	vi. 3 Pin - square power socket outlet with red neon indicator .		State
	vii. Suitably rated MCBs for auxiliary 30V DC for control, 30V DC for Trip, 230 V AC for motor , 230V AC for heaters and illumination and VT 110 VAC supplies shall be fitted.		State
8.0	**MEDIUM VOLTAGE COMPONENTS CHARACTERISTICS**		
8.1	**11kV Circuit Breaker**		
8.1.1	Manufacturer's name	Indicate	State
	Manufacturer's letter of Authorisation	Provide	State
	Copy of ISO 9001:2015 certificate	Provide	State
8.1.2	Standard of manufacture	IEC 62271-100& IEC 62271-200.	State
8.1.3	Type of circuit Breaker	Three pole operated, indoor withdrawable type, employing Vacuum Interrupter, with air insulation	State
8.1.4	Auxiliary Contacts	Plu-in	State

8.1.5	Provision of extension cable to allow for testing		State
8.1.6	Interchangeability of circuit breakers		State
8.1.7	CB operating mechanism characteristics	Motor wound spring operated, power closing with electrical release and with provision for manual (hand) charge	State
8.1.8	Operating sequence	0-0.3 sec-co-3 sec.-co	State
8.1.9	Coils	Two tripping coils and one closing coil	State
8.1.10	State of the spring	Mechanical indications	State
8.1.11	Insulation between the interrupter units and the primary plug-in contacts		State
8.1.12	Spare	A spare set, of at least 8NO and 8NC auxiliary contacts of the circuit breaker shall be provided and shall be wired to a terminal block, for connection to control circuits.	State
8.1.13	Provision of anti-pumping facility		Specify
8.1.14	Control circuit design	Automatically connects when inserting the breakers into the cubicle by use of a single plug-in cable	Specify
8.1.15	The operating mechanism	Trip free both mechanically and electrically.	State
8.1.16	Circuit Breaker Poles	Insulated	State
8.1.17	Operations manual	clear instructions on the maintenance requirements of the circuit breaker	State

Table 4:	Circuit Breaker Ratings		
	Interrupting Medium	Vacuum	State
	Number of poles	3	Specify
	Highest equipment Voltage	17.5kV	Specify
	One minute power frequency withstand voltage	38 kV	Specify
	Impulse withstand voltage (BIL)	95kV	Specify
	Frequency	50 Hz	Specify
	Rated short time current	31.5kA	Specify
	Rated short time making current (peak)	79kA	Specify
	Rated Short circuit current withstand, time	31.5 kA, 4 seconds	Specify
	First pole to clear factor	1.5	Specify
	Auxiliary D.C. voltage for closing and tripping coils	30V	Specify
	Auxiliary a.c. voltage	230V AC, 50Hz	Specify
	Tripping/closing coil auxiliary voltage	30 V DC	Specify
	Spring charging motor supply	230 V AC	Specify
	Rated normal Current for Busbar & Circuit	630A	Specify
8.2	**Current Transformers**		
8.2.1	Manufacturer's name	Indicate	State
	Manufacturer's letter of Authorisation	Provide	State
	Copy of ISO 9001:2015 certificate	Provide	State
8.2.2	Standard of manufacture	IEC 61869-2 and IEC 61869-6	Specify

8.2.3	Construction	wound epoxy resin casting insulation	State
8.2.4	Type	Single phase	Specify
8.2.5	Type of Earthing link	Removable link	
8.2.6	Rated burden	CT shall not saturate under maximum short-circuit conditions for the connected burden.	State
8.2.7	Markings	markings shall be indelibly made. The secondary terminals shall have screw type terminals.	State
8.2.8	The current transformers shall have the specified accuracy under load conditions		State
	Shall be able to withstand the effect of short-circuit fault current rating of the switchgear for 3 seconds		State
8.2.9	**Current transformers ratings**		
Table 5	**Ratings**		
	Type	Wound epoxy cast resin	Specify
	Highest System Voltage	17.5kV	Specify
	Short time Current with stand (STC), 3sec	31.5kA	Specify
	For Incomers, Bus and outgoing section	400A	Specify
	Lightning Impulse Withstand Voltage	95kVpeak	Specify
	One-Minute Power Frequency Withstand Voltage	38kVrms	Specify
	Ratio & Class		Specify
	Core 1 — Ratio	300/200/100/1A	Specify

		Class	5P 20	Specify
		Burden	15VA	Specify
	Core 2	Ratio	300/200/100/1A	Specify
		Class	0.2	Specify
		Burden	15VA	Specify
	Core 3	Ratio	300/200/100/1A	Specify
		Class	0.5	Specify
		Burden	15VA	Specify
8.3	**Voltage Transformer**			
8.3.1	Manufacturer's name		Indicate	State
	Manufacturer's letter of Authorisation		Provide	State
	Copy of ISO 9001:2015 certificate		Provide	State
8.3.2	Standard of manufacture		IEC 61896-3, IEC 60044-2	Specify
8.3.3-	Construction		Epoxy cast resin type,	Specify
8.3.4	VT type		shall be one for each of the three phases, and, star/star connected complete with removable HV fuses and links	State
8.3.5	VT mounting		A common withdrawable truck located in the cable compartment	State
8.3.6	Bus VT type		connected to a TPN MCB with auxiliary contacts mounted in LV compartment Horizontal draw out type	State
	Description		**Requirement**	

Table 6	Rated Voltage of the VT		17.5kV	Specify
	Ratio		11000/√3/110/√3	Specify
	Burden		30VA	Specify
	Impulse Withstand Voltage		95kV peak	Specify
	One-Minute Power Frequency Withstand Voltage		38kVrms	Specify
	Ratio		11000/√3:110/√3: 110/√3V	Specify
	Class	Core 1	0.2	Specify
		Core 2	0.5	Specify
9.0	**Relay**			
9.1	General Requirements			
9.1.1	Manufacturer's name		Indicate	State
	Manufacturer's letter of Authorisation		Provide	State
	Copy of ISO 9001:2015 certificate		Provide	State
9.1.2	Standard of manufacture		IEC 60255 and EMC 89/336/EEC compliant	Specify
9.1.3	Relay type		Numeric design and supports GOOSE messaging and communication protocols 60870-5-103 and 61850-9-2.	Specify
9.1.4	Communication and Data Management		Software based incorporating features for fault records, event records and diagnostic data downloaded via RS232 serial port, USB-2 and higher versions	State compliance
9.1.5	Relay current rating		1A	Specify
	Relay voltage rating		110V DC	Specify

9.1.6	Relay contacts are suitable for making and breaking the maximum currents, which they are required to control in normal service		State
9.1.7	Auxiliary Trip relay short pick up times	<30 ms	Specify
9.1.8	Relay contacts make firmly without bounce		State
9.1.9	Relay labelling		State
9.1.10	Suitable for operation on 30VDC supply without use of dropping resistors or diodes.		Specify
9.1.11	Relay LEDs are visible from the front of the panel without opening the panel door(s)		State
	Number of current inputs	5 (1/1A)	Specify
9.1.12	Number of voltage transformer inputs	4	Specify
9.1.13	Reduction of effects of electrolysis	Relay coils operating on DC shall be so connected such that they are not continuously connected from the positive pole of the station battery bank	State
9.1.14	Thermal withstand capability of the relay		State
	Detailed Relay and Device performance requirements		
	A. Three Phase Overcurrent and Earth Fault relay		
	Type	Numerical design and supports GOOSE messaging and communication protocols 60870-5-103 and 61850-9-2	Specify
	Current setting range for overcurrent relay	$0.5I_n - 2.4I_n$	Specify
	Current setting range for earth fault relay	$0.5I_n - 0.8I_n$	Specify

	I.D.M.T characteristics according to BS 142 or IEC 60255	SI, VI, EL, LTI, including definite time for the high –set elements	Specify
	Time setting multiplier	0.05 – 1.0	Specify
	Highest element for both overcurrent and earth fault protection with a setting range	1 -30I_n	Specify
	Drop off/picking up ratio	>90%	Specify
	Low transient overreach	<10%	Specify
	Features	i. Broken conductor alarm ii. Thermal overload protection iii. Circuit breaker maintenance iv. Fault records, event records and disturbance records v. Configurable output relays with ability to output starting elements to control vi. Tripping of other upstream protection relays	Specify
	B. Three-phase Directional Overcurrent and Earth Fault Relay		
	Type	Numerical design and supports GOOSE messaging and communication protocols 60870-5-103 and 61850-9-2	Specify
	Current setting range for overcurrent relay	0.5I_n – 2.4I_n	Specify
	Current setting range for earth fault relay	0.5I_n – 0.8I_n	Specify
	Quadrature connection for polarizing voltage	Vn=110 V	Specify

	High Set Element	1 -32I_n	Specify
	I.D.M.T characteristics	According to IEC 60255 and Definite time characteristic	Specify
	Normal operating boundary	±90 degrees from relay characteristic angle Relay sensitivity shall be 1% of rated value of current and current polarizing voltage at an angle equal to the relay characteristic angle	Specify
	Time setting multiplier	0.05 – 1.0	Specify
	Features	i) Applicable on the LV side of a Dyn1 transformers ii) The phase and the directional elements shall be individually selectable. iii) Broken conductor protection feature. iv) Negative sequence protection feature. v) Highest element for both overcurrent and earth fault protection, with a setting range of 1-30In. vi) Thermal protection. vii) Dedicated Breaker Fail Protection. viii) Circuit Breaker Maintenance ix) Incorporate Fault record, Event Records and	Specify

		disturbance records (minimum 1000) x) Configurable output relays with ability to output starting elements to control of other upstream Protection relays.	
	C. Trip Relay		
	Instantaneous operation, t	< 12ms	Specify
	Output contacts	At least 8(eight) No. pairs of output contacts 2 (two) No. of which should be NC contacts	Specify
	Features	i. High burden ii. Immune to capacitance discharge currents and leakage currents iii. Provision for manual reset iv. Flag or target should be a red LED or bulb and should be electrically reset	Specify
	D. Trip Circuit Supervision Relay		
	Feature	i. Continuous supervision of trip circuit breaker in both OPEN & CLOSE position ii. Trip circuit fail – Red LED iii. Trip circuit healthy – Green LED iv. Two normally closed and three normally open output contacts	Specify

9.2	**Panel Relay Specific Requirement**		
9.2.1 9.2.2	Type of relays	Numerical over current and earth fault relays capable of performing both high set and low set operation	Specify
		The directional over current and earth fault protection function	Specify
9.2.3	The relay has a card for arc flash protection		Specify
	Arc card 3 light inputs	from the cable compartment, CB compartment and bus bar compartment	Specify
	Each of the three compartments has one light sensor lens linked to the relay inputs through insulated single mode insulated glass fibre optic cable		Specify
9.2.4	Arc protection modes	light only and light + current mode	Specify
9.2.5	Outputs of the arc protection	one output to be used for cable compartment arc sensor operation	Specify
		the other output to be used for circuit breaker and bus bar compartment arc sensor operation	Specify
9.2.6	The arc flash protection operating from the cable compartment	Wired to trip the incomer and the upstream 66kV circuit breaker.	Specify
9.2.7	The arc flash protection operating from the bus bar and circuit breaker compartments	Wired to trip the incomer circuit breaker, the bus section circuit breaker and the upstream 66kV circuit breaker	Specify
9.2.8	LED indications	i. 50+50N operated ii. 51+51N operated iii. TCS1-unhealthy iv. TCS2-unhealthy v. Trip relay 86 operated	Specify

		vi. Cable compartment arc sensor operated. vii. Breaker/Busbar compartment arc sensor operated. viii. Arc sensor operated in outgoing/bus PT panel. ix. Incomer PT fuse failure. Incomer PT fuse failure.	
9.3	Feeder panels	i. Three phase over current and earth fault relay IEC 61850 compliant ii. Current test block. iii. Multifunctional meter. iv. Local/ remote switch. v. Energy meter provision vi. SEF selection switch ON/OFF vii. Circuit Breaker Control (Close & Open) push buttons viii. LV Master trip relay ix. KV meter x. Voltage selector switch xi. Master trip relay reset push button.	Specify

		xii. Current and voltage test blocks. xiii.	
9.4	**Indicating instruments**		
9.4.1	All indicating instruments are flush mounted		State
	Standard of manufacture	IEC 60051	State
9.4.2	**Incomer Cubicle LV Compartment electrical indications**	i. Circuit breaker ON - Red in colour. ii. Circuit breaker OFF - Green in colour iii. Auto Trip-Orange in colour iv. Trip circuit Healthy - White in colour v. Spring Charged - Blue in colour vi. Circuit breaker in Service - Red in colour vii. Circuit breaker in Test - Green in colour iii. Earth switch ON - Red in colour ix. Earth switch OFF - Green in colour	**State**
9.4.3	**Outgoing feeder Cubicle LV compartment electrical indications**	i. Circuit breaker ON - Red in colour. ii. Circuit breaker OFF - Green in colour iii. Auto Trip - Orange in colour iv. Trip circuit Healthy - White in colour	**State**

		v. Spring Charged - Blue in colour vi. Circuit breaker in Service - Red in colour vii. Circuit breaker in Test - Green in colour viii. Earth switch ON - Red in colour ix. Earth switch OFF - Green in colour	
9.4.4	Circuit Breaker mechanical indications	i. One mechanical ON/OFF indicator, with inscription "ON" in white letters on red background and inscription "OFF" in white letters on green background. This should be an integral part of the circuit breaker. ii. One mechanical indication of the state of the spring inscription, "SPRING CHARGED" (white letters on red background). This should be an integral part of the Circuit Breaker.	State
9.45	Earth Switch mechanical indications	One mechanical ON/OFF indicator, with inscription "ON" white letters on red background	State

		and inscription "OFF" white letters on green background. This should be an integral part of the earth switch.	
9.5	**Relay Programming and Communications**		
9.5.1	Programming Software	All data for all IEDs shall be supplied. The software User's Guide shall also be supplied.	State
9.5.2	Communications ports	Relay shall have Ethernet Communication port to facilitate connection to a PC laptop. The relevant communication cable, between the relay and the laptop shall also be provided (3 cables). Communication facilities shall be provided on each Numerical Relay for Remote Interrogation and Programming of the Numerical Relays.	State
9.5.3	Cost of Software/upgrade	All relevant software and firmware upgrades shall attract no additional cost and shall be readily available from manufacturer websites/support centres. The software and firmware upgrades shall not degrade the fundamental	State

		protection and control functionality of the relays.	
9.5.4	HMI	the relays shall have Human – Machine Interface facility (HMI) with LCD screen where one can easily access the relay information. The HMI on the relay shall be fully functional over the service life of the switchgear without degradation in screen and LEDs visibility and sensitivity of navigation keys/buttons	State
10.0	**PANEL ASSEMBLY DESIGN FEATURES**		
10.1	**Interlocks**		
	The Switchboard shall be equipped but not limited to the following electrical and mechanical interlocks for safe functioning and operation.		Specify
10.1.1	The circuit breaker shall not be racked in or out in closed position.		Specify
10.1.2	Circuit breaker shall not be racked in with earth switch closed.		Specify
10.1.3	The circuit breaker shall not be operated in the intermediate position.		Specify
10.1.4	The cable compartment door shall only be opened with the earth switch closed.		Specify
10.1.5	The racking in of the circuit breaker shall be done with the CB compartment door closed.		Specify
10.1.6	The CB compartment door shall not be opened with the CB in service position.		Specify

10.1.7	The earth switch shall only be closed with the CB in test position.		Specify
10.1.8	It shall not be possible to insert the earth switch operating handle into position except when the circuit breaker is in test position.		Specify
10.2	**Wiring**		
10.2.1	Control, voltage transformers and ac auxiliary supply wiring	PVC insulated wires not less than 2.5 mm^2, stranded flexible cable	Specify
	Current transformer wiring	PVC insulated wires of 4.0 mm^2 stranded flexible cables	Specify
10.2.2	Installation of a suitable wiring duct system firmly fixed on the panel and having covers		Specify
10.2.3	Wiring between terminals	Point to point	Specify
10.2.4	Exposed wiring is minimal		Specify
10.2.5	Instrument transformer grounding	On the terminal block in the control compartment	Specify
	Provision of facility for short circuiting the current transformers secondary windings		Specify
	Current transformer mounting in a way that their secondary winding terminals are easily accessible and visible		Specify
10.2.6	Provision of cable supports and clamp type terminal lugs		Specify
	Marking of the wires	At each point of termination on to the terminal block or device	Specify
	The wire marker or ferrule corresponds to the device number or terminal block number of origin and the number of terminal where it is connected.		Specify
10.3	**Wiring colour code**		
	Voltage transformers/Current transformers	Red, Yellow, Blue ,Black	Specify

	Auxiliary AC supply connection cable/bus wire	Red and black	Specify
	DC control wiring within panel	Grey	Specify
	Grounding/earthing cable /wire	Green with yellow stripes.	Specify
10.4	**Phase Arrangement**		
10.4.1	**For AC 3 phase and single Phase circuits**	When facing the front of the panel shall be R-Y-B-N and L-N from left to right, from top to bottom and front to back	Specify
10.4.2	For DC circuits	P-N from left to right, top to bottom and front to Back	Specify
10.5	**Phase and polarity colour code**		
	AC three phase for CT and VT secondary wiring	First Phase-Red Second Phase-Yellow Third Phase-Blue Neutral-Black	Specify
	AC Single phase	First Phase-Red Neutral-Black Ground-Green with yellow stripes.	Specify
	DC auxiliary supply connection	Positive-Red Negative-Black	Specify
11.0	**DRAWINGS**		
11.1	Before starting manufacture of the Protection and Metering switchgear panels, dimensioned drawings and data shall be Approved by KPLC first		State compliance
11.2	Compliance with the specifications shall take precedence, where drawings have conflicts		State compliance
11.3	The manufacturer takes all responsibility in connection with the works that the switchgear and shall comply with relevant IEC standards and with these specifications.		State compliance

11.4	All drawings submitted for approval or sent to KPLC for any other reason shall be in hard copy.	State compliance
11.5	The drawings shall have the following	
	a) AC single line drawing	Provide
	b) AC Schematics	Provide
	c) DC Schematics	Provide
	d) Functional Drawings	Provide
	e) Panel wiring drawing	Provide
	f) Panel device layout drawing	Provide
	g) General layout drawing for the Protection and Metering switchgear panel	Provide
12.0	**OPERATING AND MAINTAINANCE INSTRUCTIONS**	
12.1	The manufacturer shall supply detailed instruction manuals	Provide
12.2	The instruction manual shall include explanatory diagrammatic drawings to facilitate understanding of the instructions.	State compliance
12.3	The manufacturer shall, in preparing the instruction manuals, take into account the lack of experience and familiarity of the operators with this type of equipment	State compliance
12.4	One complete set of the operating and maintenance manuals for all the plant, equipment and accessories to be installed/mounted in the switchgear panels shall be sent to KPLC together with the drawings for approval.	**State**
12.5	Instructions on how to operate the relay shall be engraved on the switchgear panel, on the circuit breaker compartment describing in simple steps how to carry out correct and safe isolation, racking-in and racking-out switching operations on the circuit breaker	**State**
13.0	**Spares and Accessories**	
	i. Portable set testing plugs- One set per unit ii. Spring charging handle- One sets per unit iii. Circuit breaker draw out handle- One per panel	Specify

	iv. One coil for each Circuit breaker TRIP and CLOSE		
14.0	**Test Requirements**		
14.1	Switchgear and protection/control panels testing standards	IEC 60294	Specify
14.2	Circuit Breaker testing standards	62271-200 & 62271-100	Specify
14.3	Current transformer and voltage transformer testing standards	IEC 61869-2, IEC 61869-3 ,IEC 61869-6 , IEC 60044-1 and IEC 6044-2	Specify
14.4	Relays testing standards	IEC 60255	Specify
15.0	**Marking and Packing**		
15.1	Packing to protect from damage during transport, handling and storage		Specify
15.2	Packing and part list		Specify
15.3	Other marking details	i. Name of manufacturer and country ii. Type/Model reference number iii. Ratings (voltage, current, insulation, frequency etc.) iv. Serial number v. Month and year of manufacture vi. Property of KPLC	Specify
16	**Sample**		
16.1	Manufacture of sample panel and initial FATs		State compliance
16.2	Manufacturer shall then rectify any minor defects noted during this initial FATs		State compliance

16.3	Cancellation of tender where the manufactured sample panel is unsatisfactory and the manufacturer fails to rectify the switchgear panel to satisfactory standard within four weeks after attendance of the initial FATs	State compliance
	APPENDICES	
A	**Appendix A: Test and Inspection (Normative)**	
A1	Responsibility of the manufacturer	State
A2	Certified true copies of previous type test reports	State
	Copies of type test reports to be submitted f) Circuit Breaker g) Switchgear panels, h) Current Transformers, i) Voltage Transformer, j) Protection Relays and Measuring and Indicating Instruments	**State**
A3	List of Factory Acceptance Tests to be witnessed by Kenya Power Engineers at the factory	List
	Tests to be witnessed at the factory before shipment/delivery m) Verification of markings; n) Visual inspection; o) Power-frequency withstand test on primary winding; p) Partial discharge measurement; q) Power-frequency withstand tests on secondary winding; r) Power-frequency withstand tests between sections; s) Inter-turn overvoltage test; t) Measurement of Capacitance and dielectric dissipation factor; u) Partial discharge test; v) Test for accuracy; w) Test for rated knee point e.m.f., maximum exciting current, secondary winding resistance	List

	x) Enclosure Tightness Test at ambient temperature.	
A4	Copies of test reports all the circuit breakers, voltage transformers, current transformers and Protection and Control schemes to be submitted to Kenya Power for approval before shipment	State
A5	Upon inspection and testing, defective equipment shall be replaced by the manufacturer with no charge to Kenya Power	Specify
B	**Appendix B: Quality Management System(Normative)**	
B1	QAP	Provide
B2	Copy of ISO 9001: 2015	Provide
B3	Delivery time, Production capacity and experience of the manufacturer	State
C	**Appendix C: Technical Documentation (Normative)**	
C1	Documents submitted with tender documents for evaluation	
	a. Fully filled GTPs	State
	b. Copies of manufacturer's catalogues, manufacturing drawings, technical data	State
	c. Hard copy design drawings of the equipment done on AutoCAD	State
	d. Sales records for previous five years and reference letters	State
	e. Manufacturing capacity and manufacturer's experience	State
	f. Copies of type test certificates and type test reports by a third-party testing laboratory accredited to ISO/IEC 17025	State
	g. Copy of accreditation certificate to ISO/IEC 17025 for the testing laboratory	State
	h. Manufacturer's warranty and guarantee	State
	i. Manufacturer's letter of authorization, copy of the manufacturer's ISO 9001:2015 certificate	State
C2	To be submitted for approval before manufacture	
	a. Fully Filled Clause by clause GTPs	state
	b. Hard copy design drawings of the equipment done on AutoCAD	Specify

	c. Three sets of operational manuals and drawings detailing dimensions, panel layout, wiring and schematic.		State
	d. QAP Plan		State
	e. Test Program to be used after manufacture;		State
	f. Marking details and method to be used in marking the equipment;		State
	g. Packaging and marking details		State
C3	Documents to be submitted before shipment		State
C4	Manuals to be provided with the switchgear and control panels		List
C5	Foundation /mounting details		Provide
D.	**Appendix D: Manufacturer Qualification**		
D.1	Minimum manufacturing experience	15 years	Specify
D.2	Minimum number of years in at least 2 power utilities in at least three of the following regions: Europe, North America, Africa, Asia or South America	8 years	Specify
D.3	References	Export records with copy of contractual letters, switchgear panels details and date of sale/export, letter of satisfaction from power utilities	Specify
D.4	Has the switchgear panel failed in service or mal-operated while in service on the Kenyan power system?		State
D.5	Minimum Warranty	5 years	Specify
E.	**Training**		
E.1	Training at manufacturer's premises		Specify
E.2	Local Training		Specify

NOTE:

1) *Bidders shall give full details of the items on offer as per the specification and applicable standards. The details provided shall conform to the test reports and their certificates, as well as labelled drawings complete with dimensions, catalogues and/or brochures for the purpose of tender evaluation.*
2) *Bidders should note that the above Guaranteed Technical Particulars Schedules must be fully completed and submitted with the bid. Wherever there is conflict between the GTPs and the clauses in the specification, the clauses in the specification take precedence. Failure to complete the schedules shall lead to rejection of the bid.*
3) *Guaranteed values shall be specified. * Words like 'agreed', 'confirmed', 'As per KPLC specifications', etc. shall not be accepted and shall be considered non-responsive.*

.....

Manufacturer's Name, Signature, Stamp and Date