MODEL TECHNICAL SPECIFICATION

SECTION- DIESEL GENERATOR SET (D.G. SET)

REV. NO. : 5

Following are the major changes made in the Technical specification, Section-D.G. Set, Rev. No.5:

S.No.	Major Modification
1.	Net output of DG Set is specified at ambient temperature of 40 degree Centigrade and at an altitude of 1000 meters
2.	Technical parameters for various ratings of DG Set summarized in a table
3.	Specification for 100KVA & 500KVA DG Set also included in the specification
4.	SMPS based battery charger
5.	Microprocessor based controller for control, metering and alarm
6.	Capacity of Battery & Battery Charger specified
7.	Type test clause revised : Type Test report for diesel engine and alternator shall not be required for the makes listed in Compendium of Vendors of POWERGRID

Note: The above is the list of major changes with respect to previous revision (Rev. 4). However, the bidders are advised to read the entire section/chapter for other changes and quote accordingly.

SECTION: DIESEL GENERATOR SET

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SECTION: DIESEL GENERATOR SET

1.0 SCOPE OF SUPPLY

The scope covers supply, erection testing and commissioning of Diesel Generator set of stationary type. The D.G. Set shall have a net electrical output as specified in the BPS, under the site conditions of 40^{o} C ambient temperature & 1000 meters altitude. This net electrical output shall be measured after reducing all power consumptions for D.G. Set auxiliaries.

The scope of supply for DG set shall include the following:

(a) Diesel engine complete with all accessories such as Engine Cooling and lubrication system, Engine air filtering system, Exhaust silencer package, Fuel Intake System etc.

(b) An alternator directly coupled to the engine through coupling, complete with all accessories including Automatic voltage regulator etc.

(c) Complete starting arrangement, including two sets of batteries & SMPS based battery chargers

(d) Base frame, mounting pads, foundation bolts, etc (as required)

(e) Fuel Tank (Outside the Acoustic Enclosure)

(f) Set of MS pipes, valves, strainers, unloading hose pipes as required for fuel transfer system from storage area to fuel tank including electrically driven fuel pump

(g) All lubricants, consumable, touch up paints etc. for first filing, testing & commissioning at site. The fuel oil for first commissioning will also be provided by the contractor

(h) AMF panel & Microprocessor based controller (As per Annexure-B) for control, metering and alarm

(i) Enclosure for silent type D.G. Set enclosing Engine & the Alternator to make it work silently (with in permissible noise level as per CPCB norms) and suitable for outdoor installation.

2.0 SCOPE OF SERVICE

The Contractor shall provide following services:

(a) Design, manufacture, shop testing including assembly testing of engine & alternator

(b) Despatch& transportation to site

(c) Erection, testing & commissioning with all equipments/materials required for the purpose

3.0 D.G. SET TECHNICAL PARAMETERS

Major technical parameters for various rating of DG Set(s) are specified at Annexure-A to this technical specification.

4.0 FUEL TANK & FUEL PUMP

(a) The Fuel tank (as per Annexure-A) shall be provided on a suitably fabricated steel platform. Fuel Tank shall be kept outside acoustic enclosure & fuel piping shall be carried out to connect the D.G set kept inside the acoustic enclosure.

(b) For transferring fuel from bulk storage to fuel tank, transfer pump is envisaged. The capacity of transfer pump shall be adequate to fill the fuel tank in about 30 minutes. Fuel pump shall be electrically driven.

5.0 BATTERY & BATTERY CHARGER

(a) Two sets of Lead-acid batteries (capacity & quantity as per Annexure-A) complete with all leads, terminals and stand shall be provided. Arrangement shall be made inside the acoustic enclosure for housing the Battery set in a tray.

(b) The battery charger (230V, 1-Ph, 50 Hz) shall be SMPS based (rating as per Annexure-A) with provision for trickle/boost charge and complete with D.C. current & voltage display, battery charge status & loading indications, charger failures annunciation. Float charge mode shall have built-in current limiting features.

(c) One set of Battery & Battery Charger shall form an independent system, thus there will be two such systems i.e., Main + Standby systems for Engine Starting. In case of failure of main system, it should be possible to switchover the engine starting on the Standby system.

6.0 CONTROL AND INSTRUMENTATION INCLUDING AMF PANEL

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

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

(c) Testing facility for automatic operation of D.G.Set shall be provided in AMF panel.

(d) Microprocessor based controller shall be supplied for DG Set monitoring, metering and control system. A summary of all basic functions to be available in the DG Set Microcontroller are specified at Annexure-B.

(e) DG set shall be capable of being started/stopped manually from remote as well as local. For remote operation START/STOP push button is being provided in 415V ACDB. Interlocking of DG breaker shall be provided to prevent parallel operation of DG set with normal station supply.

(f) In addition to the shutdown conditions specified at Annexure-B, DG Set shall shutdown whenever any of the following conditions appear in the system :

1) Generator differential protection operated
2) Short circuit protection operated

(g) Following indication lamps shall be provided in AMF panel :

1) DG Mains /Alternator ON (R,Y,B phases separately)
2) Charger ON (For Both Chargers separately)
3) DG Set Breaker ON/OFF
4) Auxiliary LT Supply ON (For Source-1 & Source-2 separately)

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

(i) Following shall also be provided in AMF panel:

1) 3 Nos. single phase CT's for metering (Class-1, Output Burden=15VA)

2) 3 Nos. single phase CT's (Provided by LT switchgear manufacturer) with K_{PV} = 300V & R_{CT} = 0.25 ohm for differential protection of DG Set on neutral side.

3) One (1) Auto/Manual Selector Switch

4) Local/Remote Selector Switch for DG Set

5) A manual changeover switch to switch the ignition load on either Battery-Set 1 or Battery-Set 2

6) Two (2) Sets of Battery chargers

7) Necessary MCBs for LT Auxiliary Supply Distribution

8) Any other item required for completion of Control scheme shall be deemed to be included.

7.0 D.G. SETACOUSTIC ENCLOSURE

7.1 General requirements

(a) Diesel engine, alternator, AMF panel, Batteries and Chargers shall be installed in a suitable weather-proof acoustic enclosure. This enclosure shall be provided for protection from rain, sun, dust etc. Further, in addition to the weather proofing, Acoustic enclosures shall be designed such that the noise level of acoustic enclosure DG set shall meet the requirement of MOEF. The diesel generator sets should also conform to Environment

(Protection) Rules, 1986 as amended. The enclosure shall be suitably designed for temperature control inside the enclosure. The enclosure shall allow sufficient ventilation to the D.G. Set, so that temperature inside the enclosure is limited to 50°C. The enclosure shall have suitable viewing glass to view the local parameters of the DG Set through display unit of Microprocessor based controller.

(b) Fresh air intake for the Engine should be available abundantly; without making the Engine to gasp for air intake. A chicken mesh shall be provided for air inlet at suitable location in enclosure.

(c) The Enclosure and the layout of the equipment inside shall be designed in such a way that there is easy access to all the serviceable parts.

(d) Engine and Alternator used inside the Enclosure shall carry their respective manufacturer's Warranty and this shall not degrade their performance.

(e) Exhaust from the Engine shall be let off through Silencer arrangement to keep the noise level within desired limits. Interconnection between silencer and engine should be through stainless steel flexible hose/ pipe. Stack Height shall be governed as per CPCB guidelines.

(f) All the Controls for Operation of the D.G. Set provided in AMF Panel & Microprocessor based controller shall be easily accessable. There should be provision for emergency shutdown from outside the enclosure.

7.2 Construction Features:

(a) The enclosure shall be fabricated from at least 14 Gauge CRCA sheet steel and of modular construction for easy assembling and dismantling. The sheet metal components shall be pre-treated by Seven Tank Process and Powder coated (PURO Polyester based) both-inside and outside – for long life. The hardware and accessories shall be high tensile grade. Enclosure shall be given a lasting anti-rust treatment and finished with pleasant environment friendly paint. All the hardware and fixtures shall be rust proof and able to withstand the weather conditions.

(b) Doors shall be large sized for easy access and provided with long lasting gasket to make the enclosure sound proof. All the door handles shall be lockable type.

(c) The Enclosure shall be provided with anti-vibration pads (suitable for the loads and vibration they are required to carry) with minimum vibration transmitted to the surface the set is resting on.

(d) High quality rock wool of required density and thickness (as per Annexure-A) shall be used with fire retardant thermo – setting resin to make the Enclosure sound proof.

(e) Provision for Neutral/Body earthing shall be available. Points shall be available at two side of the enclosure with the help of flexible copper wires from alternator neutral, and

electrical panel body respectively. The earthing point shall be isolated through insulator mounted on enclosure.

8.0 DOCUMENTS

(a) Following drawings and data sheet shall be submitted for approval/information:

1) Data sheet for Engine, Alternator, Battery, DG Set Controller, AMF panel and Enclosure
2) GA drawing of DG set
3) Layout of DG set in the enclosure along with sections
4) GA and schematic of AMF panel and DG Set Controller.
5) Rating Plate (in English & Hindi)
6) Drawings, datasheets, design calculations and erection, operation & maintenance manual in hard & soft copies.
7) Certification and compliance for meeting noise level & emission parameters and other requirements in accordance with latest Notification of MOEF/CPCB.

(b) The DG Set shall be supplied with

1) DG Set test certificate
2) Engine Operation & maintenance Manual.
3) Engine Parts Catalogue.
4) Alternator Operation, maintenance & Spare parts Manual.
5) Alternator test certificate.

9.0 TESTS

9.1 Routine & Acceptance Tests

The Diesel generator set shall be tested for routine and acceptance tests in accordance with the agreed FAT procedure as per the relevant IS/IEC standards.

9.2 Type Tests

The type test report for diesel engine and alternator are not required to be submitted for the makes listed in Compendium of Vendors of POWERGRID. For the new makes, type test reports of engine and alternator as per relevant standard shall be submitted for purchaser's approval.

9.3 Commissioning Checks

In addition to the checks and test recommended by the manufacturer, the Contractor shall carryout the following commissioning tests to be carried out at site.

(a) Load Test

The engine shall be given test run for a period of atleast 6 hours. The set shall be subjected to the maximum achievable load as decided by Purchaser without exceeding the specified DG Set rating:

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

1) Ambient temperature
2) Exhaust temperature if exhaust thermometer is fitted
3) Cooling water temperature at a convenient point adjacent to the water output from the engine jacket
4) Lubricating oil temperature where oil cooler fitted
5) Lubricating oil pressure
6) Colour of exhaust gas
7) Speed
8) Voltage, wattage and current output
9) Oil tank level

The necessary load to carry out the test shall be provided by the purchaser.

(b) Insulation Resistance Test for Alternator

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

(c) Check of Fuel Consumption

A check of the fuel consumption shall be made during the load run for the purpose of proper tuning of the engine.

(d) Insulation Resistance of Wiring

Insulation resistance of control panel wiring shall be checked by 500V Megger. The IR shall not be less than one mega ohm.

(e) Functional Tests

1) Functional tests on control panel AMF Panel & Controller
2) Functional test on starting provision on the engine
3) Functional tests on all Field devices (like Fuel Transfer Pump)
4) Functional tests of AVR and speed governor

(f) Measurement of Vibration

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

(g) Noise Level check as per relevant standard

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

ANNEXURE-A

D.G. SET MAJOR TECHNICAL PARAMETERS

S.No.	PARTICULARS			
A	**ALTERNATOR**			
1.0	**Net Rated Outputat 40°C temperature & 1000m of altitude after reducing DG Set auxiliaries load**	500kVA	250kVA	100kVA
2.0	Rated Terminal Voltage	415V AC	415V AC	415V AC
3.0	No. of Phases	3	3	3
4.0	Rated Power Factor	0.8 lag	0.8 lag	0.8 lag
5.0	Rated Speed	1500 RPM	1500 RPM	1500 RPM
6.0	Rated Frequency	50 Hz	50 Hz	50 Hz
7.0	Standard	BS 2613/IS 4722/IEC 60034; latest edition		
8.0	Type of Exciter Used	Brushless, Self-Excited		
9.0	Class of Winding Insulation	Class H	Class H	Class H
10.0	Permissible Temperature Rise	Class F	Class F	Class F
11.0	Degree of Protection	IP-23	IP-23	IP-23
12.0	Overload Capacity	10% Overload for 1 hour in every 12 hours of continuous running		
13.0	Terminal Box	Seven (7) output terminals (R, Y, B, R', Y', B' & N)		
14.0	Each output terminal suitable for cable size of	2Runs of 630 sq.mm XLPE cable	2Runs of 300 sq.mm XLPE cable	1 Run of 300 sq.mm XLPE cable
	Neutral Formation	Inside AMF Panel	Inside AMF Panel	Inside AMF Panel
B	**ENGINE**			
1.0	Standard	IS 10002/BS 5514/ISO 3046/ IS 13018; latest edition		
2.0	RATING	As per Manufacturer Datasheet		
3.0	Rated Speed	1500 RPM	1500 RPM	1500 RPM
4.0	No. of Strokes	4	4	4
5.0	Cylinder Design	Multi-Cylinder	Multi-Cylinder	Multi-Cylinder
6.0	Type of Cylinder Arrangement	V-Type or Inline Type		
7.0	Method of Aspiration	Turbo-Charged		
8.0	Method of Engine Cooling	Water-Cooled (Through Radiator)		
9.0	Method of Starting	Battery Operated Auto Start		
10.0	Ignition Voltage	24V DC	24V DC	12V DC
11.0	Type of Governor	Electronic as per ISO 8528 or latest IS/BS standards		
12.0	Balancing	Dynamically balanced flywheel		
13.0	Air-Suction & Exhaust	Suction of air shall be from indoor for ventilation and exhaust flue gasses will be let out to outside atmosphere. & Condensate traps shall be provided on the exhaust pipe.		

14.0	Air Filter	Dry Type (Replaceable)		
15.0	Lubricating System	Forced (Closed Loop)		
16.0	Fuel Type	High Speed Diesel oil (HSD) as per IS:1460		
17.0	Fuel Injection	Mechanical/Electronic		
18.0	Emission Levels	In accordance with latest Notifications of MOEF/CPCB (certificate to be furnished)		
C	**ENGINE-ALTERNATOR SET**			
1.0	Maximum Starting Time	30 sec	30 sec	30 sec
2.0	Interval Between Starting Impulse	10 sec	10 sec	10 sec
3.0	Maximum no. of starting Impulse	3	3	3
4.0	Maximum Voltage Variation	± 1 %	± 1 %	± 1 %
5.0	Maximum Frequency Variation	± 2 %	± 2 %	± 2 %
6.0	Voltage Adjustment Range	90% to 110% of Nominal Voltage		
7.0	Balancing	Dynamic Balanced Rotor to minimize vibration		
8.0	Maximum Vibration Level	250 microns	250 microns	250 microns
9.0	Coupling of Engine & Alternator	Directly coupled by means of self-aligning flexible flange coupling & with a protecting guard to avoid accidental contact		
10.0	Mounting Arrangement	DG set enclosed in the acoustic enclosure shall be installed on Concrete Pedestal. Adequate number of anti-vibration mounting pads shall be fixed on the common base frame on which the engine and the alternator shall be mounted to isolate the vibration from passing on to the common base frame or the foundation of the D.G. Set.		
E	**BATTERY**			
1.0	Type	Lead-Acid	Lead-Acid	Lead-Acid
2.0	Capacity in AH	180 AH	180 AH	150 AH
3.0	Voltage of each Battery Set	24V DC	24V DC	12V DC
4.0	No. of Battery Set	2 Nos. (i.e. Main + Standby)	2 Nos. (i.e. Main + Standby)	2 Nos. (i.e. Main + Standby)
F	**BATTERY CHARGER**			
1.0	Type of Charger	SMPS based	SMPS based	SMPS based
2.0	Input	230V AC, 50 HZ, Single Phase		
3.0	Output Current	12Amps	12 Amps	10 Amps
4.0	Output Voltage	As per 24V battery system	As per 24V battery system	As per 12V battery system
5.0	Qty. of Battery Charger	2 sets	2 sets	2 sets
6.0	Automatic Float/Boost Charge Provision	Yes	Yes	Yes
7.0	Ripple	Not more than 1% (RMS)		

G	**FUEL TANK & FUEL PUMP**			
1.0	Capacity	990 ltrs (1 No.)	990 ltrs (1 No.)	990 ltrs (1 No.)
2.0	Material of Construction	MS Sheet	MS Sheet	MS Sheet
3.0	Sheet Thickness (Minimum)	2 mm	2 mm	2 mm
4.0	Accessories	Level Indicator, Filling Inlet with removable screen, outlet, drain plug, an air vent, air-breather and necessary piping		
5.0	Painting	Oil Resistant Paint		
6.0	Erection	In accordance with Indian Explosive Act of 1932		
7.0	Location	Outside Acoustic Enclosure		
8.0	Fuel Pump Type	Electrically Driven		
9.0	Fuel Pump Rating	Adequate to fill the fuel tank in 30 minutes		
F	**ACOUSTIC ENCLOSURE**			
1.0	Minimum Sheet Thickness	2 mm	2 mm	2 mm
2.0	Acoustic Material	Rockwool (Min.thickness 50mm)	Rockwool (Min.thickness 50mm)	Rockwool/ (Min.thickness 50mm)
3.0	Max. Noise Level	75 dBA at a distance of 1 meter (as per CPCB Norms)		

Annexure-B

DG SET CONTROLLER FUNCTIONAL REQUIREMENT

Measurement	Shutdown	Warning	Indication (LED)
Voltage : 3 Ph AC	Over Speed	On operation of any Protection Trip	DG Set Running
Current: 3 Ph AC	Over Load	Fail to Crank	Local/Remote Mode
Frequency	Under Voltage	Low Battery Voltage	Manual/Auto
Power Output (KVA)	Over Voltage	High Battery Voltage	Warning
Power Output (KW)	Low lube Oil Pressure	DG Set Failed to Start in 30 sec.	Shutdown
Power Factor	High Coolant Temperature	Low Level in Fuel Tank	
Engine Speed	High Temperature inside enclosure		
Running Hours	Alternator Fault		
Battery Voltage			
Lube Oil Pressure			
Coolant Temperature			

Notes:

1. Controller shall have configurable Time Delay for START/STOP of DG Set.
2. Controller shall have configurable cranking function to configure the number of cranking cycles (atleast 3 cranks) and time duration between successive cranks.
3. Controller shall also have the facility for adjustment of speed and voltage including fine adjustments in remote as well as in local mode.
4. Controller shall be IEC 61850 compliant (either directly or through a converter) for purpose of remote monitoring of the DG Set.