

DOCUMENT NO: KP1/6C/4/1/TSP/11/001-4



**Kenya Power**

**11kV Air Insulated Indoor Switchgear Panels - Specification**



Kenya Power

**TITLE:**

**11KV AIR INSULATED INDOOR SWITCHGEAR PANELS**

Doc. No.	KP1/6C/4/1/TSP//11/001-4
Issue No.	1
Revision No.	0
Date of Issue	2019-11-13

Page 2 of 37

**TABLE OF CONTENTS**

0.1 Circulation List ..... 4

0.2 Amendment Record ..... 5

FOREWORD ..... 5

1 SCOPE ..... 7

2 REFERENCES (NORMATIVE) ..... 7

3 TERMS AND DEFINITIONS ..... 8

4 REQUIREMENTS ..... 8

4.1 SERVICE CONDITIONS ..... 8

4.2 DESIGN AND CONSTRUCTION ..... 9

4.3 CHARACTERISTICS ..... 11

4.3.1 11kV Circuit Breakers ..... 11

4.3.2 Current Transformers ..... 12

4.3.3 Voltage Transformers ..... 13

4.3.4 Relays ..... 13

4.3.5 Instruments ..... 14

4.3.6 Power Cable termination ..... 15

4.3.7 Other features required in the switchgear Panels ..... 15

4.3.8 Protection Relays, Indicating and Control IEDs requirements: ..... 16

4.4 SPECIFIC SWITCHGEAR TECHNICAL REQUIREMENTS ..... 19

4.4.2 Arc Flash over Protection ..... 21

4.5 DETAILED RELAY/DEVICE SPECIFICATIONS ..... 22

4.5.1 Restricted Earth Fault relay ..... 22

4.5.2 Three phase over current and earth fault relay ..... 23

4.5.3 Earth Fault relay ..... 23

4.5.4 Synchronous Switching Relay ..... 24

4.5.5 Three-phase Directional Overcurrent and Earth Fault Relay ..... 24

4.5.6 Trip Relay ..... 25

4.5.7 Trip Circuit Supervision Relay ..... 25

4.5.8 Annunciator Unit ..... 26

4.5.9 Transducers: ..... 26

4.6 Additional Specific Requirements for the switchgear boards ..... 27

4.6.1 Testing facilities ..... 27

4.6.2 Relay/device programming software and connection cables ..... 27

4.7 SPARES ..... 27

5. MARKING AND PACKING ..... 28

**Head of Section, Standards Development**

**Head of Department, Standards**

Signed:

Signed:

Date: 2019-11-13

Date: 2019-11-13



**TITLE:**  
**11KV AIR INSULATED INDOOR  
SWITCHGEAR PANELS**

Doc. No.	KP1/6C/4/1/TSP//11/001-4
Issue No.	1
Revision No.	0
Date of Issue	2019-11-13

Page 3 of 37

APPENDICES .....	28
APPENDIX A: TESTS AND INSPECTION (NORMATIVE).....	28
APPENDIX B: QUALITY MANAGEMENT SYSTEM (NORMATIVE) .....	29
APPENDIX C: TECHNICAL DOCUMENTATION (NORMATIVE).....	29
APPENDIX D: GUARANTEED TECHNICAL PARTICULARS (GTPS) — NORMATIVE .....	31

**Head of Section, Standards Development**

Signed:

Date: 2019-11-13

**Head of Department, Standards**

Signed:

Date: 2019-11-13



**TITLE:**  
**11KV AIR INSULATED INDOOR  
SWITCHGEAR PANELS**

Doc. No.	KP1/6C/4/1/TSP//11/001-4
Issue No.	1
Revision No.	0
Date of Issue	2019-11-13

Page 4 of 37

### 0.1 Circulation List

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

### REVISION OF KPLC STANDARDS

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

### © Kenya Power & Lighting Company Plc

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

Head of Section, Standards Development

Head of Department, Standards

Signed:

Signed:

Date: 2019-11-13

Date: 2019-11-13



Kenya Power

**TITLE:**

**11KV AIR INSULATED INDOOR  
SWITCHGEAR PANELS**

Doc. No.	KP1/6C/4/1/TSP//11/001-4
Issue No.	1
Revision No.	0
Date of Issue	2019-11-13

Page 5 of 37

**0.2 Amendment Record**

Rev No.	Date (YYYY-MM-DD)	Description of Change	Prepared by (Name & Signature)	Approved by (Name & Signature)
New	2019-11-13	New issue	S. Nguli	Dr. Eng. P. Kimemia

Head of Section, Standards Development

Signed:

Date: 2019-11-13

Head of Department, Standards

Signed:

Date: 2019-11-13



**TITLE:**  
**11KV AIR INSULATED INDOOR SWITCHGEAR PANELS**

Doc. No.	KP1/6C/4/1/TSP//11/001-4
Issue No.	1
Revision No.	0
Date of Issue	2019-11-13

Page 6 of 37

## FOREWORD

This Specification has been prepared by the Standards Department in collaboration with Power System Design and Development Department (PSD & D), all of the Kenya Power and Lighting Company Plc(Kenya Power) and it lays down requirements for 11kV Air insulated indoor Switchgear Panels herein called 11kV metal enclosed switchgear and protection boards.

The specification is intended for use by Kenya Power in procurement of these metal enclosed switchgear boards for use in medium voltage substations.

This specification is in the series of:

*KP1/6C/4/1/TSP/11/001-1: Specification for 11kV Metal Clad protection & Metering Switchgear Panel (Air Insulated with Vacuum Circuit Breaker)*

*KP1/6C/4/1/TSP/11/001-2: 11kV Metal Enclosed Switchgear and Protection/ Control Panels Part 2: Spare Panels — Specification*

The specification stipulates the minimum requirements for the 11kV Metal Enclosed Switchgear and Protection board acceptable for use in the company (Kenya Power) and it shall be the responsibility of the manufacturer to ensure adequacy of the design, good workmanship and good engineering practice in the manufacture of the equipment for Kenya Power.

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

Name	Department
James Wachira	PSD & D
G. Nyambare	PSD & D
A. Shanzu	PSD & D
Stephen Nguli	Standards

Head of Section, Standards Development

Signed:

Date: 2019-11-13

Head of Department, Standards

Signed:

Date: 2019-11-13



**TITLE:**  
**11KV AIR INSULATED INDOOR SWITCHGEAR PANELS**

Doc. No.	KP1/6C/4/1/TSP//11/001-4
Issue No.	1
Revision No.	0
Date of Issue	2019-11-13
Page 7 of 37	

## 1 SCOPE

- 1.1 This specification is for 11kV Metal Enclosed Switchgear and Protection Panels for Kenya Power use in medium voltage substations
- 1.2 This specification covers a complete 11kV switchgear metal enclosed boards comprising of incoming feeders (Incomers), outgoing feeders, Bus coupler, Bus riser, control devices, protection relays, instrument transformers and all other necessary equipment and accessories to make a complete working medium voltage indoor switchgear board.

## 2 REFERENCES (NORMATIVE)

The following documents were referred to during the preparation of this specification. In case of conflict, the provisions of this specification shall take precedence. Unless otherwise stated, the latest editions (including amendments) of the following standards 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 60051 Direct acting indicating analogue electrical measuring instruments and their accessories.
- IEC 61869-2: Instrument transformers - Part 1: Current transformers.
- IEC 61869-3: Instrument transformers - Part 2: Inductive voltage transformers.
- IEC 60255: Electrical Relays.
- IEC 60529: Degrees of protection provided by enclosures (IP Code).
- IEC 60815: Guide for the selection of insulators in respect of polluted conditions
- BS 381C: Colours used in identification, coding and other special purpose
- IEC 61870-5-103: Communication Protocols
- IEC 61850-9-2: Design of electrical substation automation systems
- EMC 89/336/EEC: Directive on Electromagnetic Compatibility

Head of Section, Standards Development

Head of Department, Standards

Signed:

Signed:

Date: 2019-11-13

Date: 2019-11-13



**TITLE:**  
**11KV AIR INSULATED INDOOR SWITCHGEAR PANELS**

Doc. No.	KP1/6C/4/1/TSP//11/001-4
Issue No.	1
Revision No.	0
Date of Issue	2019-11-13
Page 8 of 37	

**3 TERMS AND DEFINITIONS**

The definitions given in the reference standards shall apply.

**4 REQUIREMENTS**

**4.1 SERVICE CONDITIONS**

The 11kV Air Insulated Switchgear panels shall be suitable for continuous indoor operation in tropical areas and harsh climatic conditions with following service and system conditions:

**4.1.1 Service Conditions**

- (a) Altitude: 2200m above mean 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.

**4.1.2 System Conditions**

The Indoor Switchgear panels shall be connected to an overhead system, which is generally unearthed (without aerial earth wire). The equipment shall be suitable for installation in supply systems of the following characteristics.

**Table 1: Equipment Characteristics**

Technical Particulars	Units	Requirements
Frequency	Hz	50
Highest System voltage	kV	17.5
Rated Normal current(Ir)	A	1600
Rated Short time current withstand (3sec)(Ik)	kA rms	31.5
Rated peak withstand current (Ip)	kA pk	78
Rated breaking capacity	kA	40
Minimum Lightning Impulse Withstand Voltage 1.2/50µs +ve, dry (peak)	kV pk	95
Minimum Power Frequency Withstand (wet and dry) Voltage (rms)(1 min)	kVrms	38
Class IV Site pollution severity (SPS) as per IEC/TS 60815	Very heavy	
Specific creepage distance as per IEC/TS 60815:2008 – class	mm/kV	31

Head of Section, Standards Development

Head of Department, Standards

Signed:

Signed:

Date: 2019-11-13

Date: 2019-11-13





**TITLE:**  
**11KV AIR INSULATED INDOOR SWITCHGEAR PANELS**

Doc. No.	KP1/6C/4/1/TSP//11/001-4
Issue No.	1
Revision No.	0
Date of Issue	2019-11-13
Page 9 of 37	

**4.2 DESIGN AND CONSTRUCTION**

- 4.2.1 The 11kV Metal Enclosed Indoor Switchgear and Protection Panels shall be designed and constructed in accordance with IEC 62271-200 and the requirements of this specification.
- 4.2.2 The switchboard shall be built up of individually metal enclosed cubicles or modules with earthed metal partitions. The circuit breakers (CB) shall be mounted on an in-built carriage of horizontal draw-out type. The switchboard shall be supplied with CB carriage/trolley to enable one operator perform switching operations.
- 4.2.3 The complete switchgear shall be air insulated fully metal enclosed and shall be such that the complete switchboard is of flush-front design. The maximum height of the board shall not exceed 2500mm.
- 4.2.4 Each cubicle shall be divided into separate compartments for busbar, MV cable connection, switching device and low voltage (LV) section.
- 4.2.5 The low voltage section shall be separate from the medium voltage section. All the Protection Relays, Auxiliary Relays, Indication Lamps, Instruments, Control and selection switches and any other associated accessories shall be mounted in this compartment.
- 4.2.6 The switchgear shall be designed for erection with the rear side close to a wall as well as for freestanding erection.
- 4.2.7 The top of the cubicle shall be provided with separate over pressure vent directed sideways.
- 4.2.8 The cable compartment shall have an anti-vermin guard plate giving protection against rats, rodents, snakes etc.
- 4.2.9 Hinged and pad lockable doors shall be provided at the LV and Circuit breaker compartment. 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.
- 4.2.10 One circuit breaker service truck/trolley shall be provided for each panel.
- 4.2.11 All metallic instrument cases, protective relay, switches etc. shall be properly earthed to the switchgear board steelwork frame.
- 4.2.12 Rear cable chamber covers shall be provided with handles and all bolts and nuts shall be stainless steel.
- 4.2.13 The air insulated switchgear and protection panels shall be constructed to IP4x degree of protection as per IEC 60529.
- 4.2.14 Mimic diagram shall be provided on the LV compartment door.

<b>Head of Section, Standards Development</b>	<b>Head of Department, Standards</b>
Signed:	Signed:
Date: 2019-11-13	Date: 2019-11-13



**TITLE:**  
**11KV AIR INSULATED INDOOR SWITCHGEAR PANELS**

Doc. No.	KP1/6C/4/1/TSP//11/001-4
Issue No.	1
Revision No.	0
Date of Issue	2019-11-13
Page 10 of 37	

- 4.2.15 The Busbar shall be single, three phase, air insulated. The primary bus bars and connections shall be of high conductivity and electrolytic Copper materials and be in unit lengths.
- 4.2.16 The Bus bars shall be marked R, Y, B and all the jointing points/ends shall be tin-plated.
- 4.2.17 Bus bars, connections and their support shall be rated 1600Amps continuously under ambient conditions and capable of carrying the short-time current associated with the short circuit ratings of the circuit breakers, for 3 seconds.
- 4.2.18 Bus bars shall be extensible at both ends; such extension shall entail the minimum possible disturbance to the existing bus bar.
- 4.2.19 The Bus bar shutters shall be painted in Red shade (Signal color 537 of BS381C) with "BUSBARS" written in white. The cable shutters shall be painted in lemon color (355 of BS381C). For Bus coupler panel, both the shutters shall be painted Red shade with 'BUSBARS' written in white
- 4.2.20 Provision shall be made for locking bus bar and circuit shutters separately.
- 4.2.21 Provision shall be made for integral circuit earthing by means of circuit breaker for circuit (cable) and bus- bar earthing. Mechanical interlocks to ensure correct switching operation shall be provided for the two circuits.
- 4.2.22 All earthing facilities shall be rated for fault making, and padlocking facility provided for the earth switch.
- 4.2.23 The material for Earth bus and cable shall be copper, and the earth bus shall be extended outside the switchboard panel
- 4.2.24 The incoming panels HT cable cut outs per phase shall be capable of accommodating three cables, whereas the outgoing shall be capable of accommodating one cable.
- 4.2.25 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<sup>2</sup> cables.
- 4.2.26 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 or front of the panel where external cable shall be connected.
- 4.2.27 At least 12 spare terminals shall be provided on the terminal block for any future requirements.

**Head of Section, Standards Development**

**Head of Department, Standards**

Signed:

Signed:

Date: 2019-11-13

Date: 2019-11-13



**TITLE:**  
**11KV AIR INSULATED INDOOR SWITCHGEAR PANELS**

Doc. No.	KP1/6C/4/1/TSP//11/001-4
Issue No.	1
Revision No.	0
Date of Issue	2019-11-13
Page 11 of 37	

- 4.2.28 Auxiliary 110VDC and single-phase 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.
- 4.2.29 The cubicle shall be tropical vermin proof. The cover plates shall be of mild steel thoroughly cleaned by shot blasting or other approved methods.
- 4.2.30 The switchgear panels shall then be given a primary coat and two coats of contrasting colour of durable and weather resisting paint. The final coat shall be powder coating and of light grey RAL 7035.
- 4.2.31 Anti-condensation heaters shall be provided inside each cubicle. They shall be located so as not to cause injury to personal or damage to equipment.
- 4.2.32 The heaters and lighting shall be controlled from a two-position control switch with positions "ON-OFF" in each cubicle. The heaters and lighting shall operate from a single-phase supply (230 VAC).

**4.3 CHARACTERISTICS**

**4.3.1 11kV Circuit Breakers**

- 4.3.1.1 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.
- 4.3.1.2 The moving portion of each circuit breaker shall consist of a three-pole circuit breaker, operating mechanism, primary and secondary disconnecting devices, auxiliary switches, position indication and necessary control wiring.
- 4.3.1.3 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.
- 4.3.1.4 The circuit breakers of the same current and voltage ratings shall be interchangeable, both electrically and mechanically.
- 4.3.1.5 The circuit breaker operating mechanism shall be motor wound spring operated, power closing with electrical release and with provision for manual charge.
- 4.3.1.6 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.
- 4.3.1.7 A spare set, of at least 10NO and 10NC auxiliary contacts of the circuit breaker shall be provided and shall be wired to a terminal board (box), for connection to SCADA Equipment.

**Head of Section, Standards Development**

**Head of Department, Standards**

Signed:

Signed:

Date: 2019-11-13

Date: 2019-11-13



**TITLE:**  
**11KV AIR INSULATED INDOOR SWITCHGEAR PANELS**

Doc. No.	KP1/6C/4/1/TSP//11/001-4
Issue No.	1
Revision No.	0
Date of Issue	2019-11-13
Page 12 of 37	

4.3.1.8 The control circuits for the circuit breaker shall automatically be connected when inserting the breakers into the cubicle by use of a single plug-in cable

**4.3.2 Current Transformers**

4.3.2.1 The incomers, feeders and Bus coupler shall be fitted with wound type epoxy cast resin current transformers.

4.3.2.2 In addition, the incomers and outgoing feeders shall be fitted with ring core type epoxy cast resin current transformer for Sensitive Earth Fault (SEF) protection.

4.3.2.3 The current transformers shall be in accordance with the requirement of IEC 61869-2 and 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 for 3 seconds.

4.3.2.4 Current transformers shall have rated burden sufficient for the connected numeric or static type relays, meters and instruments.

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

**Table 2: Current Transformer Ratings**

Description	Requirement
Type	Wound epoxy cast resin
Highest System Voltage	17.5kV
Short time Current with stand (STC)	31.5kA for 3 seconds
Maximum Continuous Thermal Rating	x1.5 In
Lightning Impulse Withstand Voltage	95kV <sub>peak</sub>
One-Minute Power Frequency Withstand Voltage	38kV <sub>rms</sub>
<b>Incoming (Incomer) and Bus coupler</b>	<b>4-cores</b>
Class X/SP	2cores, Burden:15VA, V <sub>k</sub> =250V and I <sub>k</sub> ≤30mA
Class 5P20	One core; Burden 15VA
Class 0.2	One core; Burden 15VA
Ratio	600-1500/1/1/1A
<b>Outgoing feeders</b>	<b>3core</b>
Class 5P20	2cores; Burden 15VA
Class 0.2	1core; burden 15VA
Ratio	200-400-600/1/1/1A

Head of Section, Standards Development

Head of Department, Standards

Signed:

Signed:

Date: 2019-11-13

Date: 2019-11-13

### 4.3.3 Voltage Transformers

- 4.3.3.1 Voltage transformers shall be suitable for operation of the protection relays, metering and transformer voltage regulation and their design and manufacturing shall meet requirements of IEC 61896-3 standards.
- 4.3.3.2 The voltage transformer shall be epoxy cast resin type, three phases, and, star/star connected complete with removable HV fuses.
- 4.3.3.3 Withdrawable type Voltage transformers is most preferable, and shall be fitted in the incomers and Bus PT/Bus riser panels.

**Table 3: Voltage Transformer Rating**

Description	Requirement
Highest System Voltage	17.5kV
Short time current with stand	31.5KA/3sec
Ratio	11000/√3/110/√3/110/√3V
Burden	30VA
Class	2 cores: 0.2 and 3P
Impulse Withstand Voltage	95kV peak
One-Minute Power Frequency Withstand Voltage	38kVrms

### 4.3.4 Relays

- 4.3.4.1 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 situ and to allow isolation of VT circuits, Alarm and Trip Circuits.
- Relay secondary rating shall be 1Amp (three phase) and Power Supply Voltage shall be 110VDC or (Universal 30-300VDC).
- 4.3.4.2 The relays shall be of Numeric design and supports GOOSE messaging and communication protocols 60870-5-103 and 61850-9-2.
- 4.3.4.3 The relays shall be flush mounted in design, and shall be manufactured in accordance to IEC 60255.
- 4.3.4.4 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.
- 4.3.4.5 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).

**Head of Section, Standards Development**

Signed: 

Date: 2019-11-13

**Head of Department, Standards**

Signed: 

Date: 2019-11-13



**TITLE:**  
**11KV AIR INSULATED INDOOR SWITCHGEAR PANELS**

Doc. No.	KP1/6C/4/1/TSP//11/001-4
Issue No.	1
Revision No.	0
Date of Issue	2019-11-13
Page 14 of 37	

- 4.3.4.6 Relay contacts shall make firmly without bounce and the relay mechanism shall not be affected by panel vibration or external magnetic fields.
- 4.3.4.7 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.
- 4.3.4.8 Relays shall be suitable for operation on 110VDC supply without use of dropping resistors or diodes.
- 4.3.4.9 The protection relay shall have a minimum of 5 current inputs (1/1A) and 4No. Voltage transformer inputs (110VDC)
- 4.3.4.10 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.
- 4.3.4.11 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 /3s)
- 4.3.4.12 The protection relay shall conform to IEC 60255 and EMC 89/336/EEC standards, and shall provide following incoming/outgoing feeder protections/functions;
  - i. Non directional over current (50/51)
  - ii. Non directional earth fault (50N, 51N)
  - iii. Directional over current (67)
  - iv. Sensitive earth fault through ring core C.T (64S)
  - v. Under/Over voltage protection (27/59)
  - vi. Broken conductor protection (47)
  - vii. Breaker failure protection (62 BF)
  - viii. Autoreclose function & Trip circuit supervision (for open and close circuits)
  - ix. Under/over frequency protection (81)
  - x. Synchro check (25) & Trip circuit supervision
  - xi. Measurements: I,V,P,Q,P.F

**4.3.5 Indicating Instruments**

- 4.3.5.1 All indicating instruments shall be flush mounted and shall be in accordance to requirement of IEC 60051.
- 4.3.5.2 Each switchboard panel shall have the following indications:

<b>Head of Section, Standards Development</b>	<b>Head of Department, Standards</b>
Signed:	Signed:
Date: 2019-11-13	Date: 2019-11-13



**TITLE:**  
**11KV AIR INSULATED INDOOR SWITCHGEAR PANELS**

Doc. No.	KPI/6C/4/1/TSP//11/001-4
Issue No.	1
Revision No.	0
Date of Issue	2019-11-13
Page 15 of 37	

- 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 indicating lamp complete with push button switch to provide trip circuit healthy indication check, which must function for both circuit breaker open and close positions with inscription “TRIP CIRCUIT HEALTHY” black letters on white background.
- iii. 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.
- iv. One indicator lamp to show the breaker in closed position – RED colour.
- v. One indicator lamp to show the breaker in open position – GREEN colour.

**4.3.6 Power Cable Termination**

4.3.6.1 HT cable compartment design shall be suitable either for shrinkable (or equivalent) jointing application termination.

4.3.6.2 The following provisions shall be made:

- i. The base plate of the incomers shall have cut out holes sealed with PVC sleeves for 3nos. HT cable entry per phase, whereas the outgoing feeders shall have provisions for one cable entry.
- ii. The HT cable entry provision shall be able to accommodate at least 11kV XLPE cables sizes of up to 630mm<sup>2</sup> single core (for Incomer panels), and three-core cable of up to 300mm<sup>2</sup> (for feeder panels).
- iii. Anti-condensation heaters (minimum 100W) with MCB protection and humidistat control for cable compartment with heater 'ON' indication.

**4.3.7 Other Features Required in the Switchgear Panels**

- 4.3.7.1 Trip circuit supervision for both CB ON and CB OFF.
- 4.3.7.2 Detailed nameplate for the Circuit Breaker with all VCB rating details.
- 4.3.7.3 Name plate for Current and Voltage Transformers with rating details.
- 4.3.7.4 Two sets of NO + NC auxiliary contact of circuit breaker wired to the control cable termination block for status indication.
- 4.3.7.5 High voltage presence indicator.

Head of Section, Standards Development

Head of Department, Standards

Signed:

Signed:

Date: 2019-11-13

Date: 2019-11-13



**TITLE:**  
**11KV AIR INSULATED INDOOR SWITCHGEAR PANELS**

Doc. No.	KP1/6C/4/1/TSP//11/001-4
Issue No.	1
Revision No.	0
Date of Issue	2019-11-13

- 4.3.7.6 Alarm and Annunciator scheme for entire 11kV indoor switchboard, with audible Urgent and Non-Urgent Alarm.
- 4.3.7.7 All indoor switchboard panels shall be provided with Bus-wires for all signal, commands, indications, metering etc. ready for looping to the next switchboard panel.
- 4.3.7.8 All relays shall be software based incorporating features for fault records, event records and diagnostic data downloaded via RS232 serial port, USB-2 and higher versions.
- 4.3.7.9 Auxiliary supplies for panel heating and lighting shall be 230VAC, 50Hz, single-phase 2-wire, while protection, spring charging motor, Control and Circuit Breaker Trip/Close auxiliary supply shall be 110VDC.
- 4.3.7.10 All panels shall have names at the front and at the rear as per feeder or incomer name. The names shall be engraved on a high quality long life PVC or metal material.

**4.3.8 Protection Relays, Indicating and Control IEDs requirements**

**4.3.8.1 Outgoing Feeder Panels**

All the outgoing feeders shall be equipped with but not limited to the following IEDs:

- i. Multi-functional numerical protection relay.
- ii. Auxiliary relay for lockout.
- iii. Trip circuit supervision.
- iv. Ammeter selector switch.
- v. Ammeter with MDI.
- vi. Voltage and phase IED.
- vii. Digital energy multi-meter for tariff metering to measure following data;  
KW, KWH, KVAR, KVARH, P.F, Maximum demand, Load profile etc.
- viii. Digital MVar and MW meter
- ix. MVar and MW transducers
- x. Circuit Breaker Control Switch (Close, Open & Neutral)
- xi. Circuit Breaker ON (red) and OFF (green) Indication lamps.
- xii. Anti-condensation heaters (minimum 100W) with MCB protection and humidistat control for LV compartment with heater 'ON' indication.
- xiii. SEF selection switch IN/OUT

**Head of Section, Standards Development**

**Head of Department, Standards**

Signed:

Signed:

Date: 2019-11-13

Date: 2019-11-13





**TITLE:**  
**11KV AIR INSULATED INDOOR  
SWITCHGEAR PANELS**

Doc. No.	KP1/6C/4/1/TSP//11/001-4
Issue No.	1
Revision No.	0
Date of Issue	2019-11-13

Page 17 of 37

- xiv. Auto-reclose selector switch
- xv. HV voltage indication lamps
- xvi. Circuit earth switch interlock
- xvii. Manual Close/Trip switch
- xviii. Cable Circuit Earth indications

**4.3.8.2 Transformer Incoming Panels**

All the incomer switchboard panels shall be equipped with but not limited to the following IEDs;

- i. Multi-functional numerical protection relay.
- ii. LV Master trip relay
- iii. Trip circuit supervision
- iv. Ammeter selector switch
- v. Ammeter with MDI
- vi. Digital energy multi-meter for tariff metering to measure following data; KW, KWH, KVAR, KVARH, P.F, Maximum demand, Load profile etc.
- vii. Digital MVar and MW meter
- viii. MW and MVar transducer (optional) -20 / 0 / +20 mA
- ix. KV meter
- x. Voltage selector switch
- xi. Circuit Breaker Control Switch (Close, Open & Neutral)
- xii. Circuit Breaker ON (red) and OFF (green) Indication Lamps.
- xiii. Anti-condensation heaters (minimum 100W) with MCB protection and humidistat control for cable compartment with heater 'ON' indication.
- xiv. HV voltage indication lamps
- xv. Cable Circuit Earth manual switch
- xvi. Manual Close/Trip switch
- xvii. Circuit Earth Position indications

**Head of Section, Standards Development**

**Head of Department, Standards**

Signed:

Signed:

Date: 2019-11-13

Date: 2019-11-13



**TITLE:**

**11KV AIR INSULATED INDOOR SWITCHGEAR PANELS**

**Doc. No.**

**KP1/6C/4/1/TSP//11/001-4**

**Issue No.**

**1**

**Revision No.**

**0**

**Date of Issue**

**2019-11-13**

Page 18 of 37

#### 4.3.8.3 Bus Coupler Panel

The bus coupler shall be equipped with but not limited to the following IEDs;

- i. Multi-functional numerical protection relay.
- ii. LV Master trip relay
- iii. Trip circuit supervision
- iv. Digital energy multi-meter to measure following data;  
KW, KWH, KVAR, KVARH, P.F etc.
- v. MW and MVar transducer (optional) -20 / 0 / +20 mA
- vi. Circuit Breaker Control Switch (Close, Open & Neutral)
- vii. Circuit Breaker ON (red) and OFF (green) Indication lamps.
- viii. Heater ON/OFF switch, for control of the anti-condensation heater.
- ix. HV voltage indication lamps
- x. Cable Circuit Earth manual switch
- xi. Manual Close/Trip switch
- xii. Circuit Earth Position indications

#### 4.3.8.4 Bus riser/Bus PT Panel

The Bus PT shall have digital kV meter

#### 4.3.9 Interlocks requirements for the 11kV indoor switch board;

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

##### 4.3.9.1 Panel Internal Interlocking

- (a) The withdrawable part shall only be moved from the test/disconnected position (and back) when the circuit breaker and earthing switch are off, the switch shall be off beforehand.
- (b) The circuit breaker shall only be switched on when the withdrawable part is in the test or service position. In the intermediate position, the switch shall be mechanically interlocked.

**Head of Section, Standards Development**

**Head of Department, Standards**

**Signed:**

**Signed:**

**Date:** 2019-11-13

**Date:** 2019-11-13



**TITLE:**  
**11KV AIR INSULATED INDOOR SWITCHGEAR PANELS**

Doc. No.	KPI/6C/4/1/TSP//11/001-4
Issue No.	1
Revision No.	0
Date of Issue	2019-11-13
Page 19 of 37	

- (c) Connecting and disconnecting the control wiring plug shall only be possible in the test/disconnected position of the withdrawable part.
- (d) The Bus coupler circuit breaker shall close at service position when only one incomer breaker is closed.
- (e) The earthing switch shall only be switched on if the withdrawable part is in the test/disconnected position or outside of the panel (mechanical interlock).
- (f) If the earthing switch is on, the withdrawable part shall not be moved from the test/disconnected position to the service position (mechanical interlock).
- (g) The MV cable compartment door shall not be opened if the earthing switch is open.
- (h) The earthing switch shall not be operated if the HT cable compartment door is open.
- (i) The cable compartment door shall not be opened if the earthing switch is open.
- (j) The earthing switch shall not be operated if the cable compartment door is open.
- (k) To close the 11kV incomer circuit breaker, the upstream HT transformer bay circuit breaker shall be closed.

**4.3.9.2 Door Interlocking**

- (a) The MV cable compartment door shall not be opened if the earthing switch is open.
- (b) The MV earthing switch shall not be operated if the HT cable compartment door is open.

**4.4 SPECIFIC SWITCHGEAR TECHNICAL REQUIREMENTS**

The 11kV switchgear panels shall meet the below specific technical requirements.

**4.4.1.1 Incomer and Bus coupler Switchgear Panel**

**Table 4: Transformer Incomer and Bus coupler Switchgear Panel Specific Requirements**

Description	Requirement
Panel and Switchgear Highest System Voltage	17.5kV
Rated power frequency withstand voltage, rms	38kV
Rated lightning impulse withstand voltage, peak	95kV
Rated short-time withstand current	31.5kA rms/3sec
Rated peak withstand current	78kA
Internal Arc Classification (IAC) as per IEC 62271-200	25kA, 1s
Arcing time	10-15ms
Main Busbar rating	1600A

**Head of Section, Standards Development**

Signed:

Date: 2019-11-13

**Head of Department, Standards**

Signed:

Date: 2019-11-13



**TITLE:**  
**11KV AIR INSULATED INDOOR SWITCHGEAR PANELS**

Doc. No.	KP1/6C/4/1/TSP//11/001-4
Issue No.	1
Revision No.	0
Date of Issue	2019-11-13
Page 20 of 37	

Circuit breaker design	Horizontal withdrawable type
Circuit breaker quenching medium	Vacuum
Circuit breaker breaking current	40kArms
Incomer and Bus coupler Circuit Breaker rating	12kV,31.5kA,3s,1600A
Circuit break closing time	< 60ms
Circuit breaker opening time	< 45ms
Operation sequence	O-0.3s-CO-3min-CO
Incomer CT rating	200-600-1200-1600/1-1-1-1 A
Incomer CT cores	4 Cores
Incomer CT classes	0.2, X, X, 5P20
Switchgear Control voltage	110V DC
Spring charging motor voltage	110V DC
Heating and illumination Voltage	230V AC-Single phase
Protection relay	Numerical multifunction relay
Arc flash protection design	Arc protection relay with Fibre optic sensors
Arc flash protection relay	Ultra-fast acting
Arc flash protection operation time	< 8ms
Arc flash protection covered compartments	Bus bar, Circuit breaker, MV cable connection and Control chambers
Incomer VT rating	11000/√3/110/√3V
Switchgear Panel height	Not more than 2500mm
Protection degree	IP4X

**4.4.1.2 Feeder Switchgear Panel**

**Table 1: Feeder Switchgear Panel Specific Requirements**

Description	Requirement
Panel and Switchgear Highest System Voltage	17.5kV
Rated power frequency withstand voltage, rms	38kV
Rated lightning impulse withstand voltage, peak	95kVp
Rated short-time withstand current	31.5kA, 3sec
Rated peak withstand current	78kA
Arcing time	10-15ms
Main bus bar rating	1600 A
Internal Arc Classification (IAC) to 62271-200	25kA, 1s
Circuit breaker design	Horizontal withdrawable type
Circuit breaker quenching medium	Vacuum

<b>Head of Section, Standards Development</b>	<b>Head of Department, Standards</b>
Signed:	Signed:
Date: 2019-11-13	Date: 2019-11-13



Kenya Power

**TITLE:**

**11KV AIR INSULATED INDOOR SWITCHGEAR PANELS**

Doc. No.	KP1/6C/4/1/TSP//11/001-4
Issue No.	1
Revision No.	0
Date of Issue	2019-11-13

Circuit breaker breaking current	40kArms
Outgoing feeder Circuit Breaker rating	12kV, 31.5kA,3s, 630A
Circuit break closing time	< 60ms
Circuit breaker opening time	< 45ms
Operation sequence	O-0.3s-CO-3min-CO
Outgoing feeder CT rating	200-300-600/1-1-1A
Feeder CT cores	3 Cores
Feeder CT classes	0.2, 5P20, 5P20
Switchgear Control Voltage	110V DC
Spring charging motor voltage	110V DC
Heating and illumination voltage	230V AC
Protection relay	Numerical multifunction relay
Arc flash protection design	Arc protection relay with fibre optic sensors
Arc flash protection relay	Ultra-fast acting
Arc flash protection operation time	< 8ms
Arc flash protection covered compartments	BB,CB MV cable and Control chambers
Switchgear panel height	Not more than 2500mm
Outgoing feeder Ring Core CT rating	50/1A, minimum diameter 180mm
Protection degree	IP4X

**4.4.2 Arc Flash over Protection**

- 4.4.2.1 The 11kV switchgear board shall be fitted with Ultra-fast detection and clearing arc flash protection system. The system shall be capable of detecting arc within 400nm spectrum and above.
- 4.4.2.2 The maximum allowable arcing time due to fault for the 11kV switchgear boards shall be 15milliseconds, whereas the arc flash protection system shall operate in less than 8milliseconds.
- 4.4.2.3 Arc flash system shall meet the requirements of Institute of Electrical and Electronic Engineers (IEEE) and the US Occupational Safety and Health Administration (OSHA).
- 4.4.2.3 Arc flash detection systems shall be standalone protection systems and shall not need to be coordinated with existing protection systems to achieve ultra-faster detection and clearing of arc faults.

Head of Section, Standards Development

Head of Department, Standards

Signed:

Signed:

Date: 2019-11-13

Date: 2019-11-13



**TITLE:**  
**11KV AIR INSULATED INDOOR SWITCHGEAR PANELS**

Doc. No.	KP1/6C/4/1/TSP//11/001-4
Issue No.	1
Revision No.	0
Date of Issue	2019-11-13
Page 22 of 37	

- 4.4.2.4 The system shall ensure arc flash protection in all compartments of the switchgear board (Control compartment, MV Cable connection, Breaker and Bus bar compartments)
- 4.4.2.6 The system shall automatically carry out regular self-checking of the sensor's integrity and continuity, and generate an alarm if a problem is detected.
- 4.4.2.7 Each of the three compartments shall have one light sensor lens linked to the relay optical inputs through insulated fibre optic cable.
- 4.4.2.8 The operation of arc protection shall be logically programmed to work on light only or light + current mode.
- 4.4.2.9 The arc flash protection operating from the bus bar and circuit breaker compartments shall trip the two-incomer circuit breakers and the bus section circuit breaker.
- 4.4.2.10 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.
- 4.4.2.11 The arc flash protection operating from feeder cable compartment shall be wired to trip the feeder circuit breaker only.
- 4.4.12 Additional output LEDs shall be programmed to indicate the following:
  - i. Cable compartment arc sensor operated.
  - ii. Breaker/busbar compartment arc sensor operated.

**4.5 DETAILED RELAY/DEVICE SPECIFICATIONS**

These specifications indicate the required performance characteristics for the Protection Relays, Energy Meters and other devices listed above for all the different circuits and equipment.

**4.5.1 Restricted Earth Fault relay.**

Shall incorporate at least following features;

- i. The relays shall be of Numeric design and supports GOOSE messaging and communication protocols 60870-5-103 and 61850-9-2
- ii. Relay shall reject harmonics produced by Current Transformer (C.T) saturation.

**Head of Section, Standards Development**

Signed:

Date: 2019-11-13

**Head of Department, Standards**

Signed:

Date: 2019-11-13



Kenya Power

**TITLE:**

**11KV AIR INSULATED INDOOR SWITCHGEAR PANELS**

**Doc. No.**

**KPI/6C/4/1/TSP//11/001-4**

**Issue No.**

**1**

**Revision No.**

**0**

**Date of Issue**

**2019-11-13**

Page 23 of 37

- iii. The relay shall include the associated stabilizing resistor and voltage dependent resistor (metrosil).
- iv. Current setting range 0.05-0.8In
- v. Operating time <25ms at 5 times the settings

**4.5.2 Three phase over current and earth fault relay.**

Shall incorporate at least the following features;

- i. The relays shall be of Numeric design and supports GOOSE messaging and communication protocols 60870-5-103 and 61850-9-2.
- ii. Current setting range for over current relay of 0.5In-2.4In.
- iii. Current setting range for earth fault relay of 0.5In-0.8In.
- iv. I.D.M.T characteristics according to IEC 60255 i.e. SI, VI,EL, LTI, including definite time for the high-set Elements.
- v. Time setting multiplier of 0.05-1.0
- vi. Broken conductor protection feature
- vii. Highest element for both overcurrent and earth fault Protection with a setting range of 1-30In.
- viii. Thermal overload Protection.
- ix. Dedicated Breaker Fail Protection.
- x. Circuit Breaker maintenance.
- xi. Fault records, Event Records and Disturbance records (minimum of 1000 records)
- xii. Configurable output relays with ability to output starting elements to control-tripping of other upstream Protection relays.
- xiii. Drop off/picking up ratio >90%
- xiv. Low transient overreach <10%

**4.5.3 Earth Fault relay.**

Shall incorporate at least the following features;

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

**Head of Section, Standards Development**

**Head of Department, Standards**

Signed:

Signed:

Date: 2019-11-13

Date: 2019-11-13



**TITLE:**

**11KV AIR INSULATED INDOOR SWITCHGEAR PANELS**

Doc. No.	KP1/6C/4/1/TSP//11/001-4
Issue No.	1
Revision No.	0
Date of Issue	2019-11-13
Page 24 of 37	

- ii. Current setting range of  $0.05I_n-0.8I_n$
- iii. I.D.M.T. characteristic according to IEC60255 i.e. SI, VI, EL, LTI, including definite time for the high-set Elements.
- iv. Time settings multiplier of 0.05-1.0
- v. Highest Element with a setting range of  $1-30I_n$ .
- vi. Circuit Breaker Maintenance
- vii. Fault records, Event records and Disturbance records (minimum of 1000)
- viii. Configurable output relays with ability to output starting elements to control tripping of other upstream Protection relays.
- ix. Drop off/pickup ratio > 90%
- x. Low transient overreach < 10%

**4.5.4 Synchronous Switching Relay.**

Shall incorporate at least of the following features:

- i. The relays shall be of Numeric design and supports GOOSE messaging and communication protocols 60870-5-103 and 61850-9-2.
- ii. Must be equipped with adaptive control to enable it to automatically adjust to changes in the circuit breaker closing times.
- iii. Shall have both synchronized closing and opening facility.

**4.5.5 Three-phase Directional Overcurrent and Earth Fault Relay.**

Shall incorporate at least the following features:

- i. The relays shall be of Numeric design and supports GOOSE messaging and communication protocols 60870-5-103 and 61850-9-2
- ii. Current setting range for overcurrent relay of  $0.5I_n-2.4I_n$
- iii. Current setting range for earth fault relay of  $0.5I_n-0.8I_n$
- iv. Quadrature connection for polarizing voltage ( $V_n=110\text{ V}$ )
- v. Applicable on the LV side of a Dyn1 transformer
- vi. High set Element, with a setting range of  $1-32I_n$
- vii. The phase and the directional elements shall be individually selectable.

**Head of Section, Standards Development**

**Head of Department, Standards**

Signed:

Signed:

Date: 2019-11-13

Date: 2019-11-13





**TITLE:**  
**11KV AIR INSULATED INDOOR SWITCHGEAR PANELS**

Doc. No.	KP1/6C/4/1/TSP//11/001-4
Issue No.	1
Revision No.	0
Date of Issue	2019-11-13

- viii. I.D.M.T characteristic according to IEC 60255 and Definite time characteristic
- ix. The normal operating boundary shall be  $\pm 90$  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.
- x. Time setting multiplier of 0.05-1.0.
- xi. Broken conductor protection feature.
- xii. Negative sequence protection feature.
- xiii. Highest element for both overcurrent and earth fault protection, with a setting range of 1-30In.
- xiv. Thermal protection.
- xv. Dedicated Breaker Fail Protection.
- xvi. Circuit Breaker Maintenance
- xvii. Incorporate Fault record, Event Records and disturbance records (minimum 1000)
- xviii. Configurable output relays with ability to output starting elements to control of other upstream Protection relays.

**4.5.6 Trip Relay**

Shall incorporate at least the following features:

- i. High burden tripping relay, immune to capacitance discharge currents and leakage currents.
- ii. At least 8 pairs of outputs contacts two of which should NC contacts.
- iii. Instantaneous operation,  $t < 12$ ms.
- iv. Flag or target should be a red L.E.D or bulb and should be electrically reset.

**4.5.7 Trip Circuit Supervision Relay**

The relay shall have at least the following features:

- i. Continuous supervision of trip circuit breaker in both OPEN & CLOSE position.
- ii. Trip Circuit Fail – Red L.E.D
- iii. Trip Circuit Healthy- Green L.E.D
- iv. Two Normally Closed(NC) and three Normally Open(NO) output contacts

**NB: The relay L.E.Ds shall be visible from the front of the panel without opening the panel door(s)**

Head of Section, Standards Development

Head of Department, Standards

Signed:

Signed:

Date: 2019-11-13

Date: 2019-11-13



**TITLE:**  
**11KV AIR INSULATED INDOOR SWITCHGEAR PANELS**

Doc. No.	KP1/6C/4/1/TSP//11/001-4
Issue No.	1
Revision No.	0
Date of Issue	2019-11-13

**4.5.8 Annunciator Unit,**

The relay shall at least have the following features;

- i. Silence, Accept and Reset status
- ii. Accommodate 18 signal alarms
- iii. Relay output for audible alarm and self-supervision
- iv. Integrated event register to provide analysis of the latest twenty (20) events

**4.5.9 Transducers:**

**4.5.9.1 MW Transducer:**

- i. Connection shall be 3-Phase , 3–Wire
- ii. Inputs 110VAC and Amp
- iii. Output shall be 0 to  $\pm 20\text{mA}$
- iv. Auxiliary power supply shall be 110VAC, separately connected.

**4.5.9.2 MVar Transducer**

- i. Connection shall be 3-Phase, 3 – Wire
- ii. Inputs 110V AC and Amp
- iii. Output shall be 0- +/-20mA
- iv. Auxiliary power supply shall be 110V DC, separately connected

**4.5.9.3 Current Transducer**

- i. Input 0-1Amp
- ii. Output 0-20mA
- iii. Auxiliary power supply shall be 110V DC

**4.5.9.4 Voltage Transducer:**

- i. Input 0-110 Volts
- ii. Output 0-20mA

**Head of Section, Standards Development**

Signed:

Date: 2019-11-13

**Head of Department, Standards**

Signed:

Date: 2019-11-13



**TITLE:**  
**11KV AIR INSULATED INDOOR  
SWITCHGEAR PANELS**

<b>Doc. No.</b>	<b>KP1/6C/4/1/TSP//11/001-4</b>
<b>Issue No.</b>	<b>1</b>
<b>Revision No.</b>	<b>0</b>
<b>Date of Issue</b>	<b>2019-11-13</b>

Page 27 of 37

iii. Auxiliary power supply shall be 110V DC, separately connected

#### **4.6 Additional Specific Requirements for the Switchgear Panels**

##### **4.6.1 Testing Facilities**

4.6.1.1 Separate Test facilities for each AC current and voltage transformer secondary circuit so as to give access for testing of each protective relay and its associated circuits. This may consist of either test terminal blocks 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.

4.6.1.2 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.

##### **4.6.2 Relay/device programming software and connection cables**

4.6.2.1 All software must be provided for programming and downloading of data for all IEDs supplied. The software User's Guide shall also be supplied.

4.6.2.2 The Numerical Relays shall be equipped with an RS232 or later revisions of the Communication Port to facilitate connection to a Laptop. The relevant communication cable, between the relay and the laptop shall also be provided (3 cables). Also, communication facilities shall be provided on each Numerical Relay for Remote Interrogation and Programming of the Numerical Relays.

#### **4.7 SPARES**

4.7.1 The following spares shall be supplied for each board in a station in addition to bidding document spares requirements

- i. Portable set testing plugs- One set
- ii. Spring charging handle- Two sets
- iii. Circuit breaker draw out handle- Two sets
- iv. Two numbers of Circuit breaker TRIP and CLOSE coils

**Head of Section, Standards Development**

Signed:

Date: 2019-11-13

**Head of Department, Standards**

Signed:

Date: 2019-11-13



**TITLE:**  
**11KV AIR INSULATED INDOOR  
SWITCHGEAR PANELS**

Doc. No.	KPI/6C/4/1/TSP//11/001-4
Issue No.	1
Revision No.	0
Date of Issue	2019-11-13

Page 28 of 37

## 5 MARKING AND PACKING

- 5.1 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.
- 5.2 Each assembly and package of items associated with the switchgear shall be suitably marked. A packing and parts list shall be provided.
- 5.3 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

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

Head of Section, Standards Development

Signed:

Date: 2019-11-13

Head of Department, Standards

Signed:

Date: 2019-11-13



**TITLE:**  
**11KV AIR INSULATED INDOOR SWITCHGEAR PANELS**

<b>Doc. No.</b>	<b>KPI/6C/4/1/TSP//11/001-4</b>
<b>Issue No.</b>	<b>1</b>
<b>Revision No.</b>	<b>0</b>
<b>Date of Issue</b>	<b>2019-11-13</b>

Page 29 of 37

## APPENDICES

### APPENDIX A: TESTS AND INSPECTION (NORMATIVE)

- A.1. The switchgear and protection panels shall be inspected and tested in accordance with the requirements of IEC 62271-200 and this specification. It shall be the responsibility of the manufacturer to perform or to have performed all the tests specified.
- A.2. Circuit breakers shall be inspected and tested in accordance with the requirement of IEC 62271-100 and this specification.
- A.3. Relays shall be inspected and tested in accordance with the requirement of IEC 60255 and this specification.
- A.4. Current transformers and voltage transformers shall be inspected and tested in accordance with the requirement of IEC 61869-1, IEC 61869-2 and IEC 61869-3 accordingly and this specification.
- A.5. The equipment shall be subject to Factory Acceptance Tests (FATs) at the manufactures' works before dispatch. The routine tests shall be as per relevant manufacturing standards.  
  
FATs shall be witnessed as specified in the bidding document.
- A.6. 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.

**Head of Section, Standards Development**

**Signed:**

**Date:** 2019-11-13

**Head of Department, Standards**

**Signed:**

**Date:** 2019-11-13



**TITLE:**  
**11KV AIR INSULATED INDOOR SWITCHGEAR PANELS**

Doc. No.	KP1/6C/4/1/TSP//11/001-4
Issue No.	1
Revision No.	0
Date of Issue	2019-11-13
Page 30 of 37	

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, copy of the manufacturer's ISO 9001:2008 certificate and other technical documents required in the tender.

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

**Head of Section, Standards Development**

**Head of Department, Standards**

Signed:

Signed:

Date: 2019-11-13

Date: 2019-11-13



**TITLE:**  
**11KV AIR INSULATED INDOOR SWITCHGEAR PANELS**

Doc. No.	KP1/6C/4/1/TSP//11/001-4
Issue No.	1
Revision No.	0
Date of Issue	2019-11-13

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 9001:2008;
- 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 A4 paper to be supplied prior to shipment of the switchgear. A soft copy of the drawings done on AutoCAD and editable on AutoCAD release 2000 and later versions to be supplied for commissioning and storage as a backup.

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

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.

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

Head of Section, Standards Development

Signed:

Date: 2019-11-13

Head of Department, Standards

Signed:

Date: 2019-11-13



**TITLE:**  
**11KV AIR INSULATED INDOOR SWITCHGEAR PANELS**

Doc. No.	KPI/6C/4/1/TSP//11/001-4
Issue No.	1
Revision No.	0
Date of Issue	2019-11-13

**APPENDIX D: 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**.....

Description		Bidder's offer	
1.	Manufacturer's Name	State	
2.	Name of the item	State	
3.	Type	State	
	Reference/Model	State	
	Number of item	State	
	Complete Panel	State	
	Circuit breaker	State	
	Voltage Transformer	State	
	Current Transformer	State	
	Relays	State	
4.	Country of manufacture	State	
5.	List switchgear panels to be supplied (for complete board)	Specify	
Clause	Description	Bidders offer*	
	Switchgear Panels covered	State	
	Applicable Standards	Complete Panel	List
		Circuit breaker	List
		Voltage Transformer	List
		Current Transformer	List
		Relays	List
4.1	<b>Service conditions</b>	Specify	
4.2	Construction standards of the panels and components	State	
4.3.1	Understanding that the panels are spares and therefore must be identical to the existing	Specify	
	The circuit breakers (CB) shall be horizontal withdrawable type	Specify	
	Complete switchboard is of flush-front design	Specify	
	Each cubicle shall be divided into separate compartments	Specify	
	Low voltage section shall be separate from the high voltage section	State	

**Head of Section, Standards Development**

**Head of Department, Standards**

Signed:

Signed:

Date: 2019-11-13


Date: 2019-11-13



	Switchgear erection design	Specify	
	Cubicle separate over pressure vent direction	State	
	Cable compartment protection system	State	
	Front cubicle door provided with a window	State	
	Degree of protection of panels	State	
	Bus bars, connections and support current ratings	State	
	Bus bars extensible at both ends with minimum disturbance to existing busbar		
	Switch gear inter Electrical and mechanical interlocks	Specify	
	Door interlocks	Specify	
	Provision for locking busbar and circuit shatters separately	Provide	
	Provision for integral circuit earthing with mechanical interlock	Specify	
	Earthing facilities rated for fault making	Specify	
	All panel wiring completely done and all connections wired up to the terminal block	State	
	MCBs ratings for controlling auxiliary supplies	List	
	Type and final colour of the coating, and standard	State	
	Anti-condensation heater provided	State	
	Operation mode and type of interrupter employed	State	
	Auxiliary switches type	State	
	Interchangeability of CBs	Specify	
	Motor wound spring operated mechanism	Specify	
	Mechanical indication provided	Specify	
	A spare set, of 10 NO and 10 NC auxiliary contacts provided	Specify	
	Control circuits for the CBs connection in the cubicle	Specify	
	CTs accommodated in the cubicle	Specify	
4.3.2	CT Ratings for incomer & Bus coupler and outgoing feeders	Short Time Current with stand (STC)	State
		Maximum Continuous Thermal Rating	State
		Impulse Withstand Voltage	State
		One-Minute Power Frequency Withstand Voltage	State
		CT Burden	State
4.3.3	VT Ratings	Ratio	State
		VA	State
		Class	State
		Impulse Withstand Voltage	State
		One-Minute Power Frequency Withstand Voltage	State
	LV compartment Terminal Block has a test switch (block)	Specify	

**Head of Section, Standards Development**

**Head of Department, Standards**

Signed: 

Signed: 

Date: 2019-11-13

Date: 2019-11-13



Kenya Power

**TITLE:**

**11KV AIR INSULATED INDOOR SWITCHGEAR PANELS**

Doc. No. KPI/6C/4/1/TSP//11/001-4

Issue No. 1

Revision No. 0

Date of Issue 2019-11-13

Page 34 of 37

4.3.4	Relays shall be flush mounted and of Numeric Design as per IEC 60255	Specify	
	Relay contacts maximum making and breaking maximum currents	State	
	Auxiliary Trip relays maximum pick up times	State	
	Relay mechanism not be affected by panel vibration or external magnetic fields	Specify	
	Relays provided with clearly inscribed labels	Specify	
	Relays suitable for operation on D.C supply without use of dropping resistors or diodes.	Specify	
	How to reduce the electrolysis effect on relays	Specify	
	Max. fault current not	State	
	Applicable standards	State	
	Mounting of indicating instruments and the standards complying to	Specify	
4.3.5	Indications in Each cubicle	i. Inscription on the mechanical ON/OFF indicator	Specify
		ii. Inscription on the indicating lamp	Specify
		iii. State of the spring inscription details	Specify
		iv. Breaker closed position indicator and colour	State
		v. Breaker closed position indicator and colour	State
4.3.6	Power cable termination design	Specify	
4.3.7	Other Cubicles requirements	List	
4.3.8	11kV Feeder Panels Protection Relays, Indicating and Control Accessories requirements	List	
	11kV Transformer Incomer Panels Protection Relays, Indicating and Control Accessories requirements	List	
	Arc flash protection system	Specify	
	Design and operation ( optical fibre sensor, arc protection relay and single sensors)	Specify	
	Maximum arc fault clearing time	specify	
<b>4.4</b>	<b>11KV Switch gear board requirements</b>		
4.4.1	<b>Incomer Switchgear Panel</b>		
	Panel and Switchgear voltage rating	State	
	Rated power frequency withstand voltage, rms	State	
	Rated lightning impulse withstand voltage, peak	State	
	Rated short-time withstand current	State	
	Rated peak withstand current	State	
	Internal Arc Classification (IAC) in accordance to IEC 62271-200	State	
	11kV panel type	Specify	
	Circuit breaker type (Vacuum) withdrawable	Specify	

Head of Section, Standards Development

Head of Department, Standards

Signed:

Signed:

Date: 2019-11-13

Date: 2019-11-13



**TITLE:**  
**11KV AIR INSULATED INDOOR SWITCHGEAR PANELS**

Doc. No.	KPI/6C/4/1/TSP//11/001-4
Issue No.	1
Revision No.	0
Date of Issue	2019-11-13

	Circuit breaker quenching medium	Specify
	Incomer CT rating	Specify
	Incomer CT cores	Specify
	Incomer CT classes	Specify
	Board control voltage	Specify
	Spring charging motor voltage	Specify
	Heating and illumination voltage	Specify
	Protection relay model	Specify
	Arc flash protection system design and components	Specify
	Incomer VT rating	Specify
	Panel dimensions and height	Specify
	Incomer and Bus coupler Circuit breaker rating	State
	Colour shade	State
	Main bus bar rating	State
	Bus bar material (copper)	State
	Color shade	specify
	Protection degree	State
	<b>Feeder Switchgear Panel</b>	
	Panel and Switchgear voltage rating	State
	Rated power frequency withstand voltage, rms	State
	Rated lightning impulse withstand voltage, peak	State
	Rated short-time withstand current	State
	Rated peak withstand current	State
	Internal Arc Classification (IAC) in accordance to IEC 62271-200	Specify
	11kV panel type	Specify
	Circuit breaker type	Specify
	Circuit breaker quenching medium	Specify
4.4.2	Board control voltage	State
	Spring charging motor voltage	State
	Heating and illumination voltage	State
	Feeder CT rating	Specify
	Feeder CT cores	Specify
	Feeder CT classes	Specify
	Protection relay model	State
	Arc protection system design and components	Specify
	Arc protection system maximum operating time	Specify
	Panel dimensions	Specify
	Feeder ring core CT rating and diameter	Specify

Head of Section, Standards Development

Head of Department, Standards

Signed:

Signed:

Date: 2019-11-13

Date: 2019-11-13



**TITLE:**  
**11KV AIR INSULATED INDOOR SWITCHGEAR PANELS**

Doc. No.	KPI/6C/4/1/TSP//11/001-4
Issue No.	1
Revision No.	0
Date of Issue	2019-11-13

	Feeder Circuit breaker rating	Specify
	Main bus bar rating	State
	Bus bar material	specify
	Joints and terminal points plating material	Specify
	Protection degree	State
5.1	Packing to protect from damage during transport, handling and storage	Specify
5.3	Marking on the equipment and standard accessories	Specify
A1	The switchgear and control panels inspection and testing standard	State
A2	The CBs inspection and testing standard	State
A3	Relays inspection and testing standard	State
A4	The CTs and VTs inspection and testing standards	State
A5	List of Factory Acceptance Tests to be witnessed by Kenya Power Engineers at the factory	List
A6	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
A7	Upon inspection and testing, defective equipment shall be replaced by the manufacturer with no charge to Kenya Power	Specify
B1	QAP and ISO 9001:2008/2015	State
B2	Copies of quality management certifications attached	State
B3	Delivery time, Production capacity and experience of the manufacturer	State
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. Copies of type test certificates and type test reports by a third-party testing laboratory accredited to ISO/IEC 17025	State
	f. Copy of accreditation certificate to ISO/IEC 17025 for the testing laboratory	State
	g. Manufacturer's warranty and guarantee	State
	h. Manufacturer's letter of authorization, copy of the manufacturer's ISO 9001:2008/2015 certificate	State

**Head of Section, Standards Development**

**Head of Department, Standards**

Signed:

Signed:

Date: 2019-11-13

Date: 2019-11-13



Kenya Power

**TITLE:**  
**11KV AIR INSULATED INDOOR SWITCHGEAR PANELS**

Doc. No.	KPI/6C/4/1/TSP//11/001-4
Issue No.	1
Revision No.	0
Date of Issue	2019-11-13

Page 37 of 37

C2	To be submitted for approval before manufacture	
	a. Fully Filled Clause by clause GTPs ( <b>not the ones submitted with the tender</b> )	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	
C3	Documents to be submitted before shipment	State
C4	Manuals to be provided with the switchgear and control panels	List
C5	Software to be provided	List

**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 labeled 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**

**Head of Section, Standards Development**

Signed:

Date: 2019-11-13

**Head of Department, Standards**

Signed:

Date: 2019-11-13

