

DEVELOPMENT OF PERMANENT CAMPUS (PHASE-I) FOR NALANDA UNIVERSITY

TECHNICAL SPECIFICATION Package 4D

TENDER FOR SITC OF DG SET FOR PERMANENT CAMPUS (PHASE I)

OF

NALANDA UNIVERSITY, AT RAJGIR, BIHAR.



TECHNICAL SPECIFICATIONS (DG WORKS)

MATERIAL SPECIFICATIONS

&

LIST OF APPROVED MAKES

MATERIAL SPECIFICATION

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DEVELOPMENT OF PERMANENT CAMPUS (PHASE-I) FOR NALANDA UNIVERSITY

ELECTRICAL MATERIAL SPECIFICATION

E – 1 DIESEL GENERATOR SET

Supply, Shifting, Unloading, Installation Testing & Commissioning of various Prime rated DG Sets with AMF & Auto Synch Auto Load sharing Facilities

(Imp. Note: All the related parts / controllers / components of the DG Set shall be fully communicable to hook up on SCADA / Smart Mini Grid system; all the status, faults & measurements can be able to transfer via open protocol, & further controlling of DG Set shall also be possible on same media.)

The work shall be executed as per CPWD General Specifications for Electrical Works (Part VII DG Sets-Latest Edition), as per relevant IS and as per directions of Engineer-in-charge. Additional specifications are to be read in conjunction with above and in case of variations, specifications given in Additional conditions shall apply. Nothing extra shall be paid on this account. The tenderer in his own interest must visit the site and familiarise himself with the site conditions before tendering.

1.0 GENERAL:

1.1 SCOPE:

This general specification together with the equipment sheets and attachments defines the minimum requirements the design, performance, inspection, testing and supply diesel engines for general industrial purposes.

1.2 The construction, design and rating of the diesel engine shall meet fully, the requirements of the specified driven machine and the Vendor shall select and provide the requisite ancillaries and controls with the diesel engine for its safe and satisfactory operation.

1.3 No deviations or exceptions from this specification shall be permitted without the written approval of the purchaser. Intended deviations supported by reasons there of shall be separately listed by the vendor and submitted with the bid for the consideration of the Purchaser.

1.4 Compliance with this specification shall not relieve the vendor of the responsibility of furnishing equipment and accessories of proper design, materials and workmanship to meet the specified operating conditions.

1.5 This general specification supplements the specific requirements contained in the attached equipment data sheets. In the event of any contradiction between the two, the information contained in the latter shall govern.

1.6 All required accessories, relays, communication panels, converters for SCADA, Control cabling for electrical part, earthing system using cu material stations & conductors etc shall be part of this scope.

1.7 All required statutory approval, clearances shall be part of this scope, all legal fees will be reimbursed by client against receipt of the payment to the departments as may be required.

1.8 Other attachments of the Material Requisition from a apart of this specification.

1.9 Required cut off ACB / MCCB (Motorised & SCADA enabled) shall be part of DG Set & AMF/Auto Synch panel as ay be required of suitable rating.

1.10 TERMS AND DEFINITIONS:

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- 1.10.1 The Net Calorific value of fuel is defined as the heat resulting from the complete combustion of a unit quantity of fuel oil and air, without condensation of the water vapor. A net calorific value of 9,720 Kcal/Kg (As per IS : 1460 Rev.2) shall be considered while declaring the fuel consumption and for testing purposes.
- 1.10.2 The unit of horse power as defined in this specification is the metric horse power equivalent to 4,500 n-Kg/Min. The horse power in F.P.S. system is equal to 1.014 metric horse power.
- 1.10.3 Other terms used in this specification or in the equipment data sheets are as defined in the latest edition of British Standard-5514.

2.0 STANDARD OPERATING CONDITIONS:

- 2.1 The standard operating conditions shall be defined in the latest edition of B.S.-5514 unless otherwise mentioned specifically in the equipment data sheet.

3.0 RATED POWER OUTPUT AND SPEED:

- 3.1 The diesel engine rating shall be the net output in brake horse power, which the engine is capable of delivering continuously at the stated crank shaft speed under the conditions specified under Clause 2.0 above, provided the engine is maintained in good operating condition and is serviced / overhauled regularly as per the schedules laid down by the Manufacturer.
- 3.2 No negative tolerance shall be allowed on the diesel engine rating specified by the Vendor in the equipment data sheets.
- 3.3 The engine shall be capable of satisfactorily providing an output 10 percent in excess of the continuous rating defined above, at the same speed for one hour in any period of 12 hours consecutive running.
- 3.4 The normal power requirement of the engine driven radiator fan or the coolant pump and the battery charging dynamo shall be clearly stated for the engine which is so equipped.
- 3.5 Unless otherwise specified in the equipment data sheets, the site rating of the engine shall be worked out considering the duration's specified under the latest edition of B.S.-5514 and the power absorb by all the engine driven ancillaries shall also be deducted.

4.0 DESIGN & CONSTRUCTION:

4.1 GENERAL:

- 4.1.1 The Diesel engine offered shall be of the regular production models of the manufacturer for industrial applications and already type tested either at the manufacturer's works or outside. The type test report shall be furnished to the purchaser for his review if so desired.

In case the proposed engine model has not been type tested, vendor shall furnish with the offer, a reference list of its existing industrial installation and at least three of these engines should have completed, 5,000 hours of running at site.

- 4.1.2 Unless otherwise specified in the equipment data sheets, the diesel engine shall be provided with class A1 governing as per the latest edition of B.S. 5514.
- 4.1.3 The "Cyclic irregularity" of the diesel engine for direct coupling to an electric generator, "angular deviation of p73 A.C. generators " driven by diesel engine for parallel operation, and the "engine governor speed droop characteristics ", shall be restricted to the values specified under the latest edition of B.S.-5514.

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- 4.1.4 In case diesel engines are required to drive generators in parallel, the governor fuel injection pumps provided should have identical characteristics and the speed load curves shall be made available to the purchaser's inspector for his scrutiny and approval prior to load testing. The vendor shall maintain proper record for such curves to ensure additional diesel engines if required in future with identical characteristics, could be made available to the purchaser. A set of the said curves shall also be furnished to the purchaser.
- 4.1.5 The vendor shall be responsible for carrying out torsion analysis of the dynamic system as specified in the latest edition of British Standard-5514. The results in the form of a report shall be submitted to the purchaser for scrutiny and reference, if desired.
- 4.1.6 Vendor shall provide the flexible exhaust connection /s to connect the engine exhaust to the exhaust piping. The required size of the exhaust piping should be clearly specified by the Vendor.
- 4.1.7 If specified, the common base plate for mounting the diesel engine and the driven equipment as well as the flexible coupling shall be supplied by the vendor.
- 4.1.8 Vendor shall indicate in the bid, the ISO Noise Level rating of the diesel engine with the offered exhaust silencer/s.

4.2 ENGINE STARTING:

- 4.2.1 Diesel engines shall be capable of starting without the use of cold starting aids so long the ambient temperature at the site is not below 4 °C. The vendor shall provide suitable cold starting aids with diesel engine for quick starting below 4°C of ambient and such aids shall be clearly detailed out along with the offer.

- 4.2.2 Where the diesel engine is specified / offered with battery starting arrangement, the starter motor shall be capable of starting the engine without having to disengage the driven machine with the help of a clutch.

In case of diesel engines driving fire water pumps, besides the engine mounted dynamo and voltage regulator, the Vendor shall also provide automatic battery charging equipment suitable for taking power from an alternating current power source and mounted on a free standing type of a panel.

The battery charger if specified in the equipment data sheet shall be capable of delivering a current equal to 100 percent of the 20 hour discharge rate of the battery and also equipped with charging rate selector device.

- 4.2.3 Where the diesel engine is specified / offered with compressed air starting, the Vendor shall also provide the air compressor driven by a diesel engine / electric motor and equipped with necessary instruments and controls as specified in the equipment data sheets.

The air receiver supplied by the vendor shall provide batteries and battery charging equipment (see clause B. above) for operating the electrical controls of the diesel engine.

- 4.2.4 If as specified in the data sheets, the diesel engine is required to start / stop automatically, the vendor shall provide the necessary controls (automatic – cum - manual) in the engine panel and the interconnecting wiring and piping from the panel to the engine and starting equipment. A pilot lamp shall be provided in the line side of the starting equipment circuit to indicate that the controller is in the automatic position. In the event the engine does not start after three attempts have been made, the controller shall stop all further cranking and operate the audio visual alarm.

4.3 ENGINE COOLING :

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- 4.3.1 Radiator cooled engines are offered, the diesel engine shall be provided with a radiator for mounting on the common base plate, complete with the suction / blower fan, temperature control valve and a radiator guard.
- 4.3.1.1 Raw water piping (prefabricated) and fittings, as specified in the equipment data sheets.
- 4.4 **ENGINE FUEL SYSTEM:**
 - 4.4.1 The daily service fuel tank shall be equipped with as air breather, shielded level gauge, strainer and a hand hole, besides the required fuel connections and a drain plug. The capacity of tank shall be as specified in the equipment data sheets.
 - 4.4.2 The inside surfaces of the fuel tank and the float tank shall be coated with Enamel Red or Black of I.C.I. or its equivalent and the outside surface to be given two coats of the oil resistant primer paint. Both the fuel tank and the float tank, shall be hydrostatic tested at a pressure not less than 0.35 kg /Cm².
- 5.0 **INSPECTION & TESTING:**
 - 5.1 The inspector representing Purchaser shall have entry to the plant while and wherever work for the equipment is being performed.
 - 5.2 The vendor shall have the responsibility of providing purchaser's inspector with all requisite facilities / equipment for carrying out satisfactory testing.
 - 5.3 The diesel engines shall be tested in the presence of purchaser's inspector in accordance with the latest edition of B.S. -5514 or any other equivalent standard as agreed to with the purchaser before the finalization of order.
 - 5.4 Unless otherwise specified, 10% overload provision shall be kept while setting the fuel stop for the site running.
 - 5.5 The hydrostatic test certificates for the heat exchanger / intercooler, fuel tanks and other pressure vessels shall be furnished to the purchaser's inspector for his review and approval at the time of load testing of the diesel engine.
 - 5.6 The engine control panel/s after assembly and wiring, shall be functionally tested in the presence of the purchaser's inspector.
- 6.0 **PREPARATION FOR SHIPMENT:**
 - 6.1 Immediately upon completion of all tests and inspections, all exposed machined surfaces shall be cleaned and coated with suitable rust preventive by the vendor and the unmachined surface shall be painted by at least two coats of red oxide primer.
 - 6.2 Diesel engines shall be transported assembled as far as possible.
 - 6.3 All untapped opening shall be provided with 4mm thick metal closures with full rubber gaskets and bolted by not less than 4 bolts. All connections including those for instruments, instrument leads, lubricating oil and the like shall be identified with securely attached tags indicating the type of connection, the instrument or the line description as applicable.
 - 6.4 The equipment shall be crated for domestic / export shipment as specified in the data sheets considering for storage at job site for at least 6 months. Lifting load-out, and handling instructions shall be securely attached to the exterior of the largest packing in a well marked weather proof container. Upright position

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lifting points, weight (including packing and dimensions shall be clearly identified with item no., serial no., package no., and the names of the equipment.)

7.0 PROPOSAL:

- 7.1 Proposals shall be accompanied with completely filled in Data Sheets. The vendor shall not use his own data sheets.
- 7.2 The proposals must include either a specified statement that all equipment is in accordance with the purchaser's specifications or exceptions, if any, to this general specification including attachments shall be clearly brought out by the vendor on separate sheets, supported with suitable reasons thereof for the consideration of the purchaser.
- 7.3 Additions or exclusions from the scope of supply shall be clearly brought out on separate sheets giving reasons for such deviations for the purchaser's approval.
- 7.4 The drawings and data as listed under "prints with Quote" on the vendor data requirement sheet attached with this specification shall be provided.
- 7.5 The vendor shall also submit a separate proposal for carrying out supervision of the installation and commissioning of diesel engine/s offered indicating per item rates, no. of specialists proposed to be deputed, completion time and a list indicating nature and quantity of consumable/ tools required and any other terms.

8.0 SCOPE:

- 8.1 This specification define the requirements of design, manufacture, testing and supply of self excited emergency generator complete with automatic voltage regulator, control panel, generator breaker and other accessories as specified in the material requisition.
- 8.2 Unless otherwise specified the emergency generator shall be supplied complete with
- a) Brushless excitation system complete with AVR.
 - b) Air inlet and outlet for generator cooling (inlet shall be oriented to suit local plant layout).
 - c) Lifting arrangement for the machine.
 - d) Foundation frame complete with foundation bolts and base frame.
 - e) Lube oil system integral with the prime mover lube oil system.
 - f) Spares for commissioning - recommendation
 - g) List of Spares for 4 years / 1000 hours of operation and maintenance.
 - h) Any other part / accessories not specifically mentioned above but considered necessary for safe and reliable operation.

9.0 CODES AND STANDARDS:

Unless they are in variance with the clause of this specification the diesel engine driven generator and their components shall comply with the latest edition of the applicable standards listed below:

IS : 22534 Designation for type of construction and mounting arrangement of rotating electrical machines.

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IS : 46914 Degree of protection providing by enclosures of rotating electrical machinery.

IS : 47284 Terminal marking of rotating electrical machines.

IS : 71324 Guide for testing 3 Ph. sysn. Machines.

IS : 54224 Turbine type generators.

IS : 48894 Methods of determination of efficiency of rotating electrical machines.

IS : 12714 Insulating materials for Electric machinery and apparatus in relation to their thermal stability service, classification of

IS : 47224 Specification for rotating electrical machines.

IS : 25164 A.C. Circuit breakers.

Latest CPCB norms CPCB II etc all related norms to be followed.

10.0 PERFORMANCE REQUIREMENTS:

10.1 Operative Conditions:

Generators shall be suitable for operating satisfactorily in humid and corrosive atmosphere found in pump house. Service conditions shall be as specified in the data sheet. The generator shall operate satisfactorily under sudden load application. Generator rating indicated in the data sheet shall be the net output of the set after accounting for all auxiliaries for the prime mover and generator.

10.2 Transient Voltage performance

The dip or rise in system voltage load variations is dependent on the leakage voltage drop of the machine, which shall be kept to the minimum.

In case of sudden application of full load at rated power factor the voltage drop shall not exceed 15% of the rated voltage. The rated voltage shall be restored within 0.5 to 0.8 second depending on the size of the machine.

10.3 Voltage Regulation

The voltage regulation of the machine shall be within $\pm 1\%$ of the nominal voltage under following conditions:

- a). Between no load and nominal load with p.f. of 0.8 lag to unity.
- b). With the machine cold or warm.
- c). At a speed drop of approximately 3% of the nominal speed.

10.4 Voltage setting range:

The generator terminal voltage shall be adjustable with a continuously variable potentiometer. The adjustment range shall be $\pm 5\%$.

10.5 Harmonic Content

The maximum permissible deviation from the sine wave shall be 5%. The harmonic content of the voltage shall be less than 3% measured between phases off load and up to nominal rating for a power factor of 0.8 lag to unity and with symmetrical distortion free consumers in circuit.

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10.6 Frequency limits

The Generator shall be suitable for continuous operation at rated load for frequency variation of +/- 3% of rated value in addition the vendor shall furnish the short time under-frequency operating limits.

10.7 Overloads:

The generator shall be capable of withstanding without injury the effect of a 10% overload for one hour at any given time span of 12 hours.

10.8 Short Circuit Conditions:

The generator shall be capable of withstanding without damage, a three phase, a line to line, line to earth or two line to earth short circuit for a period of 3 seconds when operating at rated speed and with an excitation corresponding to 5% over voltage at no load.

10.9 Parallel operation:

Generator sets shall be suitable for parallel operation amongst themselves, or with other generating sets or with other sources (Grid supply) at operating voltage and under load conditions up to rated value.

10.10 Excitation support system

Excitation system shall be provided with short circuit support equipment (Series compounding) to maintain three times the rated current for three seconds in case of short circuit to ensure proper fault clearance in outgoing feeders.

11.0 DESIGN AND CONSTRUCTION:

11.1 The generator design shall meet the requirement specified in data sheet and shall be suitable for the site conditions specified therein.

11.2 The generator shall be mounted on a common base frame together with the prime mover unless otherwise agreed. The generator shall be provided with necessary lifting hooks and two earth terminals for connection to main earth grid.

11.3 The generator winding shall be class "H" insulation with temperature limitation for class "B" the windings and overhangs shall be braced to withstand the short circuit forces.

11.4 The stators windings shall be brought out to six insulated terminals in two separate terminal boxes. The alternator shall, therefore, be provided with three separate terminal boxes i.e. for the line and neutral stators connections and for control connections. The terminal box for the line terminals shall have sufficient space for the termination of cable size specified in data sheet. The neutral box shall in addition to space for neutral earthing cable have sufficient room for current transformers used for protection of generator. Star connection shall be formed in the neutral side terminal box. The terminal box for control cables shall contain properly marked terminals for all internal equipment e.g. embedded temperature detectors etc. All terminals shall be stud type. The terminal boxes shall be complete with lugs and double compression cable glands. Current transformers shall be as specified in data sheet.

11.5 All parts and accessories shall be suitable to withstand stresses due to over speed / overload / short circuit conditions specified.

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- 11.6 Bearings shall be double shielded and re-lubricated. Grease in the bearing enclosure shall provide additional lubrication to bearing as well as provide sealing against dust and moisture.
- 11.7 The generator shall be air cooled unless otherwise agreed generator enclosure shall be as specified in data sheet.
- 11.8 The direction of rotation of the rotor of the machine shall be compatible with that of the prime mover. A clear indication of the direction of rotation shall be given on either end of the machine.
- 11.9 Space heaters shall be installed within the enclosure, location and max. Surface temperature of the heaters shall be such that no damage can be caused to any insulation. Heaters shall suitable for operation on a single-phase 240V AC supply unless otherwise specified.
- A suitable double pole switch shall be mounted on or adjacent to the stators frame or enclosure for the manual switching off of the heaters.
- 11.10 Field winding shall have class "H" insulation with excellent electrical and mechanical properties. The field winding shall be capable of operating at a field voltage of 125% of rated load field voltage for at least one minute starting from stabilized temperatures at rated conditions.
- 11.11 All cabling on the generator set skid shall be in GI cable trays/ conduits. All cables shall be identified close to their termination point. Double compression type cable glands shall be used for cable termination.
- 11.12 A rating plate of corrosion resistant material shall be fixed on the generator frame and shall give the following information:
- a) Manufacturer's name.
 - b) Serial Number, Type and frame reference
 - c) Rated output in KVA & KW.
 - d) Rated power factor, frequency and voltage
 - e) Rated stators current and speed in Rev. / Min.
 - f) Class of insulation
 - g) Phase rotation (CW or CCW)

12.0 EXCITATION SYSTEM:

The generator shall be provided with brushless type solid state excitation system with automatic voltage regulator. The excitation system shall include the automatic voltage regulator, AC exciter and rotary rectifier. The field of the exciter shall be fed from the stators winding through a suitable transformer and AVR. AC Voltage generated in the AC exciter shall be rectified by the rotary rectifier assembly and fed to the main field circuits. The rotor windings of the AC exciter, the rectifier assemble, main field winding of the generator and other accessories on rotor part shall be rigidly fastened to the shaft and the connection with different items shall be anti loosening type.

The exciter capacity shall be at least 20% more than the maximum requirement at any time. The exciter winding shall be insulated with class "H" insulation.

Automatic solid state voltage shall be provided with the following features as a minimum.

- Under frequency protection.
- short circuit protection.
- Cross current compensation for parallel operation.
- Voltage build up circuitry.
- Stators current limited.

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- Field current limited.

The Current and potential transformers required to feed the AVR from the generator terminal shall be adequately rated.

13.0 SYSTEM OPERATION

The emergency generator set shall normally be in an unattended area. The Control system shall operate in fail safe mode and shall include all controls and protection necessary for the safe operation of the package. The generator set shall function as per one of the following schemes:

- Auto main failure scheme (AMF).
- Manual start in service mode.

14.0 GENERATOR CONTROL PANEL :

14.1 The Local generator control panel for the generator set shall comprise of the following unless otherwise specified in the attached data sheet & Technical specification in 17.

- (a) Protection and metering equipment's.
- (b) Indicating instruments.
- (c) Control gear for generator set auxiliaries.

Any other accessories require to make the generator set operational as a package shall be included in scope of supply. If required the generator control panel shall be split into various functional sections vi. protection, metering and control, regulation etc.

All motor starters for generator set auxiliaries shall be DOL type.

Unless otherwise specified , the DC control supply required for relays , controls, closing/tripping of generator breaker, annunciation circuit and for any other purpose shall be met by a DC system consisting of battery and battery charger of suitable capacity to be supplied by the generator set manufacturer . The battery shall be sized for two hours load cycle a maximum. Battery charger shall be of the constant voltage type with current limiting feature and facilities for automatic and manual, normal and quick charging of batteries. Charger shall be sized for boost charging of batteries with 10 to 14 hours.

14.2 The panel shall be free standing , metal enclosed, dust and vermin proof type with a hinged door and having a degree of protection IP 51 as per IS:51 as per IS:2147 unless otherwise specified . Power and control equipment shall be segregated inside the panel as far as practicable. The maximum light of the operation handle/switches shall not exceed 1000 mm. and the minimum height not below 300 mm. All hardware shall be corrosion resistant and bolts, nuts and washers shall be made of galvanized zinc passivated of cadmium plated high quality steel. Unless otherwise specified the panel shall be suitable for bottom cable entry. Necessary glands shall be provided with the panel.

All auxiliary devices for control, indication, measurement and alarm such as push buttons control/selector switches, indicating lamps, metering instruments, annunciation's etc. shall be mounted on the front door of the panel. Adequate number of potential free contacts shall be provided in the control panel for any remote control, monitoring of the generator set.

14.3 All switches shall be load - break, heavy duty type. All fuses shall be non-deteriorating HRC cartridge pressure filled, link type. The contractor shall be air-break type having AC-3 duty rating. Thermal overload relays shall be three element, positive acting, ambient temperature compensated type with adjustable

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setting range and built in protection feature against single phasing. All indicating instruments shall be moving iron, flush mounting type and of 96 mm x 96 mm square pattern. All control / selector switches shall be rotary back connected type having a cam-operated contact mechanism with knob type handle. "STOP" push buttons shall be stay put type.

14.4 Wiring for power, control and signalling circuits shall be done with PVC insulated copper conductors having 660 / 1100 V grade insulation. Minimum size of control wires shall be 2.5 mm "ELEMEX" type terminals shall be acceptable for wires up to 10mm² size and for conductors larger than 10 mm² bolted type terminals with crimping lugs shall be provided. A minimum of 10% spare terminals shall be provided on each terminal block.

14.5 An adequately sized earth bus shall be provided in the panel for connection to the main earth grid. All non current carrying metallic parts of the mounted equipment's shall be earthed. Doors and movable parts shall be earthed using flexible copper connections.

14.6 Engraved nameplates shall be provided for all devices mounted on the front of the panel. Nameplate or polyester adhesive stickers shall be provided for each equipment mounted inside the panel.

15.0 PAINTING, PACKING AND TRANSPORT:

15.1 All metal surfaces shall be thoroughly cleaned of scale, rust and grease etc. prior to painting. Cleaned surfaces shall be given two coats of primer and prepared for final painting. Final finish shall be free from all sorts of blemishes.

15.2 The equipment shall be shipped to site suitably packed to prevent any damage. Each package shall have labels to show purchaser's name, purchase order and equipment no. suitable lifting lugs etc. shall be provided and lifting points shall be clearly marked on the package. Packing shall be suitable for storage at site for a minimum period of 6 months.

16.0 TESTS AND INSPECTION:

16.1 The owner or his authorized representative may visit the works during manufacture of equipment to assess the progress of work as well as to ascertain that only quality raw materials are used for the same. He shall be given all assistance to carry out the inspection.

16.2 Detailed test procedure along with the facilities available at vendors works shall be furnished along with the bid Owner's representative shall be given minimum four weeks advance notice for witnessing the final testing. Test certificates including test records and performances curves etc. shall be furnished by the vendor.

16.3 Tests

Equipment shall be tested to confirm to the appropriate standards and the following tests shall be conducted in the presence of purchaser's:

16.3.1 Functional tests, continuity tests and high voltage test on control panel to establish the performance called for in the specification.

16.3.2 Power frequency voltage test on switch gear and mechanical / electrical operational check.

16.3.3 Routine tests for alternator as per IS: 4722.

16.3.4 over speed test (1.2 times the rated speed for 2 minutes)

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- 16.3.5 Transient response tests for sudden application and rejection of loads of 25%, 50%, 75% and 100% of rated capacity.
- 16.3.6 Wave form test (type test results are acceptable)
- 16.3.7 Phase sequence test.
- 16.3.8 Vibration test
- 16.3.9 Noise level test.
- 16.3.10 Dimensional and alignment test.
- 16.3.11 String test.
- 16.3.12 Test certificate of engine / alternator / breaker manufacturer is acceptable

17.0 Technical Specifications of Diesel Engine Generator Sets of ratings: 200 KVA

Diesel Engine

Diesel Engine as prime mover: Water cooled, Electrical start, Four strokes, multi cylinder diesel engine confirming to BS: 5574/ISO: 3046 standards with 10% overload for one hour during 12 hours duration. It shall comprise of the following:

Standard Equipment:

- Radiator with blower fan & Fan Guard.
- Corrosion inhibitor coolant
- Paper element filters – fuel, lubricating oil and by-pass
- Flywheel to suit single/double bearing alternator & Flexible Coupling with starter ring.
- Flywheel housing
- Dry type air cleaner with vacuum indicator
- Residential Silencer
- Stainless steel exhaust flexible bellow
- Electric Starter
- 24V Electric starting system
- Battery charging alternator
- Safety Controls (trip) : High water temperature (HWT)
Low lubricating oil pressure (LLOP)
Engine over speed
- Exhaust Gas Turbocharger with after cooler
- Bypass thermostat

Brief Technical Particulars :

- Nos. of cylinders : Vendor to Specify (12, 10, 8, 6 & 4)
- Engine prime power rating at 1500 RPM : ____ BHP (Vendor to Specify)
- Combustion Type : Direct Injection
- Bore x Stroke (mm) : Vendor to specify
- Compression Ratio : Vendor to Specify
- Displacement : Vendor to Specify

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- Voltage : 415 V
- Voltage regulation : +/- 1 %
- Voltage adjustment : +/- 5 %
- Coolant capacity (engine only) : Vendor to Specify
- Specific fuel consumption at rated load : Vendor to Specify
(As per ISO: 3046/BS 5514)

The above fuel consumption data are based on engine operating with diesel fuel corresponding to Grade no. 2D as per ASTM D975/IS 1460:1995

This engine should be meets latest CPCB norms

Details about ECP+G:

The Electronic Control Panel with built in governor should be used on engines for governing engine speed, monitoring engine parameters & protecting the engine in catastrophic conditions. The ECPG with built in governor comprises of ECPG with software to govern the engine speed, actuator mounted in an aluminium housing, mounting parts, cable harness for interconnection, engine sensors. This ECPG eliminates the conventional EFC (electronic fuel controller) & related harness.

The primary function of the ECPG is to govern the engine speed in isochronous or droop mode. The ECPG hardware & software provides the following additional features:

- Engine speed governing
- Operator control interface
- Engine monitoring
- Engine protection
- System fault Diagnostics
- Electronic service tool

The front panel will have following parameters & indications for engine protections:

Parameters by Green LED:

Engine speed (RPM)
Lub Oil pressure (lb)
Coolant Temperature (Degree Centigrade)
Intake Air Temperature (Degree Centigrade)
Engine Run (Hours)
Battery Volts (V)
Fuel Actuator Command (%)
ECP Fault Code

Faults by Red LED:

Engine Over Speed
Low lubricating oil pressure
High coolant temperature
High water temperature
Low coolant level

Battery Charging failure
High fuel actuator command (%)

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ECP fault code

Alternator:

The above diesel engine will be coupled with the brushless type Alternator of 200 KVA (Refer BOQ). The make of Alternator shall be as specified. The alternator shall be with salient features like self excited, self regulated through AVR, three phases, 415 Volts, 50 Hz, 1500 RPM, screen protected, drip proof. The alternator shall generally confirm to IS: 4722/BS: 2613 standards. The alternators shall be with class H insulation & temperature rise limited to class "H". The alternator shall be suitable for 55°C Ambient Temperatures. The alternator shall be single bearing type.

The alternator shall be generally confirming to IS: 4722/BS: 5000 standards & shall be suitable for 10% overload for 1 hour in continuous 12 hours duration.

AMF panel

The Control panel shall be fabricated out of 14 SWG M. S. sheet. The panel shall be suitable for floor mounting, indoor type, cubicle design, dust & vermin proof. The panel shall be painted with paint shade Siemens Grey. The sheet steel shall be treated for degreasing, rinsing, degreasing, pickling, phosphating & passivation through 7-tank process.

Panel should be extensible type & can have facility to incorporate further 1 DG for synchronization. Busbar & Control wiring should have capacity for extension.

- Microprocessor based Engine generator Control package with built in AMF, Auto Synchronising, Auto Active / Reactive Load Sharing, Auto Load Management with Protection like Over Current, Reverse Power, Under/Over Voltage, Under / Over Frequency, etc.. with inbuilt key features as under: (Do considered requirements shown in point 13)
 - 8 Relay Outputs, 8 Static Outputs & 3 Programmable Digital Inputs
 - 3 Programmable Static Outputs, configurable to one of over 10 function types
 - 13 Digital Inputs, 1 Pick Up Input for RPM monitoring
 - D+/W.L. control & 3 Channel Analogue Sender Interface
 - 3-phase Generator & Mains Voltage Monitoring upto 500 V ac
 - External Adaptor to monitor up to 1000 V ac-3-phase
 - 3-phase Generator Current monitoring upto 9900 A
 - Digital Metering (SCADA ready) for Amp. Voltage, Frequency, Power Factor, KW, KVA, KVAR, KWH, Engine Run Hour, Battery Voltage etc...
 - Annunciation for Various Faults.
 - Serial Interface RS 232 or RS 485 for Grid Paralleling, Import / Export Facility, remote control & monitoring – Fully SCADA Compatible
 - Aac, Vac, Hz, Vdc, kVA, kW, kVAr & PF monitoring
 - Oil pressure, Engine Temperature & Fuel Level measurements
 - Manual, Automatic, Remote On & Off operating modes
 - 18 LEDs, 13 Push Buttons, 4 Displays & IP55 Weatherproof Housing
 - 51 Programmable Parameters, Clock & Data Setting
 - 11 Operating Messages, 44 Alarm Messages, Display Menu
 - Event & Data Logging Memory & Hour Counter
 - Automatic Scheduled Testing & Service/Maintenance
 - 6 Point Relationship for analogue senders upto 1000 Ohm

DEVELOPMENT OF PERMANENT CAMPUS (PHASE-I) FOR NALANDA UNIVERSITY

- Cycle Lube Interval, Automatic Transfer Fuel Pump Control
- Extended Temperature Range/Humidity -30°C to +70°C/95% HR
- 1 no. FP type, suitable Amps. & KA electrical motorized draw out type ACB / MCCB of specified make – Adjustable Thermal magnetic release for over current, short circuit & earth fault release Per DG of standard rating.
- Copper (till 250A) / Aluminum Busbars of adequate capacity which shall be provided with end termination
- 1 no. digital type multi meter showing Ampere, Voltmeter with inbuilt selector switch, KW, PF, Frequency, KWH etc – SCADA compatible
- Necessary set of instrument fuses, HRC type
- 3 nos. ____/5 Amps ratio (Suitable) current transformers for metering, class 0.5, 15 VA burden / ACB
- 3 nos. ____/5 Amps ratio (Suitable) current transformers for relay, class 5P10, 15 VA burden / ACB
- 1 no. F-Thyristor (Primary) Controlled Constant Voltage Constant Current Automatic Battery Charger
- 1 no. 96 sq.mm Analogue type DC Ampere meter
- 1 no. 96 sq.mm Analogue type DC Voltmeter
- 12 nos. of indicating lamps, LED type
 - Load on Genset
 - Load on Mains
 - Mains R, Y, B
 - Genset R, Y, B
 - Genset On, Off
- 1 no. 4-point annunciation with inbuilt hooter, Test, Accept & Reset push buttons for the following,
 - Low lubricating oil pressure
 - High water temperature
 - Engine over speed
 - Relay operated
- Auto/Manual Selector Switch for ACB ON/OFF
- 1 no. TNC type Breaker Control Switch for Genset ACB
- 1 no. TNC type Breaker Control Switch for Mains ACB (in main PCC panel)
- 1 set of auxiliary contactors (2no. + 2NC)
- 8 nos. / as require MCBs, 10 kA, Double pole & Single pole type
- 2 nos. Leach Relay, 24 V DC, 2 C/O with cover
- 1 nos. Emergency Stop Push buttons
- 1 set of auxiliary relays, coil voltage 24 V DC, 3 C/O, 11 pin

Base Frame:

Suitable and recommended base frame of sturdy design made out of M. S. channel with necessary reinforcement & pre-drilled holes. The base frame shall be made out of TISCO/ISSCO steel. The diesel engine and alternator will be coupled on this base frame. skid mounted type providing common bed for engine and alternator. Provision is made in Base Frame for lifting arrangement of DG set.

Acoustic Enclosure:

The Generating sets should be housed inside a high quality acoustic enclosure having salient features & constructional features such as:

1. Compact, modular construction & sleek design with low noise level 75 dBA – just whisper soft.

DEVELOPMENT OF PERMANENT CAMPUS (PHASE-I) FOR NALANDA UNIVERSITY

2. Soundproof, weatherproof & environment-friendly silent set.
3. Ready-to-use silent set, eliminates need for foundation or grouting.
4. The acoustic enclosure is manufactured & powder coated & lined with Fireproof Acoustic Material light resin rock wool as per IS: 8518. The material shall be of 48-kg/m³ density & the layer shall be 75-mm thick.
5. It is made of compact sleek design conforming to international standards to provide insertion loss of 25 dBA meeting latest CPCB norms. (2-mm thick CRCA sheet)
6. Steel outer construction with heavy-duty fabricated base frame & inbuilt fuel tank.
7. Attenuators are placed in the hot air outlet & cooling air inlet.
8. Exhaust silencer – Residential type mounted on the enclosure, exhausting to atmosphere.
9. All joints are sealed with fireproof neoprene gaskets, which withstand high temperature & pressure.
10. All high temperature exposed surfaces are insulated by glasswool with aluminium cladding.
11. Painted with weatherproof, acid-proof, heat-resistant, powder-coated after pre-treatment for degreasing, de-rusting, pickling, phosphating & passivation for durability & better look.

Fuel Tank :

The daily fuel tank should be suitably designed so as to provide a day time hours of uninterrupted and continuous power however it shall not less than specified in CPWD guidelines / specifications . For ease of monitoring the fuel level in the fuel tank, a sophisticated fuel level gauge should be provided in the control panel. For ease of operation, there is a provision for fuel inlet, which has accessibility from outside the acoustic enclosure, and designed so that the refuelling is possible even when the generating set is in operation. The tank should be fabricated from 14 SWG M.S. Sheet.

Necessary mechanical system to supply the fuel from tank to engine shall be made available.

Batteries :

2 nos. of Batteries will be provided with each Genset. Each battery shall be of 12 Volts, suitable AH and of EXIDE make with leads & Battery Cable. The batteries will be supplied in dry & uncharged condition.

Note :

200KVA Silent DG set as per CPWD and CPCB Norms Latest:

DG shall be provided with AUTO SYNCH + AMF control panel. Control panel should be extensible type with all necessary provision to connect another D G set of same or lesser rating in future with all facilities for auto synchronization, auto load sharing etc, Vendor should take the approval of GA drawing. Vendor should have to design the panel and required to submit with quotation with detail specification and single line diagram. The DG Sets shall be SCADA ready for On Off & Various status & parameters to communicate & operate through SCADA from a remote location.

82.5 KVA Silent DG set as per CPWD and CPCB Norms Latest:

Required at two different locations:

1. Location 1 : Academic/Lab Building – 82.5KVA with AMF and ATS Facilities
2. Location 2 : School Building – 82.5KVA with AMF and ATS Facilities

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DATA SHEET PRIME MOVER FOR D.G. SET

1.	Prime mover	Diesel Engine
2.	Qty required	One No. for each alternator.
3.	Service	Prime mover for generating set.
4.	Horse power	____ bHP (Vendor to specify for each rating of DG Set)
5.	RPM	1500 RPM
6.	Type	Vendor to Specify
7.	Flywheel	Require
8.	Vibration damper	Require
9.	Fuel pump air cleaner	Require
10.	Fuel pump	Require
11.	Radiator	Require
12.	Oil filter, fuel Filter etc.	Require
13.	Lub oil pump	Require
14.	24 DC V electrical System	Require
15.	Safety controls	1.LLOP, 2.HWT, 3. OS, 4.Cooldown timer 5. Low cool out level.
16.	Silencer	Required – Residential Type
17.	Coupling	Require
18.	Instrument panel consist of	As specified in AMF Panel.
a)	Meter	As specified in specs above including Engine hours etc,..
19	Fuel tank	Required for 8 Hours working capacity on rated load Capacity.
20	Battery charger	Require
20A	Battery charging Alternator	24V DC, 45 Amp.

DEVELOPMENT OF PERMANENT CAMPUS (PHASE-I) FOR NALANDA UNIVERSITY

- | | | |
|-----|--------------------------------|--|
| 21. | Engine testing | |
| a) | At shop | Require |
| b) | At site | Require |
| 22. | Tool kits | list of tools req. to be maintain at site. |
| 23. | Literature | Require |
| a) | Operation & maintenance manual | |
| b) | Parts catalogue/list | |

Note:

1. The engine HP should be selected so as to achieve required KVA / KW rating to be generated considering de-rating of engine due to altitude, temp. @ 55° C, humidity etc.
2. D.G. set should be able to start by AMF panel / remote location through SCADA.
3. D.G. set should having facility of auto synch auto load sharing as per requirement of load.
4. The engine test shall be witnessed by the client's representative if required.

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ALTERNATOR

DATA SHEET - A

- | | | |
|-----|-------------------------------------|--|
| 1. | Make | : As per make list of the Tender document |
| 2. | Rating | : As per schedule of quantities. |
| 3. | Power factor | : 0.8 |
| 4. | Rated voltage | : 415 V |
| 5. | Voltage regulation | : 5 % |
| 6. | Rated current | : Vendor to Specify |
| 7. | Speed | : 1500 RPM. |
| 8. | Frequency | : 50 Hz. |
| 9. | Method of excitation and Regulation | : Self |
| 10. | Class of insulation | : A) Stator - H with temp. rise of B
B) Rotor - H --- do ----- |
| 11. | Degree of protection | : Screen protected, drip proof. |
| 12. | Base plate | : The Engine & alternator shall be mounted and aligned on a Common base plate fabricated from steel. |
| 13. | AMF Panel | : As per specification |
| 14. | PMG excitation | : Required. |

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DATA SHEET- B (To be furnished by the bidder for each rating)

- I. ENGINE
1. Make :
 2. Model :
 3. No. of cylinders :
 4. Arrangement of cylinders :
 5. No. of stroke :
 6. Speed RPM :
 7. B.H.P Standard rating :
 8. S.H.P. Standard rating :
 9. Max. BHP at site (Over load) :
 10. Engine over load operations hrs. :
 11. Recommended fuel oil :
 12. Compression ratio :
 13. Firing order :
 14. Sp. fuel oil consumption (LTR / HR) @ 0.85 spec. gravity.
 15. Recommended Lub-oil :
 16. Method of starting :
 - a) Battery details :
 - b) Charger details :
 - c) Make of battery & charger. :
 17. Silencer type :
 18. Cooling system :
 19. Fuel system :
 1. Filters :
 - a) Type :
 - b) Nos. :
 2. Injection pump :
 - a) Type :

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- b) Nos. :
3. Injector :
- a) Type :
- b) Cooling :
4. Day tank :
- a) Capacity :
- b) Location :
20. Lubricating system :
1. Type :
2. Filters :
- a) Type :
- b) Nos :
3. Lub oil pump :
- a) Type :
- b) Rating :
21. Governing system :
22. Instrument panel : Consist of:
23. Safety control :
24. Max. period for which engine can operate without raw cooling water supply. :
25. Other accessories :
26. Exhaust system :
27. Literature :
28. Diesel engine auxiliary (Materials of Construction)
1. Base plate :
2. Fuel oil tank :

Note : All data must be filled by the contractor & provided with tender for analysis.

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SPECIAL CONDITION FOR TESTING (CONTRACTOR TO READ THIS CAREFULLY)

1.0 SCOPE :

Contractor should have to take all necessary testing/ random testing of equipments and component prior to supply as per the guidelines / rules / sampling method etc. of IS at manufacturing works or other standard lab in presence of Client's representative & consultant as witness testing. Any deviation in parameters which is not as per IS is not accepted and client reserve the rights to reject the same at any stage of the project.

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APPLICABLE STANDARDS

Sr. No.	IS No.	Description
1)	IS: 2026-1977 1981 -1994	: Transformers & fittings.
2)	IS 3639-1966	: Fittings and acc. For P.T.
3)	IS10028-Part III 1981	: Installation of Transformer.
4)	IS: 13118-1991	: Specification for High voltage AC circuit breakers.
5)	IS: 335-1993	: Insulating oil for Transformers & switch gear.
6)	IS: 2705-1992	: CT for measuring and protection.
7)	IS: 3156-1992	: Voltage (Potential) Transformers.
8)	IS: 3156-1992	: Voltage Transformer.
9)	IS: 8623-Part II 1993	: Bus-bar arrangement and marking.
10)	IS: 2099-1986	: Bushing
11)	IS: 5621-1980	: Large Hollow Porcelains Insulator
12)	IS: 2544-1973	: Insulators greater than 1000V
13)	IS: 2629-1985 IS: 2633-1986	: Hot Dip Galvanizing
14)	IS: 3842-1967	: Relays for AC system
15)	IS: 1248-2003	: Meters (measuring).
16)	IS: 10118-1982	: Installation of Switch gears.
17)	IS: 692-1994	: HV Cable Paper Insulated Lead Sheathed Cables Rated Voltage up to and Including 33 kV – Specification for
18)	IS: 1255 -1983	: Installation of HV cables and jointing.
19)	IS: 3043-1987	: Code of practice for earthing.
20)	IS: 13947-Part III -1993	: HD Air breaker, Switch gears and fuses for Voltage not exceeding 1000 Volts.
21)	IS: 13703-Part IV	: Selection, installation and

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	-1993		maintenance of fuses up to 650 Volts.
22)	IS: 13947-Part I -1993	:	General requirements for switch gear and control gear for voltage not exceeding 1000 Volts.
23)	IS: 13947-Part III -1993	:	Air-break isolators for Voltage not exceeding 1000 Volts.
24)	IS:8623-1993	:	Factory built assemblies of switch gears and control gears for voltage up to and including 1000 Volts A.C. and 1200 Volts D.C.
25)	IS: 11353-1985	:	Marking and arrangement of switch gear bus bars main connectors and auxiliary wiring.
26)	IS: 13947 PART-1	:	Cubical Boards.
27)	IS: 8084-1976	:	Insulated Busbar rating.
28)	IS: 2675-1983	:	Enclosed distribution fuse boards and cutouts for Voltage not exceeding 1000 Volts.
29)	IS: 8828-1995	:	Miniature Circuit Breaker.
30)	IS: 9926-1981	:	Fuse wire used in rewirable type electric fuses up to 650 Volts.
31)	IS: 1554-Part I -1988	:	PVC insulated electric cables Heavy duty.
32)	IS: 3961-Part II & IV -1967	:	Recommended current rating for cables.
33)	IS: 8130-1984	:	Copper conductor in insulated cables and cores.
34)	IS: 8130-1984	:	Conductor for insulated electric cables and flexible cords.
35)	IS: 3975-1999	:	Low Carbon Galvanized Steel Wires, Formed Wires and Tapes for Armouring of Cables - Specification
36)	IS: 5831-1984	:	PVC insulation and sheath of electric cables.
37)	IS: 8130-1984	:	Aluminum conductor for insulated cables.
38)	IS: 11955-1987	:	Recommended current rating for Cable.
39)	IS: 732-1989	:	Code of practice for electrical wiring installation system Voltage not exceeding 650 Volts.
40)	IS: 1646-1997	:	Code of practice for fire safety of Buildings (general) electrical installation.
41)	IS: 9537-1981	:	Rigid steel conduits for electrical wiring.

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42)	IS: 2667-1988	:	Fittings for rigid steel conduits for electrical wiring.
43)	IS: 3480-1966	:	Flexible steel conduit for electrical wiring.
44)	IS: 3837-1976	:	Accessories for rigid steel conduits for electrical wiring.
45)	IS: 694-1990	:	PVC insulated cables (wires).
46)	IS: 9537-Part III -1983	:	Installation of Rigid non-metallic conduits for electrical wiring.
47)	IS: 6946-1973	:	Flexible (playable) non-metallic conduits for electrical installation.
48)	IS: 1293-2005	:	Plugs and sockets up to 250V.
49)	IS: 8130-1984	:	Conductors for insulated electrical cables and flexible codes.
50)	IS: 9537-1980	:	Specification for conduit for electrical installation.
51)	IS: 3419-1988	:	Accessories for non-metallic conduits for electrical wiring.
52)	IS: 3854-1997	:	Switches.
53)	IS: 6538-1971	:	Plugs.
54)	IS: 13585-Part I -1998	:	Shunt Capacitors for power systems up to 650V.
55)	IS: 13703	:	Low voltage fuse and links up to 1000 volts.
56)	IS: 1913-1978	:	General and safety requirement for lighting fittings.
57)	IS: 1944-1981	:	Code of practice for lighting public thorough fares.
58)	IS: 3528-1966	:	Waterproof electric lighting fittings.
59)	IS: 3553-1966	:	Water tight electric lighting fitting.
60)	IS: 1239-Part I -2004	:	Mild Steel tubular and other wrought steel pipe fitting.
61)	IS: 10322-Part V -1987	:	Luminaries for street light.
62)	IS: 13703-Part III -1993	:	HRC fuses having rupturing capacity voltage up to 1000V.
63)	IS: 2312-1967	:	Exhaust Fan.
64)	IS: 374-1979	:	Class I Ceiling Fan.
65)	IS: 7098 (Part I, II, III)	:	XLPE armoured Cables up to

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-1988

1000V.

NOTE: All codes and standards means the latest where not specified otherwise the installation shall generally follow the Indian Standard codes of practice or relevant British Standard Codes of Practice in the absence of corresponding Indian Standards.

PLEASE FOLLOW:

- a. Indian Electricity Act of 1910 and rules issued there under revised up to date.
- b. Regulations for electrical equipment in building issued by The Bombay Regional Council of insurance Association of India.

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LIST OF PREFRED/APPROVED MAKE / MANUFACTURER FOR ELECTRICAL WORK MATERIALS

01) D.G. Set with AMF Panel	:	
Engine	:	Catter Pillar, Ashok Layland, Cummins, MTU, Volvo Penta, Perkins /MAHINDRA
Alternator	:	Stamford, Leroy Somer, Cater Pillar / KOEL
BRAND	:	KOEL, CG, JACKON, M&M, Perkins, Ashok Leland/SG
AMF, Auto-Synch-Load Sharing Panel with SCADA- Open Protocol:		As per OEM/Brand
02) ACB/MCCB/MCB/ELCB/SPD etc	:	Legrand, Schneider, L&T, Hager or as per OEM
03) Flexible Copper Wires	:	FRLS type : R.R. Kable, Havell's, Finolex, Polycab, KEI
04) PVC tape	:	Steel grip, Anchor, Jhonson as per OEM
05) Load Manager / Energy Meter	:	Schneider, Secure, Elmeasure, HPL, L&T, as per OEM
(Suitable for PC Connected and LAN with open protocol, Sample to be approved)		
06) Meters(Digital : V,A,PF etc)	:	Schneider, Secure, Elmeasure, HPL, L&T, as per OEM
07) Timer	:	Theban (Indoasain), Legrand, L&T, as per OEM
08) Relays	:	Woodwards, Areva, Siemens, L&T, ABB, Schneider, as per OEM
09) Connectors	:	ELMEX, Wago, Telemechanique, Connectwell, as per OEM
10) Current Transformer (for LV & MV)	:	Pragati, Ashok, Kalpa, AE, as per OEM
11) HRC Fuses & Fuse-Base	:	Schneider, Siemens, L&T
12) Power Terminal	:	Connectwell, Reputed, Elmex
13) Indication Lamp	:	LED Type : Schneider, L&T, RASS
14) Voltage Selector Switch	:	L&T, Salzer, Schneider
15) Ammeter Selector Switch	:	L&T, Salzer, Schneider
16) Control Cables	:	Finolex, Havell's, Polycab, KEI, Lapp Cables
17) Glands	:	Compression type, Heavy duty and deep

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threading with rubber-ring and double washers. (Sample to be approved)
HMI, Comet, Jainson, as per OEM

18) Cable Lugs : Dowells, 3-D (Copper long neck), Jainson, as per OEM

Special Notes :

- The successful tenderer will have to supply the makes from above in consultation with the Client/Architect/Consultant without any extra cost. Any deviation shall be brought to the knowledge of client / consultant, in a separate sheet with the offer.
- The final decision for accepting make specified by tenderer & or Deviations, would be of client/Architect/Consultants.
- As far as possible, the successful tenderer will have to place order directly to the manufacturer OR it's authorized dealer.
- Make of components required to be used by contractor to complete the installation, if not mentioned anywhere, shall be required to GOT IT APPROVED by Client/Architect/Consultant before installation in writing manner.
- Within a week of work order, the tender shall submit the sample of each item / GTP with GA Drawings for the approval of the Client/Architect/Consultant.

Please refer to the **CPWD General Specifications for Electrical Works (Part VII DG Sets-Latest Edition) - <https://www.cpwd.gov.in/Publication/DGSetsFinal2013.pdf>** (Download from this link)

CPWD – Central Public Works Department