ANNEXURE – 1

TECHNICAL SPECIFICATION FOR 1010 KVA Silent DG Set

1. Quantity	: 1 No
2. Rated Output	: Not less than 1010KVA
3. Nominal Voltage	: 415 Volts ± 5%
4. Number of phases	: 3
5. Frequency	: 50Hz ± 3%
6. Power Factor (Lagging)	: 0.8
7. Fuel	: HSD
8. Overload Capacity	: 10% of the rated capacity for 1 Hr. in the Interval of 12 Hrs.
9. Operating condition	: Max temperature: 40°C Max, R.H: 80%
10. Electrical system	: The DG shall be equipped with AMF Panel (Auto Main Failure), Auto/ Manual synchronisation and Auto Load Sharing.

General Arrangement:-

I. Work Covered by the tender shall include supply, transportation, delivery, installation, testing, commissioning of 1 no 1010 KVA DG set with auxiliaries required for prime power generation. The DG set shall consist of a diesel engine coupled to an electric alternator together with the necessary control panel, battery bank, fuel tank (existing), Chimney, Interconnected piping for Lube oil, Fuel and cooling system, All Control Cabling between Engine, Alternator, Engine mounted panel and AMF panel, Earthing etc. and accessories to provide prime electric power. The coupling arrangement between Engine and alternator shall be flexible, flywheel to suit flexible coupling and with flywheel housing and guard. The engine and alternator shall be mounted on a common rigid base frames fabricated from MS sections. The base frame shall be resting on Anti Vibration Mounting Pads placed on a Concrete bed. Concrete bed and other allied civil work will be provided by BHEL for which drawings shall be provided by the vendor.

II. The DG set shall be complete with all equipments, indications and controls required for fully reliable and safe operation of the DG set whether specifically stated in the specification or not. Any deviation from the tendered specification shall be listed and clearly indicated in the bids. It is essential that the operation of all protection equipments be completely reliable in all respect.

Detailed Description of Components:-

A. **Acoustic Enclosure:-**

- The DG set will be placed in the existing acoustic enclosure
- The modification of acoustic enclosure is in the scope of BHEL. The actual dimensions of bare DG set to be provided by the vendor

B. **Engine**: -

The Engine of DG set shall be prime rated of sufficient BHP to generate 1010KVA of power at not more than1500 rpm at 0.8 PF on the output Terminals of its coupled alternator. The engine shall have 10% overload capacity for one hour in every 12 hours of operation. The Engine shall be complete with radiator cooling system, Fuel system including piping and Day tank, Lube oil system, Air intake system, Exhaust System with silencers and chimney stack, Speed regulation system, Battery assisted engine starting system, and Engine mounted Control and Protection system. The engine shall conform to relevant standards and CPCB emission norms.

Cooling System:

The engine shall be radiator cooled with coolant pump, Radiator cooling fan with guard, coolant with premixed corrosion inhibitor, and Engine water temp sensors.

Lube Oil System:

Lubrication shall be forced feed through engine driven lube oil pump, lube oil priming pump(if required), strainers, Filters, lube oil cooler, lube oil sump tank, bypass system, lube oil temperature and pressure sensors. Initial filling of lubricating oil will be in the vendor scope.

Air intake system:

The aspiration of the engine shall be through air manifold turbo charger with Inter/After Cooler. It shall have sealed dry air filters. All filters have replacement elements.

Starting system

24 Volts DC starting motor complete with high capacity lead acid batteries, battery charging alternator, cables, lugs, battery stand and battery charger panel.

The Ampere Hour rating of the battery bank shall be sufficient to take care of at least three (3) Consecutive starting cycles, at the most unfavorable condition.

The charging system shall be suitable for operating on AC single phase supply to maintain the charge of the batteries while the plant is in idle mode. The system shall be able to Withstand at least 10% voltage fluctuation in supply voltage. In all cases the batteries shall be kept fully charged but protected against overcharging.

Fuel System

Fuel solenoids, Fuel injection pump suitable for Electronic Governor, Fuel filters, Fuel injectors, interconnected piping of MS Class-B, for supply and return lines from existing day tank at BHEL-EPD.

Scope shall also include piping work from the existing bulk storage tank line to the day tank with all required fittings, valves and necessary modification work to the existing line (approx. piping length shall be 15 mtrs).

Exhaust system

The exhaust system shall be complete in all respect with major components like exhaust piping of MS Class-B for chimney, expansion joint (bellow type), vibration dampers, exhaust manifold, etc.

The exhaust system shall be equipped with muffler/silencer in order to limit the sound level specified as per latest CPCB/MOEF norms.

The pressure drop in the exhaust piping including muffler, bends, and expansion joints shall be compatible with the exhaust gas leaving the engine for free flow of gases.

The entire length of the exhaust pipe up to the chimney height shall be insulated with suitable thermal insulation and 24 gauge Al cladding shall be wrapped over that.

The chimney height shall be raised up to the height in accordance with the latest updated CPCB/MOEF norms. Suitable support structure anti rust treated and two coats of Aluminium paint shall be provided for proper installation of stack. The structure shall be painted with one coat of primer and two coat of anti-corrosive and heat resistant paint.

Lighting arrester with Earth conductor and LED aviation lamp with suitable cabling shall be installed on top of the chimney support structure. Sampling port for routine monitoring of the exhaust gasses shall be provided in the stack, with suitable platform and protective railing for a person. A port for scrubbing of the ash content shall be provided. Bidders to provide a schematic and constructional features in Techno-commercial bid.

Civil works like bed for chimney support structure shall be provided by BHEL for which vendor shall provide required drawings.

Speed Regulation System:

The engine shall be provided with Electronic type Class A1 Governor. The speed regulation shall be maintained within ± 1% of the rated speed. The governors shall be suitable forsingle/ parallel operation and load sharing among different rating and speed of DG sets. Local/ remote speed low/ Raise controls shall be provided.

Engine Control and Protection System:

The following Microprocessor based Engine controls, protection and metering with MODBUS Connectivity shall be provided on the DG Set mounted panel:

Controls:

- Start/ Stop
- Local and Remote Start/ Stop

Indications/ Meters:

- Engine Coolant Temp
- Lube oil pressure, Temp
- RPM
- Engine hours running
- Battery Voltage
- Engine Over speed shutdown indication
- Low lube oil pressure trip indication

Protection:

- Engine Over Sped Shutdown
- Low lube oil pressure
- High coolant temperature

C. **Generator (Alternator):**

The Alternator shall be synchronous, brushless, self-excited, self-regulated, naturally ventilated, 1010KVA rated at 0.8 pf (lag), 3 phase neutral system, 415V, 50 hz, running at not more than 1500 RPM. Insulation class "H". The alternator shall have double bearings.

The Alternator shall have necessary inherent regulation and for close regulation there shall be automatic voltage regulation (AVR). The AVR for the generator shall be panel mounted where a control knob shall be provided for voltage control for synchronisation and voltage raise/ lower feature should be compatible with auto synchroniser for parallel operation.

Alternator shall have following characteristics:-

I. Voltage regulation of ± 1% at loads from no load to full load and power factor 0.8 lagging to unity.
II. Overload capacity of 10% of rated capacity for one hour in every 12 hrs of operation.
III. Voltage & frequency variation of 415±5% & 50±3% respectively.
IV. Alternator shall be provided with QDCTs, RTD & BTD.
V. Alternator shall be provided with CTs for differential protection and restricted earth fault.

D. Neutral Earthing

Neutral earthing shall be made with suitable neutral grounding resistance (NGR) and neutral isolation switch (NIS).

E. AMF Control and Protection Panel:

The Panel shall be fabricated out of 14G Sheet steel for doors and 16G sheet steel for others. The steel work shall be given anti rust treatment and finished with powder coating. The panel shall be mounted on base MS 'C' Channel frame work. All control wiring shall be done using copper conductor 1100V grade FRLS PVC insulated wires with suitable ferrules and lugs. 1.5 sq. mm. for control circuits and for power circuits the size shall be suitable for equipment rating. The panel shall be complete with all necessary internal wiring, control circuit relays and terminations. All circuit components, control switches, indicator lamps and push buttons shall be clearly identified by name plates.

The DG set shall be fully automatic start with overriding facility for manual operation and also during emergency/ test function. In auto mode operation, the set shall come ON and take load in case of mains failure (AMF).

The DG set shall be able to be synchronized with other DG sets in auto and manual mode with auto load sharing.

Selection controls for Synchronizing with DG in Auto/Manual mode shall be provided. CSR (check Synchronization relay), Synchronous Scope, Double voltmeter, Double frequency meter, Voltage Raise/lower switch and speed Raise/Lower switch for manual mode of operation shall be provided. Load sharing shall be automatic in manual synchronization also.

The following LED indications shall be provided:

R, Y, B Generator supply
Generator Breaker ON/OFF
Generator Breaker Spring Charge

The following flush type meters shall be provided:-

- Ammeter.
- Voltmeter.
- Frequency meter.
- Power factor meter.
- kW meter.
- kWH meter.
- Excitation current and voltage.

The following protection shall be provided:-

- Over current

- Earth Fault
- Reverse power
- Over/ Under Frequency
- Over/Under Voltage
- Differential.
- Restricted earth fault
- Engine protection like High Coolant Temperature, Low Lube Oil Pressure, Over Speed

The following Alarm/Annunciation shall be provided:-

- High engine coolant temperature
- Low lube oil pressure
- Over Speed shutdown
- Fail to start
- Over/under frequency
- Over/under Voltage
- Over current
- Earth fault
- Reverse Power
- Differential winding fault
- High Alternator Winding temperature.
- High Alternator Bearing temperature.

Note 1: Remote monitoring and control of the DG set shall be provided optionally.

F. **Make of Materials:** As per attached Annexure-3

G. **Test and Inspection**

Test of the DG set shall be conducted at Manufacturer's premises to be witnessed by BHEL representatives. The scope of the test shall be as per relevant standards. A comprehensive Quality Assurance plan (QAP) for the DG set and bought out/sub contracted items to be submitted and got approved by M/S BHEL after placement of order.

At Manufacturer's works:-

The acceptance test shall be conducted as per relevant standards during testing/inspection at manufacturer's works. The DG set shall be subjected to full load for 2 hrs minimum and 10 % overload operation.

At site:-

- The DG set shall be subjected to full load for 12 hrs. and for 1 hr. at 110% load during the 12 hour of operation. (BHEL will provide load and HSD)
- Guaranteed Specific fuel consumption shall be established.
- Noise level measurement shall be carried and guaranteed noise level shall be established.

- Engine manufacturer's certification towards Emission parameters under CPCB/MOEF norms is required.

H. Documentation

Two sets of following documents in hard copies (In English) and one set of soft copy should be supplied along with the DG set.

- General Arrangement (GA) drawing.
- Operation and maintenance manual and spare parts manual of the DG set.
- Piping and Instrumentation diagram for cooling water system and Fuel oil system.
- Schematic drawing of engine control electrical circuit.
- Engine and alternator Type test and Routine test certificates.
- Operation and maintenance manual for AMF and Synchronizing operations.
- Operation and maintenance manual for batteries and battery charger.
- Write up on control philosophy for complete emergency electrical system containing starting, stopping sequence, interlocks, metering, and annunciation, synchronization and Load sharing.
- Approval copies in original from statutory authority.

I. Standards:-

The equipment offered shall conform to the latest revision of the relevant Indian/International/ British standards and codes as indicated below:-

- Generating sets:- ISO 8528:Part1
- Engines: IS 10000, BS 5514, ISO-3046
- Alternator: IS 4722, IEC60034.

J. Guarantee:

The DG set shall be guaranteed for a period of 12 months from the date of Commissioning and handing over to BHEL or 18 Months from supply whichever is earlier.

ANNEXURE-3

Make of Major Components.

Sl No.	Name of component	Acceptable Make
1	Engine	Cummins/Mitsubishi/Caterpillar/Perkins/MTU
2	Alternator	Stamford/Toyodenki/Leroy somer

ACCEPTABLE MAKES OF OTHER MATERIALS

S.N.	Material	Acceptable Makes
1	L.T. ACB	Siemens / L&T / GE / ABB
2	L.T. SDU / FSU / SFU	Siemens/ L&T/ GE/ Havells
3	Change over switches	C&S / HPL/ Indo Asian/ Havells / L&T
4	Fuse & Fuse Distribution Boards	GE/ Siemens/ L & T./ Standard / Indo Asian / Havells/ C&S
5	Air break Contactors	Siemens/ L&T/ BCH / Telemechanique/ Schneider
6	Overload relays	Siemens / L & T/ BCH/ Schneider
7	Time delay relay	Siemens/ BCH/ L&T/ Schneider
8	Single phase Preventer	Siemens/ L & T/ BCH/ Schneider
9	Rotary/Selector switches	Siemens/ L & T/ Kaycee/ Thaker/ Reco /Switchtron/ Salzer
10	Limit switches	Siemens/ BCH/Essen
11	Toggle switches	Reco/ Kaycee
12	Push button & Indication Lamps	Siemens/ L & T/ Vaishno/ Technic
13	MCCB/ELCB/RCCB	Siemens/ L& T/ GE/ MDS / Legrand
14	MCBs & MCB Boards	Siemens/ GE/ MDS / Legrand / Indo Asian/ BCH/ C&S
15	Industrial Plug & sockets	Crompton/ BCH/ Legrand
16	Measuring Instruments	AE/ MECO/ IMP/ Conserve/ Alacrity/ Elmeasure

17	Energy Meters	BHEL/Conserve/ Alacrity/ MECO/ Elmeasure
18	Protective Relays	AREVA/ Easun Rerole/ EMCO/ ProkDvs
19	Motors	BHEL/ Siemens/ ABB/ Crompton/ Kirloskar/ AEI/ BEACON
20	Motor Starters	Siemens/ L&T/ BCH
21	CTs & PTs	TELK/ Kappa/ Siemens/ Indcoil/AEL/ Kalpa
22	Control Transformers	Indcoil/ Emco/ Kappa/ Kalpa/AEL
23	Cables	CCI/ Universal/ Fort Gloster/ Asian/ Nicco/ Premier/ Polycab/ Havells
24	PVC insulated copper wires	Finolex/ Wincap/ Polycab/ Anchor
25	Light fittings	Philips/ GEC/ Crompton/ Bajaj/ Wipro
26	Cable Glands	Dowels / Lotus/ Braco / Comet / Jainson
27	Copper Lugs	Dowell / Comet / Uma

Note: 1) Vendors shall use only Standard / ISI marked items after approval of Engineer-in-charge of BHEL, for items not listed above.

2) Vendors intending to supply of materials other than those makes as listed above shall indicate the MAKES considered in their offers with the catalogues. The right of accepting such alternate makes rests with the BHEL.