

## **TECHNICAL SPECIFICATIONS OF 2X 750 KVA DG SET**

### **1.0 INTENT OF SPECIFICATION:**

**1.1** This specification covers the design, manufacture, assembly, shop testing, packing, dispatch, transportation, supply, erection, testing, commissioning, performance and guarantee testing of Silent type Diesel Generating Sets, complete in all respects with all equipment, fitting and accessories for efficient and trouble-free operation as specified here under including statutory approvals.

### **1.2 SCOPE OF WORK :**

General Scope of work shall include design, manufacture, shop testing, packing, dispatch, transportation to site, supply, erection, testing and commissioning of the following:

- a) Diesel engine complete with all accessories, an Alternator directly coupled to the engine through flexible/ rigid coupling complete with all CTs, PTs, etc as required or as per BOQ & specifications, accessories for starting, regulation and control, including base frame, foundation bolts etc, interconnecting piping and accessories, power and control cables, glands and lugs.
- b) AMF & Synchronising panel including various meters/Annunciation and other control components as per standard practice, BOQ & specifications. Control panel cabling between bidder's & local equipment and special cables if any.
- c) Equipments necessary for fuel storing and distribution, day fuel tank, piping, valves, level controller and indicators etc. Load sharing facility with Synchronization Panel.
- d) Flexible connections and Hospital Grade Silencer of exhaust system, including thermal lagging inside canopy with rain cap suitably optimized to meet stringent noise limit silencer specifically tuned to EATS.
- e) Batteries with MS battery stand painted with one coat of Zinc Oxide and two coat of acid proof black paint and battery charging equipment, including their connections as necessary along with tools & accessories for battery maintenance.
- f) Anti Vibration Mountings etc.
- g) Preparing of all related shop drawings for approval from client/consultant and statutory bodies. Work shall be as per Final approved drawings
- h) Obtaining approval/licencing of the installation of Diesel Generators by the Electrical Inspectorate and Pollution Control bodies and any other statutory bodies. Any other registrations of Genset (eg. Industry department)
- i) Carrying out performance and guarantee test i.e. full load test for 6 hrs followed by 1 hour 110% over load and again 6 hrs full load (Total 13 hours). Vendor has to make arrangements for oil lubricants, HSD, other consumables and Electrical load of 110% capacity etc. as required
- j) The DG set shall be mounted on a suitable designed fabricated rigid common base frame with antivibration pads to provide not less than 99% vibration isolation. First filling of lube oil & HSD shall be included in DG - sets cost. The DG Set shall include all standard accessories, fittings, instruments and 3 sets of operating & maintenance manuals, spare parts

list etc. complete as per technical specifications. The DG set shall be inclusive of AMF controller, Fuel day tank, Hospital Grade Silencer of exhaust system, including thermal lagging inside canopy with rain cap suitably optimized to meet stringent noise limit silencer specifically tuned to EATS etc. complete as required.

k) The DG Sets shall be subjected to load tests at factory before dispatch & at IUCAA site after installation in the presence of IUCAA's representative with consultant. All consumables required during testing of DG Sets at factory & site testing shall be included in the scope of DG vendor. All consumables required during trial run of DG Sets on load for 13 hours out of which six hours for run up to full load, followed by six hours on full load and concluded by one hour 110% overload capacity to be arranged by DG Vendor. Also, Vendor has to arrange the 110% of rated capacity load bank availability for testing at factory and at IUCAA. The test shall be carried out as per Technical Specification & records to be submitted for approval. (The formats of all tests carried out at factory & at site with details of relevant standards as per latest standards & permissible limits should be submitted by DG vendor for reference along with tender).

**l) The design of DG Sets shall conform to the requirement of CPCB IV+ norms (CPCB IV+ Emission Compliant) for all parameters including flue gas emission and noise level.** DG set should be provided with standard accessories like anti vibration pads, AVR, electronics Class G3 governor, breaker, MFM, microprocessor-based controller (latest version), control cables, power cables complete as required up to AMF panel. BMS compatible ports & I/Os.

m) RCC foundation as per OEM's drawings, minor civil works like chasing, grouting etc, for execution of jobs. All materials must possess high quality.

#### **BMS Requirement:**

DG Vendor to specify the BMS system architecture shall be able to satisfy the client's requirement. Following are some of requirement listed for guidance but not limited to:

- 1) RS 485 / Backnet Output from each DG set for BMS.
- 2) Analog input along with monitor points for fuel level, generated voltage, current, engine temperature, Battery voltage, charging current, frequency & over speed, RPM, coolant temperature, oil temperature etc.
- 3) Potential free contacts from each DG set breaker for BMS for ON/OFF/Trip status
- 4) BMS Controller with 5 Universal Inputs and 5 Binary Outputs in MS Enclosure with required power supply, connectors, internal wiring etc.
- 5) Convertor with 2 inputs and 1 RS 232/485 output, cabling etc.

#### **GENERATOR STANDARD FEATURES:**

- 1) Vendor to provide one-source responsibility for the generating system and accessories.
- 2) The generator set and its components are prototype-tested, factory-built, and production-tested.
- 3) Two-year warranty covers all systems and components.
- 4) Industrial diesel engine with 24 Volt battery charging alternator.
- 5) Rated capacity Alternator with insulation class H & IP 23 protection.
- 6) Unit-mounted radiator.
- 7) Subbase fuel tank – Not less than 990 litres. capacity with float type level indicator, seven segment digital fuel level indicator.
- 8) Vibration isolators.
- 9) Dry type air filter with restriction indicator.

- 10) Fuel Water separator.
- 11) Main line breaker.
- 12) Starting battery and cables.
- 13) Sound enclosure with 75dB(A), (fully water proof)
- 14) Conveniently locate fuel level indication.
- 15) Operation and installation literature.

**ADVANCED DIGITAL CONTROL:**

Compact Controller comprising of :  
LED display for measurement of-

- 1) Runtime hours
- 2) Current
- 3) Voltage
- 4) Frequency & PF
- 5) Engine temperature & Oil Pressure
- 6) Engine speed (RPM)
- 7) Battery Voltage
- 8) Fuel level
- 9) Routine maintenance indicator

LED display faults:

- 1) High engine temperature
- 2) Low oil pressure
- 3) Over crank
- 4) Overspeed
- 5) Over & under voltage
- 6) Over & under frequency
- 7) E-stop
- 8) Auxiliary fault
- 9) Display warning:
- 10) Low/High battery voltage
- 11) High battery voltage
- 12) Low fuel level
- 13) Fuel Theft

Along with Remote monitoring system on Mobile phone or Desktop

Note: Vendor has to provide latest version of controller for a separate DG

**STANDARD FEATURES & ACCESSORIES:**

- 1) Master switch: Run/Off-Reset/Auto
- 2) Current selector switch
- 3) Remote two-wire start/stop capability
- 4) Event log
- 5) Superior electronics
- 6) Factory-built and production-tested
- 7) Automatic start with programmed cranking cycle
- 8) Field software upgrade possibility
- 9) Environmental specifications:
  - i) Operating temperature : - 10°C to 55°C
  - ii) Humidity : 0--95% condensing
- 10) Power Requirements:

24 VDC with fuse protection  
250 mA @ 24 VDC  
125 mA @ 24 VDC

- 11) Battery charger 24V
- 12) Mains sensing relay
- 13) Earth leakage protection

### **Important Notes:**

- 1) DG Set should accept 55% load of rated capacity of DG Set in one step at the time of starting.
- 2) DG Set's panel shall be suitable for Auto operation controlled through AMF Relay as well as manual operation.
- 3) DG Set supplier shall provide microprocessor-based DG's Local Control panel mounted on the engine having all electrical parameters, and fault indication with provision for its remote control.
- 4) DG Supplier should provide for all required hardware (converter to give BACnet compatibility, control wiring, potential free NO/NC, RS ports, A/D & D/A converters etc. as required to operate the BMS system software.) arrangement for remote start/stop and DG fault (LLOP, over speed) etc. along with remote adjustment of voltage & speed of the engine (Motorised/ solid state pot. may be required) & shall be included in the quoted rates as required.
- 5) The neutral CTs as per specification shall be provided on the neutral side of winding and connection brought out to a neutral CT box to be mounted on the alternators (All the six terminals are to be brought out and then shorted).
- 6) Supply, installation, testing & commissioning of Hospital Grade Silencer of exhaust system, including thermal lagging inside canopy with rain cap suitably optimized to meet stringent noise limit silencer specifically tuned to EATS **as per CPCB IV+ norms** with 100mm glass/ mineral wool insulation complete with wire chicken mesh and 22 gauge Aluminium cladding from engine up to silencer, including supporting arrangement suitable for the following DG Set complete as required.
- 7) Supply, fabrication, installation, testing & commissioning of M.S. day fuel tank fabricated out of min. 2.5 mm thick M.S. sheet installed on steel frame or masonry pedestal with all associated accessories, filters, valves & fittings including level controller, priming motor complete as required, float switch with contacts for remote interlock should be provided. The tank shall be suitably treated with diesel resistant paint/anticorrosive treatment. The contact of level controller shall be wired up terminal block. or as per manufacturer's design included in the enclosure. The tank level remote indicator to be provided at some suitable location as advised by client in the canopy.

### **1.3 CODES AND STANDARDS :**

1.3.1 The equipment furnished under this specification shall conform to the following latest standards, except where modified or supplemented by this specification.

<b>BS: 5514</b>	<b>: Specification for reciprocating internal combustion engine.</b>
BS: 5000	: Rotating electrical machines of particular type or for particular applications.
IS: 1239 (Part-I & II)	: Mild steel tubes and fittings.
S/IEC 60034-1	: Rotating electrical machines - Part 1: Rating and performance

ISO 1460 - ISO 1460:2020 - Metallic coatings

ISO 8528 - Reciprocating internal combustion engine driven alternating current generating

sets

ISO 9001 - international standard that specifies requirements for a quality management system (QMS)

ISO 13018 - Internal Combustion Engines - Method of Test for Pressure Charged Engines

- IS: 1651 : Stationary cells and batteries lead acid type (with tubular positive plates).
- IS: 9224 : Specification of low voltage fuses, General purpose.
- IS: 4540 : Mono-crystalline semi-conductor rectifier assemblies and equipment.
- IS: 4722 : Rotating electrical machines.
- IS: 1248 : Specification for electrical indicating instruments.
- IS: 10000 : Methods of tests for internal combustion engines.
- IS: 10002 : Specifications for performance requirements for constant speed compression ignition (Diesel) engine for general purposes (above 20 KW)
- IS: 2147 : Degree of protection provided by enclosure for low voltage switchgear and control gear.
- IS: 1600 : Code for type testing of constant speed IC engines for general purposes.
- IS: 1601 : Performance of constant speed IC engines for general purposes.

ISO 8178-1: 2017 ISO 8178-1: 2020 - Reciprocating internal combustion engines — Exhaust emission measurement — Part 1: Test-bed measurement systems of gaseous and particulate emission.

ISO 8178-3: 2019 - Exhaust emission measurement — Part 3: Test procedure for measurement of exhaust gas smoke emissions from compression ignition engines using a filter type smoke meter.

ISO 8178-4: 2017 ISO 8178-4: 2020 - Reciprocating internal combustion engines — Exhaust emission measurement — Part 4: Steady-state and transient test cycles for different engine application.

ISO 8178-7: 2015 - Reciprocating internal combustion engine-Exhaust emission measurement-Part-7: Engine family determination.

ISO 8178-9: 2019 - Reciprocating internal combustion engines — Exhaust emission measurement — Part 9: Test cycles and test procedures for measurement of exhaust gas smoke emissions from compression ignition engines using an opacimeter.

40 CFR Part 1039 - US EPA Regulation: 40 CFR Part 1039 - Control of emissions from new and in-use nonroad compression-ignition engines.

40 CFR Part 1065 - US EPA Regulation: 40 CFR Part 1065 – Engine testing procedures.

1.3.2 The installation work shall conform to Indian Electricity act and Indian Electricity Rules as amended upto the date of installation. The fuel oil installation shall meet all statutory requirements of Govt. of India as amended up to the date of installation. Any approval required from statutory authorities shall be obtained by the contractor. Nothing in this specification shall not be the limiting factor to relieve the contractor of their responsibilities.

1.3.3 The equipments furnished under this specification have to operate in a tropical climate and shall be given tropical and fungicidal treatment as per relevant specification.

#### **1.4 ENGINE :**

##### **1.4.1 Type :**

The diesel engine shall be of stationary type 6 or more Cylinder, In Line 4 stroke Turbo charged, radiator cooled engine and technologically advanced engine to meet stringent exhaust emission norms as per the latest MoEF notification. **DG Sets shall conform to the requirement of CPCB IV+ norms (CPCB IV+ Emission Compliant) for all parameters including flue gas emission and noise level.**

##### **1.4.2 Rating :**

- a) BHP rating of the engine shall be such that the DG set can continuously deliver the specified net electrical output while supplying power/driving all electrical and mechanical auxiliaries connected to alternator terminals and engine shaft at specified site conditions and ambient temperature of 50 deg C.
- b) It shall also be capable of satisfactorily driving the alternator at 10% over load at the rated speed for one hour in any period of 12 hours of continuous running.

**The successful bidder shall have to furnish supporting calculations to arrive at the diesel engine rating.**

##### **1.4.3 Speed and Vibration Level :**

Speed shall be 1500 revolutions per minute. Speed governor/over speed protection shall be provided. At due running conditions, speed shall be stabilized at plus or minus 2% nominal speed, regardless of load. At transient condition, engine speed shall vary not more than 10% plus or minus. Governor class shall be G3 for normal application unless otherwise specified. The Governor of all DG set shall be of similar characteristics to enable synchronization. The engine vibration level shall be within the permissible limits.

##### **1.4.4 Lubrication :**

- a) The engine shall have a closed cycle forced & splash lubricating system with positive oil pressure and a crank chamber for collection/storage of the lubricating oil during circulation. No moving part shall require lubrication by hand or any other external source either prior to the starting of the engine or when it is in operation.
- b) A lubricating oil filter shall be provided for operation under normal conditions for a period of 500 hours without the necessity of its replacement or cleaning.
- c) In case lubricating oil coolers are required they shall be of the water-cooled type and shall be supplied as an integral part of the Diesel Generator Set.
- d) Necessary temperature and pressure gauges and other instruments shall be supplied and fitted on the lubrication system.
- e) A lubricating oil level dipstick suitably graduated shall be provided and located in the accessible position.

##### **1.4.5 Fuel System :**

- a) The engine shall be capable of running on all types of diesel fuel oil normally available in India.

- b) The fuel consumption of the engine at full, three quarters and half of its rated power output shall be indicated by the Contractor in the bid.
- c) A fuel service tank of capacity as specified in BOQ shall be provided on a suitably fabricated steel platform. The tank shall be complete with level indicator marked in litres, filling inlet with removable screen, an outlet, a drain plug, an air vent and necessary piping. The fuel tank shall be painted with oil resistant paint. Service tank level switches (2 Nos. per tank) for alarm & trip shall also be provided by the bidder. All pipe joints should be brazed/ welded. Digital Fuel level indicator recommended with clear 7 segment display.
- d) A hand pump for pumping the fuel into the fuel service tank together with necessary pipes or tubing shall be provided. The inlet of the pump shall be provided with 10 meters long armoured hose with suitable filter & nozzle.

#### **1.4.6 Air Intake System :**

The diesel engine shall be provided with special dry type air filters having low resistance to air passage, high dust retaining efficiency and provision for easy cleaning. Filters shall be suitable for achieving satisfactory engine operation and ensuring the engine life under tropical humid conditions, with sulphur dioxide and trioxide fumes, abrasive dust and coal particles of 5 to 100 microns present in the atmosphere. The minimum efficiency of filters shall be 90% down to 5 micron size.

#### **1.4.7 Cooling :**

The diesel engine should be liquid/fluid cooled.

#### **1.4.8 Engine Governor :**

The governor shall be Class G3 type Electronic Governor as per ISO 8528 part V. It shall have necessary characteristics to maintain the speed substantially constant even with sudden variation in load. However, a tripping shall be provided if speed exceeds maximum permissible limit. The governor shall be suitable for operation without external power supply.

#### **1.4.9 Turbo Charger :**

It shall be of a robust construction, suitable of being driven by engine exhaust having a common shaft for the turbine and blower. It shall draw air from filter of adequate capacity to suit the requirements of the engine.

#### **1.4.10 Quietness of Operation :**

- a) The engine shall be designed to achieve maximum quietness of operation.
- b) Efficient Hospital Grade Silencer shall be provided for the exhaust as well as the air intake.
- c) Noise level of the set shall not exceed 75 dB at One meter distance of the DG Set.

#### **1.4.11 Engine Starting :**

- a) Engine starting shall be by electric starting motor complete with manual/automatic starting arrangement. The starter motor shall conform to IS-4722 and shall be of adequate power for its prime duty and be of inertia or pre- engaged type. The pinion shall positively disengage when the engine starts up or when the motor is de-energised. The engine cranking shall be only from the panel and any engine starting devices etc, that are given as original fitment on the engine by engine manufacturers shall be either removed or padlocking arrangement given for

this so that all normal start/stop operations could be done only from panel whether the set is AMF or manual.

**b) Time for Run-up to Speed :**

From the initial operation of the starting device, the engine shall start, run up to normal speed and be capable of accepting 80% of full load within a maximum time of 25 seconds, and full load within a further 5 seconds.

**c) Duty Cycle / Period of Operation :**

The set is intended to supply power only during an emergency for essential services and may be idle for long periods except for periodic routine run once in a day for a short time. When there is a total failure of mains power supply, the sets shall be required to operate continuously at full load for a period which at times may exceed even 18 hours at a stretch. It shall also be capable of satisfactorily running at 10% overload at the rated speed for one hour in any period of 12 hours of continuous running.

**i) Starting Duty :**

This DG Set shall withstand and shall be able to take care of starting load of largest machine and other running loads (55% of rated capacity).

**ii) Running Duty :**

This D G Set shall be capable of running continuously on primary duty of about 100% of its name plate rating. Prime power applicable for supplying power to varying electrical load for unlimited hours. Prime Power (PRP) is in accordance with ISO 8528.

**1.4.12 Engine Instrumentation :**

The following instruments mounted on instrument panel shall be essentially present as minimum, Engine speed tachometer with service hour counter.

- Lube oil pressure gauge
- Lube oil temperature gauge
- Coolant water temperature gauge

The instrument panel shall be mounted on engine using rubber dampers for vibration isolation. The gauge dials shall have clear red marking to identify the limiting dangerous levels, 'Zone markings' on the scale to indicate the normal healthy & abnormal operating zones for the parameters concerned. The metering could be either normal electromechanical analogue type or electronic digital type, latter being preferred as manufacturers fitment only.

**1.5 ALTERNATOR :**

1.5.1 The alternator shall be brushless type screen protected with revolving field Self-excited alternator conforming to IS/IEC 60034-1 Better motor starting capability and static excitation circuit controlled by field control unit suitably compounded for voltage and load current for a self-excited self-regulated system.

1.5.2 The alternator shall be in Screen Protected Drip Proof (SPDP) IP 23 enclosure, foot mounted with ball and roller bearings on end shields.

1.5.3 The alternator shall conform to IS: 4722 / IS/IEC 60034-1/ BS: 2613 and shall be suitable for tropical conditions.

1.5.4 The alternator shall comply with the following specifications:

Rating	As specified in the B.O.Q
Voltage	415 V
Voltage Regulation (Max.)	±1%
Speed	1500 RPM.

Frequency - 50 Hz.  
P. F. - 0.8 lag  
Waveform distortion/Total Harmonic Distortion - No load < 1.5%, Non distorting balanced linear load < 3 %.

Enclosure IP: 23.  
Insulation 'H' grade  
Maximum Unbalanced Load across phases - Less than or equal to 25%  
Telephonic Harmonic factor - < 2%

Excitation - Self excited, self-regulated with brushless system and static voltage control unit suitably compounded for voltage and current to maintain terminal voltage constant at  $\pm 1\%$  at all load for p.f. not less than 0.8. Terminal Box shall be suitable Rating of cable for terminating DG Sets of rating specified in BOQ with Earthing studs.

1.5.5 Alternator meets IS/IEC 60034 and the relevant section of other international standards such as BS5000, VDE 0530, NEMA MG1-32, IEC600034-1, CSA C22.2-100, AS1359. Superior voltage waveform form a 2/3 pitch wound stator

## **1.6 DIESEL GENERATOR CONTROL PANEL :**

### **1.6.1 General :**

- a) The control panel shall be sheet steel enclosed and shall be dust, weather and vermin proof providing a degree of protection of IP-54 and as per IEC 61439 part 1 and 2 standards. Sheet steel used shall be cold rolled and at least 2.00 mm thick and properly braced and stiffened.
- b) Control panel shall be provided with hidden hinged door(s) with pad locking arrangement and suitable brackets/channels shall be provided for floor mounting.
- c) All doors, removable covers and plates shall be gasketed all around with neoprene gaskets. All accessible live connections shall be shrouded and it shall be possible to change individual switches, fuses, ACBs, MCBs without danger of contact with live metal.
- d) All live parts shall be provided with at least phase to phase and phase to earth clearances in air of 30 mm and 25 mm respectively.
- e) Adequate interior cabling space and suitable removable cable gland plate shall be provided. Necessary number of cable glands shall be supplied and fitted on to this gland plate. Cable glands shall be screwed on type and made of brass.
- f) Two number of earthing terminals shall be provided.
- g) All sheet steel work shall be degreased, pickled, phosphate and then applied with two coats of finishing powder coating both inside and outside of shade Siemens Grey.

**1.6.2 Control of Diesel Generating Sets :** a) DG Set shall be capable of being controlled independently. Diesel Generator shall be capable of being stopped manually from remote as well as local. However, interlock shall be provided in the DG local control panel to prevent shutting down operations as long as DG Control circuit breaker is closed.

### **Auto Operation:**

Necessary control equipment and system incorporating various function etc. shall be provided to ensure following: -

When mains power is available, the healthiness of this power shall be monitored through a mains voltage monitor. If voltage on the 3 phases are within limits, the monitor will send a closing signal to the mains breaker and mains power will be connected to the load.

If the voltage drops on any phase or on all phases, the monitor shall sense this drop, and if this drop persists for more than a pre-adjusted period of time (say 1 to 60 seconds) a signal is sent to start the DG sets. While at the same time opening the mains supply breaker and disconnecting load from mains as voltage is below acceptable limits.

The Command shall be sent for starting the engine through the starting solenoid. When the engine is healthy, it starts up in a few seconds and the generator develops voltage and when the voltage is developed, this give a signal to the generator breaker/contactors which closes and connects the diesel generator to the load (three DGs get synchronised first). Simultaneously, it sends a signal to de-energise the engine starting circuit and the starter motor is disengaged. The engine protection circuits for high water temperature and low lubricating oil pressure and engine over speed are also energised.

***b) Resumption of Supply :***

If voltage from mains is resumed, the main voltage monitor will sense this voltage for healthiness, i.e. for maintained correct voltage for a period of time (adjustable upto three minutes) and then send a signal to the panel to stop the engine and to change over the breakers from generator to mains and normal supply is resumed to the load. Provision shall also be made for effecting the change over to normal supply through a selector switch.

***c) Failure to Start :***

A three-attempt starting facility similar to using two impulse timers and a summation timer for engine shall be provided and if voltage fails to develop within 30 seconds from receiving the first start impulse, the set shall lockout automatically and a visual and audible alarm shall be given in the remote panel. The panel shall receive "DG Trouble Alarm" (potential free contacts to be provided).

**1.7 ENGINE SAFEGUARDS:**

Safeguards shall be provided and arranged when necessary to stop the engine automatically by the following:

- a) Energising a solenoid coupled to the stop lever on the fuel injection pump rack.
- b) Deenergising "fuel on" solenoid or
- c) Energising the "fuel - cut off" solenoid.

The operation of the safeguard shall at the same time give individual warning of the failure by illuminating an appropriate local visual indicator and remote alarm at generator panel.

The contactors, relays and other devices necessary for signal and control, for above purposes shall be provided at Generator panel.bn

At the set at a easily accessible place an "EMERGENCY STOP" mushroom head stay put type P.B shall be provided to stop the set in emergency mode.

The safe guards to "STOP THE SET" shall stop the set irrespective of mode selection of the set viz Auto, Manual or test for following cases, with simultaneous isolation of alternator circuit.

Emergency stop P.B's operation.

b) Over speed.

c) Low lube oil pressure.

d) Earth fault or restricted earth fault or differential faults of Alternator.

## **1.8 BATTERY & BATTERY CHARGER :**

### ***1.8.1 Starter Battery :***

- a) The battery shall conform to the requirement of IS-1651. Starting battery sets of 12 V, heavy duty high performance approved make/quality shall be provided to enable crank & start the engine even in cold/winter morning conditions. Type/ voltage/AH capacity of same on 20 hour rated discharge period shall be indicated in the offer. The batteries shall be capable of performing at least eight (8) normal starts without recharging. Necessary battery calculations shall be furnished at the time of bid.
- b) The Battery shall be provided with good quality MS stand painted with one coat of Zinc Oxide & two coat of acid proof black paint with min **3 mm thick rubber mat** below the battery.
- c) Batteries shall be of lead container type only and not with PVC moulded sealed container so that each individual cells are available for individual monitoring during its life span. Each cell shall be provided with electrolyte filling cap with level floats for easy monitoring of electrolytic level.
- d) For each battery system following accessories shall be provided.
1. PVC Funnel - 1 No.
  2. Small PVC mugs with handle - 2 Nos. (Red & white colour)
  3. Hydrometer syringe type with float calibrated (not with zero markings only) with one spare float.
  4. Centre zero voltmeter good quality with 3V-0-3V scale.
  5. PVC jerry-can white colour with tested quality distilled water, with can clearly marked with engraved PVC inscription plate "Distilled Water".
  6. One tin of petroleum jelly (500 gms).
  7. Painter brush 1" wide - 2 nos.
  8. Hand Fuel Pump - 01 No.
- e) The battery shall be provided with 2 nos. cables, min 1.5 m long heavy duty rubber/PVC insulated cabling with brazed tinned lug at one end and with brazed tinned brass terminal lug at battery end - for connecting batteries to cranking system - with 0.25 m long inter battery connecting cable.
- f) The lugs shall be clearly stamped + or - and positive cable also red sleeved for easy identification.
- g) The batteries shall be supplied fully filled and charged ready to use.

### ***1.8.2 Battery Charging System:***

- a) Float rate charging and quick rate charging system shall be provided at the generator panel with appropriate bridge charger system, LC network, rate selector switch and generously rated charging transformer and silicon one rectifier bridge, so that the cranking battery system can be kept fully charged at all times from E.B. supply network with quick charging rate limited to 0.8 times rated discharge current with provision in control transformer and Silicon rectifier present to enable boost charging the battery at 2 times rated discharge current in case of emergencies. To this and in the mode selector switch boost charge position shall be present which however shall be kept disconnected at mode selector switch normally.

- b) Two DC ammeters to clearly indicate float charging current and quick/boost charging current shall be provided with 0-250 or 0-500 mA range and 15-0-15 or 30-0-30 A range respectively.
- c) The float charging ammeter circuit logic shall be so as to bring in circuit only on demand through a P.B. the R.S.S. (Rate selector switch) in it float charging mode to prevent damage to the ammeter.
- d) Dropper resistor network on the load side of battery charger system shall be provided so that higher charger voltages in quick or boost conditions does not get impressed on the I/L and contactor coils, which voltage shall remain well within +10% of rated voltage.
- e) Battery charging subsystem shall be designed for continuous operation at cubicle ambient of 50 deg C corresponding to 45 deg C ambient outside and should be designed to operate at 1.5 times rated maximum current corresponding to boost charge current which can reach in practice as high as 2.5 times or 3 times rated discharge current.
- f) Any charger dynamo and dynamo charging current network present on the set shall either have to be removed or made in operative so that both for AMF and manual application the cranking battery system is kept charged from the charger at the panels at all times during or shut down periods of the set.

### **1.9 ENGINE EXHAUST :**

The exhaust of DG set shall be routed through the Hospital Grade Silencer of exhaust system, including thermal lagging inside canopy with rain cap suitably optimized to meet stringent noise limit silencer specifically tuned to EATS **as per CPCB IV+ norms**. It is desired to insulate the exhaust duct/chimney with insulation & appropriate support arrangement & adequate trap door with feasibility of cleaning.

### **1.10 SPARE PARTS :**

#### **1.10.1 Mandatory Spare Parts :**

The list of mandatory spares which are considered essential by the Supplier shall be indicated in the bid for successful operation of DG Set for 3 years.

### **1.11 TESTS :**

*1.11.1* The alternator of each type and rating shall be type tested for the all tests as per IS:4722, IEEE 115 & BS:5000. Required type test certificates shall be furnished for information.

*1.11.2* The alternators and the starting motors shall be tested for the routine tests as per IS:4722 and test certificates submitted for acceptance.

*1.11.3* The control panels shall be tested/checked for following (but not limited to).

- a) Compliance to drawing, data sheet and this specification.
- b) Check for workmanship, wiring, conformity to functional requirements.
- c) Calibration of instruments, meters C.T., P.T. etc.
- d) H.V. Test
- e) I.R. Test before and after HV test.

1.11.4 The acceptance and routine tests of battery shall be done as per relevant standard.

1.11.5 Battery Charger (as per IS: 4540)

- a) All routine tests as per relevant IS.
- b) Test for ripple factor & regulation
- c) Heat run test (as type test)
- d) Operational and functional tests.

**1.12 SPECIFIC INCLUSIONS:**

The civil works related to DG foundation is included in the scope of works under this specification. DG Vendor has to make sure OEM's approved or referred civil foundation & structure drawings for genset base.

**1.13 NEUTRAL POINT** : The winding of the alternator for 750 KVA shall be star-connected and neutral side leads shall be brought out to a separate terminal box.

**1.14 ERECTION, TESTING, COMMISSIONING, PERFORMANCE & GUARANTEE TESTS / PROCEDURE AT SITE** :

Client shall provide space for genset and its equipments. Contractor shall prepare and submit to Architect/Consultant the following drawings in six sets for approval before commencing the erection for construction work at Site –

- i. Equipment Layout drawing.
- ii. Foundation drawing of each equipment and supervise the foundation casting by another agency to ensure its corrections.
- iii. Bus ducting/Power cable, control cable and earth layout drawing.
- iv. Single line diagram.
- v. AMF Panel details.
- vi. Genset and controller wiring diagram
- vii. Canopy design with frame work details.

The entire work of erection, testing and commissioning of equipment supplied under this package shall be carried out by contractor and performance and guarantee tests to be conducted at site are also included under the scope of this specification. For this purpose, the contractor shall depute suitable qualified technical supervisor to site on advance intimation to the Owner along with all special testing equipment required for testing and performance and guarantee tests. The supervisor(s) shall be responsible for the installation, testing, commissioning checks and performance & guarantee tests mentioned in relevant clauses of this volume and the checks recommended by the contractor.

The successful contractor shall submit sufficiently in advance the bio-data of the supervisor giving details of his experience for Owner's approval.

The vendor shall ensure that the equipments supplied by him are installed in a neat workman like manner such that they are levelled, properly aligned and well oriented. The tolerances shall be established in Contractors drawings and/or as stipulated by the Owner. The canopy of the Genset shall be strong and Waterproof (extra coating of any if required, has to specify while bidding)

All special tools and tackles and spares required for erection, testing and commissioning of equipment shall be supplied by the contractor. The bid shall include a list of these special tools,

tackles and spares along with their item wise prices. The total cost for these tools, tackles and spares shall be included in the bid price.

Erection, testing and commissioning manuals and procedures shall be supplied, prior to dispatch of the equipment.

The contractor shall ensure that the drawings, instruction and recommendations are correctly followed while handling, setting, testing and commissioning the equipment.

#### **1.14.1 Commissioning Check Tests/Performance and Guarantee Test :**

In addition to the checks and test recommended by the manufacturer, the contractor shall supervise the following acceptance tests to be carried out on each set.

##### **Load Test :**

The engine shall be given test run for a period of at least 13 hours depending upon the actual power factor of the load and set shall be subjected to the maximum achievable load without exceeding the engine or alternator capacity.

This full load test is to be followed immediately by a 10% overload run for one hour. The performance of the engine, alternator and exciter shall be satisfactory at the end of this overload run. All the arrangements of factory visit of IUCAA engineers & consultant - three engineers including stay-if required, shall be in the scope of DG vendor. At the end of the full-load run, and again at the end of the over-load run, tests for temperature rise and insulation resistance of the alternator as specified shall be taken.

During the load test half hourly records of the following shall be taken:

- a) Ambient temperature
- b) Exhaust temp. when exhaust thermometer is fitted.
- c) Lubricating oil temperature when an oil cooler is fitted.
- d) Lubricating oil pressure
- e) Speed
- f) Voltage, wattage and current output.
- g) Oil tank level
- h) Stored diesel oil temperature

##### **Regulation Test :**

The automatic and manual regulation of the alternator load at half and full rated load shall be tested for a nominal volt of 240 volts, between phase to neutral and at 0.8 p.f. to verify the requirements of voltage and frequency variation as per IS:4722.

##### **Speed and Governing:**

The speed of the engine shall be verified to ensure that it conforms to the requirement of BS:5514.

##### **Vibrations :**

The vibrations shall be measured during full load test as well as during the overload test and the limit shall be limited to 250 microns.

**Check of Fuel Consumption :** A check of the fuel consumption shall be made throughout the test run of full load and overload.

##### **Insulation Resistance of Wiring :**

On completion of the engine tests, the insulation of each unit of local wiring in the control cubicles and other components of the engine set, shall be tested with a 500 V insulation tester. The insulation resistance shall not be less than one mega-ohm. between wires in a cable and engine set frame of cable sheath. Test will be done before and after the running of Genset

**Functional Tests :**

- a) Protective equipment on the engine against excessive cylinder temperature and low lubrication oil pressure.
- b) Type of starting provided for the engine.
- c) Pilot and fault indication lamps.

**1.15 DATA SHEET FOR D.G. SETS (To be filled by the Vendor along with the bid)**

Sr. No.	PARAMETERS	750 KVA
---------	------------	---------

**1.0 Applicable Standards :**

**2.0 ENGINE:**

- 2.1 Type :
- 2.2 Make :
- 2.3 Model Number :
- 2.4 Engine BHP :
- 2.5 RPM :
- 2.6 No. of Cylinder :
- 2.7 Specific Fuel Consumption at 100% Load Litre/Hr. :
- 2.8 Type of Cooling :
- 2.9 Type of Starting :

**3.0 ALTERNATOR:**

- 3.1 Make :
- 3.2 Model Number :
- 3.3 Type of Enclosure :
- 3.4 Mounting :
- 3.5 KW Rating :
- 3.6 KVA Rating :
- 3.7 Insulation :
- 3.8 Excitation :
- 3.9 Terminal Box Provided (Yes/No) :
- 3.10 Earthing Studs :

**4.0 Dimensions (LxWxH) :**

**5.0 Weight (in Kgs) :**

**6.0 Anti-vibration pad provided (Yes/No) :**

**7.0 BATTERY CHARGER:**

7.1 Type:

7.2 Make:

7.3 Ampere Hour Rating:

## **8.0 CONTROL PANEL :**

- 8.1 Type :
- 8.2 Facilities provided (bidder to furnish  
Details & brief description) covered :
  - a) Monitoring :
  - b) Startup :
  - c) Changeover :
  - d) Operation :
  - f) Protection & interlocks & safeguards :
- 8.3 Cable entry :
- 8.4 Weight :
- 8.5 Dimensions :

**(NOTE : The tenderer should fill-in all the data in above format only. If above mentioned data is not filled properly or partially filled tender shall be liable to rejection).**

## **9.0 ACOUSTIC ENCLOSURE:**

The framework shall be made out of CRCA sheet & structural steel with anti-corrosive UV resistant powder coated of all parts. Specially designed acoustic doors shall be provided with glass window for visibility of the DG sets from outside. These doors shall have a proper sealing arrangement to ensure that there is no sound leakage and water leakage.

The enclosure shall be provided with suitable ventilating/exhaust fans for fresh air & hot air exhaust with all accessories required. The ventilation system shall be designed so that the temperature rise in acoustic enclosure shall be less than 15 Deg C below ambient temperature.

The enclosure shall be supplied with necessary anti vibration pads between DG & Enclosure and also between enclosure & foundation.

Specially designed to meet stringent MoEF/ CPCB IV+ norms of 75 dBA at 1mtr distance at 100% load under free field conditions

High quality noise absorbent and fire-retardant grade acoustic Insulation material (Rockwool) complying to IS 8183 External fuel & DEF filling provision. Noise level – 75dB right around measured at a distance of 1 meter from the enclosure.

## **10.0 EXECUTION :**

Vendor shall give necessary inputs for designing the foundations & shall be responsible for design, erection shall happen after completion of foundation works as per OEM's design. Vendor shall co-ordinate with other agencies like electrical contractors, civil contractors etc.

Further to erection, testing and commissioning of the DGs, the termination of cables at DGs, Between DGs and Main LT panel end shall be done by the main electrical contractor. Calibration of CTs, approval from statutory authorities like electrical inspectorate/MSEDCL/PWD, CPCB etc shall be the responsibility of the DG supplier. DG supplier shall coordinate with main electrical contractor for necessary control & power cable termination.

## **11.0 Auto Synchronizing & Auto Load Sharing Panel for 2 x 750 KVA DG Sets :**

The panel includes Motorized ACB EDO FP, 2 Nos x1250A 50 KA with O/C, S/C/ E/F & Instantaneous protection as Incomer 1 & 2 from the DG set # 1 & 2. The ACB should be equipped with UV, SC, CC etc coils to achieve mentioned protections. R-Y-B indication, ON, OFF, Trip indication, and Load Manager for measurement of ampere, voltage, Kw, kwh and frequency, and Max Demand with PC Compatible port. Microprocessor- based Relay with AMF, Auto Synchronizing & Auto Load Sharing and Auto shut off facility. It should have capability to manually synchronize the DG's. The panel should handle 2 x 750 KVA DG set load and get synchronise to share the equivalent load when crosses the certain limit. Load Manager for measurement of ampere, voltage, Kw, KWh and frequency, and Max Demand with RS 232 / RS 485 port. The panel should have the following feeders: 1No. of 2000A & 2 Nos. 1250 Amp FP EDO ACB 50 kA with ON/OFF/TRIP indication & Busbar 2500 Amp, 65 kA (and as per details mentioned in further sheets.)

The panel shall be IEC 61439 part 1 and 2 compliant double door type with the new standards vermin proof and dustproof, having minimum 7 tank chemical surface treatment process and powder coated, RAL – 7032

All internal wiring shall be of FRLSH 1.1 KV grade, PVC copper wires. CT shorting links are to be provided for Ammeter and protection circuit.

**A) GENERAL :** The panel shall be metal clad, totally enclosed, rigid, compartmentalized design, floor mounting, air insulated, extensible cubicle type for use on low voltage power, 415V, 3 phase 4 wire, 50 Hz system. The equipment shall be designed for operation in high ambient temperature and high humidity tropical atmospheric conditions. Means shall be provided to facilitate ease of inspection, cleaning and repairs for use in installations where continuity of operation is of prime importance.

**STANDARDS :**

Following equipments shall conform to the requirements as per the latest revisions of the following standards: -

- |  |                                   |
|--|-----------------------------------|
| 1. Air Circuit Breaker (ACB)               | : IS 13937- 1&2 / IEC 60947 – 1&2 |
| 2. Moulded Case Circuit Breaker (MCCB)     | : IS 13947 – 1&2/ IEC 60947 – 1&2 |
| 3. Contactors                              | : IS 13947-1&4                    |
| 4. Miniature Circuit Breaker (MCB)         | : IS 8828- /IEC 60898             |
| 5. Residual Current Circuit Breaker (RCCB) | : IS 12640 - / IEC 1008           |
| 6. HRC fuse link                           | : IS 9224 and BS 8:8              |
| 7. Current Transformer                     | : IS 2705 and IEC 185             |
| 8. Potential Transformer-                  | : IS 3156                         |
| 9. Relay -(For Static Relays)              | : IS 3231 and IS 8686             |
| 10. Indicating Instrument-                 | : IS 1248                         |

## ***B) TYPE AND CONSTRUCTION***

The panel shall be metal clad, totally enclosed, rigid, compartmentalized design, floor mounting, air insulated, extensible cubicle type, CNC fabricated for use on medium voltage power, 3 phase 4 wire 50Hz system. The overall construction shall meet Form-4 constructional requirements.

## ***C) GENERAL CONSTRUCTIONAL FEATURES:***

The Panel/switchboard shall be:

- a) CRCA-Sheet steel enclosed, indoor floor mounted free-standing cubicle type & CNC fabricated.
- b) Made up of the requisite vertical sections which when coupled together shall form continuous switchboards.
- c) Dust, vermin and damp proof and enclosure protection not less than IP 42 for indoor & IP55 for outdoor applications and IP:32 for Battery Chargers or as specified elsewhere.
- d) Each feeder/instrument compartment shall be provided with a hinged door interlocked with ACB/LBS inside the compartment such that door can only be opened when ACB/ in off position.
- e) Readily extendable on either side by the addition of vertical sections after removal of the end covers.
- f) Panel/Switchboards shall have access to the feeders, bus bars, cable termination, cable alley, etc. as required.
- g) All CTs for metering/protection shall be mounted in respective feeder compartments either in front or on the rear side of the same compartment for easy maintenance without disturbing other feeders.
- h) Mounting of any metering OR instrumentation equipments in Bus chamber is not envisaged.
- i) All CT wiring shall be done with CT terminal block with shorting facility mounted in the metering compartment.
- j) Wherever control wiring is done between the shipping sections, terminal blocks shall be provided on both sides of shipping sections with TB diagram pasted near to the TBs.
- k) The total height of the panel shall not be more than 2200mm unless otherwise specified and maximum height of switch operating handle shall not be more than 1800mm from FFL. The maximum shipping section shall be of 2000mm width. The total depth of the panel shall be adequate to cater for proper cabling space.
- l) Sheet thickness shall be as below
  - Main frame : 2.5/3mm
  - Doors : 2mm
  - Covers/partitions : 2mm
  - Gland plate : 3mm

Wherever single core cables are used, 3mm thick aluminium gland plate shall be provided. All sheet steel work forming the exterior of switchboards shall be smoothly finished, levelled and free from flaws. The corners should be rounded.

- m) The Components in the switchboards shall be so arranged as to facilitate ease of operation and maintenance and at the same time to ensure necessary degree of safety.
- n) Components forming part of the switchboards shall have the following minimum clearances:
- |                            |        |
|----------------------------|--------|
| Between phases             | - 30mm |
| Between phases and neutral | - 25mm |
| Between phases and earth   | - 20mm |
| Between neutral and earth  | - 20mm |

Creepage distances shall comply to those specified in relevant standards.

- o) All insulating material used in the construction of the equipment shall be of non-hygroscopic material treated to withstand the effects of high humidity, high temperature and tropical ambient service conditions.
- p) Functional units such as circuit breakers, fuse switches, ACBs, etc. shall be arranged in multi-tier formation except that not more than two air circuit breakers shall be housed in a single vertical section.
- q) Metallic/insulated shrouding shall be provided within vertical sections and between adjacent sections to ensure prevention of accidental contact with Main bus-bars and vertical risers during operation, inspection or maintenance of functional units and front mounted accessories. Cable terminations of one functional unit, when working on those of adjacent unit/units.
- r) All covers providing access to live power equipment/circuits shall be provided with tool operated fasteners to prevent unauthorized access.
- s) Provision shall be made for permanently earthing the frames and other metal parts of the switchgear by two independent distinct connections.
- t) Thickness tolerance for sheets shall be as applicable in relevant IS.
- u) All capacitor control panels shall be of compartmentalized design. All capacitors & reactors shall have individual compartments. Exhaust fans shall be provided for ventilation purpose.
- v) The complete panel shall be designed such that it's rating is as per SLD without derating considering ambient temperature & temperature rise as per IS/IEC. De-rating of ACBs/ACBs or the whole panel shall not be accepted. Panel shall be provided with necessary ventilation arrangements to meet the above requirement.

**(D) EACH VERTICAL SECTION SHALL COMPRISE:**

- a) A front framed structure of rolled/folded CRCA sheet steel angle section rigidly bolted together. This structure shall house the components contributing to the major weigh of the equipment such as circuit breaker cassettes, fuse switch units, main horizontal bus bars, vertical risers and other front mounted accessories.

- b) The structure shall be mounted on a rigid base frame of folded CRCA sheet steel of minimum 6 mm thickness and 100 mm height or ISMC100. The design shall ensure that the weight of the components is adequately supported without deformation or loss of alignment during transit or during operation.
- c) A cable chamber housing the cable end connections and power/control cable terminations. The design shall ensure generous availability of space for ease of installation and maintenance of cabling and adequate safety for working in one vertical / horizontal section without coming into accidental contact with live parts of the adjacent section.
- d) A cover plate at the top of the vertical section, provided with a ventilating hood wherever necessary. Any aperture for ventilation shall be covered with a perforated sheet having less than 1mm diameter perforations to prevent entry of vermin.
- e) Front and rear doors fitted with dust excluding neoprene gaskets with fasteners designed to ensure proper compression of the gaskets. When covers are provided in place of doors generous overlap shall be ensured between sheet steel surfaces with closely spaced fasteners to preclude the entry of dust.

**(E) METAL TREATMENT AND FINISH :**

- a) After fabrication, the panel shall undergo minimum 7 tank pre-treatment process for removing grease, Rust etc. and UV resistant powder coating of all parts to withstand extreme environment the panel shall be coated with zinc chromate primer (Applicable for outdoor panels).
- b) After coating of primer, the panel shall be coated with Epoxy based paint (powder coating/spray paint). Paint shade shall be as specified by the client/consultant during drawing approval.

**(F) BUS BARS :**

- a) The bus bars shall be made of high conductivity, Electrical grade Aluminum or copper (As specified in SLD), suitable for 415 volts, 3 phase 4 wires 50 Hz,
- b) The bus bars shall be suitably supported with non-hygroscopic supports to provide a fault withstand capacity as specified.
- c) High tensile (8.8 grade) bolts and spring washers shall be provided at all bus bar joints.
- d) Fish plates of equal type and size shall be used at all joints.
- e) The bus bars shall have uniform cross section throughout and shall be capable of carrying the rated current at 415V continuously. The bus bars shall be designed to withstand a temperature rise of 40 Deg. Celsius above the ambient temp. of 50 deg. Celsius. Current density (Amp/Sq.mm) shall be 1 A/sq.mm for copper & 0.8 A/Sq.mm for Aluminium.
- f) The neutral bus bars shall have a continuous rating of at least 100% of the phase bus bars unless otherwise mentioned.
- g) Bus bars shall be fully sleeved using heat shrunk PVC sleeves appropriately colour coded to identify different phases and neutral bar.

- h) All lighting & raw power panels/SMSBs shall be provided with neutral bus rated same as the size of Phase Busbars unless otherwise specified in SLD.
- i) MCCB/ACBs of rating 200A & above rating shall have copper spreaders on terminals & then connected to main busbars.
- j) All panels shall be provided with aluminium earth bus, which shall run throughout the length of switch board at top or bottom as required. Following size of earth bus shall be provided as per the switchboard rating:

PANEL RATING	Al. EARTH BUS SIZE
Up to 100A	25x3mm
250A	25x6mm
315A	25x10mm
400 to 630A	50x10mm
800 to 1000A	75x6mm
1250 to 2000A	100x10mm
2500 to 3200A	120x10mm
4000A	150x10mm

**(G) POWER/CONTROL WIRING:**

All control wiring shall be carried out with 1100/660 V grade single core PVC-FRLSH cable having stranded copper conductors with minimum cross section of 1.5 Sq.mm for potential & control circuits and 2.5 Sq.mm for current transformer circuits. Control wiring for analog, digital inputs/outputs shall be done with 1.5/1 Sq.mm screened copper cables. All power cables shall be minimum cross section of 4 Sq.mm.

The colour coding of cables shall be as below:

- a) Power up to 25 Sq.mm : Red/Yellow/Blue/black
- b) CT & PT : Red/Yellow/Blue/black
- c) Control AC : Black/Orange (for interlocks)
- d) Control DC : Grey
- e) Analog/digital circuits : Red/black-screened

Wiring shall be neatly bunched, adequately supported and properly routed to allow for easy access and maintenance. Wires shall be identified by numbered ferrules at each end. The ferrules shall be of ring type and of non-deteriorating material. They shall be firmly located on each termination so as to prevent free movement. All control circuit fuses/MCBs shall be mounted in front of the panel and shall be easily accessible. All CT wiring shall be done with CT terminal block with Shorting facility mounted in the metering compartment.

Wherever control wiring is done between the shipping sections, terminal blocks shall be provided on both sides of shipping sections with TB diagram pasted near the TBs. Control wiring for analog, digital inputs/outputs shall be done with Screened cables & routed separately to avoid EMI.

**(H) TERMINAL BLOCKS :**

Terminal blocks shall be of 500 Volts grade and of stud/screw type. Terminal blocks shall have a minimum current rating of 16 Amps and shall be shrouded. Provisions shall be made for label inscriptions. At least 25% spare terminals shall be provided on each panel and these spare terminals shall be uniformly distributed on all terminal blocks. Terminal blocks for current transformer and voltage transformer secondary leads shall be provided with test links and isolating facilities with disconnecting type TBs. Also, current transformer secondary leads shall be provided with Terminal block with short circuiting and earthing facilities.

Terminal blocks for power feeders shall be of stud type with bolts & nuts.

There shall be a minimum clearance of 250mm between the first row of terminal blocks and the associated cable gland plate. Also, the clearance between two rows of terminal blocks shall be a minimum of 150mm. The blocks shall have colour coding as per standards for easy identifications of wiring(Green, Grey, Black, etc)

**(I) CABLE TERMINATIONS :**

a) Cable entries and terminals shall be provided in the switch board to suit the number, type and size of aluminium conductor power cables and copper conductor control cable specified in the detailed specifications.

b) Provision shall be made for top or bottom entry of cables as required. Generous size of cabling chambers shall be provided with the position of cable gland and terminals such that cables can be easily and safely terminated.

c) Barriers or shrouds shall be provided to permit safe working at the terminals of one circuit without accidentally touching that of another live circuit.

e) Cable risers shall be adequately supported to withstand the effects of rated short circuit currents without damage and without causing secondary faults.

f) Sufficient height shall be provided between busbar & gland plate in case higher size cable & more number of runs. Min. cable termination heights from gland plate shall be as below:

Up to 35 Sq.mm	: 200mm
50 to 95 Sq.mm	: 250mm
120 to 185 Sq.mm	: 350mm
240 to 400 Sq.mm	: 550-600mm

**12.0 INSTRUMENT TRANSFORMERS:**

**A) CURRENT TRANSFORMERS:**

a) Current transformer shall comply with the requirements of IS 2705. They shall have ratios, outputs and accuracy as specified/required. All CT's shall be of resin cast type unless otherwise specifically called for.

b) All CT's shall be of bar type primary or suitable for the cable given type and size.

c) For all the CT's suitable type and size clamps are to be supplied for mounting in the switchboards.

- d) Polarities and terminal markings of primary and secondary shall be clearly marked on all CT's.
- e) Name plate indicating, current ratio, burden, accuracy class, type, Sr. No. Make and Model etc., shall be provided.

f) Specifications for CT's :

- 1. Current Ratios :
  - i. Primary : As per SLD
  - ii. Secondary : 5A
- 2.Type : Resin Cast
- 3.Class : PS-REF Protection  
5P10-O/C & E/F Protection  
Class 0.5 for metering
- 4. System Voltage : 440 Volts

**B) POTENTIAL TRANSFORMER:**

- a) All the Potential Transformers shall comply with the requirements of IS 3156 latest editions. All PT's shall be resin cast type and shall have Voltage ratios, output and accuracy class as specified in SLD/Data Sheet.
- b) All PT's shall be single phase, dry type suitable for mounting inside the panel/cubicles. Clamps / brackets / supports required for the mounting shall be supplied along with PT.
- c) Polarities and Terminal markings shall be clearly marked in all PT's.
- d) Name plate indicating, voltage ratio, burden, accuracy class, type, Sr. No. Make and Model etc., shall be provided.
- e) A common earth terminal for earthing of core, bolts, clamps (noncurrent carrying metal parts) etc., shall be provided.

**13.0 BREAKERS :**

**13.1 AIR CIRCUIT BREAKERS :**

**A) GENERAL:**

The ACBs shall conform to IS 13947-1 / IEC 60947-1 for general rules and IS 13947- 2/IEC 60947-2 for Circuit Breakers. The ACBs shall be suitable for 3 phase 415 Volts and should be 4 pole. All the breakers shall have topicalization as a standard feature. ACBs shall meet the following minimum parameters

- Rated operational Voltage : 800V
- Rated insulation Voltage : 1000V
- Rated impulse withstands Voltage : 9kV

No. of mechanical operations	: 25,000(up to 2000A) 15,000(above 2000A, up to 4000A)
No. of electrical operations	: 10,000(up to 2000A) 5,000(above 2000A, up to 4000A)

**B) CONSTRUCTION:**

The Breaker shall be suitable for rear and vertical mounting and line load reversibility. All ACBs shall be draw out type & shall be with service-test-isolated positions.

**C) CONTROL UNITS:**

The Control Units shall be housed in a separate enclosure and there shall be total insulation of the control unit with respect to the power unit.

The Control Unit shall be of LSI based Microprocessor type with LCD screen & suitable to provide protection against short circuit, overload, Instantaneous SC currents, neutral and earth fault protection with adjustable time delay.

The setting range of the short circuit protection shall be from 3 to 9 x In and 5 to 15 x In. The overload settings shall be adjustable from 0.4 to 1.0 times the rated current.

The breaker shall provide Earth fault protection from 0.2 to 0.7 times rated current. Neutral protection of 1-50-100% of Ir range.

The LCD display shall monitor the measured current values (average & peak), faults and log (the cause of last trip and maintenance operations).

**D) ACCESSORIES:**

The connection for the auxiliary shall be accessible from the front.

ACB shall be provided with following accessories, in addition to the item specified in Bill of Quantities. Further these devices shall be fittable at site from the front and common for all ratings.

- a) Under Voltage trip coil.
- b) Shunt trip coil.
- c) Closing coil,
- d) 4NO + 4NC auxiliary switches.
- e) Fault indicator/Reset unit.
- f) Pad lock & LOTO facility

**E) INTERLOCKING:**

ACBs shall be provided with the following interlocking: -

- a) Pad lock to prevent unnecessary manipulations of the breaker.
- b) Electrical interlock shall be done by using breaker aux. contacts only

**F) BREAKING CAPACITY:**

The ACB shall have minimum service breaking capacity of 50 kA. Preferably Ics shall be equal to ultimate breaking capacity Icu or it shall be rated as specified in SLD. Original test certificate of the ACB as per the IS shall be provided on request.

### **13.2 MOULDED CASE CIRCUIT BREAKER**

The Moulded Case Circuit Breaker shall be incorporated in the switchboard wherever specified and shall be of the current limiting type. CB shall conform to IS 2516, IS 13947-1/ IEC 947-1 (part I & II / section 1) 1977 for general rules. It should be suitable for Horizontal and Vertical mounting and line load reversibility. CB shall be suitable either for Single Phase AC 230V Or Three Phase 415V. The MCCB/ACB shall be available in four pole versions for neutral isolation. It shall have tropicalisation as standard feature. The ACB/MCCB cover and case shall be made of high strength heat-resistant and flame retardant thermosetting insulating material. The operating handle shall be quick make, quick break, trip - free type. The operating handle shall have suitable 'ON' 'OFF' 'TRIPPED' indicators and in order to ensure suitability for isolation complying with IS 13947-2/IEC947-2, the operating mechanism shall be designed such that the toggle or the handle can only be in 'OFF' position, if the main contacts are actually separated.

#### **A) ACCESSORIES:**

MCCB shall be designed to have following accessories and it shall be fittable at site.

- 1) Under voltage trip
- 2) Shunt trip
- 3) Alarm switch
- 4) Auxiliary switch

#### **B) INTERLOCKING:**

CB shall be provided with following interlocking devices for interlocking the door of a switch board.

- a) Handle (Pad lock) interlock to prevent unnecessary manipulations of the breaker.
- b) Door interlock to prevent door being opened when breaker is in ON position.
- c) The interlocking defeating device to open the door even if the breaker is in ON position, In addition to the above, all other features indicated in the Bill of Quantities/SLD shall also be provided.

#### **C) BREAKING CAPACITY:**

Short time with-standing capacities & breaking capacities for different ratings of ACBs shall be as specified in the SLD.

Preferably Ics shall be equal to Icu or all breaking capacities shall be considered for Ics.

#### **D) RELEASES:**

Unless otherwise specified all CBs up to 250A (including 250A) shall be provided with thermal magnetic releases & all CBs of rating 315A & above rating shall be provided with Microprocessor releases.

All CBs with Thermal magnetic releases shall be provided with adjustable overload of 70-80-100% & fixed short circuit releases.

All CBs with Microprocessor releases shall be provided with adjustable overload of 50- 100% & adjustable short circuit releases.

Wherever earth fault module is required it shall be inbuilt with other releases, i.e. separate module for E/F is not recommended.

#### **14.0 AMF Relay :**

AMF Relay having numeric digital controller technology, Alpha numeric LCD displays with keypad having supervision of 3 phase mains voltages & DG voltages, remote starting & stopping facilities, 3 operating modes i.e automatic, remote, manual, password protection & able to start the stand by generators in case of main failures. The relay should at least following features:

- 1) Display of voltage, frequency of mains parameters
- 2) Display of generator parameters like V, Hz, Speed, Run hours
- 3) Measurement of load current
- 4) Site name & no. is programmable
- 5) Digital inputs, 6 relay outputs, 11 LEDs
- 6) Last 3 faults & events record
- 7) Internal interlock for EB & DG breaker for fail safe operation
- 8) Wide array of time circuit for start delay, stop delay, mains restoration, recooling etc.
- 9) Full engine safety function like :
  - 9.1) Over / Under frequency, speed indication, shutdown
  - 9.2) DG fault like fail to start, fail to stop & low battery
  - 9.3) Overload protection & selectable overload setting
  - 9.4) Protection against undesired conditions monitored via digital inputs
  - 9.5) Protection against engine faults like LLOP, SCT, Low fuel & over speed, phase reversal etc

#### **15.0 Synchronization Controller Relay for Generators:**

The Synchronization Controller relay should have programmable atleast 10 digital inputs, 18 analogue input, 8 output relays, 2 analogue output & communication port like RS 232, RS 485, USB, ethernet & Bus communication & suitable converter for bacnet bus. It may also be indicated whether Stand Alone SNMP protocol-based communication interface is available for the generator control panel. The controller shall be able to control/monitor following alarms of engine & alternator:

- 1) Engine temperature warning (analog sensor)
- 2) High engine temperature alarm (analog sensor)
- 3) Temperature analog sensor fault

- 4) High engine temperature alarm (digital sensor)
- 5) Oil pressure warning (analog sensor)
- 6) Low oil pressure alarm (analog sensor)
- 7) Oil pressure analog sensor fault
- 8) Low oil pressure alarm (digital sensor)
- 9) Temperature digital sensor fault
- 10) Fuel level warning (analog sensor)
- 11) Low fuel level alarm (analog sensor)
- 12) Fuel level analog sensor fault
- 13) Low fuel level alarm (digital sensor)
- 14) High battery voltage
- 15) Low battery voltage
- 16) Faulty battery
- 17) Battery charger alternator fault
- 18) Low engine speed
- 19) High engine speed
- 20) Starting failure
- 21) Emergency button
- 22) Mechanical failure
- 23) Stop failure
- 24) Low generator frequency
- 25) High generator frequency
- 26) Low generator voltage
- 27) High generator voltage
- 28) Generator overload
- 29) External generator protection
- 30) Generator wrong phases sequence

- 31) Mains wrong phases sequence
- 32) Wrong frequency setting
- 33) Generator contactor fault
- 34) Mains contactor fault
- 35) Internal system error
- 36) Expired rental hours
- 37) Low water level in the radiator
- 38) Ambient temperature too high
- 39) Ambient temperature too low

**15.1 Controller shall be able to manage at least following functions:**

- 1) Mains/Generator Auto synchronization
- 2) Generators synchronization without limits
- 3) Bus communication
- 4) TCP/IP static address, for Ethernet/LAN control
- 5) Insulated analog output for voltage regulator +/-5V
- 6) Insulated analog output for RPM regulator 0-10V or 10-0V
- 7) Insulated voltage inputs 500Vac or 100Vac
- 8) Insulated inputs
- 9) Current measurements on Dead Bus
- 10) Active and reactive power sharing
- 11) Synchronization between sources with different powers
- 12) Quick control by display of voltage and current parameters
- 13) Sharing on mains when the mains voltage returns
- 14) Synchronoscope and "zero voltmeter" for manual operation
- 15) Self-learning function for quick and auto managed synchronizing
- 16) Management of mixed systems with several mains and several generators

17) Complete remote-control system,

## 16. Cables

### 1) *Codes And Standards* :

The design, material, construction, manufacture, inspection, testing and performance of LV power cables supplied shall comply with all currently applicable statutes, regulations and safety codes in the locality where the material will be installed. Nothing in this specification shall be construed to relieve the BIDDER of his responsibility. Where no standards are available, the supply items shall be of good quality and workmanship and backed by test results. Any supply items which are bought out by the BIDDER shall be procured from MANUFACTURERS approved by the PURCHASER.

The cables covered by this specification, unless otherwise stated, shall be designed in accordance with the latest editions of the following standards.

IS 7098 -1988 (Part I)	Specification for XLPE insulated electrical cables
IS 8130-1984	Specification for conductors for insulated electric cables and flexible cords
IS 5831-1984	Specification for PVC insulation and sheath of electric cables
IS 3975-1988	Specification for mild steel wires, strips and tapes for armouring cables
IS 694	PVC insulated cables for wiring (1100V)
The cable manufacturing company should have been qualified for ISO-9001/2.	

### 2) *Design And Manufacturing Requirements* :

Following are the technical particulars for the cables:

Power supply	: 415V, 3 phase, 4 wire,
Grounded system	: Solidly grounded.
System fault level	: 35 MVA (50 KA) symmetrical.
Type of cable	: Aluminium conductor, Cu conductors, XLPE insulated, armoured power cables
Voltage grade	: 1100 Volts
No. of cores	: 3 ½ core; 1 core

The cables supplied under this specification shall be aluminium/copper conductor, XLPE insulated, FRLS PVC sheathed and steel wire armoured cables. Adequate insulation shall be provided for the cables to operate continuously at the specified voltage with a high degree of safety and reliability throughout the life of the cables. The insulating and sheathing materials shall be high quality XLPE and PVC based compound respectively.

The armoured cables shall conform to the following construction: XLPE insulated stranded & shaped aluminium conductor cable (as the case may be) with cores suitably laid up, extruded with inner sheath of unvulcanised rubber or thermo-plastic material compatible with insulating material, round steel wire armoured and overall extruded with general purpose FRLS PVC outer sheath, black conforming to IS: 7098 (Part- I):1988, 1.1KV grade.

The insulating material for power cables shall be cross linked polyethylene (XLPE) compound as per IS-7098 (Part-I/II)-1988. Gas curing process is desirable for XLPE insulation. The

average thickness of insulation shall not be less than the values specified in Table-3 of IS-7098 (Part-1)-1988. The cores shall be identified by the following colour schedule:  
3&1/2 core: Red, yellow, blue, black, reduced neutral core being black.

### **3) Inspection And Testing :**

The BIDDER shall carry out all the shop tests and inspections specified in the following clauses in addition to those normally carried out by him. For Material not covered by any code or specifically mentioned in this specification, the tests are to be agreed with the PURCHASER. All type tests, acceptance tests, routine tests and physical tests for LV power Cables, shall be carried out as per relevant Indian and International standards like IEEE, IEC, ASTM etc, If the MANUFACTURER has already conducted the type tests, then the type test certificates shall be submitted along with his offer.

All the tests specified below shall be carried out in accordance with relevant Indian Standards by the manufacturer in the presence of purchaser's representative. **If the cable fails to pass the test specified, the purchaser shall have the option to reject it.**

#### **3.1 Routine Tests**

The following routine tests shall be carried out on each and every length of the cable in the presence of purchaser's representative at manufacturer's works.

- i) Resistance test for Aluminium/copper
- ii) High voltage test.

#### **3.2 Type tests**

The following type tests shall be carried out on samples taken out from the production lot.

- i. Tensile test for conductor
- ii. Wrapping test for conductor
- iii. Resistance test for conductor.
- iv. Test for thickness of insulation and sheath.
- v. Physical test for insulation and sheath.
- vi. Fire resistance test.
- vii. Insulation resistance test.
- viii. High voltage test (water immersion test).
- ix. Tests on armour wires.

#### **3.3 Acceptance tests**

- i. Tensile test (for aluminium).
- ii. Wrapping test (for aluminium).
- iii. Conductor resistance test.
- iv. Test for thickness of insulation and sheath.
- v. High voltage test.
- vi. Insulation resistance test.

#### **3.4 FRLS tests:**

- i. Critical Oxygen index as per ASDM-D 2863
- ii. Temperature index as per ASTM-D 2863 & BICC Handbook Chp. No.6
- iii. Smoke Density (Light Transmission) as per ASTM –D 2843
- iv. Acid gas generation as per IEC 754-1
- v. Flammability tests as per IEC 332-1 and IS 694:1990

- ***Optional Tests***

- i) Cold bend test for outer sheath.
- ii) Cold impact test for outer sheath.

The purchaser at his option may waive all or any of the type tests, provided type test certificate carried out on essentially identical cable are furnished by the manufacturer.

**4) *Guarantee :***

The cable shall be guaranteed against any type of defects and for trouble free operation conforming to this specification for a period of at least 24 months from the date of commissioning or 30 months from the date of despatch from the supplier's works, whichever is earlier. The following performance characteristics of cables shall be guaranteed at the maximum continuous rating, when operating under the specified operating conditions:

- i) Voltage drops.
- ii) Maximum current rating.
- iii) Operating conductor temperature.
- iv) Resistance at 20 deg C.

**5) *Identification Marks***

The manufacturer shall be identified throughout the length of the cable by the manufacturer's name or trade mark indented or embossed on the outer sheath of the cable. The cable shall be identified as per clause 17 of IS:1554 (Part- I)-1988.

**17. Earthing System**

Maintenance free earthing shall be carried out in accordance with Indian Electricity Rules and Regulations amended till date and also the Earth electrodes shall be provided in conformity with BIS 3043/ BS 7430 of the latest version expecting the specified values detailed herein. The earth electrodes shall be of high tensile low carbon steel circular rods, molecularly bonded copper or clad copper on the outer surface 17.2 mm dia having at least 250-micron copper plating and not less than 3.0 m length and shall be driven to a depth in the ground below the ground level and 3 meters away from any other earth electrodes or as per latest BIS 3043. The premixed powder set carbon based backfill compound shall be poured in the bore with water and re- close the bore (Preapproval needed from client). Earthing shall be covered with RCC enclosure of size 450mm (Length) x 450mm (Breadth) x 100 mm (Thick).

**Note: Contractor must visit/ inspect the work site, before quoting.**

Sr. No.	Special needs for the Genset back up for Critical Equipments.	Complied with Specifications ( Fill in information)
1	<b>Engine &amp; Alternator Make and Model Name/No.</b> (Technical specifications / literature / brochure to be attached)	
2	<b>Address of Service Center at Pune</b>	
3	<b>Response time from service centre after launching a complaint</b>	
4	<b>Response time for required spare parts from service centre after launching a complaint</b>	
5	The Diesel Generator is to provide back up power when the electric mains power has a failure. The generator set is to have " primary continuous duty " application of providing power continuously for more than 16 hours on a given day. Please see the main specifications for additional details	<b>Yes/ No</b>
6	The Diesel Generator is to provide back up power to the uninterruptible power supplies of data center digital equipments and the cooling system equipments. The Generator has to meet the full load of ups (supporting the server equipments ) in the event of mains failure in a single step after starting and stabilizing within 30 seconds in a seamless manner. In addition , the cooling equipment loads will get connected too. The DG SET of engine, alternator should be rated for meeting this step load application ( near full load ) on start up/running.	<b>Yes/ No</b>
7	The IUCAA has a comprehensive intelligent building management system for monitoring the parameters of electrical power, temperature , humidity , entry into data centre area, fire alarm and control. The Diesel Genset operational parameters as detailed in the main specifications have also to be monitored by the BMS. Parameters which are crucial for the reliable operation of data center operation such as fuel and lubrication oil levels in the tanks/ sump respectively, line voltage, current, frequency, battery voltage, charging current, engine temperature are to be provided as analog/digital levels or codified digital data through specified interface. This is an essential requirement to be met by the vendors of the DG set. The scope of BMS for DG set include the transducers for all parameters, hardware and software system as applicable for transferring the parameter to main BMS with backnet protocols and local logging of the engine parameters on dedicated stand alone system too.	<b>Yes/ No</b>
8	A lubricating oil filter shall be provided for operation under normal conditions for a period of 500 hours/ One Year without the necessity of its replacement or cleaning	<b>Yes/ No</b>

10	The DG Sets shall be subjected to load tests at IUCAA site after installation in the presence of IUCAA's representative with consultant. All the consumables required during testing of DG Sets at site shall be included in the scope of DG vendor. All consumables required during trial run of DG Sets on load for 13 hours out of which six hours for run up to full load, followed by six hours on full load and concluded by one hour 110% overload capacity to be arranged by DG vendor. Also, DG vendor to arrange the 110% Load availability for testing. The test shall be carried out as per Technical Specification & records to be submitted for approval. (The formats of all tests carried out at factory & at site with details of relevant standards as per latest standards & permissible limits should be submitted by DG vendor for reference along with tender).	Yes/ No
11	Overall Dimensions of Generator Set in mm (Length X Width X Height including Silencer)	
12	Fuel consumption at 75 % load (Ltr /Hr)	
13	Maximum time to start engine from cold and attain rated speed & ready to take one step load in Seconds	
14	Lube Oil Consumption @ % of fuel consumption	
15	Lube oil change period in hours	
16	Lube Oil Sump Capacity (Max) in Ltr.	
17	Lube Oil Sump Capacity (Min) in Ltr. to be maintain	
18	Lube Oil System Capacity in Ltr.	
19	Type of Governor	
20	Transient speed increase for sudden 100% decrease of load in %	
21	Transient speed decrease for sudden 100% increase of load in %	
22	Recovery Time in Seconds	
23	<b>Mandatory Spare Parts :</b> The list of mandatory spares which are considered essential by the Supplier shall be indicated in the bid for successful operation of DG Set for 3 years. Price may also be quoted separately for these spares.	Yes/ No
24	DG AMF & Synchronising Panel from approved panel manufacturer only (Give the name panel manufacturer)	
25	Vendor to provide one-source responsibility for the generating system and accessories.	
26	The generator set and its components are prototype-tested, factory-built, and production-tested.	
27	DG Set should accept 55% of rated capacity in one step.	Yes/ No

28	DG Sets panel shall be suitable for Auto operation controlled through AMF Relay as well as manual operation.	
29	The product should provide support for monitoring various parameters of diesel generator set over WEB and SNMP".	<b>Yes/ No</b>
	<b>OFFERS with INCOMPLETE INFORMATION ARE LIABLE TO BE REJECTED, which may be noted.</b>	

***The venders should fill the above mentioned details.***

**Seal & Signature of Bidder**

## **Onload Tapchanger for 1000 KVA, 11/0.415 kV Transformer with RTCC**

### **TAP CHANGING MECHANISM – On Load Tap Changer**

a. OLTC shall have been type tested as per IS 8468 (Part 1):2018/ IEC 60214-1 : 2014

1.1 The transformer shall be provided with Linear type Flange Mounted Onload Tapchanger type on-load tap changing mechanism. This shall be suitable for remote control operation, from switchboard in the control room, in addition to being capable of & local, manual as well as local electrical operation.

1.2 The on-load tap changer shall include the following:

- (a) An oil immersed tap selector and arcing switch or arc suppressing tap selector, provided with reactance or high speed transition resistor for reduction of make and break arcing voltages and short circuits.
- (b) Integrated Motor driven mechanism.
- (c) Control and Protection devices.
- (d) Local tap changer position indicator.
- (e) Manual operating device.

1.3 The on-load tap changer shall be designed so that the contacts do not interrupt arc within the main tank of transformer. The tap selector and arcing switch or a suppressing tap selector switch shall be located in one or more oil filled compartments. The compartment shall be provided with a means of releasing the gas produced by the arcing. It shall be designed so as to prevent the gas in OLTC the tap selector compartment from mixing with oil in the transformer tank. Provided with Pressure Relief Switch (PRS) set to specified pressure for additional; safety.

1.3.1) The tap changer shall be capable of permitting parallel operation with other transformers of the same type.

1.3.2) The transformer shall give full load output on all taps. The manual operating device shall be so located on the OLTC/transformer that it can be operated by a man standing the level of the transformer track. It shall be strong and robust in construction.

1.3.3) The control scheme for the tap changer shall be provide for independent control of the tap changers when the transformers, are in independent service. In addition, provision shall also be made to enable parallel control, when required in such a way that the tap changers of the units running in parallel operate simultaneously and there shall be no possibility of their going out of step and setting flow of circulating current. Additional features like selection of any one transformer at a time as Master/Follower visual indication during tap-changing operation and initiation of alarm in case the two transformers running parallel are not on the same tap shall also be incorporated.

- 1.3.4) Necessary interlock blocking independent control when units are in parallel shall be provided.
- 1.3.5) Under abnormal conditions such as may occur if the contactor controlling one tap changer sticks, the arrangement must be such as to switch off supply to the motor so that an out of step condition is limited to one tap difference between the units. Details of out of step protection provided for the taps should be furnished in the tender.
- 1.3.6) The contactors and associated gear for the tap change driving motors shall be housed in a local kiosk mounted adjacent to or on the transformer. The motors shall be suitable for operation with 3 phase 415 volts, 50-Hertz external power supply.
- 1.3.7) The supplier shall furnish, in addition to the equipment above, the following accessories mounted on a separate panel to be installed on the purchaser's control room for remote operation.
- Raise and Lower Push Button Switch.
  - Remote tap position indicator with Digital tap position indicator, Remote winding temperature indicator for all three HV phases and Remote oil temperature indicator and other required devices, Indicating lamps, etc., All the above temperature indicator and tap position indicator should have two numbers of 4-20mA outputs for use of SCADA.
  - An indication lamp showing tap changing in progress.
  - Nameplate for each component.
- 1.4) Complete particulars of the tap changing gear including the capacity of the motor shall be stated in the tender.

<b>Sr. No.</b>	<b>Description</b>	<b>Required Parameters</b>		<b>Bidder's Remarks</b>
1	Rated Voltage	11 kV		
2	Max. System Voltage	12 kV		
3	Max Voltage per Step	550 V		
4	Max. No. of Steps	12		
5	Max. No. of Positions	13		
6	Max. Rated through Current	200 Amp		
7	Time per Tap Change	4-6 Seconds		
8	Short Circuit Withstand	3.5kA for 3 Secs.		
9	Oil Volume			
10	Total Weight			
11	Validated for No. of Operations	Min. 500000		
12	Test Voltage :	kV	Impulse (kVp)	
12.1	To Earth	35	110	
12.2	Between Phases	35	110	
12.3	Between Adjacent Contacts	10	40	
12.4	Across Tapping Range	15	60	



## **Technical Specifications for Type Tested Compact Substation (CSS):**

CSS shall be based on OEM design having relevant type test results & MSEDCL approved, to be manufactured & procured from OEM or their authorised system house for end to end design compliance and after sales support.

The Enclosure of Compact Substation is suitable outdoor application fabricated in 2 mm GI and duly powder coated. The base frame is hot dip galvanised and rust proof. The doors of enclosure are with stainless steel hinges and locks and all safety interlocks are provided to make it tamper proof. Illumination is provided in all three compartments of CSS including all other standard accessories.

CSS shall be made out of 2mm thick GI enclosure, mounted on 150mmx5mm thick hot dipped galvanised iron base plate. All the hardware for outdoor CSS will be only of high-grade stainless steel. Heavy Gaskets on all doors, door limit switch with interlocks, LED lights in all compartments, Silicon sealant in all joint lines.

CSS will be equipped with Novec (Inert Gas) Gas flooding fire suppression system 1.5 Kg /Cubic Meter all equipped with UL certified tubing, valves, control panel, BMS connectivity, all hardware & including installation.

CSS will be equipped CSS Monitoring Systems comprising of precision Smoke (3nos)/ Temperature(4nos) / Humidity (2nos) sensor in each compartment integrated with min 6” Industrial outdoor HMI with individual screens, having BMS/ Cloud connectivity with Mobile alert/SMS feature.

### **CSS must be complying to & having valid test reports from NABL CPRI/ASTA/PEHLA –**

- IEC62271-202.
- IP23 for Transformer section, IP54 for HT & LT Section.
- Temperature Rise of complete CSS in accordance with K10/K15Class.
- Short circuit on earth circuit of 25KA, Impact Test
- **Internal Arc 21KA on CSS AFLR.**
- **Forced cooling fan systems controlled by temperature monitoring device**
- ONAN Type **1000KVA, 11KV / 0.415 kV** Hermetically Sealed Transformer as per IS 1180 Part-1, Energy Efficient Level – 1 complying to MSEDCL approved and losses having been supplied with OEM design CSS with OLTC & RTCC.

### **1000KVA, 11KV / 0.415 kV Compact Substation Type consisting of –**

- 1) HT/LT Compartment : IP54, Transformer Compartment : IP54
- 2) HT incomer – 11KV- One Isolator + One Fixed RMU 630A with OC+EF+IDMTL Protections and minimum 8 window Annunciator Window with hooter & Powerpack.
- 3) Transformer Section – As per IS 1180 Part-1, Energy Efficient Level – 1, Hermetically Sealed Transformer 1000 kVA, 11/0.415 kV ONAN type transformer with OLTC and RTCC panel losses as per IS 11171
- 4) LT Section – Incomer 1600A/50KA, 4Pole Fixed Manual Microprocessor Based LSIG ACB equipped with MFM, RYB, On/Off/Trip Indications with associated accessories. Aluminium Busbars will be EC Grade & will be as per IEC61439 design criteria.
- 5) CSS Monitoring System of Sensor + HMI as detailed in specifications.
- 6) **Built in arc safety in all 3 compartments**

- 7) Real time temperature control with BMS compatibility
- 8) Smoke sensing & Alarm in CSS with BMS compatibility
- 9) Humidity presence indicators and heaters with thermostat control for dehumidification inside the CSS.
- 10) AI/Cloud based Energy & Data Acquisition) with weatherproof local display with BMS integration.
- 11) Gas Suppression System
- 12) Factory built and Tested
- 13) Ready for network connection Design complies to new IEC 62271-2O2
- 14) Maintenance free SF6 insulated Ring Main Unit for MV networking
- 15) SCADA compatible equipments
- 16) Rust, corrosion and weather proof enclosure Independent access for all the compartments for routine maintenance
- 17) Gas Flooding System
- 18) Energy management with EV outlets
- 19) Arc Flash Protection
- 20) Smoke Protection System
- 21) AI Enabled Dashboards with BMS Compatibility
- 22) Cable entries are from bottom
- 23) Auto supply system complete so as to read the readings when mains supply is OFF.

**11 KV, 630 Amp Load Break Switch :** The Isolators offered shall conform to IS: 4710/9920 as amended to date. The isolator shall be ON Load type, triple pole, spring assisted, hand/motorized operated, non-automatic type with quick break contacts and fault indication. The operating handle shall have three positions 'ON', 'OFF' and 'EARTH' which shall be clearly marked with suitable arrangement to padlock in any position. A safety arrangement for locking shall be provided which shall prevent from the isolator operation 'ON' position to 'EARTH' position or vice versa.

## **TECHNICAL SPECIFICATIONS - 11 KV HT VCB OUTDOOR TYPE PANEL**

### **1.0 HT PANEL:**

TYPE AND RATINGS : The 11KV Switchgear panels shall comprise of 11KV Vacuum Type circuit breakers, control relay panel, instrument panel and instrument transformers (complete in all respect) etc., suitable for indoor use. The equipment shall be totally enclosed in metal clad cubical, dust and vermin proof with necessary isolation arrangement. Panel should be complete with necessary internal copper connections, control wiring, fuses and supporting framework with bolts to secure it to the floor. Panel shall be provided with space heater, door switch with lamps and 15 - Ampere power receptacle.

The breakers shall have the following ratings :

#### **System Details :-**

Type	: Vacuum Type
Rated Voltage	: 3 Phase, 11 kV $\pm$ 10%.
No. of poles	: 3
Normal System Voltage	: 11 KV
Maximum System Voltage	: 12 KV
Impulse Withstand Test Voltage	: 75 KV
One Minute Power frequency Withstand Test Voltage	: 28 KV (RMS)
Rated Current	: 630 Amp, 21 KA
Symmetrical Breaking Capacity	: 350 MVA
Rated Frequency	: 50 Hz $\pm$ 1.5 Hz
Ambient Temperature	: 45°C
System Earthing	: Non effectively earthed
Degree of Protection	: IP 67

### **1.1 STANDARD & CODES:**

Unless otherwise stated, HT switch board shall conform to the following relevant Indian standards and Indian Electricity Rules and Regulations.

- i) IS-2516 : Circuit Breakers
- ii) IS-3427 : Metal enclosed switchgear and control gear for voltage above 1000V but not exceeding 11000V A.C.

- iii) IS-4237 : General requirement for switchgear and control gear for voltages not exceeding 1000Volts.
- iv) IS-8828 : Miniature Air break circuit Breakers for voltages not exceeding 1000V.
- v) IS-4064 : Air break switches. Air break disconnectors, air break switch disconnectors and fuse combination units for voltage not exceeding 1000V AC or 1200V DC.
- vi) IS-2959 : Contactors for voltages not exceeding 1000V AC or 1200V DC.
- vii) IS-8544 : Motor starters for voltages not exceeding 1000V AC or 1200V DC.
- viii) IS-2705 : Current Transformer
- ix) IS-3156 : Potential Transformer
- x) IS-9385 : High voltage fuses
- xi) IS-6875 : Control switches
- xii) IS-1255 : H.T. Cables
- xiii) IS-1248 : Electrical Direct acting indicating instruments
- xiv) IS-722 : AC electricity Meter of Induction type
- xv) IS-2544 : Porcelain post insulators for system voltage greater than 1000V.
- xvi) IS-3231 : Electrical Relays
- xvii) IS-5082 : Wrought aluminum and aluminum alloy bars etc. for electrical purposes
- xviii) IS-2147 : Degree of protection provided by enclosures for low voltage switch gear and control gears.
- xix) IS-375 : Marking and arrangement for switchgear, busbars, main connection and auxiliary wiring.
- xx) IS-8623 : Factory built assemblies of switchgears and control gears for voltages up to and including 1000V AC & 1200V DC
- xxi) IEC 62271-100 : Various testing procedures and methods to verify the performance and safety of high and medium-voltage circuit breakers.
- xxii) IS-13118 : H.T. Circuit Breaker.
- xxiii) IEC 62271-102: Alternating current disconnectors and earthing switches
- xxiv) IEC 62271-200 : prefabricated metal-enclosed switchgear and control gear for alternating current of rated voltages above 1 kV and up to and including 52 kV.

## **1.2 SCOPE :**

1.2.1 11 KV metal clad, cubicle type indoor switchgears consisting of :

One (1) No. 350 MVA, 11 kV, 630 Amps, 21 KA VCB + RMU Panel as per BOQ.

- 1.2.2 Controls and interlocks as required for the safe operation of the switchgear.
- 1.2.3 All supporting structures and installation materials including steel foundation frame, anchor bolts, holding down bolts, etc.
- 1.2.4 Special tools and tackle required for erection, operation and maintenance of equipment.
- 1.2.5 Drawings, technical particulars, installation operation and maintenance manual for the switchgear and auxiliary equipment.

### **1.3 GENERAL DESIGN FEATURES:**

- 1.3.1 The equipment shall be installed indoor in a hot, humid climate. All equipment, accessories and wiring shall be provided with tropical finish to prevent fungus growth.
- 1.3.2 The maximum temperature rise in any part of the equipment at specified rating shall not exceed the permissible limits as stipulated in relevant standards. The derating of the equipment shall be made taking 45 degree C. as an ambient temperature of the site, if it is designed for any lower ambient temperature.

The rated peak short circuit current or the rated short time current carried by the equipment shall not cause :

- a) mechanical damage to any part of the switchgear.
- b) separation of contacts
- c) insulation damage of "Current Carrying Part"

- 1.3.3 All controls shall be suitable for 24 V D.C.

### **1.4 CIRCUIT BREAKERS :**

The circuit breakers shall be horizontal isolation, horizontal draw-out VCB type mounted on the moving carriage. The circuit breaker shall be of modular design. The rating of the circuit breaker shall be as specified elsewhere conforming to IS13118/IEC-56.

- 1.4.1 Cable Termination : Circuit breaker should be suitable for 3 core 240 Sq.mm XLPE cables for incoming and outgoing connection.
- 1.4.2 Rated operating duty : B-3 min. MB-3 min. – MB
- 1.4.3 Total make time : Not more than 5 cycles lower value is referred.
- 1.4.4 Whether trip free : Yes as per IEC
- 1.4.5 Closing mechanism & Antipumping device : Motor operated spring closing mechanism and Mechanical and electrical antipumping device shall be provided. Motor operating mechanism shall be complete with universal motor, spring, closing spring, and all necessary accessories. Spring charged/discharged indicator shall be provided.

- 1.4.6 Trip/Closing Coil voltage for Shunt trip : 24 V DC
- 1.4.7 Breakers shall be capable of making, carrying and breaking starting and full load currents, without any injurious effect.
- 1.4.8 Breakers shall be suitable for electrical operation local/remote. Mechanical interlocks shall be provided to prevent:
- a) A closed circuit breaker from being moved from service position to test position/isolated position.
  - b) Closing and opening of the circuit breaker in an intermediate position between "Service Test".
  - c) Circuit breaker can be racked in to service position only with the front door closed.
- 1.4.9 Breakers shall be complete with the following accessories.
- a) Mechanical operating device for manual closing and tripping of the breaker.
  - b) Device for manual charging of the closing spring.

At least six (6) NO and six (6) NC mechanically operated auxiliary contacts of sufficient rating (in addition to those required for breaker operation) shall be wired out to terminal block for external connection. In the case of 11 KV breaker in addition to the circuit breaker auxiliary contacts provided on breaker trolley for circuit breaker operation, a mechanically operated racking switch shall be provided on a stationary part of switchgear. This switch shall be positively operated by the breaker mechanism when the breaker is in "service" position but not when the breaker is isolated. The switch shall be provided with at least six (6) normally open and at least six (6) normally closed adequately rated auxiliary contacts for each circuit breaker for inter locking.

In case a switch with six (6) NC contacts cannot be offered as required then a switch with six (6) normally closed and two (2) normally open contacts offered along with an auxiliary relay having four (4) normally open and two (2) normally closed contacts (out of which any four contacts shall be wired out), shall be provided on each feeder cubicle.

Each circuit breaker, disconnecter and bus VT cubicle shall have necessary limit switches for service and test positions, which shall provide the required contacts for breaker operation and interlocking, position indication and disconnection of remote control circuits.

- 1.4.10 Each breaker shall have the following protections :-
- a) IDMTL and high set Instantaneous over current (H.S. on breaker controlling transformer only).
  - b) IDMTL/Instantaneous Earth Fault Protection
  - c) Master Trip Relay
  - d) Aux relays for transformer fault.

- e) Trip Circuit Supervision Relay.

## **1.5 DRAWINGS, DATA AND MANUALS:**

1.5.1 The following drawings and details shall be furnished along with the Tender.

- a) Tenderer's proposed typical general arrangement drawing showing constructional features along with the following:
  - Space required in the front for breaker withdrawal
  - Control cable entry points
  - Power cable entry points
  - Bus bar clearances phase to phase and phase to ground
  - Configuration of bus bar
  - Technical detail of supporting insulator and their spacing
  - Location of instrument transformer
  - Arrangement for mounting of mimic, control switches, instruments and indicating lamps
- b) Single line diagrams of different switchgears.
- c) Typical breaker control schematic drawing applicable to quoted equipment.
- d) Technical leaflets on :
  - Circuit breaker
  - Instrument transformers
  - Control switches, instruments and indicating lamps
- e) Type test and certificate on identical equipment offered in the Tender.
- f) Characteristic curves of all equipment.

1.5.2 The successful Bidder shall submit the required number of copies of the following drawings for approval of the Owner/Consultant. Final as built drawing, test certificates, manuals etc. for reference and records.

- a) Confirmed outline dimensional drawing of the various switchgears showing the general arrangement and indicating the following:
  - Space required in the front for breaker withdrawal.
  - Control cable entry points and termination arrangement.
  - Power cable entry points and termination arrangement.

- Bus bar clearance phase to phase and phase to ground.
  - Configuration of bus bar.
  - Technical detail of supporting insulator and their spacing.
  - Location of instrument transformers.
  - Control panel details with equipment layout.
  - Terminal block details.
- b) Single line diagram of all switchgears showing instrument transformers control switches, protection, instruments and indication, etc.
- c) Control schematic diagram of each breaker showing all safety and operation interlocks, annunciation, etc.
- d) Transport/shipping dimensions with weights.
- e) Foundation and anchor bolt details including dead load and impact load.
- f) Cross-section with parts list.
- g) Cubicle wiring diagram with terminal board disposition.

1.5.3 Any other relevant data, drawing and information necessary for review of items whether specifically mentioned or not, shall be furnished by the Contractor along with those information.

1.5.4 The responsibility of correctness of wiring diagram shall be with Contractor. The Owner/Consultants will check the final schematic after submission. If any modification, addition or alteration is considered necessary to comply with the approved schematic drawing as stated herein above, the said modification, addition or alteration shall be carried out by the Contractor either in their works if it is before delivery, or at Site after delivery at no cost to the Owner.

1.5.5 Before starting manufacture of the equipment, the Contractor shall have to take approval of these design drawings from the Owner/Consultants in writing. Any manufacturing done prior to approval of drawings shall be rectified in accordance with the approved drawing by the Contractor at his own cost and the equipment shall be supplied within the stipulated period.

**1.6 INSTALLATION:**

- a) HT Panel Comprising of :

One (1) No. 11 kV, 350 MVA, 630 A, 21 KA VCB + RMU Panel with built accessories as per BOQ.

### **1.7 ERECTION & SUPERVISION:**

Erection, testing and commissioning of the H.T. switchgears shall be done as per the directions given by Engineer-in-charge/consultant or as per the drawings provided by supplier.

All accessories, relays busbars, VCB, C. T. & P.T. supplied in separate boxes shall be assembled at factory as per the catalogue/manuals/drawings provided by VCB Manufacturer.

### **1.8 EARTHING:**

All the H.T. switchgears shall be properly earthed with 50 x 6 mm GI strips and this strip shall be connected to existing ring main earthing/earthing stations made for sub-stations.

### **1.9 SITE TESTS:**

All site tests shall be carried over by contractor in presence of Client/Consultants representative and test report submitted before Commissioning.

### **1.10 TERMINATIONS:**

H.T. 11 kV XLPE cable shall be terminated in the panel after carrying over all site tests.

## **2.0 BATTERY AND BATTERY CHARGER :**

### **2.1 GENERAL :**

This specification covers the supply, installation and field test of the battery and battery charger for 24 V DC system complete with all accessories for efficient and trouble-free operation as specified here in under.

### **2.2 EQUIPMENT TO BE INSTALLED :**

- a) One set of batteries and battery charger for 24 V system for Substation.
- b) First filling of electrolyte with 10% extra in a non returnable container, and all necessary accessories for the above system.
- c) Special tools required for erection and maintenance.

### **2.3 DESIGN REQUIREMENTS :**

#### **2.3.1 Battery & Battery Charger**

##### **2.3.1.1 Battery**

- a) The battery shall be rated for supplying total DC load of the substation. The duration of the load shall be ninety (90) minutes. The total DC load cycle shall consist of the following:

- 0-1 min. Tripping of all HT breakers on under voltage. In case the circuit breakers charge after tripping, starting current of the spring charged motor of all the above circuit breakers shall be considered for the entire 0-1 minute period. Control, indication, protection and annunciation load.
- 1-30 min. Control, indication, protection and annunciation load.
- Last min. Control, indication, protection and annunciation load.

Closing of breaker-one at a time and spring charging if spring charging occurs after closing of breaker. Consider starting current of one spring charging motor and running current of another spring charging motor to occur simultaneously during the entire one minute period.

- a) The Contractor shall compute the Ampere hour rating (10 hour rate) of the battery considering margin over the above duty cycle so that the battery shall be capable of delivering the ultimate DC load of the substation when the future switchgear and its protection panel will be installed in the same substation. The minimum capacity shall be not less than 90 AH.
- b) The Contractor shall compute the Ampere hour capacity at 10 hour discharge rate based on the above cycle and furnish the calculation. The minimum ambient temperature shall be 45 deg. C. The minimum voltage at the end of the load cycle shall not be less than 1.75 volts per cell.
- c) The batteries shall be storage type as specified.
- d) The cells shall be lead calcium or lead antimony type with plate or tubular positive plates.
- e) Each cell shall be in a suitable leak proof container with sealed cover. Vent plug and filler cap shall be provided in the cover.
- f) Separators between plates shall permit free flow of electrolyte.
- g) Cell posts shall be sealed against electrolyte creepage.
- h) Cell terminal posts shall be provided with connector clamps, bolts and nuts. Cell terminals shall be lead alloy, reinforced with copper core inserts of adequate current carrying capacity and complete with acid resistant connecting straps, bolts and nuts.
- i) Sufficient sediment space shall be provided so that the cells will not have to be cleaned out during normal life.
- j) Electrolyte normal level and lower level shall be indicated.
- k) The batteries shall be shipped uncharged with the electrolyte shipped in separate containers. 10% extra electrolyte shall be furnished to compensate for spillage during transit and erection in a non returnable container.

- l) The batteries shall be furnished complete with cell interconnects and a suitable rack protected with acid resistant paint. The arrangement of the rack shall be such as to allow easy access and adequate space for normal maintenance in battery room.
- m) The Bidder shall furnish along with the Tender, his proposed layout of the battery racks to suit the space available.

#### 2.3.1.2 Battery Charger :

- a) The battery charger shall be of solid state electronic type using silicon rectifiers and complete with all switches, fuses, contractors, and instruments.
- b) The battery charger shall be suitable for 415 volts  $\pm$  10% 3 Phase, 50 Hz supply. The charger shall have fully automatic voltage regulation and electronic current limiting. The voltage regulation shall be within  $\pm$  1% for a 0-100% load variation and  $\pm$  10% voltage variation on the AC side. Cooling shall be by means of natural convection.
- c) The minimum rating of the battery charger shall be not less than 20 amperes.
- d) The battery charger shall be housed in a free standing floor mounted/wall mounted cabinet with enclosure protection of IP-67.
- e) The instrument switches and lamps shall be flush or semi flush mounted on the front panel.
- f) The battery charger shall be constant voltage type with provision of voltage variation from float charging to boost charging voltage. The float charging voltage shall be between 2.1 to 2.3 volts per cell or at any other voltage recommended by the battery manufacturer. At float charging voltage the charger shall furnish the continuous DC load consisting of control, indication, annunciation, breaker spring charging mechanism and continuously "ON" emergency light as well as float charge and its associated battery. The boost charging voltage shall be about 2.4 to 2.5 volts/cell or at any other voltage recommended by the battery manufacturer. During equalizing or boost charging, the continuous DC load shall be fed by the charger. The loads that can not tolerate the high equalizing or boost charging voltage shall be connected through dropper diode. The battery charger shall recharge the completely discharged battery to fully capacity in 8 hours. The charger shall have 10% excess capacity.

2.3.2 Wiring : The wiring shall be complete in all respects so as to ensure proper functioning of control, protection and metering scheme.

All wiring shall be completed up to terminal blocks.

Wiring shall be done with 2.5 sq. (minimum) Class 5 standard copper conductor, flexible PVC insulated FRLS wire. The wire shall have a voltage grade of 600 V as per IEC. Lower cross section of wires may be used for solid state devices only.

Each wire shall be identified at both ends with wire designations in accordance with the approved wiring diagram. Interlocking type ferrules shall be used for identification.

Not more than two wires shall be connected to any terminal at each end. If necessary, a number of terminals shall be jumped together to provide wiring points.

Wires shall be neatly bunched and adequately supported so as to prevent sagging and strain on termination. Wires shall not be spliced or tapped between terminal points.

All spare contacts of relays and contractors shall be wired up to terminal block.

### 2.3.3 Cable Termination :

The equipment shall be designed to facilitate cable entry from bottom. Removable plates shall be furnished with compression type cable glands to make entry dust tight and no weight is transferred on the terminal. The glands shall be suitable for terminating cable armor. Compression type cable lugs as required shall be furnished for termination of power and control cables. Sufficient space shall be provided to avoid sharp bending and for easy connection. A minimum space of 200 mm from the gland plate to the nearest terminal block shall be provided.

2.3.4 Terminal Blocks : Terminal blocks shall be as specified in Technical Requirements.

2.3.5 Ground Bus : G.I ground bus of 50 mm x 6 mm cross section shall be furnished along the entire length of each panel. All devices shall be grounded to the ground bus.

## 2.4 ACCESSORIES :

2.4.1 The following accessories shall be furnished for the batteries:

- a) One (1) connector bolt wrench.
- b) One (1) hydrometer syringe.
- c) One (1) thermometer with specific gravity correction scale.
- d) One (1) electrolyte level test tube.
- e) One (1) cell testing voltmeter with leads
- f) Battery racks.

2.4.2 The charger shall be complete with the standard accessories including but not limited to the following:

- a) Solid state surge protectors on the AC and DC sides.
- b) AC failure alarm relay
- c) DC time delay low voltage relay
- d) Ground detection alarm for positive and negative leads
- e) Manual voltage adjust switch .
- f) DC ammeter and voltmeter.

**2.5 DRAWINGS, DATA AND MANUALS :**

2.5.1 The following drawings and detail shall be furnished with the Tender.

- a) Layout arrangement of battery and battery charger in the available space shown in the drawing.
- b) Schematic and wiring diagram of battery charger.
- c) Cell voltage characteristic for battery.
- d) Technical leaflets on battery and battery charger.

2.5.2 The following drawings and manuals shall be submitted by the successful Tenderer for approval :

- a) Dimensional layout arrangement of battery and battery charger.
- b) Dimensional outline drawing of battery charger panel clearly showing the location of meters, switches etc.
- c) Wiring diagram of the battery charger panel.
- d) Instruction manuals of battery and battery charger.

**APPENDIX - A : TECHNICAL PARTICULARS OF SWITCHGEAR EQUIPMENT (VENDER TO CONFIRM)**

- 1. a) Type : Outdoor, cubicle type
- b) Degree of protection : IP – 67
- 2. System rated voltage : 11 KV  $\pm$  10%
- 3. System maximum voltage : 12 KV
- 4. Frequency : 50 Hz + 3%
- 5. INSULATION LEVEL:
  - a) 1.2/50 microsecond Impulse withstand voltage : 75 KV peak
  - b) One minute power frequency withstand voltage: 28 KV rms
- 6. RATED CURRENT:
  - a) Continuous
    - Bus bar : 630 A
    - Incoming circuit breaker : 630 A

- Out-going circuit breaker : 630 A

b) Short time current  
for 3 seconds : 21 KA rms

7. CIRCUIT BREAKER:

- a) Quantity  
Incoming/Outgoing feeder : 1 No.
- b) Rated breaking capacity  
Symmetrical : 350 MVA
- c) Total breaking time : 3 cycles (maximum)
- d) Operating sequence : T,C,T
- e) Auxiliary voltage
- Control circuit : 24 V DC
  - Space heater and illumination lamp, etc. : 230 V, 1 Ph, 50 Hz

8. POTENTIAL TRANSFORMERS

- a) Quantity : One on each bus
- b) Voltage ratio : 11kV/1.732:110V/1.732
- c) Over voltage factor : As per IS-3156
- d) Accuracy class : 1
- e) Rated burden : 50 VA

9. CURRENT TRANSFORMER :

	<b>Circuit</b>	<b>Accuracy Class</b>	<b>Burden</b>
	<u>Incoming</u>		
-	For Protection	5P10	10 VA
-	For metering	0.5S	10 VA

**SEAL & SIGNATURE OF THE BIDDER**

TECHNICAL SPECIFICATION  
11 KV Metering Kiosk

**Table of Contents**

<b>1.00</b>	<b>SCOPE .....</b>	<b>3</b>
<b>2.00</b>	<b>SPARES.....</b>	<b>3</b>
<b>3.00</b>	<b>SERVICE CONDITIONS.....</b>	<b>3</b>
<b>4.00</b>	<b>STANDARDS.....</b>	<b>4</b>
<b>5.00</b>	<b>PRINCIPAL PARAMETERS .....</b>	<b>4</b>
<b>6.00</b>	<b>GENERAL TECHNICAL REQUIREMENTS.....</b>	<b>4</b>
<b>7.00</b>	<b>EARTHING.....</b>	<b>11</b>
<b>8.00</b>	<b>CABLE GLANDS.....</b>	<b>12</b>
<b>9.00</b>	<b>INSTRUMENT TRANSFORMERS .....</b>	<b>12</b>
<b>10.00</b>	<b>ELECTRONIC LOCK (OPTIONAL) .....</b>	<b>13</b>
<b>11.00</b>	<b>TESTES &amp; TEST CERTIFICATE.....</b>	<b>14</b>
<b>12.00</b>	<b>MINIMUM TESTING FACILITIES.....</b>	<b>16</b>
<b>13.00</b>	<b>MINIMUM MANUFACTURING FACILITIES.....</b>	<b>17</b>
<b>14.00</b>	<b>PROTOTYPE AND DRAWING .....</b>	<b>17</b>
<b>15.00</b>	<b>INSPECTION .....</b>	<b>17</b>
<b>16.00</b>	<b>AFTER SALES SERVICE.....</b>	<b>17</b>
<b>17.00</b>	<b>DOCUMENTATION .....</b>	<b>17</b>
<b>18.00</b>	<b>PACKING &amp; FORWARDING .....</b>	<b>18</b>
<b>19.00</b>	<b>SCHEDULE.....</b>	<b>19</b>
	<b>ANNEXURE - I .....</b>	<b>20</b>
	<b>ANNEXURE - II.....</b>	<b>21</b>

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## **1.00 SCOPE**

- 1.1 This specification covers the design, fabrication, painting and supply of metal cabinet, supply of components, wiring, testing at works, packing and supply on destination basis and performance testing of 11 kV self-equipped metering cubicle. The HT Static TOD Tri-vector meter is not in the scope of supply. The metering cubicle shall be suitable for outdoor application.
- 1.2 It is not the intent to specify herein all the complete details of the design and construction of equipments. However, the equipment shall conform in all respects to high standards of engineering, design and workmanship mentioned in clause 5.00 and shall be capable of performing continuous commercial operation upto the supplier's guarantee in a manner acceptable to the purchaser, who shall interpret the meanings of drawings and specification and shall have the power to reject any work or material which in his judgment, is not in accordance therewith. The equipments offered shall be complete with all components necessary for their effective and trouble free operation. Such components shall be deemed to be within the scope of supplier's, irrespective of whether those are specifically brought out in this specification and / or the commercial order or not.

## **2.00 SPARES**

The tenderer shall quote unit rates for the spares. The purchaser reserves the right of selection of items and quantities of these spares to be ordered. The costs of such spares shall not be considered for tender evaluation.

## **3.00 System Particulars:-**

- 3.1 Nominal System Voltage : 11kV
- 3.2 Voltage variation on supply side :  $\pm 10\%$
- 3.3 Corresponding Highest System Voltage: 12kV
- 3.4 Frequency : 50 Hz with  $\pm 3\%$  tolerance
- 3.5 Transient condition : -20 % or + 10 % combined variation of voltage and frequency.
- 3.6 Number of Phase : 3 Phases
- 3.7 Neutral earthing : Solidly earthed.

## **4.1 SERVICE CONDITIONS**

- (i) Location - Pune in the state of Maharashtra
- (ii) Maximum altitude above mean sea level- 1000 mtrs
- (iii) Maximum ambient average temp. - 50°C.
- (iv) Maximum temperature in shade - 45°C.
- (v) Minimum air temperature in shade - 3.5°C.
-

- |        |   |                          |
|--------|---|--------------------------|
| (vi)   | Relative humidity   | - 10 -100%               |
| (vii)  | Maximum annual rainfall   | - 1450 mm                |
| (viii) | Maximum wind pressure   | - 150kg/ mm <sup>2</sup> |
| (ix)   | Seismic level (Horizontal acceleration) (as per IS1893)                         | - 0.3 g                  |
| (x)    | Isoceraunic level   | - 50 (days/year)         |
| (xi)   | Climate – Moderately hot, humid, tropical, conducive to rust and fungus growth. |                          |
| (xii)  | The highest temperature in the cubicle may go up to 90°C                        |                          |

## **5.00 STANDARDS**

Unless otherwise specified elsewhere in this specification, the rating, performance and testing of the metering cubicle and accessories shall conform to the latest revisions, available at the time of submission of tender of all relevant standards listed in Annexure - I

## **6.00 PRINCIPAL PARAMETERS**

The equipment covered in this specification shall meet the technical requirements listed in Annexure - II.

## **7.00 GENERAL TECHNICAL REQUIREMENTS**

### **7.1 GENERAL ARRANGEMENT**

The metering cubicle shall be installed electrically in between the incoming supply point and the Distribution transformer of consumer's installation. The general arrangement of the cabinet shall be as per the enclosed drawing and final drawing approval has to be obtained after approval of prototype sample, as mentioned at clause 14.00. As shown in the general arrangement drawing, the metering cubicle shall be provided with following components suitably mounted:

1. 3 Nos. 11 kV level current transformers (CTs).
  2. 3 Nos. 11 kV level Potential transformers (PTs).
  3. Tinned copper bus-bars totally covered by HT insulating sleeves.
  4. The secondary wires from the terminals of CTs & PTs in the CT / PT compartment shall be covered by resin cast blocks and the secondary wires shall be brought in the metering compartment through rubber bush and shall be left open with sufficient spare length.
  5. Resin cast bushing board/s with arrangement to receive standard reputed type of cable terminations for incoming and outgoing supply points.
-

6. Adequate number of PVC cable glands to receive purchaser's incoming and / or outgoing cables with suitable cable clamping arrangement at incoming & outgoing of cubicle.
7. Electronic safety lock (optional).

The principal parameters of all the above said components are listed in Annexure - II and the general technical requirements are described hereinafter.

## 7.2 CONSTRUCTIONAL FEATURES OF THE CABINET

The metering cubicle shall consist of four metal enclosed compartments as follows:

- |                                   |        |
|-----------------------------------|--------|
| (a) CT/PT Compartment             | 1 No.  |
| (b) Cable termination compartment | 2 Nos. |
| (c) Meter compartment             | 1 Nos. |

## 7.3 General Technical Requirements of Current Transformers:-

### a) Resin Cast Assembly :-

The Resin Cast assembly shall be of a single piece construction without any joint or coupling.

### b) Insulation Material :-

Insulation Material used for Current Transformer should be Epoxy Resin Cast having Insulation Class E. The insulation of the Current Transformers shall be so designed that the internal insulation shall have higher electrical withstand capability than the external insulation. The dielectric withstand values specified in this specification are meant for fully assembled Current Transformer. The temperature rise on any part of equipment shall not exceed the maximum temperature rise limits specified in relevant IS.

### c) Earthing :-

The Current Transformer shall be provided with Two separate Earthing Terminals for bolted connection to MS flat. The size of two numbers of Earthing Terminals shall be 12 mm dia. x 30 mm length, Hot Dip Galvanized with one plain washer and one nut.

### d) Name Plate and Rating Plate:-

The Current Transformer shall be provided with non-corrosive, legible Name plate, with the information specified in relevant standards, duly engraved / punched on it. The Current Transformer shall be provided with a rating plate with dimensions and marking as per IS - 16227. The markings shall be punched and not painted. The serial number and code of the supplier shall also be punched on the

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Current Transformer to identify the unit in case of loss or damage to the rating plate.

**e) Mounting Details :-**

Mounting details for fixing the Current Transformer on supporting base channel shall be strictly in accordance with the specified details as follows:

The holes for mounting of CT shall be oval shaped with 12mm diameter.

Base Frame hole mounting centre to centre distance (mm) should be as below:

- a) For 11 kV CT : 285(L) x 140(W)
- b) For 22 kV CT : 340(L) x 170(W)
- c) For 33 kV CT : 360(L) x 170(W)

**f) Primary Winding :-**

- i) Primary winding shall be Wound Type. The primary winding conductor shall be high conductive (electrolytic grade) copper without any joint. Type of insulation used shall be described in the offer. For Primary Winding, current densities shall not exceed the limit 1.6 Amp/Sq.mm. for highest current ratio.
- ii) Enamel, if used for conductor insulation, shall be either polyvinyl acetate type or amide type and shall meet the requirements of IS - 4800. Polyester enamel shall not be used.
- iii) The design density for short circuit current as well as conductivity of the metal used for primary winding shall meet the relevant requirement of IS: 16227-2016.
- iv) The bidder shall, in his offer furnish detailed calculations for selection of winding cross sections. The cross section area of Primary Winding, cross section area of Secondary Winding, number of Primary Turns, number of Secondary Turns, Current Density etc. shall be mentioned by the bidder. The rating and the diagram plates should indicate the connection arrangement / diagram.
- v) The Primary Winding shall be designed for extended primary current at 120% of rated primary current.

**g) Secondary Winding :-**

- i) Suitably insulated copper wire of electrolytic grade shall be used for Secondary Windings. Type of insulations used shall be described in the offer. The cross section area of Secondary Winding, number of Secondary Turns, Current Density etc. shall be mentioned by the bidder.
  - ii) The excitation current of the CT shall be as low as possible. The bidder shall furnish, along with his offer, the magnetizing curves for all the cores.
-

**h) Primary Terminals :-**

The primary Terminal shall be of heavily tinned electrolytic copper of 99.9% conductivity. The minimum thickness of tinning shall be 15 microns. C.T.

**i) Secondary Terminals :-**

Secondary Terminals shall be provided with two studs having size M6X10 with safety acrylic cover.

**7.4 General Technical Requirements of Potential Transformers:-**

**a) Resin Cast Assembly :-**

The Resin Cast assembly shall be of a single piece construction without any joint or coupling.

**b) Insulation Material :-**

Insulation Material used for Potential Transformer should be Epoxy Resin Cast having Insulation Class E. The insulation of the Potential Transformers shall be so designed that the internal insulation shall have higher electrical withstand capability than the external insulation. The dielectric withstand values specified in this specification are meant for fully assembled Potential Transformer. The temperature rise on any part of equipment shall not exceed the maximum temperature rise limits specified in relevant IS.

**c) Earthing :-**

The Potential Transformer shall be provided with Two separate Earthing Terminals for bolted connection to MS flat. The size of two numbers of Earthing Terminals shall be 12 mm dia. x 30 mm length, Hot Dip Galvanized with one plain washer and one nut.

**d) Name Plate and Rating Plate:-**

The Potential Transformer shall be provided with non-corrosive, legible Name plate, with the information specified in relevant standards, duly engraved / punched on it. The Potential Transformer shall be provided with a rating plate with dimensions and marking as per IS – 16227. The markings shall be punched and not painted. The serial number and code of the supplier shall also be punched on the Potential Transformer to identify the unit in case of loss or damage to the rating plate

**e) Mounting Details :-**

Mounting details for fixing the Potential Transformer on supporting base channel shall be strictly in accordance with the specified details as follows:

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The holes for mounting of PT shall be oval shaped with 12mm diameter.

Base Frame hole mounting centre to centre distance (mm) should be as below:

a) For 11 kV PT : 280(L) x 190(W)

b) For 22 kV PT : 310(L) x 205(W)

c) For 33 kV PT : 405(L) x 230(W)

**f) Winding :-**

Suitably insulated copper wire of electrolytic grade shall be used for Secondary Windings. Type of insulation used shall be described in the offer.

**g) Primary Terminals :-**

The primary Terminal shall be of heavily tinned electrolytic copper of 99.9% conductivity. The minimum thickness of tinning shall be 15 microns. C.T.

**h) Secondary Terminals :-**

Secondary Terminals shall be provided with two studs having size M6X10 with safety acrylic cover.

**7.5 CT / PT COMPARTMENT**

7.5.1.1 3 nos. of CTs & 3 nos. of PTs shall be mounted in this compartment. Resin cast bushings of suitable size, strength & rating shall be provided on the two sides leading to two cable compartments. PT's are to be fixed on incoming side after that CT's shall be fixed keeping suitable distance as shown in drawing.

7.5.1.2 The inside terminals of the resin cast bushings, the primary terminals of CTs and primary terminals of PTs shall be connected to 25 mm X 6 mm size busbar of electrolytic grade tinned copper. All the terminals and busbar shall be covered by insulating sleeves so that no HT part is accessible. For cubicles having primary current more than 250 A, size of the bus bar shall be 25 mm x10 mm

7.5.1.3 The secondary wiring of CTs & PTs shall be carried out by 1100 V grade multi-stranded single core copper wire. Size of copper wire shall be 4 mm<sup>2</sup> for CTs & 2.5 mm<sup>2</sup> for PTs. Other end of these wires shall be brought to the meter compartment with sufficient spare length for connection to the energy meters. Entire wiring of cubicle except in the meter compartment shall be covered in rectangular box type PVC conduit so as to avoid the scattering of wires.

7.5.1.4 The CTs & PTs with base frame attached shall be firmly mounted on 75 x 40 x 5 mm base channel in CT and PT compartment. Additional support if necessary may be provided for mounting CT / PT so as to have the bushing

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terminals, CT primary terminals & PT primary terminals are at same horizontal level i.e. Busbar level.

The distance between Busbar bottom surface to mounting channel upper surface shall be as below:

- i. 11kV CT : 251mm  
11kV PT : 251mm
- ii. 22kV CT : 295mm  
22kV PT : 295mm
- iii. 33kV CT : 383mm  
33kV PT : 383mm

7.5.1.5 The CT / PT Compartment shall be provided with detachable top cover having 5 to 10 degree slope from the front to rear side with the canopy on front side.

7.5.1.6 The detachable top cover shall be provided with suitable interlock so that the same cannot be opened without opening the door of the meter compartment.

7.5.1.7 As the CTs / PTs incorporated in the cubicles are of resin cast type, ventilation for sufficient air circulation shall have to be provided. This shall be done by providing 2 Nos. air-vent pipes with small holes on plugged part bended downwards suitably as shown in the drawing.

7.5.1.8 The distance between live part of busbar to earth shall be minimum 190 mm.

#### 7.5.2 **CABLE COMPARTMENTS.**

7.5.2.1 Cable compartments for housing purchaser's cable / cable terminations shall be provided on both sides.

7.5.2.2 Detachable gland-plates shall be provided at the bottom side of this compartment for accommodating 11 / 22 / 33 kV XLPE, 3 core cables (120 mm<sup>2</sup> to 300 mm<sup>2</sup>).

7.5.2.3 Detachable covers shall be provided on sides of these compartments and the roof shall be sloping 5 to 10 degrees towards the ends with canopy.

7.5.2.4 Two Nos. of danger boards of M.S. plate shall be provided as per IS: 2551.

#### 7.5.3 **METER COMPARTMENT.**

7.5.3.1 Meter compartment with front door shall be provided on front side of the CT / PT compartment. The size of the compartment should be such that it can accommodate the HT ERSS Meter & Meter Testing equipment during load test. The minimum depth of the compartment should be 350 mm.

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- 7.5.3.2 The rubber gaskets shall be provided on stationary part of the compartment so that edges of door shall rest on it.
- 7.5.3.3 The door shall be provided with Godrej-Ultra lock (Latch type).
- 7.5.3.4 The door shall be provided with non-resettable mechanical impulse counter to monitor the number of times the door has been opened.
- 7.5.3.5 The door shall be supported by strong, heavy duty concealed type (hinges shall not be accessible from outside) hinges.
- 7.5.3.6 Toughened glass over grided window of size 200 x 200 x 5 mm mm for easy viewing the energy meter shall be provided. The glass shall be provided with suitable weather proof seal to prevent ingress of rain water and any screws, bolts and nuts for fixing the glass shall not be accessible from outside. Hinged metal cover to the glass window shall be provided to shield the glass from sun rays and mechanical damages.
- 7.5.3.7 The metering compartment shall be provided with 'Heatlon' lining through out the compartment.
- 7.5.3.8 Roof of the metering compartment shall be slopping 5 to 10 degrees towards front side with canopy.
- 7.5.3.9 The letters 'M.S.E.D.C.L.' of suitable size with 100 mm height shall be punched / embossed on front side door.

#### 7.5.4 **GENERAL FEATURES**

- 7.5.4.1 The metering cubicle shall comprise of rigid welded structural frame enclosed completely by M.S. sheets of not less than 2 mm thickness. Structural frame and supporting angles shall be of M.S. angle of size 50 x 50 x 6 mm minimum. All the compartments of the cubicle shall be welded from inside and detachable covers / components shall be bolted. Bolts with hole shall be provided for sealing purpose at opposite corners of the top cover as well as side covers. The fabrication of the cubicle shall be such that there is no ingress of water.
- 7.5.4.2 All doors and removable covers ( 2 no. I/C & O/G compartment) shall be provided with neoprene gasket 25 mm wide all around them. The top cover shall be provided with cork gasket with the width equal to the width of cover / flange of CT/PT compartment and the metering cubicle shall meet the requirements of IP - 55 protection as per IS - 12063, if the air-vents are closed.
- 7.5.4.3 The height of metering cubicle shall be such that, the meter window be at normal eye level. A bottom frame of M.S. angles as shown in the drawings shall be provided, duly welded, for mounting the cubicle on the plinth.
- 7.5.4.4 The holes for mounting of CT and PT shall be oval shaped with 12mm diameter.

Base Frame hole mounting centre to centre distance (mm) should be as below:

d) For 11 kV CT : 285(L) x 140(W)

For 11 kV PT : 280(L) x 190(W)

e) For 22 kV CT : 340(L) x 170(W)

For 22 kV PT : 310(L) x 205(W)

f) For 33 kV CT : 360(L) x 170(W)

For 33 kV PT : 405(L) x 230(W)

Distance between base channels centre to centre should be as below:

i) For 11 kV CT : 285mm

For 11 kV PT : 280mm

ii) For 22 kV CT : 340mm

For 22 kV PT : 310mm

iii) For 33 kV CT : 360mm

For 33 kV PT : 405mm

7.5.4.5 2 nos. of lifting hooks each of suitable size shall be provided suitably at the top of incoming & outgoing compartment for lifting the cubicle.

7.5.4.6 The metering cubicle shall be painted by powder coating after proper cleaning. The colour shall be 'Light Gray' 631 as per IS : 5. Finished painted appearance of equipment shall present an aesthetically pleasing appearance, free from dents and uneven surfaces.

7.5.4.7 In order to avoid rusting, automobile grade painting or suitable anticorrosive paint shall be done to cubicle.

7.5.4.8 For horizontal/vertical type metering cubicle, the incomer cables shall enter from the bottom of kiosk/cubicle and outgoing cables shall be drawn out from bottom of kiosk/cubicle as well (The drawing submitted shall be as per drawing of vertical type cubicle attached with specification).

7.5.4.9 Silica gel bags to be provided inside the compartment to absorb moisture to avoid flashover.

## **8.00 EARTHING**

8.1 Five independent G.I. earthing bolts of minimum M 10 size shall be provided on sides so that the inside and outside earthing can be done. It shall be firmly welded to the sides.

8.2 An earthing bus of copper strip of size 25 x 3 mm shall be provided and extended throughout the length of the metering cubicle. It shall be bolted / brazed to the framework at two points. PT primarily earthing may be made at 2 locations by 25 x 3 mm copper strips.

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- 8.3 All non-current carrying metal work of the Metering cubicle shall be efficiently bonded to the earth bus.
- 8.4 Hinged doors shall be earthed through flexible earthing braid.

## **9.00 CABLE GLANDS**

The sizes of 11 / 22 / 33 kV power cable being arranged by the purchaser for incoming and / or outgoing supply shall be 120 mm<sup>2</sup> to 300 mm<sup>2</sup> 3 core XLPE cables. The bidder shall provide connecting leads of adequate size with terminal clamps for connecting cable terminals to bus-bars. The arrangements shall be suitable for double bolt connection as shown in the drawing. Two sets of one plain washer and one cup washer and two nuts and one bolt shall be provided for the purchasers incoming / outgoing cable connections. The bidder's scope shall also include necessary number of heavy duty PVC cable glands for terminating 11 / 22 / 33 kV power cables.

## **10.00 TRANSFORMERS**

### **10.1 INSTRUMENT TRANSFORMERS.**

- 10.1.1 The current transformers (CTs) and potential transformers (PTs) shall conform to the requirement stipulated in relevant standards as well as in Annexure - II.
- 10.1.2 The CTs & PTs shall be of cast resin type (Insulation Class 'E') and the design and dimensions shall be universal irrespective of class so that any CT/PT can be easily replaced irrespective of manufacturer. CT/PTs shall be able to withstand the thermal and mechanical stresses resulting from the maximum short circuit & momentary current ratings specified. These shall be completely encapsulated. The resin used for manufacturing of CT / PT and Bushing Board shall be of reputed make and resin casting shall be carried out under vacuum by hot setting process only. During this process porosity in the resin casting shall be strictly avoided to get the better results of CT/PT operations. HT insulating sleeves of reputed make shall be used for HT busbar.
- HT insulating sleeves is developed by making use of cross linked, flame retardant and track resistant polyolefin. It is completely resistant to splitting.
- 10.1.3 CTs / PTs shall have polarity marks indelibly embossed on each transformer and at the associated terminal block.
- 10.1.4 CTs / PTs shall be of single phase/ single ratio type.
- 10.1.5 Core lamination shall be of high grade steel or other equivalent alloy.
- 10.1.6 Name plate showing particulars and connection diagram shall be provided. Name plate shall be made of non-corrosive material & shall be
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indelibly punched / painted and shall be firmly fixed on the body of instrument transformer.

- 10.1.7 The size and dimensions of CTs & PTs shall be strictly as per the enclosed drawing.
- 10.1.8 The CTs & PTs shall be suitable for floor mounting in the cubicle.
- 10.1.9 The primary terminals of CT shall be on top of CT and it should be threaded type.
- 10.1.10 The primary terminal of PT shall be on top of PT and it should be threaded type.
- 10.1.11 Size of primary terminals of CT & PT shall be M10 and above as per CT ratio and size of outgoing secondary terminals of CT & PT shall be M6.
- 10.1.12 The class of accuracy for CT's & PT's for various ratios at various voltage level is given in table below.

Sr. No.	Voltage & Current Rating	Class of accuracy of CT	Class of accuracy of PT
1.	11 KV : 5, 10, 25 & 50/5 A	0.5 S	0.5
2.	11 KV : 75/5A, 100/5 A, 200/5A, 300/5 A	0.2 S	0.2
3.	22 KV: 5, 10, & 25/5 A	0.5 S	0.5
4.	22 KV : 50 /5 A, 100/5A, 200/5 A, 300/5 A	0.2 S	0.2
5.	33 KV : 50/5 A, 100/5A, 200/5 A, 300/5 A, 400/5 A & above	0.2 S	0.2

- 10.1.13 The PT ratios are as follows :

For 0.2S Class of Accuracy of CT the relevant Class of Accuracy for PT shall be 0.2. For 0.5S Class of Accuracy CT the relevant Class of Accuracy for PT shall be 0.5.

## 10.2 ELECTRONIC LOCK (OPTIONAL)

A dynamic electronic locking system for the cubicle shall be offered as optional item. The dynamic lock shall consist mainly of -

- (a) MASTER UNIT with LCD to programme REMOTE at purchaser's office,
  - (b) Portable REMOTE with KEYBOARD to operate the door of the panel lock.
  - (c) PANEL LOCK with sensor to lock / unlock door of cubicle.
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## **MASTER UNIT**

The unit shall contain LCD display and a socket to connect REMOTE, when powered, it shall show current date and time. The clock for this purpose shall be simple but tamper proof clock. Once connected to REMOTE using cable, the lock shall open only when ID of MASTER matches with that of REMOTE.

The REMOTE shall be programmed for specific panel lock only. The secret code for transmission shall be complete and shall not follow normal arithmetic rules. Random codes shall be generated which shall be unique for specific lock. The secret code shall be a function of that particular date so that once a REMOTE is programmed; it shall be effective only for certain hours say end of the day.

Transmission of secret code of PANEL LOCK shall be done on dual transmission technique i.e. Infra Red (IR) and Radio Frequency (RF) encoding, using these two techniques coupled with Random Code generation technique mentioned above shall provide the secret code system which cannot be broken.

## **REMOTE**

A REMOTE of simple design having a keypad as in the telephone instrument shall be provided.

The REMOTE shall have a unique ID code to have dialog with MASTER. Once programmed the REMOTE shall be useful for operating PANEL LOCK for that particular day only.

## **PANEL LOCK**

The PANEL LOCK shall consist of an RF & IR sensor and motorised mechanical lock. The motor of the mechanical lock shall be operable at 230 +/- 10% volt single phase A.C. power supply. The lock shall have minimum 4 Nos. of cylinders of 14mm diameter which shall engage the cubical door. The sensor shall also indicate power on / off and status of lock. The MASTER and the REMOTE shall be programmable / usable for number of PANEL LOCKS - the limitations, if any, may be specified by the bidders. Any other techno-economical acceptable alternative designs shall be considered but indenter / purchaser shall be final authority in this regard.

### **11.00 TESTES & TEST CERTIFICATE**

#### **11.01 ACCEPTANCE AND ROUTINE TEST**

Following tests shall be carried out as acceptance and routine tests.

##### **11.1.1 For Current Transformers**

All tests as per clause No.7.1.2 of IS – 16227 (Part-II) 2016 amended up to date.

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### 11.1.2 **For Potential Transformers**

All tests as per clause No. No.7.1.2 of IS – 16227 (Part-III) 2015 amended up to date.

### 11.1.3 **For Complete Unit**

- i) Power frequency withstand test at 28 kV, 50 kV and 70 kV for 11 kV, 22 kV and 33 kV cubicles respectively.
- ii) Overall dimensions

For CTs and PTs, required tests shall be carried out at the works of original manufacturer's in presence of purchaser's representative.

## 11.02 **TYPE TESTS**

For the CTs and PTs, the type tests shall be carried out for each voltage class and for each rating of short time withstand current with lowest CT ratio.

### 11.2.1 **For Current Transformer**

All tests as per clause No.7.1.2 of IS – 16227 (Part-I) 2016 & as per clause no. 7.1.2 of IS – 16227 (Part-II) 2016 amended up to date, considering outdoor application of CTs.

### 11.2.2 **For Potential Transformer.**

All testes as per clause No.7.1.2 of IS – 16227 (Part-I) 2016 & as per clause no. 7.1.2 of IS – 16227 (Part-III) 2015. amended up to date, considering outdoor application of PTs.

### 11.2.3 **For Complete Unit**

- Temperature rise test on complete unit at the rated current of cubicle of each voltage class with highest C.T. ratio. (IS 3427 (1997)).
- Power Frequency Withstand Test at 28 kV, 50kV and 70kV for 11kV, 22kV and 33 KV cubicles respectively.
- Impulse Wave Withstand test at 75 kV, 125 kV & 170 kV for 11 kV, 22 kV and 33 kV cubicles (considering that the cubicles are meant for outdoor use) as per IS-2071.
- Type test for IP-55 protection as per category '1' as mentioned as per clause no. 7.5 of IS 12063.
- Short time withstand current test, shall be performed on the cubicle by passing a current of 13.1 KA for 1 Sec. for 11 kV and 26.2 KA for 1 sec. for 22 kV / 33 kV with CT / PT bypassed. (IS 3427-1997).

## 11.03 **TYPE TEST REPORTS**

The HT Metering cubicles, CTs and PTs shall be fully type tested as per relevant IS and this specification. The tenderer shall furnish detailed type

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test reports of all the type tests for offered CTs, PTs and HT Metering Cubicles. For these CTs & PTs, the type tests shall be for each voltage class and for each rating of short time current. These tests shall have been carried within 5 years prior to the date of submission of type test reports. The TTR shall have to be submitted along with offer alternatively if the relevant type test are not available with bidder same shall be submitted before commencement of supply. This being considered as the class of accuracy of CT's & PT's have been changed from 0.5 to 0.5S up to 1000 KVA and 0.2S above 1000 KVA. However the bidder has to submit the recent TTR available for 0.5 class / 0.2 Class with them as proof of being manufacturing the CT's/PT's & metering Cubicle. The purchaser reserves the right to demand repetition of some or all TTRs in presence of purchaser's representative at purchaser's cost. In case the unit fails in any one type test, the complete supply shall be rejected.

All above type tests shall be carried out at NABL Laboratories to prove that the complete HT Metering Cubicles, CTs and PTs offered meet the requirements of specification. The successful bidder shall take approval / waiver of type tests from the Chief Engineer, Testing and Quality Control, MSEDCL, Mumbai prior to commencement of supply.

## **12.00 MINIMUM TESTING FACILITIES**

The Bidder must clearly indicate the details of testing facilities available at the works of manufacturer and that the facilities are adequate to carry out all routine and acceptance tests. These facilities shall be available to MSEDCL's Engineers, if deputed to carry out or witness the tests at the manufacturer's works.

### **12.1.1 For CT/PT at original manufacturer's works**

- Class of accuracy test panel for CTs with phase angle and ratio error measuring unit with Current source, Burden box and standard CT.
- Class of accuracy test panel for PTs with phase angle and ratio error measuring unit with Voltage source, Burden box and standard PT.
- Partial discharge test setup.
- Resistance Voltage Divider.
- High Frequency Generator Set with control panel.
- Mili-Ohms Meter.
- Over voltage inter turn test equipment

### **12.1.2 HT Metering Cubicle**

- Power Frequency Withstand Test Generator Set with control panel.
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- Current source for temperature rise test with digital ammeter, volt meter, temperature indicators and Tong Tester.

### **13.1 MINIMUM MANUFACTURING FACILITIES**

The Bidder shall have following minimum manufacturing facilities in house to prove his reliability as a manufacturer of HT Metering Cubicle.

- a. Power operated shearing machine.
- b. Power operated press brake.
- c. Power operated press.

The tenderer shall furnish details of Powder Coating process employed.

### **14.00 PROTOTYPE AND DRAWING**

The successful bidder shall have to offer a prototype sample for inspection before bulk manufacturing. The prototype sample shall be inspected by a team of purchaser's representatives.

On approval of prototype, the bidder shall have to submit all the detailed drawings accordingly and get it approved from Chief Engineer, MSEDCL, Testing and Quality Control, 5<sup>th</sup> Floor, Prakashgad, Mumbai - 400051 before bulk manufacturing and supply.

No additional delivery period shall be permitted for approval of prototype and drawings.

### **15.00 INSPECTION**

The inspection may be carried out by the purchaser at any stage of manufacture. The successful bidder shall grant free access to the IUCAA & MSEDCL's representative at a reasonable time when the work is in progress.

Inspection and acceptance of any equipment under this specification by the purchaser shall not relieve the supplier of his obligation of furnishing equipment in accordance with the specification and shall not prevent subsequent rejection if the equipment is found to be defective.

### **16.00 AFTER SALES SERVICE**

The supplier shall agree for services after sales & to supply recommended spares like single core resin cast CTs & PTs of specific ratings with base frame attached with CTs & PTs as and when required by IUCAA / MSEDCL after guarantee period.

### **17.00 DOCUMENTATION**

- 17.1 The bidder shall furnish two sets of following drawings and documents along with his offer.
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- Complete assembly drawings of the metering cubicle showing plan, elevation and typical sectional views and locations of cable boxes, bus-bars, metering compartment and TV meter.
- Foundation plan showing location of foundation channels, anchor bolts and anchors, floor plan and openings for cables etc.
- Type test certificates for type testing of bought out items, if already carried out.
- Descriptive pamphlets and literature of bought out items including CT characteristic curves etc.

17.2 All drawings and data shall be annotated in English.

17.3 Successful bidder shall be required to furnish four sets of final versions of all the above said drawings and documents within 15 days after Proto type inspection, for purchaser's approval.

17.4 Approval of drawings / work by purchaser shall not relieve supplier of his responsibility and liability for ensuring correctness and correct interpretation of the drawings for meeting the requirement of the latest revision of applicable standards, rules and codes for practices. The equipment shall conform in all respects to high standards of engineering, design, workmanship and latest revisions of relevant standards at the time of ordering and purchaser shall have power to reject any work or materials which, in his judgment, is not in full accordance therewith.

## **18.00 PACKING & FORWARDING**

18.1 The equipments shall be packed in crates suitable for vertical / horizontal transport, as the case may be, and suitable to withstand handling during transport and outdoor storage during transit. The supplier shall be responsible for any damage to the equipment during transit due to improper and inadequate packing. The easily damageable material shall be carefully packed and marked with appropriate caution symbols. Wherever necessary, proper arrangement for lifting, such as lifting hooks etc. shall be provided. Any material found short inside the packing cases shall be supplied by supplier without any extra cost.

18.2 Each consignment shall be accompanied by a detailed packing list containing the following information.

- a. Name of the consignee.
- b. Details of consignment.
- c. Destination.
- d. Sign showing upper/lower side of the crate.
- e. Handling and unpacking instructions



f. Bill of material indicating contents of each package.

18.3 The supplier shall ensure that the packing list and bill of material are approved by the purchaser before dispatch.

**19.00 SCHEDULE.**

19.1 The tenderer shall fill in the following schedules which form part of the tender specification and offer. If the schedule are not submitted duly filled in with the offer, the offer shall be liable for rejection.

Schedule -'A' - Guaranteed and technical particulars.

Schedule -'C' - Tenderer's Experience

19.2 Unless otherwise brought out separately by the tenderer, the equipment offered shall be claimed to conform to the specification, scrupulously. The discrepancies between the specification and the catalogues or literature submitted as part of the offer shall not be considered as valid unless specifically brought out.



**ANNEXURE – I**  
**LIST OF APPLICABLE STANDARDS**

<b><u>SR. NO.</u></b>	<b><u>STANDARD NO.</u></b>	<b><u>TITLE</u></b>
(1)	IS – 2071	Method of High Voltage Testing
(2)	IEC – 60270	Partial Discharge Measurement
(3)	IEC – 60	High Voltage Test Techniques
(4)	IEC – 8263	Method of RIV test on high voltage insulators
(5)	IS – 16227 (Part I & II)	Current Transformers
(6)	IS – 16227 (Part I & III)	Voltage Transformers
(7)	IS – 11322	Method for partial discharge measurement in instrument transformers
(8)	IEC – 44 – Part 4	Partial Discharge Measurement
(9)	IS – 12063	Classification of degree of protection provided by enclosures of Electrical equipments.
(10)	IS – 3427	HT switchgear and control gear

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**ANNEXURE – II****PRINCIPAL TECHNICAL PARAMETERS OF EQUIPEMNT**

<b>Sr. No.</b>	<b>ITEM</b>	<b>Specification</b>		
<b>A) SYSTEM PARAMETERS</b>				
1	Rated voltage	11 kV	22 kV	33 kV
2	Highest System Voltage	12 kV	24 kV	36 kV
3	Short circuit withstand current and duration (KA rms/sec)	11 kV	22 kV	33 kV
	FOR 75/5 A, 100/5A	13.10 kA	26.20 kA	26.20 kA
	FOR 50, 25/5A	6.70 kA	13.10 kA	13.10 kA
	FOR 10/5A	3.00 kA	6.70 kA	6.70 kA
	FOR 5/5A	3.00 kA	3.00 kA	3.00 kA
4	Frequency	50 Hz	50 Hz	50 Hz
<b>B) CURRENT TRANSFORMER</b>				
1	Type	Single Phase, cast resin		
2	Insulation class	'E'		
3	Rated voltage	11 kV	22 kV	33 kV
4	Rated primary current (A)	5,10,25,50,75,100,200,300,400		
5	Rated secondary current (A)	5		
6	Basic insulation level (KV)	12/ 28/ 75	24/ 50/ 125	36/ 70/ 170
6.1	One minute power frequency Withstand voltage (KVrms)	28	50	70
6.2	1.2/50 microsecond impulse voltage (KVP)	75	125	170
7	Rated continuous thermal current	1.2 times the rated current		

8	Burden (VA)	10 VA		
9	Class of Accuracy	0.5S & 0.2 S as per requirement		
10	Instrument security factor	5 or less		
11	Core details	Single core		
12	Short circuit withstand current and duration (KA rms/sec)	11 kV	22 kV	33 kV
	For 100/5A	13.10kA	26.20 kA	26.20 kA
	For 50,25/5A	6.70 kA	13.10 kA	13.10 kA
	For 10/5A	3.00 kA	6.70 kA	6.70 kA
	For 5/5A	3.00 kA	3.00 kA	3.00 kA
13	Rated dynamic withstand current (KAp)	2.5 Times STC		
14	1 Applicable standard	IS-16227 part I & II		
15	Dimensions of CT	11 kV	22 kV	33 kV
	Height (mm)Max.	251	295	383
	Distance between terminals (mm)	110	110	110
	Mounting arrangement (mm)	285x140	340x170	360x170
<b>C) POTENTIAL TRANSFORMER</b>				
1	Rated primary voltage (V)	11000/√3	22000/√3	33000/√3
2	Rated secondary voltage (V)	110/√3		
3	Ratio Tap	Single Ratio		
4	Core details & purpose	Single core & commercial metering.		
5	Type	Resin Cast		
6	Insulation class	E		

7	Insulation level			
7.1	One minute power frequency Withstand voltage (KVrms)	28	50	70
7.2	1.2/50 microsecond impulse voltage (KVP)	75	125	170
8	Applicable standard	IS – 16227 Part I & III		
9	Ratio (V)	$\frac{11000/110}{\sqrt{3}}$	$\frac{22000/110}{\sqrt{3}}$	$\frac{33000/110}{\sqrt{3}}$
10	Rated burden	50 VA		
11	Class of accuracy	0.5 or 0.2 as per requirement		
12	Dimensions of PT	11 kV	22 kV	33 kV
	Height (mm)	251	295	383
	Mounting arrangement (mm)	280x190	205x310	405x230

#### **D) METAL CABINET**

1	Overall dimensions	As per drawing
2	Material	Mild Steel
3	Plate Thickness	
3.1	Side plates (mm)	2 mm
3.2	Bottom Plates (mm)	2 mm
3.3	Top Plate (mm)	2 mm

#### **E) BUSBARS/ CONNECTING STRIPS**

1	Material	E. C. Grade Copper
2	Cross Section	Rectangular 25mm X 6mm

**Seal & Signature of Bidder**