TENDER DOCUMENT
TENDER No.: NRO / CON / 592 / 537

FOR

SUPPLY & INSTALLATION

OF

DG Sets & Synchronising Panel

FOR

for multistoreyed Boy’s Hostel

SARDAR VALLABHBHAII NATIONAL INSTITUTE
OF TECHNOLOGY, SURAT, (SVNIT)

VOLUME – II B

TECHNICAL SPECIFICATIONS

EXECUTING AGENCY

ENGINEERING PROJECTS (INDIA) LIMITED
(A GOVT. OF INDIA ENTERPRISE)

Core-3, Scope Complex, 7,

Lodhi Road, New Delhi-110003

TEL NO: 011-24361666, 24366226 FAX NO. 011- 24363426
SCOPE OF WORK
SCOPE OF WORK

1. SCOPE OF WORK

In general the works to be performed under this contract shall comprise of the following:

1. Design, Supply, inspection, Transportation to site, storage, installation, testing & commissioning of under mentioned equipments / system.
   A. DG Set & Accessories, synchronizing panels
   B. Earthing system
   C. LT Power and Control Cables
   D. Safety Equipments

   Item wise schedule of quantity (SOQ) are indicated based on which work shall be executed. Any equipment, material, component, accessories not specifically mentioned in BOQ and technical specification but necessary for satisfactory installation and trouble free operational and maintenance of the equipment / system adopting good engineering practice shall be included in the scope of contractor without any price implication.

2. Providing complete design, engineering data, detailed drawings, schemes, commissioning procedure, O&M manuals, catalogue etc. based on SOQ/Site requirement Supply, installation, testing & commissioning of complete DG system as per approved drawings.

3. Execution of works shall be as per tender conditions & technical specification, relevant IS & code of practice in conformity with the Indian Electricity Act, 1910 and the Indian Electricity rules 2005 amended up to date, CPWD specifications for Electrical works Part - I (internal) 2005, Part -II (External) 1994, Part IV (sub station work) as amended up to date of receipt of tender, GSEB requirement and requirements of the Local Electricity supply authority and other regulations and safety codes in the locality where the equipment will be installed.

4. Ensuring interlocking/integration/interconnection among various equipments/system, safety as per requirements.

5. All Statutory approvals / license for the equipment(s) / system(s) have to be obtained by the contractor as needed including approval of relevant drawings from the electrical inspectorate of GSEB, Govt. / competent authority & approval of the entire installation, after completion of work as per the approved drawings.

6. Effective co-ordination with the other agencies to carry out the work smoothly.

7. Proper handing over of the installations in satisfactory working conditions along with required as built drawings, documents, and items as specified in the tender.

8. The work shall also include all incidental job connected with the installation of equipments.

9. All electrical equipment except battery shall be designed considering 45° C as ambient temperature. Battery shall be designed considering minimum ambient temperature (5°C). Where equipment are installed outside and exposed to direct sun-rays, rigorous weather conditions under which they are required to operate shall be taken into consideration.

10. Civil works for, DG set foundations. (Foundation drg. for all the items is to be provided by contractor after award of work) shall be done by other agency

11. Coordination with DG Panel supplier for control schemes of incomers of LT switchgear for auto load transfer of DG sets and synchronizing panel through PLC.

12. Termination LT cables at LT panels
13. Cable trenches in outdoor area for power & control cables shall be done by other agency. Details of these trenches to be provided by contractor.

3. TECHNICAL SPECIFICATIONS AND STANDARDS

All equipment and systems shall comply in all respects with the requirements of the latest editions of the relevant codes and Indian Standard. The technical specifications for the items to be executed are enclosed. Items which are not covered under the technical specifications, shall be executed as per latest IS/IE rules.

4. SITE CONDITIONS :

Max. ambient temp -- 45°C  
Min. ambient temp -- 5°C  
Max. R.H. -- 90%  
Min R.H. -- 30%

5. POWER SUPPLY :

a) LT supply 415, 3-phase, 4 wire, 50Hz, effectively earthed.  
Fault level 50 KA for 1sec.

b) Control supply 240V 1-phase, 2 wire, 50Hz effectively earthed.

6. INSPECTION OF SITE :

The contractor shall inspect and examine the site and its surrounding and shall satisfy as to the nature of the ground and sub soil, the quantities and nature of work, materials necessary for completion of the work and their availability, means of access to site and in general shall himself obtain all necessary information as to risks, contingencies and other circumstances which may influence or affect his offer. No extra claim consequent on any misunderstanding or otherwise shall be allowed.

7. PRICES :

Price shall be Inclusive of all taxes & duties, what so ever including excise duty, sales tax, VAT, service tax, octroi (if any), work contract tax, labour, tools & plants, packing, freight/ transportation & insurance up to the site, loading, unloading, fee (s) for testing, license, inspection, documents, etc, where applicable.

Prices shall be firm through out the contract period.

8. SOQ QUANTITIES :

The quantities given in the tender BOQ are tentative and may vary as per the site requirements. Only required items & quantities are to be supplied/ installed. The rate shall remain valid for any variations in the estimated quantities given in price bid. Contractor shall take detailed site measurements, for the items like Supply of LT cables, Earth strips etc., before placing purchase order-taking procurement action.

9. MAKES :

- In general, make of various items shall be as per the approved list enclosed. Where makes have not been indicated in the list, they shall be of ISI marked.

- Sample of the items or makes or the items for manufacture/ supply/ use in the work irrespective of appearing in the approved list shall be got approved from Engineer- in-charge before incorporation.
10. NEW MATERIALS:
All equipment, materials used in the work shall be brand new and free from manufacturing defects.

11. REPLACEMENT OF DEFECTIVE/ DAMAGED ITEMS
All defective/damaged items shall be replaced with the good ones without any extra cost.

13. TOOLS & PLANTS:
- All required tools & plants required for executing this work shall be arranged by the contractor

14. MAN POWER:
- Authorized, experienced, competent work force shall be deployed with competent supervision.
- They should possess requisite qualifications/ valid permits/ license/ competency certificates to work on LT Electrical Installations.
- The Electrical Engineer shall have minimum qualification of degree in electrical engineering. Whereas Electrical Supervisor shall have minimum qualification of diploma in electrical engineering and technicians shall have minimum ITI.

15. QUALITY OF WORK & WORKMANSHIP:
The quality of work, workmanship, finishing etc should be satisfactory to SVNIT/EPI.

16. REVIEW MEETINGS/ SITE INSPECTIONS:
As and when required contractor shall attend the review meetings and take necessary actions with regard to the pending works, targets, co-ordination with other agencies.
Senior/ competent officials/ engineers who can take decisions and implement from the contractor side to take stock of the situation and do the needful shall also make regular site inspections.

17. PRIOR APPROVAL OF DESPATCH SCHEDULE:
Dispatch schedules are to be informed and got approved, from Engineer in charge, before dispatch of materials.

18. TESTING AND INSPECTION:
- All equipment/systems to be supplied shall conform to type tests as per relevant standards. The Bidder/contractor shall furnish the reports of all the type tests carried out within five years of date of bid opening. These reports should be for the tests conducted on identical/similar components/equipment/systems to those offered/proposed to be supplied under this contract. In case contractor is not able to submit report of type test conducted in last five years or in case type test reports are not found to be meeting the specifications/relevant standard requirement then all such tests shall be conducted under this contract by the contractor free of cost to owner and reports shall be submitted for approval.

- At least 15 days advance notice to be given for factory inspection by purchasing officials. While inspection call is given, the actual status and details of test offered shall be communicated. Relevant Indian Standards shall be made available.

- If any equipment/material fails in the tests conducted during factory inspection, necessary rework/replacement shall be done and equipment shall be re-offered for inspection without any cost to owner.
19. **DRAWING & DOCUMENTATION TO BE SUBMITTED WITH BID**

Following information and documentations in addition to what has been asked for in respective equipment specification shall be furnished by the bidder:

- Complete SLD for the installation with metering and protection scheme.
- Filled-in guaranteed Technical Particulars, catalogue & literature for various equipment.
- Performance certificate of all major equipment.
- Type test certificate of all major equipment.
- GA drawings of all major equipment.
- Time frame of major activities including Bar chart.

23. **DRAWING & DOCUMENTATION TO BE SUBMITTED BY SUCCESSFUL BIDDER AFTER AWARD OF CONTRACT**

Following information and documentations in addition to what has been asked for in respective equipment specification shall be furnished by the successful bidder after award of contract for approval/reference/record of the SVNIT/EPI.

- Electrical layout drawing showing location of equipment, cable routing, cable trays, cable trenches, DG room layout, exhaust system, ventilation etc - Plan & Elevation drawing including sectional details.
- Single Line Diagram showing rating of components, metering and protection for DG Panel
- Earthing layout.
- Power & Control cable schedule.
- Wiring Diagram, Control schemes.
- Write-up on control philosophy for complete electrical system containing starting & stopping sequence, interlocks, metering, annunciation etc for DG sets.
- Civil foundation and structural drawing of all indoor/outdoor Installation.
- Contractor’s drawings of all electrical equipment under the scope of contract.
- All required drawings/documents/technical information required during various stages of works shall be submitted by the contractor as and when required by the SVNIT/EPI.
- All drawings submitted by the Vendor/equipment Contractor shall be in sufficient detail to indicate the type, size, general arrangement & foundation drawing, weight, the external connections, fixing arrangement required, the dimensions required for installation and interconnections with other equipment and materials, clearances and space required between various portions of equipment and any other information specifically requested.
- The above document shall be furnished in 4 sets to SVNIT/EPI and one set shall be returned with comments and approval.
24. **TOOLS & TACKLES:**

Wherever special tools & tackles are required for operation & maintenance of units/systems, the contractor supplying the equipment shall provide the same free of cost.

25. **STATUTORY LAWS/RULES/APPROVALS/LICENSE:**

The contractor/agency shall abide by the relevant statutory rules, laws, and guidelines and arrange for the approvals, if any required. That include adhering to labour laws, abiding local electricity rules etc.

Wherever formal approvals/license are essential like CEA approval, clearance by the Electrical inspectorate etc., the same shall be arranged by the contactor.

26. **FEES FOR TESTING/CALIBRATION/APPROVALS/LICENSE:**

Unless otherwise specified, the fees/charges involved for this purpose shall be borne by the contractor.

27. **SITE TESTS/ PERFORMANCE TESTS:**

Necessary site tests/ performance tests shall be conducted on the equipment to ascertain the functional / design/ site requirements. Reports shall be prepared recording the various values, parameters, observations, settings made etc. In case of unsatisfactory results, the same shall be replaced/ rectified as per the requirement without any extra cost.

28. **HANDING OVER/ CERTIFIED DATE OF COMPLETION:**

Up on the satisfactory commissioning of the entire system, the system shall be observed for 15 days. After this satisfactory trial period, the work shall be handed over officially and completion date recorded by Engineer-in-charge with all the prescribed formalities for handing over. This date shall be reckoned, as the certified date of completion and the defects liability period shall commence from this date.

Until the handing over of the installation, the responsibility lies with the contractor for safety, upkeep etc.

29. **COMPLETION PLANS:**

On completion of work, the contractor shall submit 5 sets of following as built drawings/documents.

- General Arrangements, Layout drawings with dimensions, plans, sections etc
- Single Line diagrams
- Control & Schematic Diagrams.
- Bill of Quantities indicating makes, Technical specs, quantity etc.
- Data Sheets
- Control logic (where applicable)
- Details of Inventory
- Equipment name plate details
- Instruction / Maintenance Manuals
• Test Certificates (Factory Tests, sites Test)
• Guarantee/ warranty Certificates (where applicable)
• Other documents/ drawings as per the instructions of Engineer-in-Charge.
• Keys, operating handles, tools etc as applicable

30  DEFECTS LIABILITY PERIOD:

Defects liability period shall be 12 months from the certified date of satisfactory completion & handing over of entire work to Engineer-in-charge of work.

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TECHNICAL SPECIFICATIONS
FOR DG SET
PREAMBLE:

The scope of work includes supply & installation of DG set mounted inside acoustic enclosure and associated works.

GENERAL

1.0 This specification covers the turnkey installation of 2X 630 KVA diesel generating system covering the diesel engine, alternator, engine control panel, associated accessories, cooling system, ventilation system, fuel and exhaust system, acoustic enclosure and switchgear etc.

The contractor shall assume full responsibility of co-ordinating the work with various sub-vendors and other contracting agencies at site and execute the work to the total satisfaction of the clients and statutory agencies.

2.0 SITE CONDITIONS:

Temperature

<table>
<thead>
<tr>
<th>Maximum</th>
<th>Minimum</th>
</tr>
</thead>
<tbody>
<tr>
<td>45 deg. C</td>
<td>3 deg C</td>
</tr>
</tbody>
</table>

3.0 ELECTRICAL SUPPLY SPECIFICATIONS :

 Nominal voltage : 415V + 10%
 No. of Phases : 3 + Neutral
 Frequency : 50 Hz + 3%
 Neutral earthing : Solidly Grounded.
 Control supply : 24V, 2-wire DC.

4.0 SCOPE OF WORK & EXCLUSIONS :

The scope of work shall include but not be limited to the supply, installation, testing and commissioning of the following items. The supplier shall study the requirements stipulated in the specification and also to suit the site conditions and offer a complete system with guaranteed performance under operating conditions specified.

415V, 3-phase + Neutral, 625 KVA 1500 RPM, DG set with accessories as specified.

Set mounted microprocessor based engine control panel

Radiator cooling system.

Exhaust piping including supports as per CPC norms
Thermal insulation for exhaust piping.

Exhaust stacks with steel supporting system for these sets.

Fuel piping.

Integral Acoustic enclosure.

Switchgear panel as specified

Obtaining approval of the installation from pollution control board and all other statutory authorities.

Preparation of related schematic and GA drawings for DG installation exhausts piping, fuel piping, ventilation system, acoustic enclosure, etc.

Co-ordination with other agencies to ensure timely completion.

Obtaining Diesel Engine manufacturer's approval of the installation with specific emphasis on alignment, exhaust & fuel piping and ventilation before commissioning.

Testing and commissioning of the installation.

House keeping during the installation work and removal of debris & unwanted materials on day to day basis and clearing the site on completion.

Any related work covering supply of installation materials, consumables, etc. whether specified or not, to render the system fully functional and conforming to the best engineering standards. This shall include battery charging.

**DIESEL ENGINE & ACCESSORIES**

**ENGINE**

The diesel engines shall be of approved make, direct injection, four stroke, multi cylinder, water cooled, radiator type, turbo charged, operating at a nominal speed of 1500 R.P.M and capable of developing requisite BHP.

The engine and the governing system shall be suitable for AMF duty power generating application through PLC and shall conform to BS : 5514 / IS 3046 / BS 649 / IS 10002. The unit shall be suitable for operation on high speed diesel oil available in Indian Market.

The engine shall be electric start and shall be suitable for battery assisted manual / auto starting.

The governing system of the engine shall be electronic type and suitable to control frequency variation within + 3% whenever a load is switched in or thrown off.

The engine fitments shall include but not be limited to the following.
Flexible coupling and flywheel with guard.

Dry type air filter.

Cooling radiator.

Fuel pump.

Electronic governor.

Dual fuel filter with on line filter changing provision.

Lube oil pump, oil cooler and filter.

Turbo charger.

24V DC starter & battery charging alternator.

Engine mounted microprocessor based control panel to display the following engine and electrical parameters:

Lube oil pressure indicator and temperature gauge.

Tacho meter for speed indication with hour meter.

Battery charging Ammeter.

Starting switch with key.

Over speed stop switch with contacts.

Low lube oil pressure switch.

High water temperature alarm & trip

Stainless steel flexible for engine exhaust.

Stop solenoid.

Control cables from Engine to AMF screened cables.

The engine speed shall be regulated through an electronic governing system which shall also provide the over speed protection. The governor shall ensure that the speed of the set is regulated within 1% of the nominal speed under normal operating conditions.

The DG set shall be capable of handling step load upto 70% of the capacity without dropping other loads due to voltage dips. Further the engine shall be capable of taking full load within 10 seconds of starting.

All moving parts of the engine and other associated equipment shall be provided with guards to prevent accidental contact. The guard shall be designed to facilitate easy removal and reinstallation.
The engine supplied with first filling of oil of required quantity as recommended by the manufacturers.

ACCESSORIES

The following accessories shall be supplied with the DG set.

Common base frame for the engine and alternator.

Antivibration mounts of requisite capacity (Dunlop series S make)

Residential Silencer.

Protective guards for all rotating parts.

Electric driven lube oil priming pump complete with hosepipes and couplers.

Diesel tank of 990 Ltrs. Capacity fabricated out of 6mm thick sheet steel including first filling of diesel. The tank shall be further complete with overflow pipe, drain pipe, fuel level indicator, valves, manhole with cover, low level contact & alarm.

Batteries

The batteries shall be of heavy duty, high performance lead acid type of Exide make. Each battery shall be rated 12V, 180 AH.

Battery shall be suitable for six successive starting attempts each of 10 seconds duration with a gap of 5 seconds between successive starts.

The battery shall be supplied complete with electrolyte and accessories. The accessories shall include battery stand, battery leads with terminal ends acrylic top cover and inter battery connectors.

Each battery is provided with a charger to charge the batteries when the set is not running. The charger shall get disconnected while the generator set is running.

Control Panel:

Each set shall be supplied with an engine mounted Microprocessor based control panel. The control panel shall display all the engine, alternator & battery parameters. It shall not only display faults but also keep a record of faults. An emergency stop push button will be provided to stop the DG during emergency. For Engine faults, the set will be stopped in emergency mode & for electrical faults it shall be stopped with a time delay for cooling down. An audible alarm shall be provided in the main panel to announce tripping of DG’s.

j. Alarms

The following alarms shall be provided in the DG control Panel to indicate & protect against abnormal operations.
<table>
<thead>
<tr>
<th>Condition</th>
<th>Status</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Oil Pressure</td>
<td>2 stage Alarm</td>
<td>Engine Stop</td>
</tr>
<tr>
<td>High Water Temperature</td>
<td>2 stage Alarm</td>
<td>Engine Stop</td>
</tr>
<tr>
<td>Over Speed</td>
<td>Alarm</td>
<td>Engine Stop</td>
</tr>
<tr>
<td>Low Fuel Level.</td>
<td>Day tank Alarm</td>
<td>Engine Stop</td>
</tr>
<tr>
<td>High Fuel Level.</td>
<td>Day tank Alarm</td>
<td>Engine Stop</td>
</tr>
<tr>
<td>Earth fault on Alternator</td>
<td>Alarm</td>
<td>Engine Stop</td>
</tr>
<tr>
<td>Fail to start</td>
<td>Alarm</td>
<td>Engine Stop</td>
</tr>
<tr>
<td>Battery charger fault</td>
<td>Alarm</td>
<td>Engine Stop</td>
</tr>
</tbody>
</table>

**k. Automatic Mains Failure:**

On receiving signal from voltage monitor relay (shall be supplied by the DG vendor to the panel builder) provided in the EB incomer panel for low voltage, power failure or phase failure, the set shall start & on developing the voltage the respective DG breaker shall close & start feeding loads. On resumption of EB power the voltage monitor will monitor the voltage for a preset time (3-10 min) & then trip the DG breakers & subsequently close the EB breaker. Necessary control wiring between the DG Control Panel & the DG breakers in the DG panel shall be in the scope of work of the DG vendor.

**ALTERNATOR**

1500 RPM, 415V, 3-Phase, 625 KVA, star connected, 50 Hz, 0.8 P.F, horizontal foot mounted, double bearing, self excited, self-regulated, brushless, screen protected drip proof, continuous duty alternator with class “H” insulation in IP-23 enclosure incorporating the following.

- Voltage Regulation ±1.0% of rated voltage from no load to full load.
- Self excited and self regulated.
- Permissible Overload: 10% for one hour in 12 hours of duration.
- Separately mounted adapter box suitable for cable termination of required size armoured Aluminium frls XLPE cable between alternator terminals and adapter box (2 runs of 630 sq. mm cable per phase).

6.1 The alternator shall further meet the following specifications.

- The alternator shall conform to IS 4722 / IEC 34 as amended upto date.
- The alternator shall be suitable for 20% over speed for two minutes.
- The alternator shall be capable of carrying 50% overload for a duration of one minute.
The alternator shall be capable of carrying 10% overloading for one hour in any period of 12 hrs running.

The alternator terminal voltage for any load variation should be maintained within ±5%.

The field coil terminals shall be wired to terminal box for external speed control.

Both ends of each phase winding shall be brought to the terminal box.

The alternator shall withstand a 3-phase short circuit at the terminals for a period of 3 seconds.

The total harmonic distortion shall not exceed 3% and the design shall permit upto 30% unbalance between phases while in operation.

**Performance:**

With the integral acoustic enclosure, the sound pressure levels when measured at a distance of 1mtr outside the DG enclosure louvers shall be not more than 70 dB (A) under free field conditions.

**7.4 Dimensions:**

The overall dimensions of the enclosure shall be such as to provide free movement all round the DG set inside the enclosure. Two sliding doors of adequate size shall be provided on either side of the DG set to facilitate easy inspection and carry out maintenance works.

**8.0 PIPING & ACCESSORIES:**

The piping shall be of Class “B” M.S pipe

All accessories such as strainer, isolating valves, non-return valves etc. shall be supplied as required based on approved piping layout drawings.

The piping schematic shall be submitted with the bid. Which should include supply, over flow return from engine & drain pipes.

The piping shall be painted with one coat of primer and two coats of finishing paint of approved color.

One number manual gear pump for filling the day tank shall be supplied per DG.

**9.0 Spares:**

The DG set will be supplied with the following spares, which shall be handed over at the time of commissioning.

2 sets of renewable parts of oil, fuel & air filters.
2 Nos. fan belts.
5 Nos. spare fuses of each type & size used.
2 spare relays of each type.
2 sets of fuel injectors.
1 No. Manual gear pump

11.0 INSTALLATION:

The bidder shall undertake the installation work at site. The general scope of installation work shall include but not be limited to the following.

11.1 DIESEL GENERATOR SET:

The assembled Diesel Generator set shall be installed in the container on anti-vibration mounts. The unit shall be visually inspected for any transit damage.

The contractor shall arrange for the inspection of the set by the diesel engine manufacturer’s authorized representative and obtain his approval before rolling the set.

The fuel oil day tank shall be installed over the drip tray
The batteries shall be fully charged, installed and connected.

The battery charger shall be heavy duty.

11.2 FUEL PIPING:

The fuel piping shall include supply and installation of Class “B” MS pipes of adequate size with necessary valves and accessories required for the supply & return lines from day tank to the engines. The pipes shall be painted with primer over which 2 coats approved colour paint shall be applied.

The joints in the line shall be properly sealed to avoid any leakage of fuel.

11.3 EXHAUST PIPING

The exhaust piping shall be fabricated from MS pipes.

The exhaust piping and the silencers shall be insulated using 50mm thick mineral wool inside the container & upto the exhaust stack. The insulation shall be cladded with 24G aluminium sheet.

The exhaust pipe shall be supported using spring suspension supports.
The shipping sections of the stack shall be welded at site and erected over the MS framework. The entire length including the flanges, bolts and washers shall be aluminised inside and outside to inhibit corrosion. A weather cowl shall be provided on top.

All tools and tackles used for the erection shall have valid safety certification.

12.0 TESTING:

12.1 AT MANUFACTURER’S WORKS

The routine tests and full load test on Engine, Alternator shall be carried out at manufacturer’s work in accordance with applicable Indian standards in the presence of SNVIT/EPI representative.

12.2 TESTING AT ‘OEA’s WORKS

Following tests shall be conducted at the assembler’s work in the presence of client’s representatives.

- Full load testing for 8 hours with load bank.
- Overload testing at 10% overload for one hour immediately after the full load test.
- Operation of protective devices.

12.3 SITE TESTING

Following tests shall be conducted at site in the presence of the client’s representative before energisation. The contractor shall provide all testing equipment, labour and consumables required for the testing.

Checking the alignment by engine manufacturer’s representative and obtaining approval.

Insulation resistance test on alternator, control panel and cabling.

Checking the AMF operation both on auto and manual mode through PLC and synchronization.

Checking the engine safeties for satisfactory operation.

Checking vibration levels.

Testing of individual protective devices on engine and alternator and ensuring that the wiring is carried out properly.

Full load running for 8 hours continuously. All the readings shall be logged to evaluate the fuel consumption, lube oil pressure, water & oil temperature vis-à-vis the electrical load.

One hour overload testing at 110% load shall be carried out at the end of the full load trial.
The noise level at 1m from the enclosure and the temperature rise inside the enclosure shall be measured.

Any deviation from the guaranteed parameters shall be made good and these performance parameters should be measured once again till the required results are achieved.

The DG set shall be deemed to be commissioned after satisfactory performance of all associated equipment.

13.0 TAKING OVER

The clients will take over the DG set for operation on completion of the following.

DG set are installed, tested and commissioned as per the specifications.

Original test certificates are furnished for engine, alternator, acoustic enclosure, centrifuge and all other bought out items.

Load trials are successfully conducted including the performance of acoustic enclosure and ventilation fans.

Approvals are obtained from Pollution Control Board and Electrical Inspectorate.

6 sets of AS BUILT documentation, spare parts list, maintenance chart and operation and maintenance manual are to be submitted.

The set shall be handed over with first fill of lube oil and day tanks full of diesel oil along with spares mentioned.

14.0 GUARANTEE

14.1 DG SET

The DG set and accessories shall be guaranteed for satisfactory operation for a period of 12 months from the date of commissioning or 5000 running hours from the date of supply whichever is earlier. Any defects noticed during this period shall be rectified free of cost.

The supplier shall indicate the type of records to be maintained so that the warranty claims if any are honoured by the manufacturer.

The design and installation of acoustic treatment shall ensure that the noise level at 1m from the DG Room at any point shall not exceed 70dBA while operating the set at rated load.

15.0 MAINTENANCE

15.1 The bidder shall be required to maintain the installation at no extra cost to the owner for a period of year from the date of commissioning. During this period, the contractor shall make good any defects caused due to faulty design, bad workmanship and poor quality of materials.
The response time for any break down call shall not be more than 2 hours.

During the guarantee period, the bidder shall carry out regular servicing of the unit at regular interval as recommended by the manufacturer. The consumables required for this will be made available by the clients.

16.0 DOCUMENTATION

As a part of the equipment supply, following documentation shall be furnished.

General arrangement plan of DG set.

Piping schematic diagram

Layout of fuel and exhaust piping.

Layout and constructional details of acoustic treatment.

Calculations for ventilation system design.

Engine wiring diagram.

Test certificate for engine and alternator.

Installation, operation and maintenance instructions for diesel engine, alternator.

Spare parts list.

Approval from Pollution Control Board / local authority
TECHNICAL SPECIFICATION FOR AMF PANEL / SYNCHRONISING PANEL

The panels shall be metal clad, totally enclosed, rigid, floor mounting, air insulated, cubical type for use on 415 volts, 3 phase, 4 Wire 50 cycles system. The equipment shall be designed for operation in high ambient temperature and high humidity tropical atmospheric conditions. Means shall be provided to facilitate ease of inspection, cleaning and repairs, for use in installations where continuity of operation is of prime importance. Panel shall be fabricated from 2 mm thick CRCA sheet steel Gland Plates shall be from 3 mm thick sheet steel. Degree of Protection shall be IP 54

The panel shall consist of the following:

Panel shall be operated with 4 modes of operation

1) Auto
2) Semi auto
3) Manual
4) OFF

In Auto mode operation, load sharing, synchronizing shall be done through / PLC. Master DG selected shall start first and then if load is increased on set limit, the second DG shall start after synchronizing.

In Semi manual mode of operation, DG selected shall start automatically. However synchronizing shall be done manually.

In Manual mode, DG set selected shall start manually and synchronizing shall be done manually

In OFF operation, No DG will Run.

Each DG AMF Panel shall be provided with the following

- Earth Fault Relay Micro Processor based type
- Mains supply failure monitor (3 phase voltage sensing)
- Supply failure timer
- Restoration timer
- 3 impulse automatic engine start / stop & failure to start lock out
- Generator Voltage, current & Frequency sensing – RPM indication
- Battery voltage sensing
- Selector switches & push buttons:
  - Manual / Auto / Test Selector switch
  - Generator START / STOP
  - Generator Breaker Close / Trip; Mains Breaker Close / Trip
- Indications:
  - DG ON, DG Breaker ON; Mains Breaker On; Mains ON
- Metering:
Combined digital meter to measure Volts; Amps; Frequency
Combined digital meter for kVA, kW, PF
Digital display type kWH meter
e) **SOLID STATE ANNUNCIATOR SHALL BE PROVIDED WITH THE FOLLOWING FAULTS**

<table>
<thead>
<tr>
<th>FAULTS</th>
<th>ALARM</th>
<th>TRIP</th>
<th>ANN.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Set fails to start</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Low lube oil pressure</td>
<td>✔</td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td>High water temp</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>DG overload</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Earth fault</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
</tbody>
</table>

Battery charger shall consisting of:
SMPS based automatic battery charger with DC Voltmeter; DC Ammeter
Selector switch for trickle/off/boost, auto/manual switch for boost to float changeover

copper bus bar

1.3 The equipment shall be designed to confirm to the requirements of:

IS 4237 - General requirements for switchgear and control gears for voltages not exceeding 1100 volts.

IS 2147 - Degree of protection provided by enclosures for low voltages switchgear and control gear.

IS 375 - Marking and arrangements of busbars. Individual equipment housed in the power control to the following IS specifications:

i) Air / Moulded case circuit breakers - IS 2516 (Part I & II/Sec.1) 1977
ii) Fuse switch and switch fuse units - IS 4064 : 1978.
iv) Current Transformer - IS 2705.
v) Voltage Transformer - IS 3156.
vi) Relays - IS 3231.
vii) Indicating Instruments - IS 1248.
viii) Integrating Instruments - IS 711.
ix) Control Switches and push buttons - IS 6875.
Auxiliary contractors - IS 2959.

1.4 **CONSTRUCTIONS:**

The panels shall be:

Of the metal enclosed, indoor, floor mounted, free standing type.
It shall be made up of the requisite vertical section.

Provide dust and dump protection, the degree of protection being IP 54.

It shall be readily extensible on both sides by the addition of vertical sections after removal of the end covers. Each vertical section shall comprise:
i) A front framed structure rolled / folded sheet steel channel section of minimum 3mm thick, rigidly bolted together. This structure shall house the components contributing to the major height of the equipment, such as circuit breaker cassettes, fuse switch units, main horizontal bus bars, vertical risers and other front mounted accessories.

ii) The structure shall be mounted on a rigid base frame of folded sheet steel of minimum 3mm thick and 100mm height. The design shall ensure that the weight of the components is adequately supported without deformation or loss of alignment during transit or during operation.

iii) A cable chamber shall house the cable end connections of power / control cable termination. The design shall be to ensure generous availability of space for easy installation and maintenance of cabling, and adequate safety for making in one vertical section without coming into accidental contact with live parts in and adjacent sections.

iv) A cover plate at the top of the vertical section, provided with a ventilating hood where necessary. Any aperture for ventilation shall be covered with a perforated sheet having less than 1mm diameter perforated to prevent entry of vermin.

v) Front and rear doors shall be fitted with nuts/bolts including neoprene gaskets with fasteners designed to ensure proper compression of the gaskets. When covers are provided in place of doors, generous overlap shall be assured between sheet surfaces with closely space fasteners to preclude the entry of dust. The height of the panel should not be more than 2400mm. The maximum height of any operating mechanism shall not be more than 2100mm. The total depth should be adequate to cater for proper cabling space.

vi) Doors and covers shall be of minimum 14 gauge sheet steel. All sheet steel work forming the exteriors or switchboards shall be smoothly finished, leveled and free from flaws. The corners should be rounded. The apparatus and circuits in the power control panels shall be so arranged as to facilitate their operation and maintenance and at the same time to ensure the necessary degree of safety.

Apparatus forming part of the power control panels shall have the following minimum clearances:

i) Between phases - 25 mm
ii) Between phases and neutral - 25 mm
iii) Between phases and earth - 25 mm
iv) Between neutral and earth - 25 mm

If for any reason, the above clearances are not available, suitable insulation shall be provided. Clearance shall be maintained during normal services conditions.

Creepage distances shall comply to those specified in relevant standards. All insulating materials used in the construction of the equipment shall be arranged in multi-tier formation, except that not more than two air circuit breakers shall be housed in a single vertical section. Metallic / insulated barriers shall be provided within vertical sections and between adjacent sections to ensure prevention of accidental contact with:

i) Main bus bars and vertical risers during operation, inspection or maintenance of functional units and front mounted accessories.

ii) Cable termination of one functional units, where working of those of adjacent unit / units.
All covers providing access to live power equipments / circuits shall be provided with tool operated fasteners to prevent unauthorized access. Provision shall be made for permanently earthing the frames and other metal parts of the switch gear by two independent connections.

1.4 METAL TREATMENT AND FINISH:

All steel work used in the construction of the switchboards should have undergone a rigorous metal treatment process as follows:

a) Effective cleaning by hot alkaline degreasing solution followed by cold water rinsing to remove traces of alkaline solution.

b) Picking in dilute sulfuric acids to remove oxide scales and rust formation, if any, followed by cold water rinsing to remove traces of acidic solution.

c) A recognized phosphating process to facilitate durable coating of the paint on the metal surfaces and also to prevent the spread of rusting in the event of paint film being mechanically damaged. This again, shall be followed by hot water rinsing to remove traces of phosphate solution.

Passivating in de-oxalite solution to retain and augment the effects of phosphating.

e) Drying with compressed air in a dust free atmosphere.

f) Primer coating, with two coats of highly corrosion resistant primer, applied wet on stove dried under strictly controlled conditions of temperature and time.

g) A finishing coat of stoving synthetic enamel paint to the specified shade of IS. The total thickness of paint should not be less than 25 microns.

1.5 BUS BARS

The bus bars shall be air insulated and made of high conductivity, electrolytic grade tinned Aluminium conductor. High tensile bolts and spring washers shall be provided at all bus bar joints.

The main phase bus bars shall have continuous current rating throughout the length of each power control panel, and the neutral busbars shall have a continuous rating of atleast 50% of the phase bus bars.

Bus bars shall be colour coded for easy identification of individual phases and neutral and protective earth.

CURRENT TRANSFORMER: Current transformer shall comply with the requirements of IS 2705. They shall have ratios, outputs and accuracy’s as specified / required.

INDICATING / INTERGRATING METERS: All indicating instruments shall be of flush mounting industrial pattern, conforming to the requirements of IS 1248. The instrument shall have non-reflecting dial, clearly divided and legibly marked scales and shall be provided with adjusting devices in the front.
CABLE TERMINATION: Cable entries and terminals shall be provided in the switch-board to suit the number, type and size of aluminum conductor, power cable and copper conductor control cable specified in the detailed specifications.

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

Barriers or shrouds shall be provided to permit safe working at the terminals of one circuit currents without accidentally touching that of another live circuit. Cabling risers shall be adequately supported to withstand the effects of rates short circuit currents without damage and without causing secondary faults. Cable sockets shall be of copper and of the crimping type as specified.

1.6 CONTROL WIRING:

1. All control wiring shall be carried out with 1100 / 660 V grade single core PVC cable conforming to IS 694 / IS 8130 having standard copper conductor of minimum 2.5 Sqmm section for potential circuits and 2.5 mm section for current transformer circuits. Wiring shall bear neatly bunched, adequately supported and properly routed to allow for easy access and maintenance.

Wire shall be identified by numbered ferrules at each end. The ferrules shall be of the ring and of non-deteriorating materials. They shall be firmly located on each wire so as to prevent free movement. All control circuit fuses shall be mounted in front of the panel and shall be easily accessible.

1.7 TERMINAL BLOCKS:

Terminal blocks shall be of 660 volts grade of finger touch proof type. Insulating barriers shall be provided between adjacent terminals.

1.8 LABELS:

Labels shall be on anodized aluminium, with white engraving on black background. They shall be properly secured with fasteners.

1.9 TESTS:

Routine tests shall be conducted on each power control panel in accordance with Cl 81, 2.2 of IS 8623 and shall comprise:

i) Inspections of the power and control circuits including inspection of wiring and electrical operational tests where necessary.

ii) Dielectric tests.

iii) Checking of protective measures and electrical continuity of the protective circuits.
1.10 ERECTION:

Switch boards shall be installed on suitable foundation. Foundation shall be per the dimensions supplied by the panel manufacturer. The foundation shall be flat and level. Suitable grouting holes shall be provided in the foundation. Suitable MS base channel shall be embedded in foundation on which the panel can be directly installed. The switch boards shall be properly aligned and bolted to the foundation by bottom plate or top plate as the case may be, by using brass Siemens type compression glands. The individual cables shall then be led through the panel to the required feeder compartments for necessary terminations. The cables shall be clamped to the supporting arrangements. The switch board earth bus shall be connected to the local earth grid.

1.11 PRE-COMMISSION TESTS:

Panels shall be commissioned only after the successful completion of the following tests. The tests shall be carried in the presence of architect's representative.

All main and auxiliary bus bar connections shall be checked and tightened.
All wiring terminations and bus bars joints shall be checked and tightened.
Wiring shall be checked to ensure that it is according to the drawings.
All wiring shall be tested for insulation resistance by a 1000 Volts Megger.
Phase rotation tests shall be conducted.
Suitable injection tests shall be applied to all the measuring instruments to establish the correctness and accuracy of calibration and working order.
All relay and protective devices shall be tested for correctness of settings and operation by introducing a current generator and ammeter in the circuit.
TECHNICAL SPECIFICATION FOR ACOUSTIC ENCLOSURE

1. **SCOPE OF SUPPLY:**

Supply of containerized type ACOUSTIC ENCLOSURE suitable for 1 No. 660 KVA DG set driven by radiator cooled diesel engine.

2. **DESCRIPTION:**

The acoustic enclosure shall be of free standing, floor mounting type integral with the DG set. The enclosure shall be provided with rugged heavy-duty structural steel base frame with chequered plate flooring on which the DG set is to be mounted. The enclosure shall be prefabricated factory-built and modular in construction, so that it can be easily assembled at site around the DG set. The enclosure shall consist of acoustically treated panels housed in rugged steel frames, which shall be bolted together to from the body of the enclosure. Sliding doors shall be provided, on either side, which shall also be acoustically treated, thereby providing easy access to the DG set while minimizing the operating space requirements. The construction of the acoustic enclosure shall be such that with both the acoustic doors open on the either side, full access is available to the engine and alternator. For fresh air inlet into the system a parallel baffle air inlet silencer shall be provided. Additionally, to augment the fresh air inlet requirements, a forced air ventilation duct with associated silencer shall be provided above the alternator. For hot air discharge, an acoustic discharge plenum shall be provided in front of the engine radiator, for discharge of hot air into the surroundings through a parallel baffle air outlet silencer. The enclosure shall have suitable openings in the roof module for exhaust piping.

3. **CONSTRUCTIONAL FEATURES :**

The construction and design of the Acoustic enclosure shall be very rugged, durable and shall be virtually maintenance free.

The acoustic panels shall be filled with a special grade high-density mineral wool retained on the inside by perforated GI sheets specially designed for optimum sound attenuation.

The outer surface of the Acoustic Panels shall be fabricated of performed 14G corrugated CRCA sheet steel. All sheet steel frames shall be of 14G CRCA sheets.
All structural members such as angles / channels used in the construction of the enclosure frame shall of TISCO / SAIL make only.

All materials used for Acoustic Enclosure shall be fire resistant / fire retardant grade.

The sheet steel treatment shall consist of degreasing, derusting and phosphating followed by two coats of zinc chromate primer, followed by two coats of Zinpholite surface for superior corrosion resistance and two coats of finish paint.

For effective Acoustic sealing, necessary gasketing material shall be provided.

All hardware and fittings used shall be passivated with zinc.

PERFORMANCE:

With the above Enclosure, the sound pressure levels when measured at a distance of 1 meter outside the Acoustic Enclosure shall be around 75 dB (A) under free field conditions.

Notes:

i. The above noise level is defined with all background ambient noise levels from any other source being less than 75 db (A) so as not to influence this noise level.

ii. The section of the exhaust piping within the acoustic enclosure from the engine exhaust manifold onwards upto and including the Residential silencer, must be adequately cladded with thermal insulation to limit surface temperature as also reduce noise level to less than 75 db (A).

5. DIMENSIONS:

It shall be ensured that at least 1000mm (min.) clear space is available all around the Acoustic Enclosure to ensure free air flow for the Genset as required and to facilitate accessibility for generator operation and routine maintenance.

The enclosure shall be provided with suction fans to ensure that the adequate cooling and combustion air is made available to the engine and the temperature within the enclosure is limited to 5 deg. C above ambient.

The fan shall be designed with sufficient static to draw the requisite quality of air from the duct provided for this purpose. Calculations shall be furnished to prove the adequacy of the ventilation system offered. The suction fans shall start automatically when the temperature in the enclosure reaches 40°C and shall continue to run for 5 to 10 minutes after the load is disconnected. A temperature controller shall be provided for this purpose housed in sheet steel enclosure.
Two light points controlled by a switch complete with 36W fluorescent Luminaire and lamps shall be provided. Provision shall also be made for fixing a heat detector inside the acoustic enclosure which will be connected to the central fire alarm panel.

Necessary openings shall be made for the entry of power cable and control cables, fuel piping, exhaust piping, air inlet pipe etc.

With the installation of the acoustic enclosure, there shall not be any de-rating of the DG set. The maximum temperature of oil and water shall not exceed the limits prescribed by the manufacturer of the engine. The DG set shall give rated output continuously.
Technical Particulars of Diesel Generator Set  
(To be filled up by Vendors) 

No change in make and model will be changed after submission of tender

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Description</th>
<th>Bidder's Compliance</th>
</tr>
</thead>
<tbody>
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<td>Source</td>
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<td>Manufacturer</td>
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<td>3</td>
<td>Engine</td>
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<tr>
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<td>Engine Model</td>
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<tr>
<td>3.2</td>
<td>Engine Rating</td>
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<td>3.3</td>
<td>Engine Power</td>
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<td></td>
<td>a) Gross BHP</td>
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<td></td>
<td>b) Net BHP</td>
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<td>3.4</td>
<td>No. of Cylinders</td>
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<td>3.6</td>
<td>Aspiration</td>
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<td>3.7</td>
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<td>3.8</td>
<td>Type of Fuel</td>
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<td>Type of cooling</td>
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<td>3.10</td>
<td>Recommended lube oil change</td>
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<td>3.11</td>
<td>Type of coupling</td>
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<td>3.12</td>
<td>Type of silencer</td>
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<td>Max. ambient temperture</td>
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<td>3.14</td>
<td>Speed Regulation</td>
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<td>3.15</td>
<td>Efficiency</td>
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<td>3.16</td>
<td>Standard / optional accessories</td>
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<tr>
<td>3.17</td>
<td>Weight of the Engine</td>
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<tr>
<td>3.18</td>
<td>Engine Protections provided</td>
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<tr>
<td>3.19</td>
<td>Noise level at 1 mtr from the set</td>
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</tr>
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### 4. ALTERNATOR

#### 4.1 Alternator Make

#### 4.2 Alternator Rating (Design)

#### 4.3 Continuous output rating

#### 4.4 Max.rating KW @ 0.8 PF

#### 4.5 Harmonic distortion level

#### 4.6 Rated Voltage

#### 4.7 Full load current

#### 4.8 Excitation
   - a) Excited voltage, DC volts
   - b) Excided current

#### 4.9 Overload capacity

#### 4.10 Voltage regulation

#### 4.11 Accessories required

#### 4.12 Degree of protection

#### 4.13 Class of insulation

#### 4.14 Weight of the Alternator

### 5. GENERAL

#### 5.1 Over all Dimensions
<p>| | |</p>
<table>
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<tr>
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<tbody>
<tr>
<td>5.2</td>
<td>Weight of the total set</td>
</tr>
<tr>
<td>5.3</td>
<td>Foundation details</td>
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<tr>
<td>6</td>
<td>ACOUSTIC ENCLOSURE</td>
</tr>
<tr>
<td>6.1</td>
<td>Dimensions</td>
</tr>
<tr>
<td>6.2</td>
<td>Sound level at 1 mt from the enclosure</td>
</tr>
</tbody>
</table>
# LIST OF APPROVED MAKES

## LIST OF APPROVED MAKES FOR ELECTRICAL ITEMS

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Items</th>
<th>Approved Makes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CABLES GLANDS</td>
<td>COMET / DOWELL / JAINSON.</td>
</tr>
<tr>
<td>2</td>
<td>LUGS &amp; THIMBLES</td>
<td>DOWELLS / JAINSON</td>
</tr>
<tr>
<td>3</td>
<td>1.1 KV LT POWER &amp; CONTROL CABLES</td>
<td>CCI / HAVELLS / TORRENT / RALLISON / RR</td>
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<tr>
<td>4</td>
<td>INSULATING MATS.</td>
<td>ISI MARKED.</td>
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<tr>
<td>5</td>
<td>CO2 &amp; DRY CHEMICAL TYPE FIRE EXTINGUISHER</td>
<td>SAFEX / STEELAGE (MINIMAX) / VIJAY FIRE</td>
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<tr>
<td>6</td>
<td>PRE FABRICATED CABLE TRAY</td>
<td>SLOTCO / PILCO / STEELWAYS / INDIANA / PATNY</td>
</tr>
<tr>
<td>7</td>
<td>PROTECTION &amp; OTHER RELAYS</td>
<td>AREVA / L&amp;T / ABB / SIEMENS</td>
</tr>
<tr>
<td>8</td>
<td>EARTHING PIPES</td>
<td>JINDAL / TATA / SAIL</td>
</tr>
<tr>
<td>9</td>
<td>AIR CIRCUIT BREAKER</td>
<td>L&amp;T (UPOWER)/SIEMENS (SENTRON) / C &amp; S (EQUIVALENT OF U POWER)</td>
</tr>
<tr>
<td>10</td>
<td>MOULDED CASE CIRCUIT BREAKERS</td>
<td>L&amp;T (D-SIGN) / SIEMENS (SENTRON) / LEGREND / C &amp; S / HAVELLS</td>
</tr>
<tr>
<td>11</td>
<td>FUSE DISCONNECTOR SWITCH / SWITCH FUSE UNITS</td>
<td>L &amp; T / SIEMENS / GE POWER.</td>
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<tr>
<td>12</td>
<td>HRC FUSES</td>
<td>L &amp; T / SIEMENS / GE POWER.</td>
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<td>AMMETER, VOLTmeter, KWH, PF, FREQUENCY METER</td>
<td>L &amp; T / CONSERV / AE</td>
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<td>14</td>
<td>SELECTOR SWITCH, PUSH BUTTON</td>
<td>KAY CEE / L&amp;T / GE POWER CONTROL / SIEMENS /</td>
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<td>15</td>
<td>LED INDICATION LAMPS</td>
<td>AE / EASUN / KAY CEE / SIEMENS / VAISHNOV /</td>
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<td>16</td>
<td>CT’S</td>
<td>AE / KAPPA / UNIVERSAL / KAYCEE / IMP / L&amp;T / MECO / GILBERT &amp; MAXWELL</td>
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<td>17</td>
<td>STARTERS</td>
<td>SIEMENS / L&amp;T / GE POWER / ABB / SCHNEIDER</td>
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<td>18</td>
<td>SINGLE PHASING PREVENTOR / OVER LOAD PROTECTION UNIT</td>
<td>L&amp;T / GE POWER / SIEMENS / MINILEC.</td>
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<tr>
<td>19</td>
<td>RELAYS</td>
<td>L&amp;T / AREVA / ABB / SIEMENS</td>
</tr>
</tbody>
</table>
## SCHEDULE OF TECHNICAL PARTICULARS

All the installation shall fully conform to the requirement stipulated and the tests shall be carried out as stipulated. Deviations if any shall be clearly brought out in the tender.

### Diesel engine with residential silencer.
- Caterpillar / Cummins / Perkins / Kirloskar / Volvopenta

### Alternator
- Stamford / Kirloskar / Crompton

### Antivibration mounts
- Dunlop - S class

### Battery
- Exide

### Motors
- Crompton / Siemens.

### Fans
- Almonard

### Pipes
- TATA.

<table>
<thead>
<tr>
<th>S. No.</th>
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<th>Approved Makes</th>
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<tbody>
<tr>
<td>20.</td>
<td>CONTACTORS</td>
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<td>21.</td>
<td>PUSH BUTTONS</td>
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<tr>
<td>22.</td>
<td>TIMERS</td>
<td>L&amp;T/ BCH / MDS / SIEMENS / GE POWER CONTROL</td>
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<tr>
<td>23.</td>
<td>MCB</td>
<td>LEGRAND / L&amp;T / SIEMENS / HAVELLS / C &amp; S</td>
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<tr>
<td>24.</td>
<td>DIGITAL METERS, MULTIFUNCTION METER</td>
<td>CONSERV / AE / L&amp;T</td>
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<tr>
<td>25.</td>
<td>PLC</td>
<td>ROCKWELL / ABB</td>
</tr>
<tr>
<td>26.</td>
<td>UPS 1 KVA</td>
<td>EMERSON / APC / NUMERIC</td>
</tr>
</tbody>
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