ENQUIRY SPECIFICATIONS
FOR
415 V, 1500 RPM, 3X 630 KVA
EMEGENCY D.G SET& ITS ACCESSORIES
FOR

4X125 MW KOSTI POWERPLANT
KHARTOUM SUDAN

BHARAT HEAVY ELECTRICALS LTD
INDUSTRIAL SYSTEMS GROUP
OPP – IISC , Prof C.N.R. RAO CIRCLE
BANGALORE -560 012

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415 V , 1500 RPM , 3X630 KVA EMERGENCY DG SET

EX PORT JOB TO KOST SUDAN

INDEX

S E C T I O N – I

G E N E R A L S P E C I F I C A T I O N S

1.1 SITE CONDITIONS :

	UNIT	RANGE	PREF.GUARANTEE
Temperature of ambient air	C	-5 to 50	50
Relative humidity	%	38	38
Plant Elevation above MSL (assumed)	m	380	
Seismic coefficient		- As per Munich Re World Map of National hazards, the site is placed with maximum intensity of MMV on the Modified Mercalli (MM) scale of 4.9 (fairly strong)	

- Buildings and structures to conform to ICBO Uniform Building code (UCB)

1.2 POWER SUPPLY SYSTEM

System voltage /DG OUT PUT : 415, ±10% System
Frequency : 50HZ, +3% to –5%
Phase : 3ph, 3 wire.
System fault level : 50 kA R.M.S.for 1 sec.
System Grounding : Solidly Grounded System.
DG SET Neutral Grounding : Ungrounded for3Ph, 3 W
:

Supply for Engine Aux . load & its Panel.

1) AC Voltage — 3 PH 415 V & 1 PH , 220V AC
2) AC Control supply — 1Ph , 110 V AC / 1 Ph 220 V AC
3) DC Voltage for engine control & Instrumentation — 24 V DC,220DC.
4) AC Voltage for Space heater — 240 V

SECTION – II

APPLICABLE STANDARDS

1) The equipment & accessories covered by this Specification shall be designed, manufactured and tested in accordance with the latest relevant standards and codes of practice published by the Bureau of Indian / British Standards

2) The Diesel Engine ,Alternator & Electrical Panels & accessories shall also confirm to the latest Electricity Rules & other related Statutory agencies as regards safety, Ear thing and other essential provisions specified therein for installation and operation of Diesel Power Plant At M/S National Electricity Corporation KHARTOUM, SUDAN

Applicable Standards: -

BS : 5514, ISO : 3046 1 to 7 SAE J1349, IS - 10000		For Engine
IS- 1271, 2253, 4722, 4728, 4889, 6362, 7132, 7306, 7816, 12065, 12075, 12802, 13364, 13118, IEC- 600 34		For Alternator
IS-5, 1994		Color for ready mixed paints & enamels
IS-694, 1990		PVC Insulated cables for working voltage up to and including 1100 Volts.
IS-1248Part - 1 to 9, 1991		Direct acting indicating analogue electrical measuring instrument & their accessories.
IS-2026, Part-1, 1991		Power Transformers (General)
IS-2551, 1990		Danger Notice Plates.
IS-2705,Part-1, 2,3,4, 1992		Current Transformers
IS-3156,Part-1, 2,3,4, 1992		Voltage Transformers
IS-3231,Part-0, 1,2,3, 1992		Electrical Relays for Power System Protection.
IS-5082, 1991		Wrought Aluminum & Aluminum alloy bars, Rods, Tools & Sections for Electrical purpose.
IS-5578, 1991		Guide for marking of Insulated Conductors.
IS-7372, 1995		Lead Acid storage batteries for Motor vehicles.
IS-8623, Part-1, 1993		Low voltage Switchgear & Control Gear assemblies.
IS-8923, 1990		Warning Symbol for dangerous voltages.
IS-9224, Part-2, 1991		Low Voltage Fuses : Supplementary requirement for fuses for Industrial applications.
IS-12065, 1987		Classification of degree of protection provided by enclosures of electrical equipments.

This above list is not exhaustive. Standards not listed above but are applicable also to be followed to meet requirement.

SECTION - III

TECHNICAL SPECIFICATION

Description : This specification defines the requirement of design, manufacture, testing & commissioning performance test at site and supply of the **415V, 3X630 KVA ,1500 rpm, 50Hz, 0.8 p.f, 3ph,50 degree ambient temp, Emergency DG set with its auxiliaries** . including engine mounted panel , commissioning spares , special tools . It will be the responsibility of supplier to design and supply the DG set complete with all accessories for successful and integrated operation of the plant and to meet the performance guarantee requirement .DG set shall be Manufactured & supplied in accordance with Latest Govt of India Gazette rule regarding reduction of noise level and exhaust height .

A.1) SCOPE OF SUPPLY FOR Each DG SET :

Sr. No	Description	QTY
1.	Emergency DG Set of capacity **630 KVA 50Hz , 415V, 1500 rpm**, complete with engine & Governor coupled with Alternator, AVR ,QDCT , NCT/VT & engine mounted control panel suitable for Electric Starting & AMF feature with Engine mounted radiator on common base frame with Foundation bolt / AVMS, Silencer, bellow & water ,fuel , lube oil piping on skid including Commissioning spares .**Alternator with class H Insulation and Temperature limited to B**	1 Set
2.	Fuel tank of 990 Ltr. Capacity with fuel pipes , gauges , level sensor and required hard wares. The day tank will be filled with Motorized pump from the Barrel/tanker(All required piping, valves etc shall be included)	1 set.
3.	Battery and Charger : It shall confirm to requirement of IS -7372 1) Battery and Charger for engine starting : Lead – Acid auto motive/ Maintenance free type of suitable capacity (Min. capacity 24V, 360 AH) with lead and wooden stand suitable for performing more than six consecutive start of engine without re charging . In any case continuous cranking for at least one minute shall be possible. 2) Battery and Charger for control supply : Min capacity 24v , 180AH Maint.free Battery.	1Set
4	First fill of Lub oil , JC water and diesel, coolant and other consumables	Lot
5.	Exhaust piping , insulation & hangers and Support structure starting from engine to out side DG Room Approximately 30 Mtrs height meeting pollution control norms .Aluminum cladding in side the DG Room for Exhaust(*FABRICATION OF SUPPORTS STRUCTURES and Exhaust pipes in KGS per DG should be quoted)*	1 Set
6.	Interconnecting Power & control cable for Cabling between the package equipment includes item supplied by vendor & panel supplied by BHEL with lugs, cable glands , termination kit, ferrules, cable tie and hardware's etc.inside DG Room.	Lot
7.	GI Cable trays and rack (GI supports) with all cable tray accessories & hardware's etc inside Each **DG Room. size – 18mtrs x14 metersX7mtrs**	Lot
8	Acoustic enclosure for DG Set in accordance with Latest Govt of India Gazette rule/NEC –SUDAN, regarding meeting noise level of 75 db at 1 meters..	1set
10	COMMISSIONING SPARES AS REQUIRED DURING COMMISSIONING	Lot
11	Special Tools &Tackles	1 set

12	**Supervision of Erection and Commissioning of Entire Package at site** 1) Supervision of Erection of Entire Package 2) Testing & Commissioning , load trial , PG Test of entire Package . Technician / electrician will be provided by BHEL as commissioning assistance during commissioning **.**	1 Package
13	QDCT-2NOS,NB2 RELAY(SUITABLE FOR AMF OPRATION),NVT/NCT-1NO should be in supplier scope and to be dispatched with in two months from the LOI to the panels manufacturer(except QDCT)	Per set
14	Mandatory spares as per section -v	lot
15	10 Years recommended spares should quote along with the list	lot

B) DETAILED TECHNICAL SPECIFICATION : DG Set shall automatically start to meet the load requirement in the event of Power failure.

1.0 DIESEL ENGINE: Engine Direct Injection Charged After Cooled Four Stroke, cylinders V arrangement , water cooled, turbo charged manufactured as per BS:5514 with an overload capacity of 10% for one hour in every 12 continuous operation, and suitable for emergency operation of generating set of 630 KVA 50Hz , 415V, 1500 rpm with standard accessories and attachment at site conditions.

1. Engine with all standard accessories
2. Exhaust silencer
3. Engine & Alternator fasteners.
4. Base frame and coupling.
5. EMCP

PRODUCT CONSIST :

a) Cooling system : Totally air cooled are preferable. However ,In case jacket water cooling system is offered same to be in closed cycle and shall have radiator located in front of engine with fan driven mechanically from engine shaft. Forced water circulation by means of pump driven by engine shaft .

Water cooling Radiator Consists of :

1) Radiator with temperature control valve
2) Engine driven water circulating pump
3) Jacket Water Pump, Gear Driven, Centrifugal.
4) Blower fan, fan drive and fan Guard
5) Expansion /Make -up water tank
6) Thermostat .
7) Self contained piping.

b) Fuel System : HSD shall be Provided as fuel for the diesel engines. Fuel system including fuel day tank, Control valves, PRVs etc.. Fuel system Consist of :

1) Injectors with pump

i. Fuel filters with service indicator
ii. Self contained flexible piping
iii. Fuel oil manifold with filter
iv. Fuel piping and fitting between engine & day tank
v. Fuel Day Tank - Capacity 990 ltrs should have minimum following provision

Overflow pipes , Drain valve for Fuel Tank, Vent connection for Fuel Tank,Fill connection for Fuel Tank, Inspection and Cleaning Hole for Fuel Tank, Level Gauge and Level Indicator for Day Tank.

vi)The day tank will be filled with Motorized portable pump pump from the Barrel/tanker(All required piping, valves etc shall be included)

c) Lubricating system : Auto matic pressure lubrication shall be provided by shaft driven gear type pump through an oil coole**r** and filter to end bearing, cam shaft bearing et**c** during DG Sets operation.

Lubrication System Consist of :

vi. Valves
vii. Oil pump
viii. Strainer
ix. Lube oil cooler
x. Bypass filter
xi. Self contained piping
xii. Pre lube Oil Pump, Gear Type.
xiii. Shallow Oil pan
xiv. Crankcase Breather
xv. Oil Filter

Pre lubrication required before starting of DG Set Force feed Lubrication system,consisting of ,one no electrically operated pre lubrication pump shall be be provided for Automatic start at intervals of every 1 hours for 5 minute to ensure lubrication and ready to start condition for D.G set at all times.

d**) Air intake & Exhaust gas System** : Complete Air & Exhaust gas system comprising of Intake filters ,intake manifold/ exhaust manifold expansion bellows ,exhaust piping bends ,fittings shall be in scope of vendor. Exhaust piping shall be routed from D.G. Room to outside the building and shall meet the minimum pollution control requirements in terms of discharge stack heigh SOX/NOX etc. Exhaust piping shall be Glass wool Insulated with AL.Cladding to maintain the temperature less than 70 degree in side D.G. Room. Necessary pipes flanges, bends, bolts, nuts, supports and structures inside and outside of D.G. Room for exhaust piping system shall be included in vendor scope . Drawings for support structure should be furnished to BHEL for approval.

System Consists of :

1) Dry type filter
2) Air intake manifold with necessary connections.
3) Turbocharger with after cooler
4) Exhaust manifold.
5) Flexible piping.
6) Residential silencer

e) **Governing System** : Electronic governor class-A1type as per BS 5514

i. The governor will be suitable for operation with 24V d.c. without external power supply and will provide adequate speed control. Governor shall have necessary characteristics to maintain the speed substantially constant even with sudden variation in load.. However tripping shall be provided if speed exceeds the max. permissible limit. Governor should have Motorized potentio meter for remote adjustment of DG Set frequency. The governor and excitation control systems will permit the operation of the unit either isolated or in momentarily parallel with the system without exceeding the active and reactive power limitations of the generator.

ii. A mechanical over speed trip device will be provided to automatically shut-off fuel in case the speed exceeds 10% of the rated value. Over speed sensor shall is adjustable. The standard setting point is 120% of the rated speed.

f **Jacket Water Heater** : Thermostatic controlled jacket water heater

g) **Starting system** : Electrical starting System consists of

7) Starter Motor Confirming toIS–4722 with accessories
8) Dynamo Alternator
9) Battery ,Battery stand
10) Lead, Cable Lugs etc.

h) **Base frame / Skid** : The Diesel generator shall be mounted on single structural skid complete with fuel piping, electrical and Instrumentation Cabling. The Skid shall be design to ensure convenient operation of all the equipment and accessories. Skid should be Sturdy, fabricated, welded construction, channel iron base frame suitable to take the static & dynamic load of the diesel engine and alternator and its accessories mounted on it.

I) Engine Emission Data : Vendor shall meet the engine emission data at full / part load. as per ISO 8178

J) Safety : All couplings, gears and exposed rotating parts shall be provided with adequate guards of non-sparking type. Drive belts, if use, shall be of antistatic type. Fuel Manifold & Silencer of engine shall be insulated to ensure the cladding skid temp. Not exceeding 70°C.

2 .0 GENERATOR: 630 KVA, 415V, 3ph, 3 wire 50Hz, 0.8pf lag ,1500rpm, 50 degree ambient temperature, Star connected ,,self regulated and separately excited with PMG excitation, voltage regulation± 1% of rated voltage, class H insulation and temperature rise to class B, fitted with Automatic voltage regulator , R.T.D, BTD, IP 23 Enclosure, air cooled and anti condensation heater.

The generator shall be of screen protected drip proof and self air-cooled type . The alternator should conforms to the latest standard such as BS:5000/IS:4722/IEC 34.1 and should meet the alternator data sheet. 3nos Differential C.T should be provided in Neutral terminal box along with NCT/NVT (3 nos Differential CT will be supplied loose for mounting in Netrual terminal box) .

Separate terminal boxes shall be provided for phase and neutral side leads. Terminal box should be Dust tight ,weather proof phase segregated doubled walled having degree of protection of IP 54 as per IS 13947

Terminal box shall be of sufficient size to accommodate termination of 12 nos cable of size 1Cx630 sq mm(4cables per phase and 2cables for neutral) Differential CT & NCT or VT should be provided in the neutral terminal box. There should be separate terminal box for RTD/BTD and for Space heater also.

Alternator vibration level shall not exceed the values as defined in IS 12075. Alternator driven by Diesel engine shall be able to with stand vibration level of 9 mm / sec as per BS 5000 part III.

a) TEMPERATURE DETECTORS RTD / BTD:

Resistance element temperature detectors shall be installed at the following locations:

I) Six elements of platinum each having a DC resistance of 100 ohms at 0^0 C, Suitably distributed at locations where highest temperature may be expected in stator winding and cases.

ii One (1) element in each bearing. The B.T.D's shall comply with the latest edition of IS-2028

b) EXCITATION SYSTEM: The generator shall be provided with complete excitation system capable of supplying the excitation current of generator under all condition of out put from no load to full load and capable of maintaining voltage of Generator constant at any value with +/ - 10 % of rated value . It shall be possible to set the same from remote also. The type of insulation of the armature field windings of the exciter shall be class –H and the temperature rise shall not exceed the values specified in IEC – 34 for different parts. Exciters power shall be taken from alternator terminals itself, if rotating exciter is not provided. Following type of exciter shall be furnished

1) Brush less excitation system

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c) AUTOMATIC VOLTAGE REGULATOR:

1) The regulation system shall be provided with equipment for automatic and manual control. Necessary equipment shall be included for the following:

a. To prevent automatic rise of field voltage in case of failure of potential supply.

b. To indicate transfer from automatic to manual control of excitation on fuse failure in the generator potential signal.

2) The regulator shall regulate from generator current and potential signals.

3) The regulation equipment shall function correctly between the frequency 47.5 and 51.5 C/S and shall ensure a voltage variation not more than ±1% of the set point in steady operating condition between no load to full load.

4) The voltage regulator shall be provided with compensation circuit to ensure correct division of reactive power in case of parallel operation. The excitation and voltage regulation should be designed so as to cause necessary de-excitation in case of any short circuit
5) AVR shall be shall be completely tested and wired.

d)Engine Mounted Instruments &Controls: The flexibly mounted instrument panel on engine shall be complete with Provision for remote indication of rpm meter &control of DG Set for operation start / stop, speed raise /lower , alarm & annunciation facility Following shall be provided in this panel

e)Engine Controls & Monitoring:
1) Automatic & Manual Start and manual Stop control
2) Engine Control Switch for Off/Reset
3) Cycle Cranking
4) Cool down Timer
5) Emergency Stop Push-button
6) NIL
7) **Safety Shutdown Protection and LED Indicators for** :
8) Low Oil Pressure, Low Idle & High Idle
9) High Coolant Temperature 75 C
10) Over crank
11) Over speed.

12) Digital Display for :
13) Coolant Temperature
14) Oil Pressure
15) System DC Volts
16) System Diagnostic Codes.

17) Local gauge panel consist of
i. Cooling Water temp & pressure gauge.
ii. Lube oil temperature & pressure gauge.
iii. Hour meter with RPM indicator.
iv. Exhaust temperature at out let .

f) Local Mounted Instruments :
1) Pressure gauges for and lube oil system with switches/sensor
2) Differential pressure gauges across strainers and filter with sensor
3) Speed indicator with o/s sensor
4) Exhaust pyrometers with temp.switch
5) Level sensor gauges for fuel tank
6) Local thermometers for lube oil , cooling water ,

Note : All above should have sensor/switches with two contact to take signal toDG Control panelsl for alarm /trip Transmitters & Switches for alarm and trip equipment and also for remote control and indications :

4.0 ATTACHMENTS TO THE BASIC GENSET :
Charging Alternator - 24 V, 60 Amps
Flexible Fitting, Exhaust (Shipped Loose)
Flange and Exhaust Expander (Shipped Loose)
Muffler (Shipped Loose)

Primary Fuel Filter (Shipped Loose)
Diode Fault Detector
Manual Voltage Control /Motorized pot for voltage& frequency
Electric Prelube Pump (A.C. Operated)
Electric Starting Motor
Jacket Water heater with thermostat/ Temp. controller

5.0 SOUND PROOFING SYSTEM : The sound proofing system shall be designed to achieve 75db at 1.0 mtr distance from DG Set.
The ventilation system shall be of adequate design to ensure no deterioration in performance of DG.
a) **DG Acoustic Enclosure** : The acoustic enclosure shall be provided at 800 mm distance from the DG Set. It shall be fabricated from 2.0 mm THICK CRCA Sheet with ISMC (Hot dip galvanized) frame of suitable size. The construction shall be modular type to facilitate dismantling as required for maintenance. The ISMC shall be of sufficient stiffness and rigidity.
The sound absorptive layer shall comprise of bonded type mineral wool / rock wool / glass wool of adequate thickness and density to comply the design requirements.

The exposed surface of lining shall be retained in place by a 1.6 mm thick CRCA / aluminum perforated sheet. Absorptive lining shall be provided between the perforated plate and absorbing material. Necessary acoustic sealing shall be done in the Panels/ modular unit joints.
All hardware of mild steel shall be electro – galvanized.
The acoustic enclosure shall be of modular construction to facilitate engine removal from front side. Necessary provisions shall be made in enclosure and associated ventilation
The exhaust air from radiator shall be discharge through modular duct duly insulated of adequate size. The duct cross section shall be 1.5 times the cross section of the radiator
The intake air shall be taken from outside of the room through intake air duct. Necessary opening shall be made in the wall for fixing of the intake air duct.
The door design shall be generally compatible to the enclosure design. The bonded mineral wool slab of adequate thickness shall be used. The door shall be provided with heavy duty hinges and handles. The sealing shall be done with neoprene / silicon rubber gasket to avoid leakage of noise. The size of door shall be as per the room design / functional requirements.
The construction of duct shall be from 1.6 mm thick CRCA sheet and 1 mm thick CRCA Perforated sheet. Other Constructional details shall be similar to that of the enclosure.
Ventilation system of adequate capacity shall be provided. The system shall comprise of tubular axial flow fans for air intake and air exhaust. The ventilation shall be design to ensure required air flow rate as per manufacturer recommendations after providing necessary acoustic treatment / silencers in air flow path. The ventilation system shall be design to prevent leakage of sound and maintain required room temperature for comfortable working in the area not to deteriorate performance of DG. Necessary opening in the room brick wall shall be carried out by the vendor for the installation of the ventilation system.

7) Alternator terminal boxes (IP54):
Alternator should have neutral terminal box and main terminal box
a) IN Neutral terminal box 3NOS OF DIFFERENTIAL CTS ARE TO BE MOUNTED along with NCT/NVT and QDCT-2NOS
b) MAIN TERMINAL BOX SHOULD BE SUITABLE FOR TERMINATION OF
XLPE POWER CABLES OF SIZE 4x1x630 sqmm per phase at site total 12nos of cables
c) NB2 Relay to be dispatched as a loose item to panel manufacturer(Manufacturer of the panels will be intimated latter).

SECTION IV
PAINTING

All painting shall be in accordance with IS-5 and shade as per customer approval . Epoxy paint as per Standard. Procedures like sand blasting, chemical cleaning, rinsing, drying etc. shall be done before applying Red Oxide primer. One prime coat and two finisher coats by spray gun shall be applied. The identification tag shall be white in colour Shade RAL –9010.

PAINTING PROCEDURE and PAINTING SHADE WILL BE INTIMATED DURING DETAILED ENGINEERING

SECTION - V

LIST OF TOOLS AND TACKLES & MANDATORY SPARES

LIST OF TOOLS AND TACKLES(TO BE SUPPLIED ALONG WITH THE MAIN EQUIPMENT)

Sl.No	Description		Quantity in Nos.
1	Torque Wrench (2-8 ft lb **II**),3/8" square drive		1
2	3/8" to ½" square drive		1
3	Screw driver socket ½" square drive		1
4	½" Ring and open end combination wrench		1
5	9/16" Ring and open end combination wrench		1
6	3/4" Ring and open end combination wrench		1
7	7/8" Ring and open end combination wrench		1
8	15/16" Ring and open end combination wrench		1
9	7/16" Ring and open end combination wrench		1
10	Dial gauge – 1" Travel, Least count 0.001"		1
11	Extension – ½" square drive, 5" long		1
12	Socket 1/2" – ½" square drive		1
13	Adjustable wrench – 10" long		1
14	Allen wrench set – 1/16", 5/64," 3/32," 1/8" , 5/32" , 3/16", 7/32", 1/4", 5/16" , 3/8"		1
15	Feeler gauge set – 4" long (0.0015" , 0.002" , 0.003" , 0.004" , 0.006" , 0.008" , 0.010" , 0.012" , 0.015" , 0.025"		1
16	Screw driver 12 " long		1
17	Combination plier – 8" long		1
18	Nose plier –6" long		1
19	Plastic hammer 0.1/2" diameter		1
20	Half moon spanner – ¾" x 5/8"		1
21	3377181 – Vacuum gauge 0-30"hg		1
22	3375932 – Pressure gauge 0-300psi		1
23	Hand Tachometer – 0-1500 rpm		1
24	Socket 9/16" – ½" square drive		1
25	Extension – ½" square drive, 3" long		1
26	Socket 5/8" – ½" square drive		1
27	Tool box for the above		1
28	Socket 7/8" – ½" square drive		1

THE ABOVE TOOLS AND TACKLES SIZES ARE INDICATIVE. THE ACTUAL SIZES REQUIRED FOR THE OFFERED ENGINE ,ALTERNATOR AND DG SET SHALL BE SUPPLIED

LIST OF MANDATORY SPARES FOR 3 X 630 KVA EMERGENCY DG SETS

SL NO.	ITEM DESCRIPTION	Unit	QTY		
.01.00	**DIESEL ENGINE**				

a.	Lub oil filter elements	Nos	9		
b.	Bypass filter elements	Nos	9		
c.	Fuel filter elements	Nos	9		
d.	Air cleaner	Nos	9		
e.	Coil assy.	Nos	3		
f.	Gaskets(complete replacement for one engine	set	1		
g.	Screen filter fuel pump	sets.	3		
h.	Inhibitor Corrosion	sets.	3		
i.	Solenoid coil for fuel oil system	sets.	1		
j.	Spring and gaskets for X head valve	sets.	1		
k.	Hoses with adopters	sets.	1		
l.	DC starter Assembly with clutch Engaging & dis-engaging arrangement complete with motor	sets	1		
.01.02	**ALTERNATOR,EXCITOR,PROTECTION &CONTROL PANELS**				
a.	Current transformer-1no. of each type	No.	1		
b.	Rectifiers	set	1		
c.	Diode Forward	Nos.	9		
d.	Diode Reverse	Nos.	9		
e.	Relays	No.	1		
f.	Control switches	No.	1		
g.	i.Contactors	No.	1		
	ii. Auxillary contactors	Nos.	4		
h.	Cards for automatic voltage regulator (set consist of one number of each type of cards)	set	1		
i.	Indicating lamp assy. Complete (with lens and holder) with resistor	Nos.	4		
j.	indicating lamp	Nos.	18		
k.	Coil for contactors (for both power and aux. contactors	Nos.	6		
l.	Timer	No.	3		
m.	Control fuses	set	1		
n.	Selector switch	No.	3		
01.03	Power factor meter	No.	1		
01.04	Balance meter	No.	1		
01.05	Watt-hour meter	No.	1		
01.06	Synchroscope	No.	1		
.01.07	Synchronising check relay along with guard relay	No.	1		
.01.08	Transducers for meters	No.	1		
.01.09	Temp. indicator for generator stator and rotor	No.	1		
01.10	Push buttons of different colours	set	1		
.01.11	Control Switch/selector switch/ Isolating switch	Nos.	2		

SECTION VI

INSPECTION AND TESTING

The Engine , Alternator and DG SET & panel shall be tested at manufacturers work In presence of BHEL/ Customer Representative as per approved QAP. QAP for the following will be submitted by vendor for approval

1) ENGINE & ALTERNATOR

2) DG SET & FUEL TANK

TESTS:

1) **ENGINE** : Engine & Governor testing on a Brake Dynamometer to certify the Engine output and fuel consumption & efficiency , Vibration noise level and safety trip test by simulation in accordance with the standard operating conditions as laid down in BS : 5514 for following Minimum duration.

2) Part Load (50% &75%) -1/2 hr
3) Full Load - 4 hrs
4) 10% Over Load - 1hr
5) **Alternator :** Routine tests for alternator as per IS 4722 at manufacturers works

a. Phase sequence test
b. Over load test
c. H.V Test
d. IR Value before and after HV Test
e. Vibration & noise level test
f. Transient response tests for sudden application & rejection of loads of 25%, 50%, 75%, 100% of rated capacity.
g. WINDING RESISTANCE
h. REGULATION TEST
i. OVER SPEED TEST AT 100%
j. OPEN CKT TEST
k. SHORT CKT TEST
l. VISUAL & DIMENTIONAL TEST

6) **DG SET** : DG Set testing on resistive load to certify the DG output and fuel consumption , Vibration noise level in accordance with the standard operating conditions as laid down in BS : 5514 for following duration.

7) Part Load (50% &75%) -1/2 hr
8) Full Load - 4 hrs
9) 110% Load - 1hr
10) **Fuel TANK** : D.P.& Pressure test for fuel tank
11) T.C For approval :

12) One Set of Manufacturer's Test certificates for major bought out equipments shall be made available during inspection by vendor.

13) SUPPLIER SHOULD SUBMIT INTERNAL TEST CERTIFICATES ALONG WITH THE INSPECTION CALL

14) Supplier should make arrangements for STAGE INSPECTIONS FOR a) ALTERNATOR b)ENGINE c)COMBINED DG Sets by Third party AS SUGESTED BY CUSTOMER.

15) PACKING SHOULD BE SUITABLE FOR SEA-WORTHY TRANSPORTATION

16) Type test reports for Alternator(similar rating should furnished along with offer other wise the offer will not be considered)

17) **GENERAL** : All equipments will be checked for following :
Dimensional check , Painting thickness , finish quality & workman ship.

The DG Set complete unit along with job accessories & auxiliaries shall be tested at site for 12 hrs at full load & at 10% overload for 1 hr

NOTE

1)Data sheets and QAP for the following shall be furnished along with the

1. Engine
2. Alternator.
3. Gen Set
4. Day Tank (990 liters)
5. Base frame.
6. Field Quality Plan.
7. TERMINAL BOX DETAILS
8. Battery & Battery charger

Documetation/Drawings.

2) CUSTOMER TRAINING AT SUPPLIRES WORK OR AT ANY OTHER PLACE(INDIA) will be INTIMATED LATTER BY OUR BHEL-IOD

3) DG SET and its Auxiliaries are to be offered for inspection at one place only.

4) SYSTEM ENGINEERING AND INTEGRATION of THE PROJECT FOR THE ITEMS

SUPPLIED INCLUDING Total CABLE SCHUDULE including panels supplied by BHEL.

SECTION VII

DOCUMENTATION FOR APPROVAL AND FINAL SUBMISSION

SL.	DESCRIPTION	DRG.	FOR APPROVAL	FINAL SUBMISSION

NO.		/ DOC SIZE	(A) WITHIN 1 WEEKS OF L .O .I.	BEFORE DESPATCH
1.	Design calculation for Sizing of DG Set & TVD and sound proofing / Ventilation system.	A4	16sets (I)	16 sets +CD
2.	Foundation Drawings with relevant data & details For DG set & Auxiliaries etc	A1/A 2	16 sets (A)	16 sets +CD
3.	D G Room Layout Plan & sectional view showing DG Set &accessories , Panel , exhaust pipe line , Cable & Pipeline Trench for fuel oil system, panel etc	A0/A 1	16 sets (A)	16 sets +CD
4.	OGA / GA Outline / Sectional drawings. for Engine , Alternator , Base frame , DG set & Auxiliaries and Acoustic enclosure etc	A0/A 1	16 sets (A)	16 sets +CD
5.	A) P&I drawings for Fuel & Lub.Oil, and Water circuit B) SLD For Electrical panel .	A3/A 4	16 sets (A)	16 sets +CD
6	GA / OGA , SLD, DOOR DETAIL, BOM , SCHEMATIC, TERMINAL PLAN etc FOR PANEL.	A3/A 4	16 sets (A)	16 sets +CD
7	Ear thing arrangement drawing for all equipment in DG Room.	A2/A 3	16 sets (A)	16 sets +CD
8.	Data sheet Diesel Engine & alternator & DG Set , Battery.	A4	16 sets (A)	16 sets +CD
9	Cable schedule for Package	A3/A 4	16 sets (A)	16 sets +CD
10.	Test Certificates	A4	16 sets (A)	16 sets +CD
11	Technical catalog with rating curve for component of DG Set and panel. Frequency response for noise absorbing characteristic of acoustic material shall be furnished.	A4	16sets (I)	16 sets +CD
12	O&M, Storage & Erection instruction manual	A4	16 set (I)	16 sets +CD
13	Spares Parts Catalogue	A4	16 set (I)	16 sets +CD

OGA/GA DRAWING SHALL CONTAIN FOLLOWING DATA FOR CIVIL ASSIGNMENT AND LAYOUT

Generator dimensional drawing containing:-
Elevation
Section
Foundation / Mounting
This should cover the following information.

a) Static loading and dynamic loading.
b) Details of Exhaust Silencer with spark arrestor details.
c) OGA/GA of fuel tank , Lub Oil priming pumps, Hand priming pump details.
d) Location of other auxiliary terminal boxes.
e) Location of Heaters.
f) Direction of rotation.
g) Rating plate.
h) Ear thing terminals.
i) Lifting Hooks with height
j) Mounting faces for vibration monitoring sensors
l) Protection class for Engine
m) Heat loss data i.e. heat dissipation from Engine surface
n) Standards

For foundation design vendor shall furnish the following information:	
a)	Foundation bolt & pocket hole size details and locations
b)	Static weight of each independently grouted item and location of CG.
c)	Weight distribution for each bolt sub-sole plate location and total static weight.
d)	Dynamic loading caused due to various items grouted independently.
f)	Maximum permissible amplitude of vibration on the foundation at base level.
g)	Total mass of Reciprocating and Rotating parts.

SECTION VIII
ANNEXURE –1

DATA SHEET FOR ENGINE TO BE CONFIRMED AND FILLED UP		
1	Manufacturer	

2	Engine Model / frame	
3	WT of Engine	
4	Dimension of Engine	
5	O/L Capacity of Engine in %	110% for 1 hr at every 12 hrs of running
6	No. of Cylinders & Arrangement	
7	Bore/Stroke	
8	Speed (rpm)	
9	Mean piston Speed(m)/sec	
10	Compression Ratio	
11	Type Combustion Chamber	
12	Rotation viewed from coupling end	
13	Engine cooling	Water Cooled Radiator
14	Method of starting	Electric Start
15	Mode of starting	Auto /manual
16	Mode of stopping	Manual
17	Cold starting	Required
18	Rated engine power at operating Site condition in BHP / KW (with engine driving all its ancillaries including radiator fans & Motor Driven Pumps)	
19	Power required for following Auxiliaries driven by Engine	

Radiator Fan Motor	Fuel Pump	Other Auxiliary (VENDOR TO SPECIFY)

20	Engine Governing	Class A1 as per BS-5514 with motorized Pot for manual control of frequency from Remote
21	Lube oil consumption	
22	Fuel consumption in ltr/ kw/ hr at following load	

¼ Load	½ Load	¾ Load	Full Load	110% Load

23	Mechanical Efficiency	
24	Vibration Level	Less than 250 micron
25	Noise Level	105 db at 1mtr
26	Time required for starting from cold to full load	10 to 15 sec
27	Time Intervals between starting impulses	5ses
28	No. of Starting impulses	6
28	Capacity of fuel tank	990 ltrs
30	Battery & Battery charger	24 V , 360 AH &180 AH
31	List of electrical & Mechanical Aux. And their Power consumption	
32	Complete technical literature and catalogue of Engine along with all its accessories including starting device, cooling system, governing system, fuel oil system etc	To be furnished

ANNEXURE 2

Data Sheet for Alternator to be confirmed & filled up

Make	:	CAT / AVK / Stamford /

Design ambient	:	50 deg. C
Alt above MSL	:	< 1000 MTR
Humidity	:	85%
Area classification	:	Safe
Frame designation	:	
Rated output	:	630 KVA CONT
Applicable Code	:	NEMA STD'S and ANSI.
Duty	:	Continuous
NO.of units	:	
Type of driver	:	Diesel engine
Terminal Voltage	:	415V
Enclosure	:	IP 23
Rated P.F	:	0.8 Lag
Phase/connection/ no. of terminals	:	3 Phase , 3 /4 Wire
Full load current	:	
Speed	:	1500RPM
Rated frequency	:	50 HZ
Cooling system	:	Air cooled
Max. permissible inductive loading	:	
Excitation system	:	Self excited
Steady state 3 - phase S.C currents	:	Ratio 0.7
Type of voltage regulator	:	Automatic Motorized pot for manual control of voltage from remote
3- phase S.C withstand time	:	
Painting	:	To be furnished
Colour shade	:	IS –5, 631
Insulation class	:	Class H temp rise limited to Class B
Type of excitation system	:	Brush less.
Type of cooling	:	Air cooled
Enclosure for terminal box	:	IP-54
Continuous parallel operation	:	Applicable.
Black start facility	:	Required
Generator line side termination	:	cable
Line side cable - type / size	:	
Neutral side cable -type / size	:	
Max. permissible impact load	:	150%
Method of Drive		Flexible coupling
Reactances :		
Direct axis transient reactance Xd'	:	
Direct axis sub transient reactance Xd	:	
Synchronous reactance Xd	:	
Zero sequence reactance Xo	:	
Negative sequence reactance X2	:	

Resistances and time constants :	:	
Armature resistance (25 deg.C)	:	
Armature resistance (100 deg.C)	:	
Transient time constant Td'	:	
Sub - transient time constant Td'	:	

Note 1: the Net Power available at alternator terminals shall be 630 KVA/504 KW @ 415V with rated P.F. of 0.80(lag) after accounting for deration for site conditions & alternator efficiency with engine Driving its all auxiliaries.

Efficiency	P.F	25% load	50% load	75% load	100% load
%	0.8(lag)				
%	Unity P.F				