

# TECHNICAL SPECIFICATION FOR 11 kV & 33 kV MS CROSS-ARMS

## ATTACHMENT – I

### TECHNICAL SPECIFICATION FOR CROSS-ARMS FOR 33 kV AND 11 kV OVERHEAD POWER LINES

#### **1.0 'V' SHAPE M.S. CROSS ARM WITH CLAMPS**

- 1.1 X-arms shall be made out of 100 x 50 x 6 mm and 75 x 40 x 6 mm M.S. Channel for 33KV and 75x40X6mm for 11KV.
- 1.2 The cross arm shall be hot dipped galvanized generally conforming to IS – 2633/72.
- 1.3 The X-arm should not be welded/ jointed at any place except as specified.
- 1.4 The clamps for the X-arm shall be of G.I. & shall be hot dipped galvanized generally conforming to IS – 2633/72.
- 1.5 The clamps shall be designed to fit for the specified rail & PSC poles.

#### **2.0 Shape & Size**

- 2.1 The cross arms shall be of MS channel.
- 2.2 The cross arms shall have two holes of 22 mm dia (for 11kV line) and 26 mm dia (for 33kV line) for fixing of pin insulators. The center-to-centre distance between the holes shall be 1070 mm (for 11kV) and 1525 mm (for 33kV) and holes shall be in the middle of the top width of cross arm.
- 2.3 If required by the owner, holes of specified size and spacing shall also be provided for fixing of pole back clamp to suit the pole.

#### **3.0 Marking**

The following information shall be marked on each cross arm:

- a) Manufacturer's name or trademark.
- b) Year of manufacture

ATTACHMENT - J

**LT SWITCH BOARD FOR 16, 25 & 40 KVA (Single/ 3Phase) DISTRIBUTION TRANSFORMER**

**1. GENERAL**

This specification covers LT switchboards required for 415 Volts system voltage for 3 phase 4 wires and single phase 2 wires with neutral solidly grounded system. They are to be provided in distribution substations on secondary side of transformer.

The switchboard shall comprise of MS outdoor housing containing incoming and outgoing feeders to match with the capacity of the Distribution Transformer.

LT switchboard shall be provided with insulated handles.

The box shall have two compartments each lockable separately. The LT connections through copper cable/conductor from LT bushing of DT shall terminate at porcelain fuse. The output from porcelain fuse shall be extended to the lower compartment of the box. In the lower compartment, LT buses including neutral bus shall be mounted. All outgoing LT feeders (**numbers to be decided by utility based on number of service connection/ out going feeders**) shall emanate from LT buses get connected to LT feeder through respective porcelain fuses. Suitable no. of holes with cable glands along with IS approved gaskets shall be provided in the lower compartment of the distribution. Neoprene Rubber gasket shall be used in the door to avoid ingress of moisture and other elements in the distribution box. The distribution box shall have painting as per relevant IS standards.

The Switchboard shall be made of MS of thickness not less than 2.5 mm. door panel and 4 mm Body panel and shall be dust, moisture, vermin and weather proof with degree of protection IP 55 as per IS: 13947 suitable for outdoor use. Box shall be mounted on distribution transformer / pole structure.

All parts, doors, movable covers and panels shall be fitted all around with neoprene gaskets. The gaskets shall be provided along a channel on periphery of the doors and covers. Ventilating louvers shall be provided with brass screen and filters.

The Switchboard shall have neat appearance inside and outside with all equipment mounted flush having no visible welds, with all exterior surfaces even and smooth. The door is to be provided in front with internal hinges.

Cable entries shall be from bottom. Cable gland plate and gland shall be provided at the bottom plate. The wiring shall be such that terminals are accessible by use of ordinary tools. Connections shall be provided with adequate clearance to avoid short circuits and risk of fire and ease in connection and disconnection. All internal wiring should be with fire resistance low smoke PVC insulated cables of copper core size 2.5 sq. mm minimum complying with IS: 1554.

**2. GOVERNING STANDARDS**

The equipment will be manufactured in conformity with the following Indian Standard Specification (latest editions).

IS:2950 A.C. Connectors

IS:8623/1993 Low Voltage Switchgear and Control gear Assemblies

IS:9676/1980 Temperature weather condition.

**3. PORCELAIN FUSE**

Incoming and Outgoing circuits shall be provided with porcelain fuse. The incoming circuit shall be provided with 100 A porcelain fuse base and shall have 3 sets of appropriate fuse base on out-going circuit. However, only appropriate fuse links will be used.

**4. BUS BAR AND CONNECTIONS**

Phase and neutral bus bar shall be provided along with links and connectors of electrolytic aluminium with 99.9 percent purity of approved make. The phase bus bars should be insulated with PVC or heat shrinkable sleeves of phase code coloured i.e. red, yellow and blue or suitably painted with plastic insulating compounds.

The bus bars shall be suitably supported on insulators to stand the mechanical and electric forces on account of short circuit on the system.

The bus bar conductors shall be uniform throughout its length and in no case tapered. The size shall be so chosen to limit current density to 1.0 Amps per sq. mm.

The electrical contacts between bus bars and connecting link shall be bolted type and lavish contact surface shall be provided. Bus bars shall be enclosed in a separate compartment with link arrangement for extension.

The neutral bus bar should be of the same size and current carrying capacity as that of phase bus bar.

All bus bar joints, live bolted connections; joints between cable terminals and switchgear terminals etc. shall be covered with electric insulating non-corrosive sealing compound or heat shrinkable tapes to avoid accidental contact and flashover.

**5. EARTHING**

Suitable Earthing arrangement shall be provided.

**6. TESTS**

Each type of LV Switchboard shall be completely assembled, wired, adjusted and tested at the factory as per the relevant standards and during manufacture and on completion.

**Routine Test**

The tests shall be carried out in accordance with IS 13947 and 8623 include including but not necessarily limited to the following:

- (a) Visual Check
- (b) Verification of Component Rating

- (c) Other Checks
  - i) Easy Accessibility and Maintenance
  - ii) Colour Coding provided by coloured tapes.
  - iii) Bus bar dimensions
  - iv) Degree of Protection check by paper.
- (d) Dimension check
- (e) Insulation Resistance Tests
- (f) Mechanical Operation Tests
- (g) Bus bar support and clearances
- (h) Continuity of circuits and Function
- (i) Painting
- (j) Overload Release setting of the Circuit Breakers

**Type Test**

All type tests shall be performed in accordance with IS 13947 and 8623

**7. PROTOTYPE SAMPLE**

A prototype sample of each category of the LV Switchboard should be initially manufactured and submitted for approval of purchaser before taking up mass manufacture.

**LT SWITCH BOARD FOR 63 and 100 KVA DISTRIBUTION TRANSFORMERS**

**1. GENERAL**

This specification covers LT switchboards required for 415 Volts system voltage for 3 phase 4 wires, neutral solidly grounded system. They are to be provided in distribution substations on secondary side of transformer.

The switchboard shall comprise of MS outdoor housing containing incoming and outgoing feeders to match with the capacity of the Distribution Transformer to be controlled as indicated below.

Sl. No.	Trafo. Capacity kVA	Full Load Current Amps	Incoming Circuit Configuration	Outgoing Circuits Configuration	Mounting Arrangement
(1)	(2)	(3)	(4)	(5)	(6)
1	63	88 Amp	100 Amp PORCELAIN FUSE with 200 A Fuse Base	2/3 nos - 100 Amp PORCELAIN FUSES	Channel Frame
2	100	139	200 Amp PORCELAIN FUSE	2/3 nos - 100 Amp PORCELAIN FUSES	Channel Frame

## TECH. SPECIFICATION FOR LT SWITCH BOARD FOR DIST. TRF.

The incoming circuit shall be provided with 200 A porcelain fuse base and out-going circuit shall have 3 sets of 100 A porcelain fuse base. However, only appropriate fuse links will be used.

The Switchboard shall be MS of thickness not less than 2.5 mm. door panel and 4 mm Body panel and shall be dust, moisture, vermin and weather proof with degree of protection IP 55 as per IS: 13947 suitable for outdoor use. They shall be of freestanding structure, independent floor mounting design or mounted on a channel frame at a suitable height of about 1.2 meters from the floor. It shall have sufficient channel and angle re-enforcement to resist vibrations and rigidity during transportation, erection and operation.

All parts, doors, movable covers and panels shall be fitted all around with neoprene gaskets. The gaskets shall be provided along a channel on periphery of the doors and covers. Ventilating louvers shall be provided with brass screen and filters.

The Switchboard shall have neat appearance inside and outside with all equipment mounted flush having no visible welds, with all exterior surface even and smooth. The door is to be provided in front with internal hinges.

Cable entries shall be from bottom. Cable gland plate and gland shall be provided at the bottom plate. The wiring shall be such that terminals are accessible by use of ordinary tools. Connections shall be provided with adequate clearance to avoid short circuits and risk of fire and ease in connection and disconnection. All internal wiring should be with fire resistance low smoke PVC insulated cables of copper core size 2.5 sq. mm minimum complying with IS: 1554.

The entire switchboard shall be suitable to withstand short circuit current equivalent to 25 MVA 415 Volts for one second.

### **2. OPERATION AND SAFETY**

All operations shall be from the front.

### **3. GOVERNING STANDARDS**

The equipment will be manufactured in conformity with the following Indian Standard Specification (latest editions).

IS:2950 A.C. Connectors

IS:8623/1993 Low Voltage Switchgear and Control gear Assemblies

IS:9676/1980 Temperature weather condition;

### **4. PORCELAIN FUSE**

Incoming and Outgoing circuits shall be provided with porcelain fuse.

### **5. BUS BAR AND CONNECTIONS**

Triple pole and neutral bus bar shall be provided along with links and connectors of electrolytic aluminium with 99.9 percent purity of approved make. The phase bus bars should be insulated with PVC or heat shrinkable sleeves of phase code coloured i.e. red, yellow and blue or suitably painted with plastic insulating compounds.

The bus bars shall be suitably supported on insulators to stand the mechanical and electric forces on account of short circuit on the system.

The main bus bars shall run horizontally at top and the branch bus bars vertically with connections to the individual breaker panels.

The bus bar conductors shall be uniform throughout its length and in no case tapered. The size shall be so chosen to limit current density to 1.0 Amps per sq. mm. Sufficient ventilation shall be conceived not to allow temperature rise above 30 Deg. C.

The electrical contacts between bus bars and connecting link shall be bolted type and lavish contact surface shall be provided. Bus bars shall be enclosed in a separate compartment with link arrangement for extension.

The neutral bus bar should be of the same size and current carrying capacity as that of phase bus bar.

All bus bar joints, live bolted connections; joints between cable terminals and switchgear terminals etc. shall be covered with electric insulating non-corrosive sealing compound or heat shrinkable tapes to avoid accidental contact and flashover.

## **6. EARTHING**

Earthing arrangement shall be provided with earth bars of electrolytic aluminium and earthing terminals at two ends similar to the arrangement described in General Technical Specification. The earth bar shall be of electrolytic aluminium running from end to end of the switchboard terminating in two earthing terminals at the two ends. Earthing shall be accomplished as described in General Technical Specification.

## **7. ENERGY METER**

Each incoming panel shall be provided with the energy meter. (Details of the energy meter shall be given separately by purchaser)

## **8. TESTS**

Each type of LV. Switchboard shall be completely assembled, wired, adjusted and tested at the factory as per the relevant standards and during manufacture and on completion.

### **Routine Test**

The tests shall be carried out in accordance with IS 13947 and 8623 include including but not necessarily limited to the following:

- (a) Visual Check
- (b) Verification of Component Rating
- (c) Other Checks
  - i) Easy Accessibility and Maintenance
  - ii) Colour Coding provided by coloured tapes.
  - iii) Bus bar dimensions
  - iv) Degree of Protection check by paper.
- (d) Dimension check
- (e) Di-electric Test of circuits
- (f) Insulation Resistance Tests
- (g) Mechanical Operation Tests
- (h) Bus bar support and clearances
- (i) Continuity of circuits and Function
- (j) Painting

- (k) Verification of wiring

**Type Test**

All type tests shall be performed in accordance with IS 13947 and 8623

**9. PROTOTYPE SAMPLE**

A prototype sample of each category of the LV Switchboard should be initially manufactured and submitted for approval of purchaser before taking up mass manufacture.

# TECH. SPECIFICATION FOR LEAD ACID BATTERY & CHARGER

## ATTACHMENT- K TECHNICAL SPECIFICATION FOR LEAD ACID BATTERY AND BATTERY CHARGER

### 1.0 GENERAL TECHNICAL REQUIREMENTS

- 1.1 All materials/components used in battery chargers and batteries shall be free from flaws and defects and shall conform to the relevant Indian standards and good engineering practice.
- 1.2 DC system shall consist of one float-cum-boost charger and one battery sets for 30 V system shall have one battery bank with one float cum boost chargers.
- 1.3 The contractor shall submit the drawings and get the owner's approval before proceeding.

### 2.0 BATTERY

- 2.1 The DC Batteries shall be stationary Lead-Acid type with (Plate or Tubular positive plates) for standby duty. Tubular type batteries shall be Normal Discharge type and plate type batteries shall be high discharge type . These Batteries shall be suitable for a long life under continuous float operations at 2.15 to 2.25 volts per cell, and occasional discharges. The 30 V DC system is -ve earth system.
- 2.2 Cell Terminals: All cell terminals shall have adequate current carrying capacity and shall be of lead alloy or lead alloy reinforced with copper core inserts. Cell terminal posts shall be equipped with connection bolts having acid resisting bolts and nuts.
- 2.3 Container : Containers shall be made of glass or hard rubber or suitable plastic material or glass fibre reinforced plastics or lead lined wood. Containers shall be robust, heat resistant, leak proof, non-absorbent, acid resistant and free from flaws. Glass containers shall be transparent. Electrolyte level lines shall be marked on container in case of transparent containers. Float type level indicator shall be provided in case of opaque containers. The marking for the electrolyte level should be for the upper, normal and lower limits. The material of level indicator shall be acid-proof and oxidation proof.
- 2.4 Vent Plugs: Vent plugs shall be provided in sealed type cells. They shall be of anti-splash type, having more than one exit hole and shall allow the gases to escape freely but shall prevent acid from coming out. Open type cells shall be provided with suitable arrestors to prevent spilling of electrolyte.
- 2.5 Plates : The plates shall be designed for maximum durability during all service conditions including high rate of discharge and rapid fluctuations of load. The construction of plates shall conform to latest revisions of IS : 1651 or IS:1652 as applicable. The separators shall maintain the electrical insulation between the plates and shall allow the electrolyte to flow freely. The positive and negative terminal posts shall be clearly marked.



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- 2.6 Sediment Space: Sufficient sediment space shall be provided so that cells will not have to be cleaned out during normal life.
- 2.7 Cell Insulator: Each cell shall be separately supported on porcelain or hard rubber insulators fixed on to the racks with adequate clearance between adjacent cells.
- 2.8 Electrolyte: The electrolyte shall be prepared from battery grade sulphuric acid conforming to IS:226 and distilled water conforming to IS:1069. The cells shall be shipped dry and uncharged. The electrolyte for initial filling shall be furnished separately. A minimum of 10% extra electrolyte shall be supplied after completion of initial charging.
- 2.9 Manufacturer's Identification System

The following information shall be indelibly marked on outside of each cell :

- Manufacturer's name and trade mark
- Country and year of manufacture
- Manufacturer's type designation
- AH capacity at 10 hr. discharge rate
- Serial Number
- Upper and lower electrolyte level in case of transparent containers.

### 2.10 Connectors and Fasteners

Lead or lead coated connectors shall be used for connecting up adjacent cells, rows and end take off. Bolts, nuts and washers shall be effectively lead coated to prevent corrosion. End take off connectors shall be provided for end connections from positive and negative poles of the batteries to the Power cables. More than one cable may be required to be connected to the battery terminals. Suitable arrangement for termination of multiple cables shall be provided so as to avoid extra load on the battery terminals. The cable will be single core having stranded aluminium conductor and PVC insulation which will be arranged by the Employer separately. Necessary wooden supports and lugs for termination of these cables on Batteries shall also be supplied by the Contractor. All connectors and lugs shall be capable of continuously carrying the 30 Minute discharge current of the respective Batteries and shall be capable to carry 4 kA for 1 sec.

### 2.11 Battery Racks

Battery Shall be floor mounted.

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### 3.0 TESTS

- 3.1 Batteries shall conform to all type tests as per the latest issue of IS: 1651 or IS: 1652 (whichever is applicable depending on type of Battery being offered).
- 3.2 All Acceptance tests as required by the relevant Indian Standards shall be carried out at site after completion of installation. The capacity tests shall be carried out for 10 hr. discharge rating. The Contractor shall arrange for all necessary equipment, including the variable resistor, tools, tackles and instruments. If a Battery fails to meet the guaranteed requirements the OWNER shall have the option of asking the contractor to replace the same with appropriate batteries at no extra cost and without affecting the commissioning schedule of the employer.
- 3.3 If successful Contractor has not manufactured & commissioned the specified cell size, they must manufacture & test the prototype in advance and obtain Employer's approval for the same.
- 3.4 Following type tests shall be carried out on each type of cells in the presence of Employer's representative, if desired by the OWNER:
  - i. Capacity tests
  - ii. Watt hour and AH efficiency tests

The Contractor shall give at least three (3) weeks advance notice of the date when the tests are to be carried out. Three (3) copies of Type test certificates shall be furnished to the EMPLOYER for approval before the dispatch of the equipment from works. The cost of the cells to be used for type tests shall be included in the respective Type tests charges quoted by Contractor, these cells shall not be supplied.

### 4.0 ACCESSORIES

- 4.1 The following information shall be given on the instruction cards supplied with the Battery:
  - a) Manufacturer's instruction for filling and initial charging of the Battery together with starting and finishing charging rate.
  - b) Maintenance instructions.
  - c) Designation of cell in accordance with IS: 1651 or IS: 1652 (whichever applicable).
  - d) Storing conditions of electrolyte and battery cells.
- 4.2 A complete Set of all the accessories and devices for maintenance of Batteries shall be supplied along with each type of battery bank. The following items comprise the complete set of accessories:
  - i) 8 Nos. of Hydrometers.

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- ii) 8 sets of Hydrometer syringes suitable for the vent holes in different cells.
- iii) 8 Nos. of thermometers for measuring electrolyte temperature.
- iv) 6 No. of Specific gravity correction chart.
- v) 8 Nos. of Wall mounting type holders made of teak wood for hydrometer and thermometer.
- vi) 6 Nos. of Cell testing voltmeter (3-0-3V) conforming to IS : 1248.
- vii) 4 No. of Rubber apron.
- viii) 4 Pairs of Rubber gloves
- ix) 4 Set of spanners
- x) 6 nos. Instructions cards

### 5.0 BATTERY CHARGER

The DC system shall be of 30 Volt or indicated in BPS, DC having -ve earthed. The Battery Chargers as well as their automatic regulators shall be of static type. All battery chargers shall be capable of continuous operation at the respective rated load in float charging mode, i.e. Float charging the associated DC Lead-Acid Batteries at 2.15 to 2.25 Volts per cell while supplying the DC load. The chargers shall also be capable of Boost charging the associated DC Battery at 2.0-2.7 volts per cell at the desired rate.

- 5.1 All Battery Chargers shall be provided with facility for both automatic and manual control of output voltage and current. A selector switch shall be provided for selecting the mode of output voltage/current control, whether automatic or manual. When on automatic control mode during Float charging, the Charger output voltage shall remain within  $\pm 1\%$  of the set value, for AC input voltage variation of  $\pm 10\%$ , frequency variation of  $\pm 5\%$ , a combined voltage and frequency variation of  $\pm 10\%$ , and a DC load variation from zero to full load.
- 5.2 All battery chargers shall have constant voltage characteristics throughout the range (from zero to full load) at the floating value of the voltage so as to keep the battery fully charged but without harmful overcharge.
- 5.3 All chargers shall have load limiters having drooping characteristic, which shall cause, when the voltage control is in automatic mode, a gradual lowering of the output voltage when the DC load current exceeds the Load limiter setting of the Charger. The Load-limiter characteristics shall be such that any sustained overload or short circuit in DC System shall not damage the Charger, nor shall it cause blowing of any of the Charger fuses. The Charger shall not trip on overload or external short circuit.

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- 5.4 Uniform and step less adjustments of voltage setting (in both manual and automatic modes) shall be provided on the front of the Charger panel covering the entire float charging output range specified. Stepless adjustments of the Load-limiter setting shall also be possible from 80% to 100% of the rated output current for Charging mode.
- 5.5 During Boost Charging, the Battery Charger shall operate on constant current mode (when automatic regulator is in service). It shall be possible to adjust the Boost charging current continuously over a range of 50 to 100% of the rated output current for Boost charging mode.
- 5.6 The Charger output voltage shall automatically go on rising, when it is operating on Boost mode, as the Battery charges up. For limiting the output voltage of the Charger, a potentiometer shall be provided on the front of the panel, whereby it shall be possible to set the upper limit of this voltage any where in the output range specified for Boost Charging mode.
- 5.7 The Charger manufacturer may offer an arrangement in which the voltage setting device for Float charging mode is also used as output voltage limit setting device for Boost charging mode and the Load-limiter of Float charging mode is used as current setting device in boost charging mode.
- 5.8 Suitable filter circuits shall be provided in all the chargers to limit the ripple content (Peak to Peak) in the output voltage to 1%, irrespective of the DC load level, when they are not connected to a Battery.

### **6.0 MCCB**

All Battery Chargers shall have 1 No. MCCB on the input side to receive cables from one source. It shall be of P2 duty and suitable for continuous duty. MCCBs should have auxiliary contacts for annunciation/hooter.

### **7.0 RECTIFIER TRANSFORMER**

The rectifier transformer shall be continuously rated, dry air cooled (A.N) and of class F insulation type. The rating of the rectifier transformer shall have 10% overload capacity.

#### **7.1 Rectifier Assembly**

The rectifier assembly shall be fully/half controlled bridge type and shall be designed to meet the duty as required by the respective Charger. The rectifier shall be provided with heat sink having their own heat dissipation arrangements with natural air-cooling. Necessary surge protection devices and rectifier type fast acting HRC fuses shall be provided in each arm of the rectifier connections.

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## 8.0 INSTRUMENTS

One AC voltmeter and one AC ammeter alongwith selector switches shall be provided for all chargers. One DC voltmeter and DC ammeter (with shunt) shall be provided for all Chargers. The instruments shall be flush type, dust proof and moisture resistant. The instruments shall have easily accessible means for zero adjustment. The instruments shall be of 1.5 accuracy classes.

## 9.0 AIR BREAK SWITCHES

One DC output switch shall be provided in all chargers. They shall be air break type suitable for 500 volts AC/ 250 Volt DC. The contacts of the switches shall open and close with a snap action. The operating handle of the switch shall be fully insulated from circuit. 'ON' and 'OFF' position on the switch shall be clearly indicated. Rating of switches shall be suitable for their continuous load. Alternatively, MCCBs of suitable ratings shall also acceptable in place of Air Break Switch.

## 10.0 FUSES

All fuses shall be HRC Link type. Fuses shall be mounted on fuse carriers, which are in turn mounted on fuse bases. Wherever it is not possible to mount fuses on carriers, fuses shall be directly mounted on plug-in type base. In such case one insulated fuse pulling handle shall be supplied for each charger. The Contractor depending on the circuit requirement shall choose fuse rating. All fuses in the chargers shall be monitored. Fuse failure annunciation shall be provided on the failure of any fuse.

## 11.0 BLOCKING DIODE

Blocking diode shall be provided in the positive pole of the output circuit of each charger to prevent current flow from the DC Battery into the Charger.

## 12.0 ANNUNCIATION SYSTEM

Audio-visual indications through bright LEDs shall be provided in all Chargers for the following abnormalities:

- a) AC power failure
- b) Rectifier/chargers fuse blown.
- c) Over voltage across the battery when boost charging.
- d) Abnormal voltage (High/Low)
- e) Any other annunciation if required.

Potential free NO Contacts of above abnormal conditions shall also be provided for common remote indication "CHARGER TROUBLE" in Employer's Control Board. Indication for charger in float mode and boost mode through indication lamps shall be provided for chargers. A potential free contact for float/boost mode shall be provided for external interlocks.

## 13.0 NAME PLATES AND MARKING

The nameplates shall be white with black engraved letters. On top of each Charger, on front as well as rear sides, larger and bold nameplates shall be provided to identify the Charger. Nameplates with full and clear inscriptions shall also be provided on and

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inside of the panels for identification of the various equipments and ease of operation and maintenance.

### **14.0 CHARGER CONSTRUCTION**

The Chargers shall be indoor, floor-mounted, self-supporting sheet metal enclosed cubicle type. The Contractor shall supply all necessary base frames, anchor bolts and hardware. The Chargers shall be fabricated from 2.0mm cold rolled sheet steel and shall have folded type of construction. Removable gland plates for all cables and lugs for power cables shall be supplied by the Contractor. The lugs for power cables shall be made of electrolytic copper with tin coat. Power cable sizes shall be advised to the Contractor at a later date for provision of suitable lugs and drilling of gland plates. The Charger shall be tropicalised and vermin proof. Ventilation louvers, if provided shall be backed with screens. All doors and covers shall be fitted with synthetic rubber gaskets. The chargers shall have hinged double leaf doors provided on front and on backside for adequate access to the Charger's internals. All the charger cubicle doors shall be properly earthed. The degree of protection of Charger enclosure shall be at least IP-42 as per IS: 2147.

- 14.1 All indicating instruments, control switches and indicating lamps shall be mounted on the front side of the Charger.
- 14.2 Each Charger shall be furnished completely wired upto power cable lugs and terminal blocks and ready for external connections. The control wiring shall be carried out with PVC insulated, 1.5 sq.mm. stranded copper wires. Control terminals shall be suitable for connecting two wires, with 2.5 sq.mm stranded copper conductors. All terminals shall be numbered for ease of connections and identification. Each wire shall bear a ferrule or tag on each end for identification. At least 20% spare terminals shall be provided for control circuits.
- 14.3 The insulation of all circuits, except the low voltage electronic circuits shall withstand test voltage of 2 KV AC for one minute. An air clearance of at least ten (10) mm shall be maintained throughout for such circuits, right up to the terminal lugs. Whenever this clearance is not available, the live parts shall be insulated or shrouded.

### **15.0 PAINTING**

All sheet steel work shall be pretreated, in tanks, in accordance with IS:6005. Degreasing shall be done by alkaline cleaning. Rust and scale shall be removed by pickling with acid. After pickling, the parts shall be washed in running water. Then these shall be rinsed in slightly alkaline hot water and dried. The phosphate coating shall be 'Class-C' as specified in IS:6005. Welding shall not be done after phosphating. The phosphating surfaces shall be rinsed and passivated prior to application of stoved lead oxide primer coating. After primer application, two coats of finishing synthetic enamel paint of shade-692 (smoke grey) of IS:5 shall be applied, unless required otherwise by the Employer. The inside of the chargers shall be glossy white. Each coat of finishing synthetic enamel paint shall be properly staved. The paint thickness shall not be less than fifty (50) microns.

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### 16.0 TESTS

16.1 Battery chargers shall conform to all type tests as per relevant Indian Standard. Performance test on the Chargers as per Specification shall also be carried out on each Charger as per specification. Rectifier transformer shall conform to all type tests specified in IS: 4540 and short circuit test as per IS: 2026. Following type tests shall be carried out for compliance of specification requirements:

- i) Voltage regulation test
- ii) Load limiter characteristics test
- iii) Efficiency tests
- iv) High voltage tests
- v) Temperature rise test
- vi) Short circuit test at no load and full load at rated voltage for sustained short-circuit.
- vii) Degree of protection test
- viii) Measurement of ripple by oscilloscope.

16.2 The Contractor may be required to demonstrate to the Owner that the Chargers conform to the specification particularly regarding continuous rating, ripple free output, voltage regulation and load limiting characteristic, before dispatch as well as after installation at site. At site the following tests shall be carried out:

- i) Insulation resistance test
- ii) Checking of proper annunciation system operation.

16.3 If a Charger fails to meet the specified requirements, the Contractor shall replace the same with appropriate Charger without affecting the commissioning schedule of the Substation, and without any extra cost to the owner.

16.4 The Contractor shall present for inspection, the type and routine test certificates for the following components whenever required by the OWNER.

- (i) Switches.
- (ii) Relays/MCCBs
- (iii) Instruments.
- (iv) DC fuses.
- (v) SCR.
- (vi) Diodes.
- (vii) Condensers.
- (viii) Potentiometers.
- (ix) Semiconductor
- (x) Annunciator.
- (xi) Control wiring
- (xii) Push buttons for contactors.

Makes of above equipment shall be subject to Owner approval.

**ATTACHMENT - L**

**TECHNICAL SPECIFICATION OF CONTROL & RELAY PANEL**

**1. TYPE OF PANELS**

**1.1 Simplex Panel**

Simplex panel shall consist of a vertical front panel with equipment mounted thereon and having wiring access from rear. In case of panel having width more than 800mm, double leaf-doors shall be provided. Doors shall have handles with either built-in locking facility or will be provided with pad-lock.

**2. CONSTRUCTIONAL FEATURES**

2.1 All Control and Relay panels shall be of simplex type design. It is the responsibility of the Contractor to ensure that the equipment specified and such unspecified complementary equipment required for completeness of the protective/control schemes be properly accommodated in the panels without congestion and if necessary, provide panels with larger dimensions. No price increase at a later date on this account shall be allowed. However, the width of panels that are being offered to be placed in existing switchyard control rooms, should be in conformity with the space availability in the control room.

2.2 Panels shall be completely metal clad and shall be dust, moisture and vermin proof. The enclosure shall provide a degree of protection not less than IP-4X in accordance with IS: 2147.

2.3 Panels shall be free standing, floor mounting type and shall comprise structural frames completely enclosed with specially selected smooth finished, cold rolled sheet steel of thickness not less than 3 mm for weight bearing members of the panels such as base frame, front sheet and door frames, and 2.0mm for sides, door, top and bottom portions. There shall be sufficient reinforcement to provide level transportation and installation.

2.4 All doors, removable covers and panels shall be gasketed all around with neoprene gaskets. Ventilating louvers, if provided shall have screens and filters. The screens shall be made of either brass or GI wire mesh.

2.5 Design, materials selection and workmanship shall be such as to result in neat appearance, inside and outside with no welds, rivets or bolt head apparent from outside, with all exterior surfaces true and smooth.

2.6 Panels shall have base frame with smooth bearing surface, which shall be fixed on the embedded foundation channels/insert plates. Anti vibration strips made of shock absorbing materials that shall be supplied by the contractor, shall be placed between panel & base frame.

2.7 Cable entries to the panels shall be from the bottom. Cable gland plate fitted on the bottom of the panel shall be connected to earthing of the panel/station through a flexible braided copper conductor rigidly.



### **3. MOUNTING**

3.1 All equipment on and in panels shall be mounted and completely wired to the terminal blocks ready for external connections. The equipment on front of panel shall be mounted flush. No equipment shall be mounted on the doors.

3.2 Equipment shall be mounted such that removal and replacement can be accomplished individually without interruption of service to adjacent devices and are readily accessible without use of special tools. Terminal marking on the equipment shall be clearly visible.

3.3 Contractor shall carry out cut out, mounting and wiring of the items supplied by others, which are to be mounted in his panel in accordance with the corresponding equipment manufacturer's drawings. Cut outs if any, provided for future mounting of equipment shall be properly blanked off with blanking plate.

3.4 The centre lines of switches, push buttons and indicating lamps shall be not less than 750mm from the bottom of the panel. The centre lines of relays, meters and recorders shall be not less than 450mm from the bottom of the panel

3.5 The center lines of switches, push buttons and indicating lamps shall be matched to give a neat and uniform appearance. Like wise the top lines of all meters, relays and recorders etc. shall be matched.

### **4. PANEL INTERNAL WIRING**

4.1 Panels shall be supplied complete with interconnecting wiring provided between all electrical devices mounted and wired in the panels and between the devices and terminal blocks for the devices to be connected to equipment outside the panels. When panels are arranged to be located adjacent to each other all inter panel wiring and connections between the panels shall be furnished and the wiring shall be carried out internally

4.2 All wiring shall be carried out with 1100V grade, single core, stranded FRLS tinned copper conductor wires with PVC insulation. The minimum size of the multi-stranded copper conductor used for internal wiring shall be as follows:

- All circuits except current transformer circuits and voltage transfer circuits meant for energy metering - one no 1.5mm sq. per lead.
- All current transformer circuits one no 2.5 sqmm per lead.
- Voltage transformer circuit (for energy meters): Two 2.5 sqmm. per lead.

4.3 All internal wiring shall be securely supported, neatly arranged, readily accessible and connected to equipment terminals and terminal blocks. Wiring gutters & troughs shall be used for this purpose.

4.4 Auxiliary bus wiring for AC and DC supplies, voltage transformer circuits, annunciation circuits and other common services shall be provided near the top of the panels running throughout the entire length of the panels.

4.5 Wire termination shall be made with solderless crimping type and tinned copper lugs, which firmly grip the conductor. Insulated sleeves shall be provided at all the wire terminations. Engraved core identification plastic ferrules marked to correspond with panel wiring diagram shall be fitted at both ends of each wire. Ferrules shall fit tightly on the wire and shall not fall off when the wire is disconnected from terminal blocks. All wires directly connected to trip circuit breaker or device shall be distinguished by the addition of red coloured unlettered ferrule.

4.6 Longitudinal troughs extending throughout the full length of the panel shall be preferred for inter panel wiring. Inter-connections to adjacent panel shall be brought out to a separate set of terminal blocks located near the slots of holes meant for taking the inter-connecting wires.

4.7 Contractor shall be solely responsible for the completeness and correctness of the internal wiring and for the proper functioning of the connected equipments

## **5. TERMINAL BLOCKS**

5.1 All internal wiring to be connected to external equipment shall terminate on terminal blocks. Terminal blocks shall be 1100 V grade and have 10 Amps continuous rating, moulded piece, complete with insulated barriers, stud type terminals, washers, nuts and lock nuts. Markings on the terminal blocks shall correspond to wire number and terminal numbers on the wiring diagrams. All terminal blocks shall have shrouding with transparent unbreakable material.

5.2 Disconnecting type terminal blocks for current transformer and voltage transformer secondary leads shall be provided. Also current transformer secondary leads shall be provided with short circuiting and earthing facilities.

5.3 At least 20% spare terminals shall be provided on each panel and these spare terminals shall be uniformly distributed on all terminal blocks.

5.4 Unless otherwise specified, terminal blocks shall be suitable for connecting the following conductors of external cable on each side

- All CT & PT circuits: minimum of two of 2.5mm Sq. copper.
- AC/DC Power Supply Circuits: One of 6mm Sq. Aluminium.
- All other circuits: minimum of one of 2.5mm Sq. Copper.

5.5 There shall be a minimum clearance of 250mm between the first row of terminal blocks and the associated cable gland plate or panel side wall. Also the clearance between two rows of terminal blocks edges shall be minimum of 150mm.

5.6 Arrangement of the terminal block assemblies and the wiring channel within the enclosure shall be such that a row of terminal blocks is run in parallel

and close proximity along each side of the wiring-duct to provide for convenient attachment of internal panel wiring. The side of the terminal block opposite the wiring duct shall be reserved for the Owner's external cable connections. All adjacent terminal blocks shall also share this field wiring corridor. All wiring shall be provided with adequate support inside the panels to hold them firmly and to enable free and flexible termination without causing strain on terminals.

5.7 All necessary cable terminating accessories such as gland plates, supporting clamps & brackets, wiring troughs and gutters etc. for external cables shall be included in the scope of supply.

## **6. PAINTING**

6.1 All sheet steel work shall be phosphated in accordance with the IS:6005 "Code of practice for phosphating iron and steel".

6.2 Oil, grease, dirt and swarf shall be thoroughly removed by emulsion cleaning.

6.3 Rust and scale shall be removed by pickling with dilute acid followed by washing with running water rinsing with a slightly alkaline hot water and drying.

6.4 After phosphating, thorough rinsing shall be carried out with clean water followed by final rinsing with dilute dichromate solution and oven drying.

6.5 The phosphate coating shall be sealed with application of two coats of ready mixed, stoved type zinc chromate primer. The first coat may be "flash dried" while the second coat shall be stoved.

6.6 After application of the primer, two coats of finishing synthetic enamel paint shall be applied, each coat followed by stoving. The second finishing coat shall be applied after inspection of first coat of painting. The exterior colour of paint shall be of a slightly different shade to enable inspection of the painting.

6.7 A small quantity of finished paint shall be supplied for minor touching up required at site after installation of the panels.

6.8 In case the bidder proposes to follow any other established painting procedure like electrostatic painting, the procedure shall be submitted for POWERGRID's review and approval.

## **7. MIMIC DIAGRAM**

7.1 Coloured mimic diagram and symbols showing the exact representation of the system shall be provided in the front of control panels.

7.2 Mimic diagram shall be made preferably of anodised aluminium or plastic of approved fast colour material, which shall be screwed on to the panel and can be easily cleaned. Painted overlaid mimic is also acceptable. The mimic bus shall be 2 mm thick. The width of the mimic bus shall be 10mm for bus bars and 7 mm for other connections.

7.3 Mimic bus colour will be decided by the POWERGRID and shall be furnished to the successful Bidder during Engineering.

7.4 When semaphore indicators are used for equipment position they shall be so mounted in the mimic that the equipment close position shall complete the continuity of mimic.

7.5 Indicating lamp, one for each phase, for each bus shall be provided on the mimic to indicate bus charged condition

## **8. NAME PLATES AND MARKINGS**

8.1 All equipment mounted on front and rear side as well as equipment mounted inside the panels shall be provided with individual name plates with equipment designation engraved. Also on the top of each panel on front as well as rear side, large and bold name plates shall be provided for circuit/feeder designation.

8.2 All front mounted equipment shall also be provided at the rear with individual name plates engraved with tag numbers corresponding to the one shown in the panel internal wiring to facilitate easy tracing of the wiring.

8.3 Each instrument and meter shall be prominently marked with the quantity measured e.g. KV, A, MW, etc. All relays and other devices shall be clearly marked with manufacturer's name, manufacturer's type, serial number and electrical rating data.

8.4 Name Plates shall be made of non-rusting metal or 3 ply lamicaid. Nameplates shall be black with white engraving lettering.

8.5 All the panels shall be provided with nameplate mounted inside the panel bearing LOA No & Date, Name of the Substation & feeder and reference drawing number.

## **9. MISCELLANEOUS ACCESSORIES**

9.1 Plug Point:

240V, Single phase 50Hz, AC socket with switch suitable to accept 5 Amps and 15 Amps pin round standard Indian plug, shall be provided in the interior of each cubicle with ON-OFF switch.

9.2 Interior Lighting:

Each panel shall be provided with a fluorescent lighting fixture rated for 240 Volts, single phase, 50 Hz supply for the interior illumination of the panel controlled by the respective panel door switch.

9.3 Switches and Fuses:

Each panel shall be provided with necessary arrangements for receiving, distributing and isolating of DC and AC supplies for various control, signaling, lighting and space heater circuits. The incoming and sub-circuits shall be separately provided with miniature circuit breakers (MCB). Selection of the main and sub-circuit MCB rating shall be such as to ensure selective clearance of sub-circuit faults. MCBs shall conform to IS :13947 . Each MCB shall be provided with one potential free contact and the same shall be wired for annunciation

purpose. However voltage transformer circuits for relaying and metering shall be protected by fuses. All fuses shall be HRC cartridge type conforming to IS:13703 mounted on plug-in type fuse bases. . Fuse carrier base as well as MCBs shall have imprints of the fuse 'rating' and 'voltage'.

#### 9.4 Space Heater :

Each panel shall be provided with a space heater rated for 240V , single phase, 50 Hz Ac supply for the internal heating of the panel to prevent condensation of moisture. The fittings shall be complete with switch unit .

### 10. EARTHING

10.1 All panels shall be equipped with an earth bus securely fixed. Location of earth bus shall ensure no radiation interference for earth systems under various switching conditions of isolators and breakers. The material and the sizes of the bus bar shall be at least 25 X 6 sq.mm perforated copper with threaded holes at a gap of 50mm with a provision of bolts and nuts for connection with cable armours and mounted equipment etc for effective earthing. When several panels are mounted adjoining each other, the earth bus shall be made continuous and necessary connectors and clamps for this purpose shall be included in the scope of supply of Contractor. Provision shall be made for extending the earth bus bars to future adjoining panels on either side.

10.2 All metallic cases of relays, instruments and other panel mounted equipment including gland plate, shall be connected to the earth bus by copper wires of size not less than 2.5 sq. mm. The colour code of earthing wires shall be green.

10.3 Looping of earth connections which would result in loss of earth connection to other devices when the loop is broken, shall not be permitted. However, looping of earth connections between equipment to provide alternative paths to earth bus shall be provided.

10.4 VT and CT secondary neutral or common lead shall be earthed at one place only at the terminal blocks where they enter the panel. Such earthing shall be made through links so that earthing may be removed from one group without disturbing continuity of earthing system for other groups.

### 11. INDICATING INSTRUMENTS

All instruments and meters shall be enclosed in dust proof, moisture resistant, black finished cases and shall be suitable for tropical use. All Bus voltage and frequency indicating instruments shall be provided with individual transducers and these shall be calibrated along with transducers to read directly the primary quantities. They shall be accurately adjusted and calibrated at works and shall have means of calibration check and adjustment at site. The supplier shall submit calibration certificates at the time of delivery. However no separate transducers are envisaged for digital bus voltmeters and digital frequency meters and the indicating meters provided in the synchronising equipment.

## 11.1 INDICATING INSTRUMENTS

11.1.1 Unless otherwise specified, all electrical indicating instruments shall have circular 240 degree scale and with a dial of 96mm x 96mm. They shall be suitable for flush mounting.

11.1.2 Instruments dial shall be with white circular scale and black pointer and with black numerals and lettering. The dial shall be free from warping, fading, and decolouring. The dial shall also be free from parallax error.

11.1.3 Instruments shall conform to IS:1248 and shall have accuracy class of 1.5 or better. The design of the scales shall be such as to have resolution suitable for the application. The marking of centre zero Watt /Var meters shall be IMPORT (on left) and EXPORT (on right) to indicate the direction of active/reactive power flow towards or away from the substation bus bars respectively.

11.1.4 Digital voltage and frequency meters shall be of class: 0.5 and shall have digital display of 5 and 4 digits respectively, with display size, not less than 25mm (height).

## 11.2 TRANSDUCERS

11.2.1 Transducers (for use with Indicating Instruments) shall in general conform to IEC: 688-1

11.2.2 The energy meter capability shall be used for measurement of active power, reactive power, voltage, current and frequency in three phase four wire unbalanced system.

11.2.3 One 33 kV C&R panel shall be installed for each incomer of 33 kV (Line incomer and 33 kV side of transformer). Each panel shall consist of energy meter, protection schemes, indication and control etc.

11.2.4 Voltage signal (440 Volt ac L-L) for voltmeter, PF meter, frequency meter, KW meter etc to be provided in the C&R panel shall be tapped from the respective PTs through a separate / independent copper cable.

## 11.3 ENERGY METER

Contractor shall provide Static TVM energy meter as described in document spec. no. PGCIL/BIHAR/ADLS.

## 11.4 ANNUNCIATION SYSTEM

11.4.1 Alarm annunciation system shall be provided in the control board by means of visual and audible alarm in order to draw the attention of the operator to the abnormal operating conditions or the operation of some protective devices. The annunciation equipment shall be suitable for operation on the voltages specified in this specification i.e. 30 Volt DC.

11.4.2 The visual annunciation shall be provided by annunciation facia, mounted flush on the top of the control panels.

11.4.3 The annunciator facia shall be provided with translucent plastic window for alarm point with approximate size of 35mm x 50mm. The facia plates shall be

engraved in black lettering with respective inscriptions. Alarm inscriptions shall be engraved on each window in not more than three lines and size of the lettering shall not be less than 5 mm.

11.4.4 Each annunciation window shall be provided with two white lamps in parallel to provide safety against lamp failure. Long life lamps shall be used. The transparency of cover plates and wattage of the lamps provided in the facia windows shall be adequate to ensure clear visibility of the inscriptions in the control room having high illumination intensity (350 Lux), from the location of the operator's desk.

11.4.5 All Trip facia shall have red colour and all Non-trip facia shall have white colour.

11.4.6 The annunciation system shall work in co-ordination with the existing annunciation system (hooter or bell) in the substation. If the same is not provided, hooter shall be supplied for above purpose.

11.4.7 Sequence of operation of the annunciator shall be as follows:

Sl No	Alarm condition	Fault contact	Visual Annunciation	Audible Annunciation (by Hooter)
1	Normal	Open	Off	OFF
2	Abnormal	Close	Flashing	ON
3	Accept push button pressed	Close Open	Steady on Steady on	OFF OFF
4	Reset push button is pressed	Close Open	On Off	OFF OFF
5	Lamp test push button pressed	Open	Steady On	OFF

11.4.8 Audible annunciation for the failure of DC supply to the annunciation system shall be provided and this annunciation shall operate on 240 Volts AC supply. On failure of the DC to the annunciation system for more than 2 or 3 seconds. (adjustable setting), a bell shall sound. A separate push button shall be provided for the cancellation of this audible alarm alone but the facia window shall remain steadily lighted till the supply to annunciation system is restored.

11.4.9 A separate voltage check relay shall be provided to monitor the failure of supply (240V AC) to the scheme mentioned in Clause above. If the failure of

supply exists for more than 2 to 3 seconds. this relay shall initiate visual and audible annunciation. This annunciation shall operate on Annunciation DC and buzzer shall sound.

## 11.5 SWITCHES

11.5.1 Control and instrument switches shall be rotary operated type with escutcheon plates clearly marked to show operating position and circuit designation plates and suitable for flush mounting with only switch front plate and operating handle projecting out.

11.5.2 The selection of operating handles for the different types of switches shall be as follows :

Breaker, Isolator control switches	:	Pistol grip, black
Selector switches	:	Oval or knob, black
Instrument switches	:	Round, knurled, black

11.5.3 The control switch of breaker and isolator shall be of spring return to neutral type. The switch shall have spring return from close and trip positions to "after close" and "after trip" positions respectively.

11.5.4 Instrument selection switches shall be of maintained contact (stay put) type. Voltmeter transfer switches for AC shall be suitable for reading all line-to-line and line-to-neutral voltages for non effectively earthed systems and for reading all line to line voltages for effectively earthed systems.

11.5.5 The contacts of all switches shall preferably open and close with snap action to minimise arcing. Contacts of switches shall be spring assisted and contact faces shall be with rivets of pure silver or silver alloy. Springs shall not be used as current carrying parts

The contact combination and their operation shall be such as to give completeness to the interlock and function of the scheme.

11.5.6 The contact rating of the switches shall be as follows :

<b>Description</b>	<b>Contact rating in Amps</b>
Continuous	30V DC, 10 Amp
Amp.	Make and carry 30V DC, 30
Break for Resistive load	30V DC, 20 Amp.

## 11.6 INDICATING LAMPS

11.6.1 Indicating lamps shall be of multiple LED panel mounting type with rear terminal connections. Lamps shall have translucent lamp covers to diffuse lights coloured red, green, amber, clear white or blue as specified. The lamp cover shall be preferably of screwed type, unbreakable and moulded from heat resisting material.



11.6.2 Lamps and its parts shall be interchangeable and easily replaceable from the front of the panel. Tools, if required for replacing the bulbs and lenses shall also be included in the scope of supply.

11.6.3 The indicating lamps shall withstand 120% of rated voltage on a continuous basis.

## 11.7 POSITION INDICATORS

11.7.1 Position indicators of "SEMAPHORE" type shall be provided when specified as part of the mimic diagrams on panels for indicating the position of circuit breakers, isolating/earthing switches etc. The indicator shall be suitable for semi-flush mounting with only the front disc projecting out and with terminal connection from the rear. Their strips shall be of the same colour as the associated mimic.

11.7.2 Position indicator shall be suitable for DC Voltage as specified. When the supervised object is in the closed position, the pointer of the indicator shall take up a position in line with the mimic busbars, and at right angles to them when the object is in the open position. When the supply failure to the indicator occurs, the pointer shall take up an intermediate position to indicate the supply failure.

11.7.3 The rating of the indicator shall not exceed 2.5 W.

11.7.4 The position indicators shall withstand 120% of rated voltage on a continuous basis.

## 12. RELAYS

12.1 All relays shall conform to the requirements of IS:3231/IEC-60255 or other applicable standards. Relays shall be suitable for flush or semi-flush mounting on the front with connections from the rear. Relays could be either of electromechanical,

12.2 All protective relays shall be in draw out or plug-in type/modular cases with proper testing facilities. Necessary test plugs/test handles shall be supplied loose and shall be included in contractor's scope of supply.

12.3 All AC operated relays shall be suitable for operation at 50 Hz. AC Voltage operated relays shall be suitable for 110 Volts VT secondary and current operated relays for 5 amp CT secondary. All DC operated relays and timers shall be designed for the DC voltage specified, and shall operate satisfactorily between 80% and 110% of rated voltage. Voltage operated relays shall have adequate thermal capacity for continuous operation.

12.4 The protective relays shall be suitable for efficient and reliable operation of the protection scheme described in the specification. Necessary auxiliary relays and timers required for interlocking schemes for multiplying of contacts suiting contact duties of protective relays and monitoring of control supplies and circuits, lockout relay monitoring circuits etc. also required for the complete protection schemes described in the specification shall be provided. All protective relays shall be provided with at least two pairs of potential free isolated output contacts. Auxiliary relays and timers shall have pairs of contacts as

required to complete the scheme, contacts shall be silver faced with spring action. Relay case shall have adequate number of terminals for making potential free external connections to the relay coils and contacts, including spare contacts.

12.5 All protective relays, auxiliary relays and timers except the lock out relays and interlocking relays specified shall be provided with self-reset type contacts.

12.6 No control relay which shall trip the power circuit breaker when the relay is de-energised shall be employed in the circuits.

12.7 Provision shall be made for easy isolation of trip circuits of each relay for the purpose of testing and maintenance.

12.8 Auxiliary seal-in-units provided on the protective relays shall preferably be of shunt reinforcement type. If series relays are used the following shall be strictly ensured :

- (a) The operating time of the series seal-in-unit shall be sufficiently shorter than that of the trip coil or trip relay in series with which it operates to ensure definite operation of the flag indicator of the relay.
- (b) Seal-in-unit shall obtain adequate current for operation when one or more relays operate simultaneously.
- (c) Impedance of the seal-in-unit shall be small enough to permit satisfactory operation of the trip coil on trip relays when the D.C. Supply Voltage is minimum.

12.9 All protective relays and alarm relays shall be provided with one extra isolated pair of contacts wired to terminals exclusively for future use.

12.10. The setting ranges of the relays offered, if different from the ones specified shall also be acceptable if they meet the functional requirements.

12.11 Any alternative/additional protections or relays considered necessary for providing complete effective and reliable protection should also be offered separately. The acceptance of this alternative/ additional equipment shall lie with the POWERGRID.

12.12 The bidder shall include in his bid a list of installations where the relays quoted have been in satisfactory operation.

All relays and their drawings shall have phase indications as R-Red, Y-yellow, and B-blue

12.13 PROTECTION:

**A) Transformer protection panel:**

- I.** Three shall be three over current(IDMT characteristic with a definite minimum time of 3.0 seconds at 10 times setting and have a variable setting range of 50-200% of rated current) and one earth fault element. Contractor may offer a composite unit also having these features.

**II.** There shall be high speed master trip hand reset lock out relay which shall receive inputs from all transformer protections and send command to trip coil of the circuit breaker directly.

**B) 33 kV line panels.**

**I.** There shall be three over current (IDMT characteristic with a definite minimum time of 3.0 seconds at 10 times setting and have a variable setting range of 50-200% of rated current) and one earth fault relay with directional element in each panel. The 33 kV lines are envisaged to operate in a synchronous ring having feed at multiple points. The 33 kV panels shall also house synchro-check relay.

**II.** There shall be high speed master trip hand reset lock out relay which shall receive inputs from all transformer protections and send command to trip coil of the circuit breaker directly.

**12.14 SUPERVISION RELAY**

- (a) Trip circuit supervision shall also be provided having adequate contacts for providing connection to alarm.
- (b) DC supply supervision shall also be provided having adequate contacts for providing connection to alarm.

**13. TYPE TESTS**

- 13.1 The following type tests shall be conducted on the Protective relays.
- a) Insulation tests as per IEC 60255-5
  - b) High frequency disturbance test as per IEC 60255-4 (Appendix -E) -Class III (not applicable for electromechanical relays)
  - c) Fast transient test as per IEC 1000-4, Level III (not applicable for electromechanical relays)
  - d) Relay characteristics , performance and accuracy test as per IEC 60255
    - Steady state Characteristics and operating time
    - Dynamic Characteristics and operating time for distance protection relays and current differential protection relays
  - e) Tests for thermal and mechanical requirements as per IEC 60255-6
  - f) Tests for rated burden as per IEC 60255-6
  - g) Contact performance test as per IEC 60255-0-20 (not applicable for Event logger , Distance to fault locator and Disturbance recorder )
- 13.2 Steady state & Dynamic characteristics tests on the relays (current differential protection relays), as type test, shall be carried out based on

general guide lines specified in CIGRE Committee 34 report on simulator/network analyser/PTL.

#### 14. CONFIGURATION OF C&R PANELS (33kV & 11kV)

Each panel shall consist of the following:

a	Ammeter	3 nos	for each bay
b	Wattmeter	1 no	for each line, transformer
c	Varmeter	1 no	for each bay, transformer,
d	CB control switch	1no	for each breaker
e	Red indicating lamp	1 no.	for each Circuit breaker
f	Red indicating lamp	1 no.	for each isolator
g	Green indicating lamp	1 no.	for each Circuit breaker
h	Green indicating lamp	1 no.	for each isolator
i	White indicating lamp (DC healthy lamp)	1 no	for each feeder
j	Annunciation windows Feeder with associated annunciation relays	1 Set	For Each Transformer,
k	Push button for alarm Accept/reset/lamp test	3 nos	for each control panel
l	Mimic to represent SLD	Lot	in all control panels
m	Voltmeter with selector Switch	1 no	for each new feeder/BUS
n	Cut out, mounting and wiring for WTI and selector switch	Lot	for transformers
o	Transformer REF relay	1 no	For each transformer of rating less than 5 MVA
q	Cut out for mounting & wiring for static energy meter(TVM)	1 no	for each Transformers 11 kV incoming & Outgoing and incoming feeder
r.	Trip circuit supervision relays	1 set	for each CB control panel
s.	DC supply Supervision relay	2 nos	As per scheme requirement

## TECH. SPECIFICATION OF C & R PANEL

- |    |  |                           |                   |
|----|--|---------------------------|-------------------|
| t. | Flag relays, aux. relays, timers, trip relays etc as per scheme requirements | As per scheme requirement | 1 Set             |
| u. | Bus frequency meter (Digital)  | 1 no.                     | for each main bus |
| v. | Bus healthy indication lamps   | 3 nos.                    | for each bus      |

**Note :**

- 1 For transformer feeders, all equipments of control panel shall be provided separately for HV and LV sides.
- 2 The above list of equipments mentioned for control panel is generally applicable unless it is defined elsewhere and in case of bay extension in existing substations, necessary equipments for matching the existing control panel shall be supplied
3. Each line /HV side of transformer/LV side of transformer /TBC shall be considered as one feeder for above purpose.

**TECHNICAL SPECIFICATIONS FOR 3 PHASE, 4 WIRE AC, STATIC, CLASS 0.5S, LT ENERGY METER (CT OPERATED)**

**1.0 SCOPE**

The specification covers the design, engineering, manufacture, assembly, inspection, type testing, testing at manufacturers' works before dispatch, packing supply and delivery at site, subsequent storage erection and commissioning at site (including handling, insurance during transit and storage), of Class 0.5s accuracy, LT, static electronic meters for tariff purpose, CMRI and software as per requirement given in this specification.

The bidder has to seal the meters and communication ports and provide a record (in hard copy as well as soft copy) of seals put on, progressively, every week. The record shall consist of following information of each consumer where the meter is proposed to be installed.

The meter shall be intended to be used for the LT consumers where metering shall be done on the LT side. Bidder shall have to supply suitable rating type tested CTs which shall be mounted in appropriate section of meter box. All mounting accessories including necessary hardware etc shall be supplied and erected by the contractor.

Consumer Name & Address, Consumer No. DT Number, 11 kV feeder no. / reference, 33 kV Sub station reference, Meter No. & Seals Nos.

The purchaser shall provide the details other than Meter No.& Seal Nos. for each consumer, before installation of meter.

The meter shall be 3-phase 4-wire type suitable for connection to 3 phase 4 wire system. The meter shall be capable to record & display KWH, KVARH, KVAH and maximum demand in KVA & temper events for 3 phase 4-wire system.

The meter shall consist of internal measuring elements (amorphous CTs and PTs), registers, operational indicators and test outputs enclosed together in the meter case. These CTs & PTs shall be suitably magnetically screened so as to avoid tempering the meter.

The bidder shall be responsible for attending to any post commissioning problems in equipments supplied for 10 years from the respective completion of warranty periods including supply of any parts etc. if required, on chargeable basis.

**2.0 STANDARDS APPLICABLE**

Unless otherwise specified elsewhere in this specification, the performance & testing of the meters shall conform to the following Indian/International standards and all related Indian/International standards to be read with upto-date and latest amendments/revisions thereof.

## TECH. SPECS FOR 3-P, 4-W, CT OPERATED STATIC ENERGY METER

Sl. No.	Standard No.	Title
1	IS 14697/1999	Specification of AC Static Watt hour meters, class 0.2s and 0.5s
2	CBIP Report No.88 (revised July 1996) read with amendments issued (April 99-Sep-99)	Specification for AC Static Electrical Energy Meters
3	CBIP Technical Report No.111	Specification for Common Meter Reading Instrument
4	IEC 687-1996	Specification for AC static Watt hour Meters Class 0.2 and 0.5

### 3.0 CLIMATIC CONDITION

The meters be supplied against this specification shall be suitable for satisfactory continuous operation under the following tropical conditions. Meters shall be capable of maintaining required accuracy under hot, tropical and dusty climate.

- i) Maximum Ambient Air Temperature in shade : 55°C
- ii) Minimum Ambient Air Temperature : -10°C.
- iii) Maximum Relative Humidity : 95% (condensing)
- iv) Minimum Relative Humidity : 10%
- v) Height above mean sea level\* : Upto 2200 meters
- vi) Average number of tropical monsoon (conditions/annum) : 5 months
- vii) Annual Rainfall : 100 mm to 1500 mm
- vii) Wind pressure : 200 kg /sqm

\* The specifications are applicable for meter installation upto an altitude of 2200 meter above mean sea level. For meters to be used for an altitude of above 2200 MSL necessary corrections shall have to be carried out in BIL and one minute power frequency with stand voltage capability as per relevant standard.

### 4.0 SUPPLY SYSTEM

#### 0.433 kV system

Rated pressure coil operating voltage 3x230 Volt (phase- neutral)  
Highest system voltage 0.44 kV phase to phase  
Rated Frequency 50 Hz  
Rated current through CT 100 Amp primary and 5 Amp Secondary.

Meter shall be programmed suitably keeping in view the CT ratio.

Rated current ( $I_b$ ) 3\* -/ 5 A (Connected through C T)

## TECH. SPECS FOR 3-P, 4-W, CT OPERATED STATIC ENERGY METER

### 5.0 POWER FACTOR RANGE

The meter shall be suitable for full power factor range from Zero (lagging) through Unity to Zero (leading).

### 6.0 POWER SUPPLY VARIATION

The meter should be suitable for working with following supply system variations.

Parameter	Operating range
Operating Voltage	70% to 120% of rated Voltage
Frequency	45 Hz to 55 Hz (i.e., 90% to 110% of rated freq.)

### 7.0 ACCURACY

The class of accuracy of meters for active energy shall be 0.5s. The accuracy should not drift with time.

### 8.0 POWER CONSUMPTION

8.1 The active and apparent power consumption on each voltage circuit including power supply of the meter at reference voltage temperature and frequency shall not exceed 1.5 watts and 8 VA per phase. (Table 6 of IS 14697: 1999)

8.2 The apparent power taken by each current circuit of the meter shall not exceed 1 VA per phase at basic current and reference frequency and temperature.

(Table 7 of IS 14697: 1999)

### 9.0 STARTING CURRENT

The meter shall start registering energy at 0.1% of the basic current and shall be fully functional within five seconds after the rated voltage is applied.

### 10.0 MAXIMUM CONTINUOUS CURRENT

The maximum continuous current in meters shall be 120% of rated basic current ( $I_b$ ) at which the meter purports to meet the accuracy requirements.

### 11.0 GENERAL & CONSTRUCTIONAL REQUIREMENTS

#### Meters

11.1 Meters shall be designed and constructed in such a way so as to avoid causing any danger during use and under normal conditions. However, the following should be ensured.

- a) Personal safety against electric shock
- b) Personal safety against effects of excessive temperature.
- c) Protection against spread of fire.
- d) Protection against penetration of solid objects, dust & water.
- e) Protection against fraud.



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- f) Protection against pilferage.
- g) Meter base and meter cover should be ultrasonically welded
- h) Protection against meter jamming by spurious signal injection/high magnetic field application.

11.2 The meter shall be designed with application specific integrated circuit and shall be manufactured using SMT (Surface Mount Technology). Power supply and voltage divider circuits may be of PTH technology.

11.3 All insulating material used in the construction of meters shall be non-hygroscopic, non-ageing and of tested quality. All parts that are likely to develop corrosion shall be effectively protected against corrosion during operating life by providing suitable protective coating.

The meter shall have an operation indication device such as a blinking LED/ LCD. The operation indicator shall be visible from the front window and capable of being monitored conveniently with suitable testing equipment.

11.4 The meter shall conform to the degree of protection IP 51 but without suction in the meter as per IEC 687 for protection against ingress of dust, moisture and vermin's.

11.5 The meter shall be supplied with a transparent extended terminal block cover (ETBC).

11.6 The meter-base, meter cover, terminal block and ETBC shall be made of unbreakable, high grade, fire resistant, reinforced, non-flammable, polycarbonate or equivalent high grade and good quality engineering plastic.

11.7 The meter cover shall have one window. The window shall be of transparent, high-grade engineering plastic for easily reading all the displayed values/parameters, nameplate details and observation of operation indicator. The window shall be ultrasonically welded with the meter cover such that it cannot be removed undamaged without breaking the meter cover seals.

11.8 The terminal block, the ETBC and the meter case shall ensure reasonable safety against the spread of fire. They should not be ignited by thermal overload of live parts in contact with them.

11.9 The terminal block shall be made of high grade non-hygroscopic, fire retardant, low tracking, fire resistant, reinforced poly-carbonate (not bakelite) or equivalent high grade engineering plastic which should form an extension of the meter case and have terminal holes and shall be of sufficient size to accommodate the insulation of the conductors, meeting the requirement of IS 14697: 199/CBIP technical report-88.

11.10 The terminals shall have suitable construction with barriers and cover to provide firm and safe connection of current and voltage leads of stranded copper conductors or copper reducer type terminal ends (thimbles). Appropriate bi metallic lugs should be provided with each meter for fixing of the conductor

11.11 The manner of fixing the conductors to the terminal block shall ensure adequate and durable contact such that there is no risk of loosening or undue heating. Screw connections transmitting contact force and screw fixing which may be loosened and tightened several times during the life of the meter shall be such that the

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risk of corrosion resulting from contact with any other metal part is minimized. Electrical connections shall be so designed that contact pressure is not transmitted through insulating material. The internal diameter of the terminal holes shall be 8.0 mm minimum. The clearance and creepage distance shall conform to relevant clause of IS 14697:1993/CBIP technical report No.88.

11.12 The meter shall be compact in design. The entire construction shall be capable of withstanding stresses likely to occur in actual service and rough handling during transportation. The meter shall be convenient to transport and immune to shock and vibration during transportation and handling.

11.13 The meter shall have a design to operate satisfactory for 10 years under normal electrical condition and guaranteed life of 12 months from the date of commissioning against manufacturing and design defects. The meters found defective within the guaranteed period shall be replaced / repaired by supplier free of cost within one month of intimation.

11.14 The meter shall be provided with an inbuilt accurate quartz crystal based real time clock and calendar, the maximum permissible drift in the real time clock shall be 5 minutes per year. The clock reading shall be adjustable through CMRI with proper security.

11.15 The integration period shall be set as 30 minutes as specified by SEB.

11.16 The bidder will give soft copy as well as hard copy of all the software's and technical details, software's pertaining to all meters and associated equipment supplied by him progressively every month.

### 12.0 MARKING OF THE METER

The marking on every meter shall be in accordance with relevant clauses of IS 14697/1999.

Every meter shall have nameplate beneath the meter cover such that the nameplate cannot be accessed without opening the meter cover and without breaking the seals of the meter cover and the nameplate shall be marked distinctly and indelibly. The basic marking on the meter nameplate shall be as follows:

- a) APDRP Project (Details to be given later)
- b) Manufacturer's name & trade mark
- c) Type Designation
- d) No. of phases & wires
- e) Serial number
- f) Year of manufacture
- g) Reference Voltage
- h) Rated Current
- i) Principal unit(s) of measurement
- j) Meter Constant (imp/kwh)
- k) Repeatability error as per IS 14697 -1999
- l) "Property of BSEB"

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m) Purchase Order No. & Date

### 13.0 SEALING OF METER

Reliable sealing arrangement should be provided to make the meter tamper evidence and avoid fiddling or tampering by unauthorized persons. For this, at least two (2) nos. seals on meter body, one (1) No. of seals on meter terminal cover and one (1) No. seal on each communication ports shall be provided. All the seals shall be provided in front side only. Rear side sealing arrangement will not be acceptable.

### 14.0 OUTPUT DEVICE

The meter shall have a test output accessible from the front and be capable of being monitored with suitable testing equipment while in operation at site. The operation indicator, must be visible from the front. Test output device shall be provided in the form of one common LED / LCD output device for KWH/KVAH/KVARH, with the provision of selecting the parameter being tested.

The relation between test output and the indication on display shall comply with the marking on the nameplate (imp per KWH/ KVAH/ KVARH).

### 15.0 COMMUNICATION PORT

The meters shall have a galvanically isolated continuous rated heavy duty optical communication port as per PACT/ ANSI/IEC 1107 so that it can be easily connected to a hand-held common meter reading instrument for data transfer and subsequently can be hooked to a remote metering device through PSTN/GSM/Radio modem, etc.

### 16.0 SOFTWARES

Licensed copies of the following software shall be made available and shall be installed on each common meter reading instrument (CMRI) and Base computer software (BCS) by the supplier.

Common Meter Reading Instrument (CMRI) would be loaded with user-friendly software (MS-DOS 5.0 or higher version compatible) for reading, downloading meter data and Time of Day (TOD) programming in the meter.

Windows based user interactive Base Computer Software (BCS) for receiving data from CMRI and downloading instructions from base computer software to CMRI. This BCS should have, amongst other requirements, features and facilities described later in this specification, the facility to convert meter reading data into user definable DBF (Access) and spreadsheet format for integrating with the purchaser's billing system. Here again an "Export wizard" or similar utility shall be available whereby user can select file format, what data to export, the field width selection so that it may be possible for the user to integrate the same with the user's billing data and process the selected data in desired manner.

Necessary software for loading application program into meter via CMRI serial port.

The software's shall have the flexibility to generate the following sets of reports

- Load survey reports – (refer 16.1)
- Tamper reports – (refer 16.2)

16.1 Load survey report for a pre determined time i.e. from \_\_\_\_\_ date to \_\_\_\_\_ date, to include the following.

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Customer ID, meter number, Consumer Connectivity references e.i. identity & location of pole / Distribution transformer reference, feeder reference, sub-division reference, division reference, circle reference, time, date, maximum demand ( kW) , kWh, power factor, kVAh, MD reset count, power on hours, outage duration, number of outages, Voltages max R,Y,B date time and duration, Voltages minimum R,Y,B date time and duration, load factor as (energy consumed/(maximum demand x power on hours)), average load as (energy consumed / power on hours), THD max date time and duration.

The load survey data should be available in the form of bar charts as well as in spreadsheets. The BCS shall have the facility to give complete load survey data both in numeric and graphic form.

16.2 Abnormality/tamper reports to include for a pre determined duration or month wise, tamper/abnormality count, tamper duration and tamper/abnormality history for each of the meters.

16.3 The bidder will provide soft copy of all the software in CD form along with the meters supplied.

16.4 The bidder to install & demonstrate working of software programmes of other meter manufacturers on the CMRI's to be supplied with this package as indicated in the BPS.

### 17.0 DISPLAY

17.1 The measured value(s) shall be displayed on seven segments, seven digit Liquid Crystal display (LCD) display unit, having minimum character height of 10 mm.

17.2 The data should be stored in non-volatile memory (NVM). The non-volatile memory should retain data for a period of not less than 10 years under un-power condition. Battery back-up memory will not be considered as NVM.

17.3 It should be possible to easily identify the displayed parameters through symbols/legend on the meter display itself.

17.4 In case of multiple values presented by a single display, it shall be possible to identify each displayed value/parameter through separate symbol/legend to be made available on the display itself.

17.5 The register shall be able to record and display starting from zero, for a minimum of 1600 hours, the energy corresponding to rated maximum current at reference voltage and unity power factor. The register should not roll over in between this duration.

17.6 In addition to providing serial number of the meter on the display plate, the meter serial number shall also be programmed into meter memory for identification through CMRI/meter reading print out.

### 18.0 DISPLAY SEQUENCE

The meter shall display the required parameters in two different modes as follows:

#### a) Auto Display Mode:

The following parameters hereinafter referred to as "Billing Parameters" (B.P) shall be displayed in an auto-cycle mode, in the following sequence: -

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- 1) Active energy import (forwarded) reading (kWh) of predefined date and time for billing purpose (BP kWh). However, Under CT reversal condition meter should record energy in forward direction and this should be added in energy import.
- 2) Maximum demand (kW) up to predefined date and time for billing purpose (BP kW).
- 3) Cumulative tamper count readings of predefined date and time of the last two consumption months.
- 4) Cumulative power on hours reading of predefined date and time of the last two consumption months (BP POH).

Each parameter shall be on meter display for 10 seconds and the time between two auto-cycles shall be 120 seconds.

### b) Push Button Mode:-

In addition to the auto display mode parameters listed in 18 (a), the following parameters, in the sequence given below, shall be displayed on pressing the push button(s):-

1. LCD segment check.
2. Real Time
3. Date – dd, mm, yy
4. Meter reading count
5. Cumulative power-on hours
6. Cumulative MD reset count
7. Cumulative Active energy forwarded (kWh)
8. Cumulative maximum demand (kW) of current month
9. Instantaneous phase voltage
  - 9.1 R Phase to neutral voltage
  - 9.2 Y Phase to neutral voltage
  - 9.3 B Phase to neutral voltage
10. Instantaneous line current (Amps)
  - 10.1 R Phase line current
  - 10.2 Y Phase line current
  - 10.3 B Phase line current
11. Supply Frequency (Hz)
12. Instantaneous load in –kW
13. M.D. in kW

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### c) History

History of last 12 months for all energy and demand parameter should be available in meter memory & should be downloadable through CMRI for further processing at BCS.

#### **Tamper Data:**

1. Present status of tamper
2. Date and time of last tamper occurrence with tamper identification
3. Date and time of last tamper restoration with tamper identification
4. Cumulative tamper occurrence count of all types of tampers.
5. TOD Maximum Demand (kW) Registers for 8 zones
6. TOD active energy (cumulative kWh) Registers for 8 zones

### **19.0 MAXIMUM DEMAND REGISTRATION**

The meter shall continuously monitor and calculate the average demand in kW during the integration period set and the maximum, out of these, shall be stored along with the date and time when it occurred in the meter memory. The maximum registered value shall also be made available on meter display.

The energy audit purpose parameters shall be registered and available for a minimum period of last 13 months.

### **20.0 MAXIMUM DEMAND RESET**

Facility for auto reset of MD at 00.00 hrs of first of every month shall be provided for which minimum 30 years calendar shall be programmed by the manufacturer. The meter shall display the maximum demand reset count.

### **21.0 SELF DIAGNOSTIC FEATURE**

21.1 The meter shall be capable of performing complete self-diagnostic check to monitor the circuits for any malfunctioning to ensure integrity of data memory location at all time. The meter shall have indication for unsatisfactory/nonfunctioning/malfunctioning of the following:

- a) Time and date on meter display.
- b) All display segments on meter display.
- c) Real Time Clock (RTC) status in meter reading prints out at BCS end.
- d) Non-volatile Memory (NVM) status in meter reading prints out at BCS end.

21.2 While installing the meter, it should be possible to check the correctness of Current Transformer, Potential Transformer, connections to the meter and their polarity from the functioning of the meter for different voltage injections with the help of phasor diagrams. For this purpose suitable software for field diagnosis of meter connections with the help of Meter Reading Instrument should be supplied.

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### 22.0 ABNORMALITY OF EVENTS

The meter should have features to detect the occurrence and restoration of at least the following abnormalities:

The meter shall function properly under following common abnormal conditions :

1. Phase sequence reversal	The meter shall keep working accurately irrespective of the phase sequence of the supply.
2. External magnetic influence	The metering system shall be provided with adequate magnetic shielding so that any external magnetic field (AC Electro Magnet or DC Magnet) as per the values specified in CBIP Technical Report No.88 (with latest amendments) applied on the metering system shall not affect the proper functioning and recording of energy as per error limits prescribed by CBIP.

Beside this, the meter should have features to detect the occurrence and restoration of, at least, the following common abnormal events:

- a) **Missing Potential & Potential imbalance:** The meter shall be capable of detecting and recording occurrence and restoration with date and time in the cases of Potential failure (one phase or two phases). All potential missing cases shall be considered as power failure. Meter shall also detect and log cases of voltage unbalance (from 5 % for more than 5 minutes or more- programmable) of voltages.
- b) **Voltage High / Voltage Low:** In case the average 3 phase voltage remains less (below 0.75Vref by default) than or above (above 1.15Vref by default) for a predefined period (15 minutes by default), the meter shall log such incidences with date & time. The voltage thresholds & persistence time shall be programmable using the CMRI & BCS. This abnormal condition shall be logged only when all the three-phase voltage is available.
- c) **Current imbalance:** The meter shall be capable of detecting and recording occurrence and restoration with date and time of Current unbalance (30% or more for more than 15 minutes- programmable).
- d) **Power on/off:** The meter shall be capable to record power on /off events in the meter memory. All potential failure should record as power off event.
- e) **Over load/ low load Hours:** The meter shall be capable of recording the over load / low load hours in KVA in the meter memory. The over loads limit shall be in terms of % of a limit set by purchaser (programmable using CMRI & BCS). The over/ under load limits shall be define by the purchaser during the time of final supply.

The meter shall record the total duration of the above abnormalities, time and date of their occurrences & restorations with a snapshots of electrical conditions viz. Voltage, current, PF etc

The meter shall keep records for the minimum last 250 events (occurrence + restoration) for above of abnormal conditions. It shall be possible to retrieve the abnormal event data along-with all related snap- shot's data locally using a hand held unit (HHU) through the meter's optical port or through remote data interrogation using

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remote communication interface & same can be viewed / analysed at Base computer end in simple and easily understandable format.

The threshold values for voltage, current and P.F. etc., for the purpose of logging occurrence and restoration of various types of tamper will be mutually decided by the purchaser and supplier. The supplier should, however, propose these values in their offer.

### **23.0 ABNORMALITY/ TAMPER LOGIC**

Properly defined meter abnormality/tamper logic should be provided. The logic should be capable of discriminating the system abnormalities from source side and load side and it should not log/record tamper due to source side abnormalities.

There shall be minimum three separate compartments for logging of different types of abnormalities/tampers.

Vendors under their offer should explain the logging of various abnormalities/tampers in each compartment.

Once one or more compartments have become full, the last abnormalities/tampers event pertaining to the same compartment will be entered and the earliest (first one)-abnormalities/tampers event should disappear. Thus, in this manner each succeeding abnormalities/tampers event will replace the earliest recorded event, compartment wise. Events of one compartment/category should overwrite the events of their own compartment/category only.

Abnormalities/tampers count should increase as per occurrence (not restoration) of abnormalities/tampers events. The total number of abnormalities/tampers counts should also be provided on the meter display as well as at the BCS end.

The persistence time for logging /registration of an occurrence & restoration of a temper should be 5 minutes - 10 seconds (programmable)

### **24.0 ELECTRO-MAGNETIC COMPATIBILITY AND INTERFERENCE REQUIREMENT**

The meter shall meet EMI/EMC requirements as specified in the relevant standards described in Clause 2.0 of this specification.

### **25.0 FIXING OF METERS**

Every meter should have three fixing holes, one at top & two at bottom. The top hole shall be provided with a special clip at the back of the meter so that the holding screw is not accessible after the fixing of meters. The lower fixing screw shall be provided under the sealed terminal cover. The requisite screws shall be supplied with each meter.

### **26.0 OTHER SALIENT FEATURES OF METERS**

- a) It should be possible to check the healthiness of phase voltages by displaying all the voltages on the meter display.
- b) The meter shall have provision of reading through communication port in the absence of power supply through an external source. An inductive coupling arrangement shall be provided so that it should not be possible to damage the circuit of the meter by applying excess voltage directly into the meter. The meter should be powered up using an external battery pack only in absence of power



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supply to the meter to enable taking of meter readings through display & communication port.

- c) The meter should work accurately irrespective of phase sequence of the supply.
- d) The meter should remain powered up and functional even when either of the two phases or one phase along with neutral is available to meter.
- e) The meter should continue to record accurately as per prevailing electrical conditions even if the neutral of the potential supply gets disconnected.

### 27.0 TESTS

Unless specifically waived off, all tests shall be witnessed by the purchaser.

#### 27.1 Meters

##### a) Type Tests:

One (1) out of every thousand (1000) meters or part of 1000 meters shall be subjected to the complete range of type tests prescribed in standards indicated in clause 2 above, at any of the NABL accredited test laboratories, after final assembly. In case of any failure to pass all specified tests, the bidder shall arrange to carry out the requisite modifications/replacements in the entire lot of meters at his own cost. After any such modifications and final assembly, two (2) meters selected out of the lot by the Owner's representative shall be subjected to the full range of type tests. The Owner shall accept the lot only after successful type testing.

The meters used for type testing shall be separately identified, duly marked, and supplied to the Owner in case they are fully functional and as good as other (new) meters, after necessary touching up/refurbishing. In case this is not possible, the bidder shall provide their replacements at no extra cost to Owner.

The Bidder shall arrange all type testing specified above, and bear all expenses for the same.

##### b) Acceptance Test:

All acceptance tests as stipulated in the relevant standards shall be carried out by the supplier in the presence of the purchaser's representative.

##### c) Routine Tests:

All routine tests as stipulated in the relevant standards shall be carried out and routine test-certificates/reports shall be submitted to the purchaser for approval.

### 28.0 Installation and Commissioning

The static energy meters specified above shall be installed at the premises of various consumers, located in ----- (List of consumers to be provided by the purchaser after award of work) The exact location and time-table for installation shall be finalized by the purchaser in due course, and advised to the bidder, such that bidder's responsibility in this respect ends within ----- months of completion of all supplies.

The Bidder shall be responsible for total installation and commissioning of the meters (along with test blocks, if supplied separately) as per Owner's advice, including unpacking and inspection on receipt at site, mounting the meters, connection of input& output cables to the meters including any required rewiring, functional testing, commissioning and handing over. The Bidder's personnel shall procure/carry the

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necessary tools, equipment, materials and consumables (including insulated wires, lugs, ferrules, hardware etc.).

As a part of commissioning of CMRI the Bidder shall load the software specified in this specification into the PCs at the Base computer stations, and fully commission the total meter reading scheme. He shall also impart the necessary instructions to Utility engineers.

Following technical information shall be furnished by the Bidders in their offers :

- i) Foreseen dimensions of proposed meter.
- ii) Expected weight of proposed meter.
- iii) Foreseen dimensions of CMRI
- iv) Expected weight of CMRI
- v) Details of Meter testing equipment proposed to be supplied.
- i) Dimensions and weight of the test block, if supplied separately.

### **29.0 QUALITY ASSURANCE PLAN**

29.1 The vendor shall furnish the following information along with his bid; failing which his bid shall be liable for rejection. Information shall be separately given for individual type of material offered.

- i) The structure of Organization
- ii) The duties and representatives assigned to staff ensuring Quality of work
- iii) The system of purchasing, taking delivery and verification of materials
- iv) The system for ensuring quality of workmanship
- v) The quality assurance arrangements shall conform to the relevant requirement of ISO 9001 or ISO 9002 as applicable
- vi) Statement giving list of important raw materials names of sub-suppliers for the raw materials, list of sub-suppliers for the raw materials, list of standards according to which the raw materials are tested. List of test normally carried out on raw materials in presence of vendor's representative, copies of test certificates.
- vii) Information and copies of test certificates as in (i) above in respect of bought out accessories.
- viii) List of manufacturing facilities available.
- ix) Level of automation achieved and list of areas where manual process exists.
- x) List of areas in manufacturing process, where stage inspections are normally carried out for quality control and details of such tests and inspections.
- xi) Lists of testing equipment available with the bidder for final testing of equipment specified and test plant limitation. If any, vis-à-vis the type,

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special acceptance and routine tests specified in the relevant standards. These limitations shall be very clearly brought out in schedule of deviations from specified test requirements.

29.2 The vendor shall also submit following information:

- i) List of raw materials as well as bought out accessories and the names of sub-suppliers selected from those furnished along with offers.
- ii) Type test certificates of the raw materials and bought out accessories as required by the utility.
- ii) Quality Assurance Plan (QAP) withhold points for purchaser's inspection. The quality assurance plan and purchasers' hold points shall be discussed between the purchaser and vendor before the QAP is finalized.

### **30.0 GUARANTEE**

Manufacturer shall undertake a guarantee to replace the meters upto a period of 12 months from the date of installation, which are found defective/inoperative at the time of installation, or became inoperative/defective within the guarantee period. These defective/inoperative meters shall be replaced within one month of receipt of report for such defective/inoperative meters.

### **31.0 SERVICES**

Manufacturer shall also extend services to repair the meters on chargeable basis, up to a period of 108 months from the date when the guarantee period is over i.e. after 12 months of installation & successful operation of the instant meter. These defective/inoperative meters shall be repaired within a month time at reasonable charges for which Supplier shall open a Customer Support Office at the place(s) mutually agreed by supplier and owner.