

**TECHNICAL PRE-QUALIFICATION REQUIREMENT**

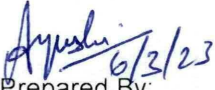
Name of Project	<b>400/220 kV GIS SUBSTATION AT ERSAMA, PARADEEP</b>
Name of Customer	<b>ODISHA POWER TRANSMISSION CORPORATION LTD. (OPTCL)</b>
Name of Package	<b>250KVA DG-SET</b>

<b>TECHNICAL PRE QUALIFICATION REQUIREMENT</b>	
<p>The bidder should have designed, supplied, erected, tested &amp; commissioned at least one number of DG-Set having a minimum rating of 125kVA or more in installations such as power plants, sub-stations, electricity boards, transmission utility, refineries, fertilizer plants, commercial, institutional or other industrial installations. Bidder should have executed the above system <b>during the last ten (10) years as on original scheduled date of bid opening of this tender.</b></p> <p>The systems should have been in <b>#successful operation for at least one (1) year prior to original scheduled bid opening date of this tender.</b></p> <p>(#) Successful operation means certificate issued by the Customer/ end user certifying the operation without any adverse remark.</p>	

<b>SUPPORTING DOCUMENTS TO BE ATTACHED</b>		
<b>Sr</b>	<b>Required Criteria</b>	<b>Supporting Documents to be submitted by bidder along with technical bid</b>
1	Design	Approved drawings/GTP/BOQ etc.
2	Supply	Copy of PO/Work Order/Material receipt certificate at site, etc.
3	Commissioning/ETC/ Execution	Pre-commissioning report / commissioning report and final work completion or handing over report/certificate for complete system.
4	Successful Operation	Performance Certificate/ Letter/ MOM from customer for satisfactory/successful operation for the same projects for which PO/WO are being submitted.

**Notes (General points):**

1. Consideration of offer shall be subject to customer's approval of bidder as approved vendor for this package.
2. Bidder to submit all supporting documents in Hindi/English. If documents submitted by bidder are in language other than Hindi/English, a self- attested English translated document should also be submitted.
3. Notwithstanding anything stated above, BHEL reserves the right to assess the capabilities and capacity of the bidder to perform the contract, should the circumstances warrant such assessment in the overall interest of BHEL.
4. After satisfactory fulfilment of all the above criteria / requirement, offer shall be considered for further evaluation as per NIT and all the other terms of the tender.

  
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भारत हेवी इलेक्ट्रिकल्स लिमिटेड  
BHARAT HEAVY ELECTRICALS LIMITED  
पारेषण व्यापार अभियांत्रिकी प्रबंधन  
TRANSMISSION BUSINESS ENGINEERING MANAGEMENT

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TYPE/ प्रकार OF DOC	<b>TECHNICAL SPECIFICATION</b>			हस्ता. / SIGN	<i>[Signature]</i>	<i>[Signature]</i>		
TITLE/ शीर्षक	<b>250kVA DIESEL GENERATOR SET</b>			नाम / NAME	<b>AJ</b>	<b>AR</b>	<b>AR</b>	
				दिनांक/ DATE	<b>06.03.23</b>	<b>06.03.23</b>	<b>06.03.23</b>	
				समूह/GROUP	<b>TBEM</b>			
ग्राहक/ CUSTOMER	<b>ODISHA POWER TRANSMISSION CORPORATION LTD. (OPTCL)</b>							
परियोजना/ PROJECT	<b>400/220 kV GIS SUBSTATION AT ERSAMA, PARADEEP</b>							
विषय-सूचि/ CONTENTS								
अनुभाग / Section	विवरण / Description					पृष्ठ संख्या/ No of Pages		
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TECHNICAL SPECIFICATION FOR 250KVA DIESEL GENERATOR SET  
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## SECTION 1 INTENT, DESIGN CRITERIA, SYSTEM REQUIREMENT AND SCOPE

### 1.1 SCOPE

- 1.1.1 This specification covers the design, manufacture, inspection and testing at Contractor's and/ or his Sub-Contractor's works, transportation & delivery (For destination) and erection, testing & commissioning at site of **minimum net electrical output of 250kVA (after considering deration for engine and alternator separately due to temperature rise inside the enclosure ie. 50°C ambient temperature, limited to class F insulation and on account of power reduction due to auxiliaries)** along with other equipment details of which are provided in different section of this specification.
- 1.1.2 **Diesel Generating Set, silent type suitable for outdoor installation** as mentioned in different sections of this specification. Diesel Generator Set of stationary type having a minimum net electrical output **(after considering deration for engine and alternator separately due to temperature rise inside the enclosure ie. 50° C ambient temperature limited to class F insulation and on account of power reduction due to auxiliaries)** shall be 250kVA, 1500RPM, 0.8Pf, 415V, 3 phase, 50Hz. along with other equipment details of which are provided in different section of this specification.
- 1.1.3 The requirement(s) specified under 'SECTION 2, SECTION 3, SECTION 4' and 'SECTION 5' of this specification shall be considered as part of this section. In case of variance between various sections, requirements of Section-1 shall prevail. **Customer spec. provided with sec-2 shall be adhered strictly.**
- 1.1.4 It shall be the responsibility of successful bidder to obtain necessary approval(s) /clearance(s) from statutory organization(s) / authority(s) wherever applicable for the equipment / system / sub-system(s) under the scope specified herein.
- 1.1.5 **The Contract shall be on unit rate basis for the package. Within the scope of the contract, no variation shall be admissible to the Contractor so far the input remains unchanged.**
- 1.1.6 **Deviation:** Any deviation or variation from the Scope requirement and/or intent of this specification shall be clearly defined clause wise with respect to the specification under relevant Deviation Schedule (Section 5.0) attached with Bid Document. Deviations in any other form including clarifications / assumptions / etc. will not be considered and it will be construed that the bid conforms strictly to the specification.
- 1.1.7 The term 'Owner' appearing in this specification shall refer to **ODISHA POWER TRANSMISSION CORPORATION LTD. (OPTCL)**, the term 'Purchaser' shall refer to **BHEL** and the term 'Contractor' shall refer to the **successful Bidder**.

### 1.2 SPECIFIC TECHNICAL REQUIREMENTS

#### 1.2.1 SYSTEM REQUIREMENT & DESIGN CRITERIA

The following shall be considered:



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1. **DG set shall have minimum net electrical output of 250kVA at specified site conditions of 50°C ambient temperature and 100% relative humidity.**
2. Diesel engine set shall be rated for 110% of full load for 1 hour in every twelve hours of continuous running.
3. The output voltage, frequency and limits of variation from open circuit to full load shall be as follows:
  - a) Maximum Voltage variation  $\pm 10\%$  of the set value provision shall exist to adjust the set value between 90% to 110% of nominal generator voltage of 415V.
  - b) Frequency 50Hz  $\pm 5\%$ .
4. **The Diesel Generator and other auxiliary motor shall be of H class with temperature rise limited to Class-F for temperature rise consideration.**
5. **Enough space and termination arrangement shall be ensured by DG set supplier inside the alternator terminal box for single run of 3.5Cx300 sq. mm XLPE cable per phase.**
6. Terminal Box- Seven (7) output terminals (R, Y, B, R', Y', B' & N)
7. Each output terminal suitable for cable size of Single Run of 3.5CX300 sq.mm XLPE cable. However exact requirement of run and size of cable shall be informed during detailed engineering stage and contractor shall comply the same without any price implication to BHEL.
8. Neutral shall be solidly grounded through CI pipe electrode. DG body shall be separately grounded through another CI pipe electrode.
9. ACB for DG has been provided in the 415V AC distribution board. Power circuit is therefore not required in AMF panel. Control scheme shall be accordingly made for auto start of DG and auto-closing and trip of DG-ACB.
10. **3 nos. CTs for differential protection shall be mounted in neutrals brought to the AMF panel while other 3 CTs shall be mounted on the LVAC Board (purchaser scope). These six nos. CTs are in purchaser's scope of supply. However DG supplier shall ensure provision (suitable adapter box) for mounting of 3 CTs in AMF Panel.**
11. Relays for Short circuit protection, Under-voltage & over Voltage shall be provided by the Purchaser in LVAC board. Contractor shall provide necessary provisions in AMF panel to interlock these relays for initiating the DG shutdown sequence as specified in this specification.
12. Although DG set is of silent type and suitable for outdoor installation, a dedicated DG room shall also be made by purchaser. DG Set will be placed indoor (in DG room) on a



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foundation suggested by contractor located near control room building area in switchyard.

- 13. List of Major guaranteed technical parameters for DG Set are given in customer's specification attached to section-2 of this technical specification. Bidder may fill the same and submit alongwith bid.**

### 1.3 SCOPE OF SUPPLY & SERVICES

The equipment and services to be furnished under this contract are detailed here under for reference. The items, though not specifically mentioned but required for safe and satisfactory operation of system will also be treated as included and the same shall be supplied at **NO EXTRA COST** to Purchaser/customer.

#### 1.3.1 SCOPE OF SUPPLY

##### A. Main Item

The scope covers supply of One (1) nos. Diesel Generator Set of stationary type having a minimum net electrical output **(after considering deration for engine and alternator separately due to temperature rise inside the enclosure ie. 50° C ambient temperature and on account of power reduction due to auxiliaries)** shall be 250kVA, 1500RPM, 0.8Pf, 415V, 3 phase, 50Hz. Essential components are as follows:

- i) Diesel engine set of adequate capacity to deliver Net electrical output 250kVA at 50 °C ambient temperature & 100% relative humidity.
- ii) ***Suitable alternator (considering suitable deration at ambient temperature of 50degC & insulation class for temperature rise as per specification) directly coupled to the engine through coupling, complete with all accessories.***
- iii) Automatic Voltage Regulator.
- iv) Complete starting arrangement including 2 sets of 24V DC Battery (each of capacity 180AH) & SMPS type battery charger (2 sets) with leads.
- v) Base frame and 1 set of AVM pads & foundation bolts.
- vi) Day tank of minimum 350 litres or as per manufacturer's standard (normally 990 litres) capacity complete with accessories viz. canopy, breather, level indicator, fuel inlet & outlet, air vent, drain plug, inlet arrangement for direct filling. The tank shall be painted with oil resistant paint. Suitably fabricated steel platform for day tank to be provided.
- vii) Motor operated pump and a set of hoses to transfer fuel from barrel to day tank.
- viii) Engine cooling and lubrication system. Engine air filtering system.
- ix) Exhaust silencer package with adequate length of exhaust piping with insulation beyond flexible connection up to the stack height as per the CPCB norms.



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- x) 15 mtrs of fuel piping with valves and fittings between day tank & engine. The day tank will be placed near the DG set and would be within 5 mtrs from the periphery of the DG set.
- xi) **Exhaust System:** Provision of M.S. Pipe of suitable diameter (class B pipe) to height 5 mtr. above rooftop of DG room (total 5 mtr. from the ground level). The size of the pipe should be such that there is no back pressure beyond allowable limits. Suitable M.S. flange, nuts & bolts with support brackets & structure, Al. Cladding on thermal insulation to be provided. Also please refer clause 3 of customer's specification attached to section-2.
- xii) **Fuel System:** Minimum 990 litre fuel tank at the base of DG set by 19mm M.S. pipe (C-Class) with fuel fitting NRV etc. with effective locking arrangement.
- xiii) AMF control panel complete with all standard protection, alarm/ annunciations and meters necessary for 250 KVA DG set  
Following shall also be provided in AMF panel:
- 1) 3 Nos. single phase CT's for metering (Class-1, Output Burden=15VA)
  - 2) 3 Nos. single phase CT's (Provided by LT switchgear manufacturer) with KPV = 300V & RCT = 0.25 ohm for differential protection of DG Set on neutral side.
  - 3) One (1) Auto/Manual Selector Switch
  - 4) Local/Remote Selector Switch for DG Set
  - 5) A manual changeover switch to switch the ignition load on either Battery-Set 1 or Battery-Set 2
  - 6) Two (2) Sets of Battery chargers
  - 7) Necessary MCBs for LT Auxiliary Supply Distribution
  - 8) Any other item required for completion of Control scheme shall be deemed to be included.

#### **CONTROL AND INSTRUMENTATION INCLUDING AMF PANEL**

- (a) Each D.G. Set shall be provided with suitable instruments, interlock and protection arrangement, suitable annunciation and indications etc. for proper start up, control, monitoring and safe operation of the unit. One local AMF control panel along with each D.G. set shall be provided by the Supplier to accommodate these instruments, protective relays, indication lamps, annunciations, battery chargers etc.
- (b) Alternatively, AMF Panel for DG Set may be installed outside the acoustic enclosure near the DG Set inside DG Room.
- (c) The AMF Panel shall have IP-52 degree of Protection as per IS:12063.
- (d) **Location of AMF panel shall be finalised during detailed engineering with customer and should be acceptable to contractor without any commercial**



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**implication. For constructional features of AMF panel, contractor must refer clause 19 of customer's spec attached to section-2.**

- (e) The D.G. sets shall be provided with automatic start facility to make it possible to take full load within 30 seconds of Power Supply failure.
- (f) Testing facility for automatic operation of D.G Set shall be provided in AMF panel.
- (g) Microprocessor based controller shall be supplied for DG Set monitoring, metering and control system.
- (h) DG set shall be capable of being started/stopped manually from remote as well as local. For remote operation START/STOP push button is being provided in 415V ACDB. Interlocking of DG breaker shall be provided to prevent parallel operation of DG set with normal station supply.
- (i) In addition to the shutdown conditions specified at Annexure-B, DG Set shall shutdown whenever any of the following conditions appear in the system:  
1) Generator differential protection operated  
2) Short circuit protection operated
- (j) Following indication lamps shall be provided in AMF panel:  
1) DG Mains /Alternator ON (R,Y,B phases separately)  
2) Charger ON (For Both Chargers separately)  
3) DG Set Breaker ON/OFF  
4) Auxiliary LT Supply ON (For Source-1 & Source-2 separately)
- (k) Thermostatically controlled space heaters and cubicle illumination operated by Door Switch shall be provided in AMF panel. Necessary isolating switches and fuses shall also be provided.
- xiv) Sound proof & weather proof enclosure in line with CPCB norms for silent type DG Set.  
Enclosure for silent type D.G. Set enclosing Engine & the Alternator to make it work silently (with in permissible noise level as per CPCB norms) and suitable for outdoor installation.  
Adequate Illumination & ventilation arrangement for DG set enclosure.
- xv) ***Lube oil and other consumable, touch up paints etc. for first testing & commissioning at site shall be under contractor scope.***  
***Fuel (HSD) for testing and commissioning at site shall be arranged by purchaser (BHEL).***

**Notes:**



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**Bidder may please see Annexure-DG (250kVA rating DG set) attached to section-4 for major technical parameters to be ensured while quoting.**

**Bidder should furnish deration calculation of engine and alternator as per format given in section-5.**

## **B. Standard Tools & Tackles**

Bidder shall include one set of standard tools and tackles required for erection, operation & maintenance of equipment. The list of tools required shall be furnished in the bid.

### **1.3.2 SCOPE OF SERVICES**

The contractor shall provide following, services:

- A. Design, manufacture, shop testing including assembly test.
- B. Dispatch transportation to Site.
- C. Erection, Testing & Commissioning of complete DG set, Battery and charger, AMF panel, fuel tank, exhaust system etc. as per this technical specification.
- D. Certification and compliance for meeting noise level & emission parameters and other requirements in accordance with latest Notification of MOEF/CPCB.
- E. Purchaser reserves the right to utilize number of visits depending upon site conditions.
- F. Submission of drawings, data, design calculations & printed erection, operation & maintenance manual.
  - i) Following drawings and data sheet shall be submitted for approval:
    - (a) Data sheet for Engine, Alternator, Battery, AMF panel and Enclosure.
    - (b) GA drawing of DG set.
    - (c) Civil foundation details of DG set
    - (d) Layout of DG set in the enclosure along with sections.
    - (e) GA and schematic of AMF panel and DG set controller.
    - (f) List of Mandatory spares and tools & tackles
    - (g) Details of rating plate (in English, Hindi & Odia) with prior approval of customer
    - (h) Drawings, datasheets, design calculations and erection, operation & maintenance manual in hard & soft copies.
    - (i) Certification and compliance for meeting noise level & emission parameters and other requirements in accordance with latest Notification of MOEF/CPCB.
  - ii) The D G Set shall be supplied with
    - (a) D G Set test certificate.
    - (b) Engine Operation & maintenance Manual



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- (c) Alternator Operation, maintenance & Spare parts Manual, Alternator test certificate.  
G. The draft O&M manual shall be submitted within 4 weeks after award of contract.

The O&M manual shall contain the following information:

- Description of the system and equipment with design particulars
- Scheme of operation and interlocks in AMF panel with the purchaser's LVAC board
- Instruction for installation, operation, maintenance and repair at site.
- Recommended inspection practices and inspection schedule.
- Ordering information for all replaceable parts

## 1.4 EXCLUSIONS

The following has been excluded from the bidder's scope:

- 1.4.1 **Unloading, Storage of DG set and shifting from storage space to its foundation at site.**
- 1.4.2 Supply and laying of power & control cables (other than used within DG set and its associated equipment supplied by contractor)
- 1.4.3 Supply of GI flat and 2 nos. CI pipe electrodes for equipment earthing.
- 1.4.4 CTs for differential protection
- 1.4.5 Fuel (HSD) for testing and commissioning at site shall be arranged by purchaser (BHEL).
- 1.4.6 Interlocking of the DG Set with the existing system. However, provision for the same shall be made in the control panel.
- 1.4.7 Construction of DG Room, RCC/PCC civil foundation for DG set, day tank. However, the supplier shall submit the foundation details of these equipment.

## 1.5 INSPECTION AND TESTING

Inspection and testing of DG set shall be done at manufacturer works as per Customer's approved GTP/drawing/QAP. The Diesel generator set shall be tested for routine and acceptance tests in accordance with the agreed FAT procedure as per the relevant IS/IEC standards. *All consumables including lubrication and fuel (HSD) etc. shall be arranged by contractor during testing at manufacturer works before dispatch.*

### Type Tests

The type test report for diesel engine and alternator are not required to be submitted for the makes listed below:

### LIST OF THE MAKES FOR WHICH TYPE TEST REPORTS NOT REQUIRED TO BE SUBMITTED

***Diesel Engine: Cummins/Greaves /Kirloskar/Caterpillar/Volvo***



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**Alternator: KEC/STAMFORD/Crompton/Volvo.**

**For the new makes, type test reports of engine and alternator as per relevant standard shall be submitted for customer/purchaser's approval.**

### **Commissioning Checks**

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

#### **(a) Load Test**

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

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

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

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

#### **(b) Insulation Resistance Test for Alternator**

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

#### **(c) Check of Fuel Consumption**

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

#### **(d) Insulation Resistance of Wiring**

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

#### **(e) Functional Tests**

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

#### **(f) Measurement of Vibration**



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

(g) Noise Level check as per relevant standard

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

### **1.6 Comprehensive scope (Gist of scope)**

**Bidder shall provide items inline with scope defined in this specification (gist of which is given below). However the same shall not be limited to scope of supply. Items not listed below but required for successful commissioning and operation of DG set shall be supplied and installed by contractor inline with this technical specification without any additional price implication to BHEL/End user.**

Sl. No.	Description
1.0	<p><b>Supply of Minimum net electrical output of 250kVA DG Set (One Nos.) at 50 degC ambient as per technical specification comprising of but not limited to:</b></p> <ul style="list-style-type: none"><li>- Diesel engine complete with all accessories</li><li>- Alternator directly coupled to engine through coupling, complete with all accessories</li><li>- Automatic voltage regulator</li><li>- Complete starting arrangement with starter motor, 2 sets of batteries each of 24V DC, 180AH capacity and 2 Nos. SMPS type battery chargers with leads etc.</li><li>- Day tank of minimum 350 litres or as per manufacturer's standard (normally 990 litres capacity)</li><li>- Motor driven oil pump to transfer fuel to day tank</li><li>- Engine cooling and lubrication system</li><li>- Engine air-filtration system</li><li>- Exhaust silencer package</li><li>- Acoustic and weather proof enclosure as per CPCB norms</li><li>- AMF panel as per this technical specification</li><li>- Base Frame</li><li>- Inspection &amp; testing of complete DG set at works before dispatch as per technical specification</li></ul>
2.0	<p><b>Supply of Complete erection material for One no. DG set but not limited to:</b></p> <ul style="list-style-type: none"><li>- 1 set of AVM Pads.</li><li>- Exhaust silencer package with 1 Set of MS class 'B' of suitable diameter for exhaust piping complete with hardware and fittings and <b>supporting structure for exhaust system as per this technical spec.</b></li><li>- 1 Set of fuel piping from day tank to engine complete with hardware &amp; fittings as per technical specification</li><li>- 1 Set of thermal insulation of exhaust piping and silencer beyond flexible connections, if required as per applicable standards.</li><li>- Set of valves, strainers and unloading hose pipes as required.</li></ul>



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	<ul style="list-style-type: none"><li>- 1 no. fabricated MS platform with painting for day tank.</li><li>- First fill of lube oil and consumables for commissioning at site.</li></ul>
3.0	<b>Supply of Standard tools and tackles for erection, operation and maintenance</b>
4.0	<b>Erection Testing &amp; Commissioning of complete DG set and its associated items as defined</b>

**Note:** Bidder should first go through the complete specification and distribute the prices under different heads of BOQ given in tender suitably.



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## **SECTION 2**

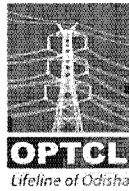
### **CUSTOMER SPECIFICATION**

Refer Customer's (POWERGRID) Specification enclosed herewith as part of section-2.

**Necessary provision should be made available to have following control and indication (Alarm/trip signals as listed) for SAS auxiliary panel from AMF panel/DG controller:**

#### **A. For Remote Indication (Digital Input to SAS Auxiliary Panel)**

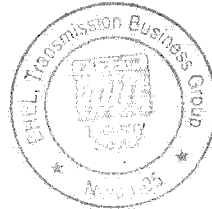
- 1) Mains 1 ON
- 2) Mains 2 ON
- 3) Alternator ON
- 4) Charger 1 ON/OFF
- 5) Charger 2 ON/OFF
- 6) Main 1 LT Supply ON/OFF
- 7) Main 2 LT Supply ON/OFF
- 8) Engine Over Heating
- 9) Lack Of fuel
- 10) Low Oil Pressure
- 11) Set Failed to start 30 Sec after receiving the first start Impulse
- 12) High Cooling Water Temperature
- 13) Low Level in daily service fuel Tank
- 14) Over speed trip
- 15) Alternator Fault
- 16) Breaker ON/OFF



**ODISHA POWER TRANSMISSION CORPORATION LIMITED**  
**OFFICE OF THE SR. GENERAL MANAGER,**  
**CENTRAL PROCUREMENT CELL,**  
**JANAPATH, BHUBANESWAR – 751022.**

## **TECHNICAL SPECIFICATION**

### **250 KVA GENERATOR**





- g) Suitable rating ACB (2 Incomers + 1 bus coupler 800A, 4 Pole 50KA rating L&T/ Siemens make ACB)
- h) Control cables and other accessories as per manufacturer
- i) Electronic KWH meter of 0.2 class acc
- J) ELCB etc.

Engine shall confirm to BS. 649 or IS 10002: 1981, Alternator BS 2613: 1970 or IS 4722: 1968 etc or its latest.

Cables (a) Control cable as required

- (b) Power cables-3.5 CoreX300 Sqmm three run for each Generator for a length of 200 mtr (Total 1200 mtrs) of PVC armored Aluminium cable.

#### 1. DIESEL ENGINE:

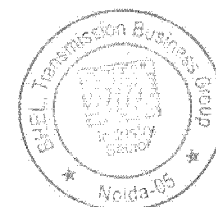
An engine of reputed make, suitable for 1X 250KVA GENSET, inline type, turbo charged, water cooled, electric starting, 1500RPM, four stroke, Multicylinder diesel engine confirming to BS: 5514/ BS: 649/IS:10000, with 10% overloading for 01 hour in any 12hours of continuous operation in standard operating conditions in our country. The engine should be able to take 100% load with deration up to 50°C ambient temperature and up to 250m altitude.

#### 2. COOLING SYSTEM:

- Heavy-duty radiator with fan
- Cooling water centrifugal pump
- Coolant Inhibitor

#### 3. EXHAUST SYSTEM:

- Exhaust Gas Turbo Charger
- Exhaust manifolds
- Suitably designed critical grade Nelson silencer complete with thermal insulation and Aluminium cladding.
- Suitably designed exhaust pipe with flexible for carrying the exhaust gases out with minimize back pressure on engine.
- Suitably designed stack of height 05mtrs above the roof of Multistoreyed building (total 35m above ground level) so that the back pressure on engine is minimum. The exhaust stack may be supported with the building wall through clamps, rubber pads, so that vibration is not transmitted to the building.



- Suitably designed pipe for connecting silencer with stack, so that the back pressure on engine is minimum.
- The engine back pressure should not be more than 2.5inches of mercury at exhaust point.
- Port hole shall be provided as per the emission regulation part- III( CPCB publication).

#### 4. FUEL SYSTEM:

- P.T. Fuel pump
- Fuel Injectors
- Fuel filters
- Fuel hoses

#### 5. LUBE OIL SYSTEM:

- Lube oil pump
- Lube oil filters
- Super Bypass filters

#### 6. INTAKE AIR SYSTEM:

- Air intake manifold
- Air cleaner with replaceable elements-inner/outer

#### 7. GOVERNER

- Electronic Governor
- Electronic control panel with digital metering

#### 8. STARTING SYSTEM:

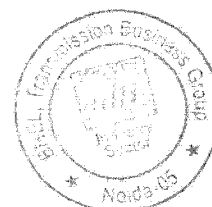
- Electric starter – 24volts DC
- Battery Charging alternator

#### 9. COUPLING ARRANGEMENT:

- Flywheel to suit single bearing alternator
- Flywheel housing (SAE housing)
- Inbuilt AM pads to reduce vibrations and eliminate misalignment of engine and alternator

#### 10. SAFTY CONTROLS:

- High water temperaure
- Low lube oil pressure
- Over speed, Over Crank



**11. ENGINE INSTRUMENT PANEL (ENGINE MOUNTED):**

- Starting switch with OFF/START KEY
- Water temperature display
- Lube oil pressure display
- RPM display
- Tachometer with hour meter

**12. MAUALS:**

- Engine operation and maintenance manual
- Alternator manual with Parts catalogue
- Engine maintenance schedule
- Warranty card
- Engine routine certificate

**13. ALTERNATOR:**

- Synchronous brushless, single bearing alternator, rated at 250KVA, suitable for continuous operation at 1500rpm generating 415volts at 0.8 power factor (lag) suitable for 50Hz, 3 phase, 4 wire system. The alternator shall be self excited, self regulated, foot mounted fitted with ball and/or roller bearings. The alternator shall be suitable for tropical climate and shall conform to BS: 2613/ IS: 4722. The class of insulation shall be "H" type.

**14. BASE FRAME:**

Heavy duty base frame of study design made of M.S. steel with necessary reinforcement and pre-drilled holes, to support the DG set and enclosure.

**15. VIBRATION INSULATION:**

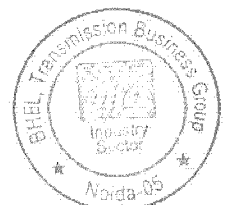
Specially designed poly bond anti-vibration mounts for vibration insulation should be used between engine/alternator and base frame.

**16. FUEL TANK**

Base fuel tank of sheet metal (14SWG), having a capacity of min. 350liters, duly fabricated and painted, complete with drain valve, air vent, level indicator, inlet and outlet connection, locking arrangement to avoid theft of oil, and housed in the base frame.

**17. BATTERIES:**

Two numbers batteries or as required for starting of 12 volts, 180 AH each in dry and uncharged condition of reputed make with ignition charging, connecting leads and terminals, provided inside the enclosure.



## 18. COUPLING AND MOUNTING ARRANGEMENT:

The engine and alternator shall be directly coupled and mounted through in build AVM pads on a heavy duty steel base frame. There shall be no chance of mis-alignment of the DG set and the vibrations of the DG set shall not get transmitted to the base-frame and to the enclosure.

## 19. AMF CONTROL PANEL:

The control panel body shall be fabricated out of 16SWG MS sheet. Panel shall be floor mounted indoor installed, dust and vermin proof. Control wiring shall be 2.5sq.mm shall be used. Cables shall be ferruled for proper maintenance/ checking/ wiring of panel. Detachable cable gland plates are to be provided. This shall be of indoor type.

The panel shall be equipped as follows:

## Power Circuit:

- One contractor for mains
- One contractor for DG set interlocked with the mains contractor.

## Metering:

- One voltmeter with selector switch
- One ammeter with selector switch
- One frequency meter
- Fuel level gauge

## Set of push buttons, selector switches and indicating lamps

- Continuous sensing of mains and generator voltage
- Auto start and changeover in case of mains failure
- Auto stop and changeover in case of mains resumption
- Three attempt starting
- Over current relay for protection against overloading of DG set

## Audio- Video annunciation with engine shutdown for

- Low lube oil pressure
- High cooling water temperature
- High canopy temperature
- Over current trip

## Battery charger consisting of

- Transformer of suitable rating



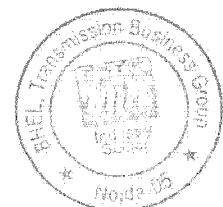
- Rectifier rate selector switch for “ Trickle” or “ Boost”
- DC ammeter and DC voltmeter
- An indicating lamp for battery being charged

20. The DG set should comply with the noise limit of 75db(A) at 01m from the enclosure surface and other requirements given in and as per the document “ System & Procedure for Compliance with Noise Limits for Diesel Generator Sets(upto 1000KVA)” issued by CPCB.

21. The diesel engine shall comply with the emission limits given in G.S.R. 371, dated 17.5.02 and G.S.R. 520, dt. 01.7.03 (irrespective of the date of implementation given in the notification) and certified as per emission norms of DOI already notified and or any latest emission note declared by the concerned authority.

## 22. ACOUSTIC ENCLOSURE:

- Acoustic enclosure should be integral part of the Gen set.
- The acoustic enclosure should be modular construction with the provision to assemble and dismantle easily as per site condition.
- There should be no protruding parts.
- The enclosure should be fabricated out of CRCA sheet of 14SWG.
- The sheet metal components should be dip seven tank pretreated.
- To have long life of the enclosure it should be P.P. based powder coated (inside as well outside). All nut and bolt hardware's be Zinc coated or Stainless Steel.
- Fuel tank at the base of the DG set should have minimum capacity of 350litres. It should be provided with breather, drain plug, fuel gauge meters to indicate fuel level and locking arrangement to avoid theft of oil.
- There should be provision for filling the fuel from outside as in the case of automobiles with locking arrangement.
- Battery should be accommodated in a separate tray in the enclosure.
- There should be provision for drain plugs for draining Mobil oil/ diesel from outside the enclosure.
- The doors to be provided with high quality EPDM gaskets to avoid leakage of sound.
- The lockable type door handles should be provided.
- Sound proofing of enclosure to be done with high quality rock wool conforming to IS 8183, of minimum 100mm thickness and density of 48-64 kg/m<sup>3</sup>.



- The rock wool should further be covered with fiber glass cloth and perforated galvanized MS sheet.
- A special critical grade silencer is required to be provided to control exhaust noise. (minimum 25dBA insertion loss)
- Specially designed anti is required to be provided to meet air requirement for combustion and heat removal. A blower should be used to meet total air requirement, air changes, if required.
- Temperature inside enclosure should not exceed beyond 7° C of ambient temperature.
- A provision for emergency shutdown from outside the container should be made.
- Control panel should carry warranty of respective manufacturer for diesel generating set in enclosure.
- The acoustic enclosure shall be rain/ water proof.

### 23. FUEL CONSUMPTION:

- Engine should be capable of providing fuel consumption of 4 units/lit of diesel, between 80 to 100% load as per BS 5514.

### 23. INSTALLATION:

- (i) The base of the Genset shall be minimum 30cm from the ground level so that the oil/fuel can be drained out easily.
- (ii) The ground up to 01m around the Genset shall be made of cement concrete platform of mix 1:2:4(1 cement, 2 Coarse Sand, 4 Stone Chips 20mm).

1X 250KVA, 380 BHP, 200KW, SILENT AMF diesel Generator set, 1500 RPM, Water cooled, 6-Cylinders, Diesel engine with AMF control panel, 250 KVA latest make Alternator as reqd. (Optional accessories and specification also be enclosed)

Diesel engine Specifications and accessories:-

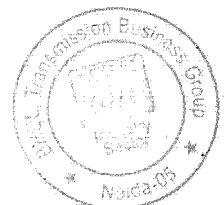
AVM with Acoustic enclosure type, Capacity-380 BHP, 6-Cylinders engine cooling system:

Water cooling, Radiator type

24V, self starting system with 2-Lead Acid batties, charging systems etc.

Diesel tank-As per manufacturer recommendation but of 350 ltr capacity minimum.

### Safety Controls:



Low Lube oil pressure  
 High water temperature  
 Battery Charging indicator  
 Oil temperature indicators  
 Warning signals with hooters  
 Rpm indicator

## Alternator

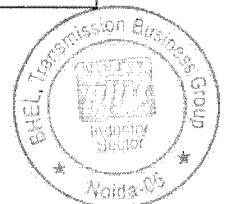
1X 250KVA capacity, 415v AC, 3phase,50Hz, 1500rpm

- a) Electronic type AVR etc.
- b) Control panel accessories
- c) Frequency meter
- d) Pilot lamps
- e) Current transformers
- f) Instrument fuses
- g) Suitable rating ACB ( 800A, 50KA rating L&T/ Siemens make with 4 Poles ACB each)
- h) Control cables and other accessories as per manufacturer
- i) Electronic KWH meter
- J) ELCB etc. Engine shall confirm to BS. 649 or IS 10002: 1981, Alternator BS 2613: 1970 or IS 4722: 1968 etc.

### SCHEDULE OF WORK AND SUPPLY

250 KVA DG set - 1 No.

SL. NO.	DESCRIPTION	QTY.
1.0	Supply of 250 KVA DG set with acoustic enclosure as per enclosed technical specification.	1 Set
2.0	AMF Control Panel with Numerical relay with Bus coupler Panel	1 Ste
<del>3.0</del>	<del>Transportation of unloading and placement of DG set to site.</del>	<del>1 Job</del>
<del>4.0</del>	<del>Preparation of concrete slab with load bearing capacity sufficient to take dead load of DG set</del>	<del>1 Job</del>
<del>5.0</del>	<del>Earthing system - 600x 600mm G.I. plate, G.I strip 50mm x 6mm, 50mm dia. G.I. pipe including fittings, Charcoal and salt, Hodi cover</del>	<del>12 nos.</del>
<del>6.0</del>	<del>G.I. Strip: 50mm X6mm</del>	<del>As per site</del>
<del>7.0</del>	<del>Cabling system 3.5 core Al. armoured cable 300 sq. mm</del>	<del>As per site</del>

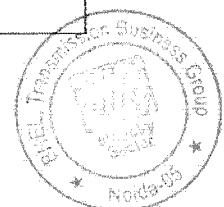


8.0	End termination of 3.5 Core Al. Armoured cable 300 sqmm with double compression Gland and thimbles	As per site
<del>9.0</del>	<del>Control Cable 2.5sq.mm 12 core</del>	<del>As per site</del>
<del>10.0</del>	<del>Connection with Main/Emergency Distribution Panels along with modifications in the Main/ Emergency Panel at substation of CPCB</del>	<del>As per site</del>
11.0	Exhaust system: Provision of M.S.pipe of suitable diameter (class B pipe) to height 5mtr above rooftop of DG room (total 5mtr from the ground level). The size of the pipe should be such that there is no back pressure beyond allowable limits. Suitable M.S. flange, nuts & bolts with support brackets & structure, Al. Cladding on thermal insulation to be provided.	As per site  As per site
12.0	Fuel system: Min. 350 litre fuel tank at the base of DG set by 19mm M.S. pipe ( C Class) with fuel fitting NRV etc. with effective locking arrangement.	
13.0	Sami Rotary Diesel Pump	One
14.0	Clearance from Various department	One Job
15.0	Testing & Commissioning	One Job

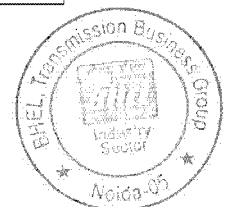
**Guaranteed Technical Particulars**

(To be furnished by the bidders)

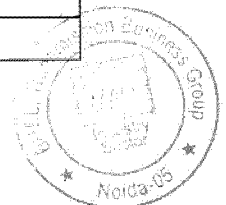
(A)	Alternator		
1.	Name of manufacturer	:	
2.	Brand Name	:	
3.	Factory Address	:	
4.	Reference Standard	:	
5.	Frequency	:	
6.	Rated Voltage	:	
7.	No. of phases	:	
8.	Rated speed	:	
a)	No load	:	
b)	Rated load	:	
9.	Phase sequence (Viewed from driving end)	:	
10.	Power factor	:	
11.	Rated output (KW/KVA)	:	
12.	Rated Current	:	
13.	Direction of rotation		



14.	Excitation system	:	
15.	Duty type	:	
16.	Class of Insulation	:	
17.	Temperature rise	:	
18.	Efficiency at rated voltage and frequency and 0.8 pf	:	
a)	In full load	:	
b)	1/3 load	:	
c)	¼ load	:	
19.	Short circuit rating (Peak)	:	
20.	Over speed limit	:	
21.	Limits of vibration	:	
22.	Type of enclosure	:	
23.	Cooling system	:	
24.	Variation in	:	
a)	Voltage	:	
b)	Frequency	:	
25.	Fly wheel effect of rotating parts	:	
26.	Cyclic irregularity	:	
27.	Irregularity of wave from %	:	
28.	Overload withstand capacity	:	
a)	Momentary	:	
b)	Intermittent	:	
C)	Sustained	:	
29.	Motor starting ability (Current / duration)	:	
	<b><u>PRIME MOVER</u></b>	:	
1.	Name of the engine manufacturer	:	
2.	Type of engine	:	
3.	Model and number of cylinders	:	
4.	IS rating	:	
a)	Rating A (With overload)	:	
b)	Rating B (Without overload)	:	
5.	Rating at site condition	:	
6.	Direction of rotation	:	
7.	No. & arrangement of cylinders	:	
8.	Whether two stroke or four stroke	:	
9.	Bore (mm)	:	
10.	Stroke(mm)	:	
11.	Cubic capacity(Litres)	:	

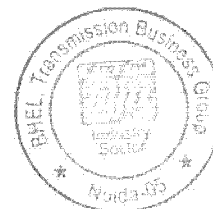


12.	Nominal Compression Ration	:	
13.	BMEP Developed	:	
14.	Mean piston speed	:	
15.	Muffler (silencer) type	:	
16.	Filter type and make	:	
a)	Air	:	
b)	Fuel	:	
c)	Lubricating Oil	:	
17.	Recommended fuel oil specification	:	
18.	Fuel oil tank capacity	:	
19.	Lubricating oil specification	:	
20.	Mode of starting, apparatus required	:	
21.	Specific fuel consumption in Litres per hour under standard reference conditions as per IS. 10000 part- II.	:	
a)	At rated output	:	
b)	At 110% of rated load	:	
c)	At 75% of rated load	:	
d)	At 50% of rated load	:	
e)	At 25% of rated load	:	
22.	Lubricating oil consumption at 100% load in litre/ engine operating hour.	:	
23.	Weight of engine	:	
24.	Overall dimension of engine	:	
25.	Performance curves as per IS-10000(part-VI) 1980 at Standard reference condition.	:	
26.	Accessories on engine as tested and for which a power allowance has been made in the manufacturers calculation of the site rating.	:	
27.	Voltage of electrical system	:	
28.	List of equipment and tools that will normally be supplied	:	
29.	List of supplementary equipment	:	
30.	Schedule of recommended maintenance and overhaul periods.	:	
31.	Maximum permissible back pressure in the exhaust system and maximum permissible intake depression.	:	
32.	Method of cooling and capacity of the cooling system with specific rates of water and oil circulation.	:	
33.	The maximum load that can be suddenly applied to the engine while it is running it is at full rated speed, at no load and at normal running temperatures.	:	
34.	The transient and permanent speed changes	:	



	that will result from the application of this load.		
35.	The transient and permanent speed rise resulting from full load being thrown off.	:	
36.	The transient and permanent speed change of load, both off and on, by all steps of 25 percent of the rated full load.	:	
37.	The steady state speed band recovery time to this speed band from all the conditions stated above.	:	
38.	Aspiration	:	
	<b><u>ACOUSTIC ENCLOSURE</u></b>	±	
1.	Name of Acoustic Enclosure manufacturer	:	
2.	Enclosure material	:	
3.	Insulation materials	:	
4.	Type of shutters	:	
5.	Overall dimension LXBXH	:	
6.	Noise level to be achieved	:	
7.	Maximum rise in inside temperature above ambient at full load	:	
8.	Provision of illumination inside the enclosure	:	
9.	Handling / Lifting facilities	:	

Engine : Cummins / Kirloskar/ Greaves / Caterpillar / Valvo make  
 Alternator: Stamford / KEC / Crompton / Valvo make  
 L.T Switchgear- L&T / Siemens/ M.G make  
 Cable- as per OPTCL vendor,  
 Relays to be of numerical type



**PROJECT: 2X500 MVA, 400/220 KV GIS S/S AT ERSAMA & ASSOCIATED 2 NOS 400 KV BAY EXTN AT DUBURI**

**CUSTOMER: ODISHA POWER TRANSMISSION CORPORATION LIMITED (OPTCL)**

Technical Specification

TB-4-420-316-xxx Rev 00

Section-3: Project Details and General Specification

## **SECTION- 3**

### **PROJECT DETAILS AND GENERAL SPECIFICATIONS**

#### **3.0 GENERAL**

This section stipulates the General Technical Requirements under the Contract and will form an integral part of the Technical Specification.

The provisions under this section are intended to supplement general requirements for the materials, equipment and services covered under other sections of tender documents and are not exclusive. However, in case of conflict between the requirements specified in this section and requirements specified under other sections, the requirements specified under respective sections shall prevail.

#### **3.1 PROJECT DETAILS**

	<b>Particular</b>	<b>Details</b>
a)	Customer	ODISHA POWER TRANSMISSION CORPORATION LIMITED (OPTCL)
b)	Engineer/Consultant/ Inspector	-
c)	Project Title	2X500 MVA, 400/220 KV GIS S/S AT ERSAMA & ASSOCIATED 2 NOS 400 KV BAY EXTN AT DUBURI
d)	Project Location	<b><u>400/220kV GIS S/S</u></b> Place: Erasama, Paradeep District: Jagatsingha State: Odisha <b><u>400kV AIS S/S Bay Extn.</u></b> Place: Duburi District: Jajapur State: Odisha
e)	Latitude & Longitude	<b><u>400/220kV GIS S/S</u></b> North: 20°12'32" and East: 86°21'44" <b><u>400kV AIS S/S Bay Extn.</u></b> North: 20°56'14" and East: 86°00'23"
f)	Nearest Railway Station	Erasama – At a distance of about 32 km from Paradeep station Duburi – At a distance of about 14 km from Jajpur Road station
g)	Distance of project location from the Railway station	Erasama – At a distance of about 32 km from Paradeep station Duburi – At a distance of about 14 km from Jajpur Road station
h)	Nearest Major Town	Bhubaneswar
i)	Distance of the town from the project site	86 Km from Erasama & 120 Km from Duburi
j)	Nearest commercial airport	Biju Patnaik International Airport, Bhubaneswar

**PROJECT: 2X500 MVA, 400/220 KV GIS S/S AT ERSAMA & ASSOCIATED 2 NOS 400 KV BAY EXTN AT DUBURI**

**CUSTOMER: ODISHA POWER TRANSMISSION CORPORATION LIMITED (OPTCL)**

Technical Specification

TB-4-420-316-xxx Rev 00

Section-3: Project Details and General Specification

k)	Distance of airport from the project site	86 Km from Erasama & 120 Km from Duburi
<b>SITE CONDITIONS</b> (for design purposes)		
a)	Annual mean if maximum monthly average temperature	50°C
b)	Annual mean if minimum monthly temperature	5°C
c)	Design ambient temperature	50°C
d)	Average Rainfall in mm	1500 mm
e)	Average thunderstorm days per year	77 days
f)	Maximum Relative humidity	100 %
g)	Average Relative humidity	85 %
h)	Height above mean sea level	Less than 1000 meters
i)	Pollution Severity	Heavily polluted
j)	Criteria for Wind Resistant design of structures and equipment	Standard Applicable - IS 875 (Part 3)
k)	Basic Wind speed "Vb" at ten meters above the mean ground level.	55m/ sec for Erasama 50 m/ sec for Duburi
l)	Risk Coefficient "K1"	1
m)	Seismic Co-efficient	0.06g Horizontal 0.01g Vertical

### 3.1.1 SYSTEM PARAMETERS

Sl.No.	Parameters	400 kV	220 kV	33 kV
1	Highest system voltage	420 kV rms	245 kVrms	36
2	System Frequency	50 Hz		
3	Variation in Frequency	+ - 2.5 %		
5	Lightning Impulse voltage	±1425kVp	± 1050kVp	170
6	Switching impulse voltage	±1050kVp	-	
7	Power frequency withstand for 1 min (rms)	630 kV (rms)	460 kV (rms)	70 kV (rms)
8	Max. fault level (3/1 sec.)	63 kA	50kA	31.5kA
9	Minimum creepage distance	13020 mm (Erasama) 10500 mm (Duburi)	7595mm (Erasama) -	1116mm (Erasama) 900mm (Duburi)
10	System Neutral Earthing	Effectively Earthed		
11	Corona Extinction Voltage	320kV	156kV	-
12	Radio Interference Voltage	500µV at 266kV	500µV at 167kV	-

### 3.1.2 AUXILIARY POWER

Nominal Voltage V	Variation	Frequency Hz or DC	Phase	Wires	Neutral Connection
430	+10%	50+5%	3	4	Solidly earthed
240	+10%	50+5%	1	2	Solidly earthed
220	187V - 242V	DC	DC	2	Isolated 2 wires

**PROJECT: 2X500 MVA, 400/220 KV GIS S/S AT ERSAMA & ASSOCIATED 2 NOS 400 KV BAY EXTN AT DUBURI**

**CUSTOMER: ODISHA POWER TRANSMISSION CORPORATION LIMITED (OPTCL)**

**Technical Specification**

**TB-4-420-316-xxx Rev 00**

**Section-3: Project Details and General Specification**

50	45V - 55V	DC	DC	2	+ve earthed
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**3.1.3** The minimum electrical clearances for 400/220/33kV switchyard shall be as given below:

	<b>400kV</b>	<b>220kV</b>	<b>33kV</b>
Phase to earth clearance	3400 mm	2160mm	320mm
Phase to phase clearance	3900 mm	2160mm	320mm
Section clearance	6500 mm	5000mm	3000mm
Ground Clearance	8000 mm	5500mm	4000mm

### **3.2 INSTRUCTION TO BIDDERS:**

The bidders shall furnish technical data sheets, catalogues, engineering data, technical information, design documents, drawings etc. fully in conformity with the technical specification.

The supplier should be approved by Employer (OPTCL). If not, it is the responsibility of the vendor to be assessed and approved by Employer, before placement of order by BHEL. Any cost involved in vendor assessment/approval must be borne by the vendor himself.

The Bidder's proposal shall be based upon the use of equipment and material complying fully with the requirements specified herein. It is recognized that the Bidder may have standardized on the use of certain components, materials, processes or procedures different than those specified herein. Alternate proposals offering similar equipment based on the manufacturer's standard practice will also be considered, provided the base offer is in line with technical specifications and such proposals meet the specified design standards and performance requirement and are acceptable to the Purchaser. Sufficient amount of information for justifying such proposals shall be furnished to Purchaser along with the bid to enable the Purchaser to determine the acceptability of these proposals.

Wherever a material or article is specified or defined by the name of a particular brand, Manufacturer or Vendor, the specific name mentioned shall be understood to be indicative of the function and quality desired and not restrictive. Other manufacturer's products may be considered provided sufficient information is furnished to enable the Employer to determine that the products proposed are equivalent to those named.

Equipment furnished shall be complete in every respect with all mountings, fittings, fixtures and standard accessories normally provided with such equipment and/ or needed for erection, completion and safe operation of the equipment as required by applicable codes, though they may not have been specifically detailed in the Technical Specifications unless included in the list of exclusions. Materials and components not specifically stated in the specification but which are necessary for commissioning and satisfactory operation of the switchyard unless specifically excluded shall be deemed to be included in the scope of the specification and shall be supplied without any extra cost. All similar standard components/parts of similar standard equipment under supply shall be inter-changeable with one another.

The bidder shall supply type tested (including special tests as per tech. specification) equipment and materials. The test reports shall be furnished by the bidder along with equipment/ material drawings. In the event of any discrepancy in the test reports, (i.e., if any test report is not acceptable due to any design/ manufacturing changes or due to non-compliance with the Technical Specification and/ or applicable standard), the tests shall be carried out without any additional cost implication to the BHEL. BHEL reserves the right to get any or all type/tests conducted/repeated.

### **3.3 CODES AND STANDARDS**

In addition to the codes and standards specifically mentioned in the relevant technical specifications for the equipment / plant / system, all equipment parts, systems and works covered under this specification shall comply with all currently applicable statutory regulations and safety codes of the Republic of India as well as of the locality where they will be installed.

Except where otherwise specified or implied, the bidder shall comply with the latest edition of the relevant Indian Standards, International Electrotechnical Commission (IEC) standards and any other standards mentioned in this Specification. The Bidder may submit for approval, equipment or materials conforming to technically equivalent National Standards. In such cases copies of the relevant Standards or part thereof, in the English language shall be submitted with the Tender.

In case of conflict the order of precedence shall be (1) IEC, (2) IS and (3) other alternative standard.

Reference to a particular standard or recommendation in this Specification does not relieve the Bidder of the necessity of providing the Contract Works complying with other relevant standards or recommendations.

The list of standards provided in the schedules of this Specification is not to be considered exhaustive and the Bidder shall ensure that equipment supplied under this contract meets the requirements of the relevant standard whether or not it is mentioned therein.

Other International/ National standards such as DIN, VDI, BS, GOST etc. shall also be accepted for only material codes and manufacturing standards, subject to the Employer's approval, for which the Bidder shall furnish, adequate information to justify that these standards are equivalent or superior to the standards mentioned above. In all such cases the Bidder shall furnish specifically the variations and deviations from the standards mentioned elsewhere in the specification together with the complete word to word translation of the standard that is normally not published in English.

### **3.4 LANGUAGE AND SYSTEM OF UNITS**

The English language shall be used in all written communications between the Employer, the BHEL/OPTCL and the Bidder with respect to the services to be rendered and with respect to all documents and drawings procured or prepared by the Bidder pertaining to the work, unless otherwise agreed by the Employer.

It is required that danger plates, equipment designation labels or plates, instruction notices on plant and general substation notices be written in English, Hindi and Oriya. Control switch and lamp labels, indicator lamp and annunciator inscriptions shall be in English only.

The Bidder must furnish a schedule giving the English, Hindi and Oriya version of all labels, notices, etc., for approval.

The design features of all equipment shall be based on the SI system of units.

### **3.5 SERVICES TO BE PERFORMED BY THE EQUIPMENT BEING FURNISHED**

The 400 kV system is being designed to limit the power frequency over voltage of 1.5 p.u. and the switching surge over voltage to 2.5 p.u. In 400 kV system the initial value of temporary over voltage could be 2.0 p.u. for 1-2 cycles. All the equipment/materials covered in this specification shall perform all its function

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satisfactorily without undue strain, restriking etc. under such over voltage conditions.

All equipment shall also perform satisfactorily under various other electrical, electromechanical and meteorological conditions of the site of installation. All equipment shall be able to withstand all external and internal mechanical, thermal and electromechanical forces due to various factors like wind load, temperature variation, ice & snow (not applicable for this project), short circuit etc for the equipment.

### **3.6 CORRESPONDENCE, DRAWINGS, APPROVAL PROCEDURE AND SAMPLES**

#### **3.6.1 Drawings & Document Submission**

All drawings submitted by the supplier including those submitted at the time of bid shall be in sufficient detail to indicate the type, size, arrangement, material description, Bill of Materials, weight of each component, break-up for packing and shipment, the external connections, fixing arrangement required. The dimensions required for installation and interconnections with other equipment and materials, clearances and spaces required for installation and interconnections between various portions of equipment and any other information specifically requested in the specifications.

Each drawing submitted by the bidder (including those of sub-vendors) shall bear project specific title block at the right hand bottom corner with clear mention of the name of the Employer, the system designation, the specifications title, the specification number, the name of the Project, drawing number and revisions. If standard catalogue pages are submitted, the applicable items shall be indicated therein. All titles, notations, markings and writings on the drawing shall be in English. All the dimensions should be in metric units.

All dimensions marked on drawings shall be considered correct although measurement by scale may differ from general arrangement drawings. Detailed drawings shall be worked to where they differ from general arrangement drawings.

All drawings for approval shall have the OPTCL-LOGO and the name of the Employer.

For presentation of design drawings and circuit documents IEC Publication 617 or equivalent standards for graphical symbols are to be followed.

The review of these document/data/drawings by the purchaser will cover only general conformance of the document/data/drawings to the specification and contract, interfaces with the equipment provided under specification, external connections and of the dimensions which might affect plan layout. This review by the purchaser may not indicate a thorough review of the dimensions, quantities and details of the equipment, material, any devices or items indicated or the accuracy of the information submitted. The review and/or approval by the purchaser shall not be considered by the bidder, as limiting any of his responsibilities and liabilities for mistakes and deviations from the requirements, specified under these specifications and documents.

All manufacturing, fabrication and execution of work in connection with the equipment/system prior to the approval of the drawings shall be at the bidder's risk. The bidder is expected not to make any changes in the design of the equipment /system, once they are approved by the Purchaser. However, if some changes are necessitated in the design of the equipment/system at a later date, the bidder may do so, but such changes shall promptly be brought to the notice of the Purchaser indicating the reasons for the change and get the revised drawing approved again in strict conformance to the provisions of the Technical Specification. Approval of bidder's drawing or work by the Purchaser shall not relieve the bidder of any of his responsibilities and liabilities under the Contract.

### 3.6.2 Bidder's Drawing Submission and Approval Procedure

The following procedure for submission and review/approval of the drawings, data reports, information, etc. shall be followed by the bidder:

- a. All data/information furnished by Vendor in the form of drawings, documents, Catalogues or in any other form for Employer's information/interface and/or review and approval are referred by the general term "drawings".
- b. The 'Master drawings list' indicating titles, Drawing Number, Date of submission and approval etc. shall be furnished by the bidder. This list shall be updated if required at suitable interval during detailed engineering.
- c. All drawings (including those of sub-vendor) shall bear at the right hand bottom corner the 'title plate' with all relevant information duly filled in. The bidder shall furnish this format to his sub-vendor along with his purchase order for sub-vendor's compliance.
- d. Three copies of all drawings shall be submitted for approval and three copies for any subsequent revision. Employer shall forward their comments within four (4) weeks of receipt of drawings.
- e. The OPTCL/BHEL reserves the right to request any additional information that may be considered necessary in order to fully review the drawings. Drawings for approval shall be submitted as paper prints and shall bear the approved contract references.
- f. Upon review of each drawings, depending on the correctness and completeness of the drawings, the same will be categorised and approval accorded in one of the following categories:

CATEGORY I	Approved
CATEGORY II	Approved, subject to incorporation of comments/modification as noted. Resubmit revised drawing incorporating the comments
CATEGORY III	Not approved. Resubmit revised drawings for Approval after incorporating comments/modifications as noted
CATEGORY IV	For information and records

- g. Bidder shall resubmit the drawings approved under Category II, III within one (1) week of receipt of comments on the drawings, incorporating all comments. Every revision of the drawing shall bear a revision index wherein such revisions shall be highlighted in the form of description or marked up in the drawing identifying the same with relevant revision number enclosed in a triangle (e.g 1.2.3. etc.).
- h. In case Bidder does not agree with any specific comment, he shall furnish the explanation for the same to Employer for consideration. In all such cases Bidder shall necessarily enclose explanations along with the revised drawing (taking care of balance comments) to avoid any delay and/or duplication in review work.
- i. It is the responsibility of the Bidder to get all the drawings approved in the Category I or IV (as the case may be) and complete engineering activities within the agreed schedule. Any delay arising out of submission and modification of drawings shall not alter the contract completion schedule.
- j. Bidder shall not make any changes in the portions of the drawing other than those commented. If changes are required to be made in the portions already approved, the Bidder shall resubmit the drawings identifying the changes (along with reasons for changes) for Employer's review and approval.

**Drawings resubmitted shall show clearly the portions where the same are revised marking the relevant revision numbers and Employer shall review only such revised portion of documents.**

### **3.6.3 As Built Drawings**

After completion of work on site all drawings shall be revised where necessary to show the equipment as installed and three copies submitted duly signed by site-in-charge. Following approval, two reproducible transparencies and twenty prints shall then be provided as required by the OPTCL/BHEL and shall be of sufficient detail to enable all parts to be identified. The bidder shall also submit, where possible, digitally stored copies of all as-built drawings on disc or CD-ROM in a format compatible with the Employer's drawing system.

Approval of drawings will not in any way relieve the Bidder of his obligations of furnishing the equipment in accordance with the specification and shall not prevent subsequent rejection if such equipment is later found to be defective.

### **3.6.4 Operation and Maintenance Manual**

- a. The Bidder shall submit to the Employer preliminary instruction manuals for all the equipment for review. The final instructions manuals incorporating Employer's comments and complete in all respect shall be submitted at least sixty (60) days before the first shipment of the equipment. The instruction manuals shall contain full details and drawings of all the equipment, the transportation, storage, installation, testing, commissioning, operation and maintenance procedures, etc. separately for each component/equipment along with log record format. After approval by the Engg. In charge the Bidder shall deliver ten (10) copies of the complete manual.
- b. If after commissioning and initial operation of the plant, the instruction manuals require any modifications/additions/changes, the same shall be incorporated and the updated final instruction manuals shall be submitted.
- c. The operating and maintenance instructions together with drawings (other than shop drawings) of the equipment, as completed, shall have sufficient details to enable the Employer to maintain, dismantle, reassemble and adjust all parts of the equipment. They shall give a step by step procedure for all operations likely to be carried out during the life of the plant/equipment, including erection, testing, commissioning, operation, maintenance dismantling and repair. Each manual shall also include a complete set of approved drawings together with performance/rating curves of the equipment and test certificates, wherever applicable. The contract shall not be considered completed for purpose of taking over until such instructions and drawings have been supplied to the Employer.
- d. A separate section of the manual shall be for each size/type of equipment and shall contain a detailed description of construction and operation, together will all relevant pamphlets.
- e. The manuals shall include the following
  - a) List of spare parts along with their drawing and catalogues and procedure for ordering spares.
  - b) Lubrication Schedule including charts showing lubrication checking, testing and replacement procedure to be carried daily, weekly, monthly & at longer intervals to ensure trouble free operation.

The Contract shall not be considered to be completed for purposes of taking over until the final Instructions manuals (both erection and O & M manuals) have been supplied to the Employer.

### **3.6.5 Final Submission of drawings and documents**

The Bidder shall furnish the following after approval of all drawings /documents and test reports:

- a. List of drawings bearing the Employer's and Bidder's drawing number.
- b. Six (6) bound sets along-with two (2) sets of CD-ROMs/ DVD/Portable hard disk of all final drawings/documents.
- c. Bidder shall also furnish six (6) bound sets of all as-built drawings including the list of all as-built drawings bearing drawing numbers. The Bidder shall also furnish two (2) sets of CD-ROMs/ DVD/Portable hard disk of all as-built drawings as decided by the Employer.
- d. The Bidder shall also furnish four (4) copies and two (2) sets of CD-ROMs/ DVD/Portable hard disk of instruction/ operations & maintenance manuals (after approval) for all the equipment.

### **3.6.6 Test Reports**

Two (2) copies of all test reports shall be supplied for approval before shipment of Equipment. The report shall indicate clearly the standard value specified for each test to facilitate checking of the reports. After final approval six (6) bound copies and two (2) sets of CD-ROMs/ DVD/Portable hard disk of all type and routine test reports shall be submitted to Employer.

### **3.7 MATERIAL /WORKMANSHIP**

Where the specification does not contain references to workmanship, equipment, materials and components of the covered equipment, it is essential that the same must be new, of highest grade of the best quality of their kind, conforming to best engineering practice and suitable for the purpose for which they are intended and shall ensure satisfactory performance throughout the service life.

In case where the equipment, materials or components are indicated in the specification as "similar" to any special standard the purchaser shall decide upon the question of similarity. When required by the specification or when required by the purchaser the bidder shall submit, for approval, all the information concerning the materials or components to be used in manufacture. Machinery, equipment, materials and components supplied, installed or used without such approval shall run the risk of subsequent rejection, it being understood that the cost as well as the time delay associated with the rejection shall be borne by the Bidder.

The design of the Works shall be such that installation, future expansions, replacements and general maintenance may be undertaken with a minimum of time and expenses. Each component shall be designed to be consistent with its duty and suitable factors of safety subject to mutual agreements. All joints and fastenings shall be devised, constructed and documented so that the component parts shall be accurately positioned and restrained to fulfill their required function. In general, screw threads shall be standard metric threads. The use of other thread forms will only be permitted when prior approval has been obtained from the Purchaser.

Whenever possible, all similar part of the works shall be made to gauge and shall also be made interchangeable with similar parts. All spare parts shall also be interchangeable and shall be made of the same materials and workmanship as the corresponding parts of the equipment supplied under the specification. Where feasible, common component units shall be employed in different pieces of equipment in order to minimize spare parts stocking requirements. All equipment of the same type and rating shall be physically and electrically interchangeable.

The equipment offered in the bid only shall be accepted for supply, with the minimum modifications as agreed/accepted.

### **3.8 PROVISIONS FOR EXPOSURE TO HOT AND HUMID CLIMATE**

Outdoor equipment supplied under the specification shall be suitable for service and storage under tropical conditions of high temperature, high humidity' heavy rainfall and environment favorable to the growth of fungi and mildew. The indoor equipment located in non-air-conditioned areas shall also be of same type.

### **3.8.1 Space Heaters**

Space heaters where provided shall be suitable for continuous operation at 240V supply voltage. On-off switch and fuse shall be provided.

One or more adequately rated permanently or thermostatically connected heaters shall be supplied to prevent condensation in any compartment. The heaters shall be installed in the lower portion of the compartment and electrical connections shall be made from below the heaters to minimise deterioration of supply wire insulation. The heaters shall be suitable to maintain the compartment temperature at approximately 10C, above the outside air temperature to prevent condensation. This shall be demonstrated by tests.

### **3.8.2 Fungi Static Varnish**

Besides the space heaters, special moisture and fungus resistance varnish shall be applied on parts which may be subjected or predisposed to the formation of fungi due to the presence or deposit of nutrient substances. The varnish shall not be applied to any surface of part where the treatment will interfere with the operation or performance of the equipment. Such surfaces or parts shall be protected against the application of the varnish.

### **3.8.3 Ventilation Openings**

In order to ensure adequate ventilation, compartments shall have ventilation openings provided with fine wire mesh of brass to prevent the entry of insects and to reduce to a minimum the entry of dirt and dust. Outdoor compartment openings shall be provided with shutter type blinds.

## **3.9 CLEANING, PAINTING AND TROPICALASATION**

### **3.9.2 General**

All paints shall be applied in strict accordance with the paint manufacturer's instructions.

All painting shall be carried out on dry and clean surfaces and under suitable atmospheric and other conditions in accordance with the paint manufacturer's recommendations.

An alternative method of coating equipment such as with epoxy resin-based coating powders will be permitted, subject to the approval of the Engg. In charge (Divisional Engr.), and such powders shall comply with the requirements of IEC 455. The Bidder shall provide full details of the coating process to the Engg. In charge (Divisional Engr.) for approval.

It is the responsibility of the Bidder to ensure that the quality of paints used shall withstand the tropical heat and extremes of weather conditions specified in the schedules. The paint shall not peel off, wrinkle, be removed by wind, storm and handling on site and the surface finish shall neither rust nor fade during the service life of the equipment.

The colors of paints for external and internal surfaces shall be in accordance with the approved color schemes.

### **3.9.3 Works Painting Process**

All steelworks, plant supporting steelworks and metalwork, except galvanised surfaces or where otherwise specified, shall be shot blasted to BS 7079 or the equivalent ISO standard. All sheet steel work shall be degreased, pickled, phosphated in accordance with the IS 6005 "Code of Practice for phosphating iron and sheet steel". All surfaces shall then be painted with one coat of epoxy zinc rich primer, two pack type, to a film thickness of 50 microns. This primer shall be applied preferably by airless spray and within twenty minutes but not exceeding one hour of shot blasting.

All rough surfaces of coatings shall be filled with an approved two pack filler and rubbed down to a smooth surface.

The interior surfaces of all steel tanks and oil filled chambers shall be shot blasted in accordance with BS 7079 or the equivalent ISO, and painted within a period of preferably twenty minutes, but not exceeding one hour with an oil resisting coating of a type and make to the approval of the BHEL/OPTCL.

The interior surfaces of mechanism chambers, boxes and kiosks, after preparation, cleaning and priming as required above, shall be painted with one coat zinc chromate primer, one coat phenolic based undercoating, followed by one coat phenolic based finishing paint to a light or white colour. For equipment for outdoor use this shall be followed by a final coat of anti-condensation paint of a type and make to the approval of the BHEL/OPTCL, to a light or white colour. A minimum overall paint film thickness of 150 microns shall be maintained throughout.

All steelworks and metalwork, except where otherwise specified, after preparation and priming as required above shall be painted with one coat metallic zinc primer and two coats of micaceous iron oxide paint followed by two coats of either phenolic based or enamel hard gloss finished coloured paint to the approval to an overall minimum paint film thickness of 150 microns.

Galvanised surfaces shall not be painted in the works.

All nuts, bolts, washers etc., which may be fitted after fabrication of the plant shall be painted as described above after fabrication.

The painted metal works shall be subjected to paint qualification test as per draft ANSI/IEEE-Std 37.21 - 1985 clause 5.2.5.

### **3.9.4 Colour Schemes**

The Bidder shall propose a colour scheme for the sub-station for the approval of BHEL/OPTCL. The decision of BHEL/OPTCL shall be final. The scheme shall include:

- Finishing colour of indoor equipment
- Finishing colour of outdoor equipment
- Finish colour of all cubicles
- Finishing colour of various auxiliary system equipment including piping.
- Finishing colour of various building items.

All steel structures, plates etc. shall be painted with non-corrosive paint on a suitable primer. It may be noted that normally all Employer's electrical equipment in Employer's switchyard are painted with shade 631 of IS: 5 and Employer will prefer to follow the same for this project also. All indoor cubicles shall be of same colour scheme and for other miscellaneous items colour scheme will be subject to the approval of the BHEL/OPTCL.

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Sl. No.	Equipment	Application Environment			
		Indoor		Outdoor	
		Colour	Code IS:5	Colour	Code IS:5
<b>400kV/220kV/132kV Class Equipment</b>					
1	Transformers	—	—	Light grey	631
2	Marshalling boxes, CTs, PT's, CVT's, surge counter casings, junction boxes etc.	Light Admiralty grey.	697	Light Admiralty grey.	697
3	Control and relay panels, PLCC cabinets etc.	Smoke grey	692	—	—
4	Porcelain parts i.e. insulators	Dark brown	412	Dark brown	412
5	All structures/ metallic parts exposed to atmosphere	Hot dip galvanised			
<b>33kV Class equipment</b>					
6	Switchgear cubicles	Smoke grey	692	Light grey	631
7	Control and relay panels LT switchgear	Smoke grey	692	—	—
8	LT switchgear exterior	Smoke grey	692	Light grey	631
9	ACDB/ MCC	Smoke grey	692	Light grey	631
10	DCDB	Smoke grey	692	—	—
11	LT bus duct in side enclosure	Matt Paint		—	—
12	LT bus duct outside enclosure	Smoke grey	692	—	—
13	Motors	Smoke grey	692	Light grey	631
14	Diesel generator engine	Smoke grey	692	—	—
15	Diesel generator	Smoke grey	692	—	—
16	LT transformers	Smoke grey	692	Light grey	631
17	Battery charger	Smoke grey	692	—	—
18	Mimic diagram 400kV 220kV 132kV 33kV 11kV 415V	Dark violet Golden yellow Sky blue Signal red Canary yellow Middle brown	796 356 101 537 309 411	— — — — — —	— — — — — —
	Miscellaneous				
19	Control modules and console inserts	Smoke grey	692	Light grey	631
20	Lighting package equipment outside	Light grey	631	Light grey	631
21	Lighting package equipment inside	Glossy white		Glossy white	
22	Water pipes	sea green	217	sea green	217
23	Air pipes	Sky blue	101	Sky blue	101
24	Transformer oil pipes	Light brown	410	Light brown	410
25	Fire Installations	Fire red	536	Fire red	536
26	Insulating oil/ gas treatment plant	Gulf red	473	Gulf red	473

**Table 10.3.4. Recommended color schemes**

### 3.10 DEGREES OF PROTECTION

Degrees of protection shall be provided in accordance with IEC 144 and IEC 529 and be as follows:

- For outdoor applications, IP 55.
- For indoor applications where purpose built accommodation is provided, e.g. switch and control and relay rooms in auxiliary plant buildings, IP 41.
- Where dust can adversely affect equipment within the enclosure, this equipment should be separately housed with a degree of protection of IP 51.

- For indoor applications where the equipment is housed in the same building as that enclosing water and steam operated equipment, the degrees of protection stated in the previous paragraph shall be up-rated to IP 44 and IP 54 respectively.

Where more severe environments exist, e.g. steam and oil vapour or other deleterious chemical environments, special measures will be necessary and the degree of protection required will be specified separately.

The Bidder shall submit a schedule for providing the degree protection to various control boxes, junction boxes etc. for the BHEL/OPTCL's approval.

### **3.11 RATING PLATES, NAME PLATES AND LABELS**

- a) All apparatus shall be clearly labelled indicating, where necessary, its purpose and service positions. Each phase of alternating current and each pole of direct current equipment and connections shall be coloured in an approved manner to distinguish phase or polarity.
- b) The material of all labels and the dimensions, legend, and method of printing shall be to approval. The surface of indoor labels shall have a matt or satin finish to avoid dazzle from reflected light.
- c) Colours shall be permanent and free from fading. Labels mounted on black surfaces shall have white lettering. „Danger“ plates shall have red lettering on a white background.
- d) All labels and plates for outdoor use shall be of non-corroding material. Where the use of enamelled iron plates is approved, the whole surface including the back and edges, shall be properly covered and resistant to corrosion. Protective washers of suitable material shall be provided front and back on the securing screws.
- e) Labels shall be engraved in Hindi, English and Oriya. Name plates shall be white with black engraved lettering and shall carry all the applicable information specified in the applicable items of the Standards.
- f) Any other relevant information which may be required for groups of smaller items for which this is not possible e.g. switch bays etc. a common name plate in Oriya with the title and special instructions on it shall be provided.
- g) No scratching, corrections or changes will be allowed on name plates.
- h) All equipment mounted on front and rear sides as well as equipment mounted inside the panels shall be provided with individual name plates with equipment designation engraved.
- i) On the top of each panel on front as well as rear sides large name plates with bold size lettering shall be provided for circuit/ feeder/ cubicle box designation.
- j) All front mounted equipment shall be also provided, at the rear, with individual name plates engraved with tag numbers corresponding to the one shown in the panel internal wiring to facilitate tracing of the wiring. The name plates shall be mounted directly by the side of the respective equipment wiring.
- k) Name plates of cubicles and panels may be made of non rusting metal or 3 ply lamicaid. These name plates may be black with white engraved lettering.

- l) The name plate inscription and size of name plates and letters shall be submitted to the BHEL/OPTCL/ Engineer for approval.
- m) The nameplates of the apparatus shall include, at least, the information listed below, together with any other relevant information specified in the applicable standards:
- Concise descriptive title of the equipment
  - Rating and circuit diagrams
  - Manufacturer's name, trade-mark, model type, serial number
  - Instruction book number
  - Year of manufacture
  - Total weight (for capacitor racks indicate weight, for capacitors indicate quantity of liquid)
  - Special instructions, if any, about storage, transportation, handling etc.
- n) Each measuring instrument and meter shall be prominently marked with the quantity measured e.g. kV, A, MW etc. All relays and other devices shall be clearly marked with manufacturers name, manufacturer's type, serial number and electrical rating data.
- o) Danger plates and plates for phase colours shall be provided as per requirement. The Bidder shall devise a system to designate equipment and sub-systems. The nameplates/labels displaying these designations shall be installed at appropriate locations. Whenever motion or flow of fluids is involved, plates showing direction of motion or flow shall also be provided.

### **3.12 BOLTS AND NUTS**

All bolts, studs, screw threads, pipe threads, bolt heads and nuts shall comply with the appropriate national standards for metric threads, or the technical equivalent.

Except for small wiring, current carrying terminal bolts or studs, for mechanical reasons, shall not be less than 6 mm in diameter.

All nuts and pins shall be adequately locked. Wherever possible bolts shall be fitted in such a manner that in the event of failure of locking resulting in the nuts working loose and falling off, the bolt will remain in position.

All bolts, nuts and washers placed in outdoor positions shall be treated to prevent corrosion, by hot dip galvanising or electro galvanising to service condition 4. Appropriate precautions shall be taken to prevent electrolytic action between dissimilar metals.

Where bolts are used on external horizontal surfaces where water can collect, methods of preventing the ingress of moisture to the threads shall be provided.

Each bolt or stud shall project at least one thread but not more than three threads through its nut, except when otherwise approved for terminal board studs or relay stems. If bolts and nuts are placed so that they are inaccessible by means of ordinary spanners, special spanners shall be provided.

The length of the screwed portion of the bolts shall be such that no screw thread may form part of a shear plane between members. Taper washers shall be provided where necessary.

Protective washers of suitable material shall be provided front and back on the securing screws.

### **3.13 GALVANISING:**

#### **3.13.1 General**

All machining, drilling, welding, engraving, scribing or other manufacturing activities which would damage the final surface treatment shall be completed before the specified surface treatment is carried out.

#### **3.13.2 Galvanising**

All metal surfaces shall be subjected to treatment for anti-corrosion protection. All ferrous surfaces for external use shall be hot dip galvanised. High tensile steel nuts, bolts and spring washers shall be electro galvanised to service condition 4. All steel conductors including those used for earthing and grounding (above ground level) shall also be galvanised according to IS 2629.

All galvanising shall be applied by the hot dip process and shall comply with IS 2629, IS 2633, IS 4759, IS 1367 or IS 6745.

All welds shall be de-scaled, all machining carried out and all parts shall be adequately cleaned prior to galvanising. The preparation for galvanising and the galvanising itself shall not adversely affect the mechanical properties of the coated material.

The threads of all galvanised bolts and screwed rods shall be cleared of spelter by spinning or brushing. A die shall not be used for cleaning the threads unless specially approved by the BHEL/OPTCL. All nuts shall be galvanised with the exception of the threads which shall be oiled. Surfaces which are in contact with oil shall not be galvanised or cadmium plated.

Partial immersion of the work will not be permitted and the galvanising tank must therefore be sufficiently large to permit galvanising to be carried out by one immersion.

Galvanising of wires shall be applied by the hot dip process and shall meet the requirements of IS 2141.

The minimum weight of the zinc coating and minimum thickness of coating for outdoor equipment shall be as follows:

a) For sections & plates above 5mm of thickness	910 gm/sq.m	127 microns
b) For sections & plates below 5mm of thickness	610 gm/sq.m	87 microns
c) For surfaces embedded in concrete	800 gm/sq.m.	

The galvanised surfaces shall consist of a continuous and uniform thick coating of zinc, firmly adhering to the surface of steel. The finished surface shall be clean and smooth and shall be free from defects such as discoloured patches, bare spots, unevenness of coating, spelter which is loosely attached to the steel globules, spiky deposits, blistered surface, flaking or peeling off, etc. The presence of any of these defects noticed on visual or microscopic inspection shall render the material liable to rejection.

After galvanising no drilling or welding shall be performed on the galvanised parts of the equipment excepting that nuts may be threaded after galvanising. Sodium dichromate treatment shall be provided to avoid formation of white rust after hot dip galvanisation.

The galvanised steel shall be subjected to six one minute dips in copper sulphate solution as per IS 2633.

Sharp edges with radii less than 2.5 mm shall be able to withstand four immersions of the Standard Preece test. All other coatings shall withstand six immersions. The following galvanising tests should essentially be performed as per relevant Indian Standards.

- Coating thickness
- Uniformity of zinc
- Adhesion test
- Mass of zinc coating

Galvanised material must be transported properly to ensure that galvanised surfaces are not damaged during transit. Application of zinc rich paint at site shall not be allowed.

### **3.14 CLAMPS AND CONNECTORS INCLUDING TERMINAL CONNECTORS**

The terminal connectors shall conform strictly to the requirements if the latest versions of following standards as amended up-to-date, except otherwise,

- i) IS: 5561 Power Connectors
- ii) IS: 617 Aluminium & Aluminium Alloy
- iii) IS: 2629 Recommended Practice for HDG of iron & steel
- iv) IS: 2633 Method of testing uniformity of coating of zinc coated articles

The material of clamps and connectors shall be Aluminium alloy casting conforming to designation A6 of IS: 617 for connecting to equipment terminals and conductors of aluminium. In case the terminals are of copper, the same clamps/connectors shall be used with 4mm thick bimetallic liner.

The material of clamps and connectors shall be Galvanised mild steel for connecting to shield wire.

Bolts, nuts and plain washers shall be hot dip galvanised mild steel for sizes M12 and above. For sizes below M12, they shall be electro-galvanised mild steel. The spring washers shall be electro-galvanised mild steel.

All castings shall be free from blow holes, surface blisters, cracks and cavities. All sharp edges and corners shall be rounded off to meet specified corona and radio interference requirements.

They shall have same current rating as that of the connected equipment. All current carrying parts shall be at least 10 mm thick. The connectors shall be manufactured to have minimum contact resistance.

Flexible connectors, braids or laminated strips shall be made up of copper/aluminium.

Current rating and size of terminal/conductor for which connector is suitable shall be put on a suitable sticker on each component which should last at least till erection time.

### **3.15 CABLE GLANDS AND LUGS/FERRULES**

Cable shall be terminated using double compression type cable glands. Testing requirements of Cable glands shall conform to BS:6121 and gland shall be of robust construction capable of clamping cable and cable armour (for armoured cables) firmly without injury to insulation. Cable glands shall be made of heavy duty brass machine finished and nickel chrome plated. Thickness of plating shall not be less than 10 micron. All washers and hardware shall also be made of brass with nickel chrome plating Rubber components shall be of neoprene or better synthetic material and of tested quality. Cable glands shall be suitable for the sizes of cable supplied/erected.

Cable lugs/ferrules for power cables shall be tinned copper solderless crimping type suitable for aluminium compacted conductor cables. Cable lugs and ferrules for control cables shall be tinned copper type. The cable lugs for control cables shall be provided with insulating sleeve and shall suit the type of terminals provided on the equipment. Cable lugs and ferrule shall conform to DIN standards.

### **3.16 WIRING, CABLING AND CABLE INSTALLATION**

#### **3.16.1 Cubicle wiring**

Panels shall be complete with interconnecting wiring between all electrical devices in the panels. External connections shall be achieved through terminal blocks. Where panels are required to be located adjacent to each other all inter panel wiring and connections between the panels shall be carried out internally. The Bidder shall furnish a detailed drawing of such inter panel wiring. The Bidder shall ensure the completeness and correctness of the internal wiring and the proper functioning of the connected equipment.

All wiring shall be carried out with 1.1 kV grade, PVC insulated, single core, stranded copper wires. The PVC shall have oxygen index not less than '29' and Temperature index not less than 250C. The wires shall have annealed copper conductors of adequate size comprise not less than three strands

The minimum cross sectional area of the stranded copper conductor used for internal wiring shall be as follows:

- All circuits excepting CT circuits and energy metering circuit of VT 2.5 sq.mm
- All CT circuits and metering circuit of VT 2.5 sq. mm

All internal wiring shall be supported, neatly arranged, readily accessible and connected to equipment terminals and terminal blocks. Wiring gutters and troughs shall be used for this purpose.

Cubicle connections shall be insulated with PVC to IEC 227. Wires shall not be jointed or teed between terminal points.

Bus wires shall be fully insulated and run separately from one another. Auxiliary bus wiring for AC and DC supplies, voltage transformer circuits, annunciation circuits and other common services shall be provided near the top of the panels running throughout the entire length of the panel suite. Longitudinal troughs extending throughout the full length of panel shall be preferred for inter panel wiring.

All inter connecting wires between adjacent panels shall be brought to a separate set of terminal blocks located near the slots of holes meant for the passage of the interconnecting wires. Interconnection of adjacent panels on site shall be straightforward and simple. The bus wires for this purposes shall be bunched properly inside each panel.

Wire termination shall be made with solderless crimping type and tinned copper lugs which firmly grip the conductor. Insulated sleeves shall be provided at all the wire terminations. Engraved core identification plastic ferrules marked to correspond with panel wiring diagram shall be fitted at both ends of each wire. Ferrules shall fit tightly on the wire and shall not fall off when the wire is disconnected from terminal blocks. Numbers 6 and 9 shall not be included for ferrules purposes unless the ferrules have numbers underscored to enable differentiation. (i.e. 6 and 9).

Fuses and links shall be provided to enable all circuits in a cubicle, except a lighting circuit, to be isolated from the bus wires.

The DC trip and AC voltage supplies and wiring to main protective gear shall be segregated from those for back-up protection and also from protective apparatus for special purposes. Each such group shall be fed through separate fuses from the bus wires. There shall not be more than one set of supplies to the apparatus comprising each group. All wires associated with the tripping circuits shall be provided with red ferrules marked "Trip".

It shall be possible to work on small wiring for maintenance or test purposes without making a switchboard dead.

The insulation material shall be suitably coloured in order to distinguish between the relevant phases of the circuit.

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When connections rated at 380 volt and above are taken through junction boxes they shall be adequately screened and “**DANGER**” notices shall be affixed to the outsides of junction boxes or marshalling kiosk. Where connections to other equipment and supervisory equipment are required the connections shall be grouped together.

### **3.16.2 LV power cabling**

**LVAC** cable terminals shall be provided with adequately sized, hot pressed, cast or crimp type lugs. Where sweating sockets are provided they shall be without additional clamping or pinch bolts. Where crimp type lugs are provided they shall be applied with the correct tool and the crimping tool shall be checked regularly for correct calibration. Bi-metallic joints between the terminals and lugs shall be provided where necessary.

Terminals shall be marked with the phase colour in a clear and permanent manner.

A removable gland plate shall be provided by the Bidder. The Bidder shall be responsible for drilling the cable gland plate. ere

Armoured cables shall be provided with suitable glands for terminating the cable armour and shall be provided with an earthing ring and lug to facilitate connection of the gland to the earth bar.

## **3.17 PRODUCTION PROCESS REQUIREMENTS**

### **3.17.1 CASTINGS**

#### **GENERAL**

All castings shall be true to pattern, free from defects and of uniform quality and condition. The surfaces of castings which do not undergo machining, shall be free from foundry irregularities. The castings shall be subject to NDT, chemical, mechanical and metallographic tests. Details of the same shall be furnished to BHEL/OPTCL for review/approval. Magnetic particle inspection (MPI) test, wherever applicable, shall be carried out in longitudinal and transverse direction to detect radial and axial cracks.

#### **IRON CASTINGS**

Iron casting material shall be in accordance with ASTM A 126 Class B. A copy of the ladle analysis shall be sent to the BHEL/OPTCL. Each casting shall have a test bar from which tension test specimens may be taken. Test specimen shall be in accordance with ASTM A 370 and tested in accordance with ASTM E8. The Bidder shall submit his procedures for testing and acceptance for iron castings for approval by the BHEL/OPTCL.

#### **STEEL CASTINGS**

Steel castings shall be manufactured in accordance with ASTM A 27 and shall be subjected to appropriate tests and inspection as detailed herein.

Copies of mandatory documentation, such as ladle analyses and mechanical test results, shall be sent to the BHEL/OPTCL. (Non-ferrous casting material and castings shall be manufactured in accordance with the appropriate ASTM standards for the material concerned).

### **3.17.2 FORGINGS**

When requested by the BHEL/OPTCL, forgings will be subjected to inspection in the regions of fillets and changes of section by suitable method. Magnetic particle, dye-penetration, radiographic or ultrasonic, or any combination of these methods may be used to suit material type and forging design.

The testing is to be carried out after the rough machining operation and is to be conducted according to the appropriate ASTM standards.

MPI test on forging shall be carried out to detect both radial and axial cracks. Ferrous forgings shall be demagnetised after such tests.

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Any indentations which prove to penetrate deeper than 2.5% of the finished thickness of the forging shall be reported to the BHEL/OPTCL giving location, length, width and depth. Any indentations which will not machine out during final machining shall be gouged out and repaired using an approved repair procedure. Repair of rotating elements by welding will only be accepted subject to detailed examination of the proposal by the BHEL/OPTCL prior to the repair being carried out.

The forging shall be tested for mechanical and metallographic tests as per ASTM. The details shall be mutually discussed/agreed upon.

### **3.17.3 FABRICATED COMPONENTS**

All components machined or fabricated from plate, sheet or bar stock shall meet the material requirements of ASTM or material specification approved by the BHEL/OPTCL.

Structural steel, rolled shapes, bars, etc. shall comply with the latest ASTM for A36.

Plate steel shall be of a designation and quality suitable for the function it is intended to perform. Insofar as it is compatible with its function, it shall comply with ASTM A283 structural quality.

All, or a representative number of such components, shall be subjected to one or more of the following tests: visual, dye penetration, magnetic particle (transverse and longitudinal), ultrasonic or radiographic. These tests shall be in accordance with the recommended practices of the ASTM. The terms of reference for acceptance shall be the applicable ASTM Specifications.

### **3.17.4 WELDING AND WELDERS QUALIFICATIONS**

#### **General**

All welding shall be carried out by qualified welders only.

All welding shall be in accordance with the corresponding standards of the American Welding Society or the American Society of Mechanical Engineers.

Other standards to determine the quality of welding process and qualifications of welders may be considered, provided that sufficient information is first submitted for the approval of the BHEL/OPTCL.

Prior to the start of fabrication, the Bidder shall submit to the BHEL/OPTCL for approval, a description of each of the welding procedures which he proposes to adopt, together with certified copies of reports of the results from tests made in accordance with these procedures.

The Bidder shall be responsible for the quality of the work performed by his welding organisation. All welding operators, to be assigned work, including repair of casting, shall pass the required tests for qualification of welding procedures and operators. The BHEL/OPTCL reserves the right to witness the qualification tests for welding procedures and operators and the mechanical tests at the samples.

The Bidder shall bear all his own expenses in connection with the qualification tests. If the work of any operator at any time appears questionable, such operator will be required to pass appropriate prequalification tests as specified by the Inspector and at the expense of the Bidder.

#### **Welding**

All welding shall be performed in accordance with the appropriate standards. The design and construction of welded joints subject to hydraulic pressure shall conform to the applicable requirement of ASME "Boiler and Pressure Vessel Code" shall be qualified in accordance with Section IX of this Code. The design and construction of welded joints not subjected to hydraulic pressure shall, as a minimum, conform to the requirements of AWS "Specification for Welded Highway and Railway Bridge" D2.0. Except for minor parts and items specifically exempted from stress relieving, all shop welded joints shall be stress relieved in accordance with the requirements of the ASME "Boiler and Pressure Vessel Code" Section VIII. In addition to satisfying the procedural and quality requirements set forth in the applicable code and/or these Specifications, all welding shall meet the following requirements for workmanship and visual quality:

- Butt welds shall be slightly convex, of uniform height and shall have full penetration.
- Fillet welds shall be of the specified size, with full throat and legs of equal length.

- Repairing, chipping and grinding of welds shall be done in a manner which will not gouge, groove or reduce the thickness of the base metal.
- The edges of the member to be joined shall expose sound metal, free from laminations, surface defects caused by shearing or flame-cutting operations or other injurious defects.

Welded joints subject to critical working stress shall be tested by approved methods of non-destructive testing, such as radiographic and ultrasonic examination, magnetic particle and liquid penetration inspection. All expenses in connection with these tests shall be borne by the Bidder. The extent of testing shall be as stipulated by the ASME „Boiler and Pressure Vessel Code”, Section VIII, but without prejudice to the rights of the Inspector or the BHEL/OPTCL to ask for additional tests,

The arc-welding process to be used and the welding qualifications of the welders employed on the work shall be used in accordance with AWS requirements and Section VIII and IX of the ASME (American Society of Mechanical Engineers) Code, latest edition, as they may apply. All welding rods shall conform to the requirements of the latest issue of Section It, part C of the ASME Code.

Gas shielded welding (TIG or MIG) used as appropriate for aluminium, stainless steel or other material shall be carried out in accordance with the best commercial practice and the following standard specifications:

- Specifications for copper and copper-alloy welding rods (AWS A5.7, ASTM B259)
- Specification for corrosion-resisting chromium and chromium-nickel steel welding rods and bare electrodes (AWS A5.9, ASTM A371)
- Specifications for aluminium and aluminium alloy rods and bare electrodes (AWS A5.10, ASTM B285).
- Specifications for nickel and nickel-base alloy bare welding filler metal (AWS A5.14, ASTM B304).

Gas welding will not normally be used in the equipment. When a particular equipment manufacture requires the use of gas welding, the proposed process and the welder’s qualification shall be in accordance with AWS B3.0.

Welding of galvanised components will not be allowed in the equipment.

Strict measures of quality control shall be exercised throughout the Equipment/ Works. The BHEL/OPTCL may call for an adequate NDT test of the work of any operator, who in his opinion is not maintaining the standard of workmanship. Should this NDT test prove defective, all work done by that operator, since his last test shall be tested at the Bidder’s expense. If three or more of these tests prove defective, the operator shall be removed from the project.

A procedure for the repair of defects shall be submitted to the BHEL/OPTCL for his approval prior to any repairs being made.

### **Welding of pipes**

Before welding, the ends shall be cleaned by wire brushing, filing or machine grinding. Each weld-run shall be cleaned of slag before the next run is deposited.

Welding at any joint shall be completed uninterrupted. If this cannot be followed for some reason, the weld shall be insulated for slow and uniform cooling.

Welding shall be done by manual oxy-acetylene or manual shielded metal arc process. Automatic or semi-automatic welding processes may be done only with the specific approval of BHEL/OPTCL.

As far as possible welding shall be carried out in flat position. If not possible, welding shall be done in a position as close to flat position as possible.

Downward technique is not allowed while welding pipes in horizontal position, unless permitted by the BHEL/OPTCL.

Combination of welding processes or usage of electrodes of different classes or makes in a particular joint shall be allowed only after the welding procedure has been duly qualified and approved by the BHEL/OPTCL.

No backing ring shall be used for circumferential butt welds.

Welding carried out in ambient temperature of 5C or below shall be heat treated.

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A spacer wire of proper diameter may be used for weld root opening but must be removed after tack welding and before applying root run.

Tack welding for the alignment of pipe joints shall be done only by qualified welders. Since tack welds form part of final welding, they shall be executed carefully and shall be free from defects. Defective welds shall be removed prior to the welding of joints.

Electrodes size for tack welding shall be selected depending upon the root opening.

Tack welds should be equally spaced.

Root run shall be made with respective electrodes/filler wires. The size of the electrodes shall not be greater than 3.25 mm (10 SWG) and should preferably be 2.3 mm (12 SWG). Welding shall be done with direct current values recommended by the electrode manufacturers.

Upward technique shall be adopted for welding pipes in horizontally fixed position. For pipes with wall thickness less than 3 mm, oxyacetylene welding is recommended.

The root run of butt joints shall be such as to achieve full penetration with the complete fusion of root edges. The weld projection shall not exceed 3 mm inside the pipe.

On completion of each run craters, weld irregularities, slag etc. shall be removed by grinding or chipping.

During the process of welding, all movements, shocks, vibration or stresses shall be carefully avoided in order to prevent weld cracks.

Fillet welds shall be made by shielded metal arc process regardless of thickness and class of piping. Electrode size shall not exceed 10 SWG. (3.25 mm). At least two runs shall be made on socket weld joints.

### **3.18 QUALITY ASSURANCE**

#### **3.18.1 GENERAL**

To ensure that the supply and services under the scope of this Contract, whether manufactured or performed within the Bidder's works or at his Sub-Bidder's premises or at Site or at any other place of work are in accordance with the Specification, with the Regulations and with relevant Indian or otherwise Authorized Standards the Bidder shall adopt suitable Quality Assurance Programs and Procedures to ensure that all activities are being controlled as necessary.

The quality assurance arrangements shall conform to the relevant requirements of ISO 9001 or ISO 9002 as appropriate.

Manufacturing Quality Plan will detail out for all the components and equipment, various tests/inspection, to be carried out as per the requirements of this specification and standards mentioned therein and quality practices and procedures followed by Bidder's/ Sub-bidder's/ sub-supplier's Quality Control Organisation, the relevant reference documents and standards, acceptance norms, inspection documents raised etc., during all stages of materials procurement, manufacture, assembly and final testing/performance testing. The Quality Plan shall be submitted on electronic media e.g. E-mail in addition to hard copy, for review. Once the same is finalised, hard copies shall be submitted for approval. After approval the same shall be submitted in compiled form on CD ROM.

The Bidder shall also furnish copies of the reference documents/plant standards/acceptance norms/tests and inspection procedure etc., as referred in Quality Plans along with Quality Plans. These Quality Plans and reference documents/standards etc. will be subject to Employer's approval without which manufacturer shall not proceed.

These approved documents shall form a part of the contract. In these approved Quality Plans, Employer shall identify customer hold points (CHP), i.e. test/checks which shall be carried out in presence of the Employer's Project Manager or his authorised representative and beyond which the work will not proceed without consent of Employer/Authorised representative in writing. All deviations to this specification,

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approved quality plans and applicable standards must be documented and referred to Employer along with technical justification for approval and dispositioning.

No material shall be despatched from the manufacturer's works before the same is accepted subsequent to pre-despatch final inspection including verification of records of all previous tests/inspections by Employer's Project Manager/Authorised representative and duly authorised for despatch by issuance of Material Dispatch Clearance Certificate (MDCC).

All material used for equipment manufacture including casting and forging etc. shall be of tested quality as per relevant codes/standards. Details of results of the tests conducted to determine the mechanical properties, chemical analysis and details of heat treatment procedure recommended and actually followed shall be recorded on certificates and time temperature chart. Tests shall be carried out as per applicable material standards and/or agreed details.

For all spares and replacement items, the quality requirements as agreed for the main equipment supply shall be applicable.

Repair/rectification procedures to be adopted to make the job acceptable shall be subject to the approval of the Employer/ authorised representative.

### **3.18.2 SUB-VENDOR**

The Bidder shall ensure that the Quality Assurance requirements of this Specification are followed by any sub-vendor appointed by him under the Contract.

The Bidder shall assess the sub-vendor's Quality Assurance arrangements prior to his appointment to ensure its compliance with the appropriate ISO 9000 standard and the Specification.

Auditing of the sub-vendor's Quality Assurance arrangements shall be carried out by the Bidder and recorded in such a manner that demonstrates to the OPTCL/BHEL the extent of the audits and their effectiveness.

### **3.18.3 QUALITY ASSURANCE DOCUMENTS**

The Bidder shall be required to submit two hard copies and two sets on CDROM of the following Quality Assurance Documents as identified in respective quality plan with tick (✓) mark.

Each QA Documentation shall have a project specific Cover Sheet bearing name & identification number of equipment and including an index of its contents with page control on each document.

The QA Documentation file shall be progressively completed by the Supplier's sub-supplier to allow regular reviews by all parties during the manufacturing.

The final quality document will be compiled and issued at the final assembly place of equipment before dispatch. However CD-Rom may be issued not later than three weeks.

Typical contents of Quality Assurance Document are as below:-

- i) Quality Plan,
- ii) Material mill test reports on components as specified by the specification and approved Quality Plans.
- iii) Manufacturer / works test reports/results for testing required as per applicable codes and standard referred in the specification and approved Quality Plans.

- iv) Non-destructive examination results /reports including radiography interpretation reports. Sketches/drawings used for indicating the method of traceability of the radiographs to the location on the equipment.
- v) Heat Treatment Certificate/Record (Time- temperature Chart)
- vi) All the accepted Non-conformance Reports (Major/Minor) / deviation, including complete technical details / repair procedure).
- vii) CHP / Inspection reports duly signed by the Inspector of the Employer and Bidder for the agreed Customer Hold Points.
- viii) Certificate of Conformance (COC) whoever applicable.
- ix) MDCC

Before dispatch/ commissioning of any equipment, the Supplier shall make sure that the corresponding quality document or in the case of protracted phased deliveries, the applicable section of the quality document file is completed. The supplier will then notify the Inspector regarding the readiness of the quality document (or applicable section) for review.

- i) If the result of the review carried out by the Inspector of the Quality document (or applicable section) is satisfactory, the Inspector shall stamp the quality document (or applicable section) for release.
- ii) If the quality document is unsatisfactory, the Supplier shall endeavour to correct the incompleteness, thus allowing to finalize the quality document (or applicable section) by time compatible with the requirements as per contract documents. When it is done, the quality document (or applicable section) is stamped by the Inspector.
- iii) If a decision is made for dispatch, whereas all outstanding actions cannot be readily cleared for the release of the quality document by that time, the supplier shall immediately, upon shipment of the equipment, send a copy of the quality document Review Status signed by the Supplier Representative to the Inspector and notify of the committed date for the completion of all outstanding actions & submission. The Inspector shall stamp the quality document for applicable section when it is effectively completed. The submission of QA documentation package shall not be later than 3 weeks after the dispatch of equipment.

#### **3.18.4 TRANSMISSION OF QUALITY DOCUMENTS**

As a general rule, two hard copies of the quality document and Two CD ROMs shall be issued to the Employer on release of QA Documentation by Inspector. One set of quality document shall be forwarded to Corporate Quality Assurance Department and other set to respective Site.

For the particular case of phased deliveries, the complete quality document to the Employer shall be issued not later than 3 weeks after the date of the last delivery similarly as stated above.

#### **3.18.5 INSPECTION, TESTING & INSPECTION CERTIFICATE**

- i. The word 'Inspector' shall mean the Project Manager and/or his authorised representative and/or an outside inspection agency acting on behalf of the Employer to inspect and examine the materials and workmanship of the works during its manufacture or erection.
- ii. The Project Manager or his duly authorised representative and/or an outside inspection agency acting on behalf of the Employer shall have access at all reasonable times to inspect and examine the materials and workmanship of the works during its manufacture or erection and if part of the works is being manufactured or assembled on other premises or works, the Bidder shall obtain for the Project Manager and for his duly authorised representative permission to inspect as if the works were manufactured or assembled on the Bidder's own premises or works.

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- iii. The Bidder shall give the Project Manager/Inspector fifteen (15) days written notice of any material being ready for testing. Such tests shall be to the Bidder's account except for the expenses of the Inspector's. The Project Manager/Inspector, unless the witnessing of the tests is virtually waived and confirmed in writing, will attend such tests within fifteen (15) days of the date on which the equipment is noticed as being ready for test/inspection failing which the Bidder may proceed with test which shall be deemed to have been made in the inspector's presence and he shall forthwith forward to the inspector duly certified copies of test reports in two (2) copies.
- iv. The Project Manager or Inspector shall within fifteen (15) days from the date of inspection as defined herein give notice in writing to the Bidder, or any objection to any drawings and all or any equipment and workmanship which is in his opinion not in accordance with the contract. The Bidder shall give due consideration to such objections and shall either make modifications that may be necessary to meet the said objections or shall inform in writing to the Project Manager/Inspector giving reasons therein, that no modifications are necessary to comply with the contract.
- v. When the factory tests have been completed at the Bidder's or sub-bidder's works, the Project Manager /Inspector shall issue a certificate to this effect fifteen (15) days after completion of tests but if the tests are not witnessed by the Project Manager /Inspectors, the certificate shall be issued within fifteen (15) days of the receipt of the Bidder's test certificate by the Project Manager /Inspector. Project Manager /Inspector to issue such a certificate shall not prevent the Bidder from proceeding with the works. The completion of these tests or the issue of the certificates shall not bind the Employer to accept the equipment should it, on further tests after erection be found not to comply with the contract.
- vi. In all cases where the contract provides for tests whether at the premises or works of the Bidder or any sub-bidder, the Bidder, except where otherwise specified shall provide free of charge such items as labour, material, electricity, fuel, water, stores, apparatus and instruments as may be reasonably demanded by the Project Manager /Inspector or his authorised representatives to carry out effectively such tests on the equipment in accordance with the Bidder and shall give facilities to the Project Manager/Inspector or to his authorised representative to accomplish testing.
- vii. The inspection by Project Manager / Inspector and issue of Inspection Certificate thereon shall in no way limit the liabilities and responsibilities of the Bidder in respect of the agreed Quality Assurance Programme forming a part of the contract.
- viii. To facilitate advance planning of inspection in addition to giving inspection notice, the Bidder shall furnish quarterly inspection programme indicating schedule dates of inspection at Customer Hold Point and final inspection stages. Updated quarterly inspection plans will be made for each three consecutive months and shall be furnished before beginning of each calendar month.
- ix. All inspection, measuring and test equipment used by bidder shall be calibrated periodically depending on its use and criticality of the test/measurement to be done. The Bidder shall maintain all the relevant records of periodic calibration and instrument identification, and shall produce the same for inspection by NTPC. Wherever asked specifically, the bidder shall re-calibrate the measuring/test equipment in the presence of Project Manager / Inspector.

### **3.19 TYPE, ROUTINE & ACCEPTANCE TESTS:**

The Bidder shall carry out the tests stated in accordance with the conditions of this Specification, without extra charge for such additional tests as in the opinion of the BHEL/OPTCL are necessary to determine that the Contract Works comply with this Specification. The tests shall be carried out generally in accordance

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with the relevant IEC's or IS or equivalent standards. The specific details of testing and inspection are given in the appropriate section of this Specification.

The Bidder shall submit Type Test Reports for all equipment being supplied by him for the BHEL/OPTCL's approval. The BHEL/OPTCL may also give instruction to carry out Type Tests, routine tests or acceptance tests. Type Test Charges shall be paid as per the rates indicated in the Price Schedules.

All materials used shall be subjected to such routine tests as are customary in the manufacture of the types of plant included in the Contract Works. These materials shall withstand satisfactorily all such tests.

All tests shall be carried out to the satisfaction of the BHEL/OPTCL, in his presence, at such reasonable times as he may require, unless agreed otherwise. Not less than three weeks' notice of all tests shall be given to the BHEL/OPTCL in order that he may be represented if he so desires. As many tests as possible shall be arranged together. Six copies of the Bidder's test reports and test sheets shall be supplied to the BHEL/OPTCL for approval.

Measuring apparatus shall be approved by the OPTCL/BHEL (Divisional Engr) and if required shall be calibrated at the expense of the Bidder at an approved laboratory.

The Bidder shall be responsible for the proper testing of the work completed or plant or materials supplied by a sub-bidder to the same extent as if the work, plant or materials were completed or supplied by the Bidder himself.

All apparatus, instruments and connections required for the above tests shall be provided by the Bidder, but the BHEL/OPTCL may permit the use for the tests on site, any instruments and apparatus which may be provided permanently on site as part of the contract works conditional upon the Bidder accepting liability for any damage which may be sustained by such equipment during the test.

The bidder shall supply suitable test pieces of all materials as required by the BHEL/OPTCL. If required by the BHEL/OPTCL, test specimens shall be prepared for check testing and forwarded at the expense of the Bidder to an independent testing authority selected by the BHEL/OPTCL.

Any costs incurred by the Employer in connection with inspection and re-testing as a result of a failure of the subject under test, or damage during transport, or erection on site before take-over by the Employer, shall be to the account of the Bidder.

No inspection or lack of inspection or passing by the BHEL/OPTCL of work, plant or materials, whether carried out or supplied by the Bidder or sub-bidder, shall relieve the Bidder from his liability to complete the Contract Works in accordance with the Contract or exonerate him from any of his guarantees.

### **3.20.1 TYPE TEST REQUIREMENTS FOR EQUIPMENTS OTHER THAN GIS**

- a) All equipment to be supplied shall be of type tested design. During detail engineering, the bidder shall submit for Owner's approval the reports of all the type tests as listed in this specification and carried out not earlier than ten years prior to the date of techno-commercial bid opening (03-March-2017). These reports should be for the test conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a Client.
- b) However if bidder is not able to submit report of the type test(s) conducted not earlier than ten years prior to the date of techno-commercial bid opening (**11-February-2022**), or in the case of type test report(s) are not found to be meeting the specification requirements, the bidder shall conduct all such

**PROJECT: 2X500 MVA, 400/220 KV GIS S/S AT ERSAMA & ASSOCIATED 2 NOS 400 KV BAY EXTN AT DUBURI**

**CUSTOMER: ODISHA POWER TRANSMISSION CORPORATION LIMITED (OPTCL)**

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**Section-3: Project Details and General Specification**

tests under this contract at no additional cost to the owner either at third party lab or in presence of client/ owners representative and submit the reports for approval.

- c) All acceptance and routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price.

### **3.20 PACKAGING & TRANSPORTATION**

The Bidder shall be responsible for the packing, loading and transport of the plant and equipment from the place of manufacture, whether this is at his own works or those of any Bidder, to Site, and for off-loading at site.

All apparatus and equipment shall be carefully packed for transport by air, sea, rail and road as necessary and in such a manner that it is protected against tropical climate conditions and transport in rough terrain and cross country road conditions. The method of packing shall provide complete protection to all apparatus and equipment during transport and storage at site in heavy rain. The method of packing shall provide adequate protection to main items of plant and those parts contained within and attached without, for transportation.

Precautions shall be taken to protect parts containing electrical insulation against the ingress of moisture. All bright parts liable to rust shall receive a coat of anti-rusting composition and shall be suitably protected. The machined face of all flanges shall be protected by means of a blank disc bolted to each face.

Where appropriate all parts shall be boxed in substantial crates or containers to facilitate handling in a safe and secure manner. Each crate or container shall be marked clearly on the outside of the case to show "TOP" and "BOTTOM" positions with appropriate signs, and where the mass is bearing and the correct position for slings. Each crate or container shall also be marked with the notation of the part or parts contained therein, contract number and port of destination. It shall be the Bidder's responsibility to dispose of all such packing.

Any damage due to defective or insufficient packing shall be made good by the Bidder at his own expense and within reasonable time when called upon by the BHEL/OPTCL to do so. Four (4) copies of complete packing lists showing the number, size, marks, mass and contents of each package shall be delivered to the BHEL/OPTCL immediately the material is despatched.

The Bidder shall inform himself fully as to all relevant transport facilities and requirements and loading gauges and ensure that the equipment as packed for transport shall conform to these limitations. The Bidder shall also be responsible for verifying the access facilities specified.

The Bidder shall be responsible for all costs of repair or replacement of the equipment, including those incurred by the Employer, arising from damage during transport, off-loading or erection on site, until take-over by the Employer.

The Bidder shall be responsible for the transportation of all loads associated with the contract works and shall take all reasonable steps to prevent any highways or bridges from being damaged by his traffic and shall select routes, choose and use vehicles and restrict and distribute loads so that the risk of damage shall be avoided. The Bidder shall immediately report to the BHEL/OPTCL any claims made against the Bidder arising out of alleged damage to a highway or bridge.

### **3.21 ENCLOSURES:**

1. ANNEXURE – A: SPECIFICATION FOR ELECTRICAL COMPONENTS



**TECHNICAL SPECIFICATION FOR 250KVA DIESEL GENERATOR SET**  
**PROJECT: 400/ 220 KV GIS SUBSTATION AT ERSAMA, PARADEEP**  
**CUSTOMER: ODISHA POWER TRANSMISSION CORPORATION LTD. (OPTCL)**  
**PURCHASER: BHARAT HEAVY ELECTRICALS LIMITED (TBG, NOIDA)**

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## **SECTION 4**

### **GUARANTEED TECHNICAL PARTICULARS**

Bidder has to ensure all the major parameters given in the Annexure-DG (Total Pages-2)

## 250kVA DIESEL GENERATOR SET (MAJOR TECHNICAL PARAMETERS)

S.No.	PARTICULARS			
A	<b>ALTERNATOR</b>			
1	Net Rated Output at 50°C temperature & 1000m of altitude after reducing DG Set auxiliaries loads		<b>250kVA</b>	Please furnish deration calculation as per annexure in section-5
2	Rated Terminal Voltage		415V AC	
3	No. of Phases		3	
4	Rated Power Factor		0.8 lag	
5	Rated Speed		1500 RPM	
6	Rated Frequency		50 Hz	
7	Standard	BS 2613/IS 4722/IEC 60034; latest edition		
8	Type of Exciter Used	Brushless, Self-Excited		
9	Class of Winding Insulation		Class H	
10	Permissible Temperature Rise		Class F	
11	Degree of Protection		IP-23	
12	Overload Capacity	10% Overload for 1 hour in every 12 hours of continuous running		
13	Terminal Box	Seven (7) output terminals (R, Y, B, R', Y', B' & N)		
14	Each output terminal suitable for cable size of		2Runs of 300 sq.mm XLPE cable	
	Neutral Formation		Inside AMF Panel	
B	<b>ENGINE</b>			
1	Standard	IS 10002/BS 5514/ISO 3046/ IS 13018; latest edition		
2	Rating at 50°C ambient and altitude upto 1000 meter	As per Manufacturer Datasheet		
3	Rated Speed		1500 RPM	
4	No. of Strokes		4	
5	Cylinder Design		Multi-Cylinder	
6	Type of Cylinder Arrangement	V-Type or Inline Type		
7	Method of Aspiration	Turbo-Charged		
8	Method of Engine Cooling	Water-Cooled (Through Radiator)		
9	Method of Starting	Battery Operated Auto Start		
10	Ignition Voltage		24V DC	
11	Type of Governor	Electronic as per ISO 8528 or latest IS/BS standards		
12	Balancing	Dynamically balanced flywheel		
13	Air-Suction & Exhaust	Suction of air shall be from indoor for ventilation and exhaust flue gasses will be let out to outside atmosphere. & Condensate traps shall be provided on the exhaust pipe.		
14	Air Filter	Dry Type (Replaceable)		
15	Lubricating System	Forced (Closed Loop)		
16	Fuel Type	High Speed Diesel oil (HSD) as per IS:1460		
17	Fuel Injection	Mechanical/Electronic		
18	Emission Levels	In accordance with latest Notifications of MOEF/CPCB (certificate to be furnished)		

<b>C</b>	<b>ENGINE-ALTERNATOR SET</b>			
1	Maximum Starting Time		30 sec	
2	Interval Between Starting Impulse		10 sec	
3	Maximum no. of starting Impulse		3	
4	Maximum Voltage Variation		± 1 %	
5	Maximum Frequency Variation		± 2 %	
6	Voltage Adjustment Range	90% to 110% of Nominal Voltage		
7	Balancing	Dynamic Balanced Rotor to minimize vibration		
8	Maximum Vibration Level		250 microns	
9	Coupling of Engine & Alternator	Directly coupled by means of self-aligning flexible flange coupling & with a protecting guard to avoid accidental contact		
10	Mounting Arrangement	DG set enclosed in the acoustic enclosure shall be installed on Concrete Pedestal. Adequate number of anti-vibration mounting pads shall be fixed on the common base frame on which the engine and the alternator shall be mounted to isolate the vibration from passing on to the common base frame or the foundation of the D.G. Set.		
<b>E</b>	<b>BATTERY</b>			
1	Type		Lead-Acid	Battery should be accommodated in a separate tray inside the enclosure
2	Capacity in AH		180 AH	
3	Voltage of each Battery Set		24V DC	
4	No. of Battery Set		2 Nos. (i.e. Main + Standby)	
<b>F</b>	<b>BATTERY CHARGER</b>			
1	Type of Charger		SMPS based	
2	Input	230V AC, 50 HZ, Single Phase		
3	Output Current		12 Amps	
4	Output Voltage		As per 24V battery system	
5	Qty. of Battery Charger		2 sets	
6	Automatic Float/Boost Charge Provision		Yes	
7	Ripple	Not more than 1% (RMS)		
<b>G</b>	<b>FUEL TANK &amp; FUEL PUMP</b>			
1	Capacity		minimum 350 ltrs or as per manufacturer's recommendation (1 No.)	
2	Material of Construction		MS Sheet	
3	Sheet Thickness (Minimum)		2 mm/ 14 SWG	
4	Accessories	Level Indicator, Filling Inlet with removable screen, outlet, drain plug, an air vent, air-breather and necessary piping		
5	Painting	Oil Resistant Paint		
6	Erection	In accordance with Indian Explosive Act of 1932		
7	Location	Outside Acoustic Enclosure		
8	Fuel Pump Type	Electrically Driven		
9	Fuel Pump Rating	Adequate to fill the fuel tank in 30 minutes		
<b>H</b>	<b>ACOUSTIC ENCLOSURE</b>			
1	Minimum Sheet Thickness		2 mm/ 14 SWG	The enclosure should be fabricated out of CRCA sheet. The doors of enclosure should be provided with high quality EPDM Gaskets to avoid leakage of sound.
2	Acoustic Material		<b>Rockwool (Min.thickness 100mm) as per IS:8183 with density of 48-64 kg/m<sup>3</sup></b>	
3	Max. Noise Level	75 dBA at a distance of 1 meter (as per CPCB Norms)		



TECHNICAL SPECIFICATION FOR 250KVA DIESEL GENERATOR SET  
PROJECT: 400/ 220 KV GIS SUBSTATION AT ERSAMA, PARADEEP  
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PURCHASER: BHARAT HEAVY ELECTRICALS LIMITED (TBG, NOIDA)

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## SECTION 5

### SCHEDULES TO BE FILLED BY BIDDER

Following documents shall be submitted during detailed engineering stage:

Drawing Title
GTP/Technical data sheet of DG set
GA drg of DG Set and Day
GA drg and details of 990 litre Day Tank
Detailed foundation drg of DG set and Day tank
Type test report of DG SET (ENGINE AND ALTERNATOR)
GA dr and scheme of AMF Panel
Deration calculation of engine and alternator as per site conditions and parameter defined in the technical specification
GA drg and scheme of Battery charger

### SCHEDULES TO BE FILLED UP BY THE BIDDER

SCHEDULE-1	Make of important components and details
SCHEDULE-2	Technical deviation
SCHEDULE-3	Schedule of unpriced BOQ
SCHEDULE-4	Deration calculation



TECHNICAL SPECIFICATION FOR 250KVA DIESEL GENERATOR SET  
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## SCHEDULE-1

### MAKE OF IMPORTANT COMPONENTS OF EQUIPMENTS AND DETAILS

ITEM NAME	NAME OF MANUFACTURER	PLACE OF MANUFACTURE OF ITEM	PLACE OF TESTING & INSPECTION	COMPLIANCE WITH ISO 9001 (YES/NO)

Place

Date

Signature of the authorized representative of

Bidder 'name -----

Designation-----

Company seal-----



TECHNICAL SPECIFICATION FOR 250KVA DIESEL GENERATOR SET  
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## SCHEDULE-2

### SCHEDULE OF TECHNICAL DEVIATION

The following are the deviations/variations/exceptions from the specification:

Section	Clause No. / Page No.	Statement of deviation / Variations / Exceptions

1. In case, this schedule is not submitted, it will be presumed that the equipment /material to be supplied under this contract is deemed to be in compliance with the specification.
2. If there is NIL deviation, even then the format to be filled as **NIL DEVIATION**
3. Continuation sheets of like size and format may be used as per the Bidder's Requirement and shall be annexed to this schedule.

Place

Signature of the authorized representative of

Bidder 'name -----

Date

Designation-----

Company seal-----



TECHNICAL SPECIFICATION FOR 250KVA DIESEL GENERATOR SET  
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### SCHEDULE-3

Bidders shall attach signed and stamped **unpriced** copy of this BOQ with their technical offer:

Sl. No.	Item Description	Unit	Qty	Whether Unit Rates have been furnished in priced bid?
1.	250 kVA DG Set alongwith all accessories and Standard tools & tackles as per technical specification	Set	1	YES
2.	AMF panel as per technical specification	Set	1	YES
3.	Exhaust pipe beyond Silencer as per technical specification	Meter	15	YES
4.	Structure for exhaust pipe as per technical specification	Kg	50	YES
5.	Erection, Testing & Commissioning of complete 250kVA DG Set and associated equipment as per technical specification	Set	1	YES

Signature of the authorized representative of Bidder

Name : \_\_\_\_\_

Designation : \_\_\_\_\_

Place : \_\_\_\_\_

Date : \_\_\_\_\_



TECHNICAL SPECIFICATION FOR 250KVA DIESEL GENERATOR SET  
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## SCHEDULE-4

### Deration calculation

Project: 400/220kV GIS-OPTCL, ERSAMA, PARADIP New S/S				
250KVA DIESEL GENERATOR SET				
Doc. No. : TB-420-563-101 Rev. 00			Schedule-4 to Section-5	
DERATION CALCULATION TO BE FILLED BY BIDDER			SHEET 1 OF 2	
<b>Alternator Sizing Calculation</b>				
Deration Calculation for minimum net electrical output of 250kVA (after considering deration for engine and alternator separately due to temperature rise inside the enclosure ie. 50° C ambient temperature, limited to class F insulation and on account of power reduction due to auxiliaries) of make.....with Alternator make.....				
SL No.	Parameters	Unit	Values	Remarks
1	kVA Requirement from Alternator(415 V,0.8 pf) with Class H to F @ 50 deg C	kVA	250	As per tender requirement
2	Deration Applicable as per the specification :			
i)	Class H Insulation with Class F temperature rise	-	X	As per Deration chart of alternator maufacturer
ii)	50 deg C Ambient Temperature	-	Y	
	Total Deration	-	(X*Y)	
3	Minimum Rating required for Alternator after deration	kVA	$250/(X*Y)$	Please check whether this rating is standard available rating of offered make alternator otherwise choose next higher size
4	Offered rating of Alternator to meet tender requirement	kVA	Z	Please mention the model no. and make of offered alternator
Hence offered Alternator Model is.....of make.....				

## Engine Sizing Calculation

SHEET 2 OF 2

**For minimum net electrical output (after considering deration for engine and alternator separately due to temperature rise inside the enclosure ie. 50° C ambient temperature, limited to class F insulation and on account of power reduction due to auxiliaries) of 250kVA /200kWe DG Set of make..... with engine make..... as per tender requirement**

SL No.	Parameter	Unit	Value	Remarks
1	Gross Engine Power at 50 deg C Ambient Temperature (as per manufacturer catalogue)	kWb	A	<b>Before Auxiliary loss</b>
2	Radiator fan loss	kWm	B	
3	Restriction loss	kWm	C	
4	Hence net power available in engine shaft after radiator fan loss	kWm	A-(B+C)=D	
5	Efficiency of alternator at full load	%	E	
6	Hence net output at alternator terminal	kWe	D*E	
		kVA	D*E/0.8	<b>pf@0.8</b>
7	As per tender specification rating of DG set	kWe	200.00	
		kVA	<b>250.00</b>	

**Note:- Hence offered engine make.....and model..... is suitable to deliver minimum 250 kVA/200 kWe which is as per tender requirement**

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