TENDER DOCUMENT

for

Renovation & Up-gradation of Protection Systems of 132kV Sub-Stations in Mizoram under Power System Development Fund (PSDF)

Volume-II

Broad Scope & Technical Specifications

Office of the Superintending Engineer, Mizoram SLDC Circle,
P&E Department, Government of Mizoram
Mizoram: Aizawl

January- 2017

VOLUME - II:

BROAD SCOPE OF WORK
&
TECHNICAL SPECIFICATIONS

INDEX

SCOPE OF WORK AND TECHNICAL SPECIFICATIONS FOR PLANT & EQUIPMENT

A. 110V BATTERY BANK, CHARGERS AND DC DISTRIBUTION BOARD

1.0 SCOPE

1.1 The scope of work is furnished below:

a) Design, manufacture, testing at manufacturer's works and supply of 110 Volt Battery Banks, Chargers and DC Distribution Boards with all fittings and accessories including supporting rack/mounting structures as applicable.
b) Loading at manufacturer's works, transportation and delivery at respective substation sites, including unloading at destination sites.
c) Erection, Testing and Commissioning of Battery Banks, Chargers and DCDB including dismantling of existing equipment, if necessary.

2.0 SERVICE CONDITIONS

2.1. The plant and materials supplied shall be suitable for operation under the following climatic and other conditions:

a) Max. Ambient temperature	: 50^{o} C
b) Min. Ambient temperature	: 4^{o} C
c) Relative humidity	: 35% - 98%
d) Average Annual Rainfall	: 3,000 mm
e) No of months of active monsoon	: 6 (May to October)
f) Seismic zone	: V
g) Altitude	: Not less than 2,210 M above sea level

3.0 TYPE TEST REPORTS

3.1. Equipment, which has never been tested for critical performance, shall not be accepted. In such cases, a promise or agreement by a bidder to have the equipment tested after award of a contract is not acceptable.

3.2. All Bids must be accompanied by the full Type Test Certificates of equipment offered. Such type test certificates shall be acceptable only if:-

(a) Tests are conducted in an independent and well known testing laboratory, or
(b) Tests are conducted in manufacturer's own laboratory. In this case (i) the laboratory must have ISO 9000 (or its equivalent) series certification; and (ii) tests have been witnessed by technically qualified representatives of earlier clients or purchaser.

3.3. Test reports to be acceptable must be related directly to the materials offered. Test reports for higher class of equipment are acceptable with commitment to perform the type tests free of any charge on the particular equipment(s) after the award of contract.

3.4. Type Test Reports older than five (5) years on the date of tender opening shall not be accepted.

4.0 GUARANTEED TECHNICAL PARTICULARS

4.1. The Guaranteed Technical Particulars of the various items shall be furnished by the Bidders in the prescribed format furnished under volume III of this tender document. The Bidder shall also furnish any other information's as in their opinion is needed to give full description and details to judge the item(s) offered by them.

4.2. The data furnished in Guaranteed Technical Particulars should be the minimum or maximum value (as per the requirement of the specification) required. A Bidder may guarantee a value more stringent than the specification requirement. However, for testing purpose or from performance point of view, the material shall be considered performed successfully if it achieves the minimum/maximum value required as per the technical specification. No preference what so ever shall be given to the bidder offering better/more stringent values than those required as per specification except where stated otherwise.

5.0 TECHNICAL SPECIFICATION OF BATTERY BANKS

5.1. **Type:**

5.1.1. The DC Batteries shall be VRLA (Valve Regulated Lead-Acid) type and shall be Normal Discharge type. These shall be suitable for a long life under continuous float operations and occasional discharges.

5.1.2. The Battery and accessories shall conform to IS: 15549/ IEC 60896 and other relevant IS/IEC standards except to the extent explicitly modified in this specification.

5.2. **Ratings:**

(i) The Ampere-hour capacity of the battery bank at **27°C at 10 hours discharge rate shall be 250 Ah.**

(ii) The nominal voltage of the battery bank shall be **110 Volts D.C**.

(iii) The number of cells in a complete battery bank set shall be **55**.

5.3**. Capacity Requirements:**

5.3.1. When the battery is discharged at 10-hour rate, it shall deliver 80% of C (rated capacity, corrected at 27^{o} Celsius) before any of the cells in the battery bank reaches 1.85V/cell.

5.3.2. The battery shall be capable of being recharged from the fully exhausted condition (1.75V/cell) within 10 hrs up to 90% state of charge. All the cells in a battery shall be designed for continuous float operation at the specified float voltage throughout the life.

5.3.3. The capacity (corrected at 27ºCelcius) shall also not be less than C and not more than 120% of C before any cell in the battery bank reaches 1.75V/cell. The battery voltage shall not be less than the following values, when a fully charged battery is put to discharge at C/10 rate:

(a) After Six minutes of discharge : 1.98 V/cell

(b) After Six hours of discharge : 1.92V/cell

(c) After 8 hours of discharge : 1.85 V/cell

(d) After 10 hours of discharge : 1.75 V/cell

5.3.4. Loss in capacity during storage at an average ambient temperature of 35º Celcius for a period of 6 months shall not be more than 60% and the cell/battery shall achieve 85% of its rated capacity within 3 charge/discharge cycles and full rated capacity within 5 cycles, after the storage period of 6 months. Voltage of each cell in the battery set shall be within 0.05V of the average voltage throughout the storage period. Ampere hour efficiency shall be better than 90% and watt hour efficiency shall be better than 80%.

5.4. **Material and constructional requirements:**

5.4.1. **Container**

The container shall be made of acid resistant and fire retardant grade polypropylene copolymer plastic and shall have chemical and electrochemical compatibility. The container material shall have an Oxygen Index of at least 28 %. The other requirement for plastic container shall be as per IS 1146.

5.4.2. **Cell Lids**

The cell lids shall be made of same plastic material as that of container and permanently fixed with the container. It shall be capable to withstand internal pressure without bulging or cracking. Fixing of Pressure Regulation Valve & terminal posts in the cover shall be such that the seepage of electrolyte, gas escapes and entry of electro-static spark are prevented.

5.4.3. **Plates**

The plates shall be of pasted construction and of good workmanship. These shall be free from cracks, white patches and other imperfections, which may affect the life and performance of the battery.

5.4.4. **Separators**

The separators used shall be of glass mat having high acid absorption capability, resistance to sulphuric acid and good insulating properties. The separator shall meet the test requirements as given in IEC/IS.

5.4.5. **Terminal posts**

Positive and negative terminals posts shall have built in lead plated copper or brass inserts. Terminals of cells shall be clearly and unmistakably identifiable and marking shall be of permanent nature. Terminal posts shall be suitably sealed at the lid to prevent leakage of any gas. Any gas escape shall be only through the venting device provided. The surface of the terminal post extending above the cell cover including

bolt hole shall be coated with an acid resistant and corrosion retarding material.

5.4.6. **Fastners**

Nuts and bolts for connecting the cells shall be made of copper, brass or stainless steel. Copper or brass nuts and bolts shall be effectively lead coated to prevent corrosion. Stainless steel bolts and nuts shall be passivated to prevent corrosion with acid.

5.4.7. **Electrolyte**

The sulphuric and water used for the preparation of electrolyte shall conform to IS 266 and IS 1069 respectively.

5.4.8. **Connectors**

When it is not possible to bolt the cell terminals directly to assemble the battery, a separate lead coated copper connectors or flexible copper cable connectors of suitable cross-section shall be provided to join the cells. The lead plating on copper connectors shall not be less than 25 micron. The sulphuric and water used for the preparation of electrolyte shall conform to IS 266 and IS 1069 respectively.

5.4.9. **Venting device**

Each cell shall be provided with a venting device (pressure regulation valve). The valve shall be self-re-sealable and flame retardant. The valve unit shall be such that it cannot be opened without a proper tool. The valve shall be capable to withstand the internal cell pressure specified by the manufacturer. Each valve regulated venting device shall be provided with flame arrestor capable of preventing the ingress of moisture/flame into the cell interior when the valve releases the gas mixture. The opening and closing pressure shall be within + 1 psi variation and manufacturer shall declare the closing and opening pressure values

5.5. **Battery Racks**

5.5.1. Batteries shall be installed on MS racks to be supplied by the Contractor to fit in the battery room. Racks/Trays shall be powder coated with acid proof, anti-corrosive paint. Rack shall accommodate 55/110 cells. Racks/Tray shall be suitably treated before painting for protection against fungus growth and other harmful effects due to tropical environment.

5.5.2. The colour of the supporting racks shall conform to shade 631 of IS: 5.

6.0 BATTERY CHARGING CABLES

6.1. **General description**

6.1.1. The Battery Chargers as well as their automatic regulators shall be of static type and shall be compatible with offered VRLA batteries.

6.1.2. The battery charging Cable shall have following two separate Boost-cum Trickle Charger sections:

(a) Section-1: Float Charger Section

(b) Section-2: Float-cum-Boost Charger Section

Each section shall have its own rectifier transformer, Rectifier Bridge and other cable so that each section can operate independent of each other.

6.1.3. The Charger shall regulate the float/boost voltage in case of prescribed temperature rise of battery as per manufacturer's recommendation to avoid thermal runaway. Necessary temperature sensors shall be provided in mid location of battery banks and shall be wired up to the respective charger for feedback control. The manufacturer shall demonstrate this feature during testing of each charger.

6.2. **Charger ratings:**

6.2.1. The charger sections shall have the following ratings:

(A) Section-1: Float Charger Section (FC):

(i) Input Voltage : 415+/- 10% volts three phase, 4 wire, 50 Hz A.C.

(ii) Output Voltage : 110 Volt (Nominal).

(iii) Output Voltage Range : 2.13 to 2.27 Volt per cell (Continuously Settable)

(iv) Total Output DC Current : 50 Amp

(B) Section-1: Float cum Boost Charger Section (FCBC):

(i) Input Voltage : 415+/- 10% volts three phase, 4 wire, 50 Hz A.C.

(ii) Output Voltage : 110 Volt (Nominal)

(iii) Output Voltage Range : 2.13 to 2.50 Volt per cell (Continuously Settable)

(iv) Total Output DC Current : 25 Amp

6.3. **Operation and control:**

6.3.1. Both the Charger Sections shall be capable for charging the battery and supplying the load simultaneously. The Float-cum-Booster charger section shall be operated either in float mode or in boost-cum-standby float charger mode.

6.3.2. Under normal operating condition, with the input AC supply present, the 'Float Charger Section' shall supply the DC load and also float the battery by trickle charging and the 'Float cum Boost Charger Section' shall be kept in hot standby mode.

6.3.3. In the event of main AC supply failure, the Sub-station DC load shall be automatically change over to the battery without any interruption. Similarly, after restoration of AC supply the normal operating condition shall be restored automatically and without any interruption.

6.3.4. Under normal operating condition, with the input AC supply present and battery requires boost charge, the battery shall be automatically change over to 'Float cum Boost Charger Section' automatically. Similarly, after completion of Boost Charging, the battery shall be automatically to 'Float Charger Section'. During this Boost Charging operation, `the float charger section' shall supply the load current only while

boost charger section of 'Float cum Boost Charger Section' shall boost charge the battery and the load supply shall be disconnected from the battery through a contact of a contractor. If the 'Float Charger Section' fails during this period, the battery shall maintain load through tap cell diode, connected at suitable cell (to limit the DC load voltage to 110% of the specified Nominal Voltage, even at maximum Boost Charging voltage), instantaneously without any interruption of the DC load supply. If the incoming AC supply or the boost charger fails during boost charging, all the cells shall be connected to the load bus through the contact of the same contactor mentioned above.

6.3.5. All Battery Chargers shall be provided with facility for both automatic and manual control of output voltage and current. A selector switch shall be provided for selecting the mode of output voltage/current control, whether automatic or manual. When on automatic control mode during Float charging, the Charger output voltage shall remain within +1% of the set value, for AC input voltage variation of +10%, frequency variation of +5%, a combined voltage and frequency variation of +10%, and a DC load variation from zero to full load.

6.3.6. All battery chargers shall have a constant voltage characteristic throughout the range (from zero to full load) at the floating value of the voltage so as to keep the battery fully charged but without harmful overcharge.

6.3.7. All chargers shall have load limiters having drooping characteristic, which shall cause, when the voltage control is in automatic mode, a gradual lowering of the output voltage when the DC load current exceeds the Load limiter setting of the Charger. The Load-limiter characteristics shall be such that any sustained overload or short circuit in DC System shall not damage the Charger, nor shall it cause blowing of any of the Charger fuses. The Charger shall not trip on overload or external short circuit.

6.3.8. Uniform and step less adjustments of voltage setting (in both manual and automatic modes) shall be provided on the front of the Charger panel (FC) covering the entire float charging output range specified. Step less adjustments of the Load limiter setting shall also be possible from 80% to 100% of the rated output current for charging mode.

6.3.9. During Boost Charging, the Battery Charger (FCBC in Boost Mode) shall operate on constant current mode (when automatic regulator is in service). It shall be possible to adjust the Boost charging current continuously over a range of 50% to 100% of the rated output current for Boost charging mode.

6.3.10. The Charger output voltage shall automatically go on rising, when it is operating on Boost mode (FCBC), as the Battery charges up. For limiting the output voltage of the Charger, a potentiometer shall be provided on the front of the panel, whereby it shall be possible to set the upper limit of this voltage anywhere in the output range specified for Boost Charging mode.

6.3.11. The Charger manufacturer may offer an arrangement in which the voltage setting device for Float charging mode is also used as output voltage limit setting device for Boost charging mode and the Load-limiter of Float charging mode is used as current setting device in boost charging mode.

6.3.12. Suitable filter circuits shall be provided in all the chargers to limit the ripple content (Peak to Peak) in the output voltage to 1%, irrespective of the DC load level, when they are not connected to a Battery.

6.3.13 An indicative logic of operation of FC & FCBC is furnished below:

System condition	Battery Status	Charger Mode	FC	FCBC	Battery	Load
AC Mains available	Battery full charged	FCBC on AUTO	ON	OFF	Supplied by FC	Supplied by FC
AC Mains Available	Battery requires boost	FCBC on AUTO	ON	ON	Supplied by BC in Boost mode	Supplied by FC
AC Mains Available	Battery requires boost	FCBC on AUTO	FAIL or OFF	ON	Supplied by FCBC in Float mode	Supplied by FCBC
A C Mains Available	Irrespective of battery condition	FCBC on Manual Float	ON	OFF	Supplied by FC	Supplied by FC
AC Mains Available	Irrespective of battery condition	FCBC on Manual Float	FAIL or OFF	ON	Supplied by FCBC in FLOAT mode	Supplied by FCBC
AC Mains Available	Irrespective of battery condition	FCBC on Manual Boost	ON	ON	Boost charged by FCBC	Supplied by FC
AC Mains Available	Irrespective of battery condition	FCBC on Manual Boost	FAIL or OFF	ON	Supplied by FCBC in Float mode	Supplied by FCBC
AC Mains Available	-----	FCBC on any Boost	OFF	OFF	On discharge	Battery will supply to load

6.4. MCCB

All Battery Chargers shall have 2 Nos. MCCBs on the input side to receive cables from two sources. Mechanical interlock should be provided such that only one shall be closed at a time. It shall be of P2 duty and suitable for continuous duty. MCCB's should have auxiliary contacts for annunciation.

6.5. Rectifier Transformer:

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

6.6. Rectifier assembly:

The rectifier assembly shall be fully/half controlled bridge type and shall be designed to meet the duty as required by the respective Charger. The rectifier shall be

provided with heat sink having their own heat dissipation arrangements with natural air cooling. Necessary surge protection devices and rectifier type fast acting HRC fuses shall be provided in each arm of the rectifier connection

6.7**.** **Instruments:**

One AC voltmeter and one AC ammeter along with selector switches shall be provided for each charger sections. One DC voltmeter and DC ammeter (with shunt) shall be provided for all Charger sections. The instruments shall be flush type, dust proof and moisture resistant. The instruments shall have easily accessible means for zero adjustment. The instruments shall be of 1.5 accuracy class. In addition to the above a centre zero voltmeter with selector switch shall also be provided for each charger sections for testing purpose. All instruments shall be with digital displays.

6.8. **Air break switches:**

Each circuit breaker shall be equipped with auxiliary switches with sufficient number of contacts for control, indication and interlocking purposes. **Ten normally open and ten normally closed contacts** shall be provided as spares. All contacts shall be rated for the DC voltage specified in data sheet.

6.9. **Fuses:**

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

6.10. **Blocking Diode:**

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

6.11. **Annunciation system:**

Audio-visual indications through bright LEDs shall be provided in each charger sections for the following abnormalities:

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

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

6.12. **Analogue and Digital Inputs:**

Following Analogue and Digital Inputs for Purchaser’s substation automation/SCADA purposes in the Charger, the analogue inputs shall be generated by distinct transducers. These inputs shall be wired up to respective

terminal blocks. The Digital Inputs shall be potential free:

Analogue Inputs

(i) Voltage of Battery
(ii) Current of Battery from Charger

Digital Inputs

(i) Charger Fails
(ii) Charger Float/Boost Mode

6.13. **Charger construction:**

6.13.1. Each Charger Section (FC & FCBC) shall be housed in two separate chambers.

6.13.2. The Chargers shall be indoor, floor-mounted, self-supporting sheet metal enclosed cubicle type. The Supplier shall supply all necessary base frames, anchor bolts and hardware. The Chargers shall be fabricated from 2.0 mm cold rolled sheet steel and shall have folded type of construction. Removable gland plates for all cables and lugs for power cables shall be supplied by the Supplier. The lugs for power cables shall be made of electrolytic copper with tin coat. Power cable sizes shall be advised to the Supplier at a later date for provision of suitable lugs and drilling of gland plates. The Charger shall be tropicalized and vermin proof. Ventilation louvers, if provided shall be backed with screens. All doors and covers shall be fitted with synthetic rubber gaskets. The chargers shall have hinged double leaf doors provided on front and on backside for adequate access to the Charger's internals. All the charger cubicle doors shall be properly earthed. The degree of protection of Charger enclosure shall be at least IP-42 as per IS: 13947 Part I. All indicating instruments, control switches and indicating lamps shall be mounted on the front side of the Charger. Each Charger shall be furnished completely wired upto power cable lugs and terminal blocks and ready for external connections. The control wiring shall be carried out with PVC insulated, 1.5 sq.mm stranded copper wires. Control terminals shall be suitable for connecting two wires, with 2.5 sq.mm stranded copper conductors. All terminals shall be numbered for ease of connections and identification. Each wire shall bear a ferrule or tag on each end for identification. At least 20% spare terminals shall be provided for control circuits. The insulation of all circuits, except the low voltage electronic circuits shall withstand test voltage of 2 KV AC for one minute. An air clearance of at least ten (10) mm shall be maintained throughout for such circuits, right up to the terminal lugs. Whenever this clearance is not available, the live parts shall be insulated or shrouded.

6.14**.** **Painting:**

All sheet steel work shall be pre-treated, in tanks, in accordance with IS:6005. Degreasing shall be done by alkaline cleaning. Rust and scale shall be removed by pickling with acid. After pickling, the parts shall be washed in running water. Then these shall be rinsed in slightly alkaline hot water and dried. The phosphate coating shall be `Class-C' as specified in IS: 6005. Welding shall not be done after

phosphating. The phosphating surfaces shall be rinsed and passivated prior to application of stoved lead oxide primer coating. After primer application, two coats of finishing synthetic enamel paint of shade-692 (smoke grey) of IS:5 shall be applied, unless required otherwise by the Employer. The inside of the chargers shall be glossy white. Each coat of finishing synthetic enamel paint shall be properly staved. The paint thickness shall not be less than fifty (50) microns.

6.15. **Tests and inspection:**

The battery charger and all the components of the charger shall be routine tested accordingly to their relevant standard.

This shall include the following -

(a) Operational check for boost cum float charger.
(b) Input / Output test of the chargers.
(c) Voltage Regulation Test
(d) Performance test of the charger.
(e) Temperature rise test of the rectifier transformer.
(f) Power frequency H.V. test / Insulation tests.

The Supplier/Manufacturer shall be required to demonstrate to the Purchaser that the Chargers conform to the specification particularly regarding continuous rating, ripple free output, voltage regulation and load limiting characteristic, before despatch as well as after installation at site. At site the following tests shall be carried out:

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

The Supplier/Manufacturer shall present for inspection, the type and routine test certificates for the following components whenever required by the Purchaser.

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

7.0 DOCUMENT SUBMISSION

The supplier shall submit following documents for approval:

a) Data sheet as per Annexure-I/GTP sheet

b) GA of cell and layout drawing

c) Discharge Data for 10 Hour, 8 Hour, 3 Hour, 2 Hour, 1 Hour, 15 Minutes and One Minute indicating capacity factors for end cell voltage of 1.75 V & 1.85 V.

d) Temperature correction factors

e) Installation and commissioning Instructions

f) O & M Manual

8.0 DC DISTRIBUTION BOARD

8.1. **General Features:**

The D.C. distribution boards shall be indoor, floor mounting of self-supporting, sheet metal clad, and cubicle type. The panels should be totally enclosed, dust tight and vermin proof and shall be made of 2.0 mm cold rolled sheet steel. The boards shall be provided with double leaf hinged doors at the back. All doors and covers shall be fitted with rubber gaskets. The doors shall be provided with locks and duplicated covers.

8.2. **Bus Bars:**

The bus bars shall be of electrolytic copper of ample cross-section. The bus bars shall be insulated from the structure by means of durable, non-hydroscopic, non-combustible and non-tracking materials.

8.3. **Detail Requirements:**

8.3.1. The 110 Volts D.C. distribution boards shall be provided with the following:

i. Mains failure alarm relay.
Ii Earth fault alarm relay.
iii. 110 Volts D.C. bell to be operated by the mains failure alarm relay.
iv. 110 Volts D.C. buzzer to be operated by the earth failure alarm relay.
v. 3 Nos. Double pole air-break circuit breaker/MCCB of 400 amp capacity with thermal overload tripping arrangement to act as follows:

- One for DC Source-1 (incomer 1)
- One for DC Source-2 (incomer 2)
- One for Bus Section

vi. 0-150 volts D.C. moving coil voltmeter to measure the bus-bar voltage. The display is to be in digital.
vii. Pilot lamp to indicate D.C. on conditions.
viii. 110 volts, double pole MCBs of following ratings for outgoing feeders.
For 110 V DCDB
a. 32 Amp, 10 Nos.
b. 63 Amp, 4 Nos.
ix. One terminal Board/block for all feeder outlets including cable glands.

8.3.2. **Automatic Supply Changeover:**

Automatic changeover between Incomer I and Incomer II is to be carried out during the failure of supply in any of one the incomers. After the restoration of the supply, system shall be restored to normal condition automatically. The requirement of changeover under various conditions are as below:

(a) Under normal conditions i.e. when supply is available in both the incomers, incomers 1 & 2 of DCDB shall be in closed condition and Bus couplers breaker shall be in open condition.

(b) In case of failure of either of the sources, the incomer of that source shall trip and Bus coupler shall get closed. On restoration of supply, normal conditions described above are to be established automatically.

8.3.3. **Analogue and Digital Inputs**

Following Analogue and Digital Inputs for Purchase's substation automation/SCADA purposes shall be provided. The analogue inputs shall be generated by distinct transducers. These inputs shall be wired up to respective terminal blocks. The Digital Inputs shall be potential free:

Analogue Inputs

(i) Voltage of Bus Section-I
(ii) Voltage of Bus Section-II
(iii) Current from Source-I
(iv) Current from Source-II

Digital Inputs

(i) Incomer-I breaker On/Off
(ii) Incomer-II breaker On/Off
(iii) Bus Section Breaker On/Off
(iv) 110 Volt DC earth fault

B. 48VOLT BATTERY BANK, CHARGERS AND DC DISTRIBUTION BOARD

1.0. SCOPE

1.1. The scope of work is furnished below:

a) Design, manufacture, testing at manufacturer's works and supply of 48 Volt Battery Banks, Chargers and DC Distribution Boards with all fittings and accessories including supporting rack/mounting structures as applicable.
b) Loading at manufacturer's works, transportation and delivery at respective substation sites, including unloading at destination sites.
c) Erection, Testing and Commissioning of Battery Banks, Chargers and DCDB including dismantling of existing equipment, if necessary.

2.0. SERVICE CONDITIONS

2.1. The plant and materials supplied shall be suitable for operation under the following climatic and other conditions:

a) Max. Ambient temperature	: 50^{o} C
b) Min. Ambient temperature	: 4^{o} C
c) Relative humidity	: 35% - 98%
d) Average Annual Rainfall	: 3,000 mm
e) No of months of active monsoon	: 6 (May to October)
f) Seismic zone	: V
g) Altitude	: Not less than 2,210 M above Sea Level

3.0 TYPE TEST REPORTS

3.1. Equipment, which has never been tested for critical performance, shall not be accepted. In such cases, a promise or agreement by a bidder to have the equipment tested after award of a contract is not acceptable.

3.2. All Bids must be accompanied by the full Type Test Certificates of equipment offered. Such type test certificates shall be acceptable only if:-

a) Tests are conducted in an independent and well known testing laboratory, or
b) Tests are conducted in manufacturer's own laboratory. In this case (i) the laboratory must have ISO 9000 (or its equivalent) series certification; and (ii) tests have been witnessed by technically qualified representatives of earlier clients or purchaser.

3.3. Test reports to be acceptable must be related directly to the materials offered. Test reports for higher class of equipment are acceptable with commitment to perform the type tests free of any charge on the particular equipment(s) after the award of contract.

3.4. Type Test Reports older than five (5) years on the date of tender opening shall not be accepted.

4.0 GUARANTEED TECHNICAL PARTICULARS

4.1. The Guaranteed Technical Particulars of the various items shall be furnished by the Bidders in the prescribed format furnished under vol. III of this tender document. The Bidder shall also furnish any other information's as in their opinion is needed to give full description and details to judge the item(s) offered by them.

4.2. The data furnished in Guaranteed Technical Particulars should be the minimum or maximum value (as per the requirement of the specification) required. A Bidder may guarantee a value more stringent than the specification requirement. However, for testing purpose or from performance point of view, the material shall be considered performed successfully if it achieves the minimum/maximum value required as per the technical specification. No preference what so ever shall be given to the bidder offering better/more stringent values than those required as per specification except where stated otherwise.

5.0 TECHNICAL SPECIFICATION OF BATTERY BANKS

5.1. **Type:**

5.1.1. The DC Batteries shall be VRLA (Valve Regulated Lead-Acid) type and shall be Normal Discharge type. These shall be suitable for a long life under continuous float operations and occasional discharges.

5.1.2. The Battery and accessories shall conform to IS: 15549/ IEC 60896 and other relevant IS/IEC standards except to the extent explicitly modified in this specification.

5.2. **Ratings:**

(i) The Ampere-hour capacity of the battery bank at **27°C at 10 hours discharge rate shall be 250 Ah.**

(ii) The nominal voltage of the battery bank shall be **48 Volts D.C**.

(iii) The number of cells in a complete battery bank set shall be **24 plus 2 spares**.

5.3. CAPACITY REQUIREMENTS

5.3.1. When the battery is discharged at 10 hour rate, it shall deliver 80% of C (rated capacity, corrected at 27^{o} Celsius) before any of the cells in the battery bank reaches 1.85V/cell.

5.3.2. The battery shall be capable of being recharged from the fully exhausted condition (1.75V/cell) within 10 hrs up to 90% state of charge. All the cells in a battery shall be designed for continuous float operation at the specified float voltage throughout the life.

5.3.3. The capacity (corrected at 27ºCelcius) shall also not be less than C and not more than 120% of C before any cell in the battery bank reaches 1.75V/cell. The battery voltage shall not be less than the following values, when a fully charged battery is put to discharge at C/10 rate:

(a) After Six minutes of discharge : 1.98 V/cell

(b) After Six hours of discharge : 1.92V/cell

(c) After 8 hours of discharge : 1.85 V/cell

(d) After 10 hours of discharge : 1.75 V/cell

5.3.4. Loss in capacity during storage at an average ambient temperature of 35º Celcius for a period of 6 months shall not be more than 60% and the cell/battery shall achieve 85% of its rated capacity within 3 charge/discharge cycles and full rated capacity within 5 cycles, after the storage period of 6 months. Voltage of each cell in the battery set shall be within 0.05V of the average voltage throughout the storage period. Ampere hour efficiency shall be better than 90% and watt hour efficiency shall be better than 80%.

5.4. MATERIAL AND CONSTRUCTIONAL REQUIREMENTS

5.4.1. **Container:**

The container shall be made of acid resistant and fire retardant grade polypropylene copolymer plastic and shall have chemical and electrochemical compatibility. The container material shall have an Oxygen Index of at least 28 %. The other requirement for plastic container shall be as per IS 1146.

5.4.2. **Cell Lids:**

The cell lids shall be made of same plastic material as that of container and permanently fixed with the container. It shall be capable to withstand internal pressure without bulging or cracking. Fixing of Pressure Regulation Valve & terminal posts in the cover shall be such that the seepage of electrolyte, gas escapes and entry of electro-static spark are prevented.

5.4.3. **Plates:**

The plates shall be of pasted construction and of good workmanship. These shall be free from cracks, white patches and other imperfections, which may affect the life and performance of the battery.

5.4.4. **Separators:**

The separators used shall be of glass mat having high acid absorption capability, resistance to sulphuric acid and good insulating properties. The separator shall meet the test requirements as given in IEC/IS.

5.4.5. **Terminal posts:**

Positive and negative terminals posts shall have built in lead plated copper or brass inserts. Terminals of cells shall be clearly and unmistakably identifiable and marking shall be of permanent nature. Terminal posts shall be suitably sealed at the lid to prevent leakage of any gas. Any gas escape shall be only through the venting device provided. The surface of the terminal post extending above the cell cover including bolt hole shall be coated with an acid resistant and corrosion retarding material.

5.4.6. **Fastners:**

Nuts and bolts for connecting the cells shall be made of copper, brass or stainless steel. Copper or brass nuts and bolts shall be effectively lead coated to prevent corrosion. Stainless steel bolts and nuts shall be passivated to prevent corrosion with acid.

5.4.7. **Electrolyte:**

The sulphuric and water used for the preparation of electrolyte shall conform to IS 266 and IS 1069 respectively.

5.4.8. **Connectors:**

When it is not possible to bolt the cell terminals directly to assemble the battery, a separate lead coated copper connectors or flexible copper cable connectors of suitable cross-section shall be provided to join the cells. The lead plating on copper connectors shall not be less than 25 micron. The sulphuric and water used for the preparation of electrolyte shall conform to IS 266 and IS 1069 respectively.

5.4.9. **Venting Device:**

Each cell shall be provided with a venting device (pressure regulation valve). The valve shall be self-re-sealable and flame retardant. The valve unit shall be such that it cannot be opened without a proper tool. The valve shall be capable to withstand the internal cell pressure specified by the manufacturer. Each valve regulated venting device shall be provided with flame arrestor capable of preventing the ingress of moisture/flame into the cell interior when the valve releases the gas mixture. The opening and closing pressure shall be within + 1 psi variation and manufacturer shall declare the closing and opening pressure values

5.5. **Battery Racks**

5.5.1. Batteries shall be installed on MS racks to be supplied by the Contractor to fit in the battery room. Racks/Trays shall be powder coated with acid proof, anti-corrosive paint. Rack shall accommodate 24 cells. Racks/Tray shall be suitably treated before painting for protection against fungus growth and other harmful effects due to tropical environment.

5.5.2. The colour of the supporting racks shall conform to shade 631 of IS: 5.

6.0 BATTERY CHARGING EQUIPMENTS

6.1. **General description**

6.1.1. The battery charging equipment shall have two separate Boost-cum Trickle Charger sections. Each section shall have its own rectifier transformer, Rectifier Bridge and other equipment so that each section can operate independent of each other. Each section of the Charger shall be housed in two separate chambers, completely separated and insulated from each other. The Battery Chargers as well as their automatic regulators shall be of static type and shall be compatible with offered VRLA batteries.

Each section of the battery chargers shall be capable of continuous operation at its rated load in float charging mode, i.e. float charging the associated Batteries at 2.13 to 2.27 Volts per cell while supplying the DC load. The chargers shall also be capable of Boost charging the associated DC Battery at 2.28 to 2.32 volts per cell at the desired rate. Each charger section shall regulate the float/boost voltage in case of prescribed temperature rise of battery as per manufacturer's recommendation to avoid thermal runaway. Necessary temperature sensors shall be provided in mid location of battery banks and shall be wired up to the respective charger for feedback control. The manufacturer shall demonstrate this feature during testing of each charger.

6.2. OPERATION AND CONTROL

6.2.1 During normal operation, one of the charger sections shall supply the normal direct current requirements of the substation and the other station battery shall be floating on the other charger section. In the event of failure of A.C. supply or failure of the both sections of the charger itself the battery shall come automatically across the load without any interruption.

Similarly in case of failure of any one section of the charger the DC load or the battery as the case may be, shall come automatically change over to the healthy charger section without any interruption.

Further, each charger section in boost charging mood, shall have provision for limiting the output voltage across the station DC Load to 110% of the Nominal Voltage specified, even at maximum boost charging voltage.

All Battery Chargers shall be provided with facility for both automatic and manual control of output voltage and current. A selector switch shall be provided for selecting the mode of output voltage/current control, whether automatic or manual. When on automatic control mode during Float charging, the Charger output voltage shall remain within +1% of the set value, for AC input voltage variation of +10%, frequency variation of +5%, a combined voltage and frequency variation of +10%, and a DC load variation from zero to full load.

All battery chargers shall have a constant voltage characteristic throughout the range (from zero to full load) at the floating value of the voltage so as to keep the battery fully charged but without harmful overcharge.

All chargers shall have load limiters having drooping characteristic, which shall cause, when the voltage control is in automatic mode, a gradual lowering of the output voltage when the DC load current exceeds the Load limiter setting of the Charger. The Load-limiter characteristics shall be such that any sustained overload or short circuit in DC System shall not damage the Charger, nor shall it cause blowing of any of the Charger fuses. The Charger shall not trip on overload or external short circuit.

Uniform and step less adjustments of voltage setting (in both manual and automatic modes) shall be provided on the front of the Charger panel covering the entire float charging output range specified. Step less adjustments of the Load limiter setting shall also be possible from 80% to 100% of the rated output current for charging mode.

During Boost Charging, the Battery Charger shall operate on constant current mode (when automatic regulator is in service). It shall be possible to adjust the Boost charging current continuously over a range of 50 to 100% of the rated output current for Boost charging mode.

The Charger output voltage shall automatically go on rising, when it is operating on Boost mode, as the Battery charges up. For limiting the output voltage of the Charger, a potentiometer shall be provided on the front of the panel, whereby it shall be possible to set the upper limit of this voltage anywhere in the output for range specified boost charging mode.

The Charger manufacturer may offer an arrangement in which the voltage setting device for Float charging mode is also used as output voltage limit setting device for Boost charging mode and the Load-limiter of Float charging mode is used as current setting device in boost charging mode.

Suitable filter circuits shall be provided in all the chargers to limit the ripple content (Peak to Peak) in the output voltage to 1%, irrespective of the DC load level, when they are not connected to a Battery.

6.3. MCCB

All Battery Chargers shall have 2 Nos. MCCBs on the input side to receive cables from two sources. Mechanical interlock should be provided such that only one shall be closed at a time. It shall be of P2 duty and suitable for continuous duty. MCCB's should have auxiliary contacts for annunciation.

6.4. **Rectifier Transformer**

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

6.5. **Rectifier assembly**

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

6.6. **Instruments**

One AC voltmeter and one AC ammeter along with selector switches shall be provided for each charger sections. One DC voltmeter and DC ammeter (with shunt) shall be provided for all Charger sections. The instruments shall be flush

type, dust proof and moisture resistant. The instruments shall have easily accessible means for zero adjustment. The instruments shall be of 1.5 accuracy class. In addition to the above a centre zero voltmeter with selector switch shall also be provided for each charger sections for testing purpose. All instruments shall be with digital displays.

6.7. **Air break switches:**

Each circuit breaker shall be equipped with auxiliary switches with sufficient number of contacts for control, indication and interlocking purposes. **Ten normally open and ten normally closed contacts** shall be provided as spares. All contacts shall be rated for the DC voltage specified in data sheet.

6.8**.** **Fuses**

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

6.9. **Blocking diode:**

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

6.10. **Annunciation System**

Audio-visual indications through bright LEDs shall be provided in each Charger sections for the following abnormalities:

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

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

6.11. **Analogue and Digital Inputs**

Following Analogue and Digital Inputs for Purchaser’s substation automation/SCADA purposes in the Charger, the analogue inputs shall be generated by distinct transducers. These inputs shall be wired up to respective terminal blocks. The Digital Inputs shall be potential free:

<u>Analogue Inputs</u>

(i) Voltage of 48V Battery

(ii) Current of 48V Battery from Charger Section I
(iii) Current of 48V Battery from Charger Section II

Digital Inputs

(i) Charger Section I Fails
(ii) Charger Section II Fails
(iii) Charger Section I Float/Boost Mode
(iv) Charger Section II Float/Boost Mode

6.12. **Charger construction:**

6.12.1. The Chargers shall be indoor, floor-mounted, self-supporting sheet metal enclosed cubicle type. The Supplier shall supply all necessary base frames, anchor bolts and hardware. The Chargers shall be fabricated from 2.0 mm cold rolled sheet steel and shall have folded type of construction. Removable gland plates for all cables and lugs for power cables shall be supplied by the Supplier. The lugs for power cables shall be made of electrolytic copper with tin coat. Power cable sizes shall be advised to the Supplier at a later date for provision of suitable lugs and drilling of gland plates. The Charger shall be tropicalized and vermin proof. Ventilation louvers, if provided shall be backed with screens. All doors and covers shall be fitted with synthetic rubber gaskets. The chargers shall have hinged double leaf doors provided on front and on backside for adequate access to the Charger's internals. All the charger cubicle doors shall be properly earthed. The degree of protection of Charger enclosure shall be at least IP-42 as per IS: 13947 Part I. All indicating instruments, control switches and indicating lamps shall be mounted on the front side of the Charger. Each Charger shall be furnished completely wired upto power cable lugs and terminal blocks and ready for external connections. The control wiring shall be carried out with PVC insulated, 1.5 sq.mm stranded copper wires. Control terminals shall be suitable for connecting two wires, with 2.5 sq.mm stranded copper conductors. All terminals shall be numbered for ease of connections and identification. Each wire shall bear a ferrule or tag on each end for identification. At least 20% spare terminals shall be provided for control circuits. The insulation of all circuits, except the low voltage electronic circuits shall withstand test voltage of 2 KV AC for one minute. An air clearance of at least ten (10) mm shall be maintained throughout for such circuits, right up to the terminal lugs. Whenever this clearance is not available, the live parts shall be insulated or shrouded.

6.13**.** **Painting**

All sheet steel work shall be pre-treated, in tanks, in accordance with IS:6005. Degreasing shall be done by alkaline cleaning. Rust and scale shall be removed by pickling with acid. After pickling, the parts shall be washed in running water. Then these shall be rinsed in slightly alkaline hot water and dried. The phosphate coating shall be `Class-C' as specified in IS: 6005. Welding shall not be done after phosphating. The phosphating surfaces shall be rinsed and passivated prior to application of stoved lead oxide primer coating. After primer application, two coats of finishing synthetic enamel paint of shade-692 (smoke grey) of IS:5 shall

be applied, unless required otherwise by the Employer. The inside of the chargers shall be glossy white. Each coat of finishing synthetic enamel paint shall be properly staved. The paint thickness shall not be less than fifty (50) microns.

6.14. **Charger rating:**

Each charger section shall have the following ratings:

For 48 Volt DC System -

a) Input Voltage : 415+/- 10% V 3-Ph 4-wire, 50Hz A.C
b) Output Voltage : 48 Volt DC (Nominal)
c) Output DC current : 60A

6.15. **Tests and inspection**

The battery charger and all the components of the charger shall be routine tested accordingly to their relevant standard. This shall include the following

(a) Operational check for boost cum float charger.
(b) Input / Output test of the chargers.
(c) Voltage Regulation Test
(d) Performance test of the charger.
(e) Temperature rise test of the rectifier transformer.
(f) Power frequency H.V. test / Insulation tests.

The Supplier/Manufacturer shall be required to demonstrate to the Purchaser that the Chargers conform to the specification particularly regarding continuous rating, ripple free output, voltage regulation and load limiting characteristic, before despatch as well as after installation at site. At site the following tests shall be carried out:

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

The Supplier/Manufacturer shall present for inspection, the type and routine test certificates for the following components whenever required by the Purchaser.

(i) Switches.
(ii) Relays/ MCCBs
(iii) Instruments.
(iv) DC fuses.
(v) SCR.
(vi) Diodes.
(vii) Condensers.
(viii) Potentiometers.
(ix) Semiconductor

(x) Annunciator.
(xi) Control wiring
(xii) Push buttons and contactors.

7.0. DOCUMENT SUBMISSION

The supplier shall submit following documents for approval:

a) Data sheet as per GTP sheet.
b) GA of cell and layout drawing
c) Discharge Data for 10 Hour, 8 Hour, 3 Hour, 2 Hour, 1 Hour, 15 Minutes and One Minute indicating capacity factors for end cell voltage of 1.75 V & 1.85 V.
d) Temperature correction factors
e) Installation and commissioning Instructions
f) O & M Manual

8.0. DC DISTRIBUTION BOARD

8.1. **General Features:**

The D.C. distribution boards shall be indoor, floor mounting of self-supporting, sheet metal clad, and cubicle type. The panels should be totally enclosed, dust tight and vermin proof and shall be made of 2.0 mm cold rolled sheet steel. The boards shall be provided with double leaf hinged doors at the back. All doors and covers shall be fitted with rubber gaskets. The doors shall be provided with locks and duplicated covers.

8.2. **Bus Bars:**

The bus bars shall be of electrolytic copper of ample cross-section. The bus bars shall be insulated from the structure by means of durable, non-hydroscopic, non-combustible and non-tracking materials.

8.3. **Detail Requirements:**

8.3.1. The 48 Volts D.C. distribution boards shall be provided with the following:

i. Mains failure alarm relay.
Ii Earth fault alarm relay.
iii. 48 Volts D.C. bell to be operated by the mains failure alarm relay.
iv. 48 Volts D.C. buzzer to be operated by the earth failure alarm relay.
v. 3 Nos. Double pole air-break circuit breaker/MCCB of 400A capacity with thermal overload tripping arrangement to act as follows:

- One for DC Source-1 (incomer 1)
- One for DC Source-2 (incomer 2)
- One for Bus Section

vi. 0-75 volts D.C. moving coil voltmeter to measure the bus-bar voltage. The display is to be in digital.
vii. Pilot lamp to indicate D.C. on conditions.
viii. 50 volts, double pole MCBs of following ratings for outgoing feeders.
For 110 V DCDB
a. 16 Amp, 3 Nos in each bus section.
b. 32 Amp, 1 No in each bus section.
ix. One terminal Board/block for all feeder outlets including cable glands.

8.3.2. **Automatic Supply Changeover:**

Automatic changeover between Incomer I and Incomer II is to be carried out during the failure of supply in any of one the incomers. After the restoration of the supply, system shall be restored to normal condition automatically. The requirement of changeover under various conditions are as below:

(a) Under normal conditions i.e. when supply is available in both the incomers, incomers 1 & 2 of DCDB shall be in closed condition and Bus couplers breaker shall be in open condition.
(b) In case of failure of either of the sources, the incomer of that source shall trip and Bus coupler shall get closed. On restoration of supply, normal conditions described above are to be established automatically.

8.3.3. **Analogue and Digital Inputs:**

Following Analogue and Digital Inputs for Purchase's substation automation/SCADA purposes shall be provided. The analogue inputs shall be generated by distinct transducers. These inputs shall be wired up to respective terminal blocks. The Digital Inputs shall be potential free:

Analogue Inputs

(a) Voltage of 48 volt Bus Section-I
(b) Voltage of 48 volt Bus Section-II
(c) Current from 48 volt Battery charger section - I
(d) Current from 48 volt Battery charger section – II

Digital Inputs

(a) Incomer-I breaker On/Off
(b) Incomer-II breaker On/Off
© Bus Section Breaker On/Off
(d) 48 Volt DC I earth fault
(e) 48 Volt DC II earth fault

C. 250kVA, 33/0.415KV TRANSFORMER

1.0. SCOPE

1.1. The brief description of scope of work under this Bidding Document is furnished below:

a) Design, manufacture, testing at manufacturer's works and supply of 250 KVA, 33/0.415 kV Transformers with all fittings and accessories as specified.

b) Loading at manufacturer's works, transportation and delivery at respective substation sites, including unloading at destination sites.

c) Erection, Testing and Commissioning.

1.2. STANDARD

1.2.1 The transformer by this specification shall, unless otherwise stated be designed, constructed and tested in accordance with the latest revisions of relevant Indian Standards indicated below or equivalent IEC and shall conform to the regulations of local statutory authorities except to the extent explicitly modified in this specification.

1.2.2 In case of any conflict between the Standards and this specification, this specification shall govern. The transformer shall comply with the latest issue of the following Indian standard.

a)	IS: 1180 (Part 1) 2014	: Specification for oil immersed DTR (Outdoor type)
b)	IS: 335	: Specification for transformer oil.
c)	IS: 12444	: Specification for copper wire rod.

2.0. TECHNICAL REQUIREMENTS

2.1 **General:**

2.1.1 The Transformers shall be of outdoor, three phase, 50 Hz, oil immersed, self-cooled and suitable for use in the climate conditions of Mizoram, i.e. Active Monsoon prone area for 7 months in a year and temperature ranges 5^{o} C to 35^{o} C. The Transformers shall be suitable for Pole mounting as well as foundation mounting.

2.1.2 The transformer shall be suitable for continuous operation with a frequency variation of (+/-) 3% from normal 50 Hz. Combined voltage and frequency variation should not exceed the rated V/f ratio by 10%.

2.2 **Core:**

2.2.1 The core shall be stacked type of high grade cold rolled grain annealed steel lamination having low loss and good grain properties, coated with hot oil proof insulation, bolted together and to the frames firmly to prevent vibration or noise. The complete design of core must ensure permanency of the core losses with continuous working of the transformers.

2.2.2 MS channel or plate shall be used on top and bottom. Channel frames on LV side to be reinforced at equidistance, if holes / cutting are done for LT lead in

order to avoid bending of channel.

MS channels/plate frames shall be painted with hot oil-resistant varnish or paint.

2.2.3 The maximum flux density in any part of the core and yokes, of each transformer at normal voltage and frequency shall be such that the flux density with (+)12.5% combined voltage and frequency variation from rated voltage and frequency does not exceed 1.9 Tesla (19,000 lines per cm^2). The manufacturer shall furnish the design calculation in support of flux density.

2.2.4 The transformers core shall be suitable for over fluxing (due to combined effect of voltage and frequency) up to 12.5% without injurious heating at full load conditions and shall not get saturated.

2.2.5 No load current shall not exceed 2% of full load current. Increase in secondary voltage of 415 volts by 12.5% shall not increase the no load current beyond 5%.

2.3 **Winding:**

2.3.1 The winding shall be of electrolytic, super enamel covered/Double paper covered (DPC) Copper round/strip conductor, free from scales and burrs.

2.3.2 LV winding shall be of strip type copper conductor/copper foil type. The neutral of the winding shall be brought out to a separate insulated terminal.

2.3.3 HV coil is wound over LV coil as crossover coils or continuous disc coils

2.3.4 Inter layer insulation shall be Kraft paper/Epoxy dotted paper. Proper bonding of inner layer insulation with the conductor shall be ensured.

2.4 **Terminal Arrangement:**

2.4.1 Bushing terminals shall be provided with suitable terminal connectors of approved type and size for overhead conductor termination of HV side and cable termination on LV side.

2.4.2 The neutral terminals of 415V winding shall be brought out on a bushing along with the 415 volt phase terminals to form a 4 wire system for the 415 volt. Additional neutral bushing shall also be provided for earthing.

2.5 **Cable Boxes:**

2.5.1 For LV side cable boxes shall be provided and shall be air insulated. They shall be of sufficient size to accommodate Purchaser's cables and shall have suitable removable side/top cover to facilitate cable termination and inspection. Cable boxes shall be dust & vermin proof.

2.6 **Off Circuit Tap Changing equipment:**

2.6.1 All transformers shall be provided with a Off Load Tap Changing equipment. The tap change switch shall be of three phase, hand operated for simultaneous switching of similar taps on the three phases by operating an external hand wheel.

2.7 Transformer Oil:

2.7.1 The insulating oil shall comply with the requirements of relevant standards IS 335. No inhibitors shall be used in oil.

2.8 Transformer Tank:

2.8.1 The transformer tank shall be of robust construction, rectangular plain tank type and shall be built up of tested MS sheet.

2.8.2 The internal clearance of tank shall be such that it shall facilitate easy lifting of core with coils from the tank without dismantling LV & HV bushings.

2.8.3 All joints of tank and fittings shall be oil tight and no bulging should occur during service. The tank design shall be such that the core and windings can be lifted freely. The tank plate shall be of such strength that the complete transformers when filled with oil may be lifted bodily by means of lifting lugs. Inside of tank shall be painted with varnish / hot oil resistant paint.

2.8.4 The four walls of the tank shall be made of two "L" shaped sheets (without joints) full welded at the corners from inside and outside of the tank for withstanding a pressure of 0.8 kg/cm2 for 10 minutes.

2.8.5 The tank shall be reinforced by welded angle on all the outside walls on the edge of the tank to form two equal compartments. Permanent deflection when the tank without oil is subject to a vacuum of 525 mm of mercury for rectangular tank and 760 mm of mercury for round tank shall not be more than 5 mm upto 750 mm length and 6 mm upto 1250 mm length. The tank shall further be capable of withstanding a pressure of 0.8 kg/sq cm (g) and a vacuum of 0.3 kg/sq cm (g) without any deformation.

2.8.6 Pressed steel radiators shall be used for cooling. The transformer shall be capable of giving continuous rated output without exceeding the specified temperature rise. 4 Nos. welded heavy duty lifting lugs of MS plate 8 mm thick (min) suitably reinforced by vertical supporting flat welded edgewise below the lug shall be provided on the side wall.

2.8.7 Pressed steel radiators shall be used for cooling. The transformer shall be capable of giving continuous rated output without exceeding the specified temperature rise. 4 Nos. welded heavy duty lifting lugs of MS plate 8 mm thick (min) suitably reinforced by vertical supporting flat welded edgewise below the lug shall be provided on the side wall.

2.8.8 Top cover fixing shall be with Stainless Steel bolts and 6 mm Neoprene bonded cork gasket conforming to IS 4253 part-II shall be placed between tank and cover. The bolts outside tank shall have 2 flat washers & one spring washer.

All bolts/nuts/washers exposed to atmosphere shall be as follows:

a) Size 12mm and below : Stainless steel
b) Above 12 mm : Steel with suitable finished like electro galvanized with passivation or hot dip galvanized

2.9. **Conservator:**

Oil gauge and the plain or dehydrating breathing devise shall be fixed to the conservator, which shall also be provided with a drain plug and a filling hole (M30 normal size thread) with cover. The capacity of a conservator tank shall be designed keeping in view the total quantity of oil and its contraction and expansion due to temperature variations.

In addition, the cover of main tank shall be provided with an air release plug to enable air trapped within to be released, unless the conservator is so located as to eliminate the possibility of air being trapped within the main tank.

The inside diameter of the pipe, connecting the conservator to the main tank, should be within 20 to 50 mm and it should be projected into the conservator so that its end is approximately 20 mm above the bottom of the conservator so as to create a sump for collection of impurities. The minimum oil level (corresponding to -5 deg.C.) should be above the sump level.

2.10. **Surface Preparation and Painting:**

Before painting or filling with oil or compound, all ungalvanised parts shall be completely clean and free from rust, scale and grease, and all external surface cavities on castings shall be filled by metal deposition. All blast cleaned surfaces (except machined faces that have to be protected) must be cleaned in accordance with ISO specification no. ISO 8501 Part 1, to a minimum standard of 'ASa2½' or 'BSa2½' prior to paint application.

External and internal surfaces of all transformer tanks and chambers and other fabricated steel items shall be cleaned of scale, rust and surface dirt by blast cleaning or other suitable approved method. After cleaning, these surfaces should be immediately covered with paint. Hot oil resistant varnish on white synthetic enamel/epoxy paint is to be used for painting the inside of all oil filled chambers, including transformer tanks. Only one thin layer (≈ 25 microns) of this is to be applied. Except for hardware, which may have to be removed at site, all external surfaces shall receive at least four coats of paint.; two coats of epoxy zinc phosphate or zinc chromate primer topped with two coats of aliphatic polyurethane glossy finish paint. The total dry film thickness shall be 100 microns minimum.

Any scratch, bruise or paint damage incurred during transportation and unloading at site should be made good by the Supplier as soon as the damage is detected. This is to be done by thoroughly cleaning the damaged area and applying the full number of coats as was applied originally.

One coat of additional paint shall be given at site over all external surfaces, including hardware, after erection by the Suppler. The make and grade of the recoat shall be same as the original coat.

2.11 **Fittings and Accessories:**

Following fittings and accessories shall be provided with each transformer:

(a) Rating and terminal marking plates shall be as per Fig-1 & Fig-3 of

IS: 1180 (Part-1) -2014.

(b) Two earthing terminals (studs and bolts should be properly galvanized and conform to IS:1363 and IS:1367.

(c) Two lifting lugs to lift core assembly.

(d) Two lifting lugs to lift complete transformer.

(e) Lifting lugs for tank cover.

(f) Thermometer pocket in accordance with IS: 3580.

(g) Air release plug on the transformer tank to release air trapped inside the tank when filling oil through conservator.

(h) Conservator tank shall have inter connection pipe projection, 20 mm above bottom of the conservator so as to create a sump for collection of impurities. It shall have 30 mm dia drain valve, oil filling hole with cap on the top of the conservator.

(i) Oil level gauge with toughened glass with "minimum" and 'maximum' marking.

(j) De-hydrating breather.

(k) Pressure Relief device or explosion vent.

(l) One drain cum sampling valve.

(m) One filter valve on the upper side of the tank.

(n) Unidirectional flat rollers.

(o) Inspection hole.

(p) Terminal connectors for HV & LV.

(q) One 33 kV 400 Amps DO Fuse set.

(r) One LT 630 Amps MCCB of make preferably ABB/Schneider

(s) 3 numbers, 30kV Polymeric Lightning Arrestor of make LAMCO/equivalent

(t) LA holder clamp with provision of earthing in HV side bushings, 3 numbers.

(u) Grounding material & accessories for earthing of transformer neutral, transformer tank and LA.

3.0 TESTING AND INSPECTION

3.1 **Inspection:**

(a) Physical and dimensional check of transformer tank and accessories.

(b) Tank crack detection of major strength weld seams by dye penetration test.

(c) Physical inspection and check of quality of varnish, if used in core.

(d) Check on completed core for measurement of iron loss and check for any hot spot by exciting the core so as to induce the designed value of flux density in the core.

(e) Sample checks for physical properties of the insulating material.

(f) Check for dielectric strength of insulating materials.

(g) Sample check on winding conductor for mechanical properties and electrical conductivity and on installation covering.

(h) Sample check on insulation paper used for windings for pH value, Bursting strength, Electric strength. (i) Check complete transformer against approved outline drawing provision for all fittings, finish etc.

3.2 **Factory Tests:**

All standard routine tests in accordance with IS: 1180 (Part-1), 2014 and latest issue of IS: 2026 shall be carried out on each transformer at Manufacturer's Works. In addition to above standard Routine tests, following tests shall also be carried out as Routine Tests for one number transformer of each category of each Package:

(a) Temperature-rise test as per IS 2026.

(b) No load current at 112.5% of rated voltage.

(c) Pressure and Oil Leakage test. (on each transformer).

(d) Routine Tests on Transformer Tank as per CBIP Manual on Transformer (CBIP Publication No. 317).

3.3 **Pre-Commissioning Tests (Field Tests):**

(a) Winding resistance measurement.

(b) Verification of vector group and polarity.

(c) Measurement of voltage ratio test.

(d) Measurement of magnetizing current.

(e) Magnetic balance test.

(f) Magnetic circuit (isolation) test.

(g) Measurement of short circuit impedance at low voltage.

(h) Insulation resistance measurement.

(i) Tests on oil filled in transformer as per IS 1866

3.4 REJECTION

3.4.1 The Purchaser may reject any transformer if during tests or service any of the following conditions arise:

i) The permissible total loss (No load loss + Load Losses at 75 ^{0} C) at 50% of rated load and 100% load loss exceeds the guaranteed value by 7½%.

ii) The difference in impedance values of any two phases during single phase short circuit impedance test exceeds 2% of the average value guaranteed by the vendor.

iii) Oil or winding temperature rise exceeds the specified value.

iv) Transformer fails on power frequency voltage withstand test.

v) Transformer is proved to have been manufactured not in accordance with the agreed specification.

3.5 TECHNICAL DATA SHEET FOR TRANSFORMER

Sl. No.	DESCRIPTION	PARAMETER
1.	Rated Capacity, KVA	250, Continuous
2	Rated Voltage	
	(a) HV, kV	33
	(b) LV, kV	0.415
3	Type of Winding	Two Winding
4	Service	Outdoor
5	No of Phases	Three
6	Frequency, Hz	50
7	Type of Cooling	ONAN
8	Impedance at 75^0 C, %	4.5
9	Max. Temp. Rise over an ambient of 50^0 C	
	(a) Oil (Temperature rise measurement by thermometer), ^{0}C	40
	(b) Winding Temperature rise measurement by resistance method) , ^{0}C	45
10	Losses	
	(a) Maximum No Load Loss without any positive tolerance, Watts	105
	(b) Maximum Copper Loss without any positive tolerance, Watts	315
11	System Apparent Short circuit level (kA)	As per IS 2026-Part 1
12	Winding Connection	
	(a) HV	Delta
	(b) LV	Star
13	Winding Insulation	
14	Insulation Level	
(i)	Power Frequency Test Level	
	(a) HV, kV (rms)	70
	(b) LV, kV (rms)	3
(ii)	Basic Impulse Level	
	(a) HV, kV (peak)	170
	(b) LV, kV (peak)	-
15	Method of earthing	Solidly Earthed
16	Tap changer	
	(a) Type	OFF LOAD on HV side
	(b) Range	(+) 2.5% to (-) 10% in equal 2.5% steps for HV Variation
17	HV Bushing	
	(a) Rated Voltage, kV	36

	(b) Rated Current, Ampere	400
	(c) Basic Impulse Level, kVp	170
	(d) Wet & Dry Power frequency Withstand Voltage,Kv (rms)	70
	(e) Min. Total Creepage Distance, mm	900
18	LV Neutral Bushing	
	(a) Rated Voltage, kV	1.1
	(b) Rated Current, Ampere	1000
	(c) Wet & Dry Power frequency withstand Voltage,kV (rms)	2.0
19	Min. Clearance in Air	
	(a) Ph-Ph (HV/LV), mm	350/25
	b) Ph-Earth (HV/LV), mm	320/25

3.6. ERECTION, TESTING AND COMMISSIONING

3.6.1 Bidders should note that, transformers shall be installed at new/existing location identified by the site engineer, at various existing substations. Transformers shall be erected on a new RCC pedestal or as decided by engineer-in-charge.

3.6.2 It is also responsibility of the supplier/Contractor to lay the power cable on LV side to connect the transformer to existing LTAC Panel of the Purchaser.

3.6.3 Bidder shall carry out the required earthing system for the commissioning of the transformer like two numbers neutral earth, two numbers transformer body earth & LA earth.

3.6.4 Before commissioning of the transformers, the Supplier/Contractor shall carry out all the site tests specified and shall take approval of the same from the Purchaser.

4.0. GUARANTEED TECHNICAL PARTICULARS

4.1. The Guaranteed Technical Particulars of the various items shall be furnished by the Bidders in the prescribed format furnished under vol. III of this tender document. The Bidder shall also furnish any other information's as in their opinion is needed to give full description and details to judge the item(s) offered by them.

D. 30kVA DIESEL GENERATING SET.

1.0. SCOPE:-

1.1. The brief description of scope covered under this Bidding Document is furnished below:

a) Design, manufacture, testing at manufacturer's works and supply of 30KVA air cooled Diesel Generating set complete with all accessories like, starting batteries, standard control panel, interconnecting cable(including cable from generator panel to change-over panel), tank, fuel/coolant/ exhaust pipes, silencer, anti vibration mountings, foundation etc.

b) Loading at manufacturer's works, transportation and delivery at respective substation sites, including unloading at destination sites.

c) Erection, Testing and Commissioning of the Diesel Generating Set including construction of concrete foundation platform and protective canopy.

d) Cabling from Generator Panel to Changeover Panel and from thereon to ACDB.

e) Supply of mandatory Spares.

1.2. It is also responsibility of the Contractor to obtain any road permits and any other permits or licenses to execute the works.

2.0. STANDARD:-

The generating set shall be designed, manufactured and tested in accordance with the latest revision of Indian standards IS 10002/1981 - Specification for Diesel Engines as amended upto date IS 4722/2001- Rotating Electrical Machines -Specification (second revision).

3.0. GENERAL:-

The generating sets shall be robust in construction factory tested and assembled to ensure perfect alignment of Engine and Alternator on a common base frame. The base frame shall be fabricated out of adequate thickness rolled steel sections. The set shall be mounted on anti-vibration mounting to prevent transfer of vibration to the foundation and structures. The Cable shall be suitable for operating at a hot humid and saline atmosphere at an ambient temperature of 45 degree centigrade.

4.0. DIESEL ENGINE

The engine shall be Multi-cylinders, vertical, 4 stroke, Direct Injection, Air/water cooled type, developing the rated Horsepower at a speed of 1500 rpm. The engine shall be provided with an Hour meter to record the hours of operation. Suitable engine heaters shall be provided to ensure quick starting of the engine after prolonged shut off where necessary.

4.1 **Starting**:-

The engine starting shall be by means of totally enclosed axial type electric starter suitable for 12 volts DC. The DC supply shall be derived from a heavy duty 12 volts maintenance free battery.

4.2 **Cooling**:-

In case of water cooled Engine, an engine driven centrifugal pump shall be employed to circulate the coolant through a cooling radiator with an axial blower fan. A temperature gauge shall be provided with contacts for stopping the engine on high temperature.

4.3 **Lubrication**:-

Pressure lubricating oil system with an engine driven pump shall be provided to cover to complete engine, with built in oil coolant heat exchangers. Full foam filters removable elements shall be provided and these shall be located at easily accessible location for ease of maintenance. The supply shall include first filling of lubricating oil. An oil pressure gauge shall be provided to monitor the lubrication oil pressure. The gauge shall be provided with contacts for stopping the engine on failure of lubricating oil flow.

4.4 **Governor:-**

The governor shall be of electronic type suitable for monitoring constant engine speed within the specified limits for auto parallel and auto load sharing operation.

4.5 **Exhaust:-**

The exhaust piping system shall be supplied with a residential silencer. The exhaust piping and the silencer shall be wrapped with rock wool and/or calcium silicate. The outside shall be neatly wrapped with aluminum cladding. The exhaust line shall be extended beyond the height of the utility building roof as required by pollution control norms.

4.6 **Daily Service Tank:-**

The supplier shall supply and install Daily Service Tank of sufficient capacity 120 lts to enable running of the generator set for 12 hours continuous run. The Daily Service Tank shall be fitted with necessary fuel gauge with shut off cocks.

4.7 **Pipe works:-**

All necessary pipes and accessories for cooling water, lubricating oil, fuel, oil and exhaust shall be designed and supplied to suit the standard arrangement for a system, mounted on anti-vibration mountings.

4.8 **Foundation and Anti-Vibration Footing:-**

The generating set shall be mounted on standard size cement concrete foundation with required number of anti-vibration footings to prevent transfer of vibration to the foundation and structure.

5.0. ALTERNATOR

The alternator shall be 30 KVA 3 phase 0.8 PF 415V, 4 wire 1500 rpm, housed in screen protected drip proof enclosure. The alternator shall be capable of delivering rated output at rated power factor with,

a. Terminal voltage differing from the rated value by not more than +/- 5%.
b. Frequency differing from the rated value by not more than +/- 0.5%.
c. Short circuit capacity of 300% for 10 seconds. .
d. Over load capacity of 110% for one hour.

5.1 **Insulation:-**

The insulation shall be class H and shall be fully impregnated for use in hot, humid, tropical climate conditions, with an ambient temperature of 50 deg.C. The stator and rotor windings of the alternator and the exciter shall be provided with acid resistant varnish finish.

5.2 **Bearings:-**

The alternator shall be provided with single bearing or two sleeves to ensure perfect alignment under all conditions. The bearing shall be self-lubricating type. Close coupling of single bearing alternator is preferable.

5.3 **Voltage Regulator**:-

A rapid response voltage regulator shall be provided to regulate the generated voltage .The overall regulations from no load to full load, including cold to hot variation and load power factor of 0.8 lag to unity shall be within 2% of the normal voltage. The excitation system shall be designed to promote rapid voltage recovery following sudden application and disconnection of load.

6.0. ACOUSTIC ENCLOSURE

The acoustic enclosure should be supplied along with DG set from the manufacturer outlet itself as per CPCB norm.

6.1 **Construction:**-

Acoustic enclosure shall be of powder coated and fabricated out of 16 SWG CRCA MS sheet. Powder coating shall be done after seven tank surface preparation process of sheet metal. The canopy shall have four hinged doors, one door with glass window to view proper parameters on the control panel. The canopy and

doors shall have inside lining of fire retardant foam/glasswool as acoustic materials.

The base frame shall be fabricated in ISMC channel or in sheet metal, with lifting hooks for convenient lifting of complete set i.e along with canopy, engine and alternator.

The sound level shall have less than 75 db (A) at a distance of 1 meter. The allowable temperature raise inside the canopy is 5 to 7 deg. Centigrade. The measurement of noise will be as per ISO 3744/ ISO 8528 (Part 10) standard.

6.2. **Salient features:-**

The canopy shall have the following features-

1. Open air installation
2. Lockable doors
3. External accessible emergency stop button
4. Provision for taking out exhaust gases through suitable pipes to prevent any leak pressure on the engine.
5. Provision for the second residential / hospital silencer to reduce the noise level as specified.

7.0 CONTROL & INSTRUMENTATION

7.1 Each D.G. Set shall be provided with suitable instruments, interlock and protection arrangement, suitable annunciation and indications etc. for proper start up, control, monitoring and safe operation of the unit. One local AMF control panel along with each D.G. set shall be provided by the Supplier to accommodate these instruments, protective relays, indication lamps etc. The AMF Panel shall have IP-52 degree of Protection as per IS: 12063.

7.2 The D.G. sets shall be provided with automatic start facility to make it possible to take full load within 30 seconds of Power Supply failure.

7.3 Testing facility for automatic operation of DG Set shall be provided in AMF panel.

7.4 DG set shall be capable of being started/ stopped manually from remote as well as local. Remote START/STOP push button shall be provided in 415V ACDB). However, interlock shall be provided to prevent shutting down operation as long as D.G. Circuit breaker is closed.

7.5 Shutdown sequence of DG set to be provided whenever any of the following conditions appear in the system:

i) Overspeed
ii) Overload.
iii) High temperature of engine and cooling water.
iv) Low lub oil pressure
v) Short circuit protection

vi) Under voltage
vii) Over voltage.

7.6 Following instruments shall be provided with Diesel Engine -

i) Lub oil pressure gauge
ii) Water temperature thermometers
iii) Engine tachometer/HR
iv) Any other instruments necessary for DG Set operation shall be provided.
v) Following indication lamps for purposes mentioned as under shall be provided in AMF panel: Pilot indicating lamp for the following:

a) Mains ON
b) Alternator ON
c) Charger ON/OFF
d) Breaker ON/OFF

vi) Visual annunciation shall be provided for set shut down due to:
a) Engine overheating
b) Low oil pressure
c) Lack of fuel
d) Set failed to start in 30 secs after receiving the first start impulse
e) High cooling water temperature
f) Low level in daily service fuel tank
g) Over speed trip
h) Audio & visual Annunciation for alternator fault.

7.7 AMF panel for control, metering, alarm and automatic change over shall be provided.AMF panel shall have facility for adjustment of speed and voltage including fine adjustments in remote as well as in local mode. The control panel shall also contain all protective and aux. relays and metering recommended by the supplier for the alternator including (but not limited to) the following:

a) Restricted Earth fault protection.
b) Over load protection.
c) Phase to phase and phase to Earth fault protection.
d) Over voltage protection.

7.8 The contractor shall furnish complete protection scheme comprising CT parameter setting range, type of relays etc.

7. 9 The CT's for different protection shall be of 5A secondary current rating.

7.10 The CTs for metering shall be of 5A secondary current rating, accuracy class 1.0 and rated VA output not less than 30.

7.11 Following shall also be provided in AMF panel:

a) Frequency meter
b) 3 Nos. single phase CT's for metering
c) One (1) DC (0-40A)
d) One (1) DC Voltmeter (0-30V)
e) One (1) Voltmeter Selector switch
f) One (1) AC Ammeter
g) One (1) AC Voltmeter
h) Three (3) Timers (24V DC)
i) Two (2) Auto / Manual Selector Switch
k) Two (2) Auto / test / Manual Selector Switch
l) Two (2) Set Battery charger as specified in Technical Specification
m) One (1) Set Phase & Neutral bus bars.
o) Any other item required for completion of Control scheme shall be deemed to be included.

7.12 Thermostatically controlled space heaters and cubicle illumination operated by Door Switch shall be provided in AMF panel. Necessary isolating switches and fuses shall also be provided.

8.0 DRAWING AND MANUALS

Technical data and all the drawings and calculation shall be submitted for approval and statutory approval of CEA shall be obtained for commissioning of the Diesel Generator set.

9.0 TESTS:-

9.1. **Factory Test:**

Complete tests at full load and 10% over load shall be carried out at the manufacturer's works to determine the performance and operating characteristics of the assembled generating set and accessories to determine whether or not the guarantees have been met. Unless otherwise specified, all routine tests shall be carried out in accordance with the standards and shall be witnessed by the representatives of the purchaser. Manufacturer test certificate with manual in triplicate shall be supplied by the vendor.

9.2. **Site Test:-**

The Contractor shall carryout the following commissioning tests to be carried out at site:

9.2.1 **Load Test:** - The engine shall be given test run for a period of at least 6 hours. The set shall be subjected to the maximum achievable load as decided by Purchaser without exceeding the specified DG Set rating. The necessary load to carry out the test shall be provided by the purchaser. During the load test, half hourly records of the following shall have to be taken:

a) Ambient temperature.
b) Exhaust temperature if exhaust thermometer is fitted.
c) Cooling water temperature at a convenient point adjacent to the water output from the engine jacket.
d) Lubricating oil temperature where oil cooler fitted.
e) Lubricating oil pressure.
f) Colour of exhaust gas
g) Speed
h) Voltage, wattage and current output.
i) Oil tank level

9.2.2 **Insulation Resistance Test for Alternator:**

An insulation resistance in mega-ohms between the coils and the frame of the alternator when tested with 500Vmegger shall not be less than IR=2x (rated voltage in KV) +1.

9.2.3 **Functional Test:**

a) Functional tests on control panel.
b) Functional test on starting provision on the engine.
c) Functional tests on all Field devices.
d) Functional tests on AVR and speed governor.

9.2.4 **Measurement of Vibration:**

The vibration shall be measured at load as close to maximum achievable load and shall not exceed 250microns.

9.2.5 **Noise Level check as per relevant standard:**

The tests shall be carried out with the DG set operating at rated speed and at maximum achievable load. Necessary correction for Test environment condition & background noise will be applied as per IS: 12065.

10.0. LT CHANGE OVER PANEL

10.1. Design, fabrication & supply of Indoor L.T. 415V distribution switchgear Panel made out of 16 SWG CRCA sheet steel Enclosure with powder coated matt grey finish. The panel shall have proper supporting and mounting structure of suitable size ‘u’ channel, provision for grouting. Provide sufficient clearance between live and non live parts as per standards. The panel should have 14 SWG gland plate. Cable alley and bus-bar chambers should be provided. The panel must have two MCCBs of requisite capacities; one for DG Set and the rest for Station Service Transformers. The terminals of the MCCBs must be of adequate size & mechanical strength to receive the terminals lugs on cables of requisite sizes. Also the two MCCBs must be so mechanically interlocked that one MCCB may be switched on at any instant of time and not both.

.

11.0. ERECTION, TESTING & COMMISSIONING INCLUDING NECESSARY CIVIL WORKS

11.1. The DG Sets shall have to be installed, tested and commissioned by the contractor after construction of the necessary foundation at the designated locations inside the respective Sub- stations of P&ED, Mizoram.

11.2. All fittings, unit assemblies, accessories, hardware foundation bolts, terminal lugs for electrical connections, cable glands and miscellaneous materials or accessories of items of work which are useful and necessary for efficient assembly and working of the equipment shall be deemed to be included in the tender within the overall cost quoted. The equipment shall be complete in all details whether such details have been mentioned or not.

11.3. Foundation shall be constructed to provide a suitable reinforced cement concrete Pedestal for both the D-G set and fuel tank with concrete proportion of1:2:4 and reinforcing steel rods of 12mm dia. RCC bed should rise at least 0.3m above the ground level. All materials required for the related civil works are under the scope of the contractor. However, the drawings for the foundation work shall be got approved by the Employer before taking up the work for execution.

11.4. 2 Nos. of earth electrodes for body earth and 2 Nos. earth electrode for neutral earth shall be provided as per IS-3043 with GI pipe ('B' Class) earth electrode. Interconnection of earth electrode, earthing of fuel oil tank, base frame etc. shall also be carried out as per relevant standards.

11.5. The Change-over panels shall have to be installed by the contractor inside the ACDB room or any other suitable locations in the Control Room Buildings as directed by the site engineer of the respective Sub-stations of P&ED, Mizoram.

11.6. The contractor shall lay and execute termination of the necessary power and control cables from the DG sets to the Change-over panels and from thereof to the ACDB panels as directed by the site engineer.

11.7. In addition to the checks and test recommended by the manufacturer, the Contractor shall carry out the commissioning tests as found suitable by purchaser/owner.

12.0 DOCUMENTS:

12.1 The following drawings and data sheets shall be submitted for approval:

i) Data sheet for Engine, Alternator, Battery, AMF panel and enclosure.
ii) GA drawing of DG set.

iii) Layout of DG set in the enclosure along with section.

12.2 The DG set shall be supplied with.

i) DG set test certificate.
ii) Engine operation and maintenance.
iii) Engine parts catalogue.
iv) Alternator operation, maintenance &Spare parts Manual.
v) Alternator test certificate.

13.0. Electrical and mechanical characteristics shall be guaranteed by the bidder. In case of failure of materials to meet the guarantee, **P&E Deptt. Mizoram** shall have right to reject the material.

14.0 Guaranteed Technical Particulars (GTP) is to be submitted by the tenderer along with the bid. Prescribed format of GTP to be furnished is provided in Volume III of this Tender Document.

E. RELAYS

1.0. SCOPE.

1.1. The scope of works is furnished below:

a) Design, manufacture, testing at manufacturer's works supply, installation testing and commissioning

b) It is also responsibility of the Contractor to obtain any road permits and any other permits or licenses to execute the works.

1.2. All the relays under the scope shall be Numerical type and shall comply with the following requirements of: IS: 3231 / IEC•60255 / IEC 61000 or other applicable standards. Relays shall be suitable for flush or semi flush mounting on the front with connections from the rear.

1.3. **The offered relays shall be completely numerical.**

- The communication protocol shall be as per IEC 61850 & IEC60870-5-103
- The test levels of EMI as indicated in IEC 61850 shall be applicable to these relays.
- Protection elements should be realized using software algorithm.
- Hardware based measurement shall not be acceptable.

1.4. The relay shall be provided with both 1A and 5A CT inputs and shall be selectable at site.

1.5. It shall be possible to energies the relay from either AC or DC auxiliary supply.

1.6. The offered relay shall have a comprehensive local MMI for interface. It shall have the following minimum elements so that the features of the relay can be accessed and setting changes can be done locally.

- At least 48 character alphanumeric backlit LCD display unit
- Fixed LEDs (for trip, Alarm, Relay available & Relay out of service) & programmable LEDs which can be assigned to any protection function for local annunciation.
- Tactile keypad for browsing and setting the relay menu.

1.7. The relay shall have the facility to set the pickup threshold (24-250V) independently per digital input to prevent the spurious pick up of binary during inputs DC earth fault condition (ESI 48- 4EB2 compliant).

1.8. The relays supplied should be compatible to redundant communication architecture, shall be complied with the IEC 62439-3 standards of parallel redundancy protocol (PRP).

1.9. The relays provided should be complied with the international standards of NERC CIP for cyber security to provide protection against unauthorized disclosure, transfer, modification, or destruction of information and/or information systems, whether accidental or intentional.

1.10. All PCB used in relays should have harsh environmental coating as per standard IEC 60068 (HEC) to increase the particle repellency and thereby increasing the life of relay

1.11. **The relay should comply to IEC 61850 protocol.**

- The relays shall generate GOOSE messages as per IEC 61850 standards for interlocking and also to ensure interoperability with third party relays.
- The relay should be upgradable to process bus interface 61850-9-2LE (Process Bus) to receive SV from non-conventional CT / PT and merging unit.
- Necessary user friendly configuration tool shall be provided to configure the relays. It should be compatible with SCL / SCD files generated by a third party system.
- Goose signals shall be freely configurable for any kind of signals using graphic tool /user friendly software.
- The relay should have time synchronization through SNTP/IRIG-B

1.12. The relays shall have the following tools for fault diagnostics

- Fault record – The relay shall have the facility to store at least 5 last fault records with information on cause of trip, date, time, trip values of electrical parameters.
- Event record – The relay shall have the facility to store atleast 512 time stamped event records with 1ms resolution.
- Disturbance records – The relay shall have capacity to store at least 8 disturbance record waveforms at 10.5 secs.

1.13. The relay settings shall be provided with adequate password protection. The password of the relay should be of 4 character upper case text to provide security to setting parameter

1.14. The relay shall have comprehensive self-diagnostic feature. This feature shall continuously monitor the healthiness of all the hardware and software elements of the relay. Any failure detected shall be annunciated through a output watchdog contact. The fault diagnosis information shall be displayed on the LCD and also through the communication port.

1.15. The Numerical Relays shall be provided with 1 Set of common support software compatible with up to date Windows platform which will allow easy settings of relays in addition to uploading of event, fault, disturbance records, measurements.

- The relay settings shall also be changed from local or remote using the same software.
- Additional functions can be added to relay by software up-gradation and downloading this upgraded software to the relays by simple communication through Laptop.

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

1.17. All AC operated relays shall be suitable for operation at 50 Hz. AC Voltage operated relays shall be suitable for 110 Volts VT secondary and current operated relays for 1 amp CT secondary. All DC operated relays and timers shall be designed for the DC voltage specified, and shall operate satisfactorily between 80% and 110% of rated voltage. Voltage operated relays shall have adequate thermal capacity for continuous operation.

1.18. The protective relays shall be suitable for efficient and reliable operation of the protection scheme described in the specification .Necessary auxiliary relays and timers required for interlocking schemes for multiplying of contacts suiting contact duties of protective relays and monitoring of control supplies and circuits, lockout relay monitoring circuits etc. also required for the complete protection schemes described in the specification shall be provided. All protective relays shall be provided with at least two pairs of potential free isolated output contacts. Auxiliary relays and timers shall have pairs of contacts as required to complete the scheme; contacts shall be silver faced with spring action. Relay case shall have adequate number of terminals for making potential free external connections to the relay coils and contacts, including spare contacts.

1.19. Timers shall be of solid state type. Time delay in terms of milliseconds obtained by the external capacitor resistor combination is not preferred and shall be avoided.

a. No control relay, which shall trip the power circuit breaker when the relay is de- energized, shall be employed in the circuits.

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

c. Auxiliary seal-in-units provided on the protective relays shall preferably be of shunt reinforcement type.

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

1.20. Any alternative / additional protections or relays considered necessary for providing complete effective and reliable protection shall also be offered separately. The acceptance of this alternative/ additional Cable shall lie with the P&E Department, Govt. of Mizoram.

1.21. All relays and their drawings shall have phase indications as -

R•Red, Y•Yellow, B•blue.

2.0. ERECTION:

a) Wiring:

Suitable wiring whenever require for fitting, fixing, commission & testing of relays and other control Cables have to completed by the bidder **without extra cost** for materials etc. All wiring shall be carried out with 1100V grade, single core, stranded, un-tinned copper conductor wires with PVC (FRLS) insulation, ferrule marking, crimping lug etc. as required. The wiring shall be flame, vermin & rodent proof and shall have Oxygen Index of not less than 29 & Temperature Index of not less than 250ºC. The number and minimum size of the stranded copper conductors (minimum 7 nos.) used for internal wiring shall be as follows:

All circuits: One 2.5 mm^2 per lead.

Each wire shall be continuous from end to end and shall not have any joint in its run. All internal wiring shall be connected only at the connection terminals of the terminal blocks, relays, instruments and other switchboard devices.

b) Tests:

The protection relays shall be completely assembled and subjected to the various routine and acceptance tests as per the relevant standards in the premises of the manufacturer of
relay in the presence of Purchaser's representative, if desired by the Purchaser. Five certified copies of the test reports shall be submitted to the Purchaser for approval before Cable is packed for shipment.

The Contractor shall specifically state the details of testing facilities available at his own or sub-vendor works.

The type test reports conducted on the protection relays and distance to fault locator in accordance with relevant IS / IEC, along with verification of degree of protection in accordance with relevant IS 13947 (Part - I) / relevant IEC from approved laboratory, shall be submitted along with the bid for Purchaser's review.

The Control & Relay panels shall also be subjected to the following tests:

i) Mechanical operation test

ii) High Voltage test/Insulation resistance test

iii) Electrical control, inter lock and sequential operation test.

iv) Verification of wiring as per approved schematic

v) Verification of degree of protection in accordance with relevant IS: 13947 (Part – I) /relevant IEC from approved laboratory.

c) Instruction manuals:

The following drawings for each item are to be supplied after award of contract:
Six copies of instruction books / descriptive literature of the following shall be supplied:

i) Literature describing construction, operation, adjustment, testing, calibration and maintenance of all protective and auxiliary

relays, instruments, control switches etc.

ii) List of spare parts giving identification number of the parts.

E - I: TECHNICAL SPECIFICATION FOR OVER-CURRENT AND EARTH FAULT RELAY.

3.0. The relay shall be numerical type having the following features:

1. Undercurrent protection (37)
2. Negative Sequence Overcurrent protection (46)
3. Broken Conductor protection (46BC)
4. Negative sequence overvoltage protection (47)
5. Thermal overload protection (49)
6. Ground fault protection (50/51N)
7. 3 phase overcurrent protection (50/51P)
8. Circuit breaker failure protection (50BF)
9. Voltage controled overcurrent protection (51V)
10. Over/Under voltage protection (59/27)
11. Residential over voltage protection (59N)
12. Residential earthfault protection (64)
13. Ground fault directional protection (67N)
14. Wattmetric earthfault protection (67W)
15. Autoreclose (79)
16. Under/Over frequency protection (81)
17. Rate of change of frequency (81R)
18. Lock-out (86)
19. Current transformer supervision (CTS)
20. Switch on to fault (SOTF)
21. Trip circuit supervision (TCS)
22. Voltage Transformer supervision (VTS)

E - II: TECHNICAL SPECIFICATION FOR DISTANCE PROTECTION RELAY.
(Numerical IEC-61850 Protocol compliance)

4.0. The relay shall:

1. be static and modular in construction

2. Have high speed phase segregated non switched distance relays for three phase systems to clear all type of line faults within the set reach of the relay.
3. Cover at least two line sections with 15% in hand margin.
4. Measure all type of faults without the need to switch the measuring elements to the faulty phase or phases. Zone switching to extend the reach of the measuring elements is not allowed. The reach of each zone shall be independently and individually adjustable and shall have settings in steps of 1%. Memory circuits with defined characteristics shall be provided in all three phases to ensure correct operation during close-up 3 phase faults and other adverse conditions. Independent zero sequence compensation shall be provided for each zone.
5. Have reverse reaching zone operating times as given in Table. The Carrier transmission time has been considered as 20 ms.
6. Have stepped time-distance characteristics and at least two directional and one non-directional independently variable time graded distance protection zones to cover two adjacent line sections.
7. Have a maximum Zone 1 operating time from fault initiation to trip impulse from relay (complete protection time excluding applicable carrier time) under source to line impedance ratios and under all possible combinations of fault with CVT being used on the line (with all filters included) and at 50% of Zone I reach as follows:
   - For S.I.R. 0.01 to 4: 30 ms at the nearest end and 50 ms at far end.
   - For S.I.R. 4 to 15: 30 ms at the nearest end and 50 ms at far end.

   Carrier transmission time is considered as 20 ms. Any reduction in carrier transmission time shall be reflected in the reduction of maximum operating time. The trip times should not be affected by DC offset and under frequency up to 47Hz.
8. Have a reach for Zones 1,2 and 3 to cover line length as per 3 above. The relay shall have an adjustable characteristic angle setting range of 30 to 75 degree, preferably adjustable dynamically following the load conditions of the power system. It should be ensured that this long coverage is consistent with limitations imposed by heavy loading and sound phase component of fault current. If so characterised by system requirements, it shall be possible to have circular characteristics of offset Mho type & Quadrilateral shaped. If the characteristics of starting relays are such that it cannot pick-up because of very low infeed, under voltage relays may also be used as supplementary relays.
9. Have two independent continuously variable time setting range of 0-3 seconds for Zone 2 and 0-5 seconds for Zone 3.
10. Have a maximum resetting time of less than 35 milliseconds.
11. Have facilities for offset features with adjustment of at least 20% of Zone 3 setting.
12. Have automatic residual compensation capabilities variable from 30-150%.
13. Be such that the setting / reach should not be affected by mutual coupling effect of double circuit line or nearby paralleled circuits. The proof of compensation should be given if provided.

14. Operate instantaneously when circuit breaker is closed to zero volt 3 phase fault.
15. Be suitable for single and three phase tripping.
16. Have a continuous current rating of twice rated current. The voltage circuit shall be capable of continuous operation at 1.2 times rated voltage. The relay shall also be capable of carrying a high short time current of 70 times rated current without damage for a period of one second.
17. Be selective between internal and external faults.
18. Incorporate three separate high speed trip relays for single phase faults and a fourth high speed trip relay for multi phase faults. Each of these shall have adequate contacts to meet the complete scheme requirements. The relay shall conform to the requirements for tripping relays specified in this specification.
19. Include power swing blocking protection which shall:
    - be of triple pole type
    - have suitable setting range to encircle the distance protection described above.
    - have a continuously adjustable time delay on pick up of setting range 0-2 seconds.
    - block tripping during power swing conditions.
20. Include fuse failure protection which shall:
    - monitor all the three fuses of CVT and associated cable against open circuit.
    - inhibit trip circuits on operation and initiate annunciation.
    - have an operating time less than seven milliseconds.
    - remain inoperative for system earth faults.
21. Have integrated two stage over voltage protection facilities.
22. Shall have comprehensive self test feature including diagnostics at power up.
23. Broken conductor detection facility.
24. Distance to fault locator

4.1. **Distance to fault locator:**

4.1.1 **General**

Distance to fault locators shall be the inbuilt features of the distance relay for both Main I and Main II, shall be capable of locating phase to phase and phase to earth faults. They shall also preferably be capable of locating open circuit faults.

a) Have built-in display feature.
b) Display directly in percent of line length or kilometres without the requirement for further calculation.
c) Have an accuracy of 3% or better for all types of faults and fault levels. This level of accuracy should not be impaired under the following conditions:
    - presence of remote end infeed
    - predominant DC component in fault current
    - high fault arc resistance
    - severe CVT transients
d) Have facility for remote data transmission
e) Meet IEC 255 Part IV or other equivalent internationally recognized standard.

f) Have mutual zero sequence compensation unit if fault locator is to be used on double circuit transmission line. Table showing Operating Times for Distance Protection is shown blow.

Operating Time (ms)	SIR = ZS/ZL)	Fault Position % of Impedance Setting
20	10	5 to 20
30	30	10 to 60
50	60	1 to 95

SIR = System Impedance ratio. Zs = Source impedance. Zl = Relay setting impedance.

g) Operation of line back-up protection to disconnect primary system faults in the case of a circuit breaker failing to operate, (i.e. circuit breaker failure protection)

h) All back-up protection systems shall be able to discriminate with main protection systems, circuit breaker fail protection and with other back-up protection systems installed elsewhere on the transmission system.

4.1.2 **Codes and Standards:**

The Cable supplied shall generally comply with the codes and standards indicated in relevant sections of this specification. Additionally the Cable shall also conform the requirements of this specification.

4.1.3 **Environmental requirement:**

The protection, control and metering Cable shall operate satisfactorily under the various atmospheric, mechanical, electrical and environmental conditions as stipulated in the relevant sections of this Specification. The Cable shall conform to EMC Class.

E – III: LOCAL BREAKER BACKUP PROTECTION RELAY.

5.0. Local Breaker Back-up protection relay for circuit breakers shall comprise the following features/characteristics –

1. The above protection shall be stand alone type or built in function of Local Breaker Backup Protection.
2. Each Circuit Breaker shall be provided with LBB or Breaker Failure Protection Scheme Relays to take care of instances of Failure of Breaker Mechanism or other Operational Failure of Circuit Breakers or for such Faults, which are not cleared by the Protection. In such an event, the other Circuits connected to the affected Zone shall be Tripped and Locked Out after a short time delay. The Protection shall not give Trip Signal during operation of the Main

Protection Relay of the Circuit concerned. The protection scheme shall be so designed that if any circuit breaker fails to trip in the event of a fault, then after a short time delay all the adjacent circuit breakers connected in the same bus will be tripped. The circuit breaker failure shall also block auto-reclosing scheme. The scheme shall be complete with timer and auxiliary relays as necessary including remote end tripping facility. The relay -

a. Shall be of numerical type and shall have continuous self monitoring and diagnostic feature.
b. Shall have an operating time of less than 15ms
c. Shall have resetting time of less than 15ms.
d. Shall be arranged to get individual initiation from the corresponding phase of main protections of line.
e. Shall have continuous thermal withstand two times rated current irrespective of the setting.
f. Shall have a timer with continuously adjustable setting range of 0.1 - 1 sec.
g. Shall have necessary auxiliary relays to make a comprehensive scheme.
h. Be suitable for Station 110 /220 Volt D. C. supply.

5.1. **Technical Specifications:**

Sl.No.	**Technical Specification**	**Particular**
1.	CT Inputs	Suitable for CT secondary 1.0 Amp
2.	Trip setting	10% -120% for Phase
3.	Operating Time :	100ms to 1200ms –in Step of 10ms.
4.	Reset Time :	20ms
5.	Dropout / Pick-up :	Above 90%.
6.	CT Burden :	Less than 0.2 VA.
7.	Auxiliary Burden :	Less than 10.0 VA
8	Control Contacts	Four set of NO contacts are given; For Trip & Annunciation (SR Type).
9.	Time Accuracy :	Within class 2.5 As per IS: 3231.
10.	Burden on CTs :	Less than 0.2VA
11.	Aux. Supply :	110 VD C.
12.	Contact Rating Trip Duty :	Make and carry for 3sec. –7500VA with max 30A & 660VAC/DC Make and carry for continuous - 1250VA with max. 5A & 660VAC/DC Break AC -1250 VA DC -100 W resistive 50W inductive.
13.	Operational Indicators (Flags)	
	ON	: Green LED indicates Relay OK

In case of following condition, LED become OFF
1. Problem in relay Hardware.
2. Auxiliary supply is not sufficient for relay operation.

FAULT	: Red LED indicates the relay trip, Hand Reset (HR) Type.
PKP	: Red LED indicates relay Pickup condition.
TRIP	: Indicates that Trip pulse is being executed. When BYPASS P.B. is pressed, actual trip is not executed.

14.	Thermal Withstand Capacity :	x40 times the normal current for 3sec. x2 Continuous
15.	High Voltage Test :	IEC 60255-5
16.	Except DC Voltage	2.0 kV (RMS), 50Hz
17.	Only DC voltage	2.8 kV DC
18.	Between Open contact of TRIP / CLOSE	1.5kV (RSM) 50Hz
19.	Between Open contact of ALARM	1kV (RSM) 50Hz
20.	Impulse Voltage Test (all circuit class –III):	IEC60255-5 5kV (peak) 1.2/50us,0.5J,3 positive and 3 negative impulse at interval of 5 secs.
21.	High Frequency test:	IEC 60255-22-1, Class III 2.5 kV (peak) 1MHz, t = 15ms 400 surges / s duration 2 s
22.	Electro static Discharge:	IEC 60255-22-2 Class III and IEC 61000-4-2class III 4kV/6kV contact discharge, 8kV air discharge, both polarities 150pF, Ri 330 W
23.	Irradiation with radio frequency field pulse modulated:	IEC 60255-22-3 and IEC 61000-4-2 class III 10V/m; 80 to 1000MHz; 80%; 1kHz AM
24.	Fast transient interference/bursts	IEC 60255-22-3 and IEC 61000-4-3, class III 4kV; 5/50ns; 5kHz burst duration = 15ms; Repetition rate 300ms; Both polarities; Ri =50W duration 1 min.
25.	Shock Test:	IEC 60255-21-2 class 1 Semi –Sinusoidal

		5g acceleration, duration 11ms, each 3 shocks in both direction of the 3 axes
26.	Vibration Test:	IEC 60255-21-1 class 1 / IEC 60068-2-6 Sinusoidal 10 to 60Hz ±0.035 mm Amplitude, 60 to 150Hz, 0.5g acceleration Sweep rate 1 octave/min; 20 cycle in 3 orthogonal

6.0. **Technical specification for relay tool kits.**

6.1. The relay tool kit shall consist of the following minimum items which should be supplied for 8 different 132kV substations under P&E Deptt. Mizoram.

1. Test plugs for use with testing Cable. Single finger test plug for MiCOM P127 & MiCOM P443. – 1 set.
2. Special type test plugs for using with modular type cases- 1 set
3. Screw driver set with multiple fixing features of different size suitable for numerical relay, Mini screw driver set : 1 set. .
4. Socket wrench with multiple fixing features of different size suitable for numerical relays. Mini socket wrench set.: 1 set.
5. Long nose pliers
   i) D307-51/C 127 mm slim long nose plier : 1 no
   ii) D310-6C 152mm tapered Long nose plier.: 1 no
   iii) D 320-41/2C midget curved chain nose plier: 1 no.
6. Wire cutting pliers and stripper 6” long. : 1 no
7. Ordinary pliers : Preferably Taparia 6” long. :1no
8. Adjustable wrench: 6 “ long. : 1no.
9. Soldering irons of
   10 Watts rating - 1 No.
   25 watts rating - 1 No.
   35 Watts rating - 1 No.
10. De-soldering pump of material :Metal, plastic with soldering wick 2.5mm width, 5 ft length. : 1no.
11. Printed Circuit Card-extender; Printed circuit card - 'Puller' Suitable for all numerical relays: R 1209-062+ RRP-375 PCB card extractor 1.6mm card inserter/extractor, material: Nylon66 : 1no
12. Test leads (Pair with 2 Mts. length) - 2 sets
13. Magnifying glass with adjustable stand.: Hand free adjustable(adjustable

crocodile holding clamp) Magnifying glass 3.5X and 12X magnification with L.E.D light and soldering stand.: 1no

14. Shorting plugs, 'pistol' prods Suitable for MiCOM P127 & P443: 2nos.

7.0. GUARANTEED TECHNICAL PARTICULARS

7.1. The Guaranteed Technical Particulars of the various items shall be furnished by the Bidders in the prescribed format furnished under vol. III of this tender document. The Bidder shall also furnish any other information's as in their opinion is needed to give full description and details to judge the item(s) offered by them.

F. GPS BASED TIME SYNCHRONIZING EQUIPMENT

1.0. SCOPE:

1.1 The scope of work is design, manufacture, testing, calibration, conducting quality assurance tests and supply to end user, including installation to purchaser's selected sites and commissioning at the satisfaction of Engineer-in-charge.

2.0. SALIENT FEATURES/STANDARD/SPECIFICATION:

2.1. Technical Specifications of bidders shall conform mandatory obligations of National/International standard which pave way for healthy operation of Time synchronizing Cable. The following operation has to be ensured by the standard:

i) The Time shall receive the co-coordinated Universal Time (UTC) transmitted through Geo Positioning Satellite System (GPS) and synchronize Cables to the Indian Standard Time in a substation.

ii) Time synchronization equipment shall include antenna, all special cables and processing Cable etc.

iii) It shall be compatible for synchronization of Event Loggers, Disturbance recorders and SCADA at a substation through individual port or through Ethernet realized through optic fiber bus.

iv) The synchronization equipment shall have 2 micro second accuracy. Cable shall give real time corresponding to IST (taking into consideration all factors like voltage & temperature variations, propagation & processing delays etc).

v) The equipment shall meet the requirement of IEC 60255 for storage & operation.

vi) The system shall be able to track the satellites to ensure no interruption of Synchronization signal.

vii) The output signal from each port shall be programmable at site for either one hour, half hour, minute or second pulse, as per requirement.

viii) The Cable offered shall have six (6) output ports. Various combinations of output ports shall be selected by the customer, during detailed engineering, from the following:

- Voltage signal: Normally 0-5V with 50milli Seconds minimum pulse duration. In case any other voltage signal required, it shall be decided during detailed engineering.
- Potential free contact (Minimum pulse duration of 50 milli Seconds.)

- IRIG-B
- RS 232C

ix) The equipment shall have a periodic time correction facility of one second periodicity.

x) Time synchronization equipment shall be suitable to operate from 110 V DC as available at Substation.

xi) Equipment shall have real time digital display in hour, minute, second (24 hour mode) & have a separate time display unit to be mounted on the top of control panels having display size of approx. 100 mm height.

3.0. GUARANTEED TECHNICAL PARTICULARS

The Guaranteed Technical Particulars of the various items shall be furnished by the Bidders in the prescribed format furnished under vol. III of this tender document. The Bidder shall also furnish any other information's as in their opinion is needed to give full description and details to judge the item(s) offered by them.

G. CONTROL CABLES

1.0 SCOPE

1.1. The scope of work is furnished below:

a) Design, manufacture, testing at manufacturer's works and supply of 1.1 KV grade PVC insulated Control Cables with stranded Copper conductors including laying at site.

b) Loading at manufacturer's works, transportation and delivery at respective substation sites, including unloading at destination sites.

1.2. It is also responsibility of the Contractor to obtain any road permits and any other permits or licenses as may be required to execute the works.

2.0 TYPE TEST REPORTS

2.1. Cable, which has never been tested for critical performance, shall not be accepted. In such cases, a promise or agreement by a bidder to have the Cable tested after award of a contract is not acceptable.

2.2. All Bids must be accompanied by the full Type Test Certificates of Cable offered. Such type test certificates shall be acceptable only if: -

(a) Tests are conducted in an independent and well known testing laboratory, or

(b) Tests are conducted in manufacturer's own laboratory. In this case (i) the laboratory must have ISO 9000 (or its equivalent) series certification; and (ii) tests have been witnessed by technically qualified representatives of earlier clients or purchaser.

2.3. Test reports to be acceptable must be related directly to the materials offered. Test reports for higher class of items are acceptable with commitment to perform the type tests free of any charge on the particular items after the award of contract.

2.4. Type Test Reports older than five (5) years on the date of Technical bid opening shall not be accepted.

3.0 GUARANTEED TECHNICAL PARTICULARS

3.1. The Guaranteed Technical Particulars of the Cable shall be furnished by the Bidders in the prescribed format furnished in Volume III of this Tender Document. The Bidder shall also furnish any other information's as in their opinion is needed to give full description and details to judge the item(s) offered by them.

3.2. The data furnished in Guaranteed Technical Particulars should be the minimum or maximum value (as per the requirement of the specification) required. A Bidder may guarantee a value more stringent than the specification requirement. However, for testing purpose or from performance point of view, the material shall be considered performed successfully if it achieves the

minimum/maximum value required as per the technical specification. No preference what so ever shall be given to the bidder offering better/more stringent values than those required as per specification except where stated otherwise.

4.0. TECHNICAL SPECIFICATION OF CONTROL CABLES

4.1. **General**

4.1.1. For all control/protection/instrumentation purposes PVC insulated armoured control cables of minimum 2.5 sq. mm Size with stranded Copper conductors shall be used.

4.1.2. All cables shall be suitable for laying in racks, ducts, trenches, conduits and underground buried installation with uncontrolled back fill and chances of flooding by water.

4.1.3. The fillers and inner sheath shall be of non-hygroscopic, fire retardantmaterial, shall be softer than insulation and outer sheath shall be suitable for the operating temperature of the cable.

4.1.4. Progressive sequential marking of the length of cable in metres at every one metre shall be provided on the outer sheath of all cables.

4.1.5. Strip wire armouring method shall not be accepted for any of the cables. For control, cables only round wire armouring shall be used.

4.1.6. The cables shall have outer sheath of a material with an oxygen index of not less than 29 and a temperature index of not less than 250°C.

4.1.7. All the cables shall pass fire resistance test as per IS:1554 (Part-I).

4.1.8. The normal current rating of all PVC insulated cables shall be as per IS:3961.

5.0 **PVC Insulated Control Cables:**

5.1. The PVC (70°C) insulated control cables shall be of FR type C1 category conforming to IS: 1554 (Part-1) and its amendments, read along with this specification. The conductor shall be stranded copper. The insulation shall be extruded PVC to type A of IS: 5831. A distinct inner sheath shall be provided in all cables whether armoured or not. The over sheath shall be extruded PVC to type ST-1 of IS: 5831 and shall be grey in colour.

5..2. Cores shall be identified as per IS: 1554 (Part-1) for the cables up to five (5) cores and for cables with more than five (5) cores the identification of cores shall be done by printing legible Hindu Arabic Numerals on all cores as per clause 10.3 of IS 1554 (Part-1).

6.0. **Cable Drums:**

6.1. Cables shall be supplied in non-returnable wooden or steel drums of heavy construction. Wooden drum shall be properly seasoned sound and free from defects. Wood preservative shall be applied to the entire drum. Drums offered shall conform to relevant standards.

6.2. A layer of water proof paper shall be applied to the surface of the drums and over the outer most cable layer.

6.3. A clear space of at least 40 mm shall be left between the cables and the lagging.

6.4. Each drum shall carry the manufacturer's name, the purchaser's name, address and contract number and type, size and length of the cable, net and gross weight stencilled on both sides of drum. A tag containing the same information shall be attached to the leading end of the cable. An arrow and suitable accompanying wording shall be marked on one end of the reel indicating the direction in which it should be rolled.

6.5. Packing shall be sturdy and adequate to protect the cables, from any injury due to mishandling or other conditions encountered during transportation, handling and storage. Both cable ends shall be sealed with PVC/Rubber caps so as to eliminate ingress of water during transportation and erection.

7.0. DATA SHEET FOR CONTROL CABLES

Sl. No.	Description	Particulars
1	Applicable Standard	IS: 1554/PT-I & its referred standards
2	Type Designation	YWY
3	Rated Voltage(volts)	1100
4	Type & Category	FR & C1
5	Suitable for earthed or unearthed system	Suitable for both
6	Conductor	
	a) Material	Plain annealed High Conductivity Stranded Copper (as per IS 8130)
	b) Grade	Electrolytic
	c) Number of wires(No.)	As per IS 8130
	d) Form of Conductor	Non-compacted Stranded circular
	e) Direction of lay of stranded layers	Outermost layer shall be R.H lay
7	Insulation	
	a) Composition of insulation	Extruded PVC type A as per IS-5831
	b) Thickness of insulation(mm)	As per applicable Standard
8	Inner Sheath material	Extruded PVC type ST-1 as per IS-5831
9	Type and material of armour	Gal. Steel wire
10	Outer Sheath (PVC)	ST-1 & FR
11	Overall diameter of cable	As per applicable Standard
12	No. of Cores	As per Bill of Materials

7.1. **Tests**

Control cables shall be tested for routine and acceptance tests as per the relevant IS/IEC standards.

H. NITROGEN INJECTION SYSTEM

1.0 SCOPE OF WORK:

1.1. The scope of work covers design, supply, erection and commissioning of Nitrogen Injection system for protection against the transformer explosion for those power transformers of 132KV sub-stations indicated in Vol. I sec.6 of this tender document, including all required civil works of oil sump, foundations, and any other required for satisfactory working of system. Each oil filled transformer shall be provided with a dedicated Nitrogen Injection system for prevention against the transformer explosion which shall use nitrogen as quenching medium. The system shall prevent transformer oil tank explosion and possible fire in case of internal / external cause. In the event of fire by external causes such as bushing fire, OLTC fires, fire from surrounding Cable etc., it shall act as a fast and effective fire fighter. It shall accomplish its role as fire preventer and extinguisher without employing water or carbon dioxide. Fire shall be extinguished within reasonable time (not more than 3 minutes so as not to harm the transformer) of system activation and within 30 seconds (maximum) of commencement of nitrogen injection. The list of past supplies in India / Abroad along with performance certificate from users of the system shall be submitted for approval of purchaser.

2.0 ACTIVATION OF THE SYSTEM

2.1. Mal-functioning of the Nitrogen injection system could lead to interruption in power supply. The supplier shall ensure that the probabilities of chances of malfunctioning of the Nitrogen injection system are practically zero. To achieve this objective, the supplier shall plan out scheme of activating signals which should not be too complicated to make the system in operative in case of actual need. The system shall be provided with automatic controls to prevent the explosion of transformers. Besides automatic control, remote electrical push button control at Control box and local manual control in the cubicle shall also be provided. The following electrical-signals shall be used for activating the system under prevention mode/fire extinguishing mode.

2.2. AUTO MODE

2.2.1 **For prevention:**

i) Differential relay operation.

ii) Buchholz relay paralleled with pressure relief valve or RPRR (Rapid Pressure Rise Relay)

iii) Tripping of all circuit breakers (on HV & LV side) associated transformer is the pre-requisite for activation of system.

2.2.2. **For extinguishing:**

i) Fire Detector
ii) Buchholz relay paralleled with pressure relief valve or RPRR (Rapid Pressure Rise Relay).
iii) Tripping of all circuit breakers (on HV & LV side) associated with transformer is the pre-requisite for activation of system.

2.2.3 **Manual Mode (Local / Remote):**

Tripping of all circuit breakers (on HV & LV side) associated with transformer is the pre-requisite for activation of system.

2.2.4 **Manual Mode (Mechanical):**

i) Tripping of all circuit breakers (on HV & LV side) associated with transformer is the pre-requisite for activation of system.
ii) The system shall be designed to be operated manually in case of failure of power supply to the system.

3.0 GENERAL DESCRIPTION

Nitrogen Injection system should be a dedicated system for each oil filled transformer. It should have a Fire Extinguishing Cubicle (FEC) placed on a plinth at a distance of 5-10 m away from transformer or placed next to the firewall (if fire fighting wall exists). The FEC shall be connected to the top of transformer oil tank for depressurization of tank and to the oil pit (capacity is approximately equal to 10% of total volume of oil in transformer tank) through oil pipes. The FEC should house a pressurized nitrogen cylinder (s) which is connected to the oil tank of transformer. The Transformer Conservator Isolation Valve (TCIV) is fitted between the conservator tank and Buchholz relay. Cable connections are to be provided from signal box to the control box in the control room, from control box to FEC and from TCIV to signal box. Detectors placed on the top of transformer tank are to be connected in parallel to the signal box by Fire survival cables. Control box is also to be connected to relay panel in control room for receiving system activation signals.

3.1 **Operation:**

On receipt of all activating signals, the system shall drain – predetermined volume of hot oil from the top of tank (i.e. top oil layer), through outlet valve, to reduce tank pressure by removing top oil to the oil pit and simultaneously injecting nitrogen gas at high pressure for stirring the oil at pre-fixed rate and thus bringing the temperature of top oil layer down. Transformer conservator isolation valve

blocks the flow of oil from conservator tank in case of tank rupture / explosion or bushing bursting. Nitrogen occupies the space created by oil drained out and acts as an insulating layer over oil in the tank and thus preventing aggravation of fire.

3.2 **System components:**

Nitrogen Injection system shall broadly consist of the following components. However, all other components which are necessary for fast reliable and effective working of the system shall deemed to be included in the scope of supply.

3.3 **Cubicle (FEC):**

3.3.1 The Cubicle Frame shall be made of CRCA sheet of 3 mm (minimum) thick complete with the base frame, painted inside and outside with post office red colour (shade 538 of IS -5). It shall have hugged / hinged split doors fitted with high quality tamper proof lock. The doors, removable covers and panels shall be gasketted all round with neoprene gaskets. The degree of protection shall be IP55. The following items shall be provided in the Cubicle.

i) Nitrogen gas cylinder with regulator and falling pressure electrical contact manometer.
ii) Electro mechanical control Cable for draining of oil of predetermined volume and injecting regulated volume of nitrogen gas.
iii) Pressure monitoring switch for back-up protection for nitrogen release.
iv) Limit switches for monitoring of the system.
v) Butterfly valve with flanges on the top of panel for connecting oil drain pipe and nitrogen injection pipes for transformer / reactors.
vi) Panel lighting (LED Type)
vii) Oil drain pipe extension of suitable sizes for connecting pipes to oil pit.
viii) Space heater.

3.4. **Control box:**

3.4.1 Control box is to be placed in the control room for monitoring system operation, automatic control and remote operation. The following alarms, indications, switches, push buttons, audio signal etc. shall be provided.

i) System Oil.
ii) TCIV open.
iii) Oil drain valve closed.
iv) Gas inlet valve closed
v) TCIV closed
vi) Detector trip
vii) Buchholz relay trip

viii) Oil drain valve open
ix) Extinction in progress
x) Differential relay trip
xi) PRV / RPRR trip
xii) Transformer / reactor trip
xiii) System out of service
xiv) Fault in cable connecting fault detector
xv) Fault in cable connecting differential relay
xvi) Fault in cable connecting Buchholz relay
xvii) Fault in cable connecting PRV / RPRR
xviii) Fault in cable connecting transformer trip
xix) Fault in cable connecting TCIV
xx) Auto / Manual / Off
xxi) Extinction release on / off
xxii) Lamp test
xxiii) Visual / Audio alarm for AC supply fail
xxiv) Visual / Audio alarm for DC supply fail

3.4.2. As far as possible the control box should be such devised that all the transformers or group thereof should be controlled from single spot.

3.5 **Transformer Conservator Isolation Valve:**

Transformer conservator isolation valve (TCIV) to be fitted in the conservator pipe line, between conservator and buchholz relay which shall operate for isolating the conservator during abnormal flow of oil due to rupture / explosion of tank or bursting of bushing. The valve shall not isolate conservator during normal flow of oil during filtration or filling or refilling, locking plates to be provided with handle for pad locking. It shall have proximity switch for remote alarm indication with visual position indicator. The TCIV should be of the best quality as malfunctioning of TCIV could lead to serious consequence. The closing of TCIV means stoppage of breathing of transformer. Locking plates shall be provided for pad locking.

3.6 **Detectors:**

The system shall be completing with adequate number of detectors (quartz bulb) fitted on the top cover of the transformer oil tank.

3.7 **Signal box:**

It shall be mounted away from transformer main tank, preferably near the transformer marshalling box, for terminating cable connections from TCIV &

detectors and for further connection to be control box. The degree of protection shall be IP55.

3.8 **Cables:**

3.8.1 Fire survival cables (capable to withstand 750º C.) of 4 core x 1.5 sq. mm size for connection of detectors in parallel shall be used. The fire survival cable shall conform to BS 7629-1, BS 8434-1, BS 7629-1 and BS 5839-1, BS EN 50267-2-1 or relevant Indian standards. 3.8.2 Fire Retardant Low Smoke (FRLS) cable of adequate size shall be used for connection of signal box / marshalling box near transformer and FEC mounted near transformer with control box mounted in control room. Fire Retardant Low Smoke (FRLS) cable of 4 core x 1.5 sq. mm size shall be used for connection between control box to DC & AC supply source, FEC to AC supply source, signal box / marshalling box to transformer conservator isolation valve connection on transformer. Separate cables for AC supply & DC supply shall be used.

3.9 **Pipes:**

Pipes complete with connections, flanges, bends and tees etc. shall be supplied along with the system.

3.10 Construction of oil drain soak pit with capacity to store at least 1000ltrs of oil shall be included in the said scheme .This oil drain pit should be connected with oil drain pipe from the power transformer. An arrangement may be made so that the drained oil may be able to pump back to the oil filtering units or to empty container/barrels and for which, all connected pipes, joints and flanges etc with centrifugal pump of required rating shall be fitted and fixed.

4.0 OTHER ITEMS TO BE SUPPLIED

(a) Oil drain and nitrogen injection openings with gate valves on transformer tank at suitable locations.
(b) Flanges between Buchholz relay and conservator tank for fixing TCIV.
(c) Detector brackets on transformer / reactor tank top cover.
(d) Spare potential free contacts activating the system i.e. in differential relay, Bucholz relay, Pressure Relief Device / RPRR, Circuit breaker of transformer.
(e) Pipe connections between transformer and FEC and between FEC and oil pit required for collecting top oil.
(f) Cabling for detectors mounted on transformer top cover.
(g) Inter cabling between signal box, control box and FEC.
(h) Butterfly valves / Gate valves on oil drain pipe and nitrogen injection pipe which should be able to withstand full vacuum.
(i) Supports, signal box etc. which are to be painted with enameled paint.
(j) Any other item required for satisfactory operation of system.

5.0 POWER SUPPLY

For Control Box 110 V DC; For FEC Auxiliary 230 V AC

6.0 SPARES FOR THREE (3) YEARS OPERATION & MAINTENANCE

The bidder apart from the below mentioned spares shall submit a list of recommendation spares for three years trouble free operation of the equipment and also furnish unit rates. The owners will scrutinize the said list and decide on the items on spares to be ordered and the quantities. These spares shall be supplied by the contractor before end of guarantee period. The owner reserves right to order the spares with six (6) months from the date of order for main equipment and the rate shall be kept valid till this date. The prices of these spares shall not be considered for evaluation of the bid.

7.0 MANDATORY SPARES

i) Cylinder filled with Nitrogen of required Capacity per substation. - 1 No.
ii) Detectors per transformer - 3 Nos.
iii) Regulator assembly per sub-station - 1 No.

8.0 MODIFICATION ON THE TRANSFORMER

a) Oil drain opening with pipe flange and manual gate valve at about 120mm below the top cover.
b) Nitrogen injection openings with suitable size of pipe with flange and manual gate valve on tank sides at about 50-200mm from the bottom plate.
c) Flanges on conservator pipe between buchholz relay and conservator tank for fixing PNRV/POBV.
d) Provision for temperature and pressure sensors if required.
e) Supply and welding of fire detector bracket on top cover.
f) Supply and welding of brackets for fixing signal box at a suitable location on top cover or tank side wall.

Bidder shall confirm adequacy of the above arrangements on transformer. Any other requirement shall be brought out clearly in the bid itself. Bidder shall also clearly indicate the sizes of various openings and valves mentioned above**. No modification on the transformer shall be allowed which affects its performance (i.e. efficiency, losses, heat dissipation ability etc.) safety, life etc. or it's any other useful parameter.** This requirement shall be paramount importance and shall form the essence of the contract. However, in any case, performance of transformer should not be affected in any manner by having Nitrogen Injection Fire Prevention Cum Extinguishing System (NIFPES) and the Contractor / Sub- Contractor shall give

an undertaking to this effect. All pipes should be washed / rinsed with transformer oil. **If any damage is done to the transformer and / or any connected Cable during installation & commissioning full recovery therefore shall be affected from the Contractor / Sub-Contractor, of NIFPES system**. **It shall be solely the responsibility of Contractor / Sub-Contractor to install, carry out pre-commissioning tests & commission NIFPES at the mentioned Sub-Station in this specification, to the entire satisfaction of the P&E Deptt. Mizoram.**

9.0 INTERLOCKS

It shall be ensured that once the NIFPES gets activated manually or in auto mode, all the connected breakers shall not close until the system is actually put in OFF mode. Also PRV shall get closed only if all the connected breakers are open.

10.0 TESTS

10.1 Contractor has to carry out the type test as per relevant IS/IEC. Specifically IP 55 on FEC or have to produce the report from NABL approved Lab. Reports of all routine test conducted as per relevant IS/IEC standards in respect of various bought out items including test reports for degree of protection for FEC / control box / signal box shall be submitted by the supplier.

10.2 The supplier shall demonstrate all the functional test associated with the following as Factory Acceptance Tests:

- FEC, Control Box
- Fire Detector
- Transformer Conservator Isolation Valve

10.3 The performance test of the complete system shall be carried out after erection of the system with transformer at site.

11.0. GUARANTEED TECHNICAL PARTICULARS

11.1. The Guaranteed Technical Particulars of the various items shall be furnished by the Bidders in the prescribed format furnished under vol. III of this tender document. The Bidder shall also furnish any other information's as in their opinion is needed to give full description and details to judge the item(s) offered by them.