



ENQUIRY SPECIFICATIONS  
FOR  
1 X 750 KVA EMERGENCY DG SETS AND ACCESSORIES  
2 x 660MW UDANGUDI STPP, STAGE-I  
TANGEDCO, TAMILNADU

Indent  
Specification  
Number

CUSTOMER : TAMIL NADU GENERATION AND DISTRIBUTION CORPORATION LTD.

IS-1-17-2002/16

## ENQUIRY SPECIFICATIONS

**1X750 KVA,415V,1500RPM,**  
**EMERGENCY DG SET AND ACCESSORIES**

**2X660MW UDANGUDI SUPER THERMAL POWER STATION STAGE-I**

**CONSULTANT: TATA CONSULTING ENGINEERS, BENGALURU**



INDUSTRIAL SYSTEMS GROUP  
BANGALORE-560 012.

PIYUSH ANAND	K V SUBBIAH	HEMANTHA UDUPA Y J
PREPARED BY	CHECKED BY	APPROVED BY

BHEL- ISG,  
BANGALORE

FOR  
1 X 750 KVA EMERGENCY DG SETS AND ACCESSORIES  
2 x 660MW UDANGUDI STPP, STAGE-I  
TANGEDCO, TAMILNADU

CUSTOMER : TAMIL NADU GENERATION AND DISTRIBUTION CORPORATION LTD.

IS-1-17-2002/16

**CONTENTS**

SECTIONS	HEADING
	NOTES FOR THE BIDDER
SECTION - I	SALIENT POINTS OF THE CONTRACT
SECTION - II	PROJECT INFORMATION AND SITE CONDITIONS
SECTION - III	APPLICABLE CODES AND STANDARDS
SECTION - IV	OPERATING PHILOSOPHY
SECTION - V	BILL OF MATERIALS
SECTION - VI	DETAILED SCOPE & TECHNICAL SPECIFICATIONS
SECTION - VII	PAINTING PROCEDURE
SECTION - VIII	INSPECTION AND TESTING PROCEDURE
SECTION - IX	PACKING AND TRANSPORTATION
SECTION - X	DOCUMENTATION
SECTION - XI	EXCLUSIONS
ENCLOSURE	
ANNEXURE-1	TENTATIVE LAYOUT FOR 750KVA DG SET
ANNEXURE-2	CUSTOMER SPECIFICATION SHEET(22 sheets)
ANNEXURE-3	QAP FOR DG SET & ACCESSORIES
ANNEXURE-4	QAP OF CONTROL PANELS

***Bidders should note that the annexure are the integral part of this specification and the signed/stamped copy of the same shall be submitted with the offer.***

**NOTES FOR THE BIDDER:**

- All equipment shall be new and unused (not reconditioned) and of recent manufacture which shall in no case be of a date of manufacture older than one year of the date of delivery.
- The list of items mentioned in the Scope of supply is not exhaustive. Anything over and above the items mentioned in the scope of supply required for making the system reliable and functional shall be in Bidder's scope.
- Design for all equipment supplied by vendor shall be in accordance with the statutory norms and accordingly all drawings to be prepared and submitted by vendor for approval considering latest statutory norms of Explosive, pollution control board, Electrical, Civil design etc applicable for DG Set and its accessories in respective states.
- Preservation of DG Set up to the commissioning date shall be in Bidder's Scope.



FOR  
1 X 750 KVA EMERGENCY DG SETS AND ACCESSORIES  
2 x 660MW UDANGUDI STPP, STAGE-I  
TANGEDCO, TAMILNADU

Indent  
Specification  
Number

**CUSTOMER : TAMIL NADU GENERATION AND DISTRIBUTION CORPORATION LTD.**

IS-1-17-2002/16

5. If commissioning gets delayed beyond the scheduled date, preservation activities to be carried out shall be clarified in detail to BHEL.
6. Bidder to provide all necessary technical documents in obtaining approval on drawings documents and datasheets during engineering from customer/consultant and shall also visit customer/consultant offices for the same if required.
7. It shall be responsibility of the supplier to convince the customer about the completeness of the parts and quantity offered under mandatory spares. Bidder shall supply all part numbers as required by customer. No item shall be written as not applicable. Similar/ related item shall be provided. Deviation in description shall be clearly brought out in the offer.
8. No item shall be manufactured / dispatched without prior written clearance from BHEL.
9. Battery, Tools and Tackles and Mandatory Spares, B-Check Kit and Lube oil and coolant as per the BOM given in this specification shall be supplied during commissioning on intimation by BHEL.
10. Make of all components to be submitted along with the offer failing which it will be presumed that any makes as required by customer shall be supplied by supplier. Reputed vendors shall be considered for all items. Minor changes shall be accommodated by the supplier in the make of accessories in case same is not getting approved by customer.
11. For any technical queries please write to [piyush.anand@bhel.in](mailto:piyush.anand@bhel.in) with CC to [hemant.udupa@bhel.in](mailto:hemant.udupa@bhel.in)
12. BHEL logos/engraved name plate shall be fixed on the equipment in prominent places. Soft copy of the logo shall be furnished to the successful bidder.
13. Bidder to upload all the documents as mentioned in the below checklist along with the offer.

S NO.	DOCUMENTS
1	<b>BHEL Enquiry specifications along with annexure, duly stamped</b>
2	<b>Data Sheet of Engine.</b>
3	<b>Data Sheet of Alternator</b>
4	<b>Deration calculations for Engine and Alternator</b>
5	<b>Data Sheet of DG set controller.</b>
6	<b>GA drawing of Acoustic Enclosure</b>
7	<b>OEM certificates from Engine and Alternator manufacturers.</b>
8	<b>List of makes of all items as per enquiry.</b>

1190052/2022/ISG-ELECTRICAL ENQUIRY SPECIFICATIONS

Indent  
Specification  
NumberBHEL- ISG,  
BANGALORE

FOR  
1 X 750 KVA EMERGENCY DG SETS AND ACCESSORIES  
2 x 660MW UDANGUDI STPP, STAGE-I  
TANGEDCO, TAMILNADU

CUSTOMER : TAMIL NADU GENERATION AND DISTRIBUTION CORPORATION LTD.

IS-1-17-2002/16

**SECTION- I****SALIENT POINTS OF CONTRACT:**

1. It shall be bidder's responsibility to ensure that the offered equipment is suitable for motor starting as mentioned in SECTION- IV of this enquiry.
2. Bidder to arrange for to and fro flight tickets, conveyance and boarding and lodging for 2 nos. officials from customer's end (TANGEDCO) who shall witness testing and inspection of DG Set and DG Control Panels at Bidder's works. Preferably, inspection of DG Set & Panels shall be conducted together

**SECTION - II****GENERAL INFORMATION:**

<b>1.1</b>	Project Title	2 x 660MW Udangudi STPP Stage-I
<b>1.2</b>	Owner	Tamil Nadu Generation and Distribution Corporation Limited (TANGEDCO)
<b>1.3</b>	Plant site location	Near Tuticorin
<b>1.4</b>	Meteorological Condition	The details given are arbitrary and may vary. The contractor should collect the actual data from the Meteorological Department pertaining to the site location and design the plant accordingly.
<b>1.5</b>	Climate	Tropical, very dry and hot summer, dry and cold winter and good rain-fall in monsoon accompanied with strong wind
<b>1.6</b>	Maximum Temperature	41 °C
<b>1.7</b>	Minimum Temperature	17 °C
<b>1.8</b>	Maximum Humidity	97%
<b>1.9</b>	Mean wind speed	20.6km/h
<b>1.10</b>	Seismicity	Zone: II as per IS : 1893
<b>1.11</b>	Design ambient temperature	50 °C

**POWER SUPPLY:**

<b>S N</b>	<b>LT Supply</b>	<b>VALUE</b>
1.	Plant LT emergency supply	415V, ± 10% 3 phase 3 wire, Resistance earthed.
2.	Plant LT auxiliary supply	415V, ± 10% 3 phase 3 Wire 4 wire solidly earthed
3.	Frequency	50 Hz, -5% to 3%
4.	System fault level	50 kA R.M.S. for 1 SEC
5.	DG Neutral Earthing	Earthing through VT
6.	Panel space heater and light	230 V AC ± 10% 1 PH with one point earthed

1190052/2022/ISG-ELECTRICAL ENQUIRY SPECIFICATIONS

Indent  
Specification  
Number

FOR  
1 X 750 KVA EMERGENCY DG SETS AND ACCESSORIES  
2 x 660MW UDANGUDI STPP, STAGE-I  
TANGEDCO, TAMILNADU

CUSTOMER : TAMIL NADU GENERATION AND DISTRIBUTION CORPORATION LTD.

IS-1-17-2002/16

7.	AC Control Supply	110 V AC $\pm$ 10% PT Voltage
8.	Control Supply for panel	220 V DC+10% to (-)15%, 2wire, Unearthed
9.	Control supply for breakers	220 V DC +10% to (-)15%, 2wire, Unearthed
10.	Control Supply for Engine	24V DC Battery Supply
11.	Short circuit rating for 220 V DC System	20 KA for 1 sec.

**SECTION – III****APPLICABLE CODES AND STANDARDS**

- The equipment & accessories covered by this Specification shall be designed, manufactured and tested in accordance with the latest relevant standards and codes of practice as applicable including the below mentioned list but not limited to it.
- The DG Set & Electrical accessories shall be also confirm to the latest Electricity Rules & other related Statutory agencies as regards explosive, electrical, safety, earthing and other essential provisions specified( RESPECTIVE STATE)
- The installation work shall confirm to Indian electricity Act and Indian electricity rules as amended up to the date this specification is issued. Nothing in this specification shall be construed to relieve the contractor of this responsibility.
- In the event of any conflict between the codes and standards referred, and the requirements of this specification, the requirements, which are more stringent, shall govern.

APPLICABLE STANDARDS	COMPONENTS/ITEMS
BS : 5514, ISO : 3046 ,SAE J1349, IS – 10000, DIN 6270,BS 649/195B	ENGINE
IS- 1271, 2253, 4722, 4728, 4889, 6362, 7132, 7306, 7816, 12065, 12075, 12802, 13364, 13118, IEC- 60034	ALTERNATOR
VDI 2063	Measurements and evaluation of mechanical vibrations of reciprocating piston engines and piston compressors.
IS-5, 2007	Color for ready mixed paints & enamels

1190052/2022/ISG-ELECTRICAL ENQUIRY SPECIFICATIONS

Indent  
Specification  
NumberBHEL- ISG,  
BANGALOREFOR  
1 X 750 KVA EMERGENCY DG SETS AND ACCESSORIES  
2 x 660MW UDANGUDI STPP, STAGE-I  
TANGEDCO, TAMILNADU

CUSTOMER : TAMIL NADU GENERATION AND DISTRIBUTION CORPORATION LTD.

IS-1-17-2002/16

IS-694, 2010-2012, IS-1554 Part 1, IS 7098 for XLPE	PVC Insulated cables for working voltage up to and including 1100 Volts.
IS-1248, Part - 1 to 9, 1991-2003	Direct acting indicating analogue electrical measuring instrument & their accessories
IS-2026, Part-1, 1991-2011	Power Transformers (General)
IS-2551, 1990	Danger Notice Plates.
IS-2705, Part-1, 2,3,4, 1992-2002	Current Transformers
IS-3156, Part-1, 2,3,4, 1992-2002	Voltage Transformers
IS-3231, Part-0, 1,2,3, 1987-2001	Electrical Relays for Power System Protection.
IS-5082, 1998-2003	Wrought Aluminum & Aluminum alloy bars, Rods, Tools & Sections for Electrical purpose
IS-5578, 1984-2001	Guide for marking of Insulated Conductors
IS-7372, 1995	Lead Acid storage batteries for Motor vehicles.
IS-60947, Part-1-5, 2007-2012	Low voltage Switchgear & Control Gear assemblies.
IS-60947, Part-1-5, 2007-2012	Low Voltage Fuses: Supplementary requirement for fuses for Industrial applications.
IS-8183	Bonded mineral wool
IS-1460 -1995	HSD
IS-60034, 750	Classification of degree of protection provided by enclosures of electrical equipments
IS 2629	Recommended practice for HOT-DIP galvanization of Iron and Steel
IS 2623	Methods for testing uniformity of coating of Zinc coated articles.
OSID-GDN-180	OSID standard on lightning protection.
IS 4722	DG starting motor

**SECTION – IV****OPERATING PHILOSOPHY:**

1. One No. Emergency DG set of 750 KVA, prime power, 415 V, 1500 RPM, 0.8 PF at 50 degree Celsius ambient has been envisaged for this Project.
2. The DG Set shall be of **Prime rating** while the Alternator shall be of **continuous duty**.
3. The worst case full load running duration of the DG can be considered to be 12 hours.
4. Emergency DG Set shall have AMF start facility and shall be capable of starting automatically on mains failure and take up the load within 30 seconds. The DG I/C circuit breaker should close automatically to energize the essential loads. Loads connected through SFU/MCCB will get applied



FOR  
1 X 750 KVA EMERGENCY DG SETS AND ACCESSORIES  
2 x 660MW UDANGUDI STPP, STAGE-I  
TANGEDCO, TAMILNADU

Indent  
Specification  
Number

**CUSTOMER : TAMIL NADU GENERATION AND DISTRIBUTION CORPORATION LTD.**

IS-1-17-2002/16

directly on closing the DG I/C breaker and balance loads will be switched on as per process requirement.

5. The DG set shall be capable of starting the largest emergency motor (90KW) DOL while the DG is operating at its base load (10KVA). Starting power factor of 0.3 and starting current of 7.7 times of full load current (including tolerance) to be considered for calculating voltage drop at motor terminals during DOL start of motor which should be within 15% .  $X_d' = 13.0\%$  and design ambient temperature of 50 degrees Celsius to be considered for above calculations. **From DG Set to Emergency section of RO DM PMCC 2 runs of 1C\*630 Sq.mm/phase ,AL,XLPE insulated, armoured cable is considered. Emergency section of RO DM PMCC to RO DM Flushing Pump Motor of 90 KW 2 runs of 3C\*240 sq.mm AL,XLPE insulated, armoured is considered. Supplier to confirm the suitability of the DG for this motor starting. Running pf of the 90kW motor =0.86, Motor efficiency =0.95.**
6. Manual control of engine speed and generator voltage shall be provided through raise/lower control switches located on AMF panel and ECP/DCS in control room.
7. On resumption of the Mains supply the DG shall be momentarily synchronized with Mains supply and the load shall be transferred to the Mains supply so that there is no break in power to the load.
8. Provision for auto as well as manual synchronization shall be provided.
9. Provision shall be provided to synchronize the DG to the EMCC Bus to take the load of the Mains supply and run in parallel for some time for testing purposes.
10. Two sets of Potential free contacts shall be provided for all major alarms and indications to be taken to Central control Room.
11. The fuel oil system and lubricating oil system shall also start simultaneously as soon the engine receives starting impulse.
12. There shall be a provision for Remote Start/ Stop of the DG set. The DG set shall have facility to stop manually from Remote/Local.
13. The DG set shall have suitable control arrangement so as to meet functional and control requirement mentioned elsewhere in the specifications.

1190052/2022/ISG-ELECTRICAL ENQUIRY SPECIFICATIONS

Indent  
Specification  
NumberBHEL- ISG,  
BANGALORE

FOR  
1 X 750 KVA EMERGENCY DG SETS AND ACCESSORIES  
2 x 660MW UDANGUDI STPP, STAGE-I  
TANGEDCO, TAMILNADU

CUSTOMER : TAMIL NADU GENERATION AND DISTRIBUTION CORPORATION LTD.

IS-1-17-2002/16

**SECTION V****BILL OF MATERIALS:**

Sl. No.	ITEM DESCRIPTION	QTY	UNIT
1	750 KVA (e) 1500 RPM, 415V 0.80pf (lag) DG with Radiator and accessories on common Base Frame.	1	Set
2	Fuel Day tank of 990 Liters capacity with accessories.	2	Set
3	24VDC, Lead Acid Type automotive Battery with accessories and stand, to be supplied at the time of commissioning.	2	Set
4	Float cum Boost Battery Charger Panel with stand.	2	Set
5	Heavy duty Changeover switch for selecting one out of two set of batteries	1	Set
6	Necessary Fuel Piping, supports, accessories for DG.	1	Set
7	Silencers , exhaust piping and stack, silencer supports and accessories like bellows, flanges, gaskets, bends , insulation and aluminium cladding and hardware. Galvanized exhaust pipe support structure	1	Set
8	Acoustic enclosure for DG.	1	Set
9	LT Power, Control, Instrument and screened cable including all accessories like lugs, glands, ties etc for DG.	1	Set
10	B-Check kit for ENGINE, to be supplied at the time of commissioning.	1	Set
11	First fill of lube oil, coolant and coolant conditioner at site for one DG, to be supplied at the time of commissioning.	1	Set
12	Tools & Tackles specific to offered DG Set.	1	Set
13	Phase side and Neutral side terminal box for Alternator	1	Set
14	AMF Panel with ACB for one DG	1	Set
15	NGR PANEL with isolator	1	Set
16	Commissioning Spares for control panels.	1	Set
17	Supervision of Erection of DG Set with exhaust piping and structure, fuel piping, control panels and cabling.	1	Set



FOR  
1 X 750 KVA EMERGENCY DG SETS AND ACCESSORIES  
2 x 660MW UDANGUDI STPP, STAGE-I  
TANGEDCO, TAMILNADU

Indent  
Specification  
Number

**CUSTOMER : TAMIL NADU GENERATION AND DISTRIBUTION CORPORATION LTD.**

IS-1-17-2002/16

18	Supervision of testing, pre commissioning checks, and commissioning and load trial of DG SET with Control Panels as per operating philosophy.	1	Set
19	Supervision of Performance Guarantee Test for DG.	1	Set
20	Factory Training for customer/BHEL personnel	10	Mandays
21	Mandatory spares for DG Set and Panels.(As per technical spec Section-VI Clause-21)	1	Lot

## SECTION VI

### **DETAILED SCOPE OF SUPPLY AND TECHNICAL SPECIFICATIONS FOR ITEMS MENTIONED IN BOM.**

Also see attached customer specification.

#### **1. DG SET:**

1. The Generating Set shall be Prime Power of 750 KVA (e) 1500 RPM 415V 0.80pf (lag) at 50°C ambient temperature at Alternator terminals excluding auxiliaries , capable of 10% over load at rated speed once in every 12 hours of operation, complete with all accessories, suitable for battery start.
2. The DG set shall be complete with Electronic Governor, with pre lube pump/motor (if required) with coupling, with QDCT, with AMF feature, with engine mounted radiator on common base frame, with elastic fastening equipment ,battery charging alternator, fly wheel cover, AVMS, turbochargers, residential Silencer, flexible bellows and reducers & water/fuel/lube oil/exhaust/air piping on skid including all erection hard ware, lube oil filters , fuel filters, heavy duty air filters, lube oil, coolant and conditioner, jacket cooling water and fuel oil etc required for factory testing.
3. The entire DG Set shall be mounted on a common base frame and the same shall be mounted on anti vibration mounting system.
4. Two nos. ground pads shall be provided on base frame for earthing.
5. The DG Set shall be housed inside acoustic enclosure (suitable for outdoor installation, if required) for noise reduction. However the entire equipment shall be inside a DG Building.
6. The governor shall have capability to maintain speed constant in case of sudden variation of load.
7. The engine shall be radiator cooled while the Alternator shall be air cooled.
8. Automatic pressure lubrication shall be provided by a shaft driven gear type pump. In addition to same hand driven/ AC motor driven lube oil priming pump (If applicable) shall be provided.



FOR  
1 X 750 KVA EMERGENCY DG SETS AND ACCESSORIES  
2 x 660MW UDANGUDI STPP, STAGE-I  
TANGEDCO, TAMILNADU

Indent  
Specification  
Number

**CUSTOMER : TAMIL NADU GENERATION AND DISTRIBUTION CORPORATION LTD.**

IS-1-17-2002/16

9. The Alternator shall be brushless type, self regulated, self excited, drip proof and screen protected. The terminal box should have IP 54 protection.
10. The AC generator shall be supplied with its excitation system, AVR and include all necessary auxiliaries.
11. The generator shall be star connected 3- phase 50 Hz synchronous generator and shall have continuous rating.
12. Alternator shall be of class H insulation with temperature rise limited to class F temperature type limits. In line with IEC 60034 part1. AVR shall be DIGITAL type.
13. Suitably rated 240 V single phase 50 Hz space heater shall be provided in the alternator to prevent moisture condensation during idle period.
14. RTD's and BTD's shall be provided in the alternator as per attached TANGEDCO customer specification.
15. The critical speed of the machine shall not be less than 120% and all coupling shall be capable of withstanding the maximum generator sudden short circuit torque.
16. The serial communication port of the DG controller shall communicate with Plant control system with Modbus /OPC protocol. All software and hardware required for the same shall be in supplier's scope.
17. The DG shall be suitable for HSD as fuel.

## **2. FUEL TANK**

1. Fuel Day Tank of 990 liters capacity along with pre-fabricated stand shall be supplied for each DG. The thickness of the tank shall be 3mm.
2. The tank shall be mounted on **pre fabricated steel platform**, with fuel pipes on tank, level indicator marked in liters .
3. The tank shall be mounted on pre fabricated steel platform, with one common level indicator (heavy duty tubular level gauge marked in litres) with channel protection for two tanks.
4. 3 nos. Level switches with NO contacts for indicating Low, very low and high level shall be provided common for two tanks. Air vent, drain plug and required hardwares shall be provided for each tank.



FOR  
1 X 750 KVA EMERGENCY DG SETS AND ACCESSORIES  
2 x 660MW UDANGUDI STPP, STAGE-I  
TANGEDCO, TAMILNADU

Indent  
Specification  
Number

**CUSTOMER : TAMIL NADU GENERATION AND DISTRIBUTION CORPORATION LTD.**

IS-1-17-2002/16

5. The height of the steel platform/stand shall be finalized during detailed engineering and shall be as per manufacturer's standards.
6. The fuel tank shall be painted with oil resistant paint and all pipe joints shall be brazed / welded.
7. Hand operated pumps (one for each DG Set) with Hose pipes of length 10 meters for transferring fuel from barrels/drums to 990 Litres Day tank shall be supplied by the bidder. Inlet of the pump shall have 5m long armoured hose with suitable filter.
8. The paint shade of the tank shall be finalized during detailed engineering.

### **3. BATTERY**

1. The DG set shall be suitable for battery starting.
2. The minimum rating of battery shall be 24 V DC 180 AH or as per actual sizing calculation whichever is higher, heavy duty Lead Acid type automotive maintenance free battery suitable for Engine starting shall be supplied by the bidder at the time of commissioning.
3. Two sets of battery has been envisaged for this project which shall be in parallel operation. Each battery set shall be 100% Stand By to the other.
4. The battery shall be suitable for 6 consecutive start of the Engine without recharging and shall also be used for control supply of DG AMF Panel for at least 8 hours and should be inclusive of 10% design margin.
5. The bidder shall also supply **prefabricated battery stand**, battery leads, nuts and bolts, hand gloves etc for maintenance purpose.

### **4. BATTERY CHARGER**

1. Suitable Float cum Boost battery Charger for recharging Engine starting battery shall be supplied. Two chargers meant for one DG may be housed in one panel.
2. The charger shall be suitable to automatically switch from Float to Boost mode depending upon the state of the battery.
3. Input supply to Battery Charger shall be single phase 230 V AC.
4. The charger shall be protected by current limiting device. The charger shall be capable of recharging the discharged battery within 08 hours.



FOR  
1 X 750 KVA EMERGENCY DG SETS AND ACCESSORIES  
2 x 660MW UDANGUDI STPP, STAGE-I  
TANGEDCO, TAMILNADU

Indent  
Specification  
Number

**CUSTOMER : TAMIL NADU GENERATION AND DISTRIBUTION CORPORATION LTD.**

IS-1-17-2002/16

5. In auto mode the charger shall operate in either float or boost mode depending upon the state of battery.
6. In manual mode , the operator may switch to either float or boost mode depending upon the requirement.
7. Potentiometer for voltage and current adjustment to be provided in the charger.
8. The battery charger shall operate in Float / Boost mode depending on the state of the battery and shall have Auto/Manual SS and Voltage and current adjusting potentiometer.
9. Necessary filters and chokes and suitable input transformer to automatically reduce charging current, as battery gradually charges up and to prevent overcharging of battery
10. The charger shall be housed inside a small cabinet with the front facia having flush mounted 96 sq mm, Class 1 digital type DC Voltmeter, DC Ammeter, AC Voltmeter and Selector switches and indicating LEDs.
11. The charger shall be mounted on a stand to meet the minimum operating height criteria (750mm). Prefabricated stand if required to be supplied with the charger.
12. The degree of protection of battery charger panel shall be IP 42.
13. The charger shall have protection for over voltage, over current and short circuit.
14. The paint shade of the Battery Charger panel shall be finalized during detailed engineering.

#### **5. HEAVY DUTY CHANGEOVER SWITCH FOR SELECTING ONE OUT OF TWO BATTERIES**

1. One no. change over switch suitable for selection between the two sets of batteries of DG shall be provided. Engine starting supply and Control supply for panels shall be taken after this switch. The switch and connecting cables shall be adequately rated to ensure that the protection relays/ auxiliary relays/ contactors/ other components do not drop/reboot during the engine starting time.

#### **6 . FUEL PIPING**

1. Necessary Fuel Piping with hardwares, U clamps, valves, pipe fittings, pipe support, flanges, gaskets, drain and vents from day tank to engine(Supply and Return line) as required for the DG Set.
2. MS channels, angles and plates, anchor fasteners to support fuel pipes inside the trenches shall also be in bidder's scope.
3. Hose pipe with accessories for connecting Fuel Lines to Engine Fuel inlet and outlet with necessary adapters/connectors to be provided by the bidder.



FOR  
1 X 750 KVA EMERGENCY DG SETS AND ACCESSORIES  
2 x 660MW UDANGUDI STPP, STAGE-I  
TANGEDCO, TAMILNADU

Indent  
Specification  
Number

CUSTOMER : TAMIL NADU GENERATION AND DISTRIBUTION CORPORATION LTD.

IS-1-17-2002/16

### 7. EXHAUST PIPING AND ACCESSORIES

1. **Exhaust piping** with flanges, bellows, gaskets, necessary nuts and bolts, hangers, starting from engine exhaust outlet to total height as per applicable norms.
2. The **entire length** of exhaust pipe and stack along with silencers to be provided with **50mm thick thermal insulation** and 24 gauge **aluminum cladding** to maintain the temperature within required limits.
3. The exhaust stack height should meet the requirement given by gazette notification of Ministry of Environment and forest, CPCB guidelines, and state pollution board guidelines for the offered rating of the DG.
4. Stack shall be complete with sampling point and carbon pockets at suitable location.
5. Erection materials like ISMC Channels, angles, base plates, anchor fasteners to support exhaust pipes and its support inside as well as outside the DG room shall be in scope of the bidder.
6. **Galvanized exhaust support structure (minimum 610g/sq.m)** (height as per applicable norms) shall be in Bidder's scope.
7. Foundation bolts for exhaust support structure in bidder's scope.
8. Platforms at suitable height in the exhaust support structure to be considered by the bidder.
9. Bidder to submit the CPCB guidelines for the height of the Stack.
10. Bidder may refer to tentative DG layout drawing **Annexure-1** to get an idea of the exhaust piping layout.
11. Bidder shall also consider miscellaneous channels and angles for erecting control panels/pipes/ fuel tank etc.
12. Lightning arrester for exhaust structure shall be in bidder's scope

### 8 . ACOUSTIC ENCLOSURE:

1. For details please refer attached customer specification.
2. The enclosure shall be fabricated out of 2mm CRCA steel for load bearing parts.
3. Enclosure shall be provided with adequate number of doors with heavy duty hinges and handles and shall have adequate lighting arrangements.
4. Suitable louvers on fresh air intake side and radiator side with acoustic treatment shall be provided. The hot air from radiator shall be discharged through modular duct.



FOR  
1 X 750 KVA EMERGENCY DG SETS AND ACCESSORIES  
2 x 660MW UDANGUDI STPP, STAGE-I  
TANGEDCO, TAMILNADU

Indent  
Specification  
Number

**CUSTOMER : TAMIL NADU GENERATION AND DISTRIBUTION CORPORATION LTD.**

IS-1-17-2002/16

5. Any type of ducting required inside or outside of the enclosure for discharge or intake of air shall be in bidder's scope.
6. The acoustic enclosure shall be suitable enough to prevent leakage of sound and bidder shall ensure that noise measurement shall not exceed 85 db(A) at a distance of 1 meter around the machine or as per CPCB norms whichever is more stringent. Noise level measurement shall be carried out using applicable and internationally acceptable standards. The measurement shall be carried out with a calibrated integrating sound level meter meeting the requirement of IEC 651 or BS 5969 or IS 9779.
7. All lighting fixtures inside the acoustic enclosure shall be in bidder's scope.
8. Paint shade of acoustic enclosure shall be finalized during detailed engineering.

#### **9. CABLES AND ACCESSORIES:**

1. LT Power & Control Cables including all accessories like lugs, Double Compression nickel plated brass glands, ties etc, Special Cables, instrument Cables, inside DG Room between equipments supplied by DG supplier (Cables between DG Supplier supplied equipment and other equipment is not in DG Supplier scope) . **However all glands, lugs and ties required on generator panels and any other equipment supplied by the bidder shall be in Bidder's scope.** List of glands/lugs required for terminating external cables (not in scope of bidder) shall be provided during detailed engineering.
2. **LT Power cables** shall be 1100V grade single/multi core, stranded H4 grade aluminum conductor, XLPE insulated, armored, with PVC inner sheath, armoured & outer sheath made of FRLS PVC compound. Minimum conductor cross section for power cables shall be 10sq mm for aluminum cables.
3. **Control cables** shall be 1100V grade, multicore, min. 2.5sq mm cross section, stranded plain annealed copper conductor having minimum 7 strands, PVC insulated, PVC inner sheathed/galvanized steel wire armored, overall FRLS,PVC outer sheathed generally conforming to IS 1554 part 1. From charger to battery minimum 6sq.mm copper cable shall be considered and from battery to engine minimum 120sq.mm copper cable shall be considered. CT circuits shall have minimum 4sq.mm Cu wire,
4. **Instrumentation cables** shall be annealed, tinned, 7-stranded copper conductor, 0.5 sq mm, PVC insulated, armoured, FRLS sheathed and twisted into pairs.
5. **Screened cable** to be provided to connect RTD and BTD in alternator to temperature Scanner and for AVR and GOVERNOR connections for voltage and speed raise/lower.

#### **10. COMMISSIONING SPARES/ B-CHECK KIT:**

1. Commissioning Spares/B-Check kit shall be supplied by the bidder at the time of commissioning.



FOR  
1 X 750 KVA EMERGENCY DG SETS AND ACCESSORIES  
2 x 660MW UDANGUDI STPP, STAGE-I  
TANGEDCO, TAMILNADU

Indent  
Specification  
Number

**CUSTOMER : TAMIL NADU GENERATION AND DISTRIBUTION CORPORATION LTD.**

IS-1-17-2002/16

2. Lube oil filters /Bypass lube oil filter /Fuel oil filter kit & its seal rings, air filters and accessories, coolant filters, coolant testing kit, alignment check of the engine and alternator and any other commissioning spares recommended by the manufacturer shall be in bidder's scope and to be supplied at the time of commissioning.
3. The B-check of the Engine shall be carried out in the presence of Bidder's experts / engine experts and the service charges towards the same to be borne by the bidder.

#### **11. LUBE OIL AND COOLANT:**

1. First fill of lube oil, coolant and coolant conditioner at site at the time of commissioning shall be in the scope of the bidder.
2. Lube oil and coolants for first fill to be supplied at the time of commissioning only and shall not be sent along with the DG Sets.
3. Manufacturer recommended coolant and lub oil shall only be supplied.

#### **12. TOOLS AND TACKLES:**

1. Bidder to supply new set of tools and tackles of reputed make specific to the supplied DG set for the maintenance of the equipment exclusively by customer.
2. These tools should be separately packed and shipped. Tentative List of tools is enclosed. Vendor to confirm suitability of the following tools for their equipment. If any addition / deletion / new list are required for the DG, it may please be furnished and will be decided during detailed engineering.

S. No	Description	S. No	Description
1	Torque Wrench (2-8 ft-lb),3/8" square drive	15	Double ended box spanners in 16 sizes with sliding bar and wallet: 6 x 7mm, 8 x 9mm, 10 x 11mm, 12 x 13mm, 14 x 15mm, 16 x 17mm, 18 x 19mm and 20 x 22mm.
2	3/8" to 1/2" square drive	16	Combination pliers – 8" long
3	Screw driver socket 1/2" square drive	17	Nose pliers –6" long
4	Ring and open end combination wrench (1/2",3/4,"9/16", 7/8", 15/16", 7/16"	18	Plastic hammer 0.1/2" diameter and iron hammer.
5	Ring Spanner Set (The ring sizes include 6X7 8X9 10X11 12X13 14X15 16X17 18X19 20X22 21X23 24X26 25X28 30X32 and are 12 in number.)	19	Half moon spanner – 3/4" x 5/8"



FOR  
1 X 750 KVA EMERGENCY DG SETS AND ACCESSORIES  
2 x 660MW UDANGUDI STPP, STAGE-I  
TANGEDCO, TAMILNADU

Indent  
Specification  
Number

CUSTOMER : TAMIL NADU GENERATION AND DISTRIBUTION CORPORATION LTD.

IS-1-17-2002/16

6	Double ended Spanner set- (12 nos in 1 set)	20	Measuring Scale and tape(3m)
7	Tool box for the above	21	5 piece file set.
8	Socket 7/8" – 1/2" square drive	22	Socket 9/16" – 1/2" square drive
9	Socket 7/8" – 1/2" square drive	23	Extension – 1/2" square drive, 3" long
10	Dial gauge – 1" Travel, Least count 0.001" with magnetic base	24	Socket 5/8" – 1/2" square drive
11	Extension – 1/2" square drive, 5" long	25	Cable splicing knife.
12	Socket 1/2" – 1/2" square drive	26	Screw driver Set
13	Adjustable wrench – 10" long	27	Electrical Tester
14	Allen Key Set	28	Insulation tapes (R,Y,B,N) - 2 each.

### 13. ALTERNATOR TERMINAL BOXES

1. Neutral Side and Phase side terminal Box shall be supplied by the bidder.
2. The terminal box shall have IP 54 protection class.
3. The terminal box shall be suitable to connect NSPBD. Dimensions will be given during detailed engineering.
4. The terminal Box shall be suitable to house protection CTs with necessary supports.
5. The paint shade of the terminal box shall be same as that of the DG Set.

### 14. AMF PANEL

**AMF panel shall receive power supply from alternator and feed to emergency MCC of Owner. It shall be provided with required air circuit breakers, CTs, PTs, protection relays, multi-function meters, indication etc.**

The following are the necessary list of components in each DG AMF Control panel. However any other components required making the system operate as per the approved operating philosophy shall be in Bidder's scope.

#### A. CURRENT /POTENTIAL TRANSFORMER

SNO	DEVICE NO.	DESCRIPTION	MAKE	TYPE	RATING	QTY
<b>A. CURRENT/POTENTIAL TRANSFORMER</b>						
1	CT with mounting arrangements.	CT FOR METERING	As per customer approved list	Cast resin	Cl-0.5, ISF<5, VA as required.	3

1190052/2022/ISG-ELECTRICAL ENQUIRY SPECIFICATIONS

Indent  
Specification  
NumberBHEL- ISG,  
BANGALOREFOR  
1 X 750 KVA EMERGENCY DG SETS AND ACCESSORIES  
2 x 660MW UDANGUDI STPP, STAGE-I  
TANGEDCO, TAMILNADU

CUSTOMER : TAMIL NADU GENERATION AND DISTRIBUTION CORPORATION LTD.

IS-1-17-2002/16

SNO	DEVICE NO.	DESCRIPTION	MAKE	TYPE	RATING	QTY
2	CT with mounting arrangements.	CT FOR DG SET CONTROLLER, if required	--do--	Cast resin	As required.	3
3	PT	Potential Transformer Draw out	--do--	Protection & Metering. Insulation E or better.	$415 / \sqrt{3} V$ $110 / \sqrt{3} V$ 100VA, CL 0.5/ 3P, Cast resin	3
4	PT	OPEN DELTA Potential Transformer for earth fault sensing.	--do--	Protection.	$415 / \sqrt{3} V$ $110 / \sqrt{3} V$ CL 0.5/ 3P, Cast resin, VA as required	3
5	PT	For earthing alternator neutral	--do--	Protection.	$300/ 110 V$	1
6	CONTROL TRANSFORMER		--do--	For distribution	$415/230$	1
<b>B. TRANSDUCERS (current and voltage ratings shall be as per respective DG ratings)</b>						
1	CTD 1,2,3	Current Transducer	---do---	<b>Aux. Supply: 220 V DC.</b> Accuracy Class-1	Dual Output: 4 – 20mA	3
2	PFTD	Power Factor Transducer	---do---	(For 3 Ph, 3 Wire System) Self-Powered. <b>Aux. Supply: 220 V DC.</b> Accuracy Class-1	Range: 0.8 Lag – 0.8 Lead Dual output: 4 – 20 mA	1
3	KWTD	Watt Transducer	---do---	3 Ph,3Wire un-balanced load. <b>Aux. Supply: 220 V DC</b> Accuracy Class-1	Dual Output: 4 – 20mA	1
4.	VTD1,2,3	Voltage Transducer 1,2,3	---do---	<b>Aux. Supply: 220 V DC</b> Accuracy Class-1	Dual Output: 4 – 20mA Input: 0 – 500 V AC	3
5.	FTD	Frequency Transducer	---do---	Self Powered. <b>Aux. Supply: 220 V DC</b> Accuracy Class-1	Range: 45 – 50 – 55 Hz Dual Output: 4 – 20mA Input: 0 – 55 Hz	1
<b>C. TEMPERATURE SCANNER</b>						
1	TC	Temperature Scanner	---do---	PT 100 (RTD)	0 – 150 deg C 16- CHANNELS	1
<b>D. MEASURING INSTRUMENT DETAILS.</b>						
1.	M	Digital Ammeter Digital Voltmeter Digital frequency meter	---do---	FLUSH MOUNTED. DIGITAL	110 V AC CL 1.0, with push buttons.	1 each

1190052/2022/ISG-ELECTRICAL ENQUIRY SPECIFICATIONS

Indent  
Specification  
NumberBHEL- ISG,  
BANGALOREFOR  
1 X 750 KVA EMERGENCY DG SETS AND ACCESSORIES  
2 x 660MW UDANGUDI STPP, STAGE-I  
TANGEDCO, TAMILNADU

CUSTOMER : TAMIL NADU GENERATION AND DISTRIBUTION CORPORATION LTD.

IS-1-17-2002/16

SNO	DEVICE NO.	DESCRIPTION	MAKE	TYPE	RATING	QTY
		Electronic kWh meter sealable type with counter display Digital kW meter Pf meter				
<b>E. AUXILIARY CONTACTORS</b>						
1	K	Auxiliary / Power Contactors	---do---		220V DC with 4NO+4NC	As required.
2	R	Auxiliary Relay	---do---		220V DC with 4NO+4NC	As required.
<b>F. SELECTOR SWITCHES</b>						
1	S/S	Selector switches	---do---		16A DC, 1/2 pole. 4 positions, lockable, Changeover etc as per the requirement.	As required.
<b>G. PUSH BUTTONS</b>						
1	S	PUSH BUTTONS	---do---	RED /GREEN / BLACK	2NO+2NC	As required
<b>H. INDICATING LAMPS (LED TYPE)</b>						
1	L	INDICATION LAMPS	---do---	CLUSTER LED TYPE	220 V DC/ 24V DC	As required
<b>I. HOOTERS</b>						
1	H	Hooters	---do---	Industrial type	220 V DC	1
<b>J. CONTROL AND POWER FUSES, NEUTRAL LINKS WITH BASE</b>						
1	F	Fuses with base and N- links with base	---do---	HRC cartridge fuse link type	220 V DC/230 V AC/ 24V DC	As required
<b>K. MCB</b>						
1	Q	MCB with Base Plate	---do---		3/4 pole, 2 Pole, 10A, 6A, AC/DC AS REQUIRED	As required
<b>L. OTHERS</b>						
1	ANNUN	Annunciator (min 16 channel)	---do---	Static annunciator, with acknowledge, reset and lamp test push buttons.	The sequence of operation shall be similar to ISA-2A	1 No.
2	T	Toggle Switch	---do---	1/2POLE	10A	As required
3	L	Limit Switch with Base	---do---	2NO+2NC	220 V DC /230V AC	As required

1190052/2022/ISG-ELECTRICAL ENQUIRY SPECIFICATIONS

Indent  
Specification  
NumberBHEL- ISG,  
BANGALORE

FOR  
1 X 750 KVA EMERGENCY DG SETS AND ACCESSORIES  
2 x 660MW UDANGUDI STPP, STAGE-I  
TANGEDCO, TAMILNADU

CUSTOMER : TAMIL NADU GENERATION AND DISTRIBUTION CORPORATION LTD.

IS-1-17-2002/16

SNO	DEVICE NO.	DESCRIPTION	MAKE	TYPE	RATING	QTY
4		Plug & Sockets, space heater(with thermostat)	---do---	2 Pin with Earth	10 A , 230V AC	As required
5	T	Any Matching Transformer if required	---do---		415V/110V 415V/24V 230V/24V	As required
6	L	Panel Lamp	---do---	CFL lamp	230 V AC	1 No.

**M. MOTORIZED POTENTIOMETERS**

1	<b>Motorized Potentiometer/ or suitable provision for Voltage Control from AMF Panel/Remote</b>				Aux supply:220 V DC	1 No.
2	<b>Motorized Potentiometer/ or suitable provision for Speed Control from AMF Panel/Remote</b>				Aux Supply, 220 V DC	1 No.
N.	<b>Provision shall be provided for starting / stopping , voltage raise / lower and speed raise / lower commands from remote along with the local operation ( from DCS)</b>					
O.	<b>Master trip relay</b>					
P.	<b>PT Fuse fail indication using MPCB</b>					
Q.	<b>Three attempt starter/cool down timer shall be included</b>					
R.	<b>220 V DC supervision relay</b>					
S.	<b>24 V DC Supervision relay</b>					
T.	<b>Under voltage relay VAG11 or comparable equivalent</b>					
U.	<b>Under/Over frequency relay P94V8 or comparable equivalent</b>					
	<b><i>Bidders to note that the above components are tentative, any other item or protection required for safe and reliable operation of the DG as per the operating philosophy shall be considered by the bidder in his offer and shall be supplied without any commercial implications to BHEL. Also, the components required as per customer specification attached shall also be provided.</i></b>					

- Components for the satisfactory working of the system and to achieve overall functional requirement are in the scope of the supplier .All CT/PT's shall be cast resin type. All standard accessories like test terminal blocks, disconnecting TB's etc. is in the scope of the supplier.
- The Panel shall have a rigid welded structural frame smooth finished and free from all flaws, enclosed completely by CRCA sheets of minimum 1.6mm for no loadbearing members and 2 mm thickness for load bearing members and 3mm thickness for gland plates/4mm for Al gland plates.. All doors panels, removable covers shall be gasketed properly with neoprene rubber gasket. The panel shall have openable front and back door with concealed hinges. Suitable shrouding arrangement shall be provided inside the panel for safety of maintenance personnel. Doors shall be provided with lockable knob.
- Enclosure Protection shall be IP 54.
- 4 sqmm cables to be used for CT and PT connection. 2.5/1.5 sq mm cables to be used for voltage connections & control wiring. Wiring shall be 1100 grade, single core stranded copper conductor wires with PVC insulation
- Maximum operating height shall be less than 1800 mm and minimum operating height more than 750 mm. adequate clearances shall be provided between all live parts and structure etc., as per relevant Indian standards.



FOR  
1 X 750 KVA EMERGENCY DG SETS AND ACCESSORIES  
2 x 660MW UDANGUDI STPP, STAGE-I  
TANGEDCO, TAMILNADU

Indent  
Specification  
Number

**CUSTOMER : TAMIL NADU GENERATION AND DISTRIBUTION CORPORATION LTD.**

IS-1-17-2002/16

6. Earthing bus of 50 x 6 mm Al shall be provided at the bottom of the cubicle. All non-current carrying metal work of the panel shall be effectively connected to the earth bus. Earth bus shall be extended out of the panel.
7. Panel wiring and termination: Panel shall be supplied completely wired internally to equipment and terminal blocks and ready for purchaser's external cable connection, at the terminal blocks. The wiring shall be securely supported, neatly arranged, readily accessible and connected to equipment terminals and terminal blocks. Wiring should run through PVC slotted channel with covers. Wiring terminations shall be made by solder less crimping fork type lugs on equipment side and pin type lugs on terminal side. Engraved tightly fitting plastic ferrules shall be provided for wire identification. These shall be suitably located for ease in external wiring.
8. **20% spare terminals shall be provided.** Window facia annunciation system shall be provided for centralized registration and indication of fault conditions. Potential free contacts are to be wired for indication. Audible alarm shall be provided. Push buttons for acknowledge, reset and test shall be provided. The facia windows shall have multiple LEDs and not incandescent lamps for illuminations in case of faults. List of faults will be finalized during drawing approval.
9. Two sets of potential free contacts to be given for all major alarms, annunciations and indications to be taken to plant control Room. Same shall be decided during detailed engineering.
10. The DG Set supplier shall provide engine governor and Automatic Voltage Regulator, which will have some signal, interlocks to the DG Control panel. Same shall be finalised during detailed engineering.
11. AMF Panel shall be provided with thermostatically controlled space heaters to keep the air inside the AMF panel enclosure sufficiently above the dew point to prevent condensation. The heaters shall be located such that wiring, buses and control devices do not get over heated.
12. **The panel shall also have feeders for all auxiliaries of the DG Set and Battery Chargers.**
13. Necessary transparent shrouding shall be provided for live parts , CT and PT terminals.
15. **NGR PANEL:**
  1. Diesel Generator's neutral shall be earthed through resistance such that the 415V system earth fault current is limited to 1A when supplied from DG. NGR shall be suitable for continuous duty. Resistor shall be punched stainless steel grid type with suitable enclosure and isolator. NGR panel shall be IP-55, suitable for outdoor installation.
  2. Isolator shall be provided with interlock from DG AMF panel so that the isolator opens when DG and Mains are running in parallel.
  3. Paint shade of NGR panel shall be finalized during detailed engineering.



FOR  
1 X 750 KVA EMERGENCY DG SETS AND ACCESSORIES  
2 x 660MW UDANGUDI STPP, STAGE-I  
TANGEDCO, TAMILNADU

Indent  
Specification  
Number

**CUSTOMER : TAMIL NADU GENERATION AND DISTRIBUTION CORPORATION LTD.**

IS-1-17-2002/16

#### **16. COMMISSIONING SPARES (PANELS)**

1. Control Fuses only – 1 set (2 Nos. of each type as used in the complete set of panels above)
2. Indicating Lamps – 1 set (2 Nos. of each type as used in the complete set of panels above).
3. Timer – 1 no. of each type.
4. Auxiliary Contactor- 1 set (1 no. of each type used in DG AMF panel above).
5. Auxiliary relay- (1 no. of each type used in DG AMF panel above).
6. MCBs - 1 set (1 no. of each type used in complete set of panels above).
7. Door Lock: - 4 nos. of each type as used in AMF and Aux DB.

#### **17.SUPERVISION OF ERECTION**

1. Supervision of Erection of DG Set Package shall be in Bidder's scope.
2. Bidder shall send his supervisor for supervision of erection of the DG Set, acoustic enclosure, fuel lines, exhaust piping, exhaust structure, Control panels, Terminal boxes, CTs, cabling etc. as and when informed by BHEL.
3. At least one week prior notice shall be provided to bidder for deputation of his engineer/supervisor.
4. Bidder's supervisor shall support BHEL officials in getting the necessary erection protocols accepted by the customer/consultant.
5. Boarding and Lodging and conveyance of bidder's supervisor/engineer is not in BHEL's scope.

#### **18.SUPERVISION OF TESTING & COMMISSIONING:**

1. Supervision of pre commissioning checks, testing of DG and accessories and control panels and supervision of Commissioning of the same as per the approved operating philosophy shall be in Bidder's scope.
2. The test equipments and manpower for testing shall be provided by BHEL at site. However the Bidder's supervisor is expected to carry his basic testing kits and tools.
3. Load trials of one entire DG Set Package on maximum available plant load. This shall also include proper training for customer's O&M team at site.



FOR  
1 X 750 KVA EMERGENCY DG SETS AND ACCESSORIES  
2 x 660MW UDANGUDI STPP, STAGE-I  
TANGEDCO, TAMILNADU

Indent  
Specification  
Number

**CUSTOMER : TAMIL NADU GENERATION AND DISTRIBUTION CORPORATION LTD.**

IS-1-17-2002/16

4. Bidder's supervisor shall support BHEL officials in getting the necessary commissioning protocols accepted by the customer/consultant.
5. Supervision of testing and settings of generator protection relay through primary/secondary injection at site either by manufacturer/bidder's engineer shall be in scope of bidder. Secondary injection kit shall be provided by BHEL.

### **19.SUPERVISION OF PG TEST**

1. Supplier to depute its representative to carryout supervision of PG Test as and when required by BHEL. Load/ Fuel not in supplier's scope.
2. The procedure for carrying out the PG Test shall be mutually decided by the supplier, BHEL and end customer/consultant.
3. The bidder shall provide support in the form of required copies of as-built drawings, documents, datasheets, protocols or any other information required by BHEL for obtaining statutory clearances from CPCB, CEA,CCOE and other applicable bodies for the supplied DG Sets (If applicable). Necessary approvals shall be taken by BHEL.

### **20. TRAINING**

1. High quality hands on training regarding various modes of operation including parallel operation, as given in BOQ shall be provided to BHEL/customer so that they can operate & maintain the DG Sets confidently. Boarding/ Lodging of BHEL/ customer engineers not in supplier scope.

Training at respective manufacturer's works on following:

- a. Diesel Engine –Operation & Maintenance, Settings for various modes of operation including parallel operation, Trouble shooting- 2 mandays
- b. Alternator & AVR –Operation & Maintenance, Settings for various modes of operation including parallel operation, Trouble shooting- 1 mandays
- c. DG Set Controller – Programming, testing, Configuring for various modes of operation, parallel operation, data transfer to remote(networking) -3 mandays.
- d. Numerical relay – relay setting, parametrization and testing of relays -4 mandays.

### **21. MANDATORY SPARES**

- Bidder to supply one set of mandatory spares for DG set package. These mandatory spares should be separately packed and shipped (refer to packing instructions).

A. Diesel Generator

BHEL- ISG,  
BANGALORE

FOR  
1 X 750 KVA EMERGENCY DG SETS AND ACCESSORIES  
2 x 660MW UDANGUDI STPP, STAGE-I  
TANGEDCO, TAMILNADU

CUSTOMER : TAMIL NADU GENERATION AND DISTRIBUTION CORPORATION LTD.

IS-1-17-2002/16

S.No	ITEMS	QTY	UNITS
1	Fuel injection nozzles	2	Set*
2	Crank shaft with standard size journals	1	Set
3	Main Bearings	1	Set
4	Big end bearings (Conrod big end)	1	Set
5	Diesel filter packs (filter elements)	20	Nos.
6	Mobile oil filter packs (lube oil filter elements)	20	Nos.
7	V-belt for radiator fan	5	Nos.
8	Fuel injector	5	Nos.
9	Fuel injection piping	1	Set
10	Ring gear for flywheel	1	Set
11	Starter	1	Set
12	Nozzle tester, barring bar, slings, eyebolts	1	Set
13	Pressure Switch	1	Set
14	Temperature Switch	1	Set
15	Pressure Sensor	1	Set
16	Temperature Sensor	1	Set
17	Rotating diodes and fuse for main field excitation of each rating	2	Nos.
18	Temperature Scanner	2	Nos.
19	CT of each type and rating	1	Set
20	Protective relay of each type	1	No.
21	Auxiliary relay of each type	1	No.
22	Timer of each type	1	No.
23	Indicating instruments of each type	1	No.
24	Fuses of each rating	1	No.
25	Indicating lamps of each type	1	No.
26	Terminal Blocks of each type	1	No.

( \*One set corresponds to actual quantity of components and devices as installed for the equipment at Site – i.e as used in one DG Set )

## SECTION – VII

### PAINTING

- All painting shall be in accordance with approved QAP and shade as per customer's approval. All painting shall be of high quality for long lasting, shall include mechanical cleaning, chemical cleaning for derusting, phosphating, application of primer and final paint of required thickness.
- Painting procedure followed by supplier for all items shall be furnished as and when required by BHEL, failing which it will be presumed that any painting procedure as required by customer will be acceptable to supplier.



FOR  
1 X 750 KVA EMERGENCY DG SETS AND ACCESSORIES  
2 x 660MW UDANGUDI STPP, STAGE-I  
TANGEDCO, TAMILNADU

Indent  
Specification  
Number

**CUSTOMER : TAMIL NADU GENERATION AND DISTRIBUTION CORPORATION LTD.**

IS-1-17-2002/16

- The paint shade and thickness for DG set, Acoustic Enclosure, Fuel tanks, Battery Charger, Control Panels etc shall be decided during detailed Engineering.

## SECTION – VIII

### INSPECTION AND TESTING

- All equipments to be supplied should be of type tested design. During detailed engineering the contractor shall submit for approval the reports of all the type tests as per relevant standards and carried out on machine and equipment of same capacity within last 5 years from the date of bid opening. Failing to do so the supplier shall conduct the entire test under this contract at his own cost either at third party lab or in presence of owner's representative and submit the reports for approval.
- Type test certificates and reports of the Engine, Alternator, Control Panels and all individual components as applicable of similar rating as per standards shall be submitted during detailed engineering for review and acceptance.
- Routine test report of the Engine and Alternator shall be furnished at the time of inspection of the DG Set by BHEL and Customer. Witness of routine test of alternator and engine has not been envisaged as of now. However all documentation as per customer QAP shall be submitted. Optional prices have been asked for witness of routine tests of engine and alternator, in case required.
- All routine/acceptance tests on DG Set and accessories and control panels shall be carried out as per relevant standards. Inspection of DG Set, accessories and control panels shall be conducted as per approved QAP.
- For Factory Test, each DG set shall be tested for four hours. Fuel for testing shall be in bidder's scope and included in the price of the DG Set.
- Control panels shall be tested with secondary injection kit.
- TC for other items mentioned in BOM to be submitted by the supplier as and when required by BHEL.
- One set of manufacturer's Test certificate and Internal Test reports to be made available at the time of inspection.



FOR  
1 X 750 KVA EMERGENCY DG SETS AND ACCESSORIES  
2 x 660MW UDANGUDI STPP, STAGE-I  
TANGEDCO, TAMILNADU

Indent  
Specification  
Number

**CUSTOMER : TAMIL NADU GENERATION AND DISTRIBUTION CORPORATION LTD.**

IS-1-17-2002/16

## SECTION IX

### PACKING AND TRANSPORTATION

1. Supplier shall be entirely responsible for ensuring that the packing suits the mode of shipment. Customer/BHEL may require inspecting and approving the packing before the materials are dispatched.
2. The bidder/supplier shall be responsible for any damage/loss of material during transit on account of improper packing.
3. Any material found short on opening the intact packing case shall have to be supplied by the bidder at no extra cost to the purchaser.
4. DG Set shall be fully packed in air tight polythene and shall be placed inside the container. All the openings on DG Set like exhaust opening, Air opening, Fuel openings to be capped tightly with metallic materials to prevent entry of water, moisture or dust.
5. All loose accessory of the engine shall be properly packed in a wooden box and shall be placed inside the container.
6. Loose erection materials shall be properly packed in sacks and supplied in wooden boxes only.
7. Control panels shall be fully packed in polythene and cushion and shall be supplied inside Plywood cases, suitable for outdoor storage.
8. Acoustic Enclosure shall also be packed in wooden crate with cushion to ensure no scratches during transportation and handling and shall be suitable for outdoor storage.
9. Mandatory Spares shall be packed in proper wooden/Tin box, suitable for long and safe storage.
10. Cables shall be supplied in cable drums. While accessories like glands and lugs shall be properly packed in wooden boxes only suitable for outdoor storage.
11. All boxes shall bear the relevant stamp, name of project, package, BHEL unit, and name of supplier.
12. Proper packing list mentioning the name and quantity of each and every item shall accompany all boxes. It shall be Bidder's responsibility to get the packing list verified and vetted by BHEL Stores in charge at Site.
13. In absence of signed packing list, it shall be Bidder's responsibility to supply any missing/damaged item at later stage.



BHEL- ISG,  
BANGALORE

FOR  
1 X 750 KVA EMERGENCY DG SETS AND ACCESSORIES  
2 x 660MW UDANGUDI STPP, STAGE-I  
TANGEDCO, TAMILNADU

Indent  
Specification  
Number

**CUSTOMER : TAMIL NADU GENERATION AND DISTRIBUTION CORPORATION LTD.**

IS-1-17-2002/16

14. All packing material shall become the property of the customer.
15. Bidder to take extreme care while packaging and transportation of materials to Site. Any damage to items due to lack of suitable packing shall be attributable to the bidder.
16. Bidder shall send its representatives for unloading and verifications of major items and shall collect required documents from BHEL-Stores for submission to BHELISG, Bangalore office along with the invoices.

## **SECTION – X** **DOCUMENTATION**

The following documentation shall be supplied to BHEL at different stages of the Project. In preparing and submitting the documentation, the requirements given in subsequent clauses shall be strictly adhered to.

The documents shall be in English language and MKS system of units.

All documents shall be submitted through BHEL's Document Management System "WRENCH" for which BHEL shall provide single login id and password to the successful bidder. Successful bidder shall receive all commented/ approved documents through "WRENCH" only.

Any documents submitted through mails will not be considered.

Procedure for uploading and downloading of documents from the portal and the list of documents to be submitted shall be informed after the award of contract.

All soft copies (except where specifically mentioned Wrench) shall be provided though pen Drive/DVD/CD as decided by Customer/BHEL.

### **List of Drawing / Documents:**

TYPE OF DOCUMENTS	TYPE OF DOCUMENTS	STATUS	TIME SCHEDULE
Sizing Calculations for battery & battery charger and catalogue of Engine, Governor, Alternator, and AVR.	Soft copy	For Technical scrutiny and Approval	Within 2 weeks on intimation by BHEL.
DG Building Layout and Cross Section considering acoustic enclosure, exhaust piping, cable trenches, cable trays, fuel trenches etc.	Soft copy	For Approval	Within 2 weeks on intimation by BHEL.
GA / OGA Drawing of Diesel Engine, Controller, Associated accessories, Alternator. Terminal Box /Adopter Box; DG Set, Base Frame.	Soft copy	For Approval	Within 2 weeks on intimation by BHEL.
GA of 990 liters fuel tank and P&ID of fuel line/system	Soft copy	For Approval	Within 2 weeks on intimation by BHEL.
QAP For all major items.	Soft copy	For Approval	Within 2 weeks on

1190052/2022/ISG-ELECTRICAL ENQUIRY SPECIFICATIONS

BHEL- ISG,  
BANGALORE

FOR  
1 X 750 KVA EMERGENCY DG SETS AND ACCESSORIES  
2 x 660MW UDANGUDI STPP, STAGE-I  
TANGEDCO, TAMILNADU

Indent  
Specification  
Number

**CUSTOMER : TAMIL NADU GENERATION AND DISTRIBUTION CORPORATION LTD.**

IS-1-17-2002/16

			intimation by BHEL.
Field Quality Plan	Soft copy	For Approval	Within 2 weeks on intimation by BHEL.
Data Sheets of Engine, Alternator, DG Set and Battery and Exhaust Structures..	Soft copy	For Approval	Within 2 weeks on intimation by BHEL.
Foundation Plan & Loading Details of DG Set.	Soft copy	For Approval	Within 2 weeks on intimation by BHEL.
GA drawing of exhaust stack with support structures, STAAD input files and calculations.	Soft copy	For Approval	Within 2 weeks on intimation by BHEL.
GA /Schematic/ BOM for AMF panel, Auxiliary Distribution Board, Battery charger panel, DG Local Isolator. Along with CT and Vt sizing calculations.	Soft copy	For Approval	Within 2 weeks on intimation by BHEL.
Proper Calculations for protections settings in Generator protection Relay.	Soft copy	For Approval	Within 2 weeks on intimation by BHEL.
GA, BOM & wiring diagram of Engine Control Panel	Soft copy	For Approval	Within 2 weeks on intimation by BHEL.
Total Integrated Cable Schedule for total integrated system which includes Electrical Panels.	Soft copy	For Approval	Within 2 weeks on intimation by BHEL.
TEST CERTIFICATES of all major items	Soft copy	For Information	Within 2 weeks on intimation by BHEL.
CATALOGUE/Manual of all electrical items.	10 Sets	For Information	Within 4 weeks on intimation by BHEL.
O&M, Storage & Erection instruction manual.	10 Sets + 2 CD	Documentation	Within 4 weeks on intimation by BHEL.
As built & Commissioned Drawings / final document	10 Sets + 2 CD	Final Documentation	Within 4 weeks on intimation by BHEL.

1. The GA / OGA drawing shall contain elevation, section, foundation / mounting for Civil Assignment and Layout.
2. Details of Exhaust Silencer; OGA/GA of, Lube oil priming pumps; Locations of total DG Auxiliaries; Location of Heaters; height; Mounting faces for vibration monitoring sensors; Heat loss data i.e., heat dissipation from engine surface/Ventilation Requirement.; Applicable codes and Standards.
3. Master Drawing list and Title Block for all the drawings and documents shall be provided to bidder immediately after award of contract.
4. Resubmission of drawings/documents shall be done within 2 weeks from the receipt of comments from BHEL/Customer.

1190052/2022/ISG-ELECTRICAL ENQUIRY SPECIFICATIONS



FOR  
1 X 750 KVA EMERGENCY DG SETS AND ACCESSORIES  
2 x 660MW UDANGUDI STPP, STAGE-I  
TANGEDCO, TAMILNADU

Indent  
Specification  
Number

**CUSTOMER : TAMIL NADU GENERATION AND DISTRIBUTION CORPORATION LTD.**

IS-1-17-2002/16

5. Bidder may note that the drawings, data and manuals listed herein are minimum requirement only. The bidder shall ensure that all other necessary write-up, information, etc required to fully describe the equipment are to be submitted with the bid.
6. Test Certificates shall be strictly in A4 size.
7. Test certificates shall have all the information as per relevant IS.
8. Test Certificates shall be marked "Certified" and shall be signed by competent authority from bidder's side.

## **SECTION XI**

### **EXCLUSIONS**

1. Load/ Fuel for commissioning, load trials and PG test of the DG at Site are not in Bidder's Scope.
2. Cable trays, supports and accessories are not in Bidder's scope.
3. Cable trench covers are not in Bidder's scope.
4. Earthing materials and plates are not in Bidder's scope.
5. Any Kind of Civil works at site is not in Bidder's scope.
6. Cables between Bidders' supplied equipments/panels and remote switchgear/DCS/Control Room is not in Bidder's Scope. However All lugs and glands on Bidder's supplied equipment shall be in bidder's cope.
7. Storage of materials, loading and unloading is not in Bidder's scope.
8. Transportation of materials from Stores to DG area is not in Bidder's scope.
9. Any kind of painting at site is not in bidder's scope.
10. Testing equipments like Primary injection kit, secondary injection kit, Megger etc at site are not in Bidder's scope.
11. Obtaining statutory clearance for DG Set is not in bidder's scope. However bidder to provide all necessary drawings and documents to get the clearance.
12. DG building lighting and fire protection is not in Bidder's scope.

## 1190082/2022/ISG-ELECTRICAL

BHEL - ISG - BANGALORE  
PROJECT ENGINEERING - ELECTRICAL

BOQ

PROJECT: 2X660MW UDANGUDI SUPERCRITICAL THERMAL POWER PROJECT, STAGE-1

INDENT NO : IS-1-17-2002/016 Dated 25-11-2022

Item : 1 X 750 KVA DG SETS WITH ACCESSORIES

Sl. No.	Item Description	QTY	UOM	Unit Rate Inclusive of Freight (Rs)	Total Price (Rs)
<b>A</b>	<b>MAIN SUPPLY</b>				
1.	750 KVA (e) 1500 RPM, 415V 0.80pf (lag) DG with Radiator and accessories on common Base Frame.	1	Set		₹ 0.00
2.	Fuel Day tank of 990 Liters capacity with accessories.	1	Set		₹ 0.00
3.	24V DC, Lead Acid Type automotive Battery with accessories and stand, to be supplied at the time of commissioning.	2	Set		₹ 0.00
4.	Float cum Boost Battery Charger Panel with stand.	2	Set		₹ 0.00
5.	Heavy duty Changeover switch for selecting one out of two set of batteries	1	Set		₹ 0.00
6.	Necessary Fuel Piping, supports, accessories for DG.	1	Set		₹ 0.00
7.	Silencers , exhaust piping and stack, silencer supports and accessories like bellows, flanges, gaskets, bends , insulation and aluminium cladding and hardware. Galvanized exhaust pipe support structure	1	Set		₹ 0.00
8.	Acoustic enclosure for DG.	1	Set		₹ 0.00
9.	LT Power, Control, Instrument and screened cable including all accessories like lugs, glands, ties etc for DG.	1	Set		₹ 0.00
10.	B-Check kit for ENGINE, to be supplied at the time of commissioning.	1	Set		₹ 0.00
11.	First fill of lube oil, coolant and coolant conditioner at site for one DG, to be supplied at the time of commissioning.	1	Set		₹ 0.00
12.	Tools &Tackles specific to offered DG Set.	1	Set		₹ 0.00
13.	Phase side and Neutral side terminal box for Alternator	1	Set		₹ 0.00
14.	AMF Panel for one DG	1	Set		₹ 0.00
15.	NGR PANEL with isolator	1	Set		₹ 0.00
16.	Commissioning Spares for control panels.	1	Set		₹ 0.00
17.	Supervision of Erection of DG Set with exhaust piping and structure, fuel piping, control panels and cabling.	1	Set		₹ 0.00
18.	Supervision of testing, pre commissioning checks, and commissioning and load trial of DG SET with Control Panels as per operating philosophy.	1	Set		₹ 0.00
19.	Supervision of Performance Guarantee Test for DG.	1	Set		₹ 0.00
20.	Factory Training for customer/BHEL personnel	10	Mandays		₹ 0.00
21.	Mandatory spares for DG Set and Panels.	1	LOT		₹ 0.00
<b>Supply Total Inclusive of Freight (I)</b>					<b>₹ 0.00</b>
<b>GST @ xx% on (I)</b>					
<b>Total Supply (with freight and GST included)</b>					<b>₹ 0.00</b>

## 1190082/2022/ISG-ELECTRICAL

MANDATORY SPARE LIST(PRICE BREAKUP REQUIRED)					
Sl. No.	Item Description	QTY	UOM	Unit Rate Inclusive of Freight (Rs)	Total Price (Rs)
A	<b>Diesel Generator</b>				
1	Fuel injection nozzles	2	Set		
2	Crank shaft with standard size journals	1	Set		
3	Main Bearings	1	Set		
4	Big end bearings (Conrod big end)	1	Set		
5	Diesel filter packs (filter elements)	20	nos		
6	Mobile oil filter packs (lube oil filter elements)	20	nos		
7	V-belt for radiator fan	5	nos		
8	Fuel injector	5	nos		
9	Fuel injection piping	1	Set		
10	Ring gear for flywheel	1	Set		
11	Starter	1	Set		
12	Nozzle tester, barring bar, slings, eyebolts	1	Set		
13	Pressure Switch	1	Set		
14	Temperature Switch	1	Set		
15	Pressure Sensor	1	Nos		
16	Temperature Sensor	1	Nos		
17	Rotating diodes and fuse for main field excitation of each rating	2	Nos		
18	Temperature Scanner	2	Nos		
19	CT of each type and rating	1	Nos		
20	Protective relay of each type	1	Nos		
21	Auxiliary relay of each type	1	Nos		
22	Timer of each type	1	set		
23	Indicating instruments of each type	1	set		
24	Fuses of each rating	1	nos		
25	Indicating lamps of each type	1	Nos		
26	Terminal Blocks of each type	1	Nos		

**BHARAT HEAVY ELECTRICALS LIMITED**  
**INDUSTRIAL SYSTEMS GROUP, BANGALORE - 560012**  
**PRE-QUALIFICATION REQUIREMENT (PQR) FOR BIDDERS**  
**PROJECT ENGINEERING-ELECTRICAL**

<b>Indent Ref:</b>	IS-1-17-2002/016	Dated :25-11-2022
<b>Project:</b>	2 X 660 MW Udangudi Supercritical Thermal Power Project	
<b>Scope of Work:</b>	DG Set & Accessories For RO DM Flushing Pump	

**Pre-Qualification Requirement: (Technical)**

<b>JOB</b>	Design , engineering, manufacturing, supply, supervision of erection and commissioning, performance testing etc. of 1*750 KVA,1500 RPM, 415 V, 0.8pf DG Sets and accessories for 2*660 MW UDANGUDI STPP STAGE-I
<b>Indent Ref:</b>	IS-1-17-2002/016

**BIDDER SHALL NOTE AND COMPLY WITH THE POINTS REFERRED UNDER 'NOTE' BELOW**

<p>1. For design, engineering, manufacture, supply, supervision of erection and commissioning of 1*750 KVA DG Sets. BIDDER or his collaborators should have designed, manufactured, supplied and commissioned at least two (2) nos. of DG Sets of rating not less than 750 KVA, at least one (1) each at two (2) different installations which should be in successful operation for at least two (2) years prior to the date of Techno-commercial bid opening of this tender. The offered make of the DG Sets (Engine and Alternator) shall be same as that of the reference plant DG Sets. The makes proposed for sub-suppliers is subject to customer approval.</p> <p>Note: Two different installations means two different project sites/locations or two different</p>
<p>2. The consideration of the bidder shall be subject to final approval of customer (TANGEDCO)/Consultant. Bidder to submit credentials (in the form of certificate from end user) / details (necessary supplying documents) seeking approval of customer(TANGEDCO)/main contractor (BHEL).</p>
<p>3. Procurement directly from the manufacturers/suppliers shall be preferred. However, if the OEM/principal insists on engaging the services of an agent, such agent shall not be allowed to represent more than one manufacturer/supplier in the same tender. Moreover, either the agent could bid on behalf of the manufacturer/supplier or the manufacturer/supplier could bid directly but not both. In case bids are received from both the manufacturer/supplier and the agent, bid received from the agent shall be ignored.</p>

*Prakash Dhand*

**BHARAT HEAVY ELECTRICALS LIMITED**  
**INDUSTRIAL SYSTEMS GROUP, BANGALORE - 560012**  
**PRE-QUALIFICATION REQUIREMENT (PQR) FOR BIDDERS**  
**PROJECT ENGINEERING-ELECTRICAL**

**Notes**

<b>1.</b>	<p><b>The following Documentary evidence to be submitted by bidder for technical PQR evaluation:</b></p> <p><b>a) For evaluating Sl. No. A.1:</b></p> <p><b>i.</b> Purchase order copy indicating          -the project for which order was undertaken          -Contact details of order placement agency</p> <p><b>ii.</b> Material Receipt Certificate or Site Inspection Report from the end user for having received the material by the end user.</p>
<b>2.</b>	Bidder shall submit requisite documents/ proof to comply with aforesaid criteria, properly indexed along with offer. The certificate should clearly indicate date of commissioning and duration of successful operation.
<b>3.</b>	Bidder shall submit documents related to proof of collaborations/ agreement / association if any.

**FINANCIAL PRE-QUALIFICATION REQUIREMENTS**

The bidder shall have Rs. 2.2 Crores or more as average annual financial turnover during any of the three consecutive Financial Years (FYs) from the immediately preceding four FYs as of 31st Mar 2022, (Example: FY to be considered shall be 2018-19, 2019-20 & 2020-21 OR 2019-20 & 2020-21 & 2021-22).

Bidder to submit Audited Annual Report (balance sheet and profit & loss account), ITCC/ITR against the Financial PQ criteria given above.

**Important Notes to the Bidder:**

1. Quotations received from bidders who do not fulfill the PQR are liable to be rejected without any further evaluation.
2. BHEL reserves the right to accept or reject any bid received at its discretion without assigning any reasons whatsoever.
3. BHEL shall not be liable for any expenses incurred by bidder in preparation of the bid irrespective of whether it is accepted or not.
4. Canvassing i.e. soliciting favour, seeking advantage etc., in any form is strictly prohibited and any bidder found to have engaged in canvassing shall be liable to have his bid rejected summarily.
5. If the bidder deliberately gives any wrong information in his tender to create circumstances for the acceptance of his bid, BHEL reserves the right to reject such application.
6. Bidder's selection is subject to approval of BHEL/BHEL's Customer/Customer's consultant for this job.

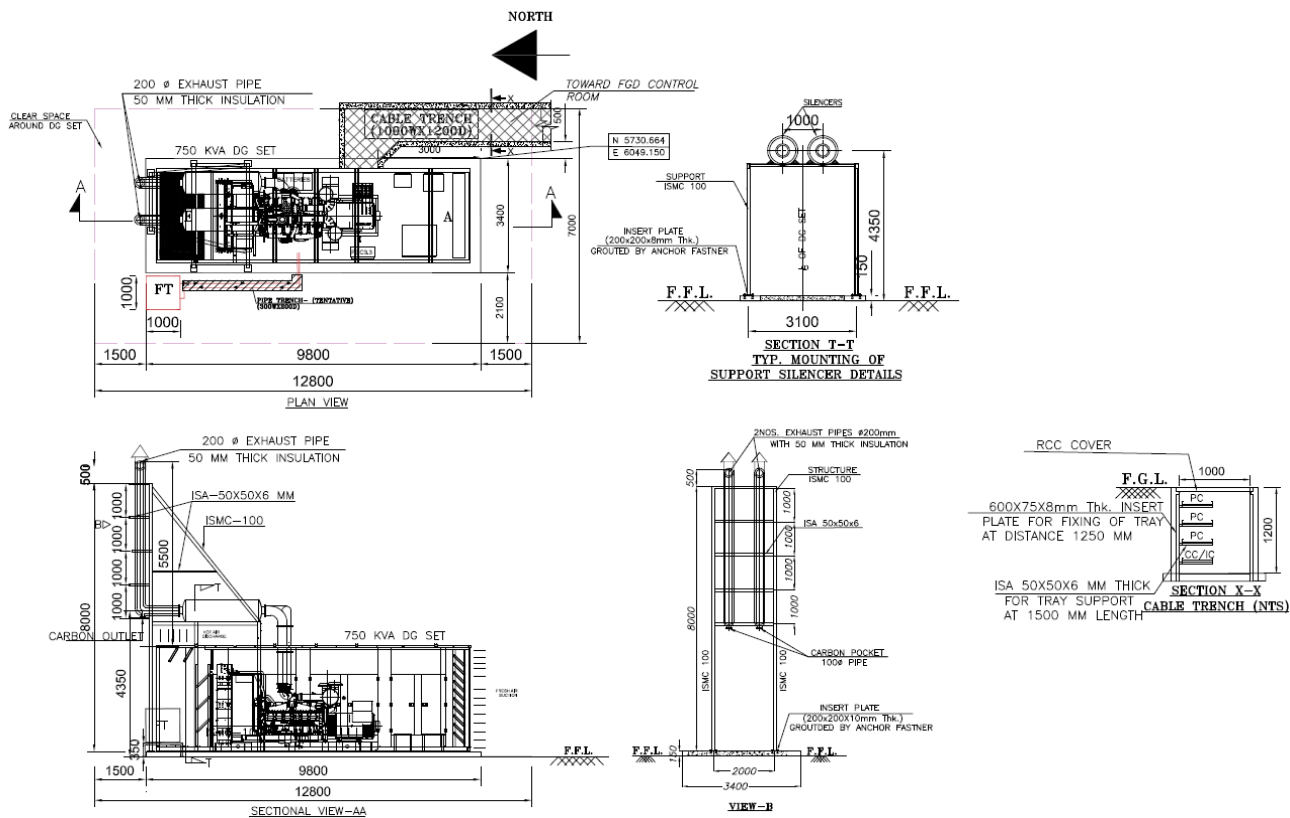
  
Piyush Anand

(Sr.Engineer/ Engineering-Electrical)

  
Hemantha Udupa YJ (Sr. Manager / Engineering-Electrical)

**ANNEXURE-1**

**TENTATIVE LAYOUT OF 750KVA DG SET**





### SECTION-3.18: DIESEL GENERATOR SET

#### 1.0.0 INTENT OF SPECIFICATION

This section covers the requirements of Diesel Generator (DG) set.

#### 2.0.0 SCOPE OF WORK

The scope of work shall include supply, installation, testing and commissioning of the following:

- a) One DG set for unit-1
- b) One DG set for unit-2
- c) One common standby DG set for two units
- d) AMF panel for each DG set
- e) DG controller unit for each DG
- f) Acoustic enclosure for DG set
- g) Exhaust stack with support structure for each DG as per CPCB norms
- h) Commissioning spares and consumables
- i) Mandatory spares
- j) Tools & tackles
- k) Any other equipment required for the system

#### 3.0.0 CODES AND STANDARDS

The equipment to be furnished under this specification shall be in accordance with the applicable section of the latest edition (including amendments) of the following Indian Standards (IS), IEC publications and other codes except where modified and/or supplemented by this specification.

- a) IS/IEC 60034 Rotating electrical machines
- b) IS 15999 Rotating electrical machines
- c) IS 13364 AC Generators driven by IC engines
- d) IS 10000 Method of tests for IC Engines
- e) IS 4503 Heat exchangers
- f) IS 803 Storage Tanks
- g) ISO 8528 Reciprocating internal combustion engine driven alternating current generating sets
- h) ISO 3046 Reciprocating internal combustion engines performance
- i) BS: 5514 Methods of tests for IC engines.
- j) BS 2613 Specification for electrical performance of rotating electrical machines
- k) Regulations laid by the office of the Pollution control board

#### 4.0.0 TECHNICAL AND OPERATIONAL REQUIREMENTS

- 4.1.0 All Electrical Equipment selection and derating shall be based on ambient temperature of 50 deg. C and relative humidity of 95% maximum.
- 4.2.0 Diesel Generator shall be rated for "**Prime duty**". Generator shall be rated of 415 V, 3 phase, 4 wire supply.
- 4.3.0 The DG Set shall provide power for essential loads, following the loss of auxiliary power. In the event of loss of auxiliary power, AC power shall be supplied by the DG set. Generator shall



feed Emergency Motor control centers. There shall be three (3) no. DG sets, one for each unit and one common standby.

- 4.4.0 Diesel Generator Sets capable of starting and picking up the load within 30 seconds. The DG set shall be sized to feed power supply for the following:
- Barring gear motors of TG set and BFP turbine
  - Seal oil system
  - Air pre heater lub oil pump
  - Jacking oil pumps of main turbine and BFP turbine
  - main oil tank vapour extractors
  - Turbine gear oil pump
  - Turbine auxiliary oil pump
  - Stator water cooling pump
  - Bearing chamber exhaust fan for hydrogen
  - Lubricating oil system of BFP, ID,FD,PA fans
  - Seal air fans
  - Scanner air fans
  - Elevators
  - DC Battery chargers
  - UPS
  - Emergency lighting
  - HP&LP bypass auxiliary PRDS oil supply motors
  - Instrumentation and data acquisition system
  - Mill lub oil pumps
  - Mill inching motor
  - BFP oil tank vapour extractors
  - DM make up pumps
  - Condenser vacuum breaker valve
  - BFP vacuum breaker valve
  - Stand by air conditioner for control room and control equipment room
  - Switchyard auxiliary power supply
- 4.5.0 The sizing of DG set shall be based on the actual loads thrown on DG sets after the emergency and not the algebraic sum of all connected loads.
- 4.6.0 The normal operating condition of the DG set is de-energized and ready. The emergency operating condition of the DG set occurs when power is not available from the power plant/grid. In this circumstance, the DG set shall be started on auto and shall be available to supply power to emergency and essential loads. On restoration of normal power supply, emergency loads to be normalized without any interruption of supply by reverse synchronisation of the DG set with the grid supply.
- 4.7.0 The DG set shall have auto and manual mode of starting enabled through an Auto/Manual selector switch. In auto mode the DG shall start automatically on receipt of mains failure signal. Under manual mode the unit shall be started from a push button.
- 4.8.0 All the controls required for starting shall be integrated to achieve automatic starting sequence both in auto mode and manual mode of operation when a single start signal is initiated.
- 4.9.0 The DG set shall be periodically tested to confirm its ready-to-start condition. It shall be manually started, brought up to speed and voltage, synchronized onto a 415 volt bus, and loaded. Following completion of the test, the DG set shall be unloaded and manually removed from service.
- 4.10.0 The DG set shall be capable of being started, synchronized to the system, and loaded to its full rating without dependence on AC auxiliary power.



- 4.11.0 The DG unit shall be capable of starting the largest motor while carrying the remaining emergency loads. Voltage drop in the Generator shall be limited to 15% during starting of motor using DOL starter while delivering base load.
- 4.12.0 Diesel engine shall be directly coupled to a generator, mounted on a common steel base and installed in the DG room.
- 4.13.0 Diesel engine shall be suitable for HSD oil as per IS 1460.
- 4.14.0 The diesel engine may stand idle for a considerable period, yet must be immediately available for full load. Any special lubricating arrangements necessary to meet this condition shall be provided. The lubricating oil capacity shall be sufficient for 24 hours continuous operation.
- 4.15.0 The diesel engine shall be cold and self-starting type. The starter battery shall be of sufficient capacity to meet the engine starting and control gear requirements.
- 4.16.0 Control & Operation
- a) The DG set shall be controlled from the Auto-On-Mains failure (AMF) panel located in the DG room and also shall be controlled from the DCS in the main control room.
  - b) During normal operating condition, unit emergency MCC shall be fed from the Unit switchgear and when normal supply is not available, the DG shall be started and hence power shall be made available to emergency MCC for feeding emergency loads.
  - c) The DG breaker shall be normally open and the DG I/C breaker to emergency MCC shall also be in open.
  - d) DG shall have Local /remote selection at AMF panel. In local mode, the DG can be started /stopped manually from AMF panel. In Remote mode, the DG can be (start/stop) controlled from DCS from main control room. In DCS Auto/Manual selection shall be provided. In manual mode, the DG can be started /stopped from DCS. In Auto mode, on receipt of (signal volt) from Emergency MCC, the DG shall start automatically.
  - e) If the normal power supply is restored, while DG is in operation, then DG shall be manually synchronized with normal supply and DG I/ C breaker shall be tripped after momentary paralleling.
  - f) Necessary arrangement to be provided for manual synchronization DG with normal supply from DCS and AMF panel.
  - g) It shall be possible to carry out speed (raise/lower) and voltage (raise/lower) from DG control panel and also from remote DCS. Signals required for the above interface shall be provided at DG control panel.
- 4.17.0 The starting time required from the initiating signal until the operating speed and voltage is attained and the engine and generator are ready to take load, shall not be greater than 30 seconds. Three attempt starting facility shall be provided using two impulse timers and a summation timer. The DG shall be capable of being stopped manually from remote and local. Interlock shall be provided in AMF panel to prevent shutting down operation as long as the circuit breaker at its generator output is closed.
- 4.18.0 The DG set shall have minimum vibration and noise under all types and conditions of load. Anti-vibration pads shall be provided to reduce DG set vibration and noise transmission to the surrounding structure. The set shall be statically and dynamically balanced. DG sets shall meet the requirements of environmental (protection) rules.
- 4.19.0 DG set shall be installed indoor with acoustic enclosure to meet MOEF requirements and housed in a separate building. The noise level shall be 90 to 95 dB under free field condition as per 'Pollution control board' norms.



4.20.0 Each DG set shall be complete with the all components and accessories such as follows:

- Diesel engine
- Step timing control injectors
- Turbocharger
- Electronic governor & engine protection/safety controls
- Microprocessor based control system
- Lube oil system with plate type lube oil cooler
- Radiator/heat exchanger & coolant inhibitor
- Outboard after cooler
- Combustion air system
- Engine starting system with starting motor
- Batteries with Battery Charger
- Pulse tuned exhaust system along with piping & structural support till the outlet point to atmosphere
- Fuel feed pump
- Automatic inlet valves and level controllers for fuel oil system
- Generator with brushless exciter and PMG
- AMF panel
- Flexible coupling
- Fly wheel housing
- Oil filters, fuel oil filters and air filters, Oil bath air cleaner
- Fuel tank
- Exhaust tack
- Necessary foundation bolts and base channels for the engine, alternator, fuel service tank and for all other equipment
- AVM pads
- All integral piping, valves and specialties, pipe supports, hangers, etc.
- Self-contained piping for various systems as mentioned above
- Acoustic enclosure

#### 4.21.0 Diesel Engine

4.22.1 The generating unit shall be complete with all auxiliaries and the performance, torsional vibration, materials and workmanship, etc. shall be in accordance with the standard practices of diesel engine manufacturer's association.

4.22.2 The diesel engine shall be a full compression diesel fuel, four stroke cycle, single acting, solid injection, radiator cooled vertical in line or 'V' type cylinder arrangement. Aspiration shall be turbocharged after cooled. The engine shall be electric start developing required BHP at 1500 RPM.

4.22.3 Engine capacity shall meet the 110% overload capacity of the Generator. for continuous operation of generator at rated capacity. In addition 10% overloading of Generator shall be taken care.

4.22.4 The diesel engine shall be provided with a Class A1 electronic governing system with transient response of 15 m.sec. The governor shall have isochronous and droop governing application to take care of heavy duty motor starting.

4.22.5 Engine speed sensing shall be done with magnetic pick up unit and PID controllers in electronic governor.



- 4.22.6 The diesel engine shall be provided with combustion controls to minimize air pollutants. A mechanical device operating independently of the governing system shall be provided to limit over speed to a safe value and to cut-off the fuel supply directly.
- 4.22.7 The engine and Generator shall be coupled by means of specially designed flexible coupling and both the units including the radiator/heat exchanger shall be mounted on a rigid base frame to form a compact arrangement.
- 4.22.8 The engine shall be properly balanced so as to transmit only small unbalanced forces to the foundation.

#### 4.22.0 **Electronic Governor**

The governing system shall be advanced electronic type provided with the following features:

- Accurate speed sensing by magnetic pickup
- Electronic PID controller
- A1 class governing with transient response of 15 m.sec.
- Isochronous & Droop governing
- Features for faster synchronizing & load sharing functions

The governor shall be provided with motor operated speed gear for remote adjustment of generator frequency. The Governor/Excitation/Control Systems shall permit operation of DG set without exceeding the active and reactive power limitation of the Generator.

A mechanical over-speed trip device shall be provided to automatically shut-off fuel in case the speed exceeds 110% of the rated value.

#### 4.23.0 **Lubrication System**

The engine lubrication system shall include an engine shaft-driven positive displacement lubricating oil pump, AC power driven pre-lubricating pump, full-flow lubricating oil strainer on the pump suction side, and a full-flow replaceable lubricating oil filter on the pump discharge side. Lubrication oil shall conform to relevant IS amended up to date. Temperature and pressure gauges shall be fitted to engine lubricating system.

The lube oil cooler shall be designed to utilize the engine coolant as the cooling medium. The heat exchanger shall be mounted on the unit base.

#### 4.24.0 **Fuel System**

A fuel system shall be furnished to regulate fuel flow to maintain constant rated engine speed regardless of load variations. The fuel system for each DG set shall include an electronic engine governor, fuel metering equipment, filter and fuel cutoff valves, and a diesel fuel oil tank.

The fuel oil tank of not less than 990 liters fuel capacity shall be of all welded steel construction complete with supports, access manhole, moisture drain valve, inlet and outlet connections, valve drain connection, level gauge, level alarm contacts (high and low), air breather, shielded level gauge and strainer. The tank shall be coated with oil resistant paint. The fuel tank shall be hydrostatically tested. Fuel tank shall be placed inside the building mounted on fabricated steel plat form.

The fuel tank shall be made of 3 mm thick MS sheet. The tank shall have fuel level indicator with brass cover for mechanical protection, filling inlet with removable fuel screen, outlet located at minimum of 25 mm above from the bottom of the drain plug, air vent and necessary piping.

Hand pump for pumping the fuel into the service tank with 5.0 m flexible tube shall be provided. The inlet of the pump shall be provided with flexible/rigid pipe with suitable filters. The fuel oil filter shall be multi-disc or fold type.



Diesel oil level indication shall be indicated at DCS.

#### 4.25.0 Engine Cooling System

Cooling shall be by an engine mounted fan cooled radiator/heat exchanger. The cooling system shall be designed for the maximum ambient temperature of 50°C. All fans, motors, coolant additive concentrate, ducting, supports, pipe work and valves required for this purpose shall be provided.

Radiator system shall utilize an engine-driven fan.

Water/coolant shall be circulated by an engine-driven pump with a stainless steel shaft. Thermostat shall be provided in Jacket water line. Cooling water for jacket and oil cooling shall be thermostatically controlled to maintain efficient operating temperature. Suitable after-coolers shall be provided for efficient combustion and reduced internal stresses for longer life.

#### 4.26.0 Combustion Air Intake System

Air intake system shall include air intake manifold, dry type air cleaner, vacuum indicator etc. A replaceable dry cartridge-type intake air filter shall be provided with the diesel engine.

The diesel engine may take combustion air directly from inside the DG room. Necessary filter silencer shall be provided in the air intake line to meet the noise criteria. Acoustic louvers of adequate size shall be provided to draw outside air in to the DG room.

#### 4.27.0 Exhaust System

The exhaust system shall meet requirements of 'Pollution Control Board'. Two numbers residential silencer shall be provided. The silencing system shall be sized to ensure against loss of engine power due to excessive back-pressure.

The exhaust system shall include turbocharger, pulse tuned exhaust manifold, stainless steel exhaust flexible connections, steel exhaust pipe, exhaust stack, Insulation for exhaust piping, galvanized support steel structure, etc.

Stack height shall be as per Pollution Control Board norms.

Suitable thermal insulation together with jackets shall be provided on all exposed hot pipes and equipment to limit the surface temperature to 60 degree C.

#### 4.28.0 Engine Starting System

A DC electric starting system shall be provided for starting the engine, complete with electric starting motor, battery charging alternator, batteries and rack, charger, charger control and automatic voltage regulator, and thermal cutout in a suitable enclosure. The Automatic start equipment shall have the following features:

- Energize the starter circuit
- Provide three intermittent cranking cycles
- De-energize the starting circuit when the engine starts
- Limit the total cranking time and lock out, requiring manual reset in the event of a failure to start

The emergency diesel generator shall be able to start and achieve rated speed within 15 seconds following the initiation of a start signal. After achieving rated speed, voltage and frequency, it shall be capable of maintaining voltage and frequency within +/- 5 & 3% respectively under steady-state load conditions.



#### 4.29.0 Ventilation System

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.

#### 4.30.0 Battery & Charger

4.30.1 Two sets of batteries and float & boost chargers shall be provided. Normally, one shall cater to the loads of AMF panel and the other to the starting loads of the engine. Each shall be a 100% stand-by to the other, so that in the event of one not being available, the other battery shall meet the load of the unavailable battery in addition to its own normal load. Each battery shall be suitably rated. A heavy-duty selector switch shall be provided to select the two batteries to supply their respective loads or to select any one of them to supply the entire load of AMF Panel and starting load. Each battery shall have its own float and boost charger, which shall be housed in a cabinet. Battery shall be mounted on stand.

4.30.2 The battery shall be capable of six (6) normal consecutive starts without recharging. Battery shall be lead acid grid electrode of adequate capacity.

4.30.3 Battery charger shall be of silicon controlled rectifier/SMPS type. Battery charger shall be able to boost charge the battery from fully discharged condition within 8 hours. The charger shall be equipped with transformer, full wave rectifiers, automatic surge suppresser, DC ammeter, voltage regulator, circuit breaker/fuse etc. Ripple shall not be more than 1% (rms) to get smooth DC voltage shall be provided. Charger shall be provided with output ammeter and voltmeter. There shall be facility to charge the batteries either in boost or in float mode. Boost or float mode shall be selectable through a selector switch. The charger shall have the following features:

- Automatic float and boost charging
- Current and voltage limiting circuits to avoid over charging
- Short circuit protection
- Reverse polarity protection
- Auto cut-off when DG set is ON

#### 4.31.0 Generator

4.31.1 The generator shall be directly connected to the engine flywheel with a flexible coupling. The generator shall be mounted on a common structural steel base frame with the engine. The generator shall be rated for three phase at 415 V, 1500 rpm, 0.8 pf lagging, 50 Hz and shall confirm to IS 13364(part II).

4.31.2 The generator shall be rated for continuous operation and shall comply with the requirements of the relevant parts of IEC-60034. The generator and exciter insulation shall be Class H. The temperature rise of the generator and exciter windings shall not exceed the limits for Class F limits when the machine is delivering rated output at 50 °C of ambient conditions.

4.31.3 Resistance temperature detector (RTD) shall be installed at the following locations:

- 12 nos. simplex RTDs in stator windings
- 1 No. duplex RTD in each bearing

4.31.4 Generator shall be capable of parallel operation with grid without any quadrature droop compensations. Generator shall have 10% overload capacity for one hour at every 12 hours of running.



- 4.31.5 The generator shall be capable of delivering continuously the rated power at rated power factor:
- When frequency variation is + 3% to -3% of the rated value
  - When the voltage variation is within +/- 10% of its rated value
  - When the absolute sum value of combined voltage and frequency variation does not exceed 10 %
- 4.31.6 The Generator shall be capable of withstanding 3-phase short circuit at its terminals for 3 seconds when the machine is operating at rated MVA and power factor and permissible maximum over voltage.
- 4.31.7 The generator shall be totally enclosed air cooled type with a degree of protection of not less than IP 23.
- 4.31.8 Strip type space heaters rated for 240 V AC, 50 Hz supply shall be provided for generator stator winding and the same shall be wired to separate terminal box.
- 4.31.9 The stator windings shall be brought out to six insulated terminals in two separate terminal boxes. The alternator shall, be provided with three separate terminal boxes i.e. for the live and neutral stator connections and for control connections. The star connection shall be formed in the neutral terminal box. Terminal box shall be capable of withstanding short circuit current for 1 sec. The terminal box shall be of dust and vermin proof construction and each shall have IP55 degree of protection.
- 4.31.10 DG sets rated 1000 KVA and above shall be connected through non segregated phase bus duct to the respective AMF panel. Busduct entry shall be from the top.
- 4.31.11 The excitation shall be brushless, with rotating diodes. Power to AC exciter field shall be supplied from directly coupled Permanent magnet type pilot exciter. The engine and Generator shall be directly coupled by means of self-aligning flexible flange coupling to avoid misalignment. The coupling shall be provided with a protecting guard to avoid accidental contact.
- 4.31.12 Required current transformers and voltage transformers for metering & protection and DAVR shall be accommodated in the generator terminal box suitably.
- 4.32.0 **Digital Automatic Voltage Regulator (DAVR)**

The DAVR shall be digital type and shall have negligible dead band and high speed of response. All essential indications/annunciation system required for DAVR/excitation system shall be provided. Provision shall be made for remote operation with necessary controls, indications and annunciation.

The DAVR shall be designed to regulate the output voltage of the generator within  $\pm 0.5\%$  of the setting from no-load to full-load and under worst condition of supply of power. The DAVR supplied shall have following characteristics:

- The DAVR shall function correctly between frequency variation of +/- 3% on 50 Hz and shall ensure a voltage variation not more than  $\pm 0.5\%$  of the set point in steady operating condition between no load to full load
- It should be able to prevent automatic rise of field voltage in case of failure of potential supply
- The excitation and voltage regulation should be designed so as to cause necessary de-excitation in case of any short circuit



- The current and voltage signal required for feedback to the DAVR shall be derived by bidder
- It shall interface with DCS for remote voltage raise/lower and speed raise/lower control

#### 4.33.0 Acoustic enclosure

4.33.1 Acoustic enclosure shall be provided covering each DG set. It shall be designed to achieve specified noise level as per State Pollution Control Board norms.

4.33.2 The sound absorptive layer shall comprise of bonded type mineral wool/glass wool of adequate thickness and density to comply the design requirements.

4.33.3 The door design shall be compatible to the acoustic treatment. 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.

4.33.4 All ventilation openings shall also be treated adequately to achieve desired sound proof.

#### 4.34.0 Anti-Vibration Pads

The DG set shall be provided with visco damper type vibration dampening pads (suitable for loads and vibration they are required to carry) with minimum vibration transmitted to the surface the set is resting on.

Skid mounting type base-frame fabricated from suitable machined MS channel to ensure perfect alignment of the engine & Generator with rigid construction and necessary reinforced to ensure minimum vibration shall be provided. The base frame shall be provided with lifting facilities and pre-drilled foundation holes suitable for permanent installation on anti-vibration pads.

#### 4.35.0 AMF(Auto-On-Mains-Failure) Panel

4.35.1 AMF panel shall receive power supply from alternator and feed to emergency MCC of Owner. It shall be provided with required air circuit breakers, CTs, PTs, protection relays, multi-function meters, indication etc. as per enclosed single line diagram.

4.35.2 The AMF panel for the generator set shall comprise of control, protection and metering equipment, indicating instruments etc. The panel shall be free standing; sheet steel enclosed having a degree of protection of IP 52. Sheet steel thickness shall not be less than 2 mm. Non load bearing members like doors, covers shall be of thickness not less than 1.6 mm.

4.35.3 The Boards shall be designed to withstand, without damage, for a fault of minimum 50 kA RMS at 415 V for one (1) second duration. The peak S/C with stand current of the bus shall be 105 kA.

4.35.4 Air circuit breakers shall be 4 pole, stored energy, trip free, air break, horizontal drawout type, motor operated. There shall be "SERVICE", "TEST" and "ISOLATED" positions for the breakers. The protective relays and instruments shall be mounted in separate compartment. ACB shall be rated for 50 kA short circuit current rating for 1 sec.

4.35.5 Necessary current transformers and voltage transformers shall also be provided for required metering and protection. The location of the CTs and VTs shall be in the AMF panel. CTs shall be cast resin type. CT shall have short time rating equal to that of switchgear. Line CT shall be mounted on AMF panel. Neutral CT shall be mounted in generator neutral bushing. VT shall be cast resin type. Line VTs shall be located in AMF panel.



- 4.35.6 Manual control of DG set such as start / stop, voltage raise / lower and speed raise / lower shall be provided on the AMF panel and remote DCS. DG set essential indications, alarms etc. shall also be available in remote DCS.
- 4.35.7 .A microprocessor-based control & protection system shall be provided for diesel engine and generator set for monitoring, metering and control. The control system shall provide an operator interface to the DG set.
- 4.35.8 Provision of synchronizing DG set with normal AC system shall be provided for testing and cut in/cut out of DG set without interruption of power supply.
- 4.35.9 DG controller shall be of type PEC 3320 of Cummins make or equivalent with reverse synchronizing facility. The controller shall have communication ports to interface with DCS and EMS system.
- 4.35.10 Control features shall be provided for the following:
- Digital engine speed governing controls
  - Digital voltage regulation
  - Generator control
  - Starting control system
  - Exhaust temperature monitoring
  - Voltage raise/lower
  - Speed raise/lower
  - Auto/Manual control
  - Start/Stop control
  - Emergency stop
  - Local/remote selection
- 4.35.11 Alarm/indicating lamps shall be provided for the status and for various alarm & trip conditions. Indicating lamps shall be of clustered LED type. The following tripping and alarms shall be provided:
- Fail to start (alarm)
  - Overload (alarm)
  - Cooling water pressure low (trip)
  - Lube oil pressure inadequate (trip)
  - Over speed (trip)
  - High coolant temperature (trip)
  - Abnormal voltage (under / over voltage) (alarm)
  - Charger ON / OFF (alarm)
  - Fuel level low in day tank (alarm and trip)
  - High lube oil temperature (trip)
  - Low air pressure in receiver (alarm)
  - Stator temperature high (alarm)
  - Protective relays operated (trip)
  - Low and high battery voltage alarm
  - Weak battery alarm
  - Fail to start alarm
- Necessary pressure switches, level switches, thermostats, flow switches, auxiliary relays etc. required for the above shall be provided.
- 4.35.12 Multifunction digital type meter having current (3 phase), voltage (3 phase), frequency, power factor, kW, kVA, kVAR and energy (accuracy 0.5) metering shall be provided for the generator. Meter shall have communication port for remote connection to DCS.



4.35.13 Metering devices for the following shall also be provided.

- Engine starting battery voltage
- Engine lube oil pressure
- Engine coolant temperature
- Engine lube oil temperature
- Hour run meter
- DC volt meter for exciter field voltage
- DC ammeter with shunt for exciter field current
- Generator temperature scanner

4.35.14 Numerical multifunction relay type suitable for flush mounting shall be provided for the following functions.

- Voltage controlled over current protection
- IDMT Over current Relay
- Overload alarm
- Reverse power protection.
- Standby earth fault protection.
- Negative phase sequence protection
- Over / under voltage protection
- Under / over frequency protection.
- Differential protection (DG set rating above 1000 kVA)
- Hand reset lockout relay

4.35.15 Control Interface for remote operation and control from DCS shall be provided. Critical parameter shall be hooked-up to DCS for indication and alarm. Required transducers and potential free contacts shall be provided in DG control panel and protection panel.

#### 4.36.0 PAINTING

Painting shall be carried out by approved process. After preparation of the under surface the equipment shall be painted with epoxy based paint. All exposed metal parts including base channel, radiator cover, air filter, oil filter dynamo, starter etc. shall be in single colour suitably finished to prohibit corrosion under climatic conditions prevailing at site. Oil resistant paint epoxy based, shall be applied as required. The final thickness of paint film on steel shall not be less than 100 microns and shall not be greater than 150 microns. Final shade shall be ONAN green for engine, generator and fuel tank.

### 5.0.0 TESTS

5.1.0 Equipment offered shall be of type tested and proven type. Type test certificates for test conducted earlier on similar rating shall be furnished. For the various bought out item test certificates from equipment manufacturer shall be furnished for Owner's review.

5.2.0 Type tests on Generator shall constitute the following:

- Measurement of resistance
- Phase sequence test
- Regulation test
- Measurement of open circuit characteristic
- Measurement of short circuit characteristic
- Efficiency test
- Temperature rise test
- Over speed test
- Insulation resistance test
- High voltage test



- Momentary over load test
- Test for vibration severity
- Determination of deviation of voltage wave form from sinusoidal

5.3.0 Routine tests on Generator shall constitute the following:

- Measurement of resistance
- Phase sequence test
- Regulation test
- Measurement of open circuit characteristic
- Measurement of short circuit characteristic
- Insulation resistance test
- High voltage test

5.4.0 The following acceptance test shall be carried out on DG set at shop and as well as at site.

- DG set shall be checked for alignment
- Full load test for a period of atleast 6 hours at rated kVA at UPF
- 10% Over load test for one hour after the full load test
- Temperature rise test
- Voltage and speed regulation test
- Speed & governing test
- Check for fuel consumption
- Insulation resistance test
- High voltage test
- Functional test
- Measurement of vibration level
- Measurement of noise level
- Performance of DG set
- Measurement of resistance & air gap
- Phase sequence test
- Regulation test
- Measurement of open circuit and short circuit characteristics
- Efficiency test
- Temperature Rise Test
- Momentary overload test
- Over speed test
- Determination of Deviation of voltage waveform from sinusoidal.
- Any other special/statutory test as laid down by Pollution control board

5.5.0 Routine tests shall be carried out for all the equipment (generator, DAVR, exciter & battery etc.) as per applicable standards. Copies of certified reports of all tests carried out at the works shall be furnished.

5.6.0 The tests to be conducted on each DG set at site shall include but not be limited to those listed below. Any other test considered necessary by the contractor shall also be carried out :

- a) Visual Test
- b) Electrical Tests
- c) Calibration of instruments relays etc.
  - Primary and secondary injections tests of protective devices.
  - Function, interlock test of control panel
  - Insulation resistance measurement of power and control circuits.
- d) Mechanical Tests
  - Trial run of engine
  - Governor testing



- Over speed trip test
- Load pick up and load rejection tests
- Load test and temperature rise measurement of engine and alternator

## e) Generator Tests

- Measurement of the insulation resistance of the stator windings to the frame and between phases, after drying out the machine.
- Measurement of the DC resistance of all windings and embedded temperature detectors
- Open circuit and short circuit tests
- Measurement of temperature rise at the rated load

## 6.0.0 TECHNICAL PARAMETERS

Sl. No.	Item Description	Unit	Data
	<b>General</b>		
1.	Equipment location		Indoor
2.	Output voltage	V, Hz	415 V, 50 Hz, 0.8 PF, 3 phase
	<b>Diesel Engine</b>		
9.	Applicable standard		BS 5514/ISO 3046
10.	Engine type		Vee configuration, 16 cylinders
11.	Speed	rpm	1500
12.	Over load capacity of engine	%	110% for 1 hour at every 12 hours of running
13.	Type of Cooling		Radiator
14.	Aspiration		Turbo-charged-After cooled
15.	Governor		Electronic – A1
	<b>Generator</b>		
1.	Applicable standard		IS/IEC 60034, IS 13364
2.	Degree of protection		IP23
3.	Class of insulation for stator, rotor & exciter		Class H
4.	Temperature rise	°C	Class F limits
5.	Speed	RPM	1500
6.	Rated voltage	Volt	415+/- 10%
7.	Rated Frequency	Hz	50 +/- 3%
8.	Rated PF		0.8 lagging
9.	Type of cooling		Air cooled
10.	Type of excitation		Brush less self-excited
11.	Type of pilot exciter		PMG
12.	No. of winding RTD & type		6 Nos. duplex or 12 nos. simplex PT100



Sl. No.	Item Description	Unit	Data
13.	No. of bearing RTD & type		1 No. duplex in each bearing, PT 100
14.	Voltage Regulation		+/-5 %
15.	Total harmonic factor		Better than 2%
16.	Wave form distortion		< 1.8% for no load & <5% on full load

### 7.0.0 DRAWINGS & DOCUMENTS

The following drawings and documents shall be submitted for approval during detail engineering stage.

- DG sizing calculation
- Technical particulars of all equipment
- General arrangement drawings of all equipment
- Cable routing layout
- General arrangement and section drawing for DG building
- General arrangement and section drawing for DG set
- Calculation and Foundation details for DG set
- Single line diagrams
- Electrical control and schematic wiring diagram
- Recommended relay setting calculations
- P&ID diagram for fuel oil system & exhaust system
- Cable Schedule & Interconnection Schedule
- Earthing drawings
- Calculation, structural & foundation drawing for stack
- Fuel system layout
- Exhaust system layout
- Statutory Certification for the complete set & the acoustic treatment
- Piping drawing
- Calculation, drawings & details for ventilation
- Drawings for engine
- Drawings for Alternator
- Drawings for fuel tank
- Drawings for battery & charger
- Details of DG control system
- Erection and commissioning procedures
- Test certificates
- Operation and maintenance manual
- Sub-vendor list
- Manufacturing quality plan
- Field quality plan



SI.No.	Description	Data
14	Synchronising equipment	
	a) Make	
	b) Type	
	c) Model no.	
15	Auto synchroniser	
	a) Make	
	b) Type	
	c) Model no.	

### 29. DG SET

SI. No.	Description	Units	Data
<b>1.</b>	<b>General</b>		
a)	Name of the Supplier		
b)	Place of manufacture		
c)	Continuous Rating of DG set at 50 deg C design ambient	KVA	
d)	Duty		
e)	Overall dimension (L x W x H)	m x m x m	
<b>2.</b>	<b>Diesel Engine</b>		
a)	Make & Place of manufacture		
b)	Model No.		
c)	Rating at 25°C intake air temperature		
d)	Derating factor for 50°C intake air temp.		
e)	Applicable standard		
f)	Engine type		
g)	Speed	rpm	
h)	Dry weight	Tons	
i)	Overall dimension (LXWXH)	m x m x m	
<b>3.</b>	<b>Governer</b>		
a)	Type		
b)	Model		
c)	Make		
d)	Frequency regulation (no load to full load)		
<b>4.</b>	<b>Consumption</b>		



SI. No.	Description	Units	Data
a)	Specific fuel consumption at	g / kwh	
	• rated load		
	• 3 / 4 load		
	• 1 / 2 load		
	• 100 % load		
	• 110 % load		
b)	Lube oil consumption at rated load	g / kwh	
<b>5.</b>	<b>Exhaust system</b>		
a)	Exhaust flow at rated power	m <sup>3</sup> / sec.	
b)	Exhaust temp at rated power	°C	
c)	Permissible exhaust back pressure	mbar	
d)	No. of exhaust outlet		
e)	Dia of exhaust outlet		
f)	No. of silencer		
g)	Type of Silencer		
<b>6.</b>	<b>Lube oil system</b>		
a)	Engine lube oil capacity	litres	
b)	Oil type		
c)	Oil filter type		
d)	Oil cooler type		
e)	Type & rating of lube oil pump		
<b>7.</b>	<b>Fuel System</b>		
a)	Fuel type		
b)	Capacity of fuel tank	litre	
<b>8.</b>	<b>Starting System</b>		
a)	Rated voltage	V	
b)	Battery capacity	AH	
c)	Permissible No. of starts		
d)	Starting time	Sec	
<b>9.</b>	<b>Cooling System</b>		
a)	Engine jacket water capacity	litre	
b)	Radiator capacity	litre	
c)	Type of water pump		
d)	Engine jacket water flow	lpm	
e)	Heat rejected to cooling water at rated kW	kW	



Sl. No.	Description	Units	Data
f)	Fan rating	kW	
g)	Water quality		
h)	Water requirement		
<b>10.</b>	<b>Air requirement for</b>		
a)	Combustion air	m <sup>3</sup> / min	
b)	Radiator cooled cooling air	m <sup>3</sup> / min	
<b>11.</b>	<b>Heat dissipation to air</b>		
a)	by engine	kW	
b)	by Generator	kW	
<b>12.</b>	<b>Stack structure</b>		
a)	Height	m	
b)	Exhaust pipe size		
c)	Material of stack support structure		
d)	Height of stack support structure		
e)	Weight of stack support structure		
<b>13.</b>	<b>Fuel Tank</b>		
a)	Capacity		
b)	Material		
c)	Thickness		
d)	Capacity suitable for how many hours of operation of DG set	hours	
<b>14.</b>	<b>Heat balance at rated load and design ambient temperature</b>		
a)	Engine Shaft output	kW	
b)	Energy absorbed by cooling water	kW	
c)	Energy dissipated in exhaust gases	kW	
d)	Energy lost to ambient by radiation and convection	kW	
<b>15.</b>	<b>Generator</b>		
a)	Make & Place of manufacture		
b)	Type & frame size		
c)	Applicable standard		
d)	Continuous Rating at 50 °C & design ambient temperature & humidity at 95% with class F temperature limits		
e)	Degree of protection		
f)	Class of insulation for stator, rotor & exciter		
g)	Temperature rise over 50 °C design ambient temperature	°C	



Sl. No.	Description	Units	Data
h)	Speed	RPM	
i)	Rated voltage	Volt	
j)	Full load current at rated voltage.	Amp	
k)	Rated PF		
l)	Over load capacity		
m)	Starting KVA capacity with	KVA	
	• 10% voltage dip		
	• 15% voltage dip		
	• 20% voltage dip		
n)	Efficiency at rated p.f at 100% load	%	
o)	Short circuit rating	kA	
p)	Type of excitation		
q)	Type of cooling		
r)	RTD's		
	• No. of winding RTD & type		
	• No. of bearing RTD & type		
s)	Weight	kg	
t)	Dimensions (L x W x H)	m x m x m	
u)	Rotor withdrawal space	m	
<b>16.</b>	<b>Automatic voltage regulator</b>		
a)	Make		
b)	Type		
c)	No. of channel		
d)	Voltage regulation		
e)	Details of limiters provided		
f)	Place of mounting		
<b>17.</b>	<b>Painting</b>		
	Material, Thickness of painting & Shade for		
a)	Engine		
b)	Generator		
c)	Fuel tank		
d)	Acoustic enclosure		
<b>18.</b>	<b>Acoustic enclosure</b>		
a)	Make & Type		
b)	Panel material		



Sl. No.	Description	Units	Data
c)	Enclosure size		
d)	Reduction in noise level		
<b>19.</b>	<b>DG room ventilation</b>		
a)	Air requirement		
b)	No.of fans		
c)	Rating of each fan		
<b>20.</b>	<b>Busduct</b>		
a)	Rating		
b)	Size		
c)	Material		
<b>21.</b>	<b>Cables</b>		
d)	Cable size		
e)	No.of runs		
f)	Type of cable		



### 30. DG AMF (AUTO-ON-MAINS-FAILURE) PANEL

Sl.No.	Description	Unit	Details by Bidder
<b>1.</b>	<b>General</b>		
2.	Make		
3.	Type		
4.	Reference standard		
5.	Overall dimension		
6.	Degree of protection		
7.	Type & Thickness of sheet metal used		
<b>8.</b>	<b>Rating</b>		
a)	Voltage	V	
b)	Current rating		
c)	Short circuit withstand current rating for 1 sec	kA	
d)	Peak withstand current rating	kAp	
<b>9.</b>	<b>Busbar</b>		
a)	Material & grade		
b)	Bus bar size	mm x mm	
c)	Continuous Current rating at 50 deg C ambient.		
d)	Maximum temperature rise over design ambient temperate of 50° C - at busbar - at joints	° C	
<b>10.</b>	<b>Current Transformer</b>		
a)	Make		
b)	Type		
c)	Rating		
d)	CT ratio, VA burden & Accuracy class		
<b>11.</b>	<b>Voltage Transformer</b>		
a)	Make		
b)	Type		
c)	Rating	V	



Sl.No.	Description	Unit	Details by Bidder
d)	Voltage ratio, VA burden & Accuracy class		
<b>12.</b>	<b>Relays</b>		
a)	Make & type of each relay		
b)	List of protections provided		
<b>13.</b>	<b>Switches</b>		
a)	List of control switches provided		
<b>14.</b>	<b>Meters</b>		
a)	List of meters provided		
<b>15.</b>	<b>Indications</b>		
a)	List of indication lamps provided		
<b>16.</b>	<b>Alarms/Annunciation</b>		
a)	List of alarms provided		
<b>17.</b>	<b>ACB</b>		
a)	Make		
b)	Type & Model no.		
c)	Current rating		
d)	No.of poles		
e)	Short-time withstand current for 1 sec.	kA	
f)	Peak withstand current	kAp	
<b>18.</b>	<b>Painting</b>		
a)	Inside shade		
b)	Outside shade		
c)	Paint thickness	Microns	



Sl.No	Description	Unit	Quantity
23.	<b>DG Set</b>		
a)	Diesel engine		
	i. Fuel injection nozzles	Set*	2
	ii. Crank shaft with standard size journals	Set*	1
	iii. Main bearings	Set*	1
	iv. Big-end bearings	Set*	1
	v. Diesel filter packs	Nos.	20
	vi. Mobile oil filter packs	Nos.	20
	vii. V-belt for radiator fan	Nos.	5
	viii. Fuel injector	Nos.	5
	ix. Fuel injection piping	Set*	1
	x. Ring gear for fly wheel	Set*	1
	xi. Starter	Set*	1
	xii. Nozzle tester, barring bar, slings, eyebolts and other special equipment necessary for servicing the engine	Set*	1
	xiii. Pressure switch	Set*	1
b)	<b>Generator (DG set)</b>		
	i. Instruments of each type	Nos.	2
	ii. Relays of each type	Nos.	2
	iii. Timers of each type	Nos.	2
	iv. Indicating lamp of each type	Nos.	2
	v. Fuses of each type and rating	Nos.	2
	vi. Rotating diodes and fuse for main field excitation of each rating	Nos.	2
	vii. Temperature scanner	Nos.	2
	viii. Carbon brushes for Generator and self-starter motor	Set*	10
	ix. CT of each type and rating	Set*	1
c)	<b>AMF panel</b>		
	i. Protection relays of each type	Nos.	2
	ii. Auxiliary relays of each type	Nos.	2
	iii. Indicating lamp each type	Nos.	2
	iv. Meters each type	Nos.	2
	v. Fuses of each type and rating	Nos.	3
24.	<b>UPS of each rating</b>		
a)	HRC Fuses of each type and rating	Nos.	5
b)	Semiconductor fuses of each rating	Nos.	5
c)	Electronic cards and modules of each type	Nos.	2
d)	Thyristors /Power transistors / power diodes of each rating	Nos.	5
e)	Filter capacitors & Chokes of each rating	Nos.	5
f)	Static transfer switch	Nos.	5





Sr. No		Component & Operations		Manufacturer's Name & Address		QAP OF DG SET AND ACCESSORIES				Format of Records			AGENCY			Remarks					
		ITEM : 2000 KVA DG SET		QAP NO : IS-4-QP-714-800-A001		QAP NO : IS-4-QP-714-800-A001				M			C			11					
				REV NO : 01		DATE : 29.05.2021				9			10								
				Page : 4 of 6																	
Sr. No	Component & Operations	Characteristics	Class	Type of Check	Quantum of Check	Reference Document	Acceptable Norms	INTERNAL INSPECTION REPORT/RECORDS	P	V	W	Remarks									
1			4	5	M C / B 6	7	8														
11	LEAKAGES	FUEL, LUB OIL, WATER LEAKAGE DURING NO LOAD RUN	MAJOR	VISUAL	100%	MINFR. STANDARD	NO LEAKAGE														
12	DG SET ASSEMBLY OPERATION CHECK ON WATER TYPE RESISTIVE LOAD BANK 05 Min on NO Load, 03 Hour on 100% Load and 1 Hour on 110%	ALL PHASE VOLTAGE	MAJOR	MEASUREMENT	100%	APPROVED DATA SHEET / SPECIFICATION	APPROVED DATA SHEET / SPECIFICATION														
		ALL PHASE CURRENT	MAJOR	MEASUREMENT	100%	APPROVED DATA SHEET / SPECIFICATION	APPROVED DATA SHEET / SPECIFICATION														
		OUTPUT FREQUENCY	MAJOR	MEASUREMENT	100%	APPROVED DATA SHEET / SPECIFICATION	APPROVED DATA SHEET / SPECIFICATION														
		LUB OIL PRESSURE, WATER TEMP, SAFETY CHECK	MAJOR	MEASUREMENT	100%	APPROVED DATA SHEET / SPECIFICATION	APPROVED DATA SHEET / SPECIFICATION														
13	DOCUMENTATION	VIBRATION AT 100% LOAD	MAJOR	MEASUREMENT	100%	APPROVED DATA SHEET / SPECIFICATION	APPROVED DATA SHEET / SPECIFICATION														
		NOISE MEASUREMENT	MAJOR	MEASUREMENT	1 NO / LOT	1 NO / LOT	APPROVED DATA SHEET / SPECIFICATION	APPROVED DATA SHEET / SPECIFICATION													
		TIME FROM STARTING COMMAND TO RATED VOLTAGE & FREQUENCY BUILD-UP	MAJOR	MEASUREMENT	100%	APPROVED DATA SHEET / SPECIFICATION	APPROVED DATA SHEET / SPECIFICATION														
		ENGINE TC																			
		ALTERNATOR TC																			
		DG SET TC																			
		O & M - ENGINE																			
		O & M - ALTERNATOR																			
		BATTERY WARRANTY CARD																			
		<b>LEGEND:</b> * RECORDS, IDENTIFIED WITH "TICK" (®) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION. ** M: MANUFACTURER/SUB-SUPPLIER C: BHEL/BHEL TPIA, B: TANGEDCO P: PERFORM W: WITNESS AND V: VERIFICATION, AS APPROPRIATE																			
		QAP NO : IS-4-QP-714-800-A001 INSPECTION CAT:1 REV: 02																			
MANUFACTURER/SUPPLIER		SIGNATURE				FOR CUSTOMER				REVIEWED BY				APPROVED BY				APPROVAL SEAL			



QUALITY ASSURANCE PLAN											
PROJECT: 2x660 MW UDANGUDI SUPERCRITICAL THERMAL POWER PROJECT- STAGE-1			Q.P. No.: IS-4-QP-714-800-A002			CONTRACT NO.: IS-1-17-2002					
ITEM: DG SET			SUB SYSTEM: CONTROL PANEL FOR DGSET			REV.: 01					
DATE: 17.06.21			PAGE: 1 OF 7			MAIN SUPPLIER: BHEL-INDUSTRIAL SYSTEMS GROUP, ISG BANGLORE					
SL NO.	COMPONENTS & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		REMARKS
					M	C/N			M	C	
1	2	3	***4	5	6	7	8	9	D*	** 10	11
<b>INCOMING MATERIALS &amp; COMPONENTS</b>											
1	CRCA SHEET FOR PANEL STRUCTURE	1.DIMENSIONAL 2.SURFACE FINISH	MA	Meas. Visual	1/Lot 1/Lot	Approved Drg.	Approved Drg.	Approved Drg.	Int. Inspe.report Int. Inspe.report	P P	
2	NUT,BOLT, WASHER	1.DIMENSIONAL 2.PAINT FINISH	MA	Meas. Visual	1/Lot 1/Lot	Approved Drg.	Approved Drg.	Approved Drg.	Int. Inspe.report Int. Inspe.report	P P	
3	LUGS	1.TYPE,SIZE,MAKE	MA	Visual	1/Lot	Approved Drg.	Approved Drg.	Approved Drg.	Int. Inspe.report	V	
4	PAINT	1.FINISH 2.SHADE	MA	Visual Visual	1/Lot 1/Lot	Paint Std. Approved Drg.	Paint Std. Approved Drg.	Paint Std. Approved Drg.	Int. Inspe.report Int. Inspe.report	V V	
5	T.B	1.RATING/MAKE 2.CONNECTION TYPE	MA	Visual	1/Lot	Approved Drg.	Approved Drg.	Approved Drg.	Int. Inspe.report Int. Inspe.report	P P	
6	WIRES	1.RATING/TYP 2.MAKE	MA	Visual Visual	1/Lot 1/Lot	Approved Drg.	Approved Drg.	Approved Drg.	Int. Inspe.report Int. Inspe.report	P P	
7	MCB	1.RATING/TYP 2.FUNCTION TEST	MA	Visual Test	1/Lot	Approved Drg.	Approved Drg.	Approved Drg.	Int. Inspe.report Int. Inspe.report	P P	
8	INDICATING INSTRUMENTS	1.RATING/TYP 2.DIMENSION 3.CLASS 4.FUNCTION TEST	MA	Visual Visual Visual Visual	100% 100% 100% 100%	Approved Drg.	Approved Drg.	Approved Drg.	Int. Inspe.report Supplier TC Supplier TC	P V V	
<b>LEGEND: *RECORDS IDENTIFIED WITH "TICK"(V) SHALL BE ESSENTIALLY INCLUDED BY THE CONTRACTOR IN QA DOCUMENTATION</b>											
<b>**M: MANUFACTURER / SUB-SUPPLIER C: CONTRACTOR / NOMINATED INSPECTION AGENCY(SUBJECT TO PRIOR APPROVAL OF ) N : , P: PERFORM W: WITNESS AND V: VERIFICATION AS APPROPRIATE CHP: SHALL BE IDENTIFIED IN COLUMN "N" AS "W"</b>											
<b>***MA: MAJOR, CR: CRITICAL</b>											
MANUFACTURER / SUB-SUPPLIER			MAIN-SUPPLIER			SIGNATURE			APPROVAL SEAL		
DOC. NO.: IS-4-QP-714-800-A002 REV: 00 CAT.....											

QUALITY ASSURANCE PLAN										
PROJECT: 2x660 MW UDANGUDI SUPERCRITICAL THERMAL POWER PROJECT- STAGE-1 CONTRACT NO.: IS-1-17-2002 MAIN SUPPLIER: BHEL-INDUSTRIAL SYSTEMS GROUP, ISG BANGLORE					Q.P. No.: IS-4-QP-714-800-A002 REV.: 00 DATE: 23.04.21 PAGE: 1 OF 7					
ITEM: DG SET		SUB SYSTEM: CONTROL PANEL FOR DGSET			Q.P. No.: IS-4-QP-714-800-A002		REV.: 00			
DATE: 23.04.21		PAGE: 1 OF 7			Q.P. No.: IS-4-QP-714-800-A002		REV.: 00			
SUB SYSTEM: CONTROL PANEL FOR DGSET		Q.P. No.: IS-4-QP-714-800-A002			REV.: 00			DATE: 23.04.21		
PAGE: 1 OF 7		Q.P. No.: IS-4-QP-714-800-A002			REV.: 00			DATE: 23.04.21		
1	2	3	4	5	6	7	8	9	10	
SL NO.	COMPONENTS & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY	REMARKS
1	2	3	4	5	6	7	8	9	10	11
9	TRANSDUCER INDICATING LAMP	1.RATING/TYPE/MAKE	MA	Visual	100%	Approved Drg.	Approved Drg.	Int. Inspe.report	P	
10		1.RATING/TYPE/MAKE	MA	Visual	100%	Approved Drg.	Approved Drg.	Int. Inspe.report	P	
		2.FUNCTION TEST	MA	Elec.	100%			Int. Inspe.report	P	
11	PUSH BUTTON	1.RATING/TYPE/MAKE	MA	Visual	100%	Approved Drg.	Approved Drg.	Int. Inspe.report	P	
		2.FUNCTION TEST	MA	Elec.	100%			Int. Inspe.report	P	
12	SWITCHES	1.RATING/TYPE/MAKE	MA	Visual	100%	Approved Drg.	Approved Drg.	Int. Inspe.report	P	
		2.FUNCTION TEST	MA	Elec.	100%			Int. Inspe.report	P	
13	ANNUNCIATOR	1.RATING/TYPE/MAKE	MA	Visual	100%	Approved Drg.	Approved Drg.	Int. Inspe.report	P	
		2.FUNCTION TEST	MA	Elec.	100%			Int. Inspe.report	P	
14	HOOTER	1.RATING/TYPE/MAKE	MA	Visual	100%	Approved Drg.	Approved Drg.	Int. Inspe.report	P	
		2.FUNCTION TEST	MA	Elec.	100%			Supplier TC	V	
15	MASTER TRIP RELAY	1.RATING/TYPE/MAKE	MA	Visual	100%	Approved Drg.	Approved Drg.	Int. Inspe.report	P	
		2.FUNCTION TEST	MA	Elec.	100%			Int. Inspe.report	P	
16	AUX. CONT/ AUX.RELAY	1.RATING/TYPE/MAKE	MA	Visual	100%	Approved Drg.	Approved Drg.	Int. Inspe.report	P	
		2.FUNCTION TEST	MA	Elec.	100%			Int. Inspe.report	P	
17	CURRENT TRANSFORMER	1.RATING/TYPE/MAKE	MA	Visual	100%	Approved Drg.	Approved Drg.	Int. Inspe.report	P	
		2.FUNCTION TEST	MA	Elec.	100%			Supplier TC	V	

LEGEND: *RECORDS IDENTIFIED WITH "TICK"(v) SHALL BE ESSENTIALLY INCLUDED BY THE CONTRACTOR IN QA DOCUMENTATION **M: MANUFACTURER / SUB-SUPPLIER C: CONTRACTOR / NOMINATED INSPECTION AGENCY(SUBJECT TO PRIOR APPROVAL OF ) N : , P: PERFORM W: WITNESS AND V: VERIFICATION AS APPROPRIATE CHP: SHALL BE IDENTIFIED IN COLUMN "N" AS "W" ***MA: MAJOR, CR: CRITICAL	
MANUFACTURER / SUB-SUPPLIER	MAIN-SUPPLIER
SIGNATURE	SIGNATURE
REVIEWED BY	APPROVED BY
APPROVED BY	APPROVAL SEAL

DOC. NO.: IS-4-QP-714-800-A002 REV: 00 CAT.....	
---	--

QUALITY ASSURANCE PLAN										
PROJECT: 2x660 MW UDANGUDI SUPERCRITICAL THERMAL POWER PROJECT- STAGE-1			Q.P. No.: IS-4-QP-714-800-A002 REV.: 00			CONTRACT NO.: IS-1-17-2002				
ITEM: DG SET SUB SYSTEM: CONTROL PANEL FOR DGSET			DATE: 23.04.21 PAGE: 1 OF 7			MAIN SUPPLIER: BHEL-INDUSTRIAL SYSTEMS GROUP, ISG BANGLORE				
SL. NO.	COMPONENTS & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	REMARKS
					M	C/N				
1	2	3	***4	5	6	7	8	9	D*	** 10
<b>IN PROCESS INSPECTION</b>										
1	FABRICATION	a) Overall Dimensions	MA	Meas.	100%	100%	Approved Drg/data sheet	Approved Drg/data sheet	Inspt. Report	P
		b) Thickness of Sheet	MA	Visual	100%	At random	Approved Drg/data sheet	Approved Drg/data sheet	Inspt. Report	P
		c) Welding	MA	Visual	100%	At random	Approved Drg/data sheet	Approved Drg/data sheet	Inspt. Report	P
2	PAINT	a) Paint Shade	MA	Visual	100%	At random	Approved Drg/data sheet	Approved Drg/data sheet	Inspt. Report	P
		b) Thickness of Paint	MA	Meas.	100%	At random	Tech.spec	Tech.spec	Inspt. Report	P
		c) Surface finish	MA	Visual	100%	At random	Tech.spec	Tech.spec	Inspt. Report	P
3	ASSEMBLY & WIRING	a) Wire size	MA	Visual	100%	At random	Approved Drg/data sheet	Approved Drg/data sheet	Inspt. Report	P
		b) Termination/ wiring	MA	Visual	100%	At random			Inspt. Report	P
		c) Mounting of Instrument	MA	Visual	100%	At random			Inspt. Report	P
		d) Earthing	MA	Visual	100%	At random			Inspt. Report	P
<p>LEGEND: *RECORDS IDENTIFIED WITH "TICK"(✓) SHALL BE ESSENTIALLY INCLUDED BY THE CONTRACTOR IN QA DOCUMENTATION</p> <p>**M: MANUFACTURER / SUB-SUPPLIER C: CONTRACTOR / NOMINATED INSPECTION AGENCY(SUBJECT TO PRIOR APPROVAL OF ) N : , P: PERFORM W: WITNESS AND V: VERIFICATION AS APPROPRIATE CHP: SHALL BE IDENTIFIED IN COLUMN "N" AS "W"</p> <p>***MA: MAJOR, CR: CRITICAL</p>										
MANUFACTURER / SUB-SUPPLIER		MAIN-SUPPLIER		SIGNATURE		REVIEWED BY		APPROVED BY		APPROVAL SEAL

DOC. NO.: IS-4-QP-714-800-A002 REV: 00 CAT.....

QUALITY ASSURANCE PLAN													
PROJECT: 2x660 MW UDANGUDI SUPERCRITICAL THERMAL POWER PROJECT- STAGE-1		Q.P. No.: IS-4-QP-714-800-A002		REV.: 00		DATE: 23.04.21		PAGE: 1 OF 7					
CONTRACT NO.: IS-1-17-2002		MAIN SUPPLIER: BHEL-INDUSTRIAL SYSTEMS GROUP, ISG BANGLORE		ITEM: DG SET		SUB SYSTEM: CONTROL PANEL FOR DGSET		Q.P. No.: IS-4-QP-714-800-A002					
SL. NO.	COMPONENTS & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS
					M	C/N				M	C	N	
1	2	3	***4	5	6	7	8	9	D*	**	10	11	
<b>FINAL INSPECTION AND TESTING</b>													
1	Control panel for DG set	a) Overall Dimensions b) Thickness of Sheet c) Paint Shade d) Thickness of Paint e) Surface finish f) Name Plate g) GA, Bills of material & 100% control logic scheme check h) Scheme logic check for starting other DG sets from one control panel	MA MA MA MA MA MA CR CR	Meas. Meas. Visual Meas. Visual Visual Phy Phy	100% 100% 100% 100% 100% 100% 100% 100%	100% At random At random Min. 5 points/Panel Min. 5 points/Panel 10% of each type 100% 100%	Approved Drg/data sheet Approved Drg/data sheet Approved Drg/data sheet Approved Drg/data sheet Smooth without lump Appd drg/ data sheet Appd drg/ data sheet Main supplier Appd drg/ data sheet	Approved Drg/data sheet Approved Drg/data sheet Approved Drg/data sheet Approved Drg/data sheet Smooth without lump Approved Drg/data sheet Approved Drg/data sheet Approved Drg/data sheet	Inspt. Report Inspt. Report Inspt. Report Inspt. Report Inspt. Report Inspt. Report Inspt. Report Inspt. Report	P P P P P P P P	W W W W W W W W		
<b>LEGEND: *RECORDS IDENTIFIED WITH "TICK"(✓) SHALL BE ESSENTIALLY INCLUDED BY THE CONTRACTOR IN QA DOCUMENTATION</b>													
<b>**M: MANUFACTURER / SUB-SUPPLIER C: CONTRACTOR / NOMINATED INSPECTION AGENCY(SUBJECT TO PRIOR APPROVAL OF ) N : , P: PERFORM W: WITNESS AND V: VERIFICATION AS APPROPRIATE CHP: SHALL BE IDENTIFIED IN COLUMN "N" AS "W"</b>													
<b>***MA: MAJOR, CR: CRITICAL</b>													
MANUFACTURER / SUB-SUPPLIER: <b>MAIN-SUPPLIER</b> SIGNATURE: _____ REVIEWED BY: _____ APPROVED BY: _____ APPROVAL SEAL: _____													
DOC. NO.: IS-4-QP-714-800-A002      REV: 00 CAT: .....													

QUALITY ASSURANCE PLAN																			
PROJECT: 2x660 MW UDANGUDI SUPERCRITICAL THERMAL POWER PROJECT- STAGE-1		Q.P. No.: IS-4-QP-714-800-A002		CONTRACT NO.: IS-1-17-2002		MAIN SUPPLIER: BHEL-INDUSTRIAL SYSTEMS GROUP, ISG BANGLORE													
ITEM: DG SET		SUB SYSTEM: CONTROL PANEL FOR DGSET		REV.: 00		DATE: 23.04.21													
DATE: 23.04.21		PAGE: 1 OF 7		FORMAT OF RECORD		D*													
ACCEPTANCE NORMS		8		9		10													
REFERENCE DOCUMENT		7		8		9													
QUANTUM OF CHECK		6		7		8													
TYPE OF CHECK		5		6		7													
CLASS		***4		3		4													
CHARACTERISTICS		3		4		5													
COMMENTS & OPERATIONS		2		3		4													
SL. NO.		1		2		3													
1		2		3		4													
i) Identification of Component layout		Visual		100%		One Panel/ Type /lot		Main supplier Appd drg/ data sheet		Appd drg/ data sheet		Inspt. Report		P		W		W	
j)Completeness of																			
i) Wiring		Elec.		100%		At random		Main supplier Appd drg/ data sheet		Appd drg/ data sheet		Inspt. Report		P		W		W	
ii) Ferruling		Visual		100%		At random		Main supplier Appd drg/ data sheet		Appd drg/ data sheet		Inspt. Report		P		W		W	
k) Size of Wires		Meas.		100%		At random		Main supplier Appd drg/ data sheet		Appd drg/ data sheet		Inspt. Report		P		W		W	
l) Spare Terminals		Meas.		100%		At random		Main supplier Appd drg/ data sheet		Appd drg/ data sheet		Inspt. Report		P		W		W	
MANUFACTURER / SUB-SUPPLIER		SIGNATURE		MAIN-SUPPLIER		LEGEND: *RECORDS IDENTIFIED WITH "TICK"(✓) SHALL BE ESSENTIALLY INCLUDED BY THE CONTRACTOR IN QA DOCUMENTATION		**M: MANUFACTURER / SUB-SUPPLIER C: CONTRACTOR / NOMINATED INSPECTION AGENCY(SUBJECT TO PRIOR APPROVAL OF ) N : , P: PERFORM W: WITNESS AND V: VERIFICATION AS APPROPRIATE CHP: SHALL BE IDENTIFIED IN COLUMN "N" AS "W"		***MA: MAJOR, CR: CRITICAL		DOC. NO.: IS-4-QP-714-800-A002		REV: 00 CAT.....		APPROVED BY		APPROVAL SEAL	

QUALITY ASSURANCE PLAN												
PROJECT: 2x660 MW UDANGUDI SUPERCRITICAL THERMAL POWER PROJECT- STAGE-1		Q.P. No.: IS-4-QP-714-800-A002		CONTRACT NO.: IS-1-17-2002		MAIN SUPPLIER: BHEL-INDUSTRIAL SYSTEMS GROUP, ISG BANGLORE		REMARKS				
ITEM: DG SET		SUB SYSTEM: CONTROL PANEL FOR DGSET		REV.: 00		DATE: 23.04.21		PAGE: 1 OF 7				
SL. NO.	COMPONENTS & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY		
					M	C/N				M	C	N
1	2	3	***4	5	6	7	8	9	D*	**	10	11
		m) Door Earthing	MA	Megger	100%	At random	Main supplier Appd drg/ data sheet	Appd drg/ data sheet	Inspt. Report	P	W	W
		n) Functional Test including HV,IR before and after HV & continuity	CR	Elec.	100%	100%	Main supplier Appd drg/ data sheet	Appd drg/ data sheet	Inspt. Report	P	W	W
		o)IP test by paper insertion method	MA	Visual	100%	At random	Main supplier Appd drg/ data sheet	Appd drg/ data sheet	Inspt. Report	P	W	W
		p)Shrouding of live accessible parts, busbar clearances, crimping check by gentle pull, verticality of panel, door alignment for smooth locking, panel and door earthing, main and earth bus size terminations and material	MA	Visual	100%	At random	Main supplier Appd drg/ data sheet	Appd drg/ data sheet	Inspt. Report	P	W	W

MANUFACTURER / SUB-SUPPLIER		SIGNATURE	
MAIN-SUPPLIER		APPROVED BY	
APPROVAL SEAL		APPROVED BY	

LEGEND: \*RECORDS IDENTIFIED WITH "TICK"(v) SHALL BE ESSENTIALLY INCLUDED BY THE CONTRACTOR IN QA DOCUMENTATION  
 \*\*M: MANUFACTURER / SUB-SUPPLIER C: CONTRACTOR / NOMINATED INSPECTION AGENCY(SUBJECT TO PRIOR APPROVAL OF ) N : , P: PERFORM W: WITNESS AND V: VERIFICATION AS APPROPRIATE CHP: SHALL BE IDENTIFIED IN COLUMN "N" AS "W"  
 \*\*\*MA: MAJOR, CR: CRITICAL

DOC. NO.: IS-4-QP-714-800-A002 REV: 00 CAT.....

	<b>QUALITY ASSURANCE PLAN</b>	PROJECT: 2x660 MW UDANGUDI SUPERCRITICAL THERMAL POWER PROJECT- STAGE-1 CONTRACT NO.: IS-1-17-2002 MAIN SUPPLIER: BHEL-INDUSTRIAL SYSTEMS GROUP, ISG BANGLORE
ITEM: DG SET SUB SYSTEM: CONTROL PANEL FOR DGSET	Q.P. No.: IS-4-QP-714-800-A002 REV.: 00 DATE: 23.04.21 PAGE: 1 OF 7	
<b>ANNEXURE</b>		

S.NO.	COMPONENTS	MAKE
1	Controller	WOODWARD
2	CT/PT	PRAGATI/ASHMORE
3	Transducer	RISHABH/AE/SECURE
4	Protection Relay	AREVA/ABB/GSPC
5	Indication Meter-AC / KWH Meter	L&T/HPL/SECURE/RISHABH/SCHNEIDER
6	Indication Meter-DC	AE/RISHABH
7	Contacto r/MPCB/MCB	L&T/SCHNEIDER
8	Control Relay	OEN/PLA/WEILDMULAR
9	Temperature Scanner	MASIBUS/MULTISPAN
10	Annunciator	MINILEC/EAPL
11	Hooter	VAISHNO
12	Battery Charger	AMARARAJA/HBL/CHABBI
13	Fuse	L&T/SIEMENS/C&S
14	Indicating Lamp	RASS/VAISHOO/L&T/TEKNIC
15	Selector Switch	SALZER/KAYCEE/RASS/VAISHANO
16	Selector Spring Returnable Actuator	RASS/VAISHOO/L&T/TEKNIC
17	Push Botton	RASS/VAISHOO/L&T/TEKNIC
18	Auto Manual Switch	SALZER/KAYCEE/RASS/VAISHANO
19	Timer	SELECTION/MINILEC/EAPL/L&T
20	Control Terminal	CONNECTWELL/ELMEX
21	Panel Lamp/Switch with socket/Space Heater with Thermostat/Door Limiting Switch	REPUTED

		DOC. NO.: IS-4-QP-714-800-A002    REV: 00 CAT.....
<b>MANUFACTURER / SUB-SUPPLIER</b>	<b>MAIN-SUPPLIER</b>	<b>APPROVED BY</b>
<b>SIGNATURE</b>	<b>SIGNATURE</b>	<b>APPROVAL SEAL</b>

LEGEND: \*RECORDS IDENTIFIED WITH "TICK"(V) SHALL BE ESSENTIALLY INCLUDED BY THE CONTRACTOR IN QA DOCUMENTATION  
 \*\*M: MANUFACTURER / SUB-SUPPLIER C: CONTRACTOR / NOMINATED INSPECTION AGENCY(SUBJECT TO PRIOR APPROVAL OF ) N : , P: PERFORM W: WITNESS AND V: VERIFICATION AS APPROPRIATE CHP: SHALL BE IDENTIFIED IN COLUMN "N" AS "W"  
 \*\*\*MA: MAJOR, CR: CRITICAL