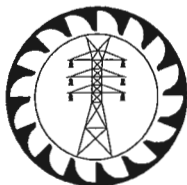


025: 2016

CEB  
SPECIFICATION

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**12KV AIR INSULATED SWITCHGEAR  
PANELS**



**CEYLON ELECTRICITY BOARD  
SRI LANKA**



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## SPECIFICATION FOR 12KV AIR INSULATED SWITCHGEAR PANELS

### 1.0 SCOPE

This specification covers the general requirements of the design, manufacture, testing, supply and delivery of 12kV Metal Clad Air Insulated Switchgear Panels with necessary measuring, control & protection equipment.

### 2.0 SYSTEM PARAMETERS

|     |                             |                     |
|-----|-----------------------------|---------------------|
| (a) | Nominal voltage (U)         | 11 kV               |
| (b) | System highest voltage (Um) | 12 kV               |
| (c) | System frequency            | 50 Hz               |
| (d) | Number of phases            | 3                   |
| (e) | Method of earthing          | Effectively earthed |
| (f) | System fault level          | 20 kA               |
| (g) | Fault duration              | 3s                  |

### 3.0 SERVICE CONDITIONS

|     |                                    |   |
|-----|------------------------------------|---|
| (a) | Annual average ambient temperature | 30 °C   |
| (b) | Maximum ambient temperature        | 40 °C   |
| (c) | Maximum relative humidity          | 90%   |
| (d) | Environmental conditions           | Humid tropical climate with heavily polluted atmosphere |
| (e) | Operational altitude               | From M.S.L. to 1500 m above M.S.L.                      |
| (f) | Isokeruanic (Thunder days) level   | 100 days  |

### 4.0 APPLICABLE STANDARDS

The equipment and components supplied shall be in accordance with the latest editions of the standards specified below and amendments thereof.

|     |                      |   |
|-----|----------------------|---|
| (a) | IEC 62271-200:2011   | A.C. Metal-enclosed switchgear and control gear for rated voltages above 1 kV and up to 52kV  |
| (b) | IEC 62271-100:2008   | High voltage alternating current circuit breakers   |
| (c) | IEC 62271-102:2001   | A.C. disconnectors and earthing switches  |
| (d) | IEC 60044-1:1986     | Current transformer   |
| (e) | IEC 60044-2:1980     | Voltage transformer   |
| (f) | IEC 60255:1996       | Electrical Relays   |
| (g) | IEC 60529:1989       | Degrees of protection provided by enclosures  |
| (h) | BS 159:1992          | Busbars and Busbar connections  |
| (i) | BS 5493:1977         | Code of practice for protective coating of Iron and Steel structures against corrosion        |
| (j) | IEC 60243-1:2013     | Electric strength of insulating materials - Test methods - Part 1: Tests at power frequencies |
| (k) | IEC 61850            | Communication networks and systems in substation  |
| (l) | IEC 60870-5-104:2006 | Network access for IEC 60870-5-101  |
| (m) | IEC 60870-5-103:1997 | Companion standards for the informative interface of protection system                        |
| (n) | IEC 60870-5-101:2003 | Companion standard for basic telecontrol tasks  |
| (o) | IEC 60455-2:2015     | Resin based reactive compounds used for electrical insulation - Part 2: Methods of test       |
| (p) | IEC 60455-2-2:1984   | Specification for solventless polymerisable resinous  |



|     |                |  |
|-----|----------------|--|
|     |                | compounds used for electrical insulation - Part 2-2: Methods of test - Test methods for coating powders for electrical purposes. |
| (q) | IEC 61036:1996 | Alternating Current Static Watt-Hour Meters for Active Energy (Classes 1 and 2)  |

## 5.0 BASIC FEATURES

### 5.1 Technical Requirements

|     |  |                        |
|-----|--|------------------------|
| (a) | Rated Voltage  | 12 kV                  |
| (b) | Rated continuous current                             | 630 / 800 A            |
| (c) | Frequency  | 50 Hz                  |
| (d) | Number of phases                                     | Three                  |
| (e) | Rated insulation levels                              |                        |
|     | i) Impulse (1.2/50 $\mu$ s) withstand voltage (peak) | 75 kV                  |
|     | ii) Power frequency withstand voltage (rms)          | 28 kV                  |
| (f) | Rated short time current / duration                  | 20 kA / three (3) Sec. |
| (g) | Degree of protection (as per IEC 529)                | IP43                   |
| (h) | Temperature rise                                     | As per IEC 62271       |

### 5.2 Design

The 12 kV switchgear panels shall be of metal clad air insulated and extensible type suitable for indoor application. Primary circuit (12 kV bus bars) shall be covered with epoxy insulating material.

Female terminals in the breaker should be insulated with epoxy insulating material and provision should be made for test probes to be inserted without short circuiting the phases.

The breaker shall be of vacuum circuit breaker with the facility to replace the vacuum interrupter. All 12 kV live parts shall be covered with epoxy resin insulating material.

### 5.3 Equipment and Materials

#### 5.3.1 Circuit Breakers

- The circuit breakers shall be of standard design and construction conforming to IEC 62271-100. The interrupting medium of the circuit breaker shall be vacuum.
- The control mechanism of the circuit breakers shall be of spring assisted trip free type with remote / local control selector switch and manual operation facility.
- Electrical and manual spring charging shall be possible with manual & electrical close / open of the circuit breaker.
- The circuit breaker shall have a mechanical counter to register the number of circuit breaker trippings due to operation of protective relay.
- Characteristics of the Circuit Breakers shall be as follows;

|     |   |             |
|-----|---|-------------|
| (a) | Number of poles   | 3           |
| (b) | Type  | Indoor      |
| (c) | Rated voltage   | 12 kV       |
| (d) | Frequency   | 50 Hz       |
| (e) | Rated insulation levels                                 |             |
|     | i) Impulse (1.2/50 $\mu$ s) withstand voltage (peak)    | 75 kV       |
|     | ii) Power frequency withstand voltage (rms)/1min        | 28 kV       |
| (f) | Rated normal current (as per in the schedule of prices) | 630 / 800 A |
| (g) | Rated short circuit breaking current (rms)              | 20 kA       |
| (h) | Rated short circuit making current (rms)                | 50 kA       |

|     |                                  |                                       |
|-----|----------------------------------|---------------------------------------|
| (i) | First pole to clear factor       | 1.5                                   |
| (j) | Duty cycle                       | 'O' – 0.3 min. – 'CO' – 3 min. – 'CO' |
| (k) | Tripping supply voltage          | 24 VDC                                |
| (l) | Electrical spring charging motor | 24 VDC                                |

### 5.3.2 Busbars

- i) The primary circuit shall be of single busbar type and the busbar shall be made of electrical grade high conductivity, hard drawn copper capable of carrying continuously a current of 630 / 800A (as per the requirement indicated in the price schedule) without exceeding the maximum temperature rise specified in the relevant standard.
- ii) All 12 kV live parts and interconnection between panels (busbars) shall be covered with epoxy resin insulating material.
- iii) Material used for epoxy insulation should be of good quality. Epoxy material as well as epoxy components such as busbar supports, insulators etc. should be subjected to testing for mechanical, thermal and electrical properties such as tensile and compressive strengths, glass transition temperature and proof tracking index as per IEC 60455-2 & 60455-2-2. Reports of tests carried out to this effect should be annexed to the offer.

### 5.3.3 Current Transformers

- i) Current transformers shall conform to IEC 60044/1 and comply with the following.

|     |                       | Measuring   | Metering     | Protection   |
|-----|-----------------------|---|--------------|--------------|
| (a) | Class                 | 3.0   | 0.2          | 5 P          |
| (b) | Burden                | To match the measuring, metering and protection equipment |              |              |
| (c) | Accuracy limit factor | -   | -            | 20           |
| (d) | Frequency             | 50 Hz   | 50 Hz        | 50 Hz        |
| (e) | C.T. ratios           | As specified  | As specified | As specified |

- ii) Magnetizing curves and the secondary resistance shall be provided for each type and rating of current transformer. Also all technical details, routine test reports of CT's shall be furnished with the offer.
- iii) Type test certificates conforming to IEC 60044/1 shall be furnished with the offer.

### 5.3.4 Voltage Transformers

- i) Voltage transformers shall be of cast epoxy resin insulated type complying with IEC 60044/2, HRC type fuses or MCBs shall be provided for protection of secondary windings.
- ii) Primary fuses of three phase set of voltage transformers shall preferably be withdrawal type for easy removal.
- iii) The characteristics of the voltage transformer for metering and measuring shall be as follows;

|     |  |                                      |
|-----|--|--------------------------------------|
| (a) | Class  | 0.2 for metering & 1.0 for measuring |
| (b) | Rated voltage  | 12 kV                                |
| (c) | Rated insulation levels                              |                                      |
|     | i) Impulse (1.2/50 $\mu$ s) withstand voltage (peak) | 75 kV                                |
|     | ii) Power frequency withstand voltage (rms)/1min     | 28 kV                                |
| (d) | Rated voltage factor                                 | 1.2                                  |
| (e) | Burden   | 50 VA                                |
| (f) | Frequency  | 50 Hz                                |
| (g) | Transformer ratio                                    | 11 kV / 110 V                        |
| (h) | No. of phases  | 3                                    |



### 5.3.5 Energy Metering Instruments

- i) The Programmable poly phase metering equipment shall comply with the CEB standard 071:1998 and CEB R1 standard 071-1:2006 except for the method of mounting and accuracy class.
- ii) Meter equipment shall be of flush mounting type and accuracy class 0.5.
- iii) The meters shall be calibrated by the supplier taking into consideration the errors of current and voltage transformers tested separately and test results identifying meter serial number and the panel serial number shall be dispatched with panels.
- iv) Volt free switching contact pulse output shall be available to send the energy measurements to SCADA system.
- v) RS232 bus interface shall be available additionally for remote meter reading facility.
- vi) 24V output shall be available to send measurements through RS485 bus interface for communication with MODBUS protocol. The manufacturer/supplier shall provide all details and parameter setting including inter-operability table under above protocol.
- vii) Necessary software package, software keys and a hand held programming unit shall be supplied with the metering panels to be re-programmed by the user.
- viii) The make of the programmable meter shall be subject to the approval of CEB.
- ix) Energy meters shall be readable without opening any front covers/doors of the panel and shall be of tamperproof sealable type.
- x) The scroll down sequence of the energy meter will be given by CEB and it shall be adopted in the energy meter.
- xi) The meters shall have the facilities to store the minimum of four months data and to display the necessary data when required; Monthly kWh consumption, Cumulative kWh Consumption at Resets and Reset Count.

### 5.3.6 Cable Terminations

- i) Terminals shall be suitable for heat shrinkable type with provision for earthing the armour up to 240 mm<sup>2</sup>, 12 kV, Wire Armoured cables.
- ii) In case of radial panels the termination should be suitable for 400mm<sup>2</sup> / 1C cables.
- iii) Facilities for cable testing and cable fault locating shall also be provided at the termination.

### 5.3.7 Protection

- i) Basic features of Numerical Relays

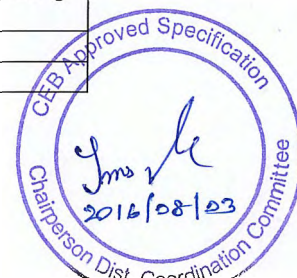
|     | Description        | Requirement    |
|-----|--------------------|----------------|
| (a) | Auxiliary Supply   | 24V DC +/- 10% |
| (b) | Rated VT Secondary | 110 V (L-L)    |
| (c) | CT inputs          | 4 Nos          |
| (d) | VT inputs          | 3 Nos          |

- ii) Settings

Approximate settings possible shall be as follows.

- a) Inverse Time Phase Over Current & Earth Fault

|     |                 |  |
|-----|-----------------|--|
| (a) | IEC Curve       | Normal Inverse, Very Inverse, Extreme Inverse, Long Inverse (Selectable) |
| (b) | Pickup          | 10% to 200% in 1% steps  |
| (c) | Time Multiplier | 0.05 to 3.00 in 0.01 steps   |



## b) Definite Time Phase Over Current/Earth Fault 1 &amp; 2

|     |            |                             |
|-----|------------|-----------------------------|
| (a) | Pickup     | 50% to 2000% in 1% steps    |
| (b) | Time Delay | 0 s to 20 s in 0.01 s steps |

- iii) Minimum 3 Nos. Binary inputs and 3 Nos. Binary outputs shall be provided as spares other than the Binary input/output which are already used in the control and indication circuit.

## Memory and Recording Features:

- a) Relay should have event log, trip log and Oscillographic disturbance record (DR). All logs should go into history. All tripping of relay should initiate DR without extra binary input. Triggering of DR with binary input should be user configurable.
- b) The fault should be date and time stamped.
- iv) The relays used shall only be from the following manufactures of the countries indicated.
- ABB Relays AB, Sweden/Switzerland/Germany
  - Alstom France/ England
  - Toshiba Corporation, Japan
  - Siemens AG, Germany
  - Group Schneider, England/France/Italy
  - Schweitzer Engineering Laboratories, Inc. (SEL), USA
  - General Electric, USA
- v) The numerical relay unit shall be suitable for use in the tropical climatic as given under the clause 3.0 service conditions.
- vi) Conformal Coating should be provided to protect printed circuits boards from the contaminants in the environment, moisture and dust. Bidder should submit the detail and documents to prove the standards and the specifications of materials used for conformal coating with their offer.
- vii) It shall be possible to select required type of IDMT characteristics for over current and earth fault protection. Relay should contain at least two relay protection groups and the remote and manual changing of the relay protection group.
- viii) The numerical relay unit shall have RS485 interface to communicate with the RTU via IEC 60870-5-103 protocol (or Ethernet Interface to communicate through TCP/IP with RTU via IEC 61850). All the addresses and other information for each parameter shall be provided by the supplier with regards to data communication with the relay.
- ix) Trip output of the relay should not be latched type.
- x) The relay should have facility to monitor the healthiness of its circuits and components by own watchdog monitoring system.
- xi) All the numerical type protective relays shall be able to program / parameterized directly (locally) by a portable computer (PC). A portable computer shall be given with the entire relay operating, configuring and testing software installed in it. All other accessories equipment needed to communicate with the relays shall be provided.
- xii) The portable computer should be rugged in construction and brand/model, clock speed, memory, HDD capacity, ROM Drive, modem, network card, and operating system shall be approved by the Engineer/Project Manager and shall be best available in the market at the time of delivery.
- xiii) Relays shall be able to be synchronized with an external GPS Clock.
- xiv) Relay contacts shall be suitable for making and breaking the maximum currents which they may be required to control in normal service but where contacts of the protective relays are unable to deal directly with the tripping currents, approved auxiliary contacts, relays or auxiliary



switches shall be provided. In such cases the number of auxiliary contacts or tripping relays operating in tandem shall be kept to the minimum in order to achieve fast fault clearance times. Separate contacts shall be provided for alarm and tripping functions.

- xv) Relays shall be provided with clearly inscribed labels describing their application, version, type, serial number and rating etc. in addition to the general purpose labels. To minimize the effect of electrolysis, relay coils operating on DC shall be so connected that the coils are not continuously energized from the positive pole of the battery. Relay shall be suitable for operation on DC systems as specified in Technical Particulars and Guarantees, without the use of voltage dropping resistors. Terminal arrangements shall be to the engineer's approval.
- xvi) All protection relays shall be equipped with dedicated DC supply via MCB. The DC supply of all the protection relays shall be maintained by means of an auxiliary contact of the related MCB, which provide an alarm in case of loss of supply. Any interruption of the DC supply to relays (internal and external) shall initiate an alarm. The type and rating of above MCBs shall be acceptable to CEB.
- xvii) Converters and inverters used for feeding relays shall have their outputs monitored and shall initiate an alarm in the event they fail. These devices shall be of short circuit proof design. All relays shall be adequately protected against damage from incoming surge and shall meet relevant IEC standards.
- xviii) Following shall be configured and engineered in relay to send the signals using the IEC 60870-5-103 protocol via RS485 to acquire/receive relevant information to/from RTU of the SCADA system. (or IEC 61850 protocol via TCP/IP Ethernet Port)

|     |                                |  |
|-----|--------------------------------|--|
| (a) | Alarms / Signals / Indications | <ul style="list-style-type: none"> <li>• Over Current IDMT</li> <li>• Over Current Definite Time (Instantaneous)</li> <li>• Earth Fault IDMT</li> <li>• Earth Fault Definite Time (Instantaneous)</li> <li>• Relay Group Indication 1</li> <li>• Relay Group Indication 2</li> <li>• Circuit Breaker Spring Charge Failure</li> <li>• Protection Relay Watch Dog (Protection relay fail)</li> <li>• Trip circuit supervision</li> <li>• Circuit breaker status indicators</li> <li>• Earth switch status indicators</li> </ul> |
| (b) | Measurement                    | <ul style="list-style-type: none"> <li>• Current Measurement</li> <li>• Voltage Measurement</li> </ul>   |
| (c) | Controls                       | <ul style="list-style-type: none"> <li>• Relay Group Setting Change to 1</li> <li>• Relay Group Setting Change to 2</li> <li>• Circuit breaker control</li> </ul>  |

- xix) Protection Scheme for Relay

|     | ANSI Code | Protection Function                 | Feeder Type         |                           |             |
|-----|-----------|-------------------------------------|---------------------|---------------------------|-------------|
|     |           |                                     | Incoming & Outgoing | Transformer & HT metering | Bus Section |
| (a) | 51        | IDMT Over Current                   | X                   | X                         | X           |
| (b) | 51N       | IDMT Earth Fault                    | X                   | X                         | X           |
| (c) | 50        | Definite Time Over Current 1        | X                   | X                         | X           |
| (d) | 50N       | Definite Time Earth Current 1       | X                   | X                         | X           |
| (e) | 50        | Definite Time Over Current 2        | X                   | X                         | X           |
| (f) | 50N       | Definite Time Earth Current 2       | X                   | X                         | X           |
| (g) | 59/27     | Over/Under Voltage                  | X                   |                           |             |
| (h) | 50BF      | Breaker Failure                     | X                   | X                         | X           |
| (i) |           | Number of protection setting groups | 2                   | 2                         | 2           |



|     |      |                                     |   |   |   |
|-----|------|-------------------------------------|---|---|---|
| (j) |      | Self-supervision of the relay       | X | X | X |
| (k) | 74TC | Trip circuit Supervision            | X | X | X |
|     |      | <b>Additional Functions</b>         |   |   |   |
| (l) |      | Oscillographic fault records        | X | X | X |
| (m) |      | Event logging / fault logging       | X | X | X |
| (n) |      | Relay alarm / Trip Indication Reset | X | X | X |
|     |      | <b>Measurements</b>                 |   |   |   |
| (o) |      | Voltage, Current                    | X | X | X |
| (p) |      | Zero sequence current measurement   | X | X | X |

### 5.3.8 Earthing

- i) The copper earthing conductor shall be provided along the entire length of the panel. The cross sectional area of the earthing conductor shall not be less than 150 mm<sup>2</sup> and the current density shall not exceed 200 A/mm<sup>2</sup> under the specified earth fault conditions.
- ii) Inter-panel Copper links shall be provided to facilitate the continuation of earthing conductor, when panels are to be connected together.
- iii) Integral earthing should be provided. It shall be possible to earth the cable with facility for padlocking and mechanical interlocking shall be provided to prevent earthing the busbar.
- iv) All metallic parts of the functional units intended to be earthed shall be bonded to the earthing conductor of the panel.

### 5.3.9 Auxiliary Circuits

- i) Two auxiliary contacts should be available to give out a double point signal to indicate the Local / Supervisory status of the panel.
- ii) Sufficient additional auxiliary contacts shall be provided to accommodate SCADA facility.
- iii) Control and auxiliary devices shall be segregated by earthed metallic partitions from the main circuit.
- iv) Terminal and other auxiliary apparatus requiring attention while the equipment is in service, shall be accessible without exposing to high voltage conductors.
- v) Auxiliary switches and auxiliary circuits shall be capable of carrying a current of at least 10A at 24 VDC continuously.
- vi) PVC insulated flexible copper wire shall be used for control wiring. For the purpose of identification, the control wiring shall be provided with numbered tags to distinguish the different circuits.
- vii) DC supply to relays, meters and control circuits shall monitor and DC failure alarm shall be available for future SCADA use.

### 5.3.10 Construction of panels

The panels shall be of free standing type with bottom cable entry facility for all cables up to three core 240mm<sup>2</sup>. Radial panels in addition, have bottom entry facility for 400mm<sup>2</sup> single core cables. All steelwork shall be constructed of steel sheets with a minimum thickness of 2mm. They shall be completed with all necessary terminal plates, cable glands for cable entry, wiring trunkings for small wiring and multi core cables. Cable glands shall be of Brass and shall fit for cables from 70mm<sup>2</sup> to 240mm<sup>2</sup>. Wiring trunkings shall be adequate sizes for accommodating incoming and outgoing cables for present and future requirements.



The length of panels should not exceed 2000mm for any type of panel.

Indoor cubicles and panels shall be of at least IP 43 protection class. Anti-condensation heaters, controlled by thermostats shall be provided at the breaker compartment and the cable compartment of each panel.

Doors shall be of 2mm thick sheet steel, equipped with 1200 concealed hinges, with foamed-in seal. Each door shall be fitted with suitable earth straps of at least 16mm<sup>2</sup> highly flexible stranded copper wire with insulation in green-yellow colour.

External effects of internal arc shall be limited by a suitable design to prevent any danger to an operator during the time he performs his normal duties. Test evidence in accordance with IEC 60298 to verify the design is required.

Side plates for panels shall be provided equivalent to 50% of the panels ordered, at the rate of one side plate for a panel. Provision for nomenclature plate should be fixed in front of the panel. This plate should be removable type and made for easy marking.

For each panel a separate cable connection compartment and a low voltage compartment shall be provided. The switchboard panel shall be suitable for mounting on a concrete floor or plinth and necessary foundation fixing bolts and rails shall also be provided. The depth of the panel shall be not more than 1250mm.

The bidder shall provide connection diagrams for the termination of all incoming cabling.

#### 5.3.11 Panel wiring

- i) Labelling shall be provided with each panel and each circuit. Cabling from CTs shall terminate at the panel on isolating links of the "shorting disconnecting type". Shorting Links shall also be provided.
- ii) The general arrangement of all indicating devices, control switches and relays etc. and single line diagram & schematic diagrams of control & protection schemes shall be to the approval of CEB.
- iii) Both ends of every wire core and all secondary panel wiring shall be fitted with numbered slip-on ferrules of moisture and oil-resisting insulation material having a glossy finish, and with their identification numbers clearly engraved, each being the same as for the relevant terminal.
- iv) Ferrules, of white colour with black letters, shall be fitted in such a way that they cannot become detached when the wire is removed from the terminal (i.e. end crimps shall be provided).
- v) Terminal blocks shall be numbered consequently in both sides, preferably beginning with 1, from left to right or top to bottom. Terminal blocks shall have 20% spare terminals of each type. Spare cores shall also be numbered.

#### 5.3.12 SCADA Provision

The following shall be provided by the supplier for the completion of the SCADA System which will be provided by another party.

- i) All necessary equipment and material including auxiliary relays, cables, cable containment, wiring terminal blocks, test switches, isolation devices and labeling.
- ii) All the wiring and terminations from protective relays, auxiliary contacts and energy meters to the relevant destinations detailed in the "Input Output Schedule for the SCADA system".
- iii) Sufficient digital inputs and outputs in the numerical protection relays and auxiliary contacts must be available to initiate / process the following in the "Input output Schedule for the SCADA system".



- Double Command (DC) via auxiliary contacts

Two auxiliary contacts with one normally on state and other in normally off state are wired up to for two independent volt free contacts which will create the operation upon the double command information received through RTU of the SCADA.

- Single Command (SC) through relays

Relay is configured to receive single point information through IEC 60870 via RS485 from RTU of the SCADA system and to carry out the necessary operations.

- Single Point (SP) through relays

Single signal of normally on state is configured by the protection relay as binary input and send through IEC 60870-5-103 via RS485 or IEC 61850 to the RTU of the SCADA system.

- Single Point (SP) via Auxiliary contact

Single signal is taken from an independent volt free contact in normally on state and wired to an auxiliary contact on the circuit breaker panel which shall send the signal to the RTU of the SCADA system.

- Double Point (DP) via Auxiliary contact

Two signals are taken from two independent volt free contacts with one in normally on state and other in normally off state. They shall be wired up to two adjacent auxiliary contacts on the terminal block which shall send the each signal to the RTU of the SCADA system.

- Double Values (DV) Measurement

Protection relays in clause 5.3.7 shall be configured and engineered to provide Current, Voltage measurement values to a RTU the SCADA system through IEC 60870-5-103 via RS485.

- Energy Measurement

Energy meters in clause 5.3.5 should be wired to auxiliary contact at terminal block configured to provide a switching contact accordance with the energy (kWh) to RTU as a counter to the SCADA to calculate energy.

iv) Input Output Schedule for the SCADA system.

|              | SCADA Provision                    | Signal Type | Taken from or Sent to | Feeder Type   |          |             |            |         |
|--------------|------------------------------------|-------------|-----------------------|---------------|----------|-------------|------------|---------|
|              |                                    |             |                       | Ring & Radial | Outgoing | Transformer | HT Metered | Bus bar |
| Measurements | Voltage                            | DV          | Relay                 |               | X        |             | X          | X       |
|              | Current                            | DV          | Relay                 | X             | X        | X           | X          | X       |
|              | Energy                             | Switching   | Energy Meter          |               |          |             | X          |         |
| Controls     | Circuit Breaker Open / Close       | DC          | 2xAuxC                | X             | X        | X           | X          | X       |
|              | Relay Protection Group Change to 1 | SC          | Relay                 | X             | X        | X           | X          | X       |
|              | Relay Protection Group Change to 2 | SC          | Relay                 | X             | X        | X           | X          | X       |

|                          |  |    |            |   |   |   |   |   |
|--------------------------|--|----|------------|---|---|---|---|---|
| Status indications       | Circuit Breaker Open / Close                                       | DP | 2xAuxC     | X | X | X | X | X |
|                          | Rack in / Rack out Position  | DP | 2xAuxC     | X | X | X | X | X |
|                          | Earth position Open / Close  | DP | 2xAuxC     | X | X | X | X | X |
|                          | Panel Control Local / Supervisory                                  | DP | 2xAuxC     | X | X | X | X | X |
|                          | Relay Protection Setting Group Position 1                          | SP | Relay      | X | X | X | X | X |
|                          | Relay Protection Setting Group Position 2                          | SP | Relay      | X | X | X | X | X |
| Alarm / Trip Indications | Over Current Operated IDMT   | SP | Relay      | X | X | X | X | X |
|                          | Earth Fault Operated IDMT  | SP | Relay      | X | X | X | X | X |
|                          | Over Current Operated Definite Time (1 & 2)                        | SP | Relay      | X | X | X | X | X |
|                          | Earth Fault Operated Definite Time (1 & 2)                         | SP | Relay      | X | X | X | X | X |
|                          | Relay Faulty   | SP | Relay      | X | X | X | X | X |
|                          | Trip Circuit Fail  | SP | Relay      | X | X | X | X | X |
|                          | Circuit Breaker Spring Charge Fail                                 | SP | Relay      | X | X | X | X | X |
|                          | 11kV Panels Auxiliary DC MCB Trip / Off                            | SP | MCB 1xAuxC | X | X | X | X | X |
|                          | 11kV Panels Auxiliary DC MCB Trip / Off Group alarm for all panels | SP | MCB 1xAuxC | X | X | X | X | X |

### 5.3.13 Finish

The outer surface of the switchgear panel shall have light gray (RAL 7035) colour powder coating finish suitable for indoor application. The thickness of powder coating shall not be less than 50µm.

## 5.4 Types of Switchgear Panels

### 5.4.1 Radial Feeder Panels

Radial and ring feeder panels rated 630A and 800A shall be equipped with the following.

|     |        |  | 630A Panels | 800 A Panels |
|-----|--------|--|-------------|--------------|
| (a) | 1 No.  | Busbar Rating  | 630 A       | 800 A        |
| (b) | 1 No.  | Circuit Breaker – Normal operating current                                       | 630 A       | 800 A        |
| (c) | 3 Nos. | Current Transformer ratio for over current, earth fault protection & measurement | 600 / 1     | 800 / 1      |

|     |        |  |               |               |
|-----|--------|--|---------------|---------------|
| (d) | 1 No.  | Ammeter with selector switch with scale range  | 0 - 600 A     | 0- 800 A      |
| (e) | 1 No.  | Three phase 12 kV Voltage Transformer ratio for Voltage & Energy Measurement               | 11 kV / 110 V | 11 kV / 110 V |
| (f) | 1 No.  | Voltmeter with selector switch   |               |               |
| (g) | 1 No.  | Integral numerical relay for measuring, protection and control purposes                    |               |               |
| (h) | 3 Nos. | Live cable indication  |               |               |
| (i) | 2 Nos. | Anti-condensation heaters & thermostats (Temperature adjustable range from 25 °C to 40 °C) |               |               |

#### 5.4.2 Ring Feeder Panels

Radial and ring feeder panels rated 630A and 800A shall be equipped with the following.

|     |        |  | 630A Panels | 800 A Panels |
|-----|--------|--|-------------|--------------|
| (a) | 1 No.  | Busbar Rating  | 630 A       | 800 A        |
| (b) | 1 No.  | Circuit Breaker – Normal operating current   | 630 A       | 800 A        |
| (c) | 3 Nos. | Current Transformer ratio for over current, earth fault protection & measurement           | 600 / 1     | 800 / 1      |
| (d) | 1 No.  | Ammeter with selector switch with scale range  | 0 - 600 A   | 0- 800 A     |
| (e) | 1 No.  | Integral numerical relay for measuring, protection and control purposes                    |             |              |
| (f) | 3 Nos. | Live cable indication  |             |              |
| (g) | 2 Nos. | Anti-condensation heaters & thermostats (Temperature adjustable range from 25 °C to 40 °C) |             |              |

#### 5.4.3 Outgoing Feeder / Transformer Control Panels

Outgoing feeder panels and the transformer panels rated 630 A / 800 A shall be equipped with the following.

|     |        |   | 630A Panels   | 800 A Panels  |
|-----|--------|---|---------------|---------------|
| (a) | 1 No.  | Busbar Rating   | 630 A         | 800 A         |
| (b) | 1 No.  | Circuit Breaker – Normal operating current  | 630 A         | 800 A         |
| (c) | 3 Nos. | Current Transformer ratio for over current, earth fault protection & measurement  | 300 / 150 / 1 | 300 / 150 / 1 |
| (d) | 1 No.  | Ammeter with selector switch with scale range   | 0 - 300 / 150 | 0 - 300 / 150 |
| (e) | 1 No.  | Integral numerical relay for measuring, protection and control purposes   |               |               |
| (f) | 3 Nos. | Live cable indication   |               |               |
| (g) | 2 Nos. | Anti-condensation heaters & thermostats (Temperature adjustable range from 25 °C to 40 °C)  |               |               |
| (h) | 2 Sets | Auxiliary contacts normally opened and normally closed to be used for new inter tripping connections ( for Transformer Control Panels ) |               |               |



#### 5.4.4 Bus Section Panel

Bus section panel rated 630A / 800A shall be equipped with the following.

|     |        |  | 630A Panels | 800 A Panels |
|-----|--------|--|-------------|--------------|
| (a) | 1 No.  | Busbar Rating  | 630 A       | 800 A        |
| (b) | 1 No.  | Circuit Breaker – Normal operating current   | 630 A       | 800 A        |
| (c) | 3 Nos. | Current Transformer ratio for over current, earth fault protection & measurement           | 600 / 1     | 600 / 1      |
| (d) | 1 No.  | Ammeter with selector switch with scale range  | 0 - 600     | 0 - 800      |
| (e) | 2 Nos. | Anti-condensation heaters & thermostats (Temperature adjustable range from 25 °C to 40 °C) |             |              |

#### 5.4.5 Metering Panel

These metering panels are to be used to meter the power fed to consumers at 11kV and the metering panels shall be equipped with the following.

|     |        |  | 630 A Panel   | 800 A Panel   |
|-----|--------|--|---------------|---------------|
| (a) | 1 No.  | Busbar set of rating   | 630           | 800           |
| (b) | 1 No.  | Circuit Breaker-normal current rating  | 630           | 800           |
| (c) | 3 Nos. | Current Transformers for Over Current and Earth Fault Protection & measurement Ratio                         | 150 – 300 / 1 | 200 – 400 / 1 |
| (d) | 1 No.  | Ammeter with selector switch (Dual scale plates shall be provided)   | 0 – 150 / 300 | 0 – 150 / 300 |
| (e) | 3 Nos. | Current Transformers ratio for Energy Measurement  | 150 – 300 / 1 | 200 – 400 / 1 |
| (f) | 1 No.  | Voltage Transformers three phase 12kV for Voltage & Energy Measurement                                       | 11 kV / 110 V |               |
| (g) | 1 No.  | Voltmeter with selector switch   |               |               |
| (h) | 1 No.  | Integral Numerical relay for measuring, protection and control purposes                                      |               |               |
| (i) | 3 Nos. | Live cable indication  |               |               |
| (j) | 2 Nos. | Anti-condensation Heaters & thermostats ( Temperature adjustable range from 25 °C to 40 °C )                 |               |               |
| (k) | 1 No.  | Programmable Poly Phase Meter As per CEB Standard 071:1998 (Flush mounting type with rear terminal) attached |               |               |

### 6.0 QUALITY ASSURANCE

The manufacturer shall possess ISO 9001:2008 Quality Assurance Certification for the manufacturer of 12kV Metal Enclosed Switchgear Panels for the plant where the offered Switchgear panels are manufactured. The Bidder shall furnish a copy of the ISO Certificate certified as true copy of the original by the Manufacturer, along with the offer.

### 7.0 ADDITIONAL REQUIREMENTS

#### 7.1 Minimum Requirements for Manufacturers and Main Equipment

The bidder shall ensure, that each main equipment (listed below) offered under this contract, is manufactured by a manufacturer with a minimum of fifteen (15) years successful experience in



manufacturing comparable equipment, in rated voltage and capacity, to the equipment offered under the contract. In addition, minimum of ten (10) years experience shall be in manufacturing for orders from outside the country of the manufacturer.

In respect of each main equipment offered under this contract, the bidder shall ensure that equipment identical in design had been in service for a minimum period of five (5) years. In addition minimum of three (3) years service shall be outside the country of the manufacturer.

If the offered equipment is manufactured under license, the manufacturing/service experience of equipment manufactured by the parent company would be counted only if clear documentary evidence is given to prove that the equipment is identical in design to original equipment manufactured by the parent company.

Bidder shall provide adequate evidence of compliance to above requirements to the satisfaction of the CAPC. Bids non-complying with above requirements or with incomplete evidence of compliance would be rejected.

Main equipment list:

- (a) Indoor Switchgear
- (b) Circuit Breakers
- (c) Capacitor Banks
- (d) Current Transformers
- (e) Voltage Transformers
- (f) Disconnecting switches
- (g) Earthing Switches
- (h) Surge Arrestors

## 7.2 Tools

All special tools and accessories required for installation, operation and maintenance of equipment shall be clearly indicated in the offer and shall be supplied with panels.

## 7.3 Spares

The Annex - A indicates the suggested spares for a 10 year trouble free service. However the Bidder shall indicate in the schedule of prices the type of spares and the quantities recommended by the manufacturer for the product they have offered. The prices of spares shall also be indicated.

## 7.4 Name Plates

The Annex - A indicates the suggested spares for a 10 year trouble free service. However the Bidder shall indicate in the schedule of prices the type of spares and the quantities recommended by the manufacturer for the product they have offered. The prices of spares shall also be indicated.

Name Plates shall include the following information.

- a) Manufacturer's name and trademark.
- b) Serial number or type designation.
- c) Applicable rated values
- d) Number and year of the relevant standard.

The name of each functional unit shall be legible during normal service. The removable parts, if any, shall have a separate nameplate with the data relating to the functional unit they belong to, but this nameplate need only be legible when removable part is in the removed position.

## 7.5 Labeling

All equipment, control positions, indicator positions, control/indicator identification, terminals, small wiring of instrumentation and protection of the panel shall be identifiable by clear markings and labeling in English Language with relevant colour code, if any. The labels shall be made out of durable materials and prints permanently edged.



## 7.6 Circuit Labels

All panels shall be provided with a Blank label (white) for Circuit labeling.

## 8.0 INSPECTION AND TESTING

### 8.1 Inspection

The report of routine tests performed on each equipment shall be made available for the observation of the inspector.

### 8.2 Sample / Acceptance Test

The following Sample/Acceptance tests shall be witnessed by the Engineer appointed by the purchaser. Extra copies of these test certificates shall also be furnished with the equipment.

- a) Power frequency voltage test on main circuit.
- b) Dielectric test on auxiliary and control circuits.
- c) Measurement of the resistance of the main circuit.
- d) Partial discharge measurement.
- e) Mechanical operation tests.
- f) Tests on electrical devices.
- g) Verification of correct wiring
- h) All routine tests as per IEC 62271-100 for circuit breakers shall also be carried out.
- i) Functional tests as specified

### 8.3 Type Tests

#### a) Switchgear Panels

Certified copies of the type test carried out in accordance with the IEC62271-200 and as indicated below shall be furnished with the offer.

- i) Lightning Impulse Voltage Tests.
- ii) Power Frequency Tests.
- iii) Partial Discharge Tests
- iv) Dielectric Test on Auxiliary and Control circuits
- v) Temperature-rise tests
- vi) Measurement of resistance of the main circuit.
- vii) Tests on main circuits.
- viii) Tests on main earthing circuits.
- ix) Mechanical operation tests;
  - a) Interlocks.
  - b) Switching device and removable parts.
- x) Verification of degree of protection.
- xii) Measurement of leakage currents.
- xiii) Weatherproofing test
- xiv) Arcing due to internal faults in all HV Compartments.
- xv) Short time and peak withstand current
- xvi) Verification of making and breaking capacities.

#### b) Circuit Breaker

Certified copies of the Certificates of type tests carried out in accordance with the IEC 62271-100 and IEC 60694 indicated below shall be furnished with the offer.

- i) Dielectric test.
- ii) Temperature-rise tests.
- iii) Measurement of the resistance of the main circuit.
- iv) Time - current tests.
- v) Mechanical operation test.





- vi) Making and breaking and short time withstand current tests.
- vii) Duty cycle test (full breaking capacity)

Records and reports of the type tests for making, breaking and short time current performance as per "APPENDIX CC" of IEC 60056 shall be furnished.

#### c) Auxiliary Equipment

Certified copies of the certificates of type tests carried out in accordance with the following standards shall be furnished with the offer.

- i) Current Transformers - IEC 60044-1
- ii) Voltage Transformer - IEC 60044-2
- iii) Programmable polyphase meters - IEC 61036

#### d) Protection Relays

Type test reports for the following tests shall be submitted for the approval of CEB along with Bid.

- i) Dielectric Withstand Test - IEC 60255-5
- ii) High Voltage Impulse Test, Class III - IEC 60255-5  
(5 kV peak, 1.2/50  $\mu$ s; 3 Positive and 3 negative shots at interval of 5 s)
- iii) DC Supply Interruption - IEC 60255-11
- iv) AC Ripple on DC supply - IEC 60255-11
- v) Voltage Dips and Short Interruptions - IEC 61000-4-11
- vi) High Frequency Disturbance - IEC 60255-22-1, Class III
- vii) Fast Transient Disturbance - IEC 60255-22-4, Class IV
- viii) Surge withstand capability - IEEE / ANSI C 37.90.1(1989)

#### e) Accepted test laboratories and institutions

The type test certificates for short and peak withstand current tests, verification and making and breaking capacities/duties cycle tests as indicated in Clause 8.3 (a) (xv) and 8.3 (b) (iv) shall be from one of the following testing authorities who are the members of the European Organization for Testing and Certification for Short Time Current Test and Short Circuit Breaking / Making Tests.

- i) ASTA Certification Services - (ASTA) UK
- ii) Centro Elettrotecnico Sperimentale Italiano S. P. A. - (CESI) Italy
- iii) Ensemble Des Stations D'Essais a" Grande Puissance Francaises (ESEF) – France
- iv) B.V. KEMA - (KEMA) – Netherlands
- v) Gesellschaft for Elektrische Hocheleistungsprufungen - PEHLA- Germany
- vi) Scandinavian Association for Testing of Electrical Power Equipment - (SATS) Scandinavia
- vii) Short Circuit Testing Liaison North America - (STLNA) - North America
- viii) Central Short-Circuit Testing Committee - (STLNA) - North America
- ix) Central Short-Circuit Testing Committee - (JSTC) - Japan
- x) Central Power Research institute (CPRI) India
- xi) KERI – SEOUL, Korea Electrotechnology Research Institute – Republic of Korea

#### 8.4 Routine Tests

The following Routine tests as per IEC 62271-200 and IEC 60694 shall be carried out on each panel and the routine test reports shall be made available for the observation of the CEB Inspector at the time of inspection.

- i) Power-frequency voltage tests on the main circuit
- ii) Dielectric tests on auxiliary and control circuits
- iii) Measurement of the resistance of the main circuit
- iv) Partial discharge measurement
- v) Mechanical operation tests
- vi) Tests of auxiliary electrical, pneumatic and hydraulic devices
- vii) Verification of correct wiring



### 8.5 Test Certificates

The test certificates should clearly identify the equipment concerned, showing the manufacturer's identity, type/model and basic technical parameters. The test certificates referred to shall be issued from a **recognized independent testing authority acceptable to the Purchaser.**

### 9.0 INFORMATION TO BE FURNISHED WITH THE OFFER

The following shall be furnished with the offer.

- a) Catalogues describing the equipment and indicating the model number (in English Language).
- b) Make, rated values and characteristics of all breakers, switches, busbars, fuses, instruments, relays, wiring materials etc.
- c) Mechanical characteristics incorporating overall dimensions, weight, constructional features, operating mechanism of switches and associated equipment/interlocks/access covers and doors.
- d) List of materials, kit and accessories that shall be supplied for each cable termination.
- e) Details of earthing, earth bar, earth conductor/ strap bonding and termination.
- f) Type test certificates as per clause 8.3.
- g) The number of operations (normal and fault conditions) after which vacuum bottle has to be replaced.
- h) ISO 9001:2008 Certification for all components as per Clause 6.0.
- i) Completed schedule of guaranteed technical particulars (Annex B)
- j) A list of power utilities outside the country of manufacture to whom the 12kV panels were sold, indicating the name of the utility, quantities sold and the year of sale during the last five (05) years.
- k) Magnetization curves and the secondary resistance shall be provided for each type and rating of current transformer. Also all technical details, routine test reports of CTs shall be furnished with the offer.

**Offers of bidders who have failed to provide above particulars shall be rejected.**

### 10.0 TECHNICAL LITERATURE AND DRAWINGS

The selected Bidder shall supply along with the equipment five copies of operational/maintenance manuals of Circuit breakers, Relays, switches, CT, VT, energy meters & selector switches etc. for each type of panel ordered including all relevant drawings, technical literature, hand books, wiring diagrams in order to facilitate easy installation, faultless operation and maintenance. Routine test reports shall also be furnished with the equipment.

|     | Description   | Quantity   |
|-----|---|------------|
| (a) | Cable for connection of Relay to Laptop along with converter and power supply if required for relay local setting | 3 Set      |
| (b) | Manual, hard copy in good quality paper properly bounded  | 3 Set      |
| (c) | Copy of Type Test Certificate along with manual   | With offer |
| (d) | Basic application software for setting change, parameterization etc.  | 3 Nos.     |
| (e) | CD with software (licensed) to download disturbance recorder, event logger collection and evaluation of those     | 3 Nos.     |
| (f) | Graphical configuration tool for I/P, O/P and functional building block for protection                            | 3 Nos.     |
| (g) | IEC 60870-5-103 Interoperability tables and mapping details shall be supplied in IEC format                       | 3 Nos.     |
| (h) | Any other software, if required for integration with SCADA  | 3 Nos.     |



## 11.0 ANNEX

- Annex - A - Schedule of Spares
- Annex - B - Schedule of Guaranteed Technical Particulars - To be filled by the Bidder.
- Annex - C - Non Compliance Schedule



## SCHEDULE OF SPARES

(To be filled and submit with the bid)

The approximate requirement of spares suggested by the purchaser is indicated below.  
The total price of the spares also shall be indicated in the schedule of prices.

|  |  | Qty (Specified by the Procurement Entity) | Unit FOB | Total FOB |
|--|--|---|----------|-----------|
|  | Current Transformers of each rating (Single-phase units)     |   |          |           |
|  | i) .....<br>(pl. specify ratio)                              |   |          |           |
|  | ii) .....<br>(pl. specify ratio)                             |   |          |           |
|  | iii) .....<br>(pl. specify ratio)                            |   |          |           |
|  | iv) .....<br>(pl. specify ratio)                             |   |          |           |
|  | v) .....<br>(pl. specify ratio)                              |   |          |           |
|  | Voltage Transformers (Single phase units)                    |   |          |           |
|  | Voltage Transformer;   |   |          |           |
|  | i) Primary Fuses   |   |          |           |
|  | ii) Secondary Fuses / Breakers                               |   |          |           |
|  | Vacuum interrupters complete with CB contacts if replaceable |   |          |           |
|  | Numerical relays   |   |          |           |
|  | Anti-condensation Heaters & Thermostats                      |   |          |           |
|  | Auxiliary opening coil                                       |   |          |           |
|  | Auxiliary closing coil                                       |   |          |           |

Total FOB value .....

Total CIF value .....

## Note

1: CEB reserves the right of ordering all the items or selected items depending on the requirement.

2: Above quantity shall be equal to the percentage of the ordering quantity, rounded to the closest integer. The minimum quantity shall be considered as one.



**SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS**

(This schedule shall be duly filled by the Manufacturer)

|          |  |        | CEB Requirement     | Offered |
|----------|--|--------|---------------------|---------|
| <b>1</b> | <b>Switchgear panels</b>   |        |                     |         |
|          | (a) Name of Manufacturer   |        |                     |         |
|          | (b) Country of Origin  |        |                     |         |
|          | (c) Make and Model No. / Catalogue number  |        |                     |         |
|          | (d) Rated voltage  | kV     | 12                  |         |
|          | (e) Normal Current Rating  | A      | 630/800             |         |
|          | (f) Frequency  | Hz     | 50                  |         |
|          | (g) No. of phases  |        | Three               |         |
|          | (h) Rated Insulation Levels  |        |                     |         |
|          | i) Lighting impulse (1.2/50 $\mu$ s) withstand voltage (peak)                                      | kV     | 75                  |         |
|          | ii) 1 min. power frequency withstand voltage kV (rms)  | kV     | 28                  |         |
|          | (i) Degree of Protection   |        |                     |         |
|          | i) Against approach to live parts  |        | IP43                |         |
|          | ii) Enclosure  |        | IP43                |         |
|          | (j) Rated short time current (3 Sec)   | kA     | 20                  |         |
|          | (k) Temperature rise   | °C     | As per IEC 62271    |         |
|          | (l) Thickness of the Sheet Metal of the cubicle  | mm     | 2                   |         |
|          | (m) Type and method of earthing of cable terminal  |        | As per clause 5.3.8 |         |
|          | (n) Whether the primary circuit is full-insulated  | Yes/No | Yes                 |         |
|          | (o) Indicate particulars of mechanical interlocking facilities provided                            |        |                     |         |
|          | (p) Where the remote operation facility provided   | Yes/No | Yes                 |         |
|          | (q) Whether the provision for incorporating SCADA system In the future provided ( Furnish details) | Yes/No | Yes                 |         |
| <b>2</b> | <b>Circuit breaker</b>   |        |                     |         |
|          | (a) Name of Manufacturer   |        |                     |         |
|          | (b) Country of Origin  |        |                     |         |
|          | (c) Make & Model No. and year of manufacture   |        |                     |         |
|          | (d) Number of poles  |        | 3                   |         |
|          | (e) Rated voltage  | kV     | 12                  |         |
|          | (f) Rated frequency  | Hz     | 50                  |         |
|          | (g) Rated Insulation Levels  |        |                     |         |
|          | i) Lighting impulse (1.2/50 $\mu$ s) withstand voltage (peak)                                      | kV     | 75                  |         |
|          | ii) 1 min. power frequency withstand voltage kV (rms)  | kV     | 28                  |         |
|          | (h) Rated normal current   | A      | 630/800             |         |
|          | (i) Rated short circuit breaking current (rms)   | kA     | 20                  |         |
|          | (j) Rated short circuit making current (peak)  | kA     | 50                  |         |
|          | (k) Rated short time withstand current & duration  | kA/sec | 20/3                |         |
|          | (l) First pole to clear factor   |        | 1.5                 |         |



|          |  |                 |                                       |  |
|----------|--|-----------------|---------------------------------------|--|
|          | (m) Rated operating duty cycle                     |                 | 'O' – 0.3 min. – 'CO' – 3 min. – 'CO' |  |
|          | (n) Opening time                                   | ms              |                                       |  |
|          | (o) Closing time                                   | ms              |                                       |  |
|          | (p) Method of Closing                              |                 | As per clause 5.3.1                   |  |
|          | (q) Method of Tripping                             |                 | As per clause 5.3.1                   |  |
|          | (r) Whether the Circuit Breaker is Trip free type  | Yes/No          | Yes                                   |  |
|          | (s) Tripping supply voltage                        | V               | 24                                    |  |
| <b>3</b> | <b>Interrupters</b>                                |                 |                                       |  |
|          | (a) Name of Manufacturer                           |                 |                                       |  |
|          | (b) Country of Origin                              |                 |                                       |  |
|          | (c) Make and Model No. and year of manufacture     |                 |                                       |  |
|          | (d) Rated current                                  | A               |                                       |  |
|          | (e) Rated voltage                                  | kV              |                                       |  |
|          | (f) Recommended No. of operations at rated current |                 |                                       |  |
|          | (g) Recommended No. of operations on short circuit |                 |                                       |  |
| <b>4</b> | <b>MCBs</b>  |                 |                                       |  |
|          | (a) Name of Manufacturer                           |                 |                                       |  |
|          | (b) Country of Origin                              |                 |                                       |  |
|          | (c) Make and Model No. and year of manufacture     |                 |                                       |  |
|          | (d) Type   |                 |                                       |  |
|          | (e) Rated current                                  | A               |                                       |  |
|          | (f) Rated voltage                                  | V               |                                       |  |
| <b>5</b> | <b>Bus bars</b>                                    |                 |                                       |  |
|          | (a) Name of Manufacturer                           |                 |                                       |  |
|          | (b) Country of Origin                              |                 |                                       |  |
|          | (c) Type and formation of Bus Bars                 |                 | As per clause 5.3.1                   |  |
|          | (d) Material                                       |                 | As per clause 5.3.1                   |  |
|          | (e) Type of insulation                             |                 | As per clause 5.3.1                   |  |
|          | (f) Whether the busbar is fully insulated          | Yes/no          | Yes                                   |  |
|          | (g) Clearance between busbars:                     |                 |                                       |  |
|          | i) Phase – Phase                                   | mm              | Please Specify                        |  |
|          | ii) Phase – Earth                                  | mm              | Please Specify                        |  |
|          | (h) Cross sectional area                           | mm <sup>2</sup> | Please Specify                        |  |
|          | (i) Continuously current carrying capacity         | A               | 630/800                               |  |
|          | (j) Maximum Temperature rise at rated current      | °C              | As per IEC 62271                      |  |
|          | (k) Mounting Arrangements vertical / horizontal    |                 |                                       |  |
| <b>6</b> | <b>Current transformers</b>                        |                 |                                       |  |
|          | (a) Name of Manufacturer                           |                 |                                       |  |
|          | (b) Country of Origin                              |                 |                                       |  |
|          | (c) Model / catalogue No. & year of manufacture    |                 |                                       |  |
|          | (d) Accuracy Class                                 |                 |                                       |  |
|          | i) Measuring                                       |                 | 3.0                                   |  |



|          |  |                 |                                    |  |
|----------|--|-----------------|------------------------------------|--|
|          | ii) Metering   |                 | 0.2                                |  |
|          | iii) Protection  |                 | 5 P                                |  |
| (e)      | Rated voltage  |                 |                                    |  |
|          | i) Measuring   | kV              | 12                                 |  |
|          | ii) Metering   | kV              | 12                                 |  |
|          | iii) Protection  | kV              | 12                                 |  |
| (f)      | Rated short time rating  |                 |                                    |  |
|          | i) Measuring   | kA              | 20                                 |  |
|          | ii) Metering   | kA              | 20                                 |  |
|          | iii) Protection  | kA              | 20                                 |  |
| (g)      | Duration   |                 |                                    |  |
|          | i) Measuring   | sec             | 3                                  |  |
|          | ii) Metering   | sec             | 3                                  |  |
|          | iii) Protection  | sec             | 3                                  |  |
| (h)      | Accuracy limit factor  |                 |                                    |  |
|          | i) Measuring   |                 | As per Clause 5.3.3                |  |
|          | ii) Metering   |                 | As per Clause 5.3.3                |  |
|          | iii) Protection  |                 | As per Clause 5.3.3                |  |
| (i)      | Burden   |                 |                                    |  |
|          | i) Measuring   | VA              | As per Clause 5.3.3                |  |
|          | ii) Metering   | VA              | As per Clause 5.3.3                |  |
|          | iii) Protection  | VA              | As per Clause 5.3.3                |  |
| (j)      | Frequency  |                 |                                    |  |
|          | i) Measuring   | Hz              | 50                                 |  |
|          | ii) Metering   | Hz              | 50                                 |  |
|          | iii) Protection  | Hz              | 50                                 |  |
| (k)      | C.T. ratios  |                 |                                    |  |
|          | i) Measuring   |                 |                                    |  |
|          | ii) Metering   |                 |                                    |  |
|          | iii) Protection  |                 |                                    |  |
| <b>7</b> | <b>Voltage transformers</b>  |                 |                                    |  |
| (a)      | Name of Manufacturer   |                 |                                    |  |
| (b)      | Country of Origin  |                 |                                    |  |
| (c)      | Model / catalogue No. & year of manufacture                        |                 |                                    |  |
| (d)      | Rated voltage  | kV              | 12                                 |  |
| (e)      | Rated insulation level   |                 |                                    |  |
|          | i) One minute power frequency withstand voltage (rms.)             | kV              | 75                                 |  |
|          | ii) Lightning impulse (1.2/50 $\mu$ s) withstand voltage (peak)    | kV              | 28                                 |  |
| (f)      | Accuracy Class   |                 | 0.5 for metering/1.0 for measuring |  |
| (g)      | Burden   | VA              | 50                                 |  |
| (h)      | Frequency  | Hz              | 50                                 |  |
| (i)      | V.T. ratios  |                 | 11kV/110V                          |  |
| <b>8</b> | <b>Earthing</b>  |                 |                                    |  |
| (a)      | Name of Manufacturer   |                 |                                    |  |
| (b)      | Country of Origin  |                 |                                    |  |
| (c)      | Material of earth conductor  |                 |                                    |  |
| (d)      | Whether the earth conductor is provided for entire length of panel | Yes /No         | Yes                                |  |
| (e)      | Cross sectional area of the earth conductor                        | mm <sup>2</sup> | Minimum 150                        |  |

|           |   |                    |     |  |
|-----------|---|--------------------|-----|--|
|           | (f) Current density at rated fault current  | A/mm <sup>2</sup>  | 200 |  |
|           | (g) Indicate particulars of mechanical interlocking facility provided in the earthing circuit |                    |     |  |
| <b>9</b>  | <b>Relays</b>   |                    |     |  |
|           | (a) Name of Manufacturer and  |                    |     |  |
|           | (b) Country of Origin   |                    |     |  |
|           | (c) Model / catalogue No. & year of manufacture   |                    |     |  |
|           | (d) Type  | Numerical / Static |     |  |
|           | (e) Whether the following types of characteristic curve programmable                          |                    |     |  |
|           | i) Over Current<br>1. IDMT<br>2. Instantaneous  | Yes/No<br>Yes/No   |     |  |
|           | ii) Earth fault<br>1. IDMT<br>2. Instantaneous  | Yes/No<br>Yes/No   |     |  |
|           | (f) Whether the provision for incorporating SCADA system in future is available               | Yes/No             |     |  |
|           | (g) Whether the hand held programming unit provided Quantity                                  | Yes/No<br>Nos      |     |  |
| <b>10</b> | <b>Energy metering instruments</b>  |                    |     |  |
|           | (a) Name of Manufacturer  |                    |     |  |
|           | (b) Country of Origin   |                    |     |  |
|           | (c) Model / catalogue No. & year of manufacture   |                    |     |  |
|           | (d) Whether the instrument is programmable type   | Yes/No             | Yes |  |
|           | (e) Whether the programming software provided   | Yes/No             | Yes |  |
|           | (f) Whether the hand held programming unit provided Quantity                                  | Yes/No<br>Nos.     | Yes |  |
| <b>11</b> | Whether Cable Terminations Provided as per Clause 5.3.6?                                      | Yes/No             | Yes |  |
| <b>12</b> | Whether Protection Features Provided as per Clause 5.3.7?                                     | Yes/No             | Yes |  |
| <b>13</b> | Whether SCADA Provision Provided as per Clause 5.3.12?  | Yes/No             | Yes |  |
| <b>14</b> | Whether Radial Feeder Panels, if Provided, Conform to Clause 5.4.1?                           | Yes/No             | Yes |  |
| <b>15</b> | Whether Ring Feeder Panels, if Provided, Conform to Clause 5.4.2?                             | Yes/No             | Yes |  |
| <b>16</b> | Whether Outgoing Feeder/Transformer Control Panels, if Provided, Conform to Clause 5.4.3?     | Yes/No             | Yes |  |
| <b>17</b> | Whether Bus Section Panels, if Provided, Conform to Clause 5.4.4?                             | Yes/No             | Yes |  |
| <b>18</b> | Whether Metering Panels, if Provided, Conform to Clause 5.4.5?                                | Yes/No             | Yes |  |

I / We certify that the above data are true and correct.

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SEAL AND SIGNATURE OF THE MANUFACTURER/ Date





**Non-Compliance Schedule**

On this schedule the bidder shall provide a list of non-compliances with this specification, documenting the effects that such non-compliance is likely to have on the equipment life and operating characteristics. Each non-compliance shall be referred to the relevant specification clause.

| Clause No. | Non-Compliance |
|------------|----------------|
|            |                |
|            |                |
|            |                |
|            |                |
|            |                |

.....  
Signature of the Manufacturer/bidder and seal

.....  
Date

I/We certify that the above data are true and correct

.....  
Signature of the Bidder and seal

.....  
Date

