

**LT  
SWITCHGEAR**

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**1.0.0 SCOPE**

This specification covers the design, manufacture, installation, testing, commissioning and supply of indoor 415V LT switchgear. For quantity, type of breaker, short time rating and other specific details, please refer to the technical & specific requirement sheets enclosed.

The equipment to be offered under this specification shall be of proven design by way of commercial operation for a minimum period of three years in a Commercial building /industrial plant. Further, the switchgear must have been type tested in the same configuration that has been offered.

**2.0.0 STANDARDS**

In general the equipment shall conform to all relevant IS/IEC standards. In case of any contradiction between the IS/IEC and this specification, the more stringent of the two shall apply.

- |                      |  |
|----------------------|--|
| a) IS 2959           | :AC contactors upto 1000V  |
| b) IS 13947          | :AC Circuit Breakers   |
| c) IS 2705           | :Current Transformers  |
| d) IS 3156 & 4146    | :Potential Transformers  |
| e) IS 4047           | :Air break switches for voltage not exceeding 1000V                                      |
| f) IS 6875           | :Control switches  |
| g) IS 1822           | :Motor duty Switches   |
| h) IS 12021          | :Specification for control transformer   |
| i) IS 8623           | :Factory built assembly of switchgear & control gear                                     |
| j) IS 13947 (Part I) | :Degree of protection for enclosure  |
| k) IS 3842           | :Specification for electrical relays for AC system                                       |
| l) IS 2208 & 9224    | :Specification for HRC fuses   |
| m) IS 5082           | :Wrought Al. and Aluminium alloys, bars, rods, tube and sections for electrical purposes |
| n) IS 4237           | :General requirement for switchgear & control gear for voltage not exceeding 1000V       |
| o) IS 3231           | :Electrical relays for power system protection   |

**3.0.0 DESIGN AND PERFORMANCE REQUIREMENT**

3.1.1 All the 415V AC, devices/equipment like bus support insulators, circuit breakers, VTs, etc., mounted inside the switchgear shall be suitable for continuous operation and satisfactory performance under the following supply conditions:

- a) Variation in supply voltage :  $\pm 10\%$
- b) Variation in supply frequency :  $\pm 5\%$

**3.2.0 CONSTRUCTION**

- 3.2.1 The switchgear panel shall be designed, manufactured and tested in accordance with relevant Indian Standards. The panels shall be indoor, metal enclosed, single/double front, free standing type. All fuse switch, switch fuse and air circuit breaker feeders shall be in fully compartmentalised fixed/draw out design as specified in the specific requirement sheets. The sheet steel (CRCA) used for fabrication shall be of 1.6mm for non-load bearing members and 2.0 for load bearing members. The panels shall be supplied with required base channels. The insulators shall be made of high epoxy resin moulding. The busbars and cable chambers shall be housed in separate chambers.
- 3.2.2 The busbar and cable chambers should be fitted with bolted covers with gaskets and should be shrouded to avoid direct access to live parts immediately after opening respective covers. The busbars and jumper connections shall be insulated to full maximum operating voltage. The cubicle shall be designed for IP4X protection. The vermin proofing shall be such that the vermin cannot enter from one compartment to another/busbar chambers. Neoprene gaskets shall be used for all doors, covers and openings.
- 3.2.3 The busbars and connectors shall be made of high conductivity Copper. The busbars shall be amply sized to carry the rated continuous current under the specified ambient temperature without exceeding the total temperature of 85°C. Unless otherwise stated, the entire busbar shall be rated for the continuous rated current of the incomer. When sectionalised with a bus coupler, both the busbars shall be of the same rating.
- 3.2.4 The entire switchboard along with all components shall be designed for the ambient site condition. The minimum area of cross section of the neutral shall be half that of the phase busbar, unless other wise specified. The busbar shall be interleaved for current carrying capacity greater than 4000A. ✓
- 3.2.5 The busbars and their connections shall be capable of withstanding, without damage, the thermal and mechanical effects of through fault currents equivalent to the short time rating of the switchgear. It shall be possible to extend the switchboard on both sides.

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The busbars shall be sleeved and with respected phase colour. The sleeves shall be rated for an insulation level of 1100V.

- 3.2.6 Each compartment shall have hinged doors with gaskets and shall not form part of withdrawal chassis of breaker chamber. Suitable door interlock with switch / breaker shall be provided with provision for emergency defeat feature.
- 3.2.7 Suitable lifting hooks shall be provided. These hooks when removed shall not leave any opening on the enclosure.
- 3.2.8 Switchgear shall be designed for a bottom cable entry and the busbars preferably shall be located at top, unless otherwise specified.
- 3.2.9 The trolley shall be lockable in fully draw out position. Trolleys / modules of same size shall be completely interchangeable. There shall be positive indication for various position of the trolley.
- 3.2.10 All switchgears compartments shall be totally enclosed with necessary barriers & adjustable horizontal frame with rail arrangement. It shall be possible to change the module size by repositioning compartment supports.
- 3.2.11 All switch drives other than rotary switches shall be lockable in "OFF" position.
- 3.2.12 It is envisaged to use tube suppression system for the switchgear provision to accommodate the tube shall be made.

### 3.3.0 SAFETY SHUTTER DEVICES

- 3.3.1 Shutters shall be provided at busbar chamber cut-out for closing the same when the withdrawal chassis of the modules are drawn out.
- 3.3.2 The busbar shutters shall be automatically operated by the movement of the carriage.

### 3.4.0 INSULATORS

- 3.4.1 Insulators of moulded or resin bonded material shall have a durable, non-hygroscopic surface finish having a high anti-tracking index. Insulators, barriers made out of hylam, synthetic resin bonded paper, and treated wood will not be accepted.
- 3.4.2 Insulators shall be mounted on the switchgear structure such that there is no likelihood of their being mechanically over-stressed, during normal tightening of the mounting and bus bars, connections etc.

### 3.5.0 AIR CIRCUIT BREAKERS

- 3.5.1 The circuit breaker shall be capable of making and breaking the specified fault currents without straining or damaging any part of the switchgear. The breakers shall be air break, motor/manual operated (as specified in specific requirement sheet) and horizontal draw out type.

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- 3.5.2 The circuit breaker shall be stored energy closing type, manual/electrically operated with tripping mechanism. The circuit breaker shall be provided with 4 NO + 4 NC (specifically for purchaser's use) of auxiliary potential free contacts required for indication, control, interlocking and other purposes. All contacts shall be wired to a terminal block.
- 3.5.3 Circuit breakers with stored energy closing mechanism shall be capable of making the rated short-circuit current, when the stored energy is suitably charged by a spring.
- 3.5.4 It shall also be capable of closing on no-load without suffering undue mechanical deterioration. The maximum make-time shall also be not exceeded.
- 3.5.5 The direction of motion of the handle, for manual spring charging shall be marked. A device indicating when the spring is charged fully shall also be provided.
- 3.5.6 Motors and their electrically operated auxiliary equipment for charging a spring shall operate satisfactorily between 85% and 110% of the rated supply voltage.
- 3.5.7 The breaker operating mechanism should store energy for O-C-O operation and shall not, in any case, get stuck in closed position during this cycle. After failure of power supply to the motor, at least one open-close-open operation of the circuit breaker shall be possible.
- 3.5.8 The breaker operating mechanism shall be electrically and mechanically trip-free in all positions. The breaker should also be provided with both mechanical and electrical anti-pumping devices.
- 3.5.9 The Incomers shall be provided with Microprocessor based Numerical Relay with IEC-61850 while ACBs for Outgoing feeders shall be provided with microprocessor based comprehensive releases for protection against overload, short circuit and earth faults. The releases shall be SCADA compatible & talk to other systems on an Open communication protocol. The Communication Port shall be provided in front/back.
- 3.5.10 The circuit breakers shall be suitable for locking in fully isolated condition.
- 3.5.11 Following interlocks and features shall be provided so that
- a) Truck can be moved within panel only when CB is off.
  - b) CB can be closed only when the test (or) service limit switches permit.
  - c) Breaker compartment door cannot be opened when the CB is in Service/test position.
  - d) Breaker cannot be put in to service position with compartment door open.
  - e) Earth slide beyond the test position till trolley is drawn out.
- 3.5.12 Closing and tripping coil shall operate satisfactorily under the following conditions of supply voltage variation:

- a) Closing coils – 85% to 110% of rated voltage.
- b) Trip coils – 70% to 110% of rated voltage.

#### 4.0.0 SWITCHES, FUSE, CONTACTORS

- 4.1.1 The switches shall be with silver plated contacts and capable of breaking safely full load current of associated equipment. Switches shall be quick make and break type and capable of breaking the circuit even if the mechanism spring fails. Barriers shall be provided to prevent inter phase arcing. Switches and contactors for motor feeder shall be adequately rated for motor duty (AC-3). Wherever called for, the same shall be sized for capacitor switching. Fuses shall be HRC line type. Fuses shall be provided with plungers and shall be visible without removal of fuse from service. Fuse pullers shall be provided.

#### 5.0.0 CURRENT TRANSFORMERS

- 5.1.1 The current transformers shall have synthetic cast resin insulation and be of the single phase type, with number of cores as per the specific requirements.
- 5.1.2 The primary & secondary connections shall be clearly labelled.
- 5.1.3 All current transformers shall have insulation level and short time rating as per main switchgear. All current transformers shall be dimensioned to carry continuously a current of 120% of the rated current. The ratios shall be as per the specific requirements.

#### 6.0.0 VOLTAGE/POTENTIAL TRANSFORMER

- 6.1.1 The voltage transformers shall be insulated for full voltage rating.
- 6.1.2 The PT shall have synthetic resin insulation and be of single phase type. Rated secondary voltage shall be  $110\sqrt{3}$  unless otherwise specified.
- 6.1.3 PT shall be capable of withstanding thermal and mechanical stresses resulting from short circuit and momentary current rating of breaker/switches.

#### 7.0.0 METERS, RELAYS AND OTHER ACCESSORIES

- 7.1.1 All relays shall be of switchboard pattern, back connected, drawout type suitable for flush mounting and fitted with dust tight cases and provided with flag indicators and hand reset devices. The relays shall conform to IS. A set of test block and test lead for necessary secondary injection tests shall be included. All relays in drawout cases shall have suitable spring loaded contacts for inserting test block.
- 7.1.2 Relays shall be provided with hand reset type contacts. The flag indication shall be suitable for external hand resetting and mechanically interlocked to prevent falling when relays are subjected to vibration. The rating of the auxiliary contacts shall not be less than 10 A at 240 V AC and 5 A for 110V DC.

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- 7.1.3 Each incomer / feeder shall be equipped with relays as detailed in the specific requirements.
- 7.1.4 All relays shall have the following features
- a) Microprocessor Based.
  - b) Shall be suitable for auxiliary supply, as indicated in the specific requirement.
  - c) Shall be of drawout type suitable for flush mounting.
  - d) All auxiliary relays shall be of semi-flush or surface mounting type.
- 7.1.5 All protective relays shall be provided with adequate number of self reset contacts and hand reset flag indicators.
- 7.1.6 Wherever called for, APFC relays of adequate steps shall be provided in the PCC panels.
- 7.1.7 Required CTs shall be provided in the incomer of the panels for feeding the APFC relay. Suitable timers shall be provided in the manual mode of operation to ensure that a capacitor is not switched ON immediately after switching OFF.
- 7.1.8 Motor duty contactors shall be three pole air break electro-magnetic type suitable for making and breaking locked rotor current of the motor. The connection of the contactor shall be direct-on-line type. Reversible motor contactors shall be mechanically and electrically interlocked with each other. The contact material shall have anti-weld properties. 3 main contacts 2NO and 2NC auxiliary contacts shall be provided as a standard future. The aux. Contact shall be rated for min. 5A at 240V AC and 1.5A at 110V DC. Over-load relays for the contactors shall be three element, compensated time lag, hand reset and bimetallic thermal type with adjustable setting range. The relay shall have at least 1NO + 1NC change over contacts. The thermal overload relay shall have reset facility without opening the door. Required no. of aux. Relays/contactors shall be considered to suit the specific schematic requirement.
- 7.1.9 Indicating instruments shall be flush mounted, back connected, with anti parallax circular scales with black pointer and black markings. Size of the instruments shall be 144 x 144 mm and scale shall be 240° type. All indicating meters shall be of taut band type. The element shall be shock resistant and shielded from magnetic fields. The covers shall be of shadow proof design, utilising all available light. Zero adjustments for pointers shall be accessible from the front of the instrument. All auxiliary equipment such as shunts, transducers etc that are required shall be included in the scope of supply.
- 7.2.0 METERS**
- 7.2.1 All Incomers & all outgoings shall have Multifunction meter.



7.2.2 MFM shall be suitable for measuring unbalanced loads on a 3 - phase, 4 wire systems and shall operate on 415V 3 $\phi$ , 4 wires supply.

7.2.3 The Outgoing feeders shall be provided with Electronic digital Energy meter with pulsed Digital output for remote metering.

### 7.3.0 INDICATING LAMPS / PUSH BUTTONS

7.3.1 These shall be switchboard type, low power consumption, filament type lamps complete with necessary resistors. Lamps shall be provided with screwed translucent covers to diffuse light. The lamp covers shall preferably be unbreakable, moulded, heat resistant material and shall be provided with chromium plated bezels. If desired, the Subcontractor shall quote for cluster LED type Indicating lamps also.

7.3.2 Push Buttons shall be heavy duty, push to actuate type with coloured button and inscription marked with its function. Each push button shall have minimum 2 NO + 2 NC contacts or as required, rated 10 A at operating voltage. Push button shall be shrouded type except for emergency trip button (if provided) which shall be mushroom type for easy identification. Push button colour shall be as follows

- |             |   |        |
|-------------|---|--------|
| a) Stop/off | - | Red    |
| b) Start/ON | - | Green  |
| c) Reset    | - | Yellow |
| d) Test     | - | Black  |

### 8.0.0 CONTROL SWITCHES/SELECTOR SWITCHES

8.1.1 Control and meter selection switches shall have integral name plate and for all other devices, the same shall be located below the respective devices. Instrument and devices mounted on the face of the panels shall also be identified on the rear with the same number.

8.1.2 All control switches shall be rotary, back connected type having cam operation contact mechanism. Phosphor bronze contacts shall be used on switches.

8.1.3 The handle of control switches used for circuit breaker operation shall turn clockwise for closing and anti-clockwise for tripping and shall be spring return to neutral from close/trip with lost motion device.

8.1.4 Control switch for DG and Incomer panels shall have one set of Lost-motion spare contacts.

8.1.5 Ammeter selector switches shall be with off position and with make before break feature and shall have 3 positions to read the three phase currents. Voltmeter selector

switches shall also be of 3 position and off position, suitable to read phase to phase voltages.

- 8.1.6 The control switches, operating handles, meters, relays etc shall be mounted at the front of the switchgear panels. The instruments shall not be mounted less than one metre or more than two metres from the floor level. Ammeters and Voltmeters are to be provided with selector switches. Operating handles shall not be mounted at a height more than 1.75 meters. Breaker Control switches wherever provided shall be so designed that when released by the operator it shall automatically return to a neutral position. They shall be fitted in sequence with lock to avoid inadvertent operation and shall be arranged such that after passing the "closed" position the control switch cannot be moved into the "Closed" position again without passing the "open" position. Each panel shall have indicating lamps for "ON", "OFF", "TRIP" "TRIP CIRCUIT HEALTHY" and "SPRING CHARGED".

#### 9.0.0 AUXILIARY SUPPLY

- a) DC Supply : 110V DC  $\pm$  6% for trip circuit and indication lamps
  - b) AC Supply : 220V, 1 phase, 50 Hz for closing circuit
- 9.1.1 Control supply power at 110VDC shall be supplied at one point. Separate DC Insulated Wire buses shall be provided. DC supply required for protection/ indication/ tripping shall be taken from the above wire busbars through protective fuses.
- 9.1.2 Suitable fuses and links shall be provided for individual circuits for protection and also for isolation from bus wire without disturbing the other circuits. Buswires from panel to panel shall be wired through necessary control terminals.
- 9.1.3 Panel heaters and thermostats shall be provided in all the panels.
- 9.1.4 Control supply 240V AC shall be supplied at one point. A separate bus shall be provided. The AC supply required for closing circuit, for space heater and thermostat.

#### 9.2.0 CONTROL FUSES

- 9.2.1 All control fuses shall be of HRC link type conforming to IS 2208. All fuses and links shall be provided with suitable identification labels.

#### 10.0.0 CONTROL WIRING

- 10.1.1 Stud type terminals with identification ferrules shall be used. Local dependent marking as well as remote end dependent marking may be indicated in the ferruling at terminal blocks. Interlocking type ferrules shall be used. All wires carried within the switchgear enclosure shall be HRPVC insulated and neatly arranged so as to be readily accessible and to be easily replaceable. Wherever necessary the wires should be run in cable

- 10.1.2 troughs and the wiring should be routed so that the same remains away from areas where electrical flame or flash over may occur. No conduit or cables shall be carried through the bus bar chamber.
- 10.1.3 The voltage transformer wiring shall be done by HRPVC insulated, 1100V grade multi stranded flexible copper conductor of size 1.5 Sq.mm and all the current transformer and DC control wiring shall be of the same type of cable as specified above with conductor size of 2.5 Sq.mm. The colour coding shall be as per IS 375.
- 10.1.4 AC and DC wiring are to be distinguishable functionwise; AC and DC terminals are to be separated by shrouded terminal separators.
- 10.1.5 All spare contacts of switches / relays shall be wired upto the terminal blocks.
- 10.1.6 20% extra spare terminals shall be provided. All terminals shall be suitable for terminating 2 wires from bottom and top side of the terminal block. However not more than one wire shall be terminated from either side on any terminal.
- 10.1.7 All CT wiring shall be terminated on shorting and disconnecting type terminals.

#### **11.0.0 NAME PLATE**

Suitable anodised Aluminium name plate of 1.2 mm thick shall be provided on all the switchboards and individual compartments.

#### **12.0.0 EARTHING**

- 12.1.1 An earth bus of requisite section shall be provided. It shall extend throughout and solidly connect all panels in a line with proper terminals, at the end to connect to the station earthing system. The terminal arrangement at the ends shall be suitable for connection to Earth flat and shall be complete with bimetallic washers etc.
- 12.1.2 All doors shall be earthed by a copper cable. Hinges shall not be used as a means earthing.

#### **13.0.0 CABLE CHAMBER**

- 13.1.1 The position of the cable chamber shall be such that the cables can be safely taken and carried through one meter trench at the bottom of the switchgear line up and the jointing carried out in a convenient and satisfactory manner. The cable termination arrangement for multiple cables shall permit connection and disconnection of individual cables without disturbing the other cables. Each panel shall have a separate cable alley. Cable alleys shall consist of cable supporting arrangement so that the load of the cable does not act on the terminals. Special warning labels shall be provided on removable covers (or) doors giving access to cable terminals and busbars.

**14.0.0 PAINTING**

- 14.1.1 All metal surfaces shall be thoroughly cleaned and degreased to remove mill scale, rust, grease and dirt. Fabricated structure shall be pickled and then rinsed to remove any trace of acid. The under surface shall be prepared by applying a coat of phosphate paint and a coat of yellow zinc chromate primer. The under surface shall be made free from all imperfections before undertaking finishing coat.
- 14.1.2 After preparation of the under surface, the switchgear panel shall be spray painted with two coats of final paint. Colour shade of final paint shall be RAL 7032 (epoxy based). The finished panel shall be dried in staving oven in dust free atmosphere. Panel finish shall be free from imperfections like pin holes, orange peels, run off paint etc. The vendor shall furnish painting procedure details along with the drawings submission.
- 14.1.3 All unpainted steel parts shall be cadmium plated or suitably treated to prevent rust corrosion. If these parts are on moving element, then these shall be greased.

**15.0.0 TEST**

- 15.1.1 All routine tests as per standards & type tests / acceptance tests as per Standards. The Subcontractor shall include all prices for conducting tests.
- 15.1.2 The Subcontractor shall furnish the reports of all the type tests carried out in **within five years** of the date of bid opening. Tests shall be as per "SECTION-E0". These reports should be for the tests conducted on identical/similar components/ equipments / systems to those offered / proposed to be supplied under this contract.
- 15.1.3 In case Subcontractor is not able to submit report of type test(s) conducted in last five years. Or in case type test report(s) are not to be meeting the specification / relevant standard requirements, then all such tests shall be conducted under this contact by the Subcontractor free of cost to Contractor, and reports shall be submitted for approval.

**16.0.0 DRAWINGS AND DOCUMENTS**

- 16.1.1 Drawings and Guaranteed Technical Particulars (Tenderer to be furnish)

As soon as possible after the award of the contract the manufacturers shall supply **two** copies of drawings which will describe the equipment in detail for approval, and shall subsequently provide **Seven** completed sets of final drawings, one of which shall be reproducible. All the drawings shall be made in AUTOCAD and the final drawings shall be given to us in electronic form.

- 16.1.2 The following drawings of technical literature for each item are to be supplied as part of this contract.

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- a) Technical Data sheets
- b) Plan, Front, Back and Side views and Transport sections with weight of each panel and Transport sections (Refer clause 31.1.3 also)
- c) Door Equipment Layout
- d) Sectional View of each type of feeder and each chamber
- e) Foundation Layout showing Base frame details, cut-outs for cables
- f) Single Line Diagram
- g) Schematic Diagram
- h) Terminal Diagram
- i) Equipment List
- j) Termination schedules
- k) Inter Panel Wiring Diagram
- l) Heat Load details
- m) Any other drawing required for completeness
- n) Type test reports

16.1.3 Six copies of instruction books/Operation and maintenance manuals and spare parts bulletins per transformer.

### 17.0.0 SPARES

17.1.1 The Subcontractor shall also quote for any other item of spares recommended for five years normal. The purchaser will decide on the actual spares of number of sets thereof to be ordered on the basis of the list and the itemised prices of spares. But for evaluation of the tenders the cost of one set of spares for one set will alone be taken into account.

### 18.0.0 DEVIATION

Deviation taken from specifications (if any) should be listed out separately clause wise and explicitly under the heading "DEVIATIONS". Deviations indicated in the guaranteed technical particulars (or) elsewhere will not be considered and accepted

### 19.0.0 SPECIFIC REQUIREMENT

19.1.1	System voltage	:	415V
19.1.2	No. of phase	:	3 phase, 4 Wire
19.1.3	System frequency	:	50Hz
19.1.4	Voltage variation	:	$\pm 10\%$
19.1.5	Frequency variation	:	$\pm 5\%$

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19.1.6	System Neutral Earthing	:	Effective earthed
19.1.7	Design ambient	:	50°C
19.1.8	Service	:	Indoor
19.1.9	Fault level (Sym.)	:	70kA for 1 sec
19.1.10	Fault level (Dyn.)	:	105kA (Peak)
19.1.11	Switchgear details		
	a) Type	:	Metal enclosed, Compartmentalized
	b) Degree of protection	:	IP4X
	c) Thickness of sheet steel		
	1) Front	:	2.5mm thick CRCA
	2) Sides	:	2mm thick CRCA
	d) Cable Entry	:	Bottom (Top for panels inside passenger Terminal building)
19.1.12	Paint Shade	:	RAL 7032
19.1.13	Busbar material	:	Copper
19.1.14	Support insulators	:	Epoxy
19.1.15	Temperature rise	:	40° C rise above 45° C ambient
19.1.16	1 min. power frequency withstand voltage	:	2.5kV (rms)
19.1.17	Control voltage		
	For trip circuit and indication	:	110V DC
	For spring charging, space heater closing and space heaters	:	220V 1 phase AC
19.1.18	ACB Feeder / MCCB Feeders		
	a) Type	:	Electrically operated with manual draw-out facility / manually operated (refer related SLD)
	b) Protection	:	Refer Clause 3.5.9
	c) Metering	:	Refer respective SLD

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d) Indication	:	
i. CB ON	:	1
ii. CB OFF	:	1
iii. CB AUTO TRIP	:	1
iv. CB Trip healthy	:	1
v. DC supply fail	:	1
vi. CB "SERVICE"	:	1
vii. CB "TEST"	:	1
19.1.19 Aux. Relays		
a) Lock out relay	:	1 No.
b) Trip circuit Supervision Relay	:	1 No.
19.1.20 Aux. Components		
a) CB ON PB	:	1
b) CB OFF PB	:	1
19.1.21 Switch fuse Feeder/Fuse Switch feeder	:	≥200 A Standard fixed type.
a) Type	:	Fixed type combination fuse switch.
b) Protection	:	Fuse.
19.1.22 Current transformer	:	To be provided wherever metering and protections are indicated.
a) Ratio	:	Refer respective SLD
b) VA burden	:	Refer respective SLD
c) Class	:	Refer respective SLD
19.1.23 Metering details	:	Refer respective SLD
19.1.24 MCCB/MCB Feeders	:	≥200 A Draw out Type
Protection	:	Refer SLD
19.1.25 Indicating lamps	:	LED Type

**20.0.0 DATASHEET (TO BE FURNISHED BY SUBCONTRACTOR)**

**20.1.0 SWITCH BOARD**

- 20.1.1 Manufacturer's Name
- 20.1.2 Type
- 20.1.3 Type of mounting
- 20.1.4 Sheet steel Thickness
- 20.1.5 Whether suitable for Cable entry from bottom
- 20.1.6 Whether nameplates for Switchboard and individual Compartments provided
- 20.1.7 Whether Space Heaters provided
- 20.1.8 Whether Panel Extension Possible
- 20.1.9 Whether locking facility is available for individual Compartment
- 20.1.10 Main Bus bar
  - a) Current Rating
  - b) Material
  - c) Grade
  - d) Cross section
- 20.1.11 Earth Bus bar
  - a) Current Rating
  - b) Material
  - c) Grade
  - d) Cross Section
- 20.1.12 Continuous current Rating for Ambient Condition of site when installed in IP 4X Switch board
  - a) Main Bus bar at Ambient Specified
  - b) Tappings at Ambient Specified
- 20.1.13 Temperature rise of Bus bars while
  - a) Carrying rated Current and Installed in IP 4X enclosure at an Ambient Temp
  - b) Under Short Circuit Condition
- 20.1.14 Degree of Protection of Enclosure



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20.1.15	Minimum Clearance in Air	:
	a) Between Phases	:
	b) Between Phase to Earth	:
20.1.16	Clearance required at the Back & Front of Panel	:
20.1.17	Overall Dimension of the Switch Board (mm)	:
	a) Length	:
	b) Width	:
	c) Depth	:
	d) Height	:
	a) Maximum	:
	b) Minimum	:
20.1.18	Weight of Panel Board (kg)	:
<b>20.2.0</b>	<b>CIRCUIT BREAKERS</b>	
20.2.1	Manufacturer's Name	:
20.2.2	Type	:
20.2.3	Manufacturer's Type reference	:
20.2.4	Closing Mechanism	:
20.2.5	Normal Current rating in Air & corresponding Ambient Temperature	:
20.2.6	Derating factor for Ambient condition at Site	:
20.2.7	Service Voltage & Frequency	:
20.2.8	Maximum Voltage at which CB can Operate continuously	:
20.2.9	Rated Making Capacity	:
20.2.10	Rated Breaking Capacity	:
	a) Symmetrical	:
	b) Asymmetrical	:
20.2.11	Short Circuit With stand Capacity	:
	a) 3 Sec	:
	b) 1 Sec	:
20.2.12	Total Make time	:
20.2.13	Total Break time	:

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- 20.2.14 No. of Breaks per pole :
- 20.2.15 Total Length of Break per pole :
- 20.2.16 No. of Auxiliary Contacts (NO/NC) for Purchaser's Use :
- 20.2.17 Type of Arc Control Device :
- 20.2.18 Arc Duration time
  - a) 100 % Load Current :
  - b) 10 % Load Current :
- 20.2.19 Spring Charging Motor
  - a) Type :
  - b) Voltage :
  - c) Rating in kW :
  - d) Protection relay provided :
  - e) Protective MCB s provided :
  - f) Spring Charging time :
- 20.2.20 Power required for
  - a) Closing :
  - b) Tripping :
- 20.2.21 Confirm that trip & Closing Coils will be suitable for 110 V DC and the Spring Charging motor will be suitable for 230 V AC :

**20.3.0 INSTRUMENT TRANSFORMERS**

- 20.3.1 Makes
  - a) CTs :
  - b) PTs :
- 20.3.2 Manufacturer's Type reference :
- 20.3.3 Standards followed :
- 20.3.4 Confirm that CTs and PTs will be epoxy resin cast insulated :
- 20.3.5 3 second short time current rating of CTs, kA. :
- 20.3.6 1 second short time current rating of CTs, kA. :
- 20.3.7 Dynamic current rating of CTs, kA :

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**20.4.0 GENERAL**

- 20.4.1 Confirm that accuracy classes shall be as specified & ratios / capacities shall be as per approval
- 20.4.2 Confirm that all Protective metering ,control devices ,transducers as required shall be provided
- 20.4.3 Enclose Technical particulars, Datasheets, Catalogues of all types of relays and other equipment being offered by you
- 20.4.4 All relevant technical literature including type test certificates shall be enclosed
- 20.4.5 List and quantity of commissioning spares offered (Full list shall be enclosed)
- 20.4.6 List and quantity of maintenance spares for two years successful operation of the plant (Full list shall be enclosed)

**LT**  
**PRIME POWER**  
**SILENT**  
**DG-SET**

**INDEX**

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### 1.0.0 SCOPE

This specification is intended for design, manufacture, testing, transporting to site of LT DG Set with all associated Equipments. The equipment to be offered under this specification shall be of proven design by way of commercial operation for at least three years in similar project.

### 2.0.0 CODES AND STANDARDS

2 1.1 The equipment shall comply with the latest edition of the following standards.

IS: 4722	-	Specification for rotating machinery
IS: 10000	-	Diesel Engine
IS: 1460	-	Fuel Oil for DG Set
IS: 4729		Measurement and evaluation of vibration of rotating electrical machines.
ISO 3046	-	Engine Driven Alternators

2 1.2 Stack height, Acoustics, Air Emission and Fuel oil Installations shall meet the requirement given by Gazette Notification of Ministry of environment & Forest dated 17-05-02, 01-07-03, CPCB Guidelines, all Statutory Requirement of Government of India and State Pollution Board Guidelines.

**3.0.0 GENERAL**

- 3.1.1 The DG set shall continuously deliver specified Net Electrical Output while supplying power to all electrical and Mechanical auxiliaries connected. The DG set shall be prime power rated.
- 3.1.2 DG set shall be with Acoustic enclosure. The exhaust shall be discharged through Stack outside the enclosure. N.A.
- 3.1.3 The engine shall be supplied with Silencer, Exhaust & ventilation ducting, piping, valves and fittings, expansion joints, drain plugs, flanges, Starters for ventilation/Exhaust fans/Priming pumps, etc.
- 3.1.4 DG Set when loaded up to 50 % shall be capable of starting Motor as specified in Specific requirement with terminal voltage drop being restricted to 15%.Detailed calculations shall be submitted by Subcontractor.
- 3.1.5 All couplings shall be capable of withstanding Maximum Alternator sudden SC torque.
- 3.1.6 All moving parts shall be provided with guards to prevent accidental contact.

#### 4.0.0 ENGINE

- 4.1.1 The diesel engine shall be Stationary type, four stroke, multi-cylinder, turbo charged, inner cooled, compression ignition with direct mechanical fuel injection system.
- 4.1.2 The engine shall be derated in accordance with the Standards to suit site conditions.
- 4.1.3 The engine shall be directly coupled to the Alternator. It shall be Electric Start and suitable for battery assisted manual/auto starting.
- 4.1.4 The noise level shall be limited to 75 db at one meter from DG enclosure which is Acoustic treated room.
- 4.1.5 The Engine shall be capable of withstanding without damage, without exceeding manufacturer Design limits and also without reducing maintenance intervals established for continuous operation.
- a) 50% overload for 15 seconds.
- b) 10% overload for one hour every twelve hours.
- 4.1.6 The engine shall be capable of producing the desired nominal output to the Alternator terminals and with machine operating under ambient conditions as specified in the specific requirements.

#### 4.2.0 Fuel Oil System

- 4.2.1 The system shall be complete with Simplex type filters, hoses, piping, fitting, valves, supports, Control & instrumentation and all other accessories to make it complete.
- 4.2.2 Day tank of 990 litres fuel capacity shall be mounted on Fabricated Steel platform. The tank shall be complete with level indicator marked in litres, two nos. of Level switches, filling inlet with removable screen, outlet, a drain plug, an air vent and necessary piping.
- 4.2.3 The fuel tank shall be painted with Oil resistant paint.
- 4.2.4 All pipe joints shall be brazed/ welded.
- 4.2.5 Galvanised sheet steel trays beneath the engine & Day tank to collect leakage oil.

#### 4.3.0 Lubricating Oil system

- 4.3.1 Automatic pressure lubrication shall be provided by a shaft driven gear type pump through an Oil cooler and fin mesh filters to the bearings, drives, governor, etc.
- 4.3.2 If Lubricating Oil pump is used for intermittent priming, one hand



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driven and one electric motor driven Oil priming pump shall be provided for each DG Set. A suitable starter shall be provided in Control Panel.

4 3 3 Lubricating Fuel oil filter shall be provided for operation under normal conditions of a more than 250 hours without necessity of its replacement or cleaning.

4 3.4 All necessary accessories like pressure gauges, temperature and oil level indicators, valves, pressure switches for Alarm & Control shall be furnished.

### 4.4.0 Cooling System

4 4.1 The system shall be closed cycle and shall have radiator in front of the engine with a fan driven mechanically from the engine shaft.

4.4.2 Forced water circulation shall be by means of pump driven by engine shaft.

4.4.3 The radiator tubes shall be of copper with sufficient heat transfer area.

### 4 5 0 Governing System

4 5 1 The governing system of the engine shall be electronic type of class A1 type as per BS-5514

4 5 2 The governor shall ensure that the speed of the set is regulated within 1% of nominal speed under normal operating conditions

4 5 3 It shall be suitable to control frequency variation within  $\pm 3\%$  whenever a load of 200 KW is switched in or thrown off.

4 5 4 The DG set shall be capable of handling step load upto 40% of the capacity without dropping other loads due to voltage dips. Further the engine shall be capable of taking full load within 10 seconds of starting.

4 5 5 The governors shall be suitable for operation without external power supply and shall provide adequate speed control in the event of failure of electrical governor circuitry.

4 5 6 A mechanical over speed trip device shall be provided to automatically shut off fuel in case the speed exceeds 110% of the rated value.

4 5 7 Critical Speed of the machine shall not be lesser than 120% of normal speed.

**4.6.0 Battery & Charger**

- 4 6 1 The batteries shall be of 24V, heavy duty, and high performance lead acid type. The AH capacity shall be selected to suit the engine requirements.
- 4 6 2 Battery shall be suitable for six successive starting attempts each of 10 seconds duration with a gap of 5 seconds between successive starts.
- 4 6 3 The battery shall be supplied complete with electrolyte and accessories. The accessories shall include battery stand, battery leads with terminal ends acrylic top cover and inter battery connectors.
- 4.6.4 Each battery is provided with a charger to charge the batteries within ten hours when the set is not running. The charger shall get disconnected while the DG set is running.
- 4 6 5 The charger shall be provided with DC Voltmeter, DC Ammeter and Automatic Voltage Stabilizer.
- 4 6 6 The charger shall work satisfactorily for supply voltage variation of +10%. It shall have Necessary filters to reduce the ripple factor less than 3.

**4.7.0 Engine Mounted Control Panel**

- 4 7 1 Microprocessor based control panel shall be mounted on Engine to display the following engine and electrical parameters:
  - a) Lube oil pressure and temperature Indicator.
  - b) Tachometer for speed indication with hour meter.
  - c) Battery charging Ammeter.
  - d) Starting switch with key.
  - e) Over speed stop switch with contacts.
  - f) Low lube oil pressure switch.
  - g) High water temperature alarm & trip
- 4 7 2 It shall not only display faults but also keep a record of faults. An emergency stop push button will be provided to stop the DG during emergency. For Engine faults, the set will be stopped in emergency mode & for electrical faults it shall be stopped with a time delay for cooling down.
- 4 7 3 An audible alarm shall be provided in the main panel to announce tripping of DG. The panel shall have output port for BMS monitoring.



**4.8.0 Auxiliary Equipment**

4.8.1 The following equipment shall be supplied (but not limited to the following)

- a) Flywheel with Guard
- b) Fuel piping
- c) RPM Indicator
- d) Lubricating Oil Cooler (if applicable)
- e) Exhaust Silencer & Piping
- f) Fuel & Lubricating Oil Filters, air filters
- g) Temperature Gauges for Water
- h) Pressure gauges for Lubricating Oil
- i) Hand Barring gear
- j) Foundation bolts & Base Channels
- k) Common base Frame for the Engine & Alternator
- l) Starting & Protective Equipment
- m) Lifting arrangement
- n) Radiator
- o) Any other equipment necessary for proper operation, Maintenance & Operating personnel safety.

**5.0.0 ALTERNATOR**

5.1.1 The Alternator shall be 415V, 3-Phase, star connected, 50 Hz, 0.8 P.F, horizontal foot mounted, double bearing, self excited, brushless, screen protected drip proof, continuous duty alternator with class "H" insulation in IP-22 enclosure incorporating the following.

- a) 3 Phase sensing AVR
- b) Continuous damper winding.
- c) RTDs and one anti condensation heaters wired to a separate terminal box.
- d) Pilot exciter.
- e) Neutral CT of adequate ratio and class for REF relay
- f) Separately mounted adapter box suitable for termination of cable size specified in Specific Requirement.
- g) RTD for Bearing temperature of Alternator.

5.1.2 The Alternator shall be capable of delivering the rated output at rated power factor as per specific requirement.

5.1.3 The Alternator selected should be a low reactance, 3 phase sensed machine, utilizing a 2/3<sup>rd</sup> pitch stator winding design. In addition, it is recommended that 3 phase sensing AVR fitted should utilize "Transistor" rather than Thyristor circuitry.

## 5.2.0 General Requirements

5.2.1 The alternator shall further meet the following specifications.

- a) The alternator shall be suitable for 20% over speed for two minutes.
- b) The alternator shall be capable of carrying 50% overload for a duration of 1 minute.
- c) The alternator shall be capable of carrying 10% overloading for one hour in any period of 12 hrs running.
- d) Terminal voltage for any load variation should be maintained within + 5%.
- e) The prime mover response should be such that with 200kW load throw OFF / ON for the Alternator both transient and steady state frequency variation should be within + 3%. The Alternator terminal voltage for this load variation should be maintained with + 5%.
- f) The field coil terminals shall be wired to terminal box for external speed control. Both ends of each phase winding shall be brought to terminal box.
- g) The alternator shall withstand a 3-phase short circuit at the terminals for a period of 3 second
- h) The total harmonic distortion shall not exceed 3% and the design shall permit upto 30% unbalance between phases while in operation.

## 5.3.0 Windings

5.3.1 The conductor shall be of high Electrolytic grade of Copper.

5.3.2 The Alternator winding shall have class of insulation class H with temperature rise limited to Class F.

5.3.3 The winding shall be given power house treatment i.e., two coats of Varnish and Final coat of resin.

5.3.4 The total insulation shall be non-Hygroscopic.

## 5.4.0 Temperature Detectors

5.4.1 Six Nos. of RTD (Duplex) shall be suitably located in Stator Winding where highest temperature may be expected and One element in each bearing

5.4.2 RTD shall be connected to Thermistor relay in the Panel which shall have contacts for alarm and trip.

**5.5.0 Excitation System**

- 5.5.1 The excitation system shall be a brush-less system with all accessories, and shall be capable of supplying the excitation current of the Alternator under all conditions of output from no load to full load and capable of maintaining voltage within  $\pm 1\%$  of the set value.
- 5.5.2 The voltage setting range shall be -10% to +10% of rated Voltage. It shall be possible to set from remote also.
- 5.5.3 The exciter shall have class F insulation with temperature rise limited to class B.

**5.6.0 Automatic Voltage Regulators**

- 5.6.1 The AVR shall regulate the output voltage from Alternator current/voltage signals. The regulation system shall be follow up the provided with equipment for automatic and manual control. Necessary motorized potentiometer for manual control raise / lower PBs shall be provided.
- 5.6.2 When there is a failure of AVR, the Alternators excitation control is transferred immediately to manual control without any change in excitation current.
- 5.6.3 Necessary equipment for field suppression and surge protection shall be provided.
- 5.6.4 The response time of exciter and the Alternator shall be matched to avoid hunting.
- 5.6.5 Suitable measures shall be taken for field failure protection. The manufacture should specify the method adopted for the same with proper equipment specification and schemes.

**5.7.0 Terminal box**

- 5.7.1 The line and neutral leads of phase windings of the Alternators shall be brought to six terminals in two separate cable boxes.
- 5.7.2 The terminal box shall be of adequate size to terminate Cables as specified in Specific Requirement.
- 5.7.3 For Single phase cables, gland plate shall be of Non-Magnetic.
- 5.7.4 The degree of Protection shall be IP-54.

**5.8.0 Space Heater**

- 5.8.1 It shall be located in Lower part of alternator to maintain internal temperature above dew point to prevent moisture condensation when set is not running.
- 5.8.2 These heaters shall be switched ON automatically when Set is not running.
- 5.8.3 Supply shall be 240V, single phase, 50 Hz.

## 6.0.0 GENERATOR CONTROL PANEL

### 6.1.0 Construction

- 6.1.1 The control panel is free standing, floor mounting, sheet steel clad, and cubicle type with flush front. The panel is fabricated from sheet steel of min. thickness 2mm. sufficient stiffeners is to be provided wherever required. The gland plate thickness shall be 3mm.
- 6.1.2 The panel is fabricated to ensure totally enclosed bus bar chamber complete shrouding of live parts when the panel is open after switching off the circuit breaker and ample space for cabling. The cable entry shall be from Bottom.
- 6.1.3 The instruments and control fuses for the instruments are located in a separate compartment to enable maintenance of the instrument without switching off Alternator.
- 6.1.4 The bus bars are made of Copper to withstand the fault level of the DG set. The supports for the bus bars are non-hygroscopic.
- 6.1.5 All indicating Instruments shall be flush mounted and of size 96mm x 96mm.
- 6.1.6 The control panel is complete with wiring necessary for proper functioning of the DG set. The control wires are ferruled.
- 6.1.7 Neoprene gaskets shall be provided between all openings & joints. The Degree of protection shall be IP-52.
- 6.1.8 Tinned Copper flat of adequate size shall be provided for earth connection shall be provided.
- 6.1.9 Paint shade shall be RAL 7032.
- 6.1.10 Panel shall be provided with Panel illumination lamp operated by door switch and thermostat Space heater.

### 6.2.0 Controls & Indications

- 6.2.1 The following Controls (Both Local & Remote) shall be provided in the Control Panel. For which a local-remote selector switch is provided.
- |    |                 |   |           |
|----|-----------------|---|-----------|
| a) | Starting        |   |           |
| b) | Stopping        |   |           |
| c) | Speed Control   | - | Raise/Low |
| d) | Voltage Control | - | Raise/Low |

6.2.2 The following Indications shall be provided in the Control Panel

- e) AC Voltmeter & Ammeter with Selector switches.
- f) Wattmeter & Watt-hour meter
- g) Frequency meter
- h) DC Ammeter & DC Voltmeter of Battery Charger
- i) AC Supply/DC Supply Healthy
- j) Battery Charger ON/OFF
- k) LT Breaker of DG

Voltage & frequency Transducer with Dual output of -20 mA shall be provided

6.2.3 The provision for following Status/signal for Owner's usage shall be provided.

- a) DG Fail to start
- b) DG Start Command actuated/ reset
- c) DG Working/ Stop signal
- d) DG Trouble/Normal signal
- e) DG Control Supply failure/Normal signal

#### 6.3.0 Starting

6.3.1 The DG set shall be automatically started, once the Grid Supply has failed

6.3.2 There should be provision given for manual starting in case AMF system has failed. The starting of the DG set shall be through a starting switch for manual start.

6.3.3 Remote Starting facility shall also be provided. DG set shall send Automatic closing command to its LT Breaker on achieving rated voltage frequency on its terminals. Necessary relays for the purpose shall be included.

6.3.4 Three-attempt starting facility shall be provided using Impulse timer & Summation timer. The DG shall lockout in case of failure of above.

#### 6.4.0 Stopping

6.4.1 The DG Set shall be stopped manually both from Local & Remote.

6.4.2 In Auto mode, interlock shall be provided to prevent Shutting down operation when its LT Breaker is in closed condition

6.5.0 **Tripping & Alarms**

6.5.1 The following alarm/trip signals shall be provided in DG Control Panel to indicate & protect against Abnormal Operating Conditions

Condition	Trip	Alarm
a) Fail to Start		<input checked="" type="checkbox"/>
b) Lube Oil pressure low	<input checked="" type="checkbox"/>	
c) Over Speed	<input checked="" type="checkbox"/>	
d) DG Overload		<input checked="" type="checkbox"/>
e) High Cooling water Temperature	<input checked="" type="checkbox"/>	
f) Low Fuel level in Day Tank		<input checked="" type="checkbox"/>
g) Very Low Fuel level in Day Tank	<input checked="" type="checkbox"/>	
h) Stator Temperature High		<input checked="" type="checkbox"/>
i) Electrical Protection Operated	<input checked="" type="checkbox"/>	
j) Priming pump Tripped		<input checked="" type="checkbox"/>

6.5.2 In case of tripping, restart shall be prevented until the faults are removed and manual resetting is done.

7.0.0 **ACOUSTIC ENCLOSURE**

7.1.0 **Construction**

7.1.1 The acoustic enclosure shall be of free standing, floor mounting type integral with the DG set. The enclosure shall be provided with rugged heavy-duty structural steel base frame with chequered plate flooring on which the DG set is to be mounted.

7.1.2 The enclosure shall be prefabricated factory-built and modular in construction, so that it can be easily assembled at site around the DG set.

7.1.3 The enclosure shall consist of acoustically treated panels housed in rugged steel frames, which shall be bolted together to form the body of the enclosure. Sliding doors shall be provided, on either side, which shall also be acoustically treated, thereby providing easy access to the DG set while minimizing the operating space requirements.

7.1.4 The construction of the acoustic enclosure shall be such that with both the acoustic doors open on the either side, full access is available to the engine and alternator. Adequate number of viewing glass windows shall be provided.

7.1.5 For fresh air inlet into the system a parallel baffle air inlet silencer



- shall be provided. Additionally, to augment the fresh air inlet requirements, a forced air ventilation duct with associated silencer shall be provided above the alternator.
- 7.1.6 For hot air discharge, an acoustic discharge plenum shall be provided in front of the engine radiator, for discharge of hot air into the surroundings through a parallel baffle air outlet silencer. The enclosure shall have suitable openings in the roof module for exhaust piping.
  - 7.1.7 The acoustic panels shall be filled with a special grade high-density mineral wool retained on the inside by perforated GI sheets specially designed for optimum sound attenuation. Sealing shall be done with Neoprene/Silicone Rubber gaskets.
  - 7.1.8 The outer surface of the Acoustic Panels shall be fabricated of perforated 16G corrugated CRCA sheet steel. All sheet steel frames shall be of 16G CRCA sheets.
  - 7.1.9 All materials used for Acoustic Enclosure shall be fire resistant / fire retardant grade.
  - 7.1.10 The sheet steel treatment shall consist of degreasing, derusting and phosphating followed by two coats of zinc chromate primer, followed by two coats of Zinpholite surface for superior corrosion resistance and two coats of finish paint.
  - 7.1.11 It shall be ensured that at least 800mm (min.) clear space is available all around the Acoustic Enclosure to ensure free air flow for the DG set as required and to facilitate accessibility for Alternator operation and routine maintenance.
  - 7.1.12 The enclosure shall be provided with suction fans to ensure that the adequate cooling and combustion air is made available to the engine and the temperature within the enclosure is limited to 5 °C above ambient.
  - 7.1.13 The fan shall be designed with sufficient static to draw the requisite quality of air from the duct provided for this purpose. The suction fans shall start automatically when the temperature in the enclosure reaches 40 °C and shall continue to run for 5 to 10 minutes after the load is disconnected. A temperature controller shall be provided for this purpose housed in sheet steel enclosure.
  - 7.1.14 Two light points controlled by a switch complete with 36/40W fluorescent Luminaire and lamps shall be provided. Provision shall also be made for fixing a heat detector inside the acoustic enclosure which will be connected to the central fire alarm panel.
  - 7.1.15 Necessary openings shall be made for the entry of power cable and

control cables, fuel piping, exhaust piping, air inlet pipe etc.

- 7.1.16 With the installation of the acoustic enclosure, there shall not be any de-rating of the DG set. The maximum temperature of oil and water shall not exceed the limits prescribed by the manufacturer of the engine. The DG set shall give rated output continuously
- 7.1.17 The ventilation system shall be designed to provide an air volume of not less than 80,000CFM whenever the DG set is in operation.
- 7.1.18 The ventilation fan shall be of the axial flow type

#### **7.2.0 Performance**

- 7.2.1 With the above Enclosure, the sound pressure levels when measured at a distance of 1 meter from the acoustically treated DG enclosure shall be around 75 dB (A) under free field conditions.

#### **8.0.0 NAME PLATE**

- 8.1.1 Suitable name plate shall be provided for each piece of equipment for easy identification. Material of the name plate shall be plastic, 3 mm thick or approved equivalent. Letters shall be white on black background.

#### **9.0.0 FUEL HANDLING SYSTEM**

##### **9.1.0 FUEL TANK**

- 9.1.1 Fuel tank with mounting brackets complete with indicator, fuel inlet and outlet, air vent, drain plug, inlet arrangement for direct filling and a set of fuel hoses shall be supplied.

##### **9.2.0 Fuel Oil Storage tank**

- 9.2.1 Fuel Oil storage Tank shall conform to IS 10987: 1992. The HSD storage tank shall be cylindrical type fabricated out of MS plates conforming to IS: 2003 with flat ends with pedestal suitable for underground mounting. The shell thickness shall be 6mm and end thickness 10 mm complete with air vent, drain, inlet outlet nozzles and Level switch (Float switch). The tank shall be duly painted with 2 coats of weather protection and moisture protection paint. The capacity of the tank shall be sized for 48 hours continuous operation without fuel refill for two DG sets of specified rating at each Substation.

##### **9.3.0 Fuel Oil Piping**

- 9.3.1 The piping for HSD shall be MS ERW heavy class conforming to IS 1239. The piping shall be complete with flanges, long radius seamless bends, nuts, bolts, gaskets, supports etc.

9.4.0 **Day Tank**

- 9.4.1 The HSD day tank shall be cubicle type made out of MS plates of 5 mm thickness conforming to IS 2003 with all welded joints. The tank shall be complete with Inlet, Outlet, drain and overflow nozzles and level gauge glass, level control switches (magnetic type) and 2 Nos. solenoid valves, HSD flow meter with strainer.
- 9.4.2 Oil shall be pumped automatically to Day Tank from Fuel Storage Tank whenever oil level in Day tank fall below limit.

**10.0.0 DRAWINGS AND DOCUMENTS**

- 10.1.1 Drawings and Guaranteed Technical Particulars (Subcontractor to be furnish)
- 10.1.2 Two weeks after the award of the contract the manufacturers shall supply **Two** copies of drawings which will describe the equipment in detail for approval, and shall subsequently provide **Seven** completed sets of final drawings, one of which shall be reproducible. All the drawings shall be made in AUTOCAD and the final drawings shall be given to us in electronic form.
- 10.1.3 The following drawings / technical literature are to be supplied as part of this contract.
- a) GA Drawing for DG set: Within 1-2 weeks from date of LOI
  - b) Foundation drawing with loading data
  - c) Schematic drawings
  - d) All control & Indication circuit drawings
  - e) Schematic P&I drawing for Lube oil
  - f) Component list with ratings & ranges of all items.
  - g) Design/Engineering of DG exhaust system including BOQ
  - h) Design/Engineering of DG cooling system including the design of cooling tower, piping & cooling sizing of cooling water pumps including BOQ.
  - i) (Option) Radiator type cooling with BOQ
  - j) Design / Engineering of automatic Fuelling
  - k) System including the BOQ.
- 10.1.4 The final drawings with erection/operation & maintenance manual and literature, write ups and description of DG set excitation system, voltage regulator governor and other auxiliaries shall be submitted in 6 sets with one CD containing all documents & drawing in AUTOCAD

#### **11.0.0 TESTS**

11.1.1 All routine tests as per standards & type tests / acceptance tests as per Standards. The Subcontractor shall include all prices for conducting tests. The Subcontractor shall furnish the reports of all the type tests carried out in **within five years** of the date of bid opening. Tests shall be as per "SECTION-E0". These reports should be for the tests conducted on identical/similar components/ equipments / systems to those offered / proposed to be supplied under this contract. In case Subcontractor is not able to submit report of type test(s) conducted in last five years. Or in case type test report(s) are not to be meeting the specification / relevant standard requirements, then all such tests shall be conducted under this contract by the Subcontractor free of cost to Contractor, and reports shall be submitted for approval.

#### **12.0.0 SPARES**

12.1.1 The Subcontractor shall also quote for any other item of spares recommended for five years normal

#### **13.0.0 PACKING AND DESPATCH**

13.1.1 All equipment covered under this specification including all accessories shall be properly packed and delivered at the purchaser's site in order to prevent any damage during transit and in storage at site.

#### **14.0.0 DEVIATION**

14.1.1 Deviation taken from specifications (if any) should be listed out separately clause wise and explicitly under the heading "DEVIATIONS". Deviations indicated in the guaranteed technical particulars (or) elsewhere will not be considered and accepted

## 15.0.0 SPECIFIC REQUIREMENTS

15.1.0	<b>General</b>		
15.1.1	Net Electrical Output	:	1000kVA
15.1.2	Voltage	:	415 V, 3 Phase
15.1.3	Frequency	:	50 Hz
15.1.4	Fuel	:	High Speed Diesel
15.1.5	Rated Speed	:	1500 rpm
15.1.6	Governor	:	Class A1, Electronic type
15.1.7	Vibrations	:	Maximum 250 microns peak to peak
15.1.8	Starting	:	Electrical Self starting
15.1.9	Fuel tank (Day tank)	:	990 Litres
15.1.10	Cooling	:	Radiator cooled
15.1.11	Paint Shade	:	RAL 7032
15.1.12	Termination Arrangement	:	Bus Duct
	<b>Engine</b>		
15.1.13	Type		Stationary type, four stroke, multi-cylinder, turbo charged
15.1.14	Overload Capability	:	50% overload for 15 seconds 10% overload for 1 hour every 12 hours.
15.1.15	Step load	:	40%
15.1.16	Starting time	:	10 s
15.1.17	Critical Speed	:	> 120% of Rated speed
15.1.18	Battery	:	24V, Lead Acid
15.1.19	Battery AH	:	Vendor to Design
15.1.20	Output port from Engine mounted Control panel for BMS Monitoring	:	Required
15.2.0	<b>Alternator</b>		
15.2.1	Operational Requirements	:	As per Clause 5.2.0

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15.2.2	Winding	:	Copper
15.2.3	Insulation Class	:	H, Temperature rise limited to Class F
15.2.4	Excitation System	:	Brushless
15.3.0	<b>Generator Control Panel</b>		
15.3.1	Installation	:	Inside Acoustic Enclosure, along DG set
15.3.2	Start & Stopping of DG Set	:	Local & Remote
15.3.3	Speed Control	:	Local & Remote
15.3.4	Voltage Control	:	Local & Remote
15.3.5	Status Signals to Remote	:	Required (as per Clause 6.2.3)
15.4.0	<b>Acoustic Enclosure - N.A.</b>		
15.4.1	Type of Enclosure	:	Screen protected Drip proof
15.4.2	Material	:	Special grade, 150 kg/mm <sup>3</sup> mineral wool
15.4.3	Sound pressure levels when measured at a distance of 1 meter outside the Acoustic Enclosure under free field conditions.	:	70 dB
15.4.4	Degree of protection	:	IP 54
15.5.0	<b>Fuel Storage Tank</b>		
15.5.1	Capacity	:	Vendor to Furnish
15.5.2	Location	:	Underground

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15.6.0	<b>Service Conditions</b>		
15.6.1	Maximum ambient Temperature	:	45 deg C
15.6.2	Maximum Relative Humidity	:	75%
15.6.3	Altitude	:	1000m MSL
15.7.0	<b>Current Transformer</b>		
15.7.1	Type	:	Cast Resin
15.7.2	Ratio	:	1500/ 5A
15.7.3	Knee point Voltage	:	$\geq 125$ V
15.7.4	CT Resistance		$\leq 3$ ohm
15.7.5	Class	:	PS
15.7.6	Insulation	:	E
15.8.0	<b>Voltage Transformer</b>		
15.8.1	Type	:	Cast Resin
15.8.2	Secondary Voltage	:	110 V
15.8.3	Rated Voltage Factor	:	1.2
15.8.4	Class	:	1.0
15.8.5	Insulation	:	E
15.8.6	Burden	:	20 VA

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15.0.0 DATASHEET (TO BE SUBMITTED BY SUBCONTRACTOR)

15.0.1	Manufacturer	:
15.0.2	<b>Engine</b>	:
15.2.1	Engine Model	:
15.2.2	Engine Rating	:
15.2.3	Engine Power	:
	a) Gross BHP	:
	b) Net BHP	:
15.2.4	No. of Cylinders	:
15.2.5	Engine RPM	:
15.2.6	Type of Starting	:
15.2.7	Type of Fuel	:
15.2.8	Fuel Consumption	:
	at	
	a) Rated Load	:
	b) 75% of Rated	:
	c) 50% of Rated	:
15.2.9	Type of cooling	:
15.2.10	Recommended lube oil change	:
15.2.11	Systems (	:
	flow/scheme	
	diagram is to be	
	enclosed )	
	a) Governing	
	arrangement	
	b) Cooling	:
	systems	
	c) Fuel	:
	d) Lubrication	:
	e) Exhaust	:
	f) Air filtration,	:
	dry type / other	
	type	
	g) Protection	:
15.2.12	Type of coupling	:
15.2.13	Type of silencer	:
15.2.14	Speed Regulation	:
15.2.15	Efficiency	:
15.2.16	Standard / optional	:
	accessories	



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16.2.17	Weight of the Engine	:
16.2.18	Engine Protections provided	:
16.2.19	Noise level at 1 m from the set	:
16.3.0	<b>Alternator</b>	
16.3.1	Alternator Make	:
16.3.2	Alternator Rating ( Design )	:
16.3.3	Continuous output rating	:
16.3.4	Max. rating kW @ 0.8 PF	:
16.3.5	Harmonic distortion level	:
16.3.6	Rated Voltage	:
16.3.7	Full load current	:
16.3.8	Excitation	
	a) Exciter voltage. DC volts	:
	b) Exciter current	:
16.3.9	Overload capacity	:
16.3.10	Voltage regulation	:
16.3.11	Accessories required	:
16.3.12	Degree of protection	:
16.3.13	Class of insulation	:
16.3.14	Weight of the Alternator	:
16.4.0	<b>General</b>	
16.4.1	Over all Dimensions	:
16.4.2	Stack Height	:
16.4.3	Weight of the total set	:
16.4.4	Foundation details	:
16.5.0	<b>Acoustic Enclosure</b>	
16.5.1	Dimensions	:
16.5.2	Sound level at 1 m from the enclosure	: