MATERIAL CODE EL8349010045

Rev.00:	Issued By	Prepared By	Checked By	Approved By	Date
Ist Issue	SPV PROD GROUP	[signature]	V. Srivastava [signature]	[signature]	11.7.19

1.0 TENDERER'S UNDERTAKING / CONFIRMATION

The tenderer is required to furnish the following undertaking / confirmation on his letterhead failing which his offer is not likely to be entertained. Here, the tenderer may also list out his own conditions or his deviations from the tender, if any, giving exact reference of specific clause of condition of tender keeping in mind that uncalled for deviations from tender or own conditions of the tenderer may result in rejection of his offer

To,
BHEL - EPD,
Malleswaram complex,

Bengaluru-560012

Dear Sirs,

NIT FOR 2000 KVA,11 kV DG SET INCLUDING ACOUSTIC ENCLOSURE, AMF AND PARALLEL OPERATION PANEL FOR PREMISES OF BHEL - EPD, BENGALURU CONFIRMATION OF OUR ACCEPTANCE OF TENDER CONDITIONS AND SPECIFICATIONS

We hereby confirm our acceptance of terms/conditions/specifications of NIT in full and further confirm that our offer is in total conformity with the requirement of specifications / conditions / BOQ / Drawings of the NIT.
We further confirm that our offer does not have any of our own conditions or any deviations from NIT except the following (The tenderer may list out his deviations / conditions, if any, here with adequate reference to the tender clauses. In case of no deviation, the tenderer may mention 'NO DEVIATION'. Additional sheets may be used, if required, but the number of sheets attached should be specified here.)

Signature (Tenderer)

1.1 THE WORK

In general, the contractor shall supply, store, erect, test and commission all the equipment required for DG set and associated Electrical Installation in conformity with relevant rules and regulations. The contractor shall furnish all the materials, Labour, tools and equipment accessories /systems for **EPD premises of BHEL at Bangalore** as per the schedule of quantity,specification & drawings.

Brief description of items included for **2000 KVA,11kV DG set , Quantity : 1 No**

a) Diesel Engine
b) Alternator
c) Acoustic Enclosure
d) Exhaust Chimney
e) AMF Panel & Parallel Operation Panel
f) NIS cum NGR panel suitable for 2000 KVA(11kV) DG set
g) 630A, 11kV VCB Panel (I/C & O/G)
h) Diesel Tank (Day Oil)
i) DG Controller
j) Cable & Cable jointing
k) Control/ Signal wiring
l) Exhaust Piping
m) Aviation Lighting & Lightning Arrester
n) Neutral & Body EarthingPit using Copper and GI plate.
o) Safety Items (33 kV Rubber Mats,Fire Stand with 4 Buckets, 33kV Rated Safety Gloves (02 Pair)
p) 11kV HT cable, Ladder and Perforated Type GI Cable Tray , HT End Termination Kit
q) CEA Approval from concern authority.

NOTE:

1) All Civil works such as Foundation of DG set, Exhaust support structure, DG Room, Cable trenches etc is excluded and will be in the scope of BHEL.
2) Material handling equipments like mobile crane(7 TON), forklift (3 TON) availble with BHEL will be provided. However Cranes or material handling equipment with higher capacity over and above indicated capacity has to be arranged by the supplier and the cost incurred for the same will be borne by supplier.
3) Vendors are requested to viste the site before submitting in the tender and meet Engineer-In-Charge
4) Vendor to submit the prelimanary layout drawing of DG set along with panels & chimney along with technical bid.

2.1 GENERAL SPECIFICATION AND CONDITIONS

2.1.1 LICENSED CONTRACTOR :

The contractor deployed for carrying the work shall be a licensed Electrical Contractor, possessing a valid Electrical Contractor's license in the state, employing licensed supervisors and skilled workers having valid permits as per the regulations of Indian Electricity Rules and local Electrical Inspector's requirements.

2.1.2 DEFINITIONS / ABBREVIATIONS :

The following abbreviations used in the Bill of Quantities specifications and drawings represent:-

I.S.S	:	Indian Standard Specifications.
B.I.S	:	Bureau of Indian Standards.
I.E.R	:	Indian Electricity Rules 1956 amended upto date.
B.S.	:	British Standard.
B.S.C.P.	:	British Standard Code of Practice.
H.R.C.	:	High Rupturing Capacity.
G.I.	:	Galvanized Iron.
MS	:	Mild Steel.
CI	:	Cast Iron.
PVC	:	Polyvinyl Chloride.
CT	:	Current Transformer.
OCB	:	Oil Circuit Breaker.
VCB	:	Vacuum Circuit Breaker.
ACB	:	Air Circuit Breaker.
CFS	:	Combination Fuse Switch.
MCCB	:	Moulded Case Circuit Breaker.
MCB	:	Miniature Circuit Breaker.
IC	:	Iron Clad.
ICTPN	:	Iron Clad Triple Pole & Neutral.
ICDP	:	Iron Clad Double Pole.
DB	:	Distribution Board.
KVA	:	Kilo Volt Ampere.
NC	:	Normally Closed.
KVAR	:	Kilo Volt Ampere - Reactive.
SWG	:	Standard Wire Gauge.

2.1.3 REGULATIONS AND CODES & STANDARDS :

The installation shall conform in all respects to Environment Pollution Control Rules 1986 and Central Pollution Control Board with regard to noise and air pollution, Indian Standard Code of Practice for Electrical wiring installations. It shall also be in conformity with the current Indian Electricity Rules and the Regulations and requirements of the local Electric Supply Authority in so far as these become applicable to the installation. Wherever this specification calls for a higher standard of materials and/or workmanship than those required by any of the above regulations these specifications shall take precedence over the said regulation and standards. In general, the materials, equipment and workmanship not covered by the above shall conform to the following Indian Standards, unless otherwise called for:-

i. Diesel Generators

a. Equipment :

Diesel Engine

IS-10000, BS- 5514 and as per standard practice of Diesel engine manufacturer's association of USA.

Generator

IS-4722/ IEC-60034, IS 12065, IS 12075

Fuel Oil for DG Set IS 15217 Diesel Fuels – Specifications IS 1460

Recommended Practice for Hot-Dip Galvanizing of Iron and Steel IS 2629 Methods for testing uniformity of coating of zinc coated articles IS 2633

b. Installation:

The installation work shall conform to Indian Electricity Act and Indian Electricity Rules as amended up to the date this specification is issued. Any approval required from statutory authorities shall be obtained by the Contractor. Nothing in this specification shall be construed to relieve the Contractor of this responsibility.

c. Performance:

Equipment complying with other internationally accepted standards such as ASA, IEC, B S , V D E e t c . will also be considered if they ensure performance and constructional features equivalent to or superior to standards listed above. In such a case, the Bidder shall clearly indicate the standard(s) adopted and also furnish a copy in English of the latest revision of the standards along with copies of all official amendments in force as on date of opening of bid. Bidder shall clearly bring out the salient features for comparison.

d. Type

Diesel Engine

Stationary type, four stroke, electric start with Vertical in line or 'V' type cylinder arrangement and turbo charged, water cooled with provision of 10% overload for 1 Hour in any 12 hour running duration.

DG set including stack height, acoustics, air emission and fuel oil installation shall meet the requirement given by gazette notification of Ministry of Environment & Forest, CPCB guidelines, all statutory requirement of Govt. of India and State Pollution Board Guidelines & as updated as on date of bid opening.

.ii. Technical Requirements

a)	Electrical Output	:	As specified in BOQ.
b)	Ambient temperature	:	50 degree
c)	Fuel	:	High Speed Diesel and also suitable for Ultra Low Sulfur Diesel (S<0.1%)
d)	Rated Speed	:	1500 rpm
e)	Duty	:	Round the clock continuous running, of which one hour at 10% overload at rated speed.
f)	Governor	:	Electronic Spreed Governor (A1 type as per BS:5514)
g)	Daily service Fuel tank	:	990 litres, fabricated from sheet metal complete with drain valve, air vent, and inlet and outlet connection. The fuel tank shall be floor mounted type placed outside the acoustic enclosure.
h)	Air intake system	:	Air intake manifold,Vaccum indicator, Dry type air filter, (minimum efficiency 90% down to 5 microns size)
i)	Cooling	:	Forced water-cooled for Engine & Air cooled for Alternator.
j)	Vibrations	:	Max. 250 microns peak to peak with anti- vibration pads.
k)	Paint Shade	:	As per DG set manufacturer standard practice.

iii. Switchgears :

Vacuum Circuit Breaker
Preferred Make : ABB, Schneider, Merlin-Gerin, GE, Siemens, C&G, L&T, Mitsubishi
Rated Voltage : 11/12KV
Rated Current : 630A
Incoming CT Ratio: 200/5 A or 200/1 A
Outgoing CT Ratio: 100/5 A or 100/1 A
SC Breaking capacity: 18-21KA/3Sec
No. Of Phases: 3
Making Capacity : 52.5 KA
Impulse Withstand : 75 KVp
Rated Frequency: 50Hz
Power frequency withstand Voltage : 28 KVrms
Meters (A / V / F / PF / KWH etc.), Preferred Make : RISHAB, L&T, SCHNEIDER,AE
Control Supply Voltage: 230V
Measuring Meter Type (DIGITAL), Preferred Make : Schneider and SEM
Ingress Protection rating : IP 54

NOTE:

a) Interlocking which prevents racking-in and racking-out of the circuit breaker when closed.
b) Interlocking which prevents manual or electrical closing of the circuit breaker in the intermediate positions between connected or isolated.
c) Interlocking which prevents either the circuit breaker from being racked in when the relative earthing switch is closed and the earthing switch from being closed with the circuit breaker racked in.
d) Bus bar compartment shall be provided with 3 single phase copper busbar of suitable size.
e) Type test cetificate for VCB to be provided with technical bid.

iv) Cables:

Code of practice for installation and maintenance of paper, insulated power cables (upto & including 33 KV)	I.S. 1255 - 1967
PVC insulated cables (For voltage upto 1100 V (Part-I) with Aluminium conductors	I.S. 694 - 1964 (Part-II)
PVC insulated (Heavy duty) electric cables Part-I for voltage upto 1100 V	I.S. 1554 – 1964

v) Accessories

Code of practice for earthing	I.S. 3043 – 1966
Glossary of terms for electrical cables and conductors	I.S. 1885 - 1971
Code of practice for safety of buildings (general) electrical installations	I.S. 1646 - 1961
Protection of buildings and allied structures against Lighting	I.S. 2309 - 1963
Current Transformers	I.S. 2705 – 1964 (Part-I to III)
Voltage Transformers	I.S. 3156 - 1965 & 1966 (Part-I to III)

2.1.4 INSPECTION AND APPROVAL OF THE WORK BY LOCAL AUTHORITY :
On completion of this work, the contractor shall obtain and deliver to the Employer / Owners/Engineer-in-charge the certificate of inspection and approvals by the Electrical Inspectorate o f Local Government and/or any other statutory authority as may be required. The Consultant/ Engineer-in-charge shall have access to the manufacturer's premises for inspection of any items of the tender for which the contractor has to make arrangement with different manufacturer minimum 15 days notice to be given to the consultants/Engineer-in-charge for the sam.e

2.1.5 DRAWINGS :
The Drawings, Specifications and bill of quantities shall be considered as a part of this contract and any work of materials shown on the drawing and not called for in the specifications or vice versa shall be executed as if specifically called for in both. The design drawings or tender drawings indicate the extent and general arrangement of various equipment and their wiring etc. and are essentially diagrammatic. The work shall be installed as indicated on the drawings, however any minor change if found essential to coordinate the installation of the work with other traders shall be made without any additional cost to the Owners. The data given herein and on the drawings is as could be secured but its complete accuracy is not guaranteed. The drawings and specification are for the assistance and guidance of the contractor. The exact location, distance and levels etc will, be governed by the space conditions. The contractor shall visit site and examine all relevant Drawings before starting the work and report to the Engineer-in-charge / Consultants any discrepancies which in his opinion appear on them and get them clarified. He shall not be entitled for any extras for commissions or defects in Drawings when they conflict with other work.

2.1.6 SHOP DRAWINGS :
The contractor shall prepare and submit to the Consultants/Engineer-in-charge for their approval detailed shop drawings of the entire installation within 7 days from the date of signing of contract. The approval of drawings however will not exonerate the contractor of his responsibility to execute the work as per conditions of the contract.

2.1.7 COMPLETION DRAWINGS :
At the completion of the work and before issuance of certificate of 'virtual completion', the contractor shall submit to the Owner, layout drawings drawn at approved scale indicating the complete work as installed, in 6 sets and the originals after securing approval of the same from the Consultants.

2.1.8 FOREMAN / SUPERVISOR :
The contractor shall employ competent, licensed qualified full time electrical foreman/ supervisors to direct the work of electrical installations in accordance with the drawings and specifications. The Foremen/Supervisor shall be available at all times on the site to receive instructions from the Consultants/Engineer-in-charge for the day to day activities throughout the duration of the contract. The Foreman/Supervisor shall correlate the progress of the work in conjunction with all the relevant requirements of Electricity Supply Authority.
The skilled workers employed for the work should possess competency certificate from the electrical Inspectorate of the Local Government for relevant work.

2.1.9 CLEANLINESS AND SITE CLEARANCE :
The contractor shall ensure to keep the site clean by removing the debris and waste/excess materials from the site then and there. All the fixtures, plant and equipment after their installation and commissioning shall be cleaned up by the contractor without leaving any marks or stains and a fresh coat of painting shall be applied before handing over.

2.1.10 GUARANTEE AND DEFECTS LIABILITY PERIOD :
The contractor shall guarantee that all equipment shall be free of any defects due to defective materials and bad workmanship and that the equipment shall operate satisfactorily and the performance and efficiencies of the equipment shall not be less than the desired values. The guarantee shall be valid for a period of 12 months, or more if so offered by tenderer, after taking over and any parts found defective shall be replaced free of cost by the contractor. If the performance during the guarantee period is not satisfactory, the guarantee will be extended till satisfactory which the performance should be found absolutely satisfactory. The services of the contractor's personnel if requisitioned during this period for such work shall be made available free of any cost of the Owner.

If the defects be not remedied within a reasonable time, the Owner may proceed to do so the contractor's risk and expenses without prejudice to any other rights.

2.1.11 PRICES AND RATES :
The prices quoted shall be basic cost plus all taxes, duties, freight, labour, installation, testing and commissioning etc complete as required to be indicated separately. The space allocated for major equipment shall be taken into consideration before ordering the equipment and equipment shall fit into the space provided with required clearances all around as per relevant ISS and IER or as per manufacturer's recommendations.

2.1.12 AGREEMENT :

Successful Tenderer shall be required to enter into an agreement as per Standard proforma. The Tenderer shall indicate specifically the service facility available at the site of installation for servicing the Generating Set during the guarantee period and also providing service beyond the guarantee period.

2.1.13 TESTING :

DIESEL GENERATING SET:

The following tests shall be conducted on Alternator and DG set:

Factory Tests:

The factory test shall incorporate the following:

i. Type tests.
ii. Routine tests.
iii. High Voltage test.
iv. Short Circuit current test.
iv. Instantaneous short circuit.
v. Insulation resistance test.

These tests **(ii to v)** shall be conducted as per the requirements of B.S.: 2613 or IS: 4722 and the copy of test certificates shall be furnished which should not be more than 5 years old from the date of inviting tender.

Valid Type test Certificates for the model offered shall be furnished.

Factory Acceptance Test

These should include a) 2 Hrs running of DG set at 90% rated load b) Temperature rise

Site Tests :

After the erection,commissioning,wiring and earthing of DG set, the following tests shall be conducted :

i. Insulation resistance of the generator.
ii. Speed, No-Load Voltage and full load voltage regulation.
iii. Frequency at no-load, half load & full load.
iv. Full load test for 2 hours at rated voltage, speed and frequency.
v. Trial run of the set for a minimum period of 2 hours continuously on No Load. On satisfactory completion of no load run the set shall be run for a period of three days for 8 hours every day at 100% load. Fuel oil etc shall be made available by BHEL for testing

The readings shall be observed with calibrated meters. Only one meter shall be used for the test. The readings shall be properly tabulated and submitted in Triplicate.

Testing of Controls:

All the safety controls and protective devices of the DG set shall be tested for correct calibration and operation. The results of the tests shall be tabulated and submitted in Triplicate.

3.1 TECHNICAL SPECIFICATIONS :

a) ENGINE

Air Intake System:
Air intake manifold,Dry type air cleaner,Vacuum indicator

Exhaust System :
Turbocharger,Flexible connection,Exhaust manifold,Residential silencer

Lubricating System :
Oil pan, Engine mounted lub oil pump, Full flow lub oil filter, Lube oil by-pass filter,AC motor driven Lube oil priming pump.

Fuel System :
Electronic Speed Governor & Electronic Speed Control Unit, PT fuel pump with Electronic Governor, PTD injector, 24V DC solenoid coil, Replaceable fuel filter. Starting System, 24V DC electric starter, 24V DC battery charging alternator

Cooling System:
Engine driven fan,Radiator,Radiator Guard,Gear driven Coolant pump,Thermostat

Switches & Sensors:
Low Lube Oil Pressure Switch,High Water Temperature Switch,Lube Oil Pressure Sensor, Water Temperature Sensor.

Others :
Vibration damper,Flywheel with housing

b) ALTERNATOR

Synchronous alternator of rating as specified in BOQ, suitable for continuous operation at 1500 RPM, designed at 50 °C ambient temperature generating 11kV at 0.8 pf. (lag), 50 Hz, 3 phase, 3 wire system. The alternator shall be brushless type, separately excited & self- regulated through an AVR. The alternator will be suitable for tropical climate and shall generally confirm to IS: 4722. The salient features of the alternator are:

- ± 1% voltage regulation (max) in static conditions.
- IP: 23 protection with class 'F' insulation & temperature rise limited to class 'F' insulation limited.
- Permanent lubricated sealed bearing.
- Permissible overload of 10% for one hour in 12 hours of operation

c) BASE FRAME

Engine and alternator are mounted, coupled and aligned on a common channel iron fabricated Base Frame with pre-drilled holes.

d) FUEL TANK (DAY OIL TANK)

Daily service fuel tank 990 ltrs from 14 SWG sheet metal complete with drain valve, air vent, inlet and outlet connection.The fuel tank shall be floor mounted type placed outside the acoustic enclosure.

e) BATTERIES

Number of batteries of 12V, 180 AH capacity in dry and uncharged condition with its leads as per DG requirement.

f) CONTROL PANEL

Control Panel shall be totally enclosed dead front dust and vermin proof pattern free standing type sheet steel 14 gauge construction incorporating & complete with the following devices for the DG Set.

1 Set DG control relay panel suitable for 2000 KVA(11kV) DG set
1 Set NIS cum NGR panel suitable for 2000 KVA(11kV) DG set with Neutral Grounding Transformer (NGT) and Neutral Gorunding Resistor (NGR)
1 No. AC Ammeter of suitable scale with selector switch.
1 No. AC voltmeter 0-12 kV with selector switch.
1 No. Mode selector switch OFF/ALT/MAINS/LOAD.
1 No. Frequency Meter.
1 No. KWH Meter, 1 No. Hooter
1 Set Current Transformers of suitable ratio for Metering.
1 Set. Battery charger consisting:

a) Transformer and Rectifier.
b) DC Ammeter.
c) DC voltmeter.
d) Charging rate selector switch OFF/TRICKLE/BOOST.
e) Charging mode/fully charged mode indication

1 No. single phase preventer.
1 Set indicating lamps, 'LOAD ON SET' 'LOAD ON MAINS' fails to start battery charger, Low lube oil pressure, high water temperature.
1 Set push button, start, stop, reset.
Complete wiring and arrangement for auto start and required inter locking comprising generally the following or as specified in schedule of quantities

g) ARRANGEMENT :

The engine to be directly coupled to the Alternator through a specifically designed flexible coupling in order to form a compact arrangement and both the units engine and alternator to be mounted on a rigid fabricated steel bed plate including foundation bolts channels etc.

4.1 CABLES AND EARTHING :

4.2 CABLES :

4.2.1 GENERAL :
The cables shall be supplied, inspected, laid, tested and commissioned in accordance with drawings. Specifications, cable manufacturer's Instructions and Indian Standard IS: 1554-1976.

4.2.2 MATERIAL :
The MV cable shall be XLPE Aluminum conductor armoured cable of 11kV grade.

4.2.3 INSPECTION :
All cables shall be inspected upon receipt at site and checked for any damage during transit.

4.2.4 JOINTS IN CABLES :
The contractor shall take care to see that all the cables received at site are apportioned to various locations in such a manner as to ensure maximum utilisation and avoidance of cable jointing. This apportioning shall be got approved by the Engineer-in-charge before the cables are out to lengths. Where joints are unavoidable the location of such joints shall be got approved.

4.2.5 JOINTING BOXES FOR CABLES :
Cable joint boxes shall be of appropriate size, suitable for XLPE armoured cables of particular voltage rating.

4.2.6 JOINTING CABLES :
All cable joints shall be made in suitable, approved cable joint boxes, jointing of cables in the joint boxes and the filling in of compound shall be done in accordance with manufacturer's instructions and in approved manner. All straight T-joints shall be done in epoxy mould boxes with epoxy resin.

All terminal ends of conductors shall be heavily soldered upto atleast 50 mm length where applicable.

All cables shall be joined colour to colour and tested for continuity and insulation resistance before jointing commences. The sheath of cables must not be removed until preparations for jointing are completed. Joints shall be finished on the same day as commenced and sufficient protection from the weather shall be arranged. Joints shall be made by means of suitable solder for conductors, the conductors being firmly butted into the connections or thimbles or ferrules and the whole soldered with proper solder and soldering flux or crimped. The conductors shall be efficiently insulated with high voltage insulating tape and by using spreaders of approved size and pattern. The joints shall be completely topped up with epoxy compound so as to ensure that the box is properly filled.

4.2.7 CABLE TERMINATIONS :
Cable termination shall be done in cable terminal box using cable glands and the cable ends sealed with sealing compound

4.2.8 BONDING OF CABLES :

Where a cable enters any piece of apparatus, it shall be connected to the casing by means of an approved type of armoured clamp and gland. The clamps must grip the armouring firmly to the gland or casing, so that no undue stress is passed on the cable conductor due to vibration. The glands shall be fixed to the lead sheath by means of either a 'plumbing joint' or a cone of approved material, capable of being compressed into lead sheath. The gland or cone shall be capable of effecting a good electrical bond between both the armouring of the cable, and the casing.

4.2.9 LAYING OF CABLES :

Cables shall be laid by skilled and experienced workmen using adequate rollers to minimise stretching of cable. The cable drums shall be placed on jacks before unwinding the cable.
Great care shall be exercised in laying cables to avoid forming kinks. The relative position of the cables, laid on the cable tray shall changes in direction in horizontal and vertical planes, the cable shall be bent smooth with a radius of bend not less than 12 times the diameter of cable. Distinguishing marks shall be made on the cable ends for identification. Insulation tapes of appropriate voltage and in red, yellow and blue colours shall be
wrapped just below the sockets for phase identification.

4.2.10 CABLES INSIDE BUILDING :

Cables inside buildings shall be laid on the cable trays/trenches. All cables passing through walls shall run through Asbestos Cement pipes of adequate diameter or as directed. Parallel
cables shall be spaced atleast 50 mm apart maintaining their relative position over the entire length.

4.2.11 TESTING OF CABLES :

Test shall be conducted for insulation between phases and between phase and earth for each length of cable, before and after jointing. On completion of cable laying work, the following tests shall be conducted in the presence of the Engineer-in-charge.

a. Insulation Resistance Test (Sectional and Overall)
b. Continuity/Resistance Test
c. Sheathing continuity test,
d. Earth test.

All tests shall be carried out in accordance with relevant standard code of practice and electricity rules. The Contractor shall provide necessary instruments, equipment and labour for conducting the above tests and shall bear all expenses in connection with such tests. All tests shall be carried out in the presence of the Engineer-in-charge.

4.3 EARTHING SYSTEM :

4.3.1 EARTHING :

All the non-current carrying metal parts of electrical installation shall be earthed properly. All metal conduits, trunking, cable sheaths, switchgear, distribution boards, light fittings
and all other parts made of metal shall be bonded together and connected by means of specified earthing conductors to an efficient earthing system. All earthing shall be in conformity with Indian Electricity Rules and Indian Standards IS: 3043-1966.

4.3.2 EARTHING CONDUCTORS :

Earthing conductors shall be of Electrolytic Copper and shall be protected against mechanical injury or corrosion.

4.3.3 SIZING OF EARTHING CONDUCTORS :

The cross sectional area of copper earthing conductor shall not be smaller than half of the largest current carrying conductor subject to an upper limit of 80 sq.mm. If the area of the largest current carrying conductor or bus bar exceeds 169 sq.mm. to provide atleast half the cross sectional area, of the current carrying conductor or bus bars. All fixtures, outlet boxes and junction boxes shall be earthed with 16 SWG copper wire. All single phase metal clad switches and distribution boards shall be earthed with 4 mm dia copper wire.

All 3 phase switches and distribution boards upto 60 amps rating shall be earthed with 2 Nos. distinct and independent 3 mm dia copper wires. All 3 phase switches and distribution boards upto 100 amps rating shall be earthed with 2 Nos. distinct and independent 4 mm dia copper wires. All switches, bus bar, ducts and distribution boards of rating 200 amps and above shall be earthed with a minimum of 2 Nos separate and independent 25 mm x 3 mm copper tape.

4.3.4 CONNECTION OF EARTHING CONDUCTORS :

Main earthing conductors shall be taken from the earth connections at the main switch boards to an earth electrode with which the connection is to be made. Sub-mains earthing conductors shall run from the main switch board to the sub-distribution boards. Final distribution boards earthing conduits shall run from sub-distribution boards.

Circuit earthing conductor shall run from the exposed metal of equipment and shall be connected to any point on the main earthing conductor, or its distribution boards or to an earth leakage circuit breaker. Metal conduits, cable sheathing and armouring shall be earthed at the end adjacent to switch boards at which they originate, or otherwise at the commencement of the run by an earthing conductor in effective electrical contact with cable sheathing. Where equipment is connected by flexible cord, all exposed metal parts of the equipment shall be earthed by means of an earthing conductor enclosed with the current carrying conductors within the flexible cord. Switches, accessories, light fittings etc which are rigidly secured in effective electrical contact with a run of metallic conduit shall not be considered as a part of the earthing conductor for earthing purposes, even though the run of metallic conduit is earthed.

4.3.5 PROHIBITED CONNECTIONS :

Neutral conductor, sprinkler pipes, or pipes conveying gas, water, or inflammable liquid, structural steel work, metallic enclosures, metallic conduits and lighting protection system conductors shall not be used as a means of earthing system. The electrical resistance measured between earth connection at the main switchboard and any other point on the completed installation shall be low enough to permit the passage of current necessary to operate fuse or circuit breakers, and shall not exceed 1 ohm.

4.3.6 EARTH CONNECTIONS :

All metal clad switch and other equipment carrying single phase current, shall be connected to earth by a single connection. All metal clad switches/equipment carrying medium voltage shall be connected with earth by two separate and distinct connections. The overlapping in copper strips at joints where required shall be minimum 75 mm. The joints shall be riveted and brazed in approved manner. Swathed lugs of adequate capacity and size shall be used for termination of all conductor wires above 6 sq.mm. size. Lugs shall be bolted to the equipment body to be earthed after the metal body is cleaned of paint and other oily substances and properly tinned.

4.3.7 RESISTANCE TO EARTH :
The resistance of earthing system shall not exceed 1 ohm.

4.3.8 EARTHING STATION (PLATE EARTHING) :
Earthing electrode shall consist of a tinned copper plate not less than 600 mm x 600 mm x 3 mm thick. The plate electrode shall be buried as far as practicable below permanent moisture level but in any case not less than 3 meters below ground level.
Wherever possible, earth electrodes shall be located as near the water tap, water drain or a down take pipe as possible. Earth electrodes shall not be installed in proximity to a metal fence. It shall be kept clear of the building foundations and in no case shall it be nearer than 2 meters from the outer face of the wall.
The earth plate shall be set vertically and surrounded with 150 mm thick layer of charcoal dust and salt mixture. A 20 mm GI pipe shall run from the top edge of the plate to the ground level. The top of the pipe shall be provided with a funnel and a mesh for watering the earth through the pipe. The funnel over the GI pipe shall be housed in a masonry chamber approximately 100 mm x 300 mm x 300 mm deep.

4.4 TESTING :

4.4.1 GENERAL :
At the completion of the work, the entire installation shall be subjected to the following tests:
1. Wiring continuity test.
2. Insulation resistance test.
3. Earth continuity test.
4. Earth resistivity test.

Beside the above, any other test specified by the local authority shall also be carried out. All tested and calibrated instruments for testing, labour, materials and incidentals necessary to conduct the above tests shall be provided by the contractor at his own cost.

4.4.2 TESTING OF WIRING :
All wiring system shall be tested for continuity of circuits, short circuits, and earthing after wiring is completed and before installation is energized.

4.4.3 TESTING OF EARTH CONTINUITY PATH :
The earth continuity of conductor metallic envelopes of cables shall be tested for electric continuity and the electrical resistance of the same, along with the earthing lead but excluding any added resistance or earth leakage circuit breaker, measured from the connection with the earth electrode to any point in the earth continuity conductor in the completed installation, shall not exceed one ohm.

5.1 ACOUSTIC ENCLOSURE

Vendor to visit and inspect the site condition and provide the acoustic enclosure as per CPCB guidelines and other statutory requirements. The technical offer shall provide the construction details of acoustic enclosure and compliance requirements of guidelines as above. The necessary civil works required for acoustic enclosure shall be described in technical offer which will be provided by BHEL.

Technical Specification for Acoustic Enclosure

a) The enclosure is to be fabricated out of CRCA sheet.
b) The sheet metal components should be hot dipped in NINE TANKS pretreated before powder coating.
c) Enclosure to be powder coated (inside as well outside) with a special pure polyester based powder. All Nuts and, bolt/external hardware should made from stainless steel.
d) The doors to be gasketed with high quality EPDM gaskets to avoid leakage of sound.
e) The door handles should be lockable type.
f) Sound proofing of enclosure to be done with high quality rock wool/mineral wool confirming to IS 8183.
g) The rock wool to be further covered with fibre glass cloth and perforated powder coated MS sheet.
h) Specially designed attenuators to be provided to control sound at air entry to the container and exit from the container.
i) Adequate ventilation to be provided to meet air requirement for combustion and heat removal.
j) As per CPCB norms with acoustic enclosure the noise level shall be 25 dBA at one meter under free field condition for DG set.

5.2 EXHAUST PACKAGE

The Exhaust Package consists of all components of Exhaust Assembly like hood, sound attenuator, fan, duct piece assembled together by means of flexible connections and then fixed rigidly on the supporting frame incorporating vibration isolation pads.

5.3 EXHAUST ASSEMBLY:

The exhaust assembly comprises exhaust hood, sound attenuator, fan and the duct piece placed on the supporting base frame in required sequence and fixed firmly on to the base frame. Flexible connections will be provided between sound attenuator and the fan and between fan and the duct piece.

6.1 VIBRATION ISOLATORS

Vibration isolators shall be provided for all moving (rotating) equipment to isolate vibration of equipment and prevent it from being transmitted to supports of the equipment, which may be foundations or suspenders. Such equipment may be the water chilling machines, DG Sets, pumps, motors, AHUs, CSUs/FCUs, fans etc. Vibration isolators shall also be provided for fluid / air carriers like pipes and ducts. The objective of these isolators will be to prevent the possibility of vibrations of equipment / materials getting transmitted to their foundations
/ supports / suspenders.
Depending upon the actual application different types of vibration isolators shall be provided to suit the actual requirement at site.

6.2 RUBBER FOOT ISOLATORS :

The rubber foot mountings shall be so designed that the rubber is protected from oil and physical damage and only good quality of synthetic rubber shall be used. It shall be loaded in shear and compression, a combination to give longer life with the best load / deflection characteristics. It should retain its cushioning effect and should have no tendency to get compressed and gradually become solid in due course of time.

7.1 LIST OF APPROVED MAKES FOR EQUIPMENT AND MATERIALS

Only approved makes for different materials / equipment as given below shall be used for this work. No other make shall be accepted. Any make listed below but not conforming to Technical Specifications/ Standards prescribed in the Tender shall not be accepted.

S.No	Description of Items	Manufacturer
1	**DG Set** : Preferred Engine Make:	Cummins/Caterpillar/Perkins / Mitsubishi
	Preferred Alternator Make:	Stamford/ Leroy Somer/ Kirloskar Electric / Crompton Greaves/ Jyoti
2a	AMF Panel & Parallel Operation Panel	Manufacturer of DG set whose DG set is accepted / Trinitron / KEPL / Tricolite
2b	LT Panels / Emergency Panel	Trinitron / KEPL / Tricolite
2c	Controller Make for Parallel Operation	Woodward Easygen 3500 XT
3	HT Cables (FRLS / XLPE Aluminium : 11 KV)	Finolex / Skytone / CCI/Polycab/Havells
4	LT Cables (FRLS / XLPE Aluminium : 1.1 KV)	Finolex / Skytone / CCI/ Polycab/Havells
5	Control Cables	Finolex / Skytone / National
6	PVC Insulated Copper Conductor FRLS Wires 650/1100 Volts Grade	Finolex / Skytone / CCI
7	Cable Glands (Double Compression)	Comet / Dowells
8	Crimping type Lugs / Thimbles	Dowells
9	Air Circuit Breaker (ACB)	L&T / Siemens / Alstom
10	Moulded Case Circuit Breaker (MCCB)	L&T / Alstom / Crompton
11	Miniature Circuit Breaker (MCB)	MDS / Havells / Siemens /L&T
12	E.L.C.B.	Legrand / Siemens / L&T
13	Starters, Contactors, Push Button and Overload Relays	L&T / Siemens / Crompton
14	Battery Charging Panel	Statcon / Exide
15	Batteries (Sealed Maintenance Free)	Amaron / Exide/Amron/Amco/Rocket
16	Battery Charger	Logicstat / BCH / Amaron / Volstate / HVL Knife
17	Current Transformers	Automatic Electric / Kappa / Maxgilbor
18	Analog Energy / Power Meter	IMP / Rishab (L&T) / SPI
19	Electronic Digital Energy / Power : Meter (A/V/PF/Hz/KW/KWH) with LED Display	Enercon / AE /Secure Meter
20	Toggle Switches, Selector Switches	Kaycee/ Salzer (L&T)

S.No	Description of Items	Manufacturer
21	Push Buttons and Indicating Lamps (LED Type)	Schneider / L&T (ESBEE) / Siemens / Vaishno
22	Protective & Auxiliary Relay	Alstom / ABB / L&T / Siemens
23	Overload Relays with Built-in Single: Phase Preventer	Schneider (Telemechanique) / ABB / L&T/ Siemens
24	Time Delay Relays	LT-LK / Bhartiya Cutler Hammer / L&T
25	APFC Relay (Digital Microprocessor: Based Compatible PC/PLC)	L&T / Siemens / Enercon
26	Timer	Schneider(Telemechanique) /L&T / Siemens
27	Changeover Switches	HH Elcon / Control & Switchgear
28	Switch Fuse Units, HRC Fuse	L&T / Siemens / Alstom
29	Capacitors Banks	Siemens / L&T / Ducati
30	Cable Tray	Slotco / Pilco / MEK
31	MS Conduits and its Accessories	Steel Craft / BEC
32	GI Strip and Earthing Material	Bharati / Indiana
33	Cable Tray	Indiana / Bharati / Slotco / Venus
34	Terminal Strip	Connectwell / Elmex
35	Jointing Kit XLPE (11 KV	Ray Chem / Xicon / Birla 3M
36	UPS (Online)	Tata Libert / Aplab / APC (American Power Co)
37	Portable Fire Extinguishers	Vijay Fire / Minimax / Reliable
38	Fuel Transfer Pump (flame proof	Kirloskar / Crompton / Bharat Bijlee /Thusako
39	Pipes / Valves / Sheet	
	a. MS Pipes upto 200mm dia	TATA Steel / Jindal Hissar
	b. MS Pipes above 200 & upto :400mm dia	SAIL /Jindal (HeavyDuty Factory Rolled)
	c. MS Pipes above 400mm dia	SAIL (Heavy Duty Factory Rolled
	d. GS Sheet : For All Thicknesses	SAIL
	For 22 G & 24 G	ISPAT / Nippon-Denro
	e. Aluminium Chequered Plate	Bharat Aluminium / Hindalco
	f. Gate / Globe Valve (Fire Safe)	Leader / Castle / Audco / Arpita
	g. Check Valve / NRV(Fire Safe)	Advance / Castle / Audco / Arpita
	h. Ball Valve (Fire Safe)	Advance / Castle / Audco / Arpita

S.No	Description of Items	Manufacturer
40	Axial Fan	Humidin / Nicotra / Comefri / Kruger
41 a)	Extruded Aluminium Grilles/ Diffusers (Anodised / Powder Coated	Caryaire/ Dynamic/ Opella / Ravi Star
b)	Volume Control Dampers	Caryaire/ Ravistar/ Dynamic/ Continental
c)	Butterfly damper	Caryaire/ Dynamic/ Ravistar/ Continental
d)	Fire retarding canvas for flexible connection and Hessian	Novair / Pyroguard
e)	Sound Attenuator	Caryaire/Ravistar/Noisecon/ Continental
42	Acoustic Lining	
a)	Fiberglass / Mineral Wool	Lloyd Insulation / Supreme /Owens Corning / Up-Twiga
b)	Hessian Fire Retarding	Navair/Pyroguard
43	Vibration Isolators	
a)	Springs, Neoprene Pads	Resistoflex / Emerald / Dunlop
b)	Flexible Connections	Flexonics / Mason / Resistoflex
44	Paint	Asian / Nerolac / ICI
45	Any Other Item	Make and sample to be approved by Consultants

Note : If make of any equipment / material required for the work is not available in this list, the same should be brought to the notice of B H E L by the tenderer in writing before submitting his offer.

8.1 EQUIPMENT DATA

The following information regarding the equipments offered shall be furnished by tenderer along with tender. The tenderer should fill out this proforma and attach to his offer along with technical catalogues / details without which the offer may not be considered.

S.No	Description	Details furnished by Tenderer
1.0	**DG Set (Engine + Alternator)**	
	a. Make and Model	
	b. Prime Power Rating : KVA	
	c. Output Voltage and Frequency	
	d. Power Factor	
	e. No. of Phases	
	f. Dimensions of assembled DG set : L x W x H (mm)	
1.1	**Engine**	
	I. PHYSICAL PARAMETERS :	
	a. Manufacturer	
	b. Make	
	c. Model	
	d. Configuration of Cylinders. (inline or vee-type, angle for vee-type).	
	e. Construction of body. (Mould casting or welded).	
	f. Number of cylinders	
	g. Bore : mm	
	h. Stroke : mm	
	j. Direction of rotation seen from fly wheel side (clockwise / anticlockwise).	
	k. Displacement : Cub, Inch, Ltrs :	
	l. Dimensions :	
	i. Length : mm	
	ii. Width : mm	
	iii. Height : mm	

S.No	Description	Details furnished by Tenderer
	m. Total net weight (Engine + Radiator and Fan) : Kg	
	n. Aspiration (Natural / turbocharged / turbocharged with cooling)	
	p. Fuel	
	q. Vibration Isolators	
	r. Governor (Electronic / Pneumatic / Mechanical / any other)	
	s. Type of coupling	
	t. Day tank capacity : Ltrs	
	v. Compression Ratio	
	w. Compression air intake at 100% load : M^3 per minute	
	x. Piston Speed : M/sec	
	II. PERFORMANCE PARAMETERS :	
	a. Power developed : Gross BHP	
	: Net BHP	
	b. RPM to give above output	
	c. Fuel consumption at full load with radiator and fan : Ltr per hour	
	d. Fuel consumption at 75% load with radiator and fan : Ltr per hour	
	e. Lube oil consumption at full Load :	
	: Ltr per hour	
	f. Lube oil system capacity : Ltrs	
	g. Air intake at full load : CFM	
	h. Cooling Capacity (Engine + Radiator): Ltr	
	j. Fan air flow across radiator : M^3/min	
	k. Exhaust Temperature : Deg C	
	l. Engine water flow : Ltr per min.	

S.No	Description	Details furnished by Tenderer
	m. Starting mechanism (Battery / compressed air)	
	n. Battery : Make	
	: Capacity-Amp hours	
	p. Battery charger : Make	
	q. Starting time : Seconds	
1.2	**ALTERNATOR :**	
	a. Manufacturer	
	b. Make	
	c. Model	
	d. Type (Brushless ?)	
	e. Power : KVA	
	f. Voltage regulation (± 1%?)	
	g. Insulation class :	
	h. P F :	
	j. RPM for above power :	
	k. Rating (continuous ?) :	
	l. Voltage (11 kV ?)	
	m. Voltage regulator (Automatic ?) :	
	n. Connection :	
	p. Rated voltage :	
	q. No. of Phases :	
	r. Standard Enclosure (IP class) :	
	s. Winding pitch :	
	t. Rotor winding :	
	v. Rotor (dynamically balanced?) :	
	w. Wave form distortion :	
	x. Total harmonic factor :	
1.3	**MAKE OF AMF & Parallel operation PANEL :**	
1.4	**VACCUM CIRCUIT BREAKERS :**	

S.No	Description	Details furnished by Tenderer
	a. Manufacturer :	
	b. Make :	
	c. Model :	
	d. Type (Electrical draw out ?) :	
1.5	**BUS BAR (COPPER) Dimension**	
1.6	**CABLE MAKE :**	
1.7	**FUEL PUMP :**	
	a. Manufacturer	
	b. Make	
	c. Model	
	d. Type	
	e. HP	
	f. RPM	
	g. Voltage	
	h. Suction/discharge size : mm	
	j. Capacity Ltrs / Hour	
	k. Head Metric	
1.8	**TIME FOR STARTING / LOAD TRANSFER :**	
	a. Minimum time gap between mains failure and starting & attaining full speed of the set. : Seconds	
	b. Minimum time gap between mains failure & transfer of full load to the set : Seconds	
	c. Specify stages if load is to be transferred to the set in stages and time taken by each stage and total time :	
	d. Confirm if the full load can be transferred at a time	
1.9	Total quantity of Lube oil for one charge.: Litres	

9.1 Pre-Qualification Criteria:

1.) Offer shall be for new equipment and not for any refurbished or used equipment.

2) Vendor should either be a OEM (Original Equipment Manufacturer) for Engine & Alternator or an Authorized Dealers/ Service Provider of the OEM for Engine & Alternator. Authorized Dealers / Service providers to submit the authorization and competency certificate issued from OEM in Supplying Engine & Alternator.

3) The vendor should have already supplied and commissioned a minimum of 05 nos. of 2000KVA,11kV or above rating DG Set in India during the past 5 years (01.04.2014 to 31.03.2019) and these must be operating satisfactorily. The details of the customers with contact details, DG Set installed, date of installations etc. to be provided. BHEL reserves the right for independent verification of the references provided

NOTE:

A) Vendors to have valid necessary contractor, supervisory and wireman permit licenses from Electrical Inspectorate for carrying out the work or vendor shall deploy approved electrical contractor having Electrical inspectorate permit on behalf of his company with validity to carry out the work during the year 2019-20 and the whole responsibility lies with the vendor.

B) Vendor should confirm compliance to all statutory conditions as per factories act and its relevant amendments for the Installation & Commissioning activity within the premises of BHEL. The workman of vendor should possess ESI, PF for executing the work at BHEL-EPD

SPECIFICATION REVIEWED AND APPROVED

	NAME	SIGNATURE
Prepared by	CHANDRA KETU	
	MOHAN J	
Checked by	VAIBHAV SHRIVASTAV	
	R.K. SINGH	
Approved by	S. ARUNACHALAM	
	CN PURUSHOTHAM	

Rev 00:	Issued By	Prepared By	Checked By	Approved By	Date
I st Issue	SPV PROD GROUP				11.7.19

BHARAT HEAVY ELECTRICALS LTD.,
ELECTRIC & PHOTOVOLTAIC DIVISION, IISC POST, BENGALURU - 560012

DEPARTMENT : SCR & WEX - Projects

Ref : PR No. 50003245
Date: 11.07.2019

LIST OF LINE ITEMS / BILL OF MATERIALS

Sl No.	Item / Description	Unit	Quantity	Rate	Amount	Remarks
1	2000 KVA, 11 kV DG SET WITH ACOUSTIC	set	1			The 2000 KVA DG set as per Purchase Specification No. SPV-UT-022 Complete inclusive of the following units / components and not limited to:
						a. Diesel Engine - 1 No
						b. Alternator -1 No
						c. Exhaust System - 1 No
						d. Diesel Tank - 1 No
						e. AMF & Parallel Operation Panel - 1 each
						f. Acoustic Enclosure for DG - 1 Lot
						g. Control & Signal Wiring
						h. Cable & Cable Jointing
						i. 11kV VCB
						j. NIS cum NGR panel
						k. Obtaining clearence /approvals from statutory bodies.
						l. Earthings
						m.Battery
						n. Power & Control Panel with HMI - Visual system and associated software - 1 Lot
						o. Additional / Associated equipment : Other accessories as required.
2	Installation and Commissioning of the system at BHEL - EPD	Set	1			
3	Training of BHEL Staff on Operation and Maintenance					
4	Technical Documentation, Software and other associated information					
5	Consumables for a period of 2 years	Set	1			Bidder to indicate and provide details (Optional)
6	Spare Parts package for a period of 2 years	Set	1			Bidder to indicate and provide details (Optional)
7	Vendor to provide the details for civil foundation (drawings & Layout) for DG set with acoustic and the same will be carried out by BHEL	Set				Bidder to indicate and provide details